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Sub report 4-4
Analyses of hydrological models for climate change modelling – VHM

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Modelling water availability and water allocation strategies in the Scheldt basin

Sub report 4-4 – Analyses of hydrological models for climate change modelling – VHM

Dridi, K.; Maroy, E.; Velez, C.; Pereira, F.; Nossent, J.; Mostaert, F.

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Author(s):	Naranjo, P.; Maroy, E.; Velez, C.

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Project leader:	Pereira, F.	Getekend door:Fernando Pereira (Signat Getekend op:2021-07-02 13:39:18 +02:0 Reden:Ik keur dit document goed

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Head of Division:	Mostaert, F.	Getekend door:Frank Mostaert (Signature Getekend op:2021-07-02 13:11:01 +02:0 Reden:Ik keur dit document goed

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Abstract

The water balance model of the Scheldt and Meuse basins will be used in order to perform low flow forecasts and calculate climate change scenarios. Within the current subtask is investigated which is the most appropriate hydrological model for the sub catchments of the water balance model of the Scheldt basin in order to meet this prerequisite. This sub report describes the calibration and evaluation of the VHM model, a lumped conceptual model for continuous rainfall-runoff simulation (Willems P., 2014) developed by the Hydraulics Division in KU Leuven in Belgium.

The optimization during calibration is performed based on an automatic procedure, followed by a visual control. During the optimization routine the parameter sets are selected based on 2 criteria: (1) absolute error on cumulated total flow at each time step, and (2) logarithmic Nash-Sutcliff efficiency. The first criterion aims to model the global flow pattern, the latter focuses mainly on the low flows.

Overall, the performance of the calibrated VHM models is similar compared to the other lumped rainfall-runoff models already calibrated: PDM, NAM and WETSPA. The summarized results for each of the gauged sub catchments within the study area, allow the user to get insight in the performance of the VHM model for each of the involved sub catchments. Based on this information and the evaluation of the NAM, PDM and WETSPA models, the user can make a well-grounded decision on which model to use for the considered objective.

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1 Introduction

1.1 Objectives

The water balance model of the Scheldt basin will be used in order to perform low flow forecasts and calculate climate change scenarios. The goal of this subtask of the project 'Modelling water availability and water allocation strategies in the Scheldt basin', is to define the most appropriate hydrological models for the water balance model of the Scheldt basin in order to meet this prerequisite. Therefore, different hydrological models for each of the subcatchments in the study area are set up and evaluated on their appropriateness for low flow forecasting and climate change scenarios. The regarded models are NAM (DHI, 2009), PDM (Moore, 2007), VHM (Willems, P., 2014) and Wetspa . Overall descriptions of these models can be found in Vansteenkiste et al. (2011). After evaluation of each of these hydrological models, the most appropriate model for each catchment can be used for the particular application.

In the current project, hydrological VHM models for the gauged catchments (i.e. catchments upstream of a gauging station) are calibrated whereby the focus is mainly on low flows. For each of the hydrological catchments, the VHM parameters will be determined.

The calibration is performed based on an automatic optimization procedure followed by a visual control. During the optimization routine the best parameters set is selected for each catchment based on 2 criteria: (1) Absolute error on cumulated total flow at each time step, and (2) Logarithmic Nash-Sutcliff efficiency. The first criterion aims to model the global flow pattern, the latter focuses mainly on the low flows.

Ungauged catchments will inherit model parameters from similar neighboring catchments.

After validation and robustness checks, the newly calibrated VHM models will, if suitable, ready to be used for low flow forecasting and climate change scenario simulations.

1.2 Structure of the report

In a first section, the addressed catchments are defined and reliable gauging stations selected (Section 2). Second, rainfall and evapotranspiration are then interpolated for the selected catchments, according to the Thiessen polygon method (Section 3).

The general structure and parameters of the VHM model are outlined in Section 4 while the calibration strategy and basic logic behind the automated calibration algorithm are explained in Section 5.

Once all VHM models for the gauged catchments are calibrated, flow is simulated for 47 years (1967-2013). Ungauged catchments are simulated using parameters of a nearby catchment with similar characteristics. Results are synthetized in Section 6 and detailed in the appendices.

Section 7 presents conclusions of the calibration and some recommendations to consider when using the calibrated VHM models in the next steps of the project.

2 Catchment delineation

2.1 General

The inputs of the water allocation model are discharge time series at the upper boundaries and entries of tributaries in the modelled water network. This rainfall runoff discharge is simulated by means of one of the abovementioned hydrological models (NAM, PDM, VHM, Wetspa). Apart from the Scheldt catchment as such, the IJzer basin and the catchment of the Brugse Polders are also included in the water allocation model and therefore also included to this study. The map on Figure 1 shows the main river basins included in the water allocation model. In this report, results will be structured geographically per basin. The development of hydrological VHM models for the Meuse basin, which is also included in the water allocation model, is subject to a distinct report (Maroy et al., 2021).

Delineated hydrological subcatchments for the water allocation model were collected in 2010 based on past modelling studies (De Boeck et al. 2011) and updated within the framework of the present study. Figure 1 shows an overview of the delineated catchments in the water allocation model.

For the gauged catchments, where a time series of measured discharge is available, the VHM models are calibrated.

Some of the gauged catchments in the water allocation model are subdivided in different subcatchments to distribute the inflow over the modelled river stretches. Each of these subcatchments inherits the parameters of the main gauged catchment. An example of this is the Leie catchment upstream of the measuring station the Menen, which is subdivided into 27 subcatchments. The catchment itself is calibrated on the discharge timeseries of the gauging station the Menen. Within the water allocation model the rainfall runoff of each of these 27 subcatchments is calculated based on its particular interpolated rainfall- and evaporation series and linked individually to the appropriate modelled water course. For more detail about the choices and methodology of catchment delineation, please see De Boeck et al. (2011)[1] . Ungauged models inherit VHM parameters from similar neighboring catchments.

All catchments of the water allocation model received a unique informative code, as defined in the previous phase of the project (De Boeck et al., 2011). Each code consists of 12 characters, relative to the catchment location, main water course and gauging station:

- **Character 1 :** region where the catchment is located (V: Flanders; W: Wallonia; N: Netherlands; F: France)
- **Characters 2 and 3:** number of the Flemish hydrographic basin to which the catchment belongs.
- **Characters 4,5 and 6:** initials of the main water course
- **Characters 7, 8 and 9:** first three digits of the gauging station code (or 3 letter initials) for gauged catchments, and "000" for ungauged catchments.
- **Characters 10, 11 and 12:** three digit-suffix that ensure catchment code differentiation.

[1] WL2011R724_04c_rev2_1_DO3.doc

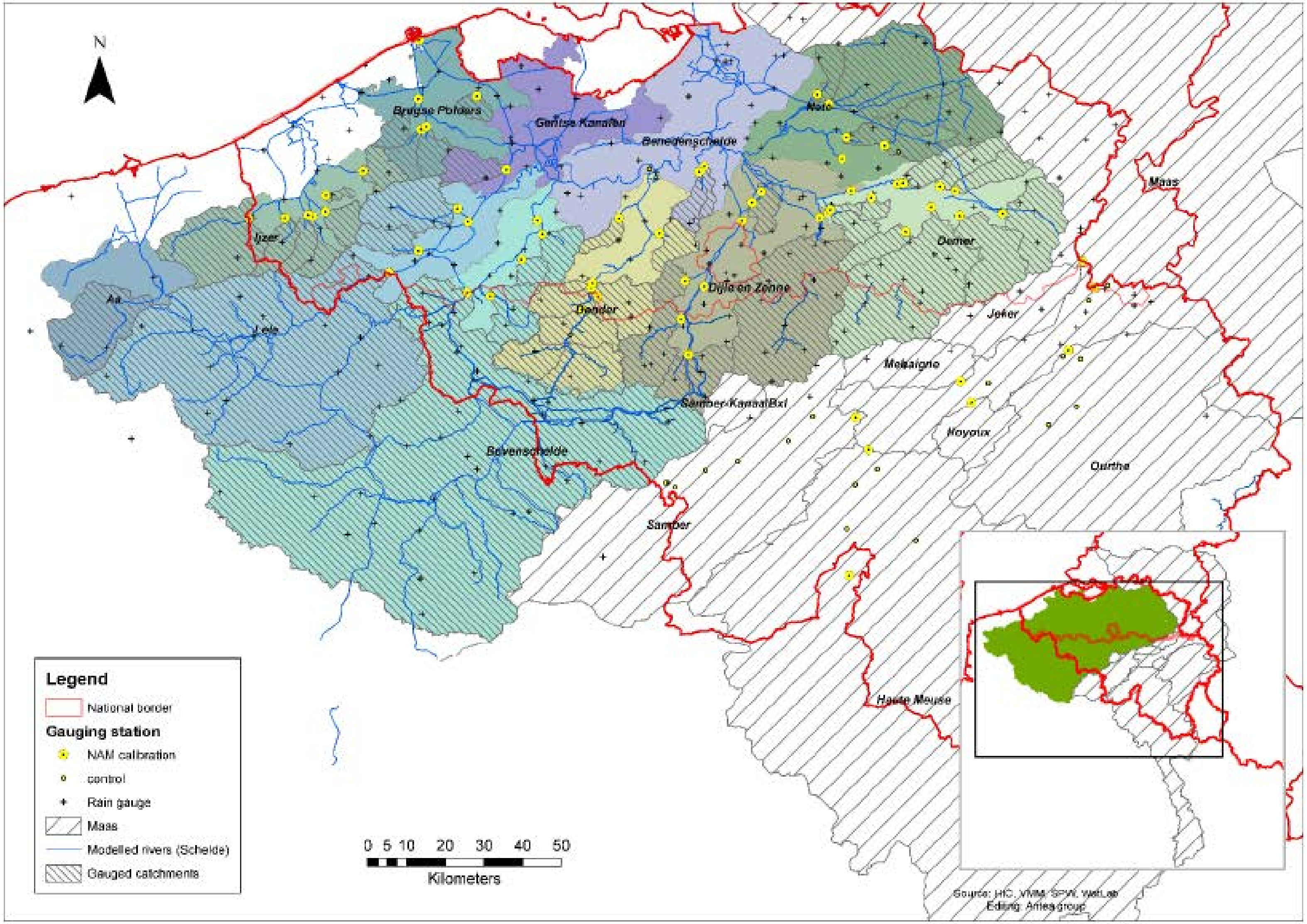


Figure 1 – Map of gauged and ungauged catchments of the Scheldt basin, Meuse, the Brugse polders and the IJzer.

2.2 Gauged catchments

Table 1 lists the gauged stations used for calibration of the rainfall-runoff models. Catchments that were calibrated jointly are listed in Table 2.

Table 1 – List of gauging stations on the Scheldt and its tributaries for calibration of hydrological models

Gauging station (code - water course; location)	Catchment ID	Area (km²)	Gauged years
48810102 - Handzamevaart; Kortemark	V01HAN488180	78,6	1994-2016
46810102 - Ijzer; Roesbrugge Haringe	V01HEI468999	393,0	1986-2016
49510102 - Ieperlee; Zuidschote	V01IEP495080	63,4	1983-2014
49270102 - Kemmelbeek; Boezinge	V01KEM492060	73,9	1986-2015
49610102 - St. Jansbeek; Merkem	V01MAR496120	76,1	1986-2016
49110102 - Poperingevaart; Oostvleteren	V01POP491030	84,9	1984-2016
49910102 - Steenbeek; Merkem	V01SSV499140	16,1	1990-2009
44210102 – Ede; Maldegem	V02EDE442120	45,5	1983-2016
42610102 - Hertsbergebeek; Oostkamp	V02HER426010	77,3	1986-2016
4220102 – Kerkebeek; Sint-Michiels	V02KER422030	62,7	1983-2008
42510102 - Rivierbeek; Oostkamp	V02RIV425020	64,0	1983-2016
44656122 - Poekebeek; Nevele	V03POE446000	106,8	1983-2010
3610102 - Kleine Molenbeek; Liezele	V04MOL036110	32,6	1966-2016
3710102 - Grote Molenbeek; Malderen	V04MOM037100	67,3	1966-2016
38680122 – Leie; Menen	F05LEI386999	2981,8	1998-2016
40310102 - Heulebeek; Heule	V05HEU403210	91,9	1972-2016
40110102 - Mandel; Oostrozebeke	V05MAN401230	258,4	1967-2013
32580122 - Bovenschelde; Bossuit	F06BOS325999	5217,6	2001-2014
34710102 - Maarkebeek; Etikhove	V06MAA347160	48,7	1972-2016
34210102 - Zwalm; Nederzwalm	V06ZWA342190	112,1	1972-2016
L5412 – Rhosnes; Amougies	W06RHOL54100	161,9	2012-2016
28510102 – Bellebeek; Essene	V07BEL285070	88,7	
28970102 – Mark; Viane	V07MAR289015	173,9	1976-2016
28210102 – Molenbeek; Erpe Mere	V07MOE282100	46,4	1986-2016
28810102 – Molenbeek; Geraardsbergen	V07MOG288020	23,1	1985-2014
2708-1050 Dendre; Lessines	W07DENLES999	511,8	
11110102-Barebeek; Elewijt	V08BAR111370	69,9	1997-2004
9310102 – Dijle; Wilsele	V08DIJ093400	886,9	1974-2014
23310102 – Zuunbeek; St Pietersleeuw	V08ZUU233100	64,8	1985-2016
2371-10050 Samme; Ronquieres	W08SAMRON000	133,6	1989-2016
L5670 –Senette; Ronquieres	W08SENL56010	70,4	1977-2016
1951-10050 Zenne; Tubize	W08SENTUB030	215,9	1975-2016
13610102 – Demer; Hasselt	V09DEM136000	255,1	1997-2016
15210102 - Gete; Halen	V09GET152080	800,4	1969-2013
16310102 – Herk; Kermt	V09HER163010	274,6	1977-2016
14710102 - De Hulpe; Molenstede	V09HUL147150	80,1	1986-2016

Gauging station (code - water course; location)	Catchment ID	Area (km²)	Gauged years
14310102 - Grote Losting; Wezemaal	V09LOS143300	15,2	1986-2016
16110102 - Mangelbeek; Lummen	V09MAN161040	102,9	1983-2011
14410102 - Motte; Rillaar	V09MOT144270	33,6	1986-2010
14510102 - Velp; Ransberg	V09VEL145100	96,8	1969-2016
14110102 - Rotselaar; Winge	V09WIN141310	64,7	1986-2016
14810102 - Zwarte Beek; Lummen	V09ZWA148120	96,2	1983-2016
8610102 - Grote Laak; Vorst	V10GLA086020	62,6	1986-2014
7610102 - Grote Nete; Geel-Zammel	V10GNE076999	243,5	1985-2013
5210102 - Kleine Nete; Grobbendonk	V10KNE052000	584,7	1983-2016
6210102 – Molenbeek; Pulle	V10MOP062140	77,3	1986-2014
8210102 – Wimp; Wiekevorst	V10WIM082050	65,4	1989-2007

Table 2 – Catchments calibrated jointly based on one gauging station

Station (code - water course; location)	Joint code	Catchments
46810102 - IJzer; Roesbrugge Haringe	**F01IJZ468000**	V01HEI468010 F01YSE468000
38680122 – Leie, Menen	**F05LEI386001**	F05BEC386023 F05DEU386090 V05LEI386180 F05BEC386025 F05DEU386110 F05LOI386035 F05BOU386005 F05DEU386120 F05LYS386000 F05CLA386017 F05DEU386130 F05LYS386010 F05CLA386020 F05DEU386140 F05LYS386015 F05DEU386040 F05DEU386150 F05LYS386115 F05DEU386050 F05DEU386160 F05MAR386070 F05DEU386060 F05LAW386018 F05MAR386100 F05DEU386080 F05LAW386030 W05LYS386170
32580122 - Bovenschelde; Bossuit	**F06BOS325001:**	F06BOS325000 F06ERC325030 W06BOS325095 F06BOS325015 F06HOG325070 W06BOS325105 F06BOS325016 F06RHO325060 W06BOS325115 F06BOS325017 F06SCA325020 W06HAI325080 F06BOS325018 F06SCA325025 W06HAI325085 F06BOS325019 F06SEL325040 W06HAI325090 F06ECA325050 F06SEN325010

2.3 Ungauged catchments

The VHM parameters for the ungauged catchments in the modelled area, are inherited from neighboring gauged catchments. The link between the ungauged and the corresponding gauged catchment is made based on the catchment characteristics (soil, slope, concentration time, land use).

3 Input data preprocessing

3.1 Thiessen polygon method

Interpolated precipitation was produced for each catchment according to the Thiessen polygon method, using Hydr@ (IMDC, 2010). Rainfall and evapotranspiration are interpolated using weights inversely proportional to the distance to the weather station, using measurements available for each time step. Because of the large scale and the long term nature of time series used in this study, a daily time step is used. For consistency reasons, calibration is also based on daily time series. Both meteorological and discharge time series are thus sampled at a daily time step.

3.2 Precipitation

Thiessen precipitation needed to be calculated for all delineated subcatchments (Section 2). Source data consists hereby of rainfall measurements from 1967 to 2013, spread over the entire model area and around. The Scheldt catchment extends over France, Flanders, Wallonia and the Netherlands. Precipitation data was thus gathered from instances in Belgium, Netherlands and France. For Belgium, precipitation data was gathered from KMI (The Royal Meteorological institute) and SPW (Public Services of Wallonia). For France, data was gathered from Météo France. Crosses on Figure 1 show used rainfall metering stations on and around the Scheldt basin (Météo France and KMI).

Since the previous NAM calibration study in Flanders (De Boeck et al. 2011), reliability of the rainfall interpolation was greatly increased for the French Leie and Bovenschelde (discussed in Michielsen et al., 2021). Due to additional data from the French weather stations, the amount of rain gauges for the the Bovenschelde and Leie (including the French part) increases to 46 rain gauges and 30 respectively (Table 3).

Table 3 – Number of rain gauges per hydrographic basin

Hydrographic basin	Surface area (km^2)[2]	Number of subcatchments (gauged and ungauged)	Number of rain gauges
Benedenschelde	1 704	24	21
Bovenschelde	5 947	33	46
Brugse Polders	1 046	24	13
Demer	2 334	36	29
Dender	1 384	17	17
Dijle en Zenne	2 450	49	37
Gentse Kanalen	917	29	11
Ijzer	1 046	18	9
Leie	3 886	39	30
Nete	1 673	20	24

[2] Bekkenbeheerplannen Vlaanderen(ANON., 2009)

3.3 Evapotranspiration

Whereas there is a lot of precipitation input data, it doesn't apply for evaporation data. Thiessen evaporation data is very scarce. As an example, for the entire period (from 1967-2013), there was only one active PE station in France, located in Langres, 10 km outside the southernmost part of the Scheldt basin. The evaporation per catchment was calculated based on interpolation of PE data which was already available from the Scheldt basin (a combination of Uccle and Herentals data). All interpolated evapotranspiration timeseries are practically identical because of their geographical proximity.

4 Rainfall-runoff modelling methodology

The hydrological model used which is investigated in this sub report is the conceptual rainfall-runoff VHM model. VHM is a rainfall-runoff lumped model structure developed by *the Hydraulics Division in KU Leuven in Belgium (Willems P., 2014).*

For each catchment, discharge is simulated based on a unique set of parameters using interpolated rainfall and potential evapotranspiration time series as input. A description of VHMM is outlined below.

4.1 Structure of the VHM hydrological model

The VHM model is "top-down", lumped, conceptual rainfall-runoff model. The term "top-down" refers to the flexibility of setting the model structure, or whether adapting the multiple working hypotheses method, instead of using pre-defined model conceptualization. This model uses an empirical and step-wise technique that is based on a data-based analysis of response characteristics after the examination of the various model components step by step. Figure 2 below shows the general structure of the VHM model. After the transformation of the observed rainfall series into a single time series of rainfall input, this latter is separated into different fractions; the main series that contributes to the quick runoff flow x_{QF}can be divided into an overland flow portion $x_{OF}$and an interflow portion x_{IF}. While $x_{SF}$is the series that concerns the slow flow runoff, the x_{UF}concerns the soil moisture storage portion. The total runoff $x_{TF}$is the sum of the quick and the slow flow portions (Willems, P., 2014).

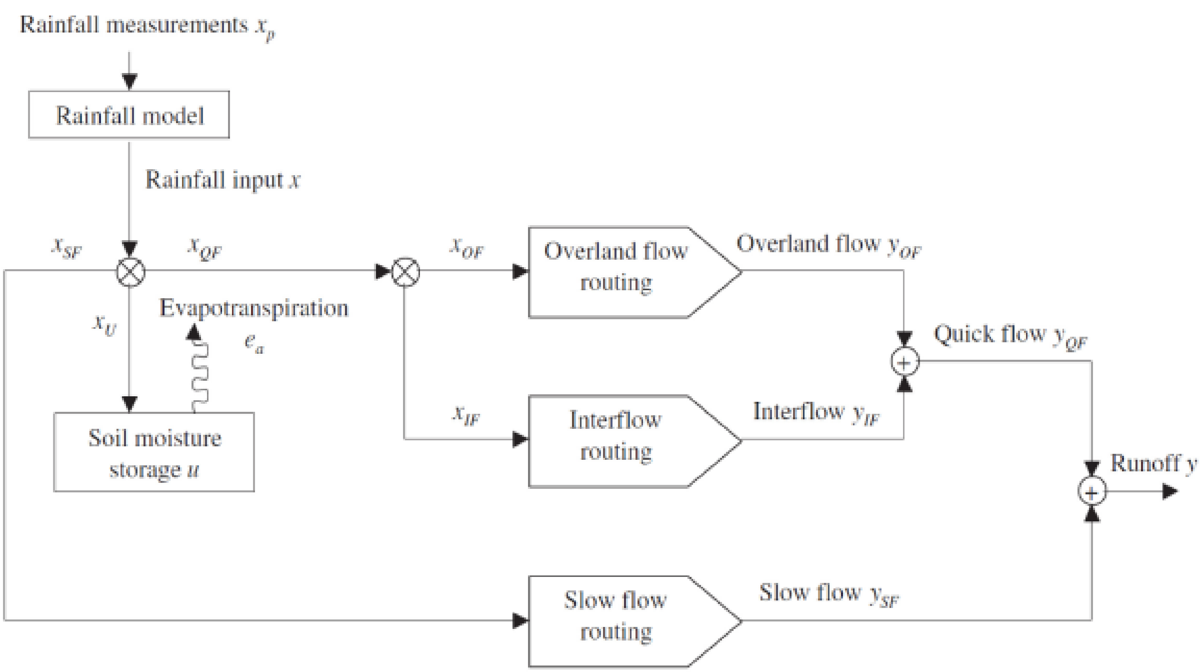


Figure 2 – Structure of the VHM model (Willems, P., 2014)

4.2 VHM parameters description

1. *Maximum soil moisture storage SM_{max}*

SM_{max}[mm] defines the maximum soil moisture storage which is the total amount of water that is stored in the soil within the plants' root zone. Depending on the soil texture and the crop rooting depth, this parameter varies within 50 and 500mm.

2. *Maximum soil evaporation SM_{evap}*

SM_{evap} [mm] or maximum soil evaporation, is the maximum quantity of water that can be evaporated from the soil. It varies from 0 to 100mm.

3. *Soil fraction parameters c1, c2 and c3*

To determine the soil moisture storage fraction, the soil fractions parameters are determinative to establish an equation between soil moisture and soil moisture fraction. They usually varies between 0 and 1, however, depending on the catchments, they can reach higher or lower values.

4. *Overland flow fraction parameters cOF1, cOF2*

These parameters are the surface runoff separation process parameters that are used to determine the overland runoff fraction. They varies between 0 and 1.

5. *Interflow fraction parameter cIF1, cIF2*

In analogy with the overland flow fraction parameters, cIF and the factors that express the interflow fraction in function of the soil moisture content. They also varies between 0 and 1.

6. *Baseflow time constant CKBF*

CKBF [hours] determines the shape of the hydrograph in dry periods (exponential decay). It can be estimated from hydrograph recession analysis. CKBF values range from 500 to 5000 hours.

7. *Interflow time constant CKIF*

CKIF [hours] determines, together with SMmax, the amount of interflow. It is the dominant routing parameter of the interflow. Range is 20 to 500 hours.

8. *Overland flow time constant CKOF*

CKBF [hours] determines, together with SMmax, the amount of overland flow. It is the dominant routing parameter of the overland flow. Range is 4 to 50 hours.

5 Calibration strategy

5.1 Optimization algorithm

The algorithm used for optimization of VHM parameters is the Non-dominated Sorting Genetic Algorithm II or NSGA II (Kalyanmoy et al. 2002). This algorithm is suitable for optimization problems with multiple objective functions.

Variable values are generated in the first iteration. Each solution, that is to say an array of variable values, is called an *individual.* A *population* is a group of N solutions in each iteration. In the following iterations the created individuals are going to be "children" of the previous population, that is to say they are going to inherit "features" from couples of individuals chosen in the previous population according to specified selection and crossover techniques. The user can choose to randomly mutate the children features when an offspring is created.

The algorithm will then perform the *evaluation* of the solutions through the Pareto comparison, that is to say a solution dominates, or is better than, another solution if it is better than or equal to the other solution in all objectives and strictly better in at least one objective. A combined population R of parent and children population is formed; the individuals in it are sorted according to non-domination. Since all previous and current population members are included in R, the elitism is ensured. The best N solutions will be the population of the next iteration.

5.2 Objective function

Automatic calibration is consists of optimizing (1) agreement between the average simulated and observed catchment runoff (overall volume error) and (2) overall agreement of the shape of the hydrograph. To assess these two aspects, evaluation is based on the following goodness-of-fit indexes:

1. Absolute error on cumulated total flow at each time step (to minimize), and
2. Logarithmic Nash-Sutcliff efficiency (to maximize).

These two objectives are suited for NSGA-II optimization because they are contradictory for a number of model parameters. A reduced number of objectives (two) facilitates and fastens the algorithm convergence while ensuring good overall performance of the model. It is also important that these objectives be contradictory in order for the optimum to be well defined. There are generally trade-offs between performance for high and low flows. Therefore, final manual and visual checks will complete performance evaluation with possible focus on low or high flow.

The efficiency E proposed by Nash and Sutcliffe (1970) is defined as one minus the sum of the absolute squared differences between the predicted and observed values normalized by the variance of the observed values during the period under investigation. It is calculated as follows:

$$E = 1 - \frac{\sum_{i=1}^{n}(O_i - P_i)^2}{\sum_{i=1}^{n}(O_i - \hat{O})^2} \qquad \text{Eq. 1}$$

with O observed and P predicted values.

To reduce the sensitivity to extreme values, the Nash-Sutcliffe efficiency E is also calculated with logarithmic values of O and P. Through logarithmic transformation of runoff values, the peaks are flattened and the low flows are kept more or less at the same level. As a result, the influence of low flow values is increased in comparison to the flood peaks, resulting in a higher sensitivity of log NSE to systematic model over- or underprediction (Krause et al. 2005).

The second objective of the algorithm is minimizing the absolute error on cumulated values at each time step (day). This ensures that the water balance remains satisfactory throughout the simulation (all years simulated).

The two goodness-of-fit statistics can be represented in 2 dimensions to represent the set of solutions evaluated by the algorithm. The best pairs constitute the Pareto front.

In order to select one single best solution, the two performance indexes were normalized (or rescaled) across the explored range (Eq. 2): with xmin set to zero for the absolute error, and xmax set to 1 for the logarithmic NSE.

$$x' \frac{x-xmin}{xmax-xmin} \qquad \text{Eq. 2}$$

This normalization resulted in values between 0 and 1 for the absolute error and between -1 and 1 for the NSE. The final solution was then selected among the final Pareto front, looking at the minimum Euclidian distance to theoretical optimum: log NSE = 1 and Absolute Error =0 (Eq. 3).

$$d = \sqrt{(x_B - x_A)^2 + (y_B - y_A)^2} \qquad \text{Eq. 3}$$

An example of Pareto front and final selection is shown in Figure 3 and Figure 4.

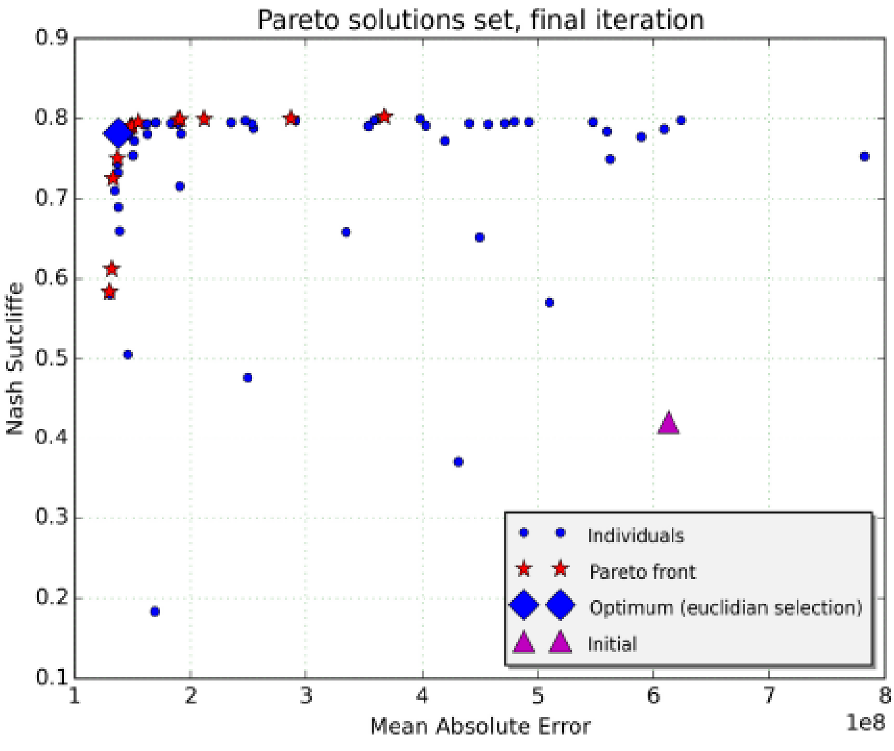


Figure 3 – All evaluated candidates (individuals) and final population of solutions (Pareto front)

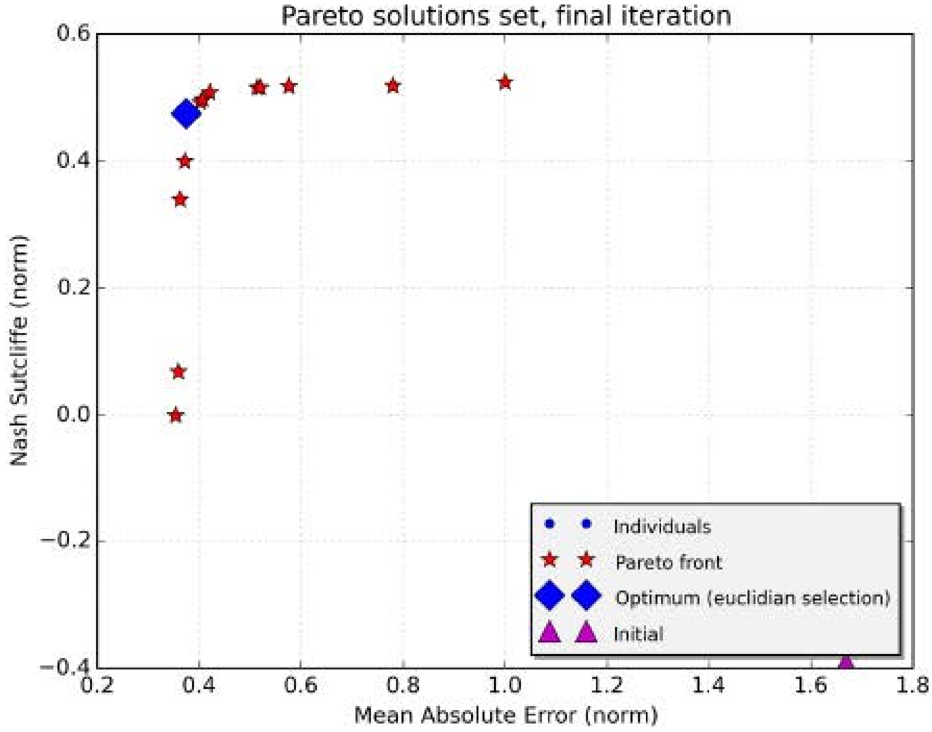


Figure 4 – Rescaled final population of solutions (Pareto front)

5.4 Implementation in Python

The Python version of the NSGA II algorithm was adapted for hydrological optimization purposes using a general framework supporting three rainfall-runoff models: NAM, PDM, VHM and Wetspa. Description of how the VHM model and the other lumped models are being implemented in Python can be found in Vansteenkiste et al. (2011) and Tran et al. (2014 a, b).

The calibration Python shell currently supports the following:

- Optimization of (one or all) model parameters for a given calibration period,
- Evaluation of model parameters for a given validation period,
- Plotting results of various alternative parameter sets on the same plot or separately (for example, the final population generated by the algorithm),
- Generating automatic reports of calibration and validation as Word document,
- Manual calibration for a given calibration period.

The first rainfall-runoff conceptual model used in this subtask is VHM. As a general rule, all twelve parameters, except C3, were optimized. The explored parameter space is defined by boundaries in Table 4. There are no bibliographical sources that have recommendations about the VHM parameters, however, we were based on the previous researches results and the past experience. In some particular cases, the optimum was not well defined or the algorithm could not converge in reasonable range and these boundaries were adjusted. Catchment surface area was considered reliable and was not optimized.

Whenever optimization was not delivering good results, boundaries were narrowed down using manual calibration.

Table 4: VHM parameters and optimization boundaries

Parameters	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
Lower boundary	0,5	0,1	0	0	-4	-4	0	-6	0	29	5	25
Upper boundary	1	5	4	3	6.5	20	5	20	3	1	120	2400

6 VHM model calibration

6.1 Model configuration

In most cases and when data were available, a calibration period of 13 years was used, preferably from January 2001 to December 2013. Nevertheless, different time series were selected when available data were insufficient or unreliable, choosing 13 years of calibration if possible.

Four windows of typical events were selected for visual evaluation:

- 11/2002-04/2003 (high flow) – 6 months
- 06/2008-11/2008 (transition) – 6 months
- 02/2005-11/2005 (low flow) – 10 months
- 11/2010-04/2011 (recession) – 6 months

The calibrated parameters were validated for the entire time series of available data (also outside of the calibration period). Normally this period ranges from 1967 to 2013. Adjustments for a certain catchment are reported in the catchment-specific paragraphs below.

We have to note that all the gauged catchments have been manually calibrated with the “VHM build and calibration tool” by “K.U.Leuven – Hydraulics Laboratory”, before that the parameters can be optimized by the automatic calibration. In fact, the initial values of the model parameters can affect the resulted one and the quality of the output model. At the end, we chose the methodology that gives better objectives and better visual resemblance to the gauged rainfall.

6.2 Model evaluation

While the optimization is limited to two objectives, logarithmic NSE and absolute error, it can be interesting to look at the other indexes listed when evaluating the final results. For example:

- Nash-Sutcliff efficiency
- Relative error (negative or positive) or bias
- Kling-Gupta efficiency (Gupta et al. 2009 and Kling et al. 2012)
- Relative Nash-Sutcliff efficiency

$$E_{rel} = 1 - \frac{\sum_{i=1}^{n}\left(\frac{O_i - P_i}{O_i}\right)^2}{\sum_{i=1}^{n}\left(\frac{O_i - \bar{O}}{O_i}\right)^2} \qquad \text{Eq. 4}$$

Since this work focuses on low flows, more importance is given to logarithmic NSE. However, high NSE values should also be sought in order to ensure good enough performance for higher flows as well, as much as possible.

An exact agreement between simulation and observations must not be expected because of different error sources (errors in meteorological input data, errors in measured discharge, errors inherent to the model structure). Calibration can only minimize those errors due to non-optimal parameter values.

NSE and logNSE values above 0.7 can be considered good. Values below zero mean that the predictive power of the model is worse than the measured average. Considering deviation of the measured discharge time series and errors in the meteorological inputs, NSE values are not expected to be above 0.8 (Willems, 2007).

Visual evaluation of the fit between simulated and observed total discharge is also taken into consideration to select the final solution, with a focus on good agreement of simulations for low flows. When useful, Nash-Sutcliffe efficiency (non-logarithmic) was also taken into account for evaluating the final set of candidates (when other fitness indexes were equivalent for example).

Apart from the calibration period, these goodness-of-fit statistics were calculated on the entire time series of available data (also outside of the calibration period) in order to validate calibrated parameters whenever more than 13 years of data was available.

The following section synthetizes the main results and conclusions of the VHM calibration in each river basin. Detailed graphs and calculated statistics, for calibration and validation periods, are given for each gauged catchments in Annex 3 to Annex 12.

The final sets of parameters for each calibrated PDM model and for each transposed VHM model are summarized in Annex 1.

6.3 IJzer basin

6.3.1 Context

Although there is no interaction between the Scheldt catchment and the IJzer catchment, the latter is included in the regional water allocation model for the sake of completeness.

The total surface area of the IJzer catchment is of 1 101 km² from which about one third is located in France (WL, 2006). This represents 1,6 % of the total study area (Scheldt basin + IJzer, excluding the Meuse). On the French side, the main tributaries are the Peene Becque, the Sale Becque and the Herzeele. In Flanders, the Poperingevaart, the Kemmelbeek, the Ieper-IJzer Canal with the Ieperlee and Martjensvaart, Stenensluisvaart, Houtensluisvaart and Handzamevaart are the main tributaries of the IJzer. Note that these tributaries are all discharging from the right bank of the IJzer River.

There are 8 gauged catchments in the IJzer catchment, covering 786 km² (70 % of the IJzer catchment area). Subcatchments V01HEI468010 and F01YSE468000 are located upstream of the gauging station in Roesbrugge. Figure 5 shows the catchments and corresponding measurement points.

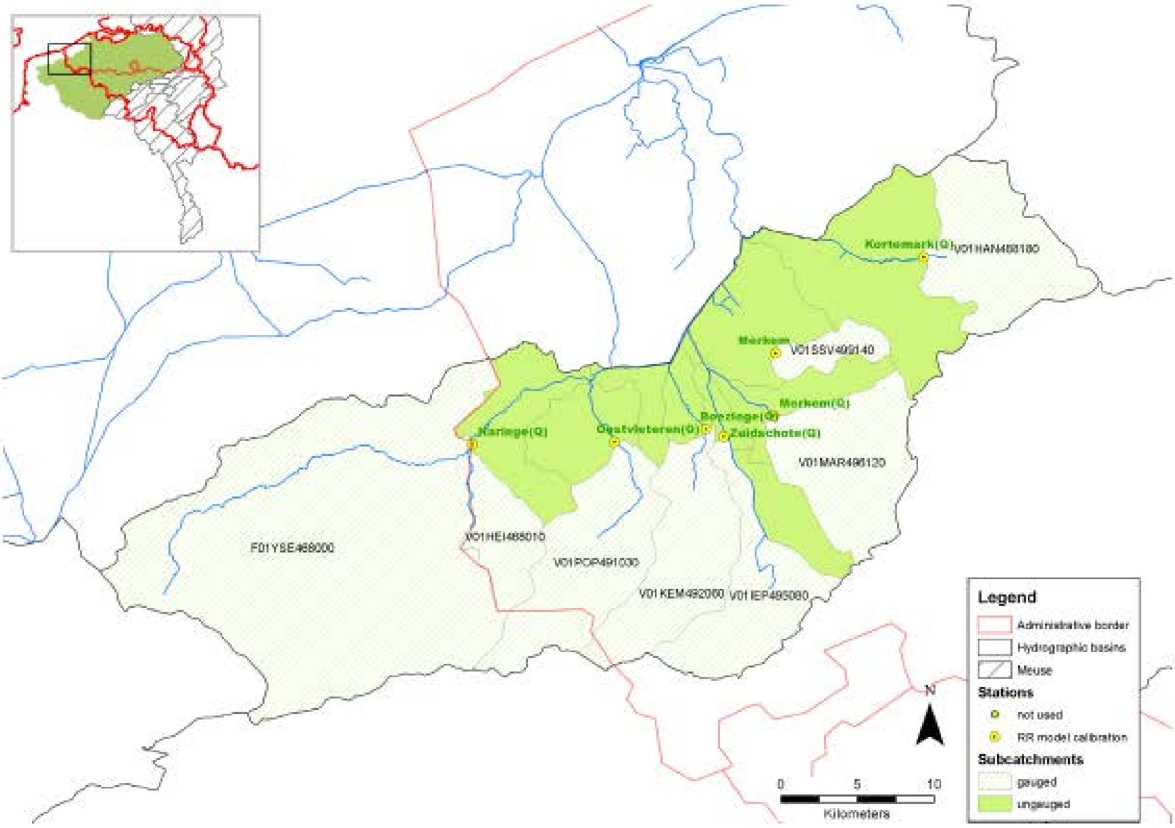


Figure 5 – Catchments and flow metering station on the IJzer basin

6.3.2 Model performance

Table 5 and Table 6 present general performance statistics for the gauged subcatchments of the IJzer basin for the calibration and validation period. Graphs of simulations for the subcatchments **V01HAN488180** (best model performance in this catchment) and **V01IEP495080** (worst model performance in this catchment) are presented below (Figure 6 to Figure 13). For more detailed results on the remaining subcatchments is referred to Annex 3.

While some catchments reached good values of NSE, LogNSE and RelErr (**V01HAN488180, V01SSV499140…**), **V01IEP495080**, on the opposite, showed the worst indicators among these latter. It was also the case with the other models PDM and NAM; which may be explained by the complex hydrological situation of the catchment, influenced by the presence of structures and diversions.

Despite the variability of these indicators from one catchment to another, the correlation between the gauged series and the simulated ones are visually good.

Remarks on the discharge measurements:

For the catchment **F01IJZ468000**, the period from 1996 to 2005 was discarded (for both calibration and validation) due to unreliable high observed discharge values. The measured base flow is indeed unnaturally high during this period and most likely due to a loss of measurement quality or change of gauging parameters of the station, that were unaccounted for. This exclusion results in a reduction of the calibration period to 9 years.

The calibration period selected for the catchment with code **V01IEP495080** is 1996-2008 since the discharge data after 2008 is not trustworthy. For the catchment **V01SSV499140** there is not observe discharge from the beginning of the year 2009. Moreover, the gauging device for this catchment in Merkem was replaced in 2005 resulting in a shift in the discharge time series. Therefore, data before mid-2005 was discarded from calibration as well as it is not consistent with the time series before. Because years of data are relatively scarce for this catchment , years 2005-2008 are used for validation however, despite their lower quality.

Table 5 – Overview of calibration results for gauged subcatchments in the IJzer basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Calibration period	Approx. distance to rain gauge over calibration period (km)
48810102 - Handzamevaart; Kortemark	V01HAN488180	78.6	0.702	0.734	1.6	2001-2013	< 2004 : 11 >= 2004 : 2.5
46810102 - Ijzer; Roesbrugge Haringe	F01IJZ468000 (V01HEI468010 and F01YSE468000)	393.007	0.522	0.605	-3.3	2005-2013	6
49510102 - Ieperlee; Zuidschote	V01IEP495080	63.423	0.555	0.447	-2.1	1996-2008	4
49270102 -Kemmelbeek; Boezinge	V01KEM492060	73.893	0.575	0.484	2.2	2001-2013	6
49610102 - St. Jansbeek; Merkem	V01MAR496120	76.137	0.673	0.605	-1.9	2001-2013	8
49110102-Poperingevaart; Oostvleteren	V01POP491030	84.868	0.585	0.617	-1.3	2001-2013	3.6
49910102 - Steenbeek; Merkem	V01SSV499140	16.095	0.608	0.623	0	1996-2005	< mid-2008 : 10 >= mid-2008 : 2

Table 6 – Overview of validation results for gauged subcatchments in the IJzer basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Validation period
48810102 - Handzamevaart; Kortemark	V01HAN488180	78.6	0.712	0.736	3.5	1967-2013
46810102 - Ijzer; Roesbrugge Haringe	F01IJZ468000 (V01HEI468010 and F01YSE468000)	393.007	0.698	0.529	7.5	1967-2013
49510102 - Ieperlee; Zuidschote	V01IEP495080	63.423	0.487	0.501	-27.5	1967-2013
49270102 -Kemmelbeek; Boezinge	V01KEM492060	73.893	0.562	0.481	10.5	1967-2013
49610102 - St. Jansbeek; Merkem	V01MAR496120	76.137	0.679	0.596	2.8	1967-2013
49110102-Poperingevaart; Oostvleteren	V01POP491030	84.868	0.574	0.578	-14.9	1967-2013
49910102 - Steenbeek; Merkem	V01SSV499140	16.095	0.59	0.601	-2.4	1967-2013

48810102 - Handzamevaart; Kortemark (V01HAN488180)

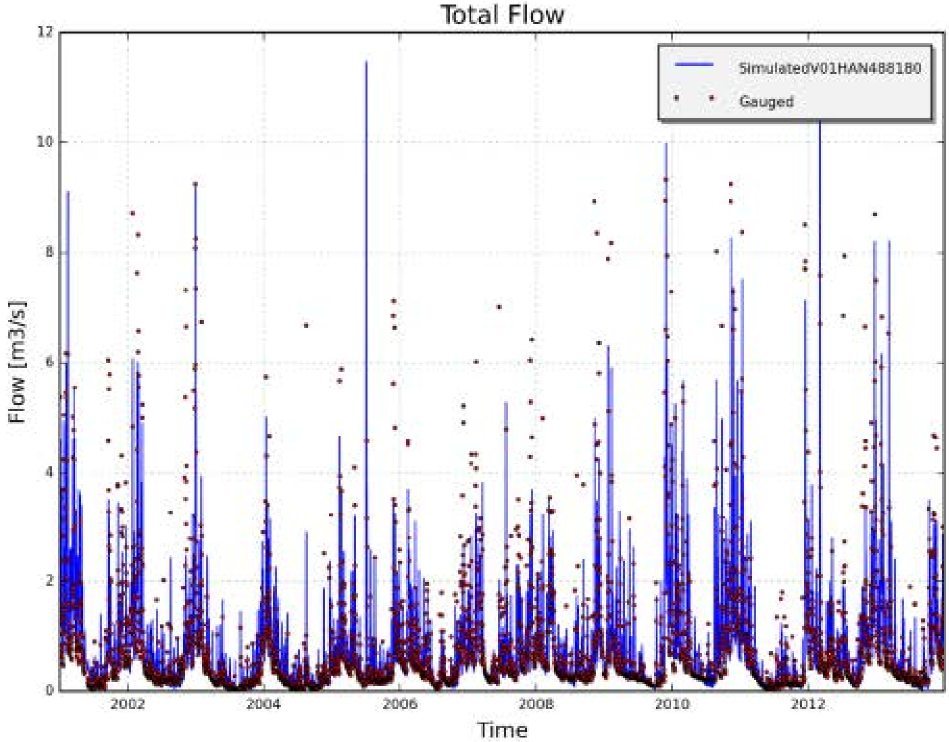


Figure 6 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V01HAN488180, station 48810102 - Handzamevaart; Kortemark (2001-2013)

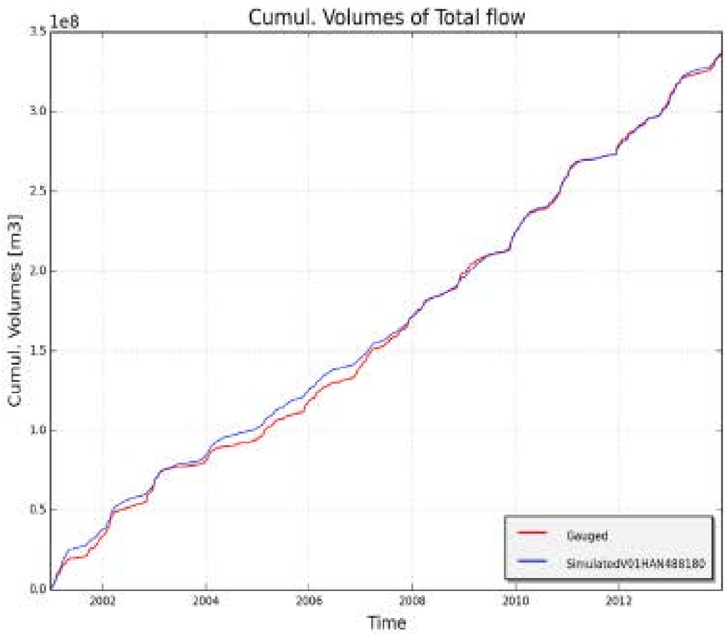


Figure 7 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V01HAN488180, station 48810102 - Handzamevaart; Kortemark (2001-2013)

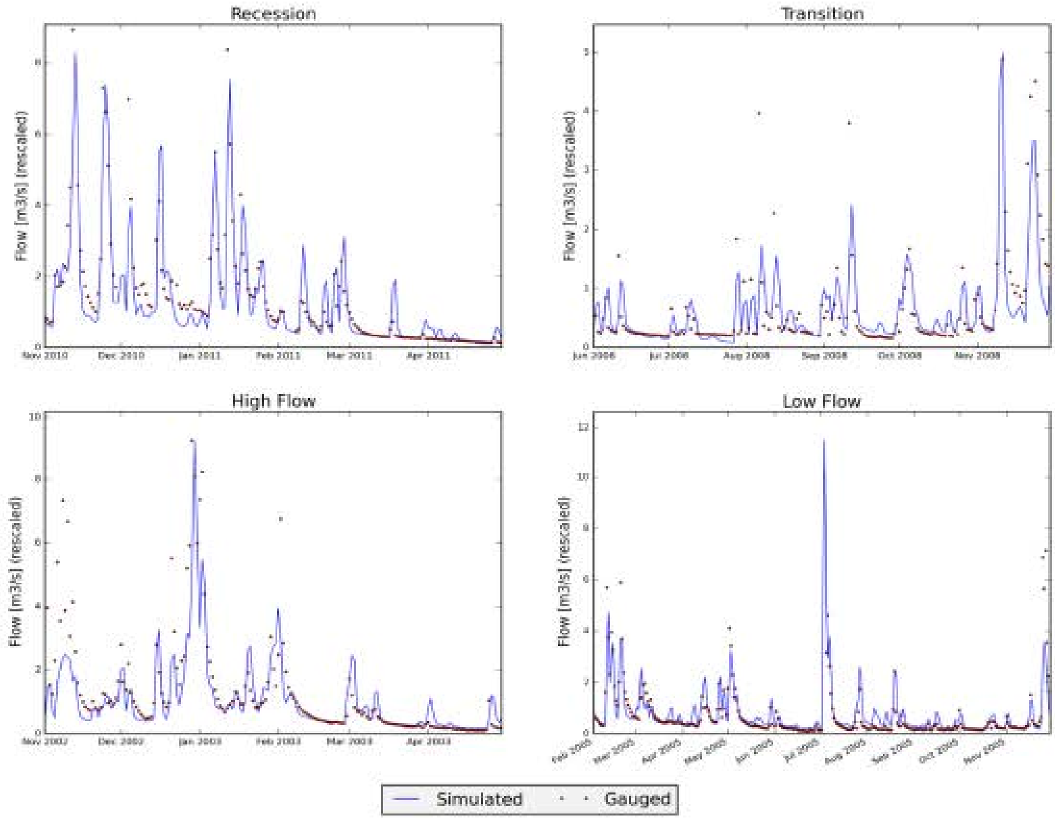


Figure 8 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V01HAN488180, station 48810102 - Handzamevaart; Kortemark

49510102 - Ieperlee; Zuidschote (V01IEP495080)

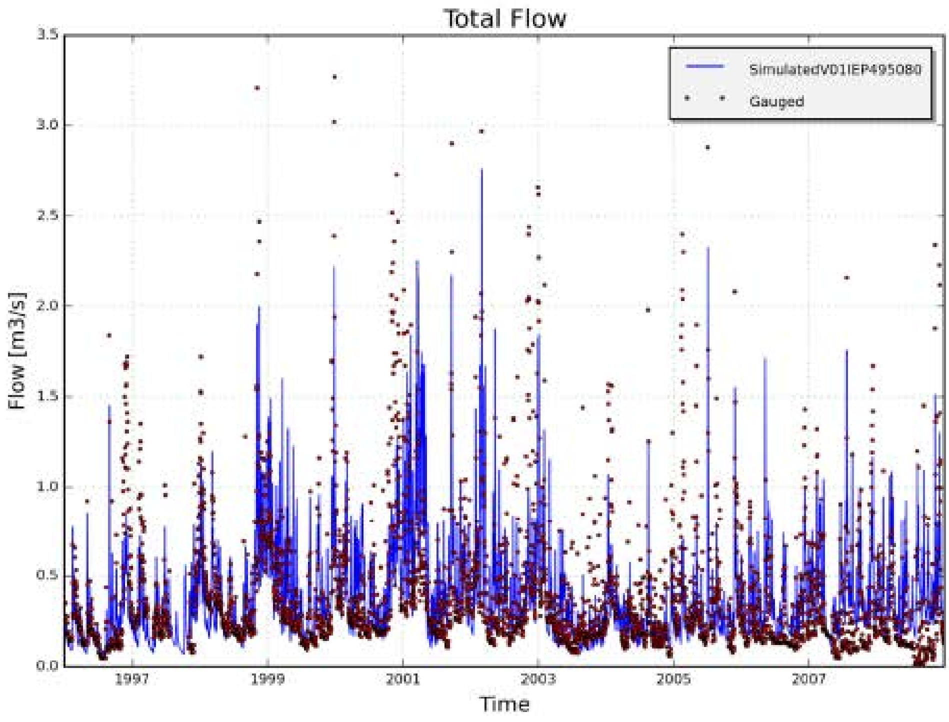


Figure 9 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote 1996-2008)

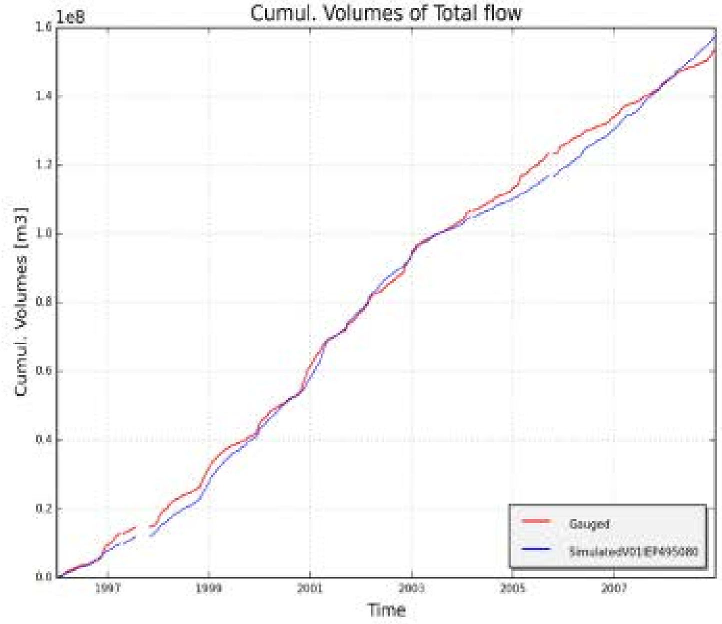


Figure 10 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote (1996-2008)

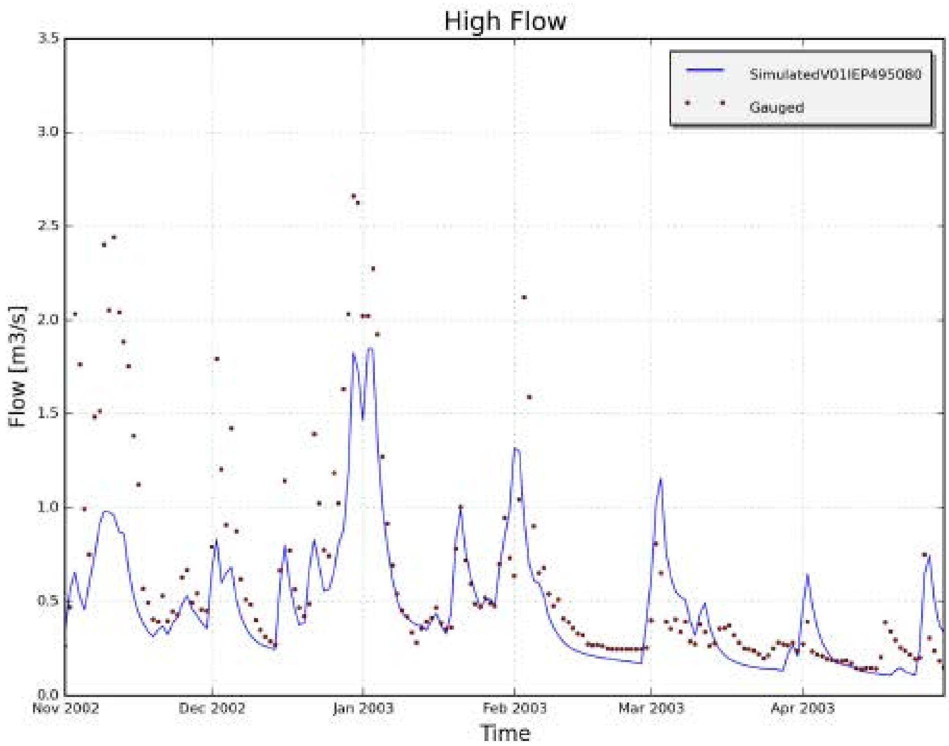


Figure 11 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote

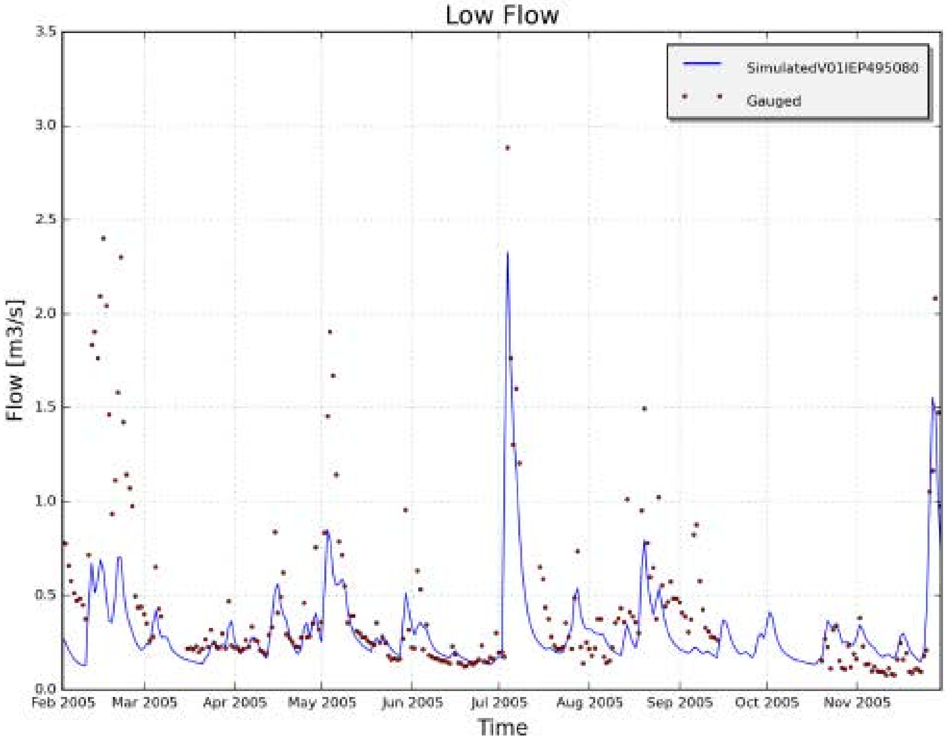


Figure 12 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote

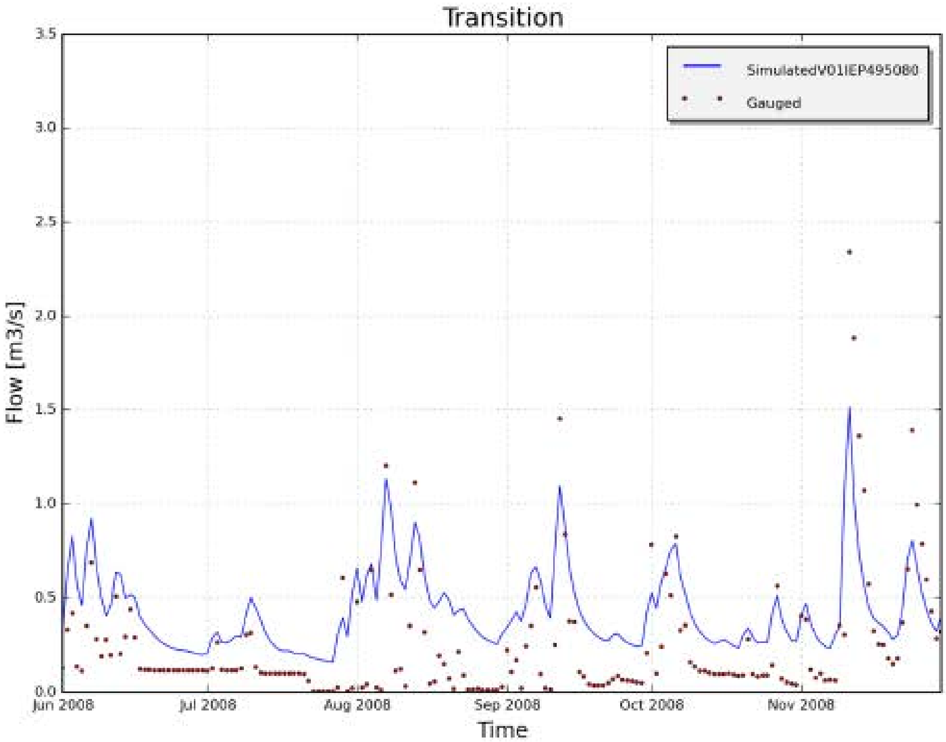


Figure 13 – Measured (red) and simulated (blue) daily discharge [m³/s] during transition events on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote

6.4 Brugse Polders

6.4.1 Context

The catchment of the Brugse Polders has an area of 1046 km², which is 4 % of the total area of subcatchments within the water allocation model. The Brugse Polders catchment is limited by the North Sea in the North and by the Dutch border in the Northeast. The main rivers of the basin are the canal connecting Gent and Oostende (Kanaal Gent-Oostende), the deviation canal (Afleidingskanaal) of the Leie and the Leopold canal. These artificial canals conduct water from the Leie catchment towards the sea. Additionally, several local polder water courses flow into these canals (De Boeck et al. 2011).

In the Brugse Polders, four gauged catchments account for 29 % of the total surface area (Figure 14).

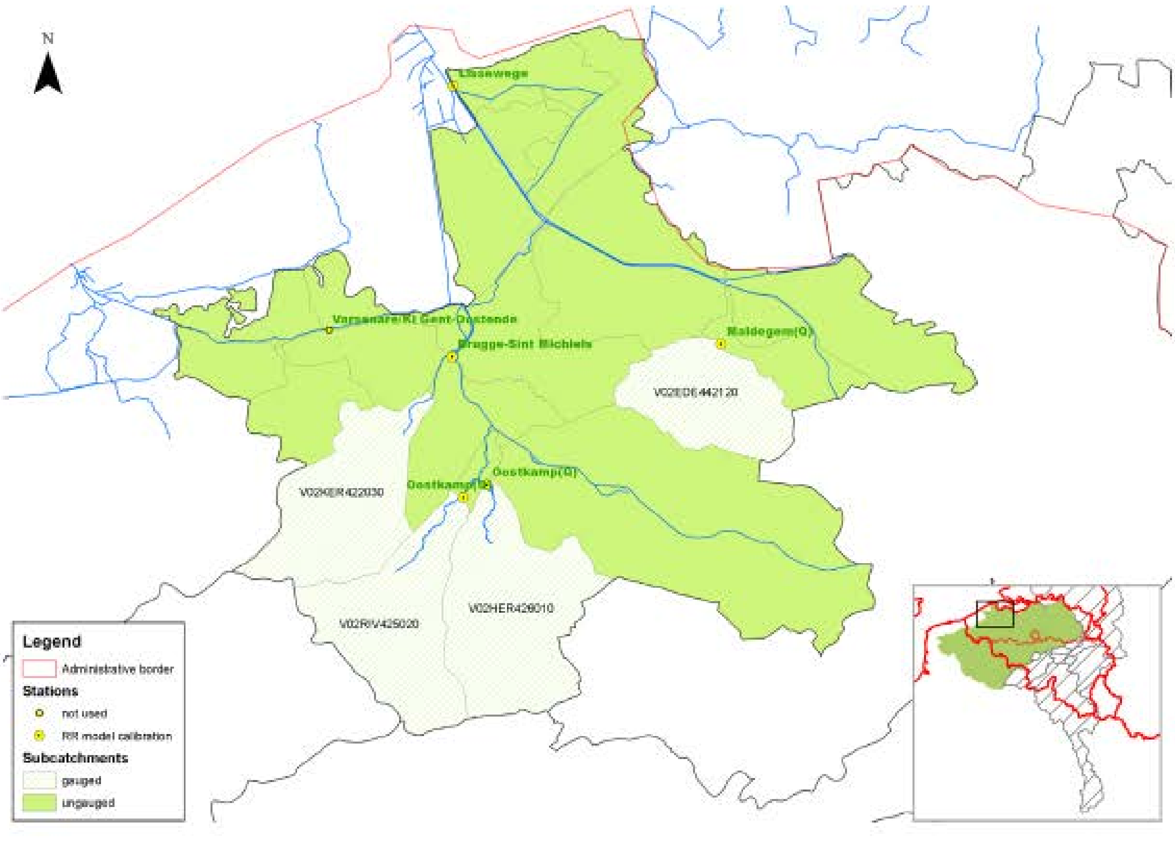


Figure 14 – Subcatchments and measurement points in the catchment of the Brugse Polders

6.4.2 Model performance

Table 7 and Table 8 present general performance statistics for the gauged catchments of the Brugse Polders for the calibration and validation period. Graphs of simulations of the subcatchment **V02EDE442120** (best performance) and **V02RIV425020** (worst performance) are presented below (Figure 15 to Figure 20): Structure of the VHM model . For more detailed results on the other catchments, see Annex 4.

Apart from the logNSE of V02KER422030, the evaluation parameters for all of the catchments are quite satisfying even if we consider the validation results. This can be due to the fact that all of these catchments have small areas.

Remarks on the data: V02KER422030 does not have data after 2007, consequently the period 1995-2007 was selected for the calibration.

Table 7 – Overview of calibration results for gauged catchments on the Brugse Polders

Gauging station	Catchment code	Area (km^2)	NSE	logNSE	RelErr (%)	Calibration period	Approx. distance to rain gauge over calibration period (km)
44210102 - Maldegem	**V02EDE442120**	45.489	0.722	0.631	0.8	2001-2013	<2013 : 7 2013 : 10
42610102 - Hertsbergebeek; Oostkamp	**V02HER426010**	77.272	0.654	0.549	0	2001-2013	2011 & 2013 : 13 Other years: 5
4220102 - Kerkebeek, Sint-Michiels	**V02KER422030**	62.719	0.691	0.627	0.6	1995-2007	< 2000 : 3 >=2000 : 11
42510102- Rivierbeek; Oostkamp	**V02RIV425020**	63.98	0.647	0.616	-1.1	2001-2013	2001-2003 : 13 Other years : 7.5

Table 8 – Overview of validation results for gauged catchments on the Brugse Polders

Gauging station	Catchment code	Area (km^2)	NSE	logNSE	RelErr (%)	Validation period
44210102 - Maldegem	**V02EDE442120**	45.489	0.725	0.592	-5.1	1967-2013
42610102 - Hertsbergebeek; Oostkamp	**V02HER426010**	77.272	0.662	0.595	-4.8	1967-2013
4220102 - Kerkebeek, Sint-Michiels	**V02KER422030**	62.719	0.642	0.607	-6.2	1967-2013
42510102- Rivierbeek; Oostkamp	**V02RIV425020**	63.98	0.639	0.552	-6	1967-2013

44210102 - Maldegem (V02EDE442120)

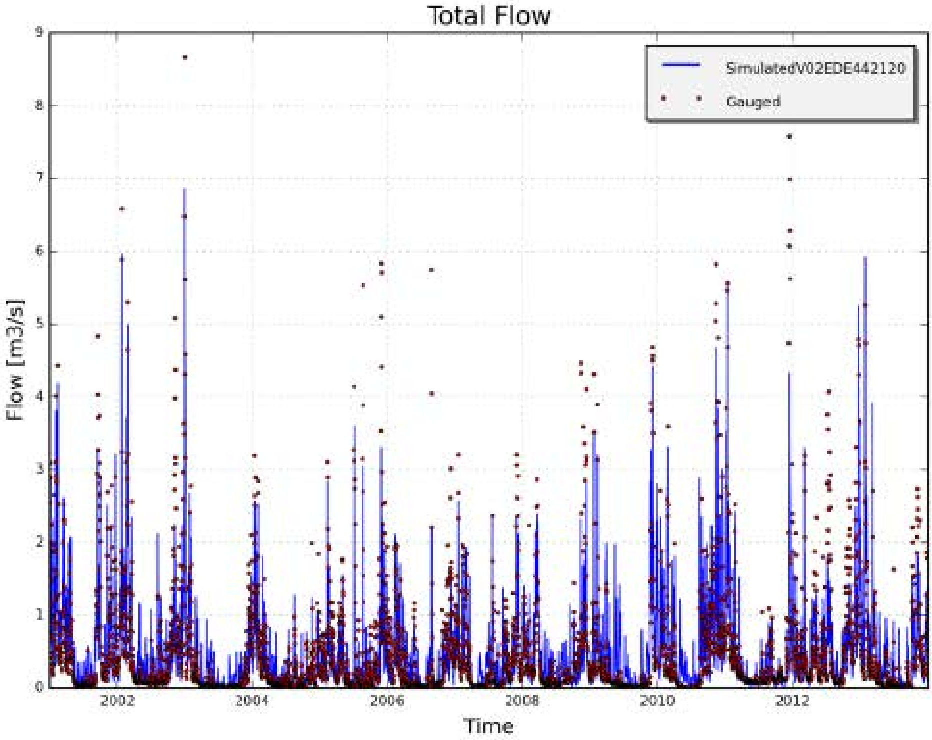


Figure 15 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V02EDE442120, station 44210102 - Maldegem(2001-2013)

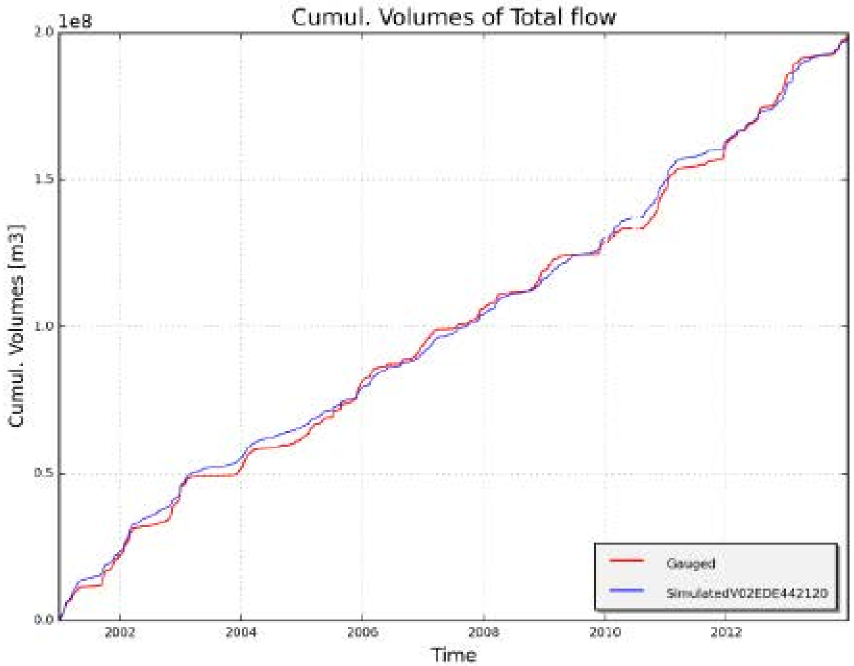


Figure 16 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V02EDE442120, station 44210102 - Maldegem (2001-2013)

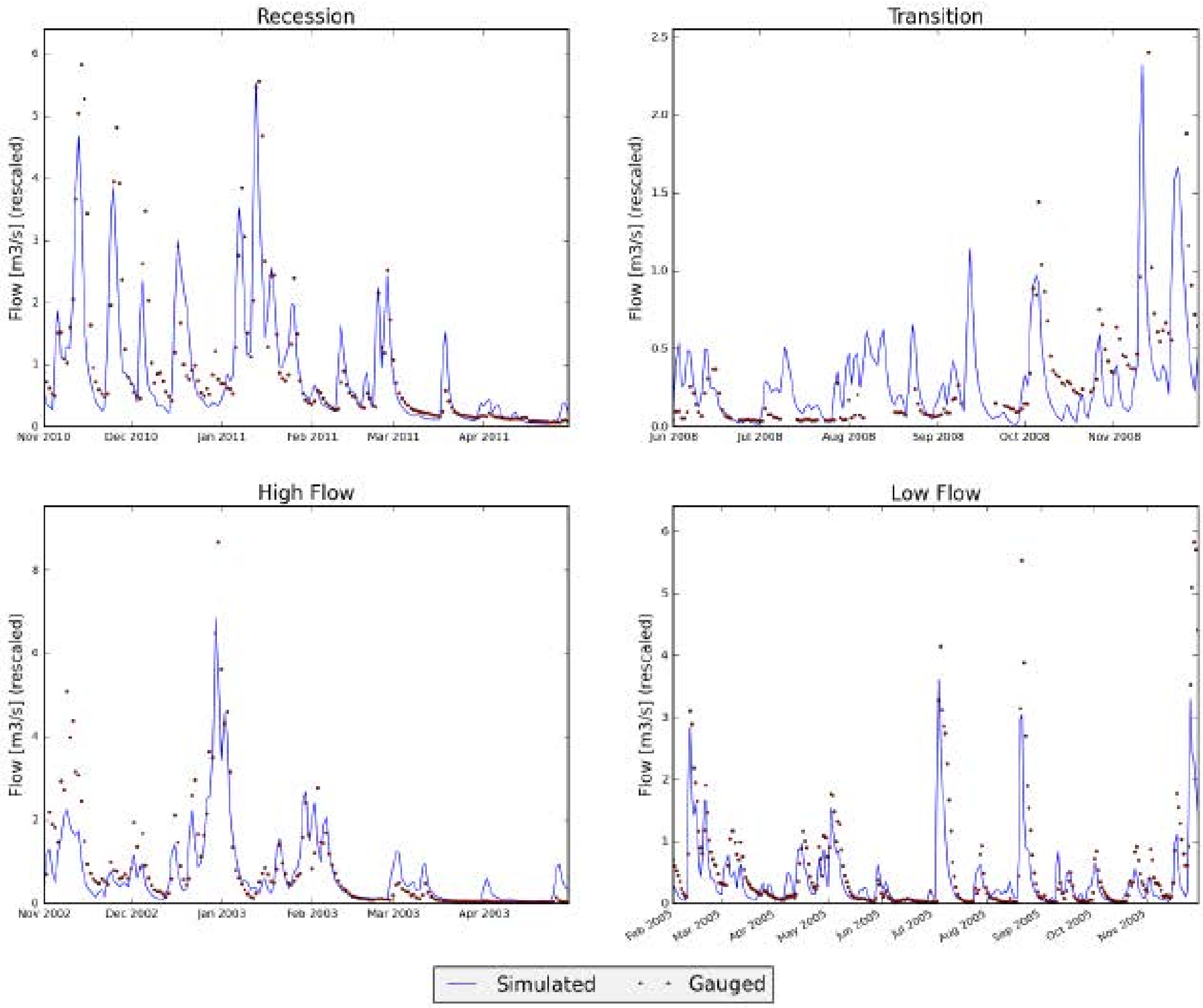


Figure 17 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V02EDE442120, station 44210102 – Maldegem

42610102 - Hertsbergebeek; Oostkamp (V02HER426010)

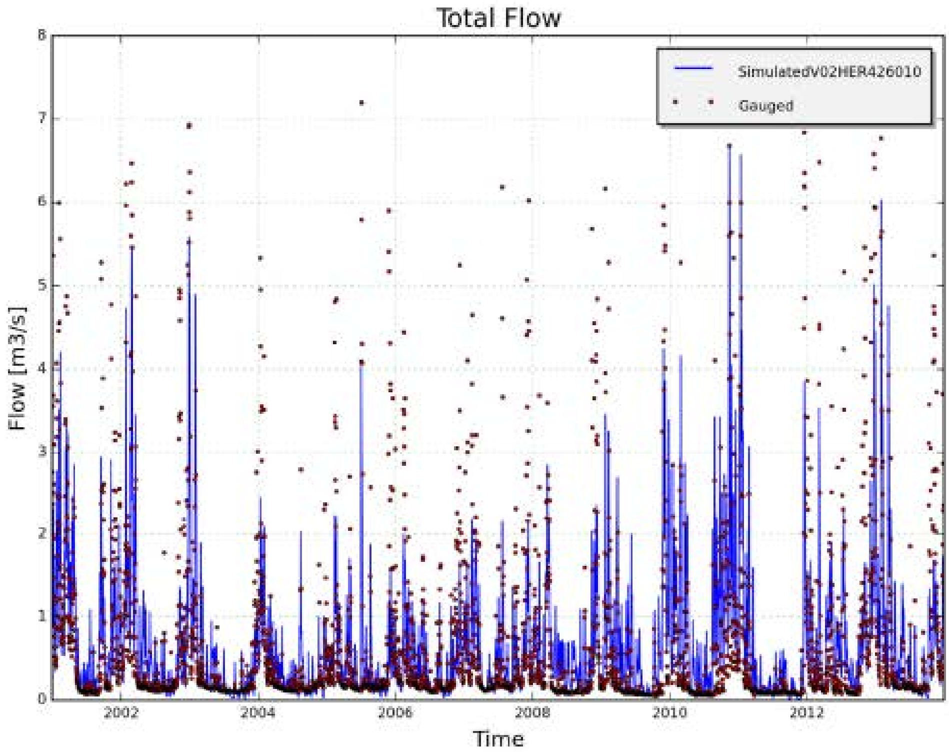


Figure 18 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V02HER426010, station42610102 - Hertsbergebeek; Oostkamp (2001-2013)

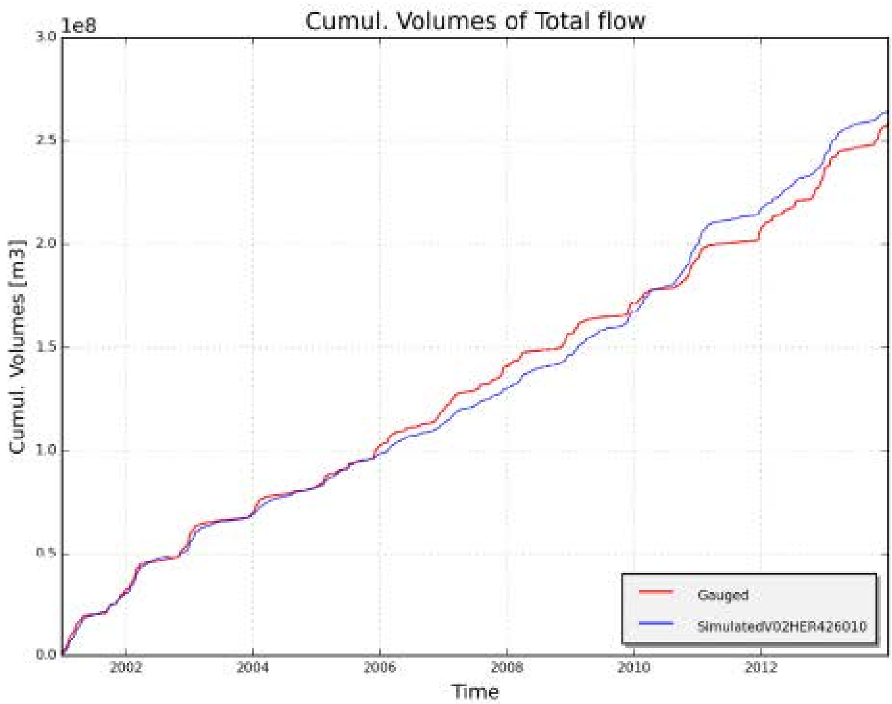


Figure 19 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V02HER426010, station42610102 - Hertsbergebeek; Oostkamp (2001-2013)

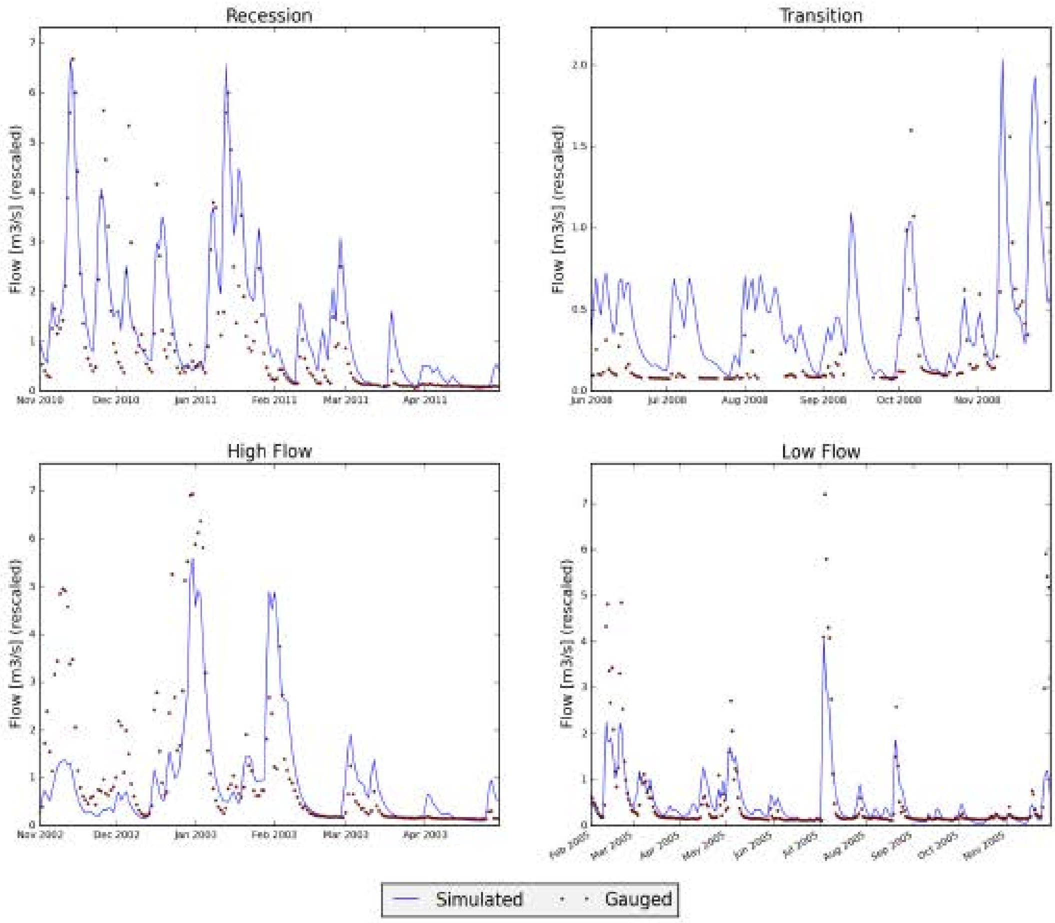


Figure 20 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V02HER426010, station42610102 - Hertsbergebeek; Oostkamp

6.5 Gentse Kanalen

6.5.1 Context

The Gentse Kanalen catchment, covers a cluster of canals and their respective catchments and has a surface area of 917 km² (De Boeck 2011). The catchment represents 4 % of the total model area of the water allocation model. The Gentse Kanalen basin is limited West by the Brugse Polders, East by the Benedenschelde and South by the Leie catchment. The Dutch border stands in the North of the basin. Both the Leopold canal and the Gent-Terneuzen canal discharge into the Westerschelde (Western Scheldt) in the Netherlands.

There is only one gauged catchment within the basin of the Gentse Kanalen: 44656122 on the Poekebeek in Nevele. During the previous study the discharge at the Molenbeek in Puivelde was checked, based on project specific discharge data of the Sigmaplan update project (De Boeck et al., 2011). This station is not a permanent discharge station and consequently no new calibration is possible for this subcatchment. Catchments and measurement points are shown on the map in Figure 21. The gauged and recalibrated area of the basin amounts for 12 % of the total surface area of the basin.

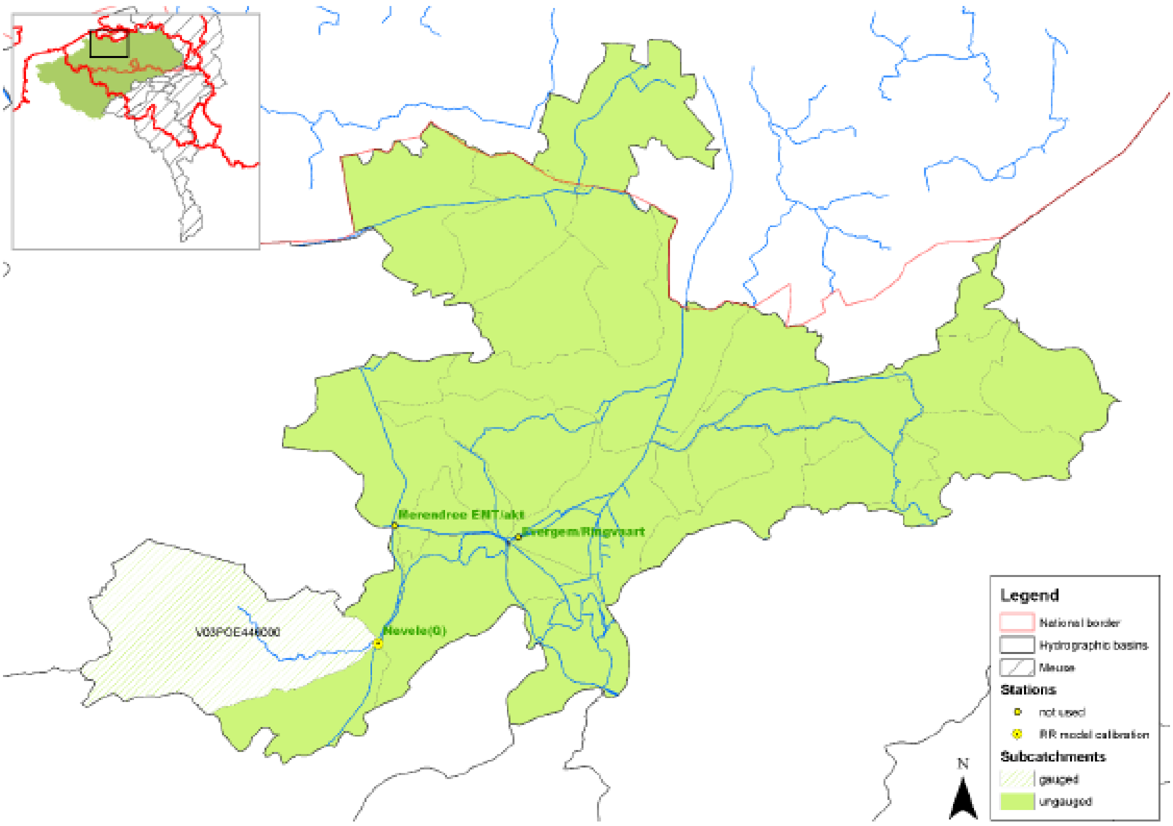


Figure 21 – Subcatchments and measurement points on the Gentse Kanalen catchment

6.5.2 Model performance

Table 9 and Table 10 present general performance statistics for the gauged subcatchments of the Gentse Kanalen catchment for the validation and calibration period. The subcatchment shows a correct performance for the validation and calibration period with values of NSE and LogNSE above 0.6. Graphs of the simulation of the subcatchment V03POE446000 are presented below (Figure 22 and Figure 23). For more detailed results on the other catchments is referred to Annex 5.

Remarks on the data: the Poekebeek (**V03POE44600**) discharge was not measured from 18/01/2001 to 29/11/2004 and after 2009. Hence, the calibration period starts as soon as 1993 as to include 13 years of data.

Table 9 – Overview of calibration results for gauged catchments on the Gentse Kanalen

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Calibration period	Approx. distance to rain gauge over calibration period (km)
44656122 - Poekebeek; Nevele	V03POE446000	106.837	0.723	0.645	-0.7	1993-2010	< 1995 : 9 >= 1995 : 6

Table 10 – Overview of validation results for gauged catchments on the Gentse Kanalen

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Gauged years
44656122 - Poekebeek; Nevele	V03POE446000	106.837	0.727	0.669	8.1	1967-2013

44656122 - Poekebeek; Nevele (V03POE446000)

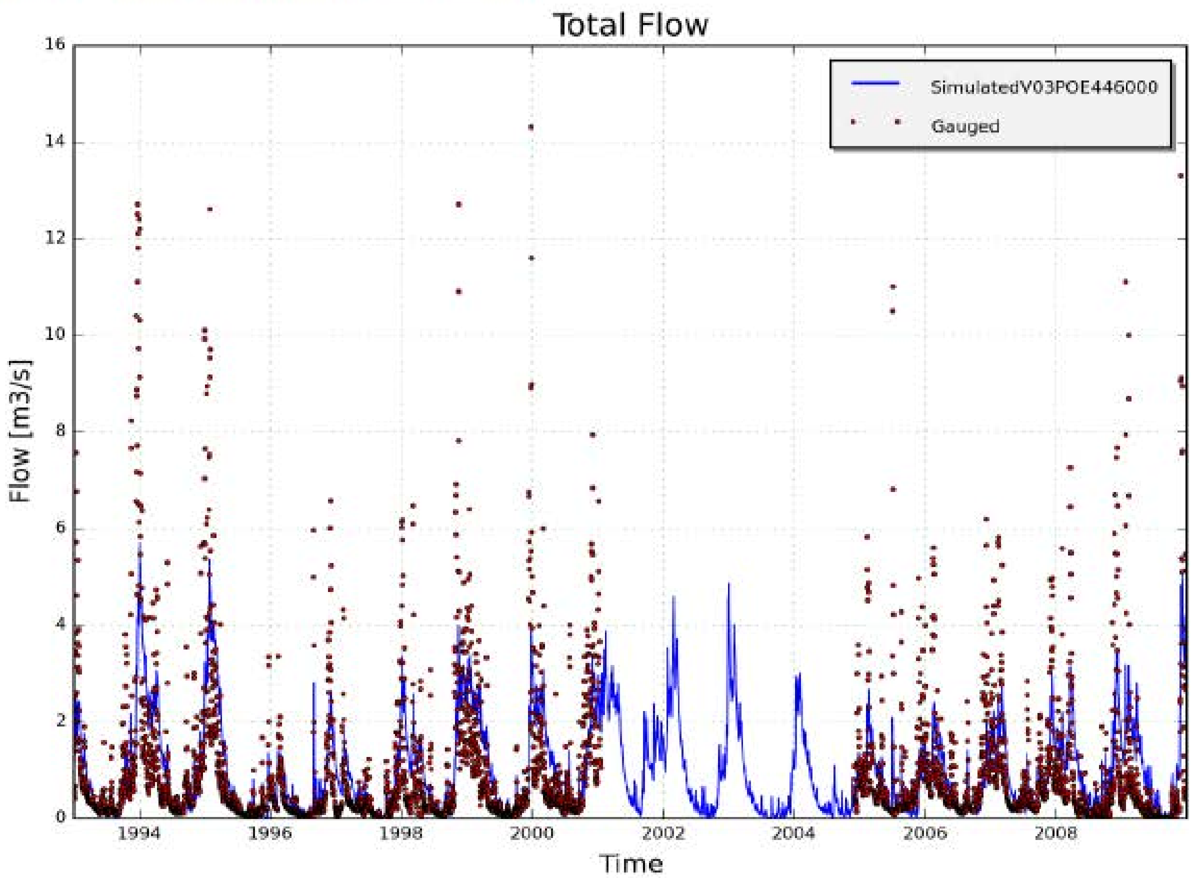


Figure 22 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V03POE446000, station 44656122 - Poekebeek; Nevele(1993-2010)

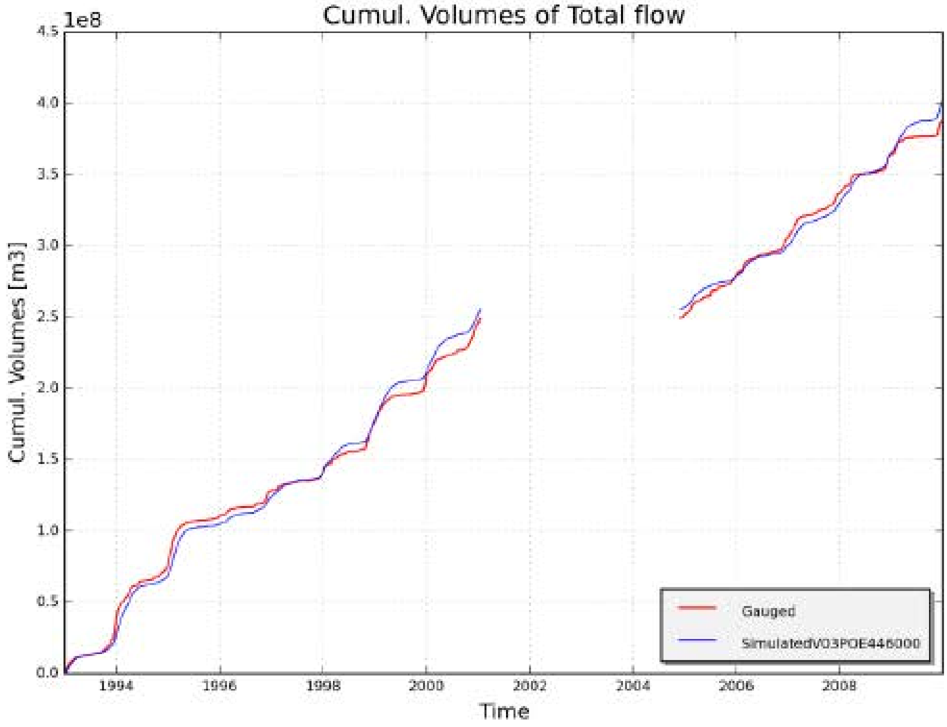


Figure 23 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V03POE446000, station 44656122 - Poekebeek; Nevele (1993-2010)

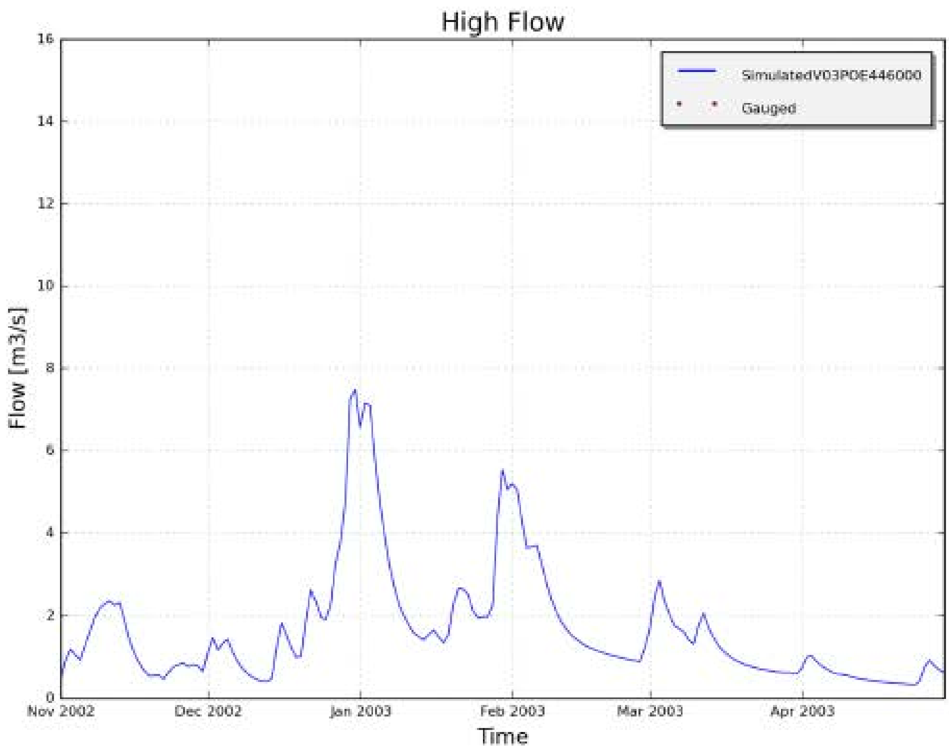


Figure 24 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific high flow events on catchment V03POE446000, station 44656122 - Poekebeek; Nevele

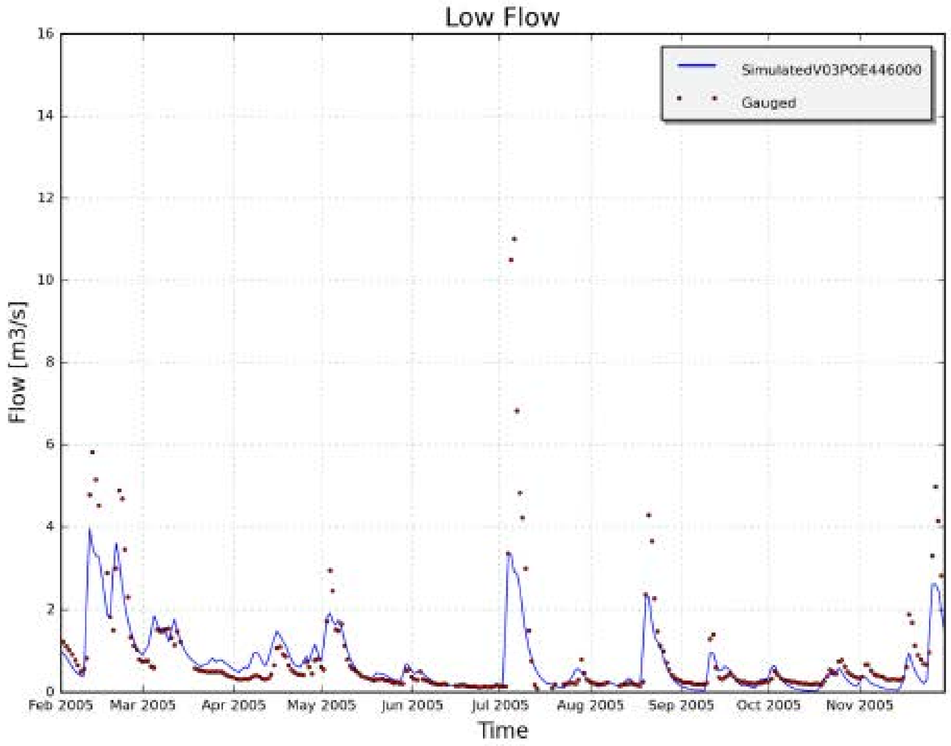


Figure 25 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low flow events on catchment V03POE446000, station 44656122 - Poekebeek; Nevele

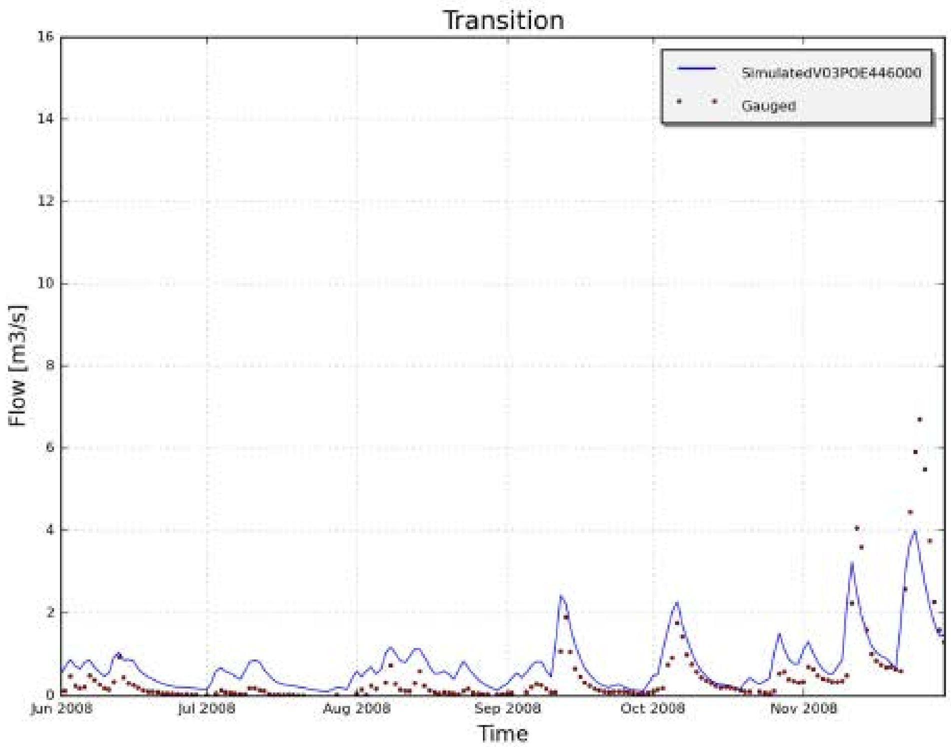


Figure 26 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific transition events on catchment V03POE446000, station 44656122 - Poekebeek; Nevele

6.6 Benedenschelde

6.6.1 Context

The catchment of the Benedenschelde is 1 704 km² and belongs to the main Scheldt catchment. It covers the Flemish part of the tidal rivers in the Scheldt estuary, except the catchments corresponding to the main tributaries in this reach (Nete, Demer, Dijle, Zenne and Dender). The Benedenschelde catchment accounts for 8 % of the total catchment of the study area.

About 6 % of the surface area of the basin is gauged. During the previous study the discharge at the Ledebeek in Bormt was checked, based on project specific discharge data of the Sigmaplan update project (De Boeck et al., 2011). This station is not a permanent discharge station and consequently no new calibration is possible for this subcatchment.

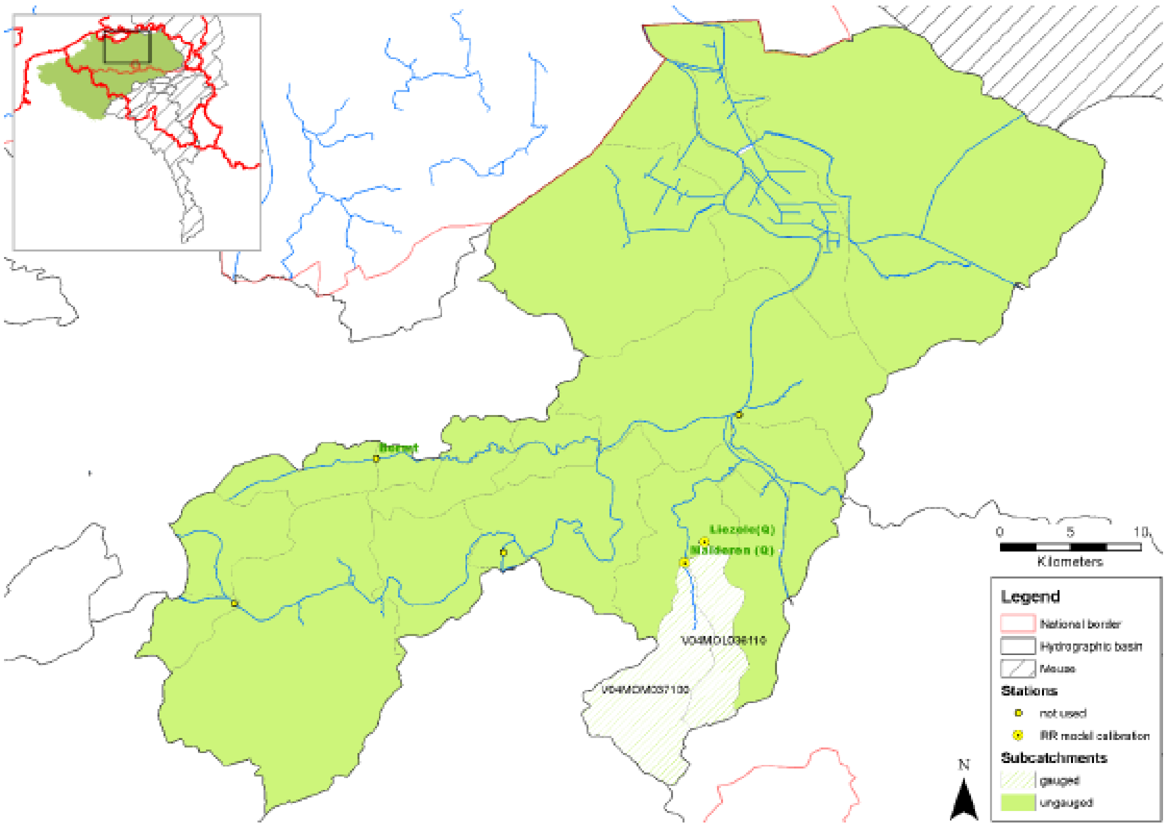


Figure 27 – Subcatchments and measurement points on the Benedenschelde catchment

6.6.2 Model performance

Table 11 and Table 12 present general performance statistics for the gauged catchments of the Benedenschelde basin for the calibration and validation period. Graphs of simulation of the catchment **V04MOM037100** (best model performance) and **V04MOL036110** (worst model performance) are presented below (Figure 25 to Figure 27).

For both of the catchment, the low flows are over-estimated and the slopes in the recession don't match with the gauged ones. These results were obtained even though we aim to define the adequate model parameters by manual calibrating before the optimization.

Table 11 – Overview of calibration results for gauged catchments on the Benedenschelde basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr(%)	Calibration period	Approx. distance to rain gauge over calibration period (km)
3610102 - Kleine Molenbeek, Liezele	**V04MOL036110**	32.562	0.56	0.667	0.4	2001-2013	< 2007 : 10 >=2007 : 6
3710102 - Grote Molenbeek, Malderen	**V04MOM037100**	67.301	0.669	0.657	0.3	2001-2013	6

Table 12 – Overview of validation results for gauged catchments on the Benedenschelde basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr(%)	Validation period
3610102 - Kleine Molenbeek, Liezele	**V04MOL036110**	32.562	0.612	0.57	12.5	1967-2013
3710102 - Grote Molenbeek, Malderen	**V04MOM037100**	67.3	0.651	0.567	15.6	2001-2013

3710102 - Grote Molenbeek, Malderen (V04MOM037100)

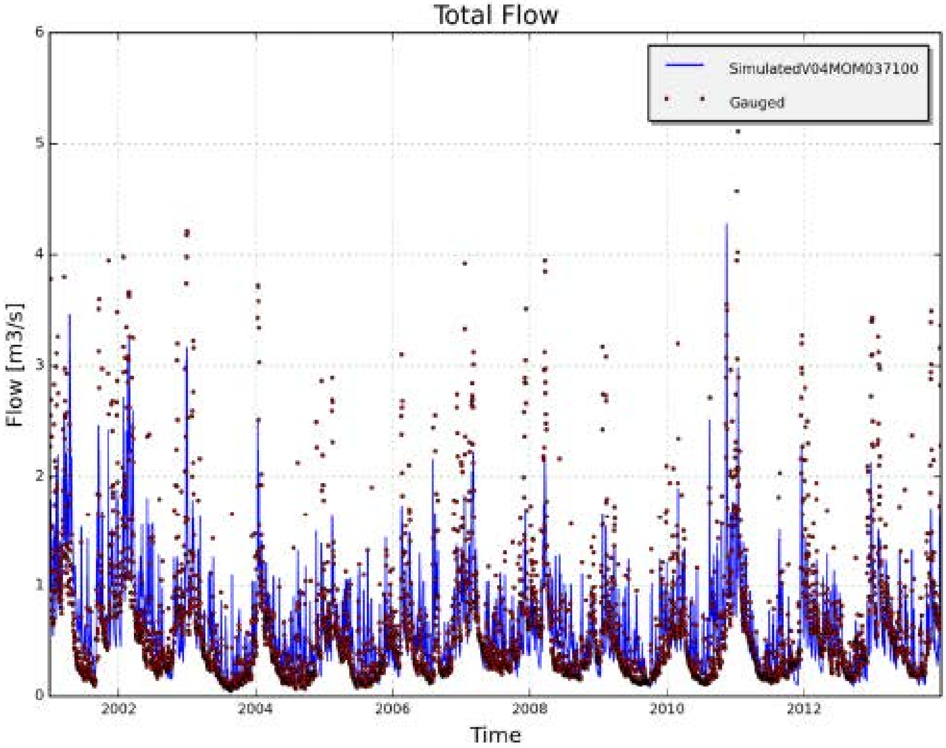


Figure 28 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V04MOM037100, station 3710102 - Grote Molenbeek, Malderen (2001-2013)

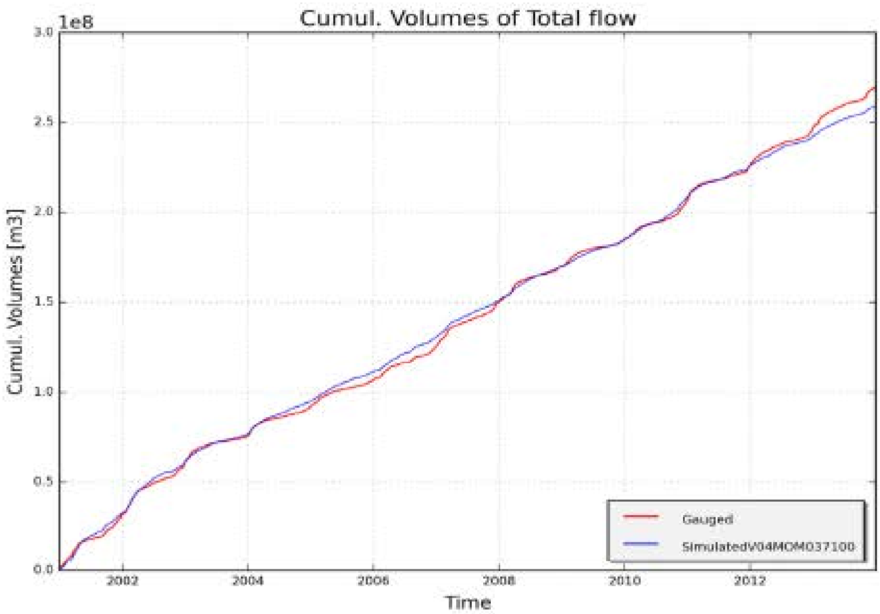


Figure 29 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V04MOM037100, station 3710102 - Grote Molenbeek, Malderen (2001-2013)

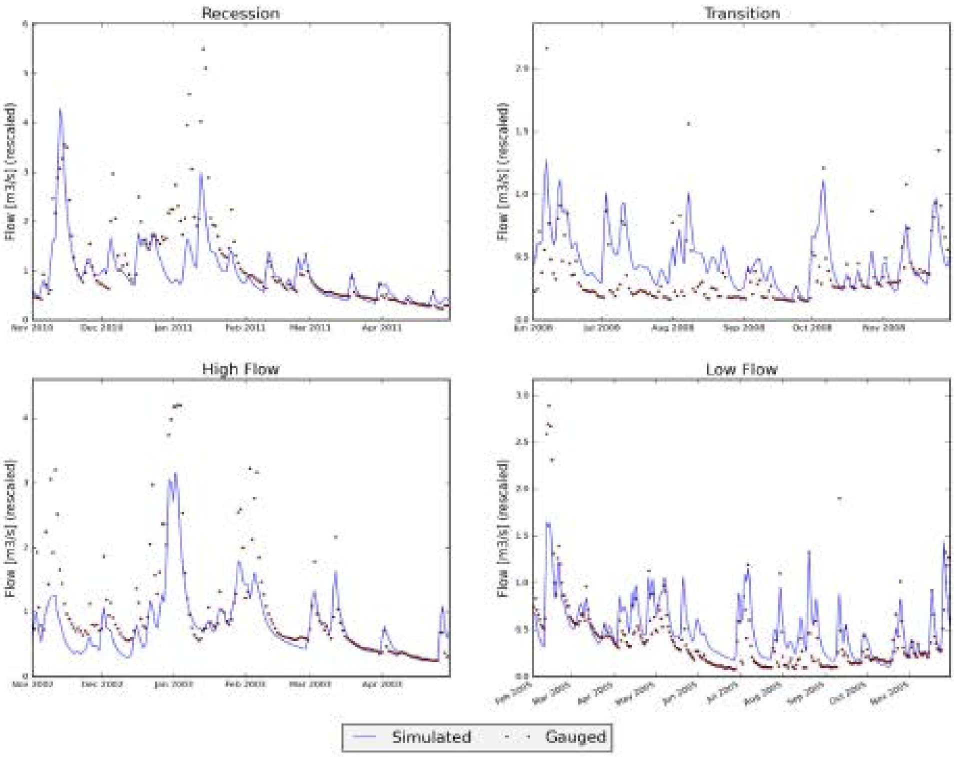


Figure 30 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V04MOM037100, station 3710102 - Grote Molenbeek, Malderen

3610102 - Kleine Molenbeek, Liezele (V04MOL036110)

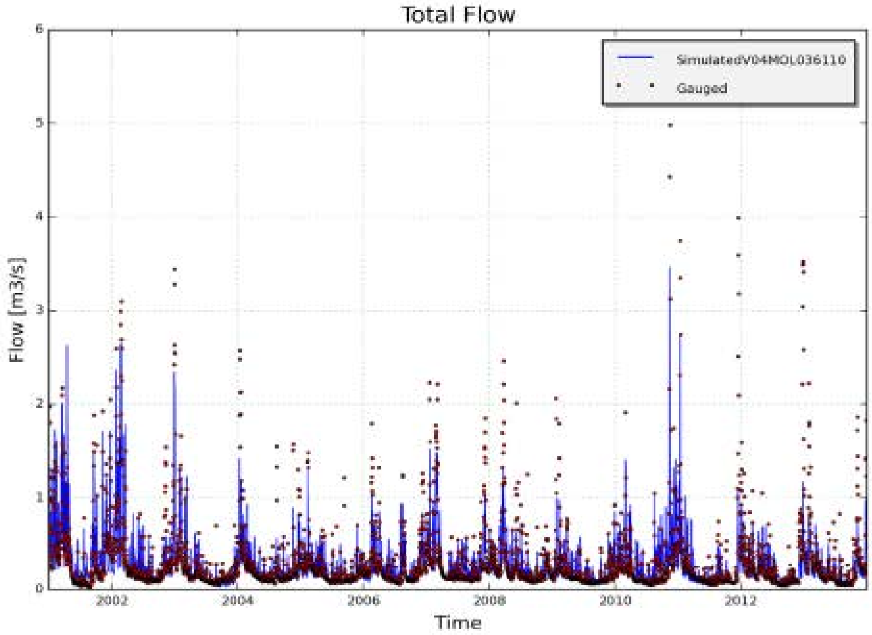


Figure 31 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V04MOL036110, station 3610102 - Kleine Molenbeek, Liezele(calibration period)

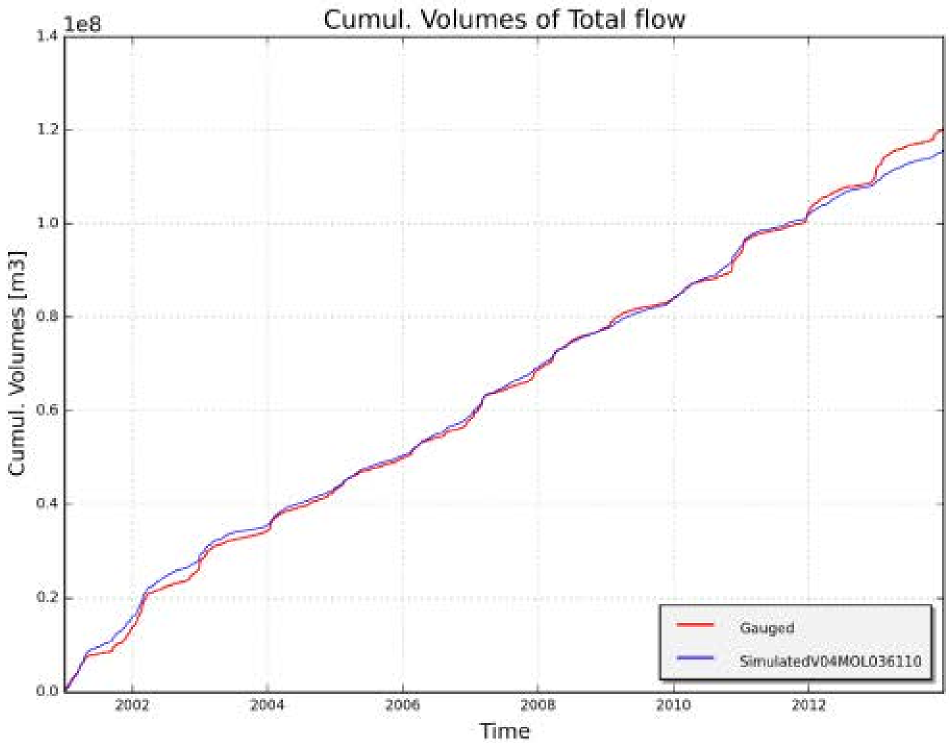


Figure 32 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V04MOL036110, station 3610102 - Kleine Molenbeek, Liezele (calibration period)

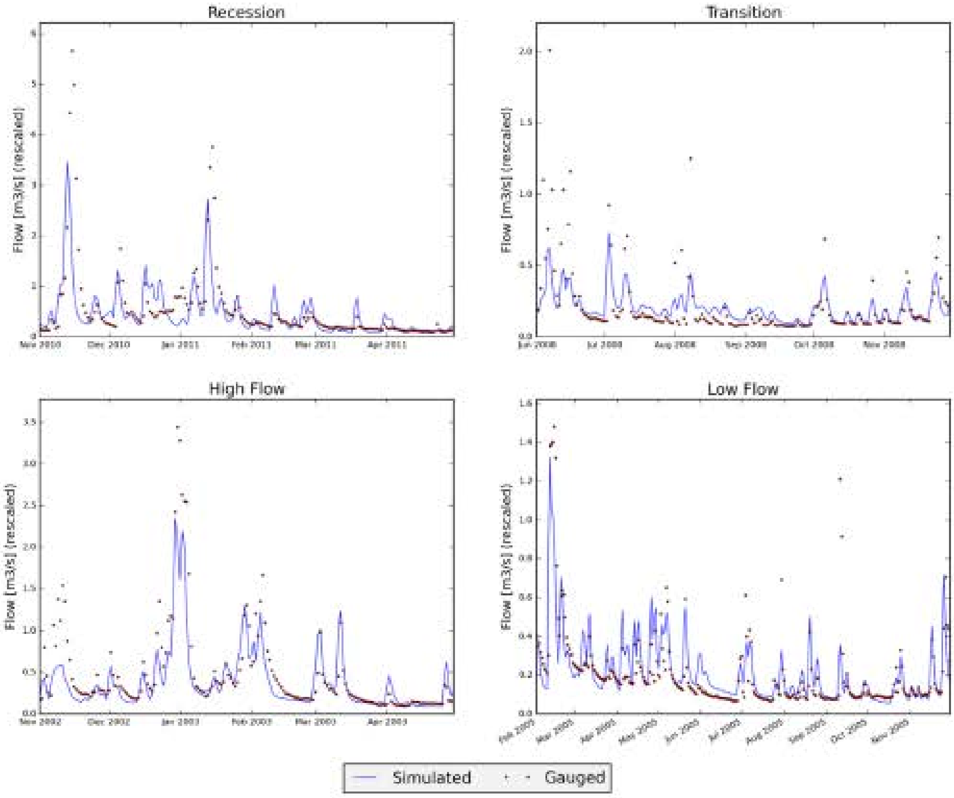


Figure 33 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V04MOL036110, station 3610102 - Kleine Molenbeek, Liezele

6.7 Leie

6.7.1 Context

The Leie catchment, being part of the international "Leie and Deûle" basin, has an area of 3 886 km² of which 982 km² is situated in Flanders. In Ghent, the Leie confluences with the Scheldt. The subcatchments of the Leie count for 18 % of the total study area.

In France, the Leie (or Lys in French) is connected to the Canal de Neufossé and the Canal d'Aire à la Bassée, both part of the canal system between Duinkerke and Denain. This canal constitutes the East-West link between the Scheldt, the Deûle, the Leie and the North Sea. The Dunkerque-Denain canal is supplied with water of the Schelde and its tributary, the Scarpe. Some of the water flowing from the Scheldt in the canal system, flows back to the Leie through the canalised Deûle. This interaction of rivers and canals leads to an enlarged complexity regarding the calibration of a hydrological model for this catchment.

Figure 34 shows the location of the flow gauges used for calibration of the NAM models on the Leie basin.

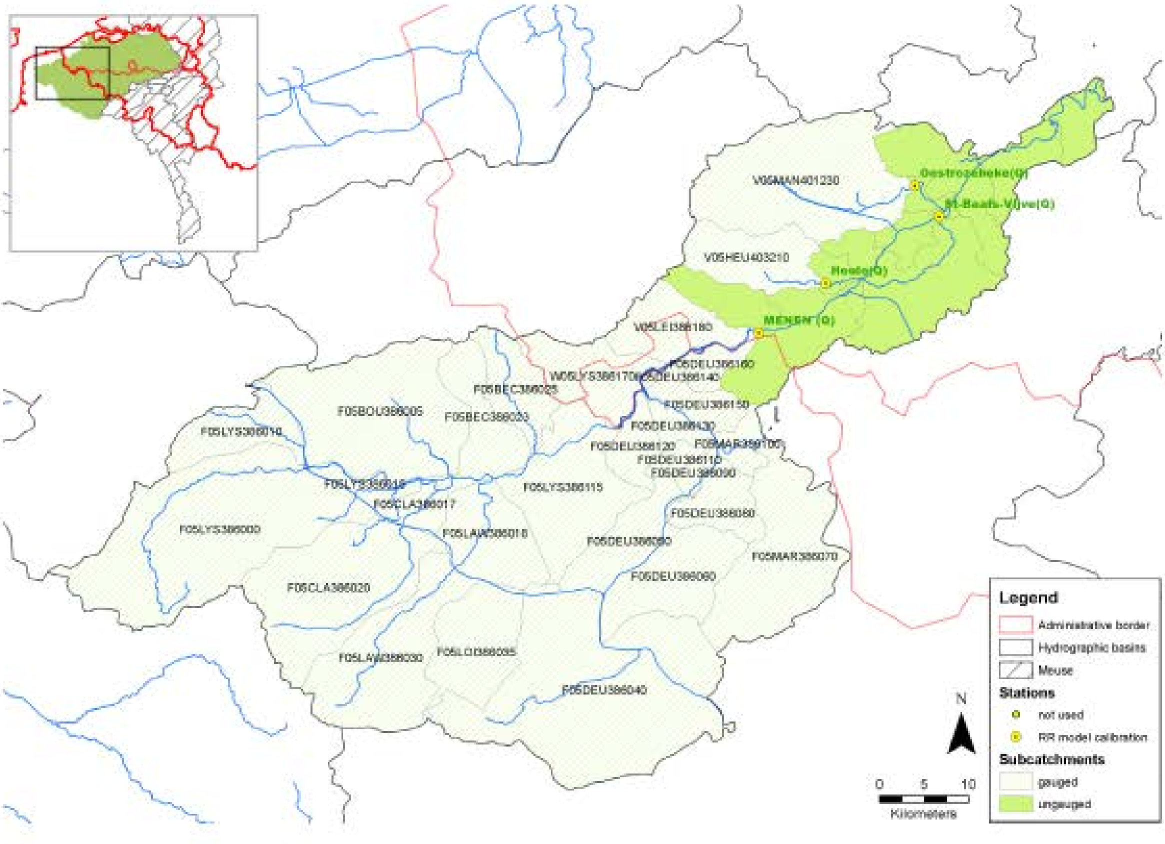


Figure 34 – Subcatchments and measurement points on the Leie catchment

The recalibration of the catchment upstream of the gauging station in Menen on the Leie (station 38680122), is done for this 1 big gauged subcatchment. However, the final runoff for the water allocation model is simulated separately for the 22 subcatchments separately, to be able to distribute the flow over the complex canal system described above.

With three gauging stations in Menen, Heule and Oostrozebeke, 85,6 % of the Leie basin is covered by discharge measurements.

6.7.2 Model performances

Table 13 and Table 14 present general performance statistics for the gauged catchments of the Leie basin for the calibration and validation period . Graphs of simulations for the catchments **F05LEI386999** (best model performance) and **V05HEU403210** (worst model performance) are presented below (

Figure 35 to Figure 39). For more detailed results on the other catchments, see Annex 7. In paragraph 3.2 it was already mentioned that refinement of the precipitation data in the Leie catchment significantly improves the performance of the hydrological model for the catchment upstream Menen, compared to the first version of the water allocation model (see Michielsen et. al, 2021).

Even though we obtained really good values of the evaluation parameters for the catchment F05LEI386999, the low flow in the calibrated model is overestimated comparing to the gauged one. However, for high flow and recession, they are quite close to the gauged flow.

Despite the fact that the obtained evaluation parameters for V05HEU403210 are lower than the ones for the first catchments, the visualization of the calibrated low flow indicates a good correlation with the gauged one.

Remarks on the data: The catchment **V05MAN401230** has unreliable observed data for some periods. There is a hole in the data from 1978 to August 1982, and then from 1996 to 2004. In 2005 and the second part of 2006, discharge values were estimated based on the activity of the weir 1km upstream. From the end of 2007 (09/11/2007) on, data also get the "U" data quality flag. Data is therefore less reliable during this period and was excluded from both calibration and validation. Calibration was performed on the continuous period of 1983-1995, preferred to a more recent but discontinued period.

Table 13 – Overview of calibration results for gauged catchments on the Leie basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Calibration period	Approx. distance to rain gauge over calibration period (km)
38680122, Leie te Menen	F05LEI386999	2981.78	0.794	0.801	-0.6	2001-2013	*Irrelevant given the size of the basin*
40310102 - Heulebeek; Heule	V05HEU403210	91.912	0.761	0.662	-2.9	2001-2013	<2004 : 6 >=2004 : 10
40110102 - Mandel; Oostrozebeke (L05_409)	V05MAN401230	258.442	0.749	0.758	-0.1	1983-1995	8

Table 14 – Overview of validation results for gauged catchments on the Leie basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Validation period
38680122, Leie te Menen	F05LEI386999	2981.78	0.8	0.814	-0.6	1967-2013
40310102 - Heulebeek; Heule	V05HEU403210	91.912	0.75	0.623	-6	1967-2013
40110102 - Mandel; Oostrozebeke	V05MAN401230	258.442	0.71	0.619	-2.7	1967-2013

38680122, Leie te Menen (F05LEI386999)

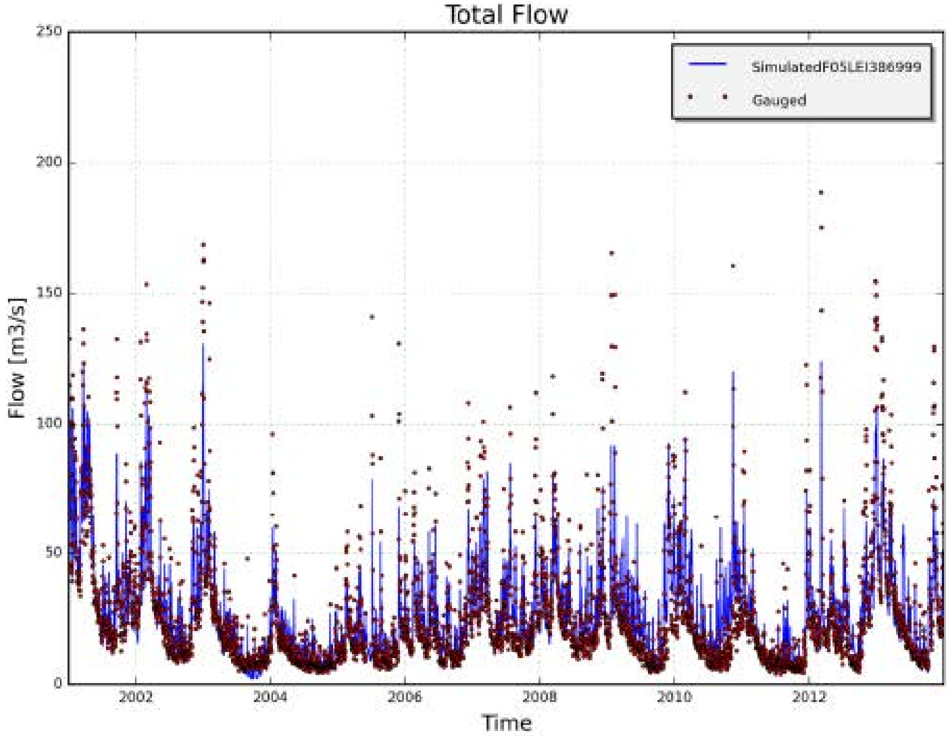


Figure 35 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment F05LEI386999, station 38680122 – Leie, Menen(2001-2013)

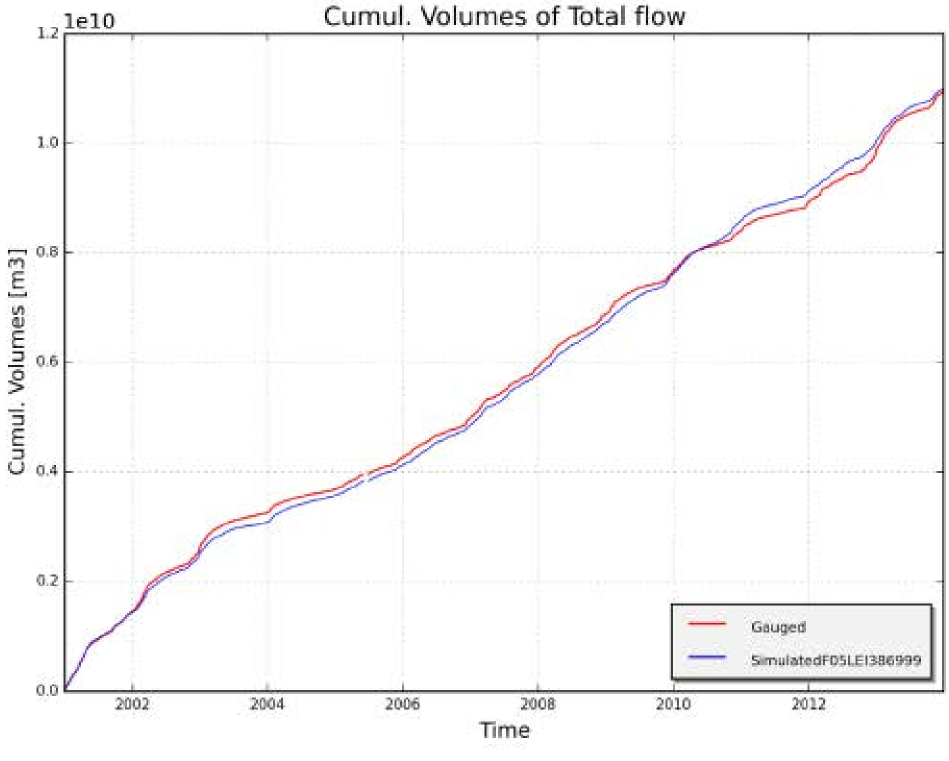


Figure 36 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment F05LEI386999, station 38680122 – Leie, Menen(2001-2013)

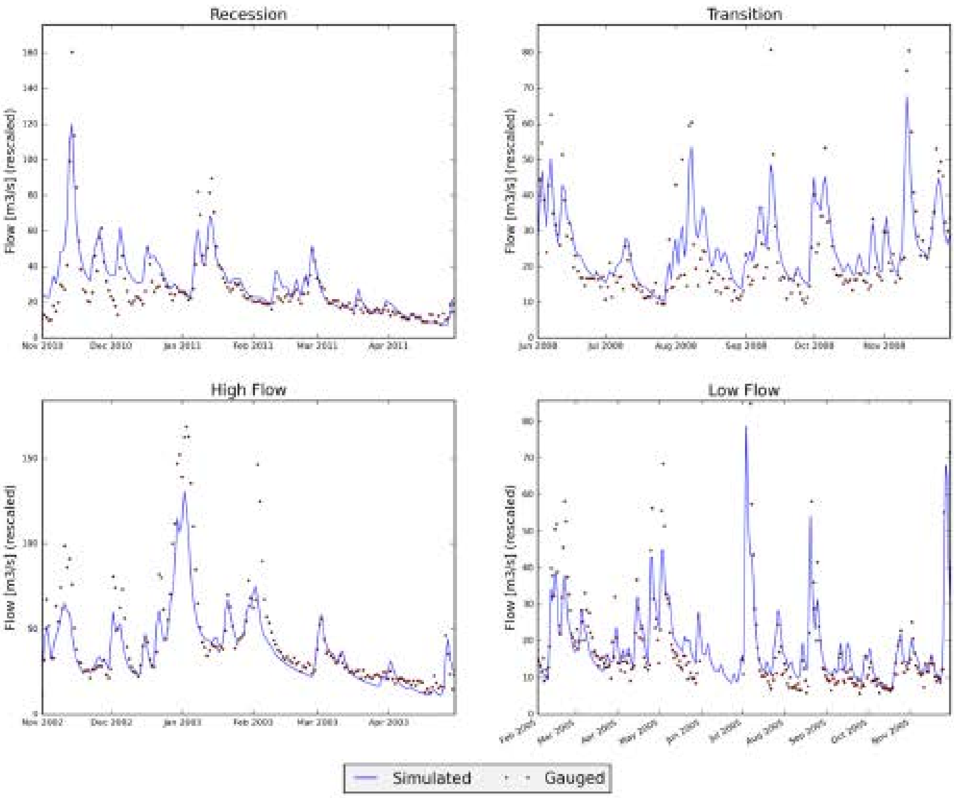


Figure 37 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment F05LEI386999, station 38680122 – Leie, Menen(2001-2013)

40110102 - Mandel; Oostrozebeke (V05HEU403210)

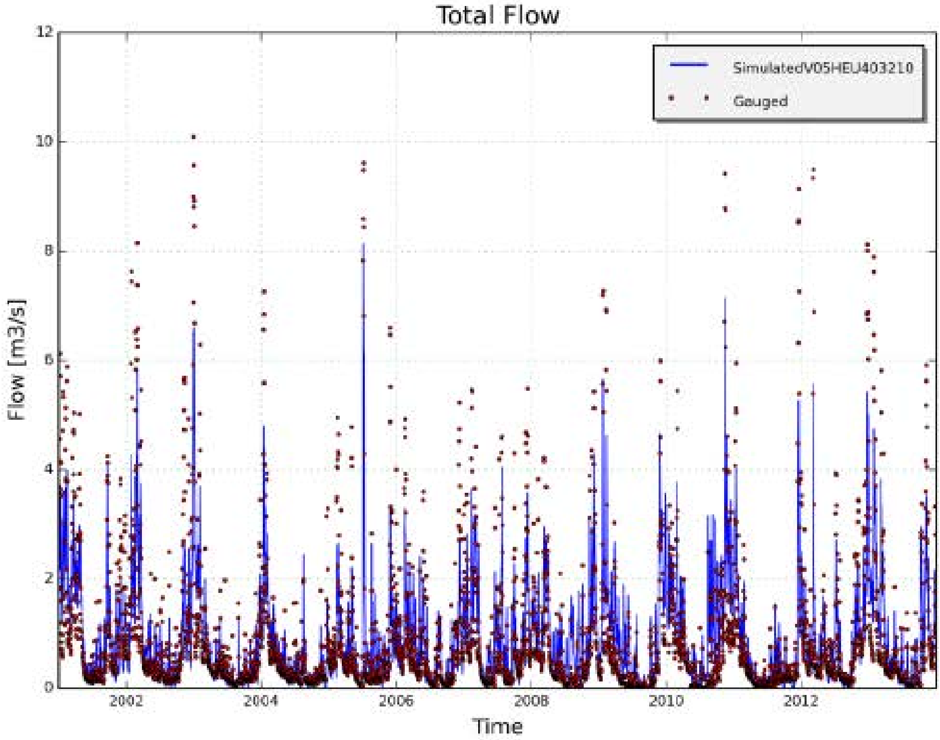


Figure 38 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V05HEU403210, station 40310102 - Heulebeek; Heule (calibration period 2001-2013)

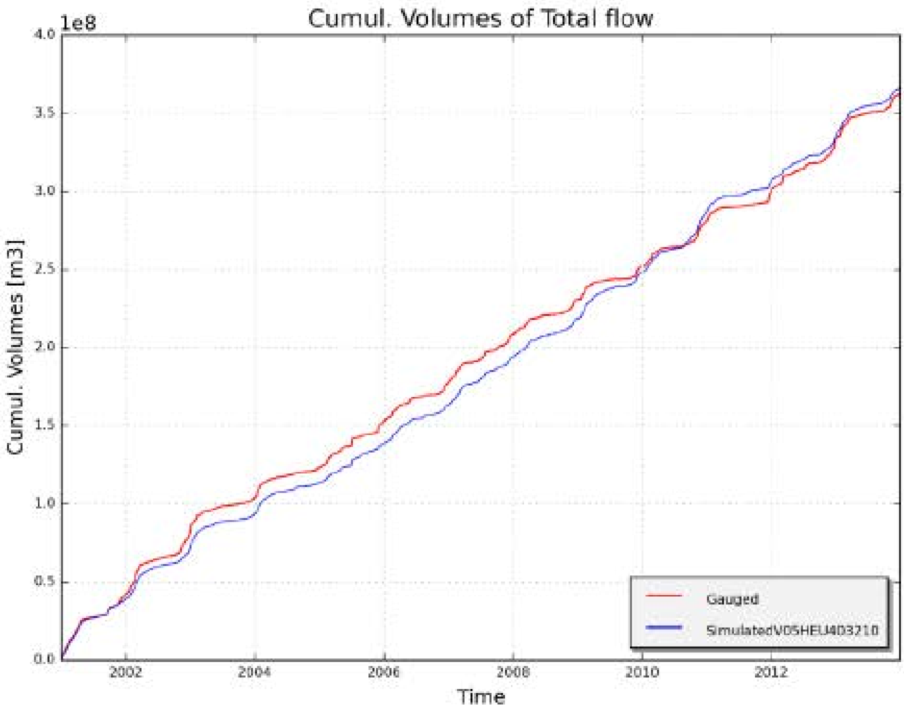


Figure 39 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V05HEU403210, station 40310102 - Heulebeek; Heule (calibration period 2001-2013)

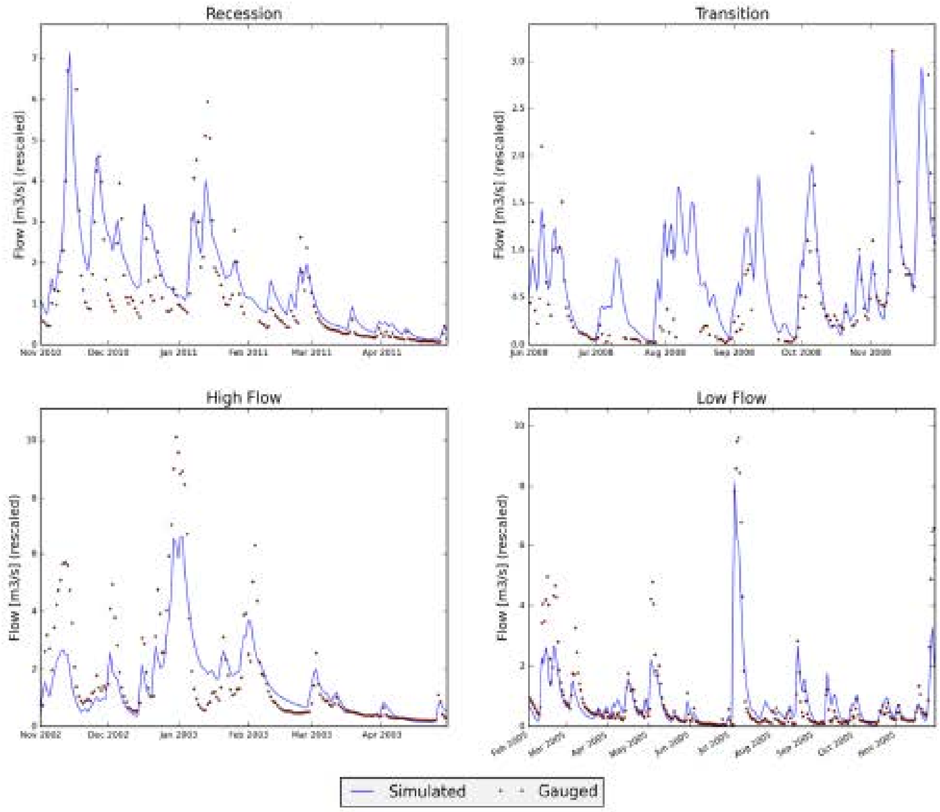


Figure 40 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment 05HEU403210, station 40310102 - Heulebeek; Heule

6.8 Bovenschelde

6.8.1 Context

The Bovenschelde basin extends over France, Wallonia and Flanders. This basin has an area of approximately 576 km². Before it enters Flanders in Spiere-Helkijn, the Scheldt has a length of 124 km and a corresponding upstream catchment of 5 380 km² in France and Wallonia. The Bovenschelde basin accounts for 30 % of the total catchment of the study area. The Bossuit-Kortrijk canal connects the Bovenschelde to the Leie, whereas the Spierekanaal links the Bovenschelde to the Deûle.

Figure 41 shows the location of the catchments and measuring points on the Bovenschelde basin. Actually, the subcatchments upstream from the station in Bossuit (32580122) can be seen as one gauged subcatchment. However, as stated before, the discharge is simulated separately for each subcatchment to generate input for the water allocation model. The total surface area considered gauged is thus 97 % (Figure 41).

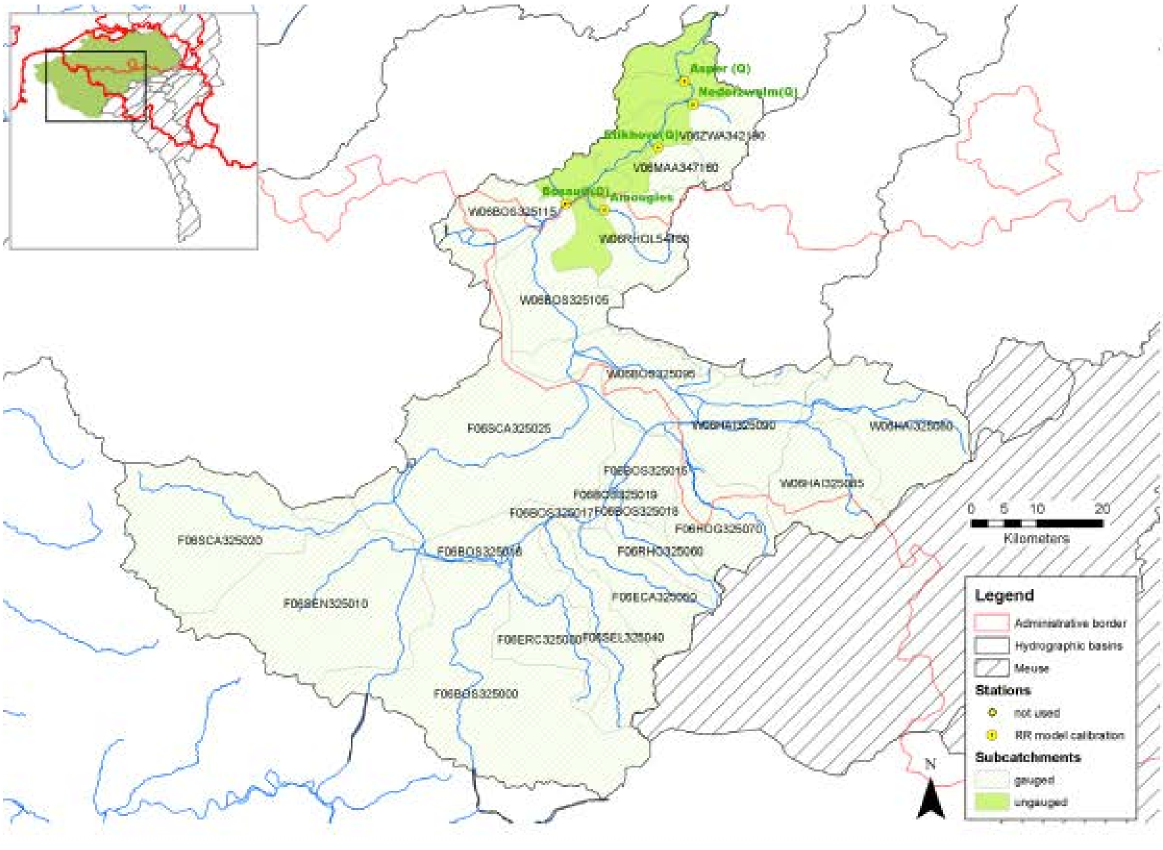


Figure 41 – Subcatchments and measurement points on the Bovenschelde catchment

6.8.2 Model performance

Table 15 and Table 16 present general performance statistics for the gauged catchments of the Bovenschelde basin for the calibration and validation period. Graphs of simulations of the catchments **F06BOS325999** (best performance) and **V06MAA347160** (worst performance) are presented below (Figure 42 to Figure 47). For more detailed results on the other catchments, see Annex 8.

The best performance parameters of VHM for **F06BOS325001** and **V06ZWA342190** were achieved. However, **V06ZWA342190** showed poor results in the validation with NSE and LogNSE around 0,4.

For **F06BOS325001**, the water volume during the calibration is quite unstable and non-correlate with the gauged data. However, the visualization demonstrates bad quality of the data for this catchment which can cause this instability. LogNSE for **V06MAA347160** couldn't be calculated even though we altered the initial set of parameters. For this catchment, the water volume corresponds well to the gauged volume. The pics and the low flows were well simulated.

Remarks on the data: The station 32580122 on the Bovenschelde in Bossuit **(F06BOS325001)** only has records from 13/09/2001 onwards. The catchment **W06RHOL54100** only has observed discharge data from January 2000 onwards. Using the usual 2001-2013 period for calibration, there is therefore only one year of extra data for validation.

Discharge of the Maarkebeek in Etikhove **(V06MAA347160)** was estimated in 2005 and discharges above 12 m^3/s are mostly estimated.

In Nederzwalm **(V06ZWA342190)**, suspicious data was removed in 1982; moreover, data records start to be more unstable and regularly interpolated from August 2012 onwards. Therefore, the year 2013, where the most records were missing or interpolated, is excluded from both calibration and validation periods.

Table 15 – Overview of calibration results for gauged catchments on the Bovenschelde basin

Gauging station	Catchment code	Area (km^2)	NSE	logNSE	RelErr (%)	Calibration period	Approx. distance to rain gauge over calibration period (km)
32580122 - Bovenschelde; Bossuit	F06BOS325999	5217.6	0.717	0.625	-4.4	2002-2013	*Irrelevant given the size of the basin*
34710102 - Maarkebeek; Etikhove	V06MAA347160	48.7	0.58		-0.4	2001-2013	6
34210102 - Zwalm; Nederzwalm	V06ZWA342190	112.1	0.639	0.677	-1.5	2000-2012	7
L5412 Amougies - Rhosnes	W06RHOL54100	161.9	0.554	0.381	-0.8	2012-2013	< 1999 : 3 1999 - 2000 : 6 2000 - 2009 : 13 >=2009 : 5.5

Table 16 – Overview of validation results for gauged catchments on the Bovenschelde basin

Gauging station	Catchment code	Area (km^2)	NSE	logNSE	RelErr (%)	Validation period
32580122 - Bovenschelde; Bossuit	F06BOS325999	5217.6	0.719	0.637	-5.3	2002-2013
34710102 - Maarkebeek; Etikhove	V06MAA347160	48.7	0.55		-17.5	1972-2012
34210102 - Zwalm; Nederzwalm	V06ZWA342190	112.1	0.455	0.487	2.3	1973-2013
L5412 Amougies - Rhosnes	W06RHOL54100	161.9	0.551	0.398	-1.2	2012-2013

32580122 - Bovenschelde; Bossuit (F06BOS325999)

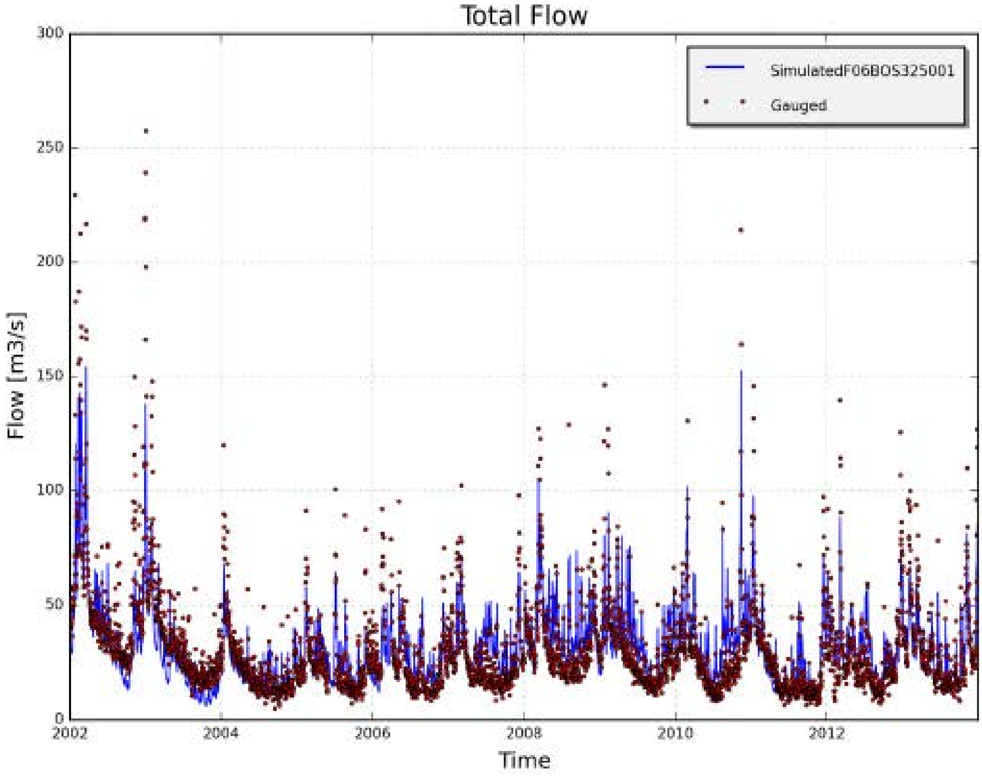


Figure 42 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment F06BOS325999, station 32580122 - Bovenschelde; Bossuit (calibration period 2002-2013)

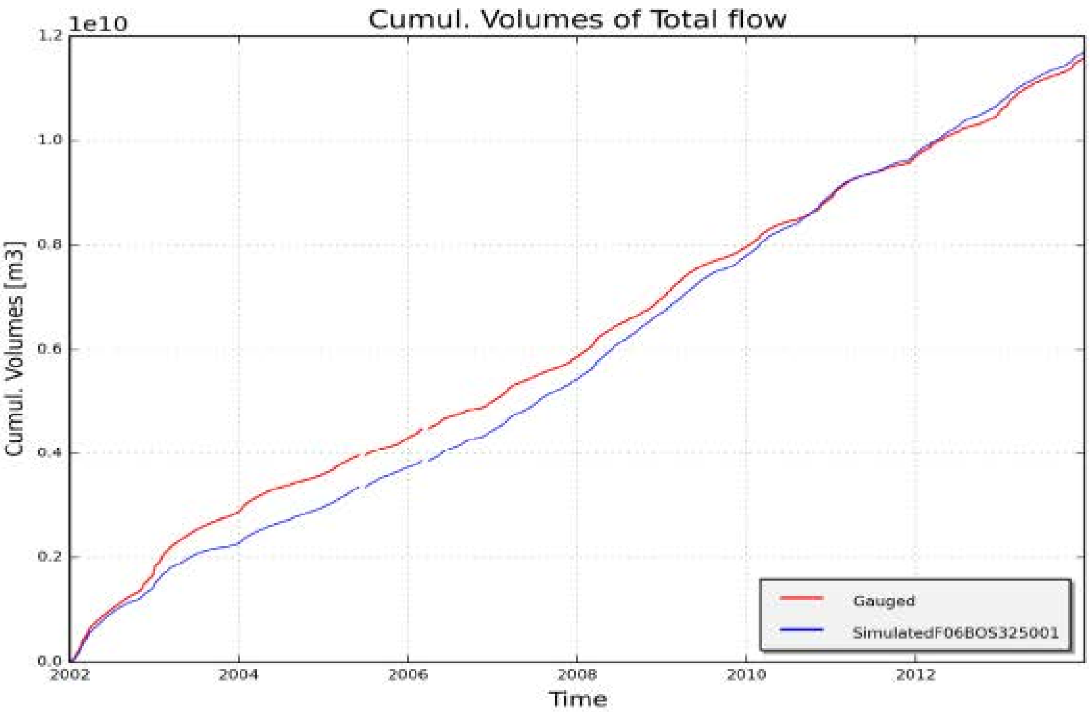


Figure 43 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment F06BOS325999, station 32580122 - Bovenschelde; Bossuit (calibration period 2002-2013)

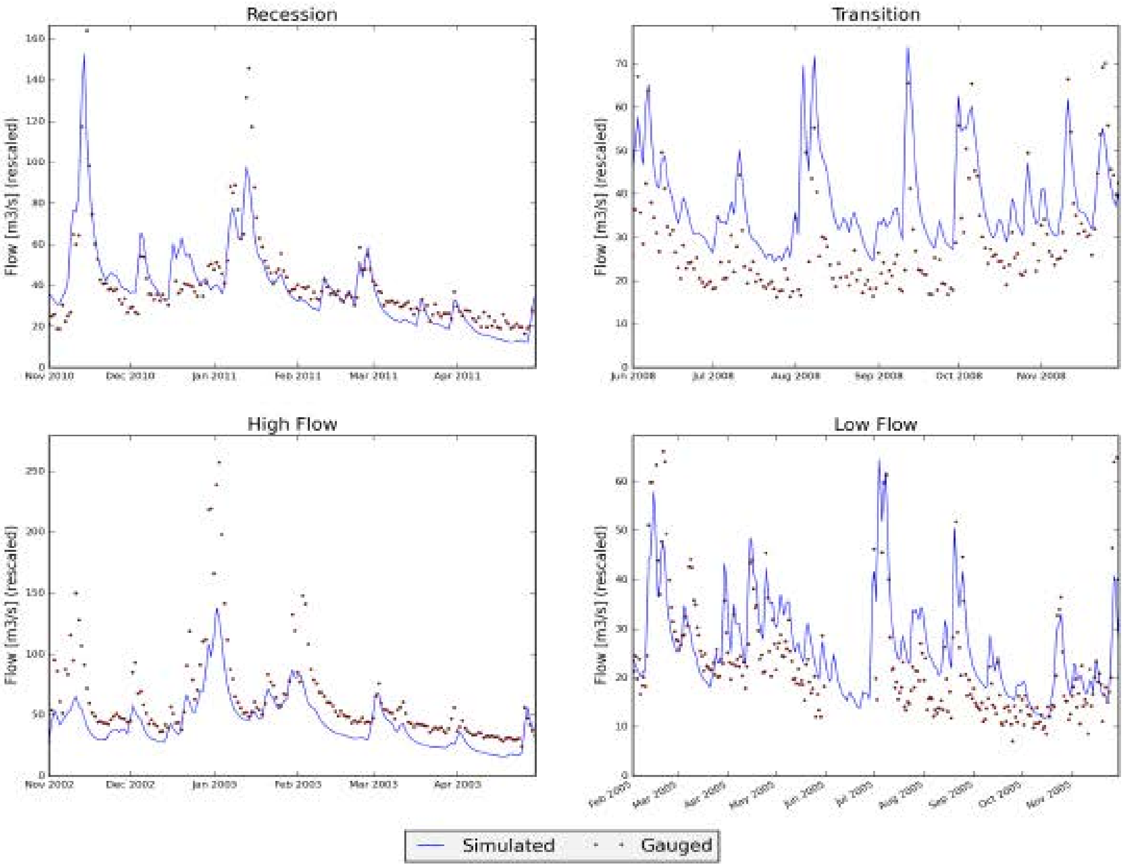


Figure 44 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment F06BOS325999, station 32580122 - Bovenschelde; Bossuit

34710102 - Maarkebeek; Etikhove (V06MAA347160)

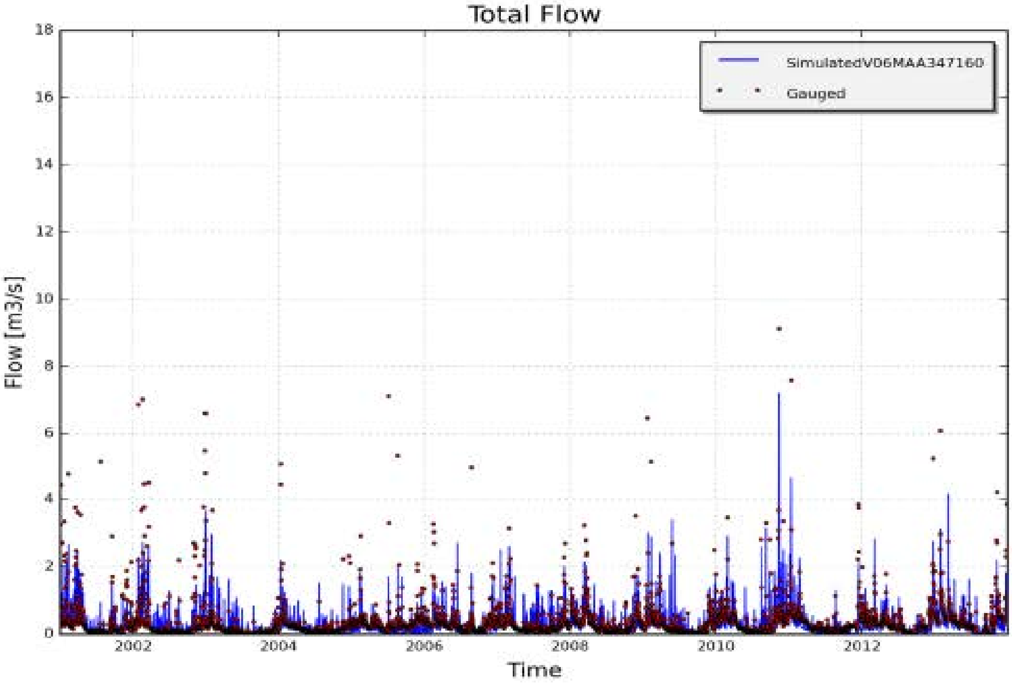


Figure 45 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V06MAA347160, station 34710102 - Maarkebeek; Etikhove (calibration period 2001-2013)

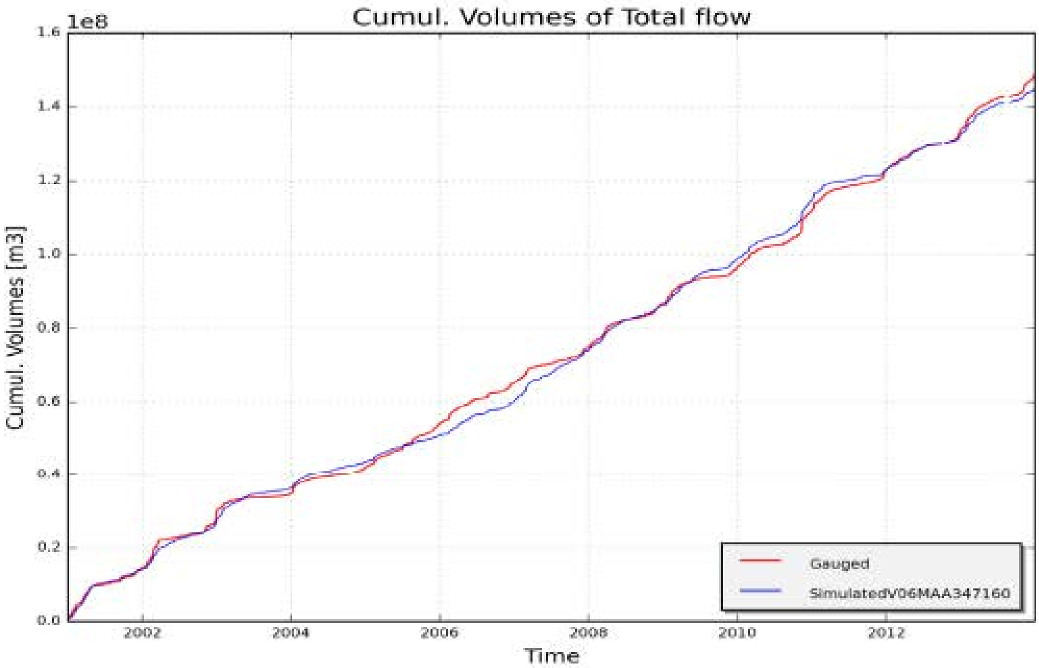


Figure 46 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V06MAA347160, station 34710102 - Maarkebeek; Etikhove (calibration period 2001-2013)

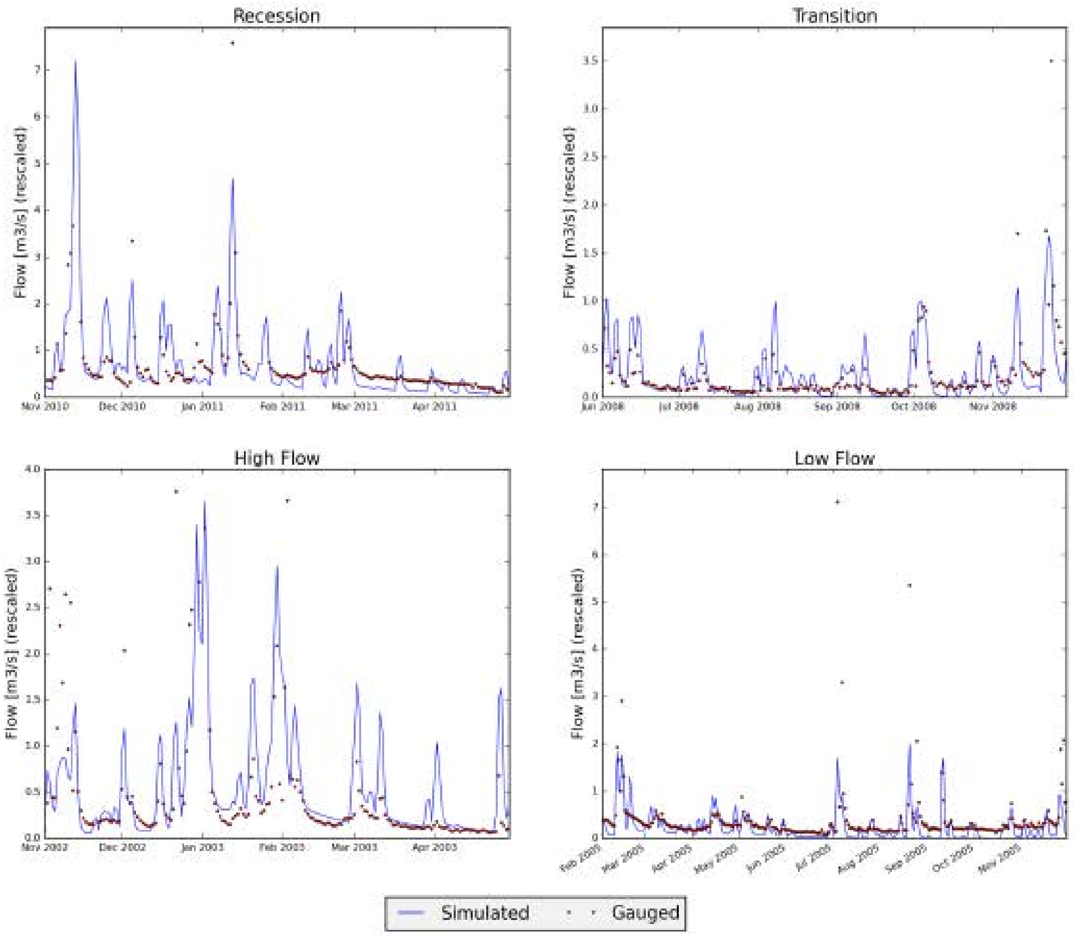


Figure 47 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V06MAA347160, station 34710102 - Maarkebeek; Etikhove (calibration period 2001-2013)

6.9 Denderbekken

6.9.1 Context

The Dender basin has an area of 1 384 km² and extends over Wallonia and Flanders. The upstream part (675 km²) is located in Wallonia and the lower part (709 km²) in Flanders. The Dender basin accounts for 6 % of the total catchment of the study area.

With 5 gauging stations used for model calibration, the portion of gauged catchments in this basin accounts for 61 % of total catchment area. The gauging station in Lessines is used to calibrate a hydrological model for the catchment upstream of this gauging station. In the water allocation model, this catchment is divided into 3 subcatchments.

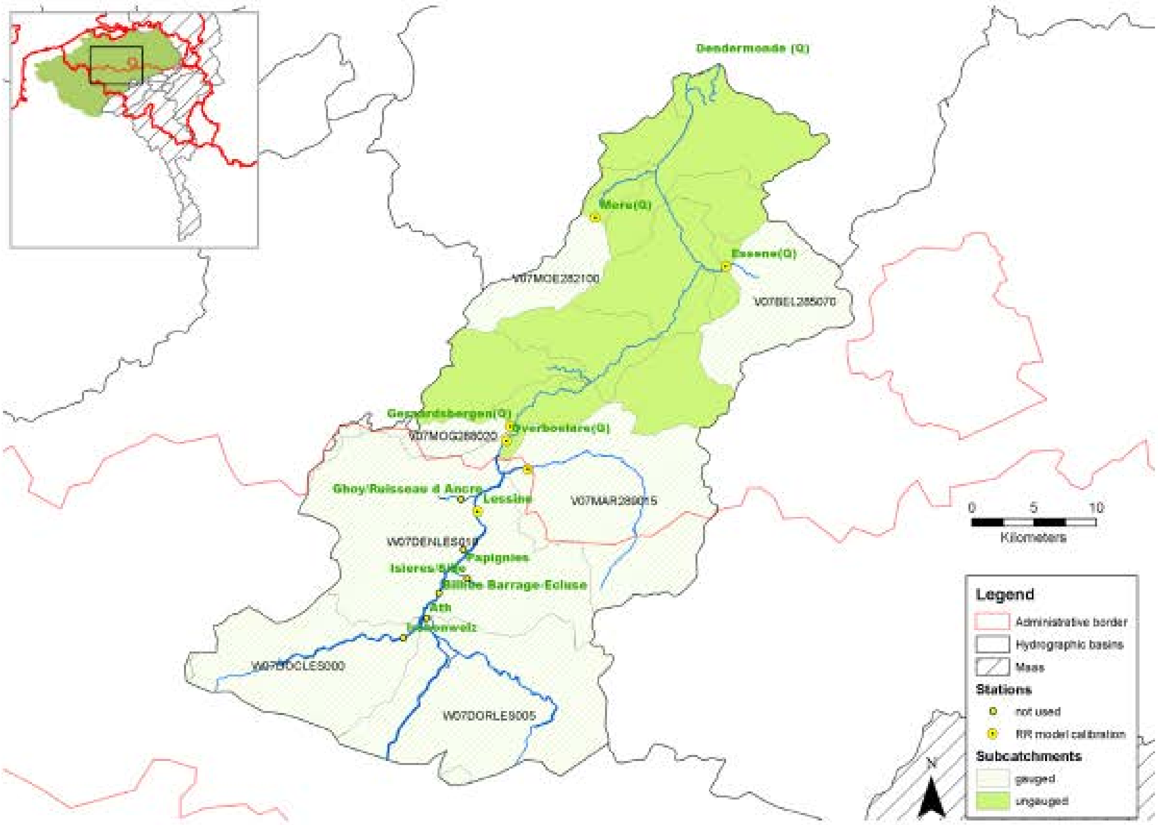


Figure 48 – Subcatchments and measurement points in the Dender catchment

6.9.2 Model performance

Table 17 and Table 18 present the general performance statistics for the gauged catchments of the Dender catchment for the calibration and validation period. Graphs of simulations for the catchments **V07BEL285070** (best model performance) and **V07MOG288020** (worst model performance) are presented below (Figure 49 to Figure 53). For more detailed results on the other catchments is referred to Annex 9.

Despite the fact that **V07BEL285070** has best model performance, this latter doesn't reflect well the low flow; it overestimates it. The graphs for all the types of calibrated flows are not considered contiguous to the gauged flows.

However, the calibrated flows for **V07MOG288020** are absolutely close to the gauged one, which can be explained due to the fact that that isn't so many and high picks in the gauged low flow of this catchment.

Remarks on the data: For the gauging station 28210102 on the Molenbeek in Erpe Mere (**V07MOE282100**), high discharge values are unreliable above 5m3/s from 1999 to 2003 and in 2005. Discharge data was discarded from 27/10/2009 until 15/06/2011 in the WISKI series. Consequently, the calibration period was limited to 2009. Years 2012 and 2013 have a lot of missing data and interpolated values and show an unusual high-baseflow behavior. They were therefore excluded from both validation and calibration.

For discharge measurements in Geraardsbergen (**V07MOG288020**), the years after 2009 have been deleted due to the existence of unreliable measured discharge data and therefore the calibration series starts in 2007. In 1999, high discharge values were estimated (above 2.7 m3/s). In 2000 and 2001, high values were estimated with lower accuracy. From 2000 to 2002, low flows measurements had to be corrected because the gauge did not measure low levels adequately.

The discharge data in Lessines start in 15/01/2008 for catchment **W07DENLES004**. Calibration therefore limited to 2008-2013. Validation will happen in Overboelare for both **W07DENLES004 and V07MAR289015.**

Table 17 – Overview of calibration results for gauged catchments on the Dender basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Calibration period	Approx. distance to rain gauge over calibration period (km)
28510102 - Bellebeek, Essene	V07BEL285070	88.7	0.697	0.686	0.5	2001-2013	8
28970102 - Mark, Viane	V07MAR289015	173,9	0.687	0.534	-0.1	2001-2013	< 2003 : 12 2003 – 2011 : 10 >=2011 : 2
28210102 - Molenbeek, Erpe Mere	V07MOE282100	46.4	0.511	0.709	-0.5	1997-2009	< 2004 : 10 >= 2004 : 5
28810102 - Molenbeek, Geraardsbergen	V07MOG288020	23.094	0.545	0.505	0.4	1997-2009	< 2009 : 3 >= 2009 : 15
27081002 – Dender, Lessines	W07DENLES004	511.84	0.52	0.538	-0.1	2008-2013	*Irrelevant given the size of the basin (max 16 km)*

Table 18 – Overview of validation results for gauged catchments on the Dender basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Validation period
28510102 - Bellebeek, Essene	V07BEL285070	88.642	0.594	0.566	-6.9	1967-2013
28970102 - Mark, Viane	V07MAR289015	173.9	0.694	0.482	8.4	1977-2013
28210102 - Molenbeek, Erpe Mere	V07MOE282100	46.367	0.491	0.671	4.8	1967-2013
28810102 - Molenbeek, Geraardsbergen	V07MOG288020	23.1	0.525	0.45	-8.9	1986-2013
26880122 – Dender, Overboelare	W07DENOVB005	799.2	0.518	0.537	-0.8	2001-2013

28970102 - Mark, Viane (V07BEL285070)

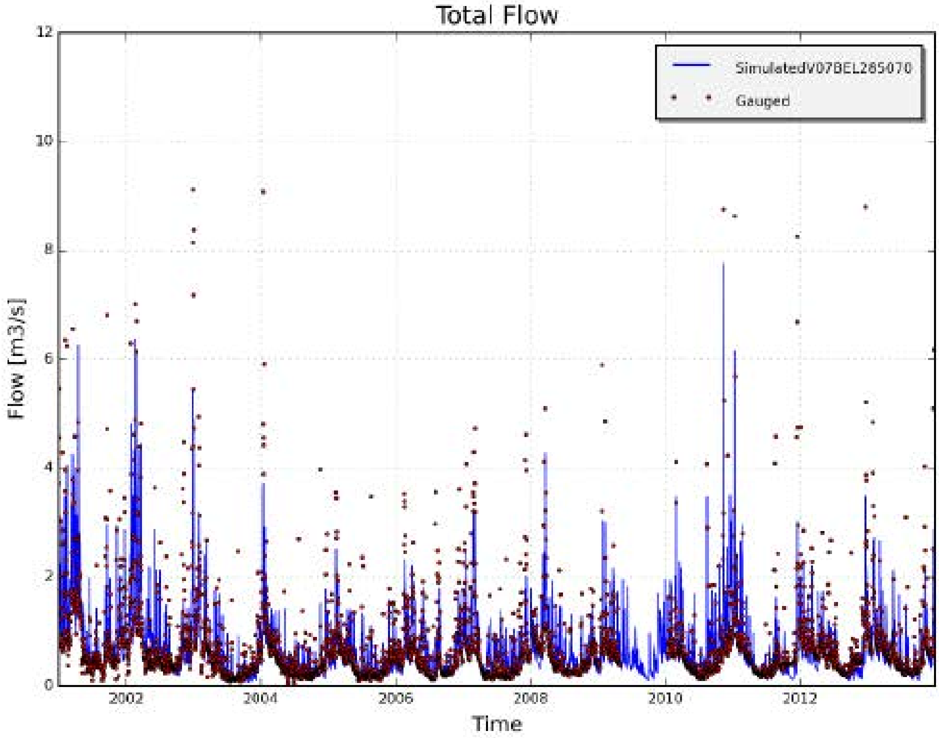


Figure 49 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V07BEL285070, station 28510102 - Bellebeek, Essene (2001-2013)

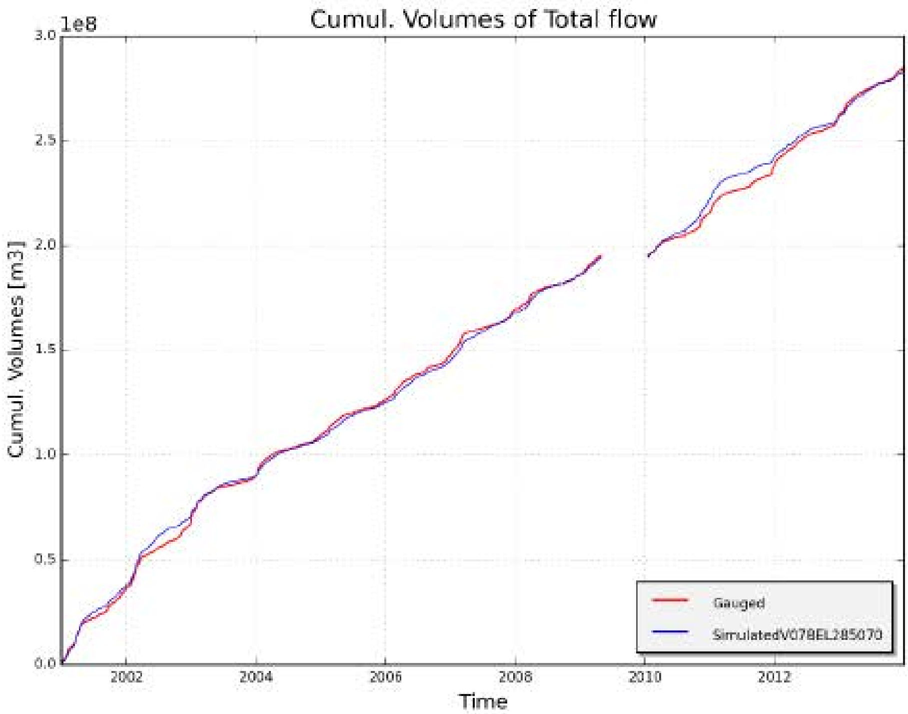


Figure 50 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V07BEL285070, station 28510102 - Bellebeek, Essene (2001-2013)

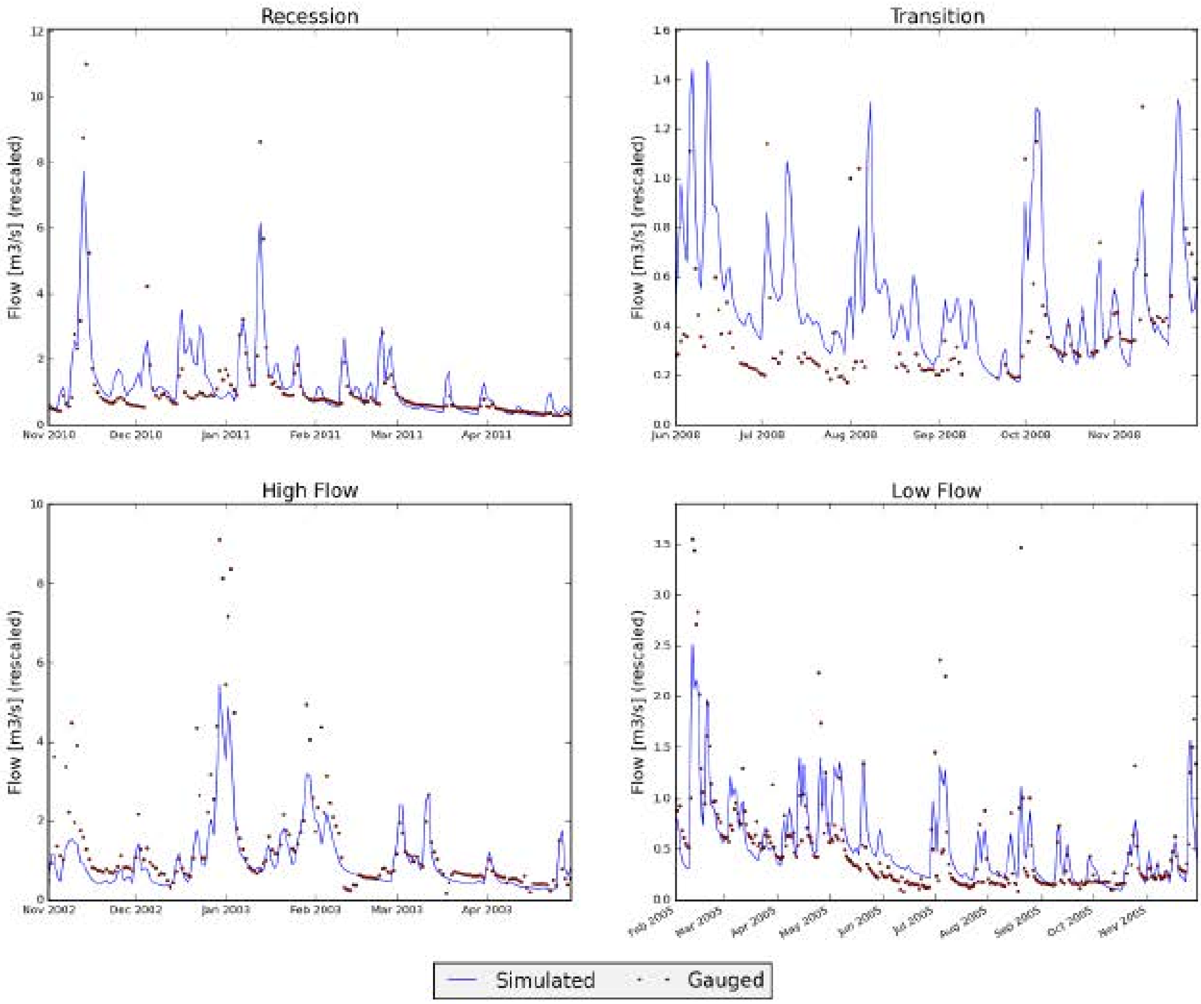


Figure 51 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V07BEL285070 , station 28510102 - Bellebeek, Essene

28810102 - Molenbeek, Geraardsbergen (V07MOG288020)

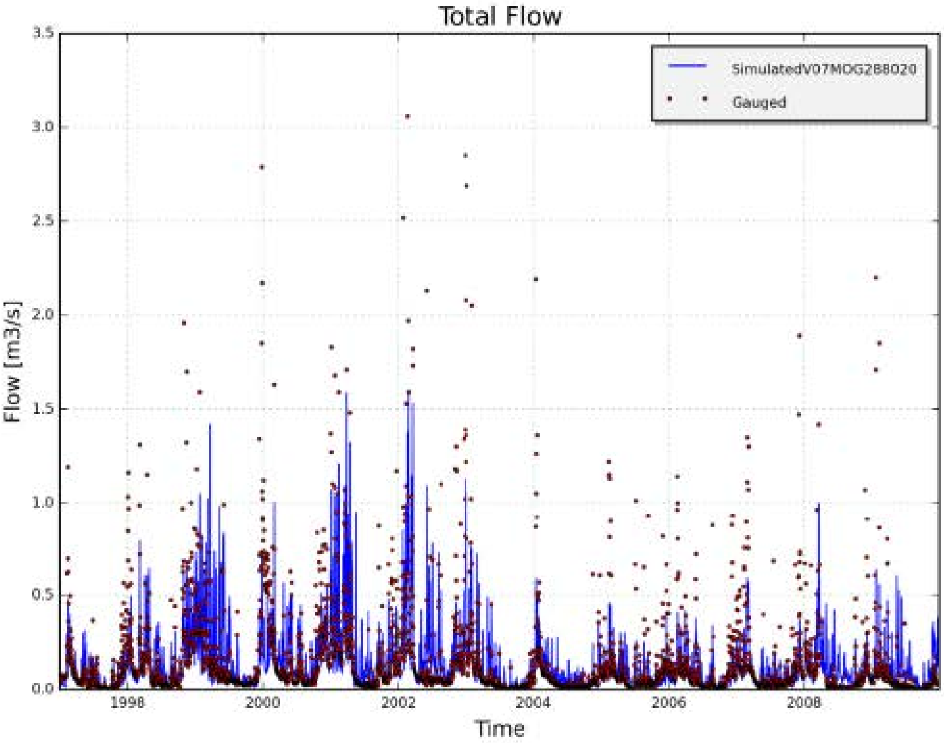


Figure 52 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen (1997-2009)

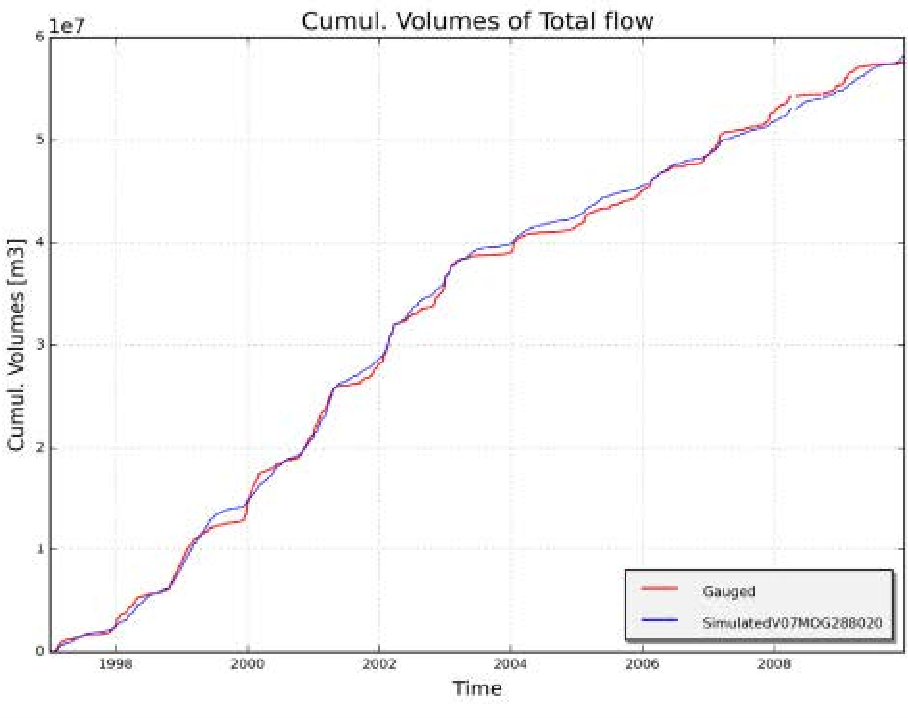
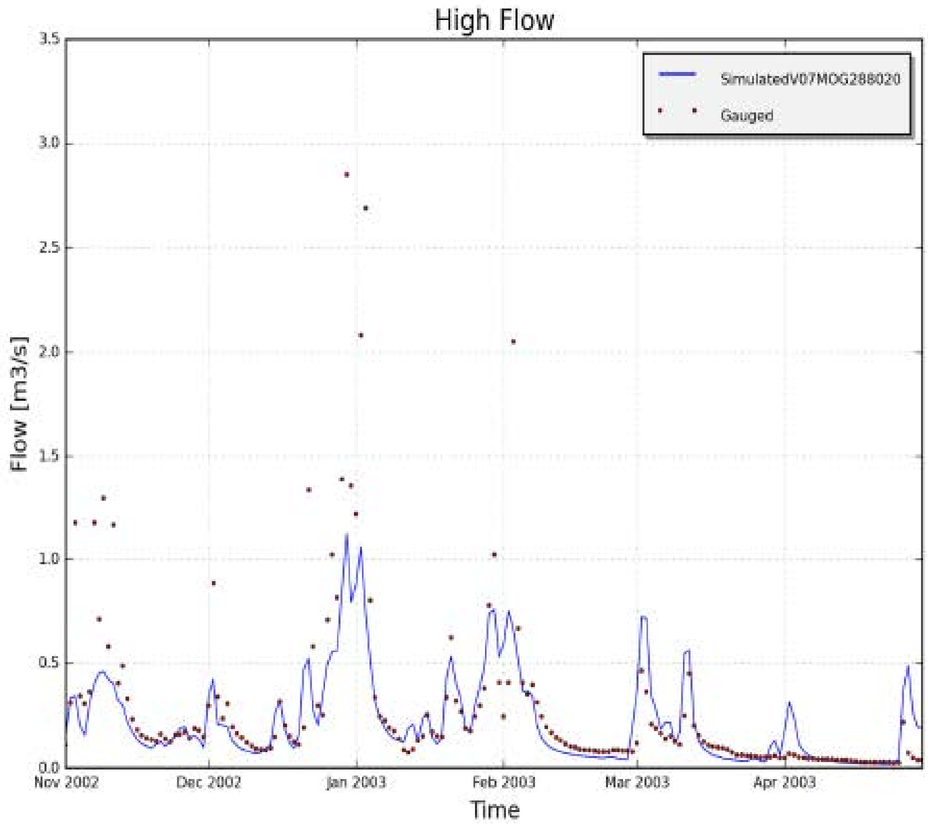


Figure 53 – Measured (red) and simulated (blue) cumulative discharge [m³] on V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen (1997-2009)



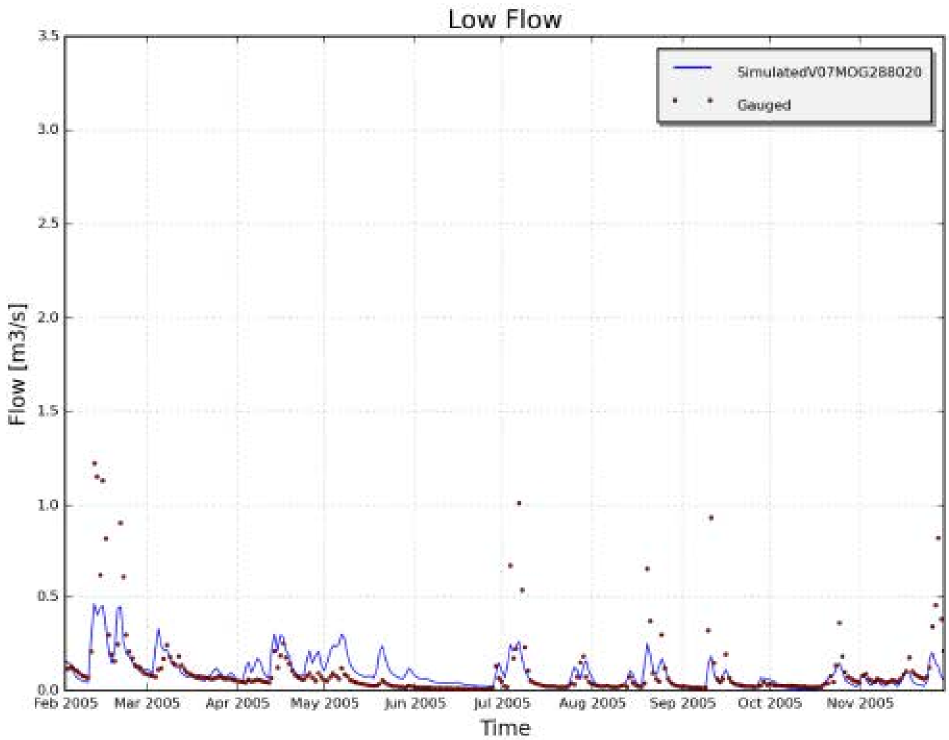


Figure 54 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen

6.10 Dijle and Zenne

6.10.1 Context

The Dijle basin stretches over Flanders (55 %) and Wallonia (45 %) and has an area of about 1 290 km². The Zenne basin (ca. 1 160 km²) spreads across Wallonia (50 %), Brussels (14 %) and Flanders (36 %). In total, the Dijle and Zenne basin accounts for 11 % of the total area of the Scheldt basin.

Catchments and gauging stations are represented at Figure 55. Five stations are located on the Zenne on its tributaries before the confluence with the Dijle, measuring discharge for 43 % of the Zenne catchment. The discharge of the Dijle is measured by one station in Wilsele (67 % of the catchment surface area is gauged).

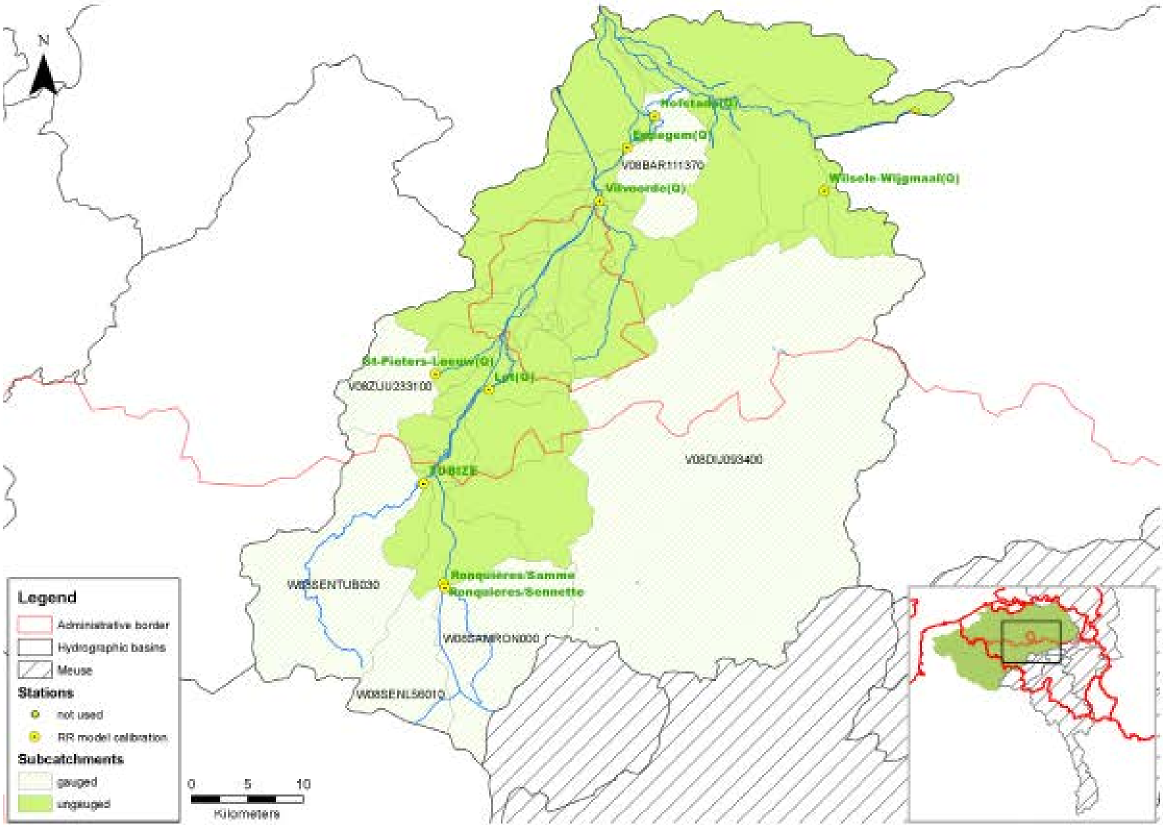


Figure 55 – Subcatchments and measurement points on the Dijle and Zenne catchment

6.10.2 Model performance

Table 19 and Table 20 present general performance statistics for the gauged catchments of the Dijle and the Zenne basins for the calibration and validation period. Graphs of simulations for the catchments **V08BAR111370** (best model performance) and **W08SENRON010** (worst model performance) are presented below (Figure 56 to Figure 61). For more detailed results on the other catchments, see Annex 10.

Besides the medicore values of the evaluation parameters obtained after the calibration of the catchment **W08SENRON010**, it is crucial that this model is considered the worst one in this basin.

Not only the base flow in the low flows and transition are overestimated, but also the model underestimate the flows in all the other parts and it doesn't get to the picks

When it comes to the catchment **V08BAR111370**, the simulation doesn't allow us to view the shape of the flow graph during the low flow period. But when we look at the high flow and the cumulative flow, we can deduct that it is a model that is well functioning and gave us good results.

Remarks on the data: The Barebeek catchment **(V08BAR111370)** only has measured discharge data from 02/01/1997 to 04/11/2004. This entire period was used for calibration. The catchment **W08SAMRON000** does not have data after 2010. A 13-year calibration period was therefore selected from 1998 to 2010.

For **V08ZUU233100,** most of discharge records were estimated or suspect from August 2005 to May 2006. It is suspect in the summer of 1994 and 2008 as well as 2009 (June to November). Measured flow is also suspiciously constant in the spring of 2003 with a lot of repeated records from April to December 2003. This period seems therefore less trustworthy.

Discharge of the Dijle **(V08DIJ093400)** is measured by a VMM station in Wilsele, where measurements are known to be disturbed by plant growth. Corrections were made by the VMM to account for this effect but with limited accuracy. Data quality is poor or suspect on most years until 2013. Therefore, the rainfall and potential evapotranspiration timeseries were exceptionally extended in order to have two years and a half of reliable data (2013-mid 2015).

Table 19 – Overview of calibration results for gauged catchments on the Dijle and Zenne basins

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Calibration period	Approx. distance to rain gauge over calibration period (km)
11110102-Barebeek, Hofstade (Elewijt)	V08BAR111370	70.0	0.741	0.755	1.1	1997-2004	7
9310102 - Dijle, Wilsele	V08DIJ093400	861,4	0.605	0.137	1.2	2013-2015	*Irrelevant given the size of the basin (max 12)*
23310102 - Zuunbeek, St Pietersleeuw	V08ZUU233100	64,8	0.603	0.492	22.3	2001-2013	< 2007 : 12 2007 - 2009 : 10 > 2009 : 10
2371-10050 Samme, Ronquieres	W08SAMRON000	134,0	0.693	0.773	0.4	1998-2010	< 2008 : 4 2008 - 2010 : 8 > 2010 : 5
L5670 -Senette, Ronquieres	W08SENRON010	70,4	0.566	0.361	-6.7	2001-2013	< 2002 : 2 2002-2006 : 8 > 2006 : 11
1951-10050 Zenne, Tubize	W08SENTUB030	215,9	0.671	0.621	-0.3	2001-2013	6

Table 20 – Overview of validation results for gauged catchments on the Dijle and Zenne basins

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Validation period
11110102-Barebeek, Hofstade	V08BAR111370	70.08	0.695	-0.191	0.014	1967-2013
9310102 - Dijle, Wilsele	V08DIJ093400	861,4	0.595	0.737	-2.6	1974-2013
23310102 - Zuunbeek, St Pietersleeuw	V08ZUU233100	64,8	0.586	0.48	29.8	1985-2013
2371-10050 Samme, Ronquieres	W08SAMRON000	134.097	0.71	0.65	-0.092	1967-2013
L5670 -Senette, Ronquieres	W08SENRON010	70,4	0.512	0.376	-15.6	1977-2013
1951-10050 Zenne, Tubize	W08SENTUB030	215.911	0.652	0.612	-3.5	1967-2013

11110102-Barebeek, Hofstade (Elewijt) (V08BAR111370)

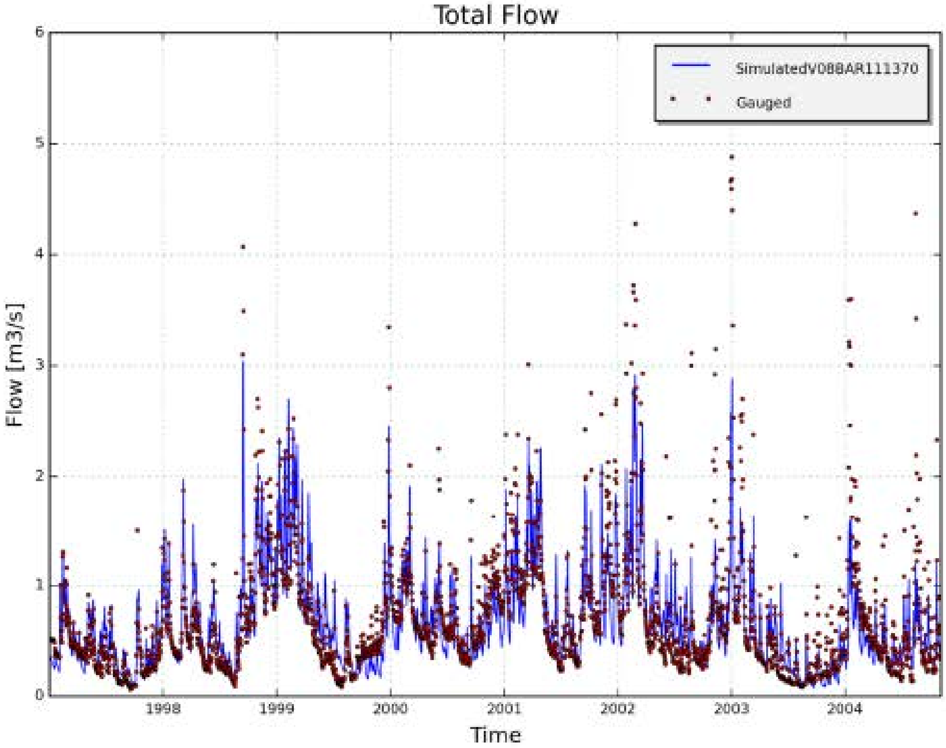


Figure 56 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V08BAR111370, station 11110102-Barebeek, Hofstade (Elewijt) (2001-2013)

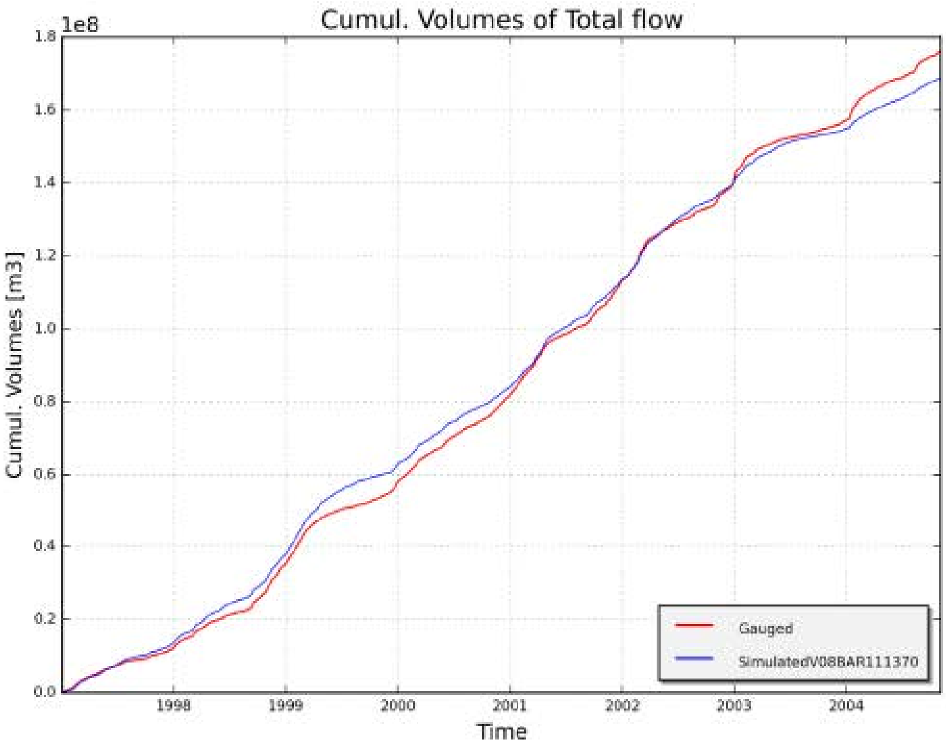


Figure 57 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V08BAR111370, station 11110102-Barebeek, Hofstade (Elewijt) (2001-2013)

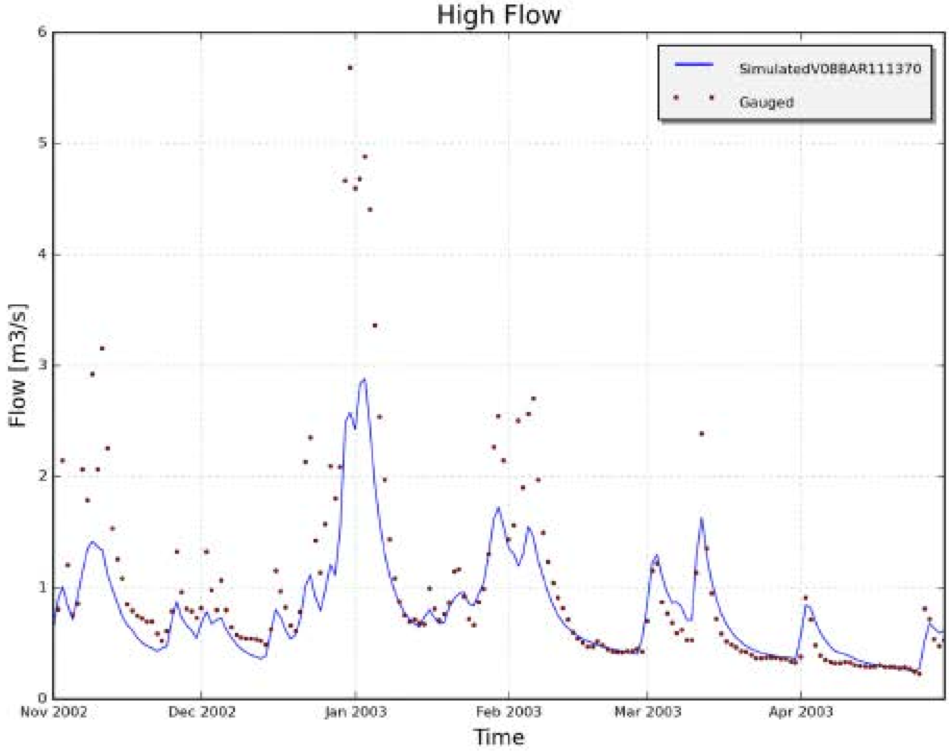


Figure 58 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V08BAR111370, station 11110102-Barebeek, Hofstade (Elewijt)

L5670 -Senette, Ronquieres (W08SENRON010)

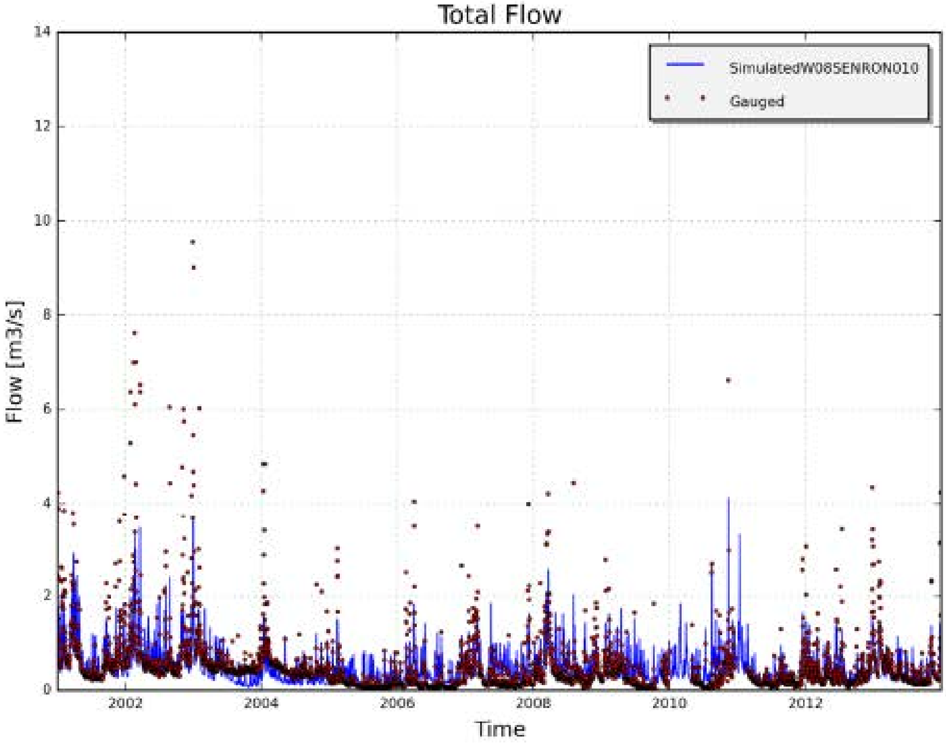


Figure 59 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment W08SENRON010, station L5670 -Senette, Ronquieres (2001-2013)

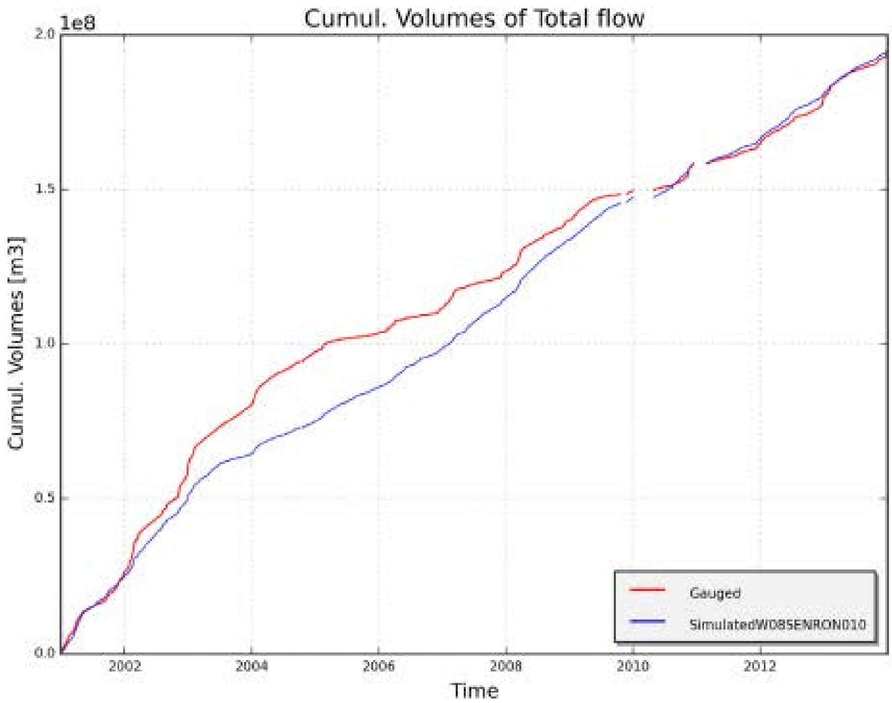


Figure 60 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment W08SENRON010, station L5670 -Senette, Ronquieres (2001-2013)

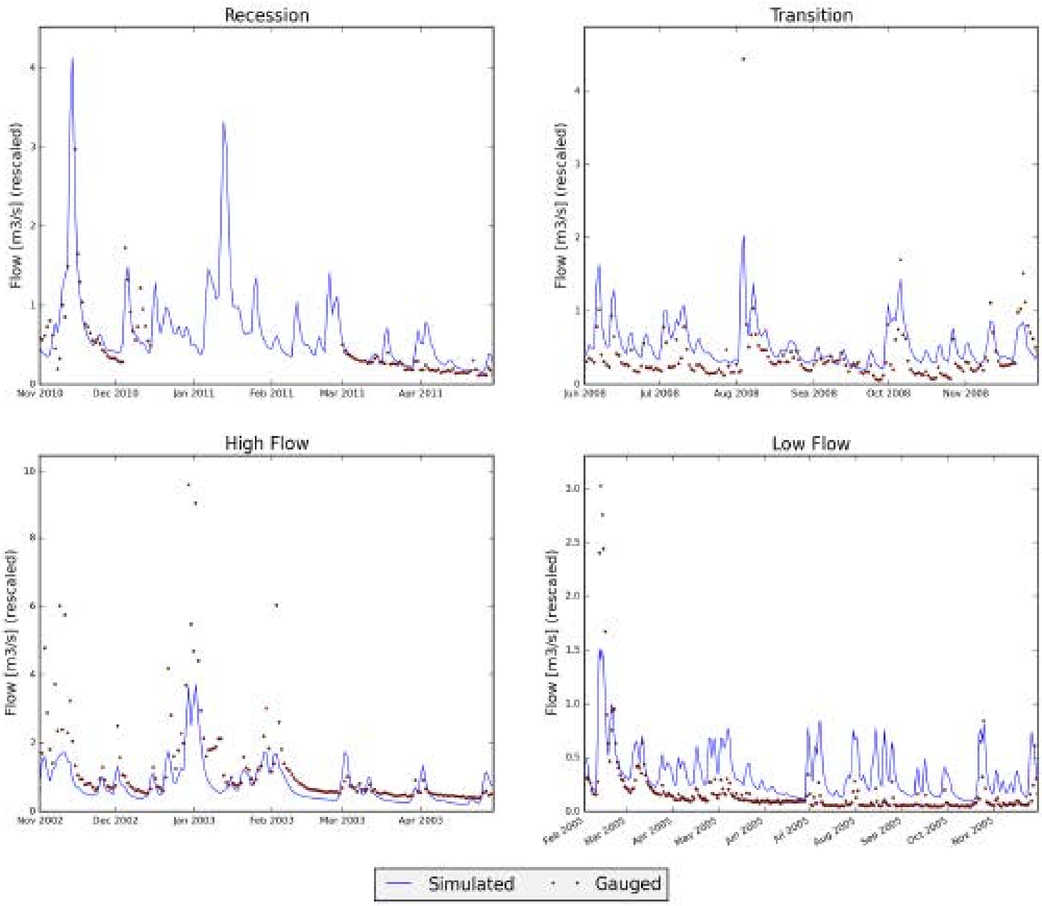


Figure 61 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment W08SENRON010, station L5670 -Senette, Ronquieres

6.11 Demerbekken

6.11.1 Context

The Demer basin has an area of 2 334 km². From that, 1 919 km² is located in Flanders, the rest being in Wallonia. It contributes for 10 % of the total surface area of the Scheldt basin. The navigable rivers in this catchment are the Demer and the Albert canal.

With 10 gauging stations, 80,3 % of the catchments in the Demer is gauged. These stations are listed in **Remarks on the data:** Some catchments are calibrated for a different period than usual (2001-2013).

Years 2011-2013 have been deleted from the simulation of the catchment **V09DEM136000** due unreliable (suspiciously high) measured base flow.

The catchment **V09LOS143300** has portions of discharge measurements with moderate to poor quality, or missing values from August 2010, resulting in the years 1997-2010 being used for calibration. Note that data in 2001 and before is unchecked and therefore more uncertain.

The catchment **V09MAN161040** does not have data available from the beginning of 2011 and between 11/05/2003-31/12/2004, so the calibration period 1998-2010 has been used.

In the case of the Herk in Kermt/Spalbeek (**V09HER163010**), data is checked from 2002 until 2016, with the exception of 2010. The calibration period is therefore chosen from 2003 to 2013 in order to ensure maximum reliability during the calibration. The years before are used for validation nevertheless.

There is no observed discharge data for **V09MOT144270** after 2010. High discharge values are estimations above 3 m³/s from 2000 to 2001 included. Measurements start to be unstable in 2008 and it is unchecked before 1997, so the period chosen for calibration is 1997-2007. Validation can be performed using the station located in Tielt, slightly upstream (station L09_14A with a surface area of approximatively 26.6 km²).

In reference to the catchment **V09ZWA148120**, there is no discharge data in Lummen (Zwartebeek) between 1997 and 2001. Moreover values are missing or suspect from 2008 on. Therefore, calibration period is selected between 2001 and 2008 to ensure continuous reliable observations. Note that there is uncertainty associated with a correction for the effect of plant growth on observed discharge (discharge was corrected to be lower than actual measurements in the summer of 2002 and 2003).

V09HUL147150 refers to the basin of the Zwart Water river, gauged in Molenstede (L09_147). Data is checked with good quality since 2002. Note that the second half of 2007 is estimated.

For the Zwartebeek discharge in Lummen (**V09ZWA148120**), values are suspect for most of 2011 and less than good quality starting April 2012. Therefore the calibration period is limited to 2001-2008.

Table 21 and depicted on Figure 62.

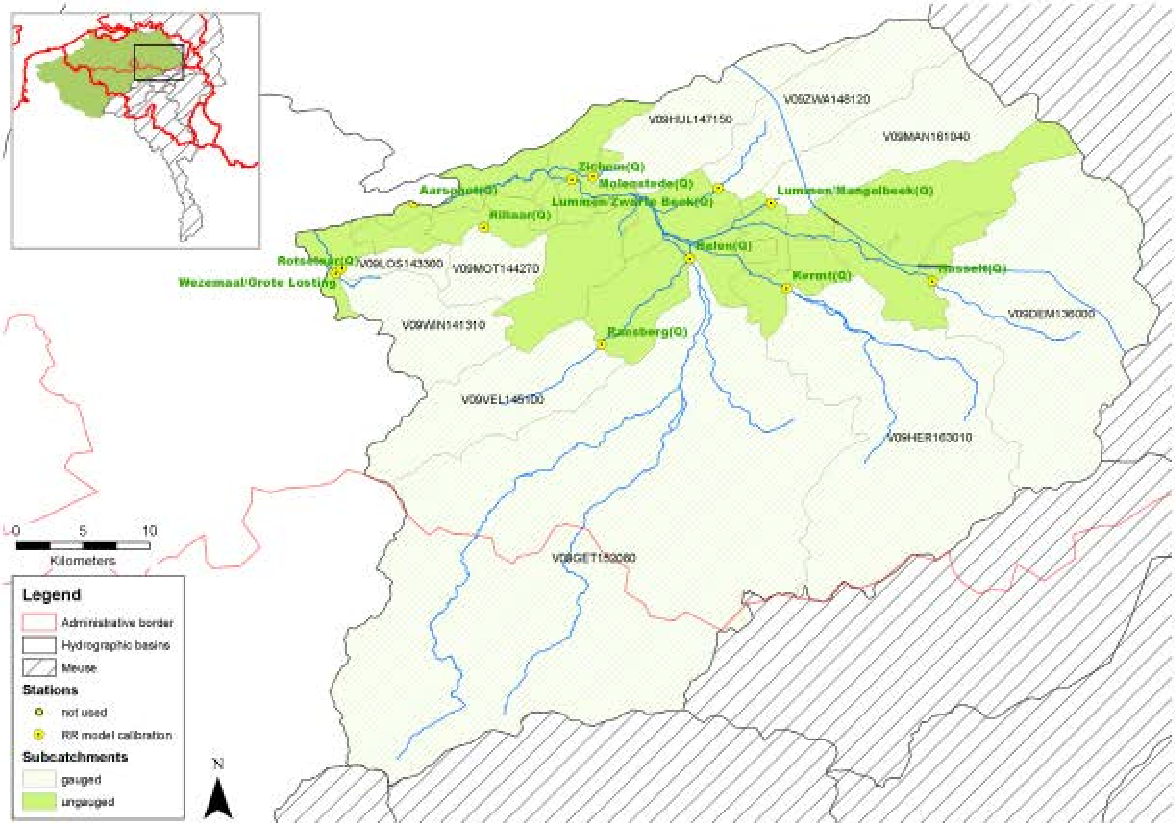


Figure 62 – Subcatchments and measurement points in the Demer catchment

6.11.2 Model performance

Remarks on the data: Some catchments are calibrated for a different period than usual (2001-2013).

Years 2011-2013 have been deleted from the simulation of the catchment **V09DEM136000** due unreliable (suspiciously high) measured base flow.

The catchment **V09LOS143300** has portions of discharge measurements with moderate to poor quality, or missing values from August 2010, resulting in the years 1997-2010 being used for calibration. Note that data in 2001 and before is unchecked and therefore more uncertain.

The catchment **V09MAN161040** does not have data available from the beginning of 2011 and between 11/05/2003-31/12/2004, so the calibration period 1998-2010 has been used.

In the case of the Herk in Kermt/Spalbeek (**V09HER163010**), data is checked from 2002 until 2016, with the exception of 2010. The calibration period is therefore chosen from 2003 to 2013 in order to ensure maximum reliability during the calibration. The years before are used for validation nevertheless.

There is no observed discharge data for **V09MOT144270** after 2010. High discharge values are estimations above 3 m^3/s from 2000 to 2001 included. Measurements start to be unstable in 2008 and it is unchecked before 1997, so the period chosen for calibration is 1997-2007. Validation can be performed using the station located in Tielt, slightly upstream (station L09_14A with a surface area of approximatively 26.6 km^2).

In reference to the catchment **V09ZWA148120**, there is no discharge data in Lummen (Zwartebeek) between 1997 and 2001. Moreover values are missing or suspect from 2008 on. Therefore, calibration period is selected between 2001 and 2008 to ensure continuous reliable observations. Note that there is uncertainty associated with a correction for the effect of plant growth on observed discharge (discharge was corrected to be lower than actual measurements in the summer of 2002 and 2003).

V09HUL147150 refers to the basin of the Zwart Water river, gauged in Molenstede (L09_147). Data is checked with good quality since 2002. Note that the second half of 2007 is estimated.

For the Zwartebeek discharge in Lummen (**V09ZWA148120**), values are suspect for most of 2011 and less than good quality starting April 2012. Therefore the calibration period is limited to 2001-2008.

Table 21 and Table 22 present general performance statistics for the gauged catchments of the Demer basin for the calibration and validation period. Graphs of the catchments with code **V09VEL145100** (best model performance) and **V09LOS143300** (worst model performance) are presented below (Figure 63 to Figure 68). For more detailed results on the other catchments, see Annex 11.

Aside from **V09HUL147150** and **V09LOS143300**, the catchments in this basin showed good evaluation parameters of the model, despite the fact of the disproportionality of the areas of these catchments from one to another.

When the low flows are well simulated for **V09VEL145100**, the simulated flows during the transition and the high flows period are overestimated comparing to the gauged ones.

When it comes to **V09LOS143300,** the simulated cumulative total flow is quite higher than the gauged one from 1998 to 2010. This reflects the poor performance of the model since it overestimates the base flow and it can be explicitly viewed during 1999.

Remarks on the data: Some catchments are calibrated for a different period than usual (2001-2013).

Years 2011-2013 have been deleted from the simulation of the catchment **V09DEM136000** due unreliable (suspiciously high) measured base flow.

The catchment **V09LOS143300** has portions of discharge measurements with moderate to poor quality, or missing values from August 2010, resulting in the years 1997-2010 being used for calibration. Note that data in 2001 and before is unchecked and therefore more uncertain.

The catchment **V09MAN161040** does not have data available from the beginning of 2011 and between 11/05/2003-31/12/2004, so the calibration period 1998-2010 has been used.

In the case of the Herk in Kermt/Spalbeek (**V09HER163010**), data is checked from 2002 until 2016, with the exception of 2010. The calibration period is therefore chosen from 2003 to 2013 in order to ensure maximum reliability during the calibration. The years before are used for validation nevertheless.

There is no observed discharge data for **V09MOT144270** after 2010. High discharge values are estimations above 3 m^3/s from 2000 to 2001 included. Measurements start to be unstable in 2008 and it is unchecked before 1997, so the period chosen for calibration is 1997-2007. Validation can be performed using the station located in Tielt, slightly upstream (station L09_14A with a surface area of approximatively 26.6 km^2).

In reference to the catchment **V09ZWA148120,** there is no discharge data in Lummen (Zwartebeek) between 1997 and 2001. Moreover values are missing or suspect from 2008 on. Therefore, calibration period is selected between 2001 and 2008 to ensure continuous reliable observations. Note that there is uncertainty associated with a correction for the effect of plant growth on observed discharge (discharge was corrected to be lower than actual measurements in the summer of 2002 and 2003).

V09HUL147150 refers to the basin of the Zwart Water river, gauged in Molenstede (L09_147). Data is checked with good quality since 2002. Note that the second half of 2007 is estimated.

For the Zwartebeek discharge in Lummen (**V09ZWA148120**), values are suspect for most of 2011 and less than good quality starting April 2012. Therefore the calibration period is limited to 2001-2008.

Table 21 – Overview of calibration results for gauged catchments on the Demer basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Calibration period	Approx. distance to rain gauge over calibration period (km)
13610102 - Demer; Hasselt	V09DEM136000	255,8	0.719	0.662	-0.2	1998-2010	6
15210102 - Gete; Halen	V09GET152080	800.395	0.713	0.627	-0.6	2001-2013	*Irrelevant given the size of the catchment (max 10)*
16310102 - Herk, Kermt (Spalbeek)	V09HER163010	274.602	0.607	0.547	-1.2	2003-2012	12
14710102 - Zwart Water (affluent of De Hulpe); Molenstede	V09HUL147150	80.13	0.403	0.017	-1.6	2001-2013	7
14310102 - Grote Losting; Wezemaal	V09LOS143300	15.176	0.25	0.243	18.8	1997-2010	< 2000 : 8 >= 2000 : 4
16110102 - Mangelbeek; Lummen	V09MAN161040	103.081	0.666	0.615	-0.2	1998-2010	10
14410102 - Motte; Rillaar	V09MOT144270	33.59	0.647	0.509	3	1995-2007	5
14510102 - Velp; Ransberg	V09VEL145100	96.801	0.725	0.657	0.5	2001-2013	7
141 - Rotselaar ; Winge	V09WIN141310	64.739	0.675	0.58	1	2001-2013	< 2001 : 10 >= 2001 : 2
14810102 - Zwarte Beek; Lummen	V09ZWA148120	96.515	0.637	0.48	3.2	2001-2008	3

Table 22 – Overview of validation results for gauged catchments on the Demer basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr (%)	Validation period
13610102 - Demer; Hasselt	V09DEM136000	255.882	0.654	0.55	-1.3	1967-2013
15210102 - Gete; Halen	V09GET152080	800,4	0.661	0.58	6.3	1969-2012
16310102 - Herk, Kermt	V09HER163010	274,6	0.594	0.498	10	1977-2013
14710102 - De Hulpe; Molenstede	V09HUL147150	80,1	0.436	0.101	10.3	1987-2013
14310102 - Grote Losting; Wezemaal	V09LOS143300	15,2	0.265	0.299	6.7	1987-2012
16110102 - Mangelbeek; Lummen	V09MAN161040	103,1	0.669	0.569	0.7	1984-2009
14A - Motte; Tielt	V09MOT14A100	33,6	0.525	0.208	-13	2009-2013
14510102 - Velp; Ransberg	V09VEL145100	96.801	0.671	0.594	0	1967-2013
141 - Rotselaar ; Winge	V09WIN141310	64,7	0.579	0.585	3.9	1987-2013
14810102 - Zwarte Beek; Lummen	V09ZWA148120	96,5	0.545	0.336	-9.7	1983-2013

14510102 - Velp; Ransberg (V09VEL145100)

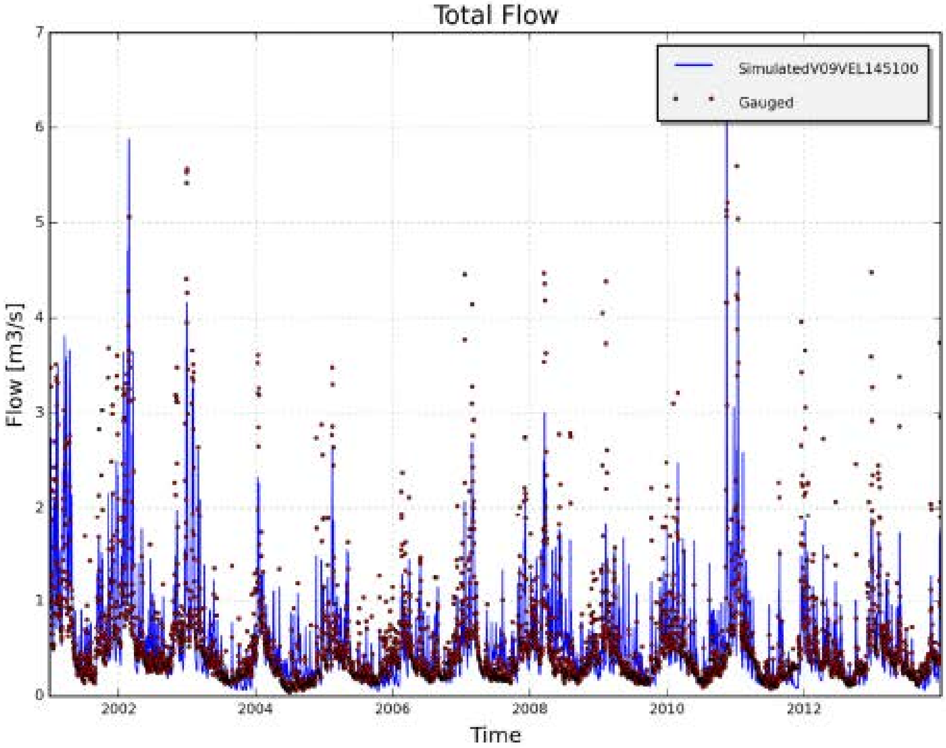


Figure 63 – Measured (red) and simulated (blue) daily discharge [m³/s]
on catchment V09VEL145100, 14510102 - Velp; Ransberg (1997-2013)

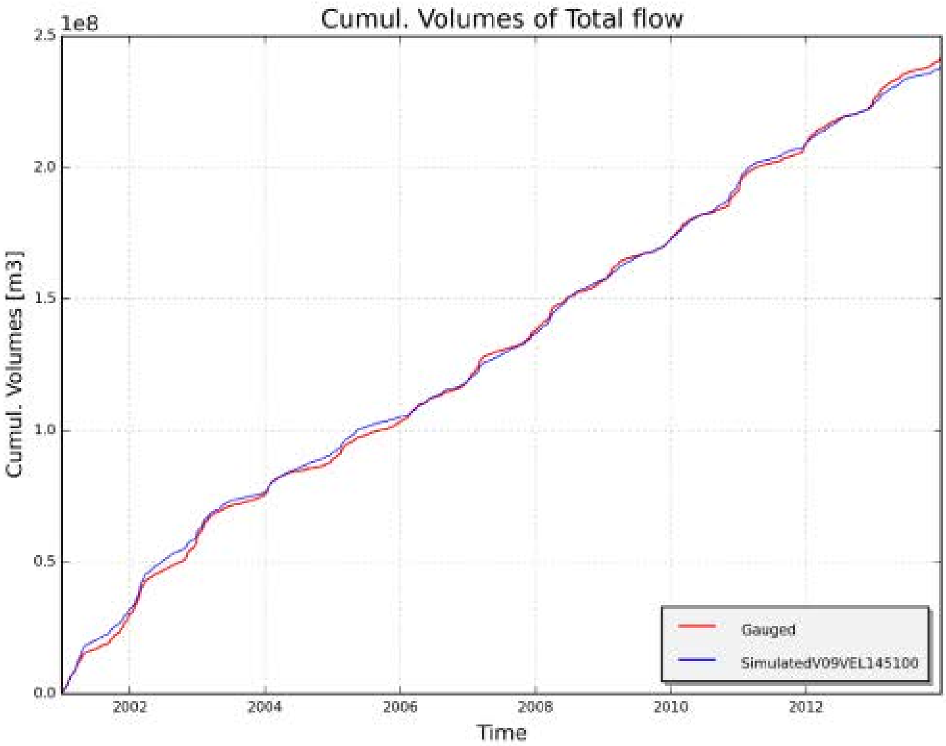


Figure 64 – Measured (red) and simulated (blue) cumulative discharge [m³]
on V09VEL145100, 14510102 - Velp; Ransberg (1997-2013)

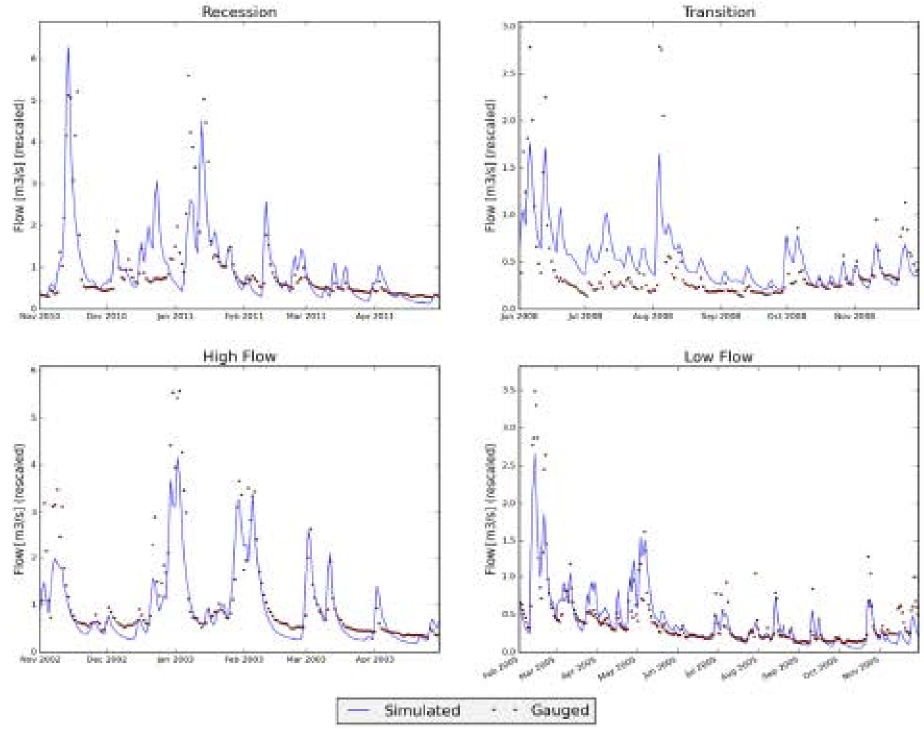


Figure 65 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V09VEL145100, 14510102 - Velp; Ransberg

14310102 - Grote Losting; Wezemaal (V09LOS143300)

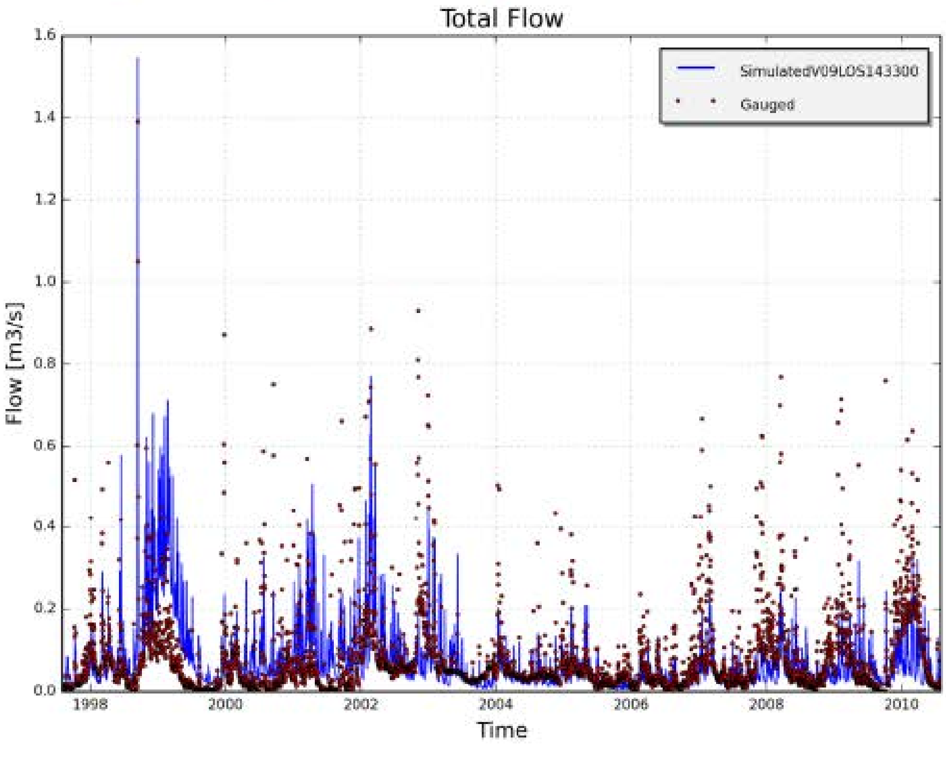


Figure 66 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V09LOS143300, station14310102 - Grote Losting; Wezemaal (2001-20013)

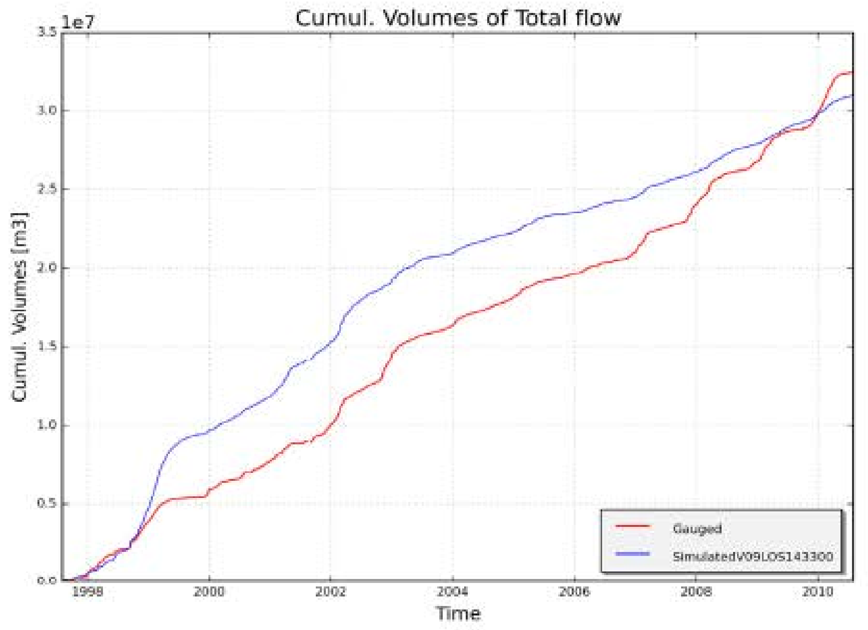
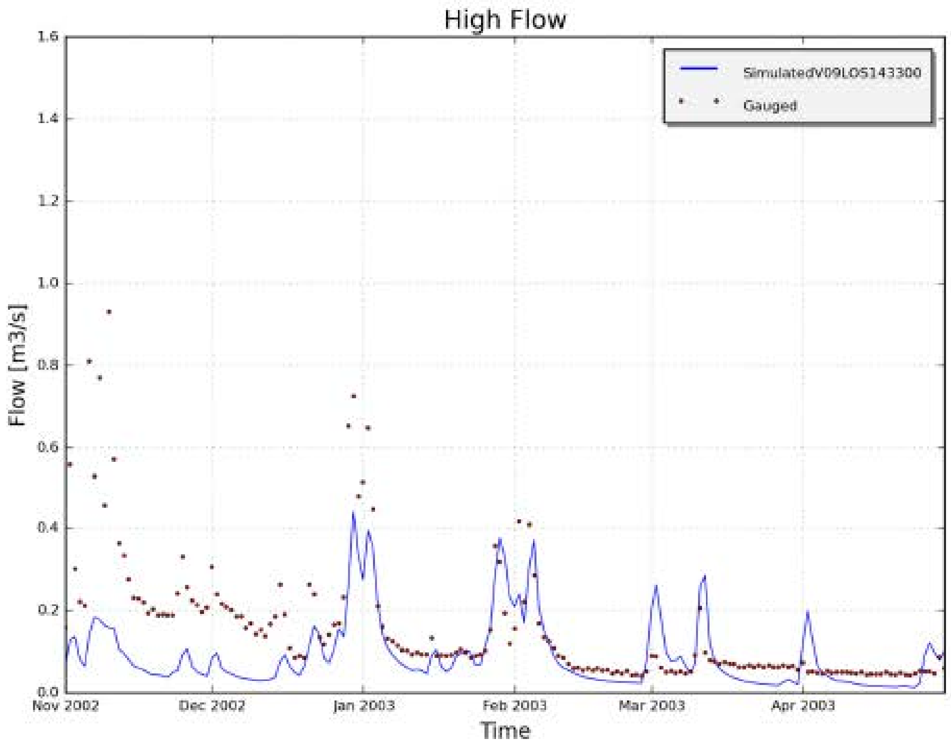


Figure 67 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment catchment V09LOS143300, station14310102 - Grote Losting; Wezemaal (2001-2013)



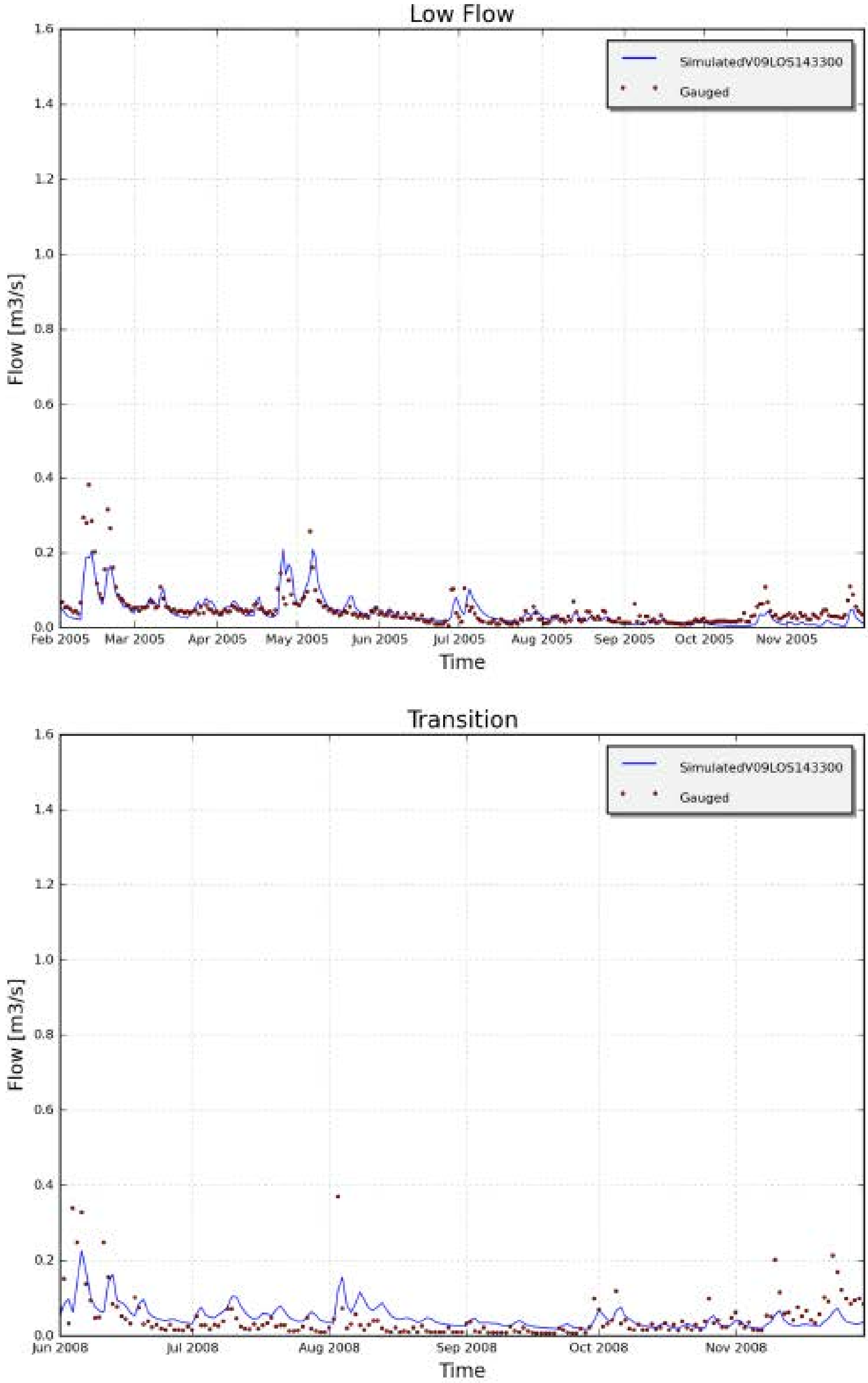


Figure 68 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment catchment V09LOS143300, station14310102 - Grote Losting; Wezemaal

6.12 Netebekken

6.12.1 Context

The Nete catchment reaches over 1 673 km² and is located in North-East of Flanders. It can be divided into two catchments corresponding to the main rivers: Kleine Nete and Grote Nete. These two rivers flow together in Lier, where they coincide in the Beneden-Nete. This flows together with the Dijle to become the Rupel. The Nete basin accounts for 8 % of the total surface area of the Scheldt basin.

There are 5 gauging stations used for calibration of the rainfall-runoff models, covering 63 % of the Nete catchment surface area.

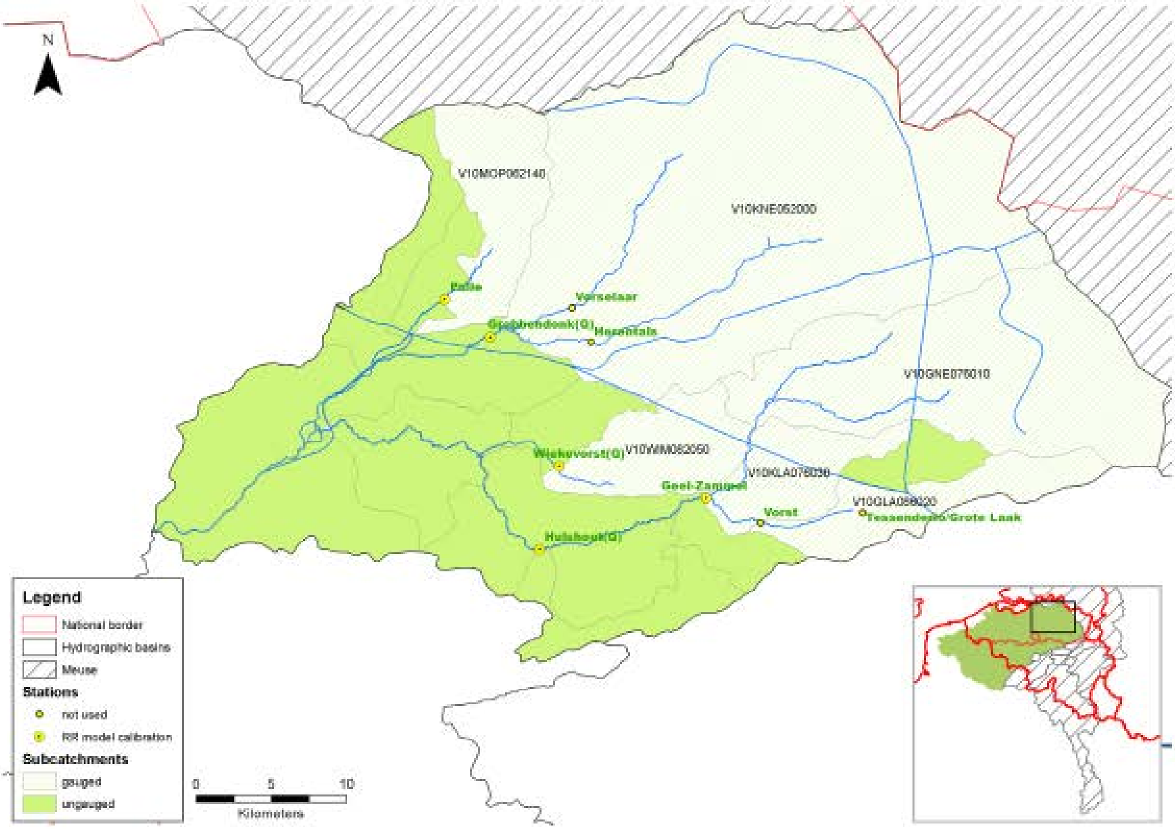


Figure 69 – Subcatchments and measure points for the Nete basin

6.12.2 Model performance

Table 23 and Table 24 present general performance statistics for the gauged catchments of the Nete basin. Graphs of simulations of the catchments with code **V10KNE052000** (best model performance) and **V10MOP062140** (worst model performance) are presented below (Figure 70 to Figure 62). For more detailed results on the other subcatchments is referred to Annex 12.

The model performance is satisfactory for most of the catchments in the Nete basin, with NSE and Log NSE values above 0.60 and Relative error values lower than ±2 (i.e. **V10KNE052000, V10MOP062140**). However, it is necessary to highlight the difficulties found in some of the catchments. It is known that within this catchment several water courses are liable to abundant vegetation, which causes changes in the q(h) relationships at the gauging station. This leads to more uncertainties in the gauged discharges. Although the catchment with code **V10GLA086020** presents good statistical results for the calibration period (Table 23), there is a tendency to underestimate low flows.

For the catchment **V10KNE052000,** even though the NSE and NSE_log reached values higher than 0.7, we found the calibrated model overestimating the flow between February 2005 and July 2005, and underestimating it between the period July2005 and December 2005.

But when it comes to **V10GNE076999,** the low flows are well simulated and show good correlation with the gauged flows.

A lot of data are missing during the calibration period for **V10MOP062140**, which automatically affects the performance of this model. The calibration of the low flow period didn't take place, not allowing us to evaluate how this model perform. Also, the simulated flow during the transition period is very unstable due to the disturbance of the gauged data.

Data remarks: Some catchments are calibrated for different periods as the normally used (2001-2013). The gauging station 8610102 - Grote Laak in Vorst (V10GLA086020) does not have discharge data from 2008 and during the years 1997 and 1998, so that the period selected for the calibration of this catchment is shorter (1999-2007). The calibration period of the catchment V10GNE076999 is 2003-2013 since there is not data available in 2002. The catchment with code V10MOP062140 does not have data from 23/04/2010 to 11/10/2011 and from 01/01/2004 to 31/12/2006. Rainfall was recorded in Houthulst, closest to the catchment, starting in June 2008 only. Rainfall data before then is therefore less reliable. A continuous period of 13 is thus used from 1991 to 2003. According to the gauging station 8210102 – Wiekevorst (V10WIM082050), the calibration period only lasts until the year 2007 due to unavailability of discharge data.

Table 23 – Overview of calibration results for gauged catchments on the Nete basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr	Calibration period	Approx. distance to rain gauge over calibration period (km)
8610102 - Grote Laak, Vorst	**V10GLA086020**	62,6	0.738	0.656	-0.4	1999-2007	5
7610102 Grote Nete/Geel Zammel	**V10GNE076999**	243,5	0.716	0.683	-2	2003-2013	10
5210102 - Kleine Nete; Grobbendonk	**V10KNE052000**	584,7	0.756	0.72	-0.2	2001-2013	10 (*large basin*)
6210102 - Molenbeek, Pulle	**V10MOP062140**	77,3	0.613	0.658	1.1	1997-2013	< 2001 : 8 >= 2001 : 6 2010 : 12
8210102 - Wiekevorst	**V10WIM082050**	65,7	0.625	0.599	0.6	1995-2007	< 2008 : 8 >= 2008 : 2

Table 24 – Overview of validation results for gauged catchments on the Nete basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr	Validation period
8610102 - Grote Laak, Vorst	**V10GLA086020**	62.621	0.575	0.329	-16.7	1967-2013
7610102 Grote Nete/Geel Zammel	**V10GNE076999**	359.885	0.684	0.595	-4.5	1967-2013
5210102 - Kleine Nete; Grobbendonk	**V10KNE052000**	584.669	0.772	0.698	-1.4	1967-2013
6210102 - Molenbeek, Pulle	**V10MOP062140**	77,3	0.647	0.645	15.7	1987-2013
8210102 – Wiekevorst	**V10WIM082050**	65,7	0.567	0.529	13.6	1990-2007

5210102 - Kleine Nete; Grobbendonk (V10KNE052000)

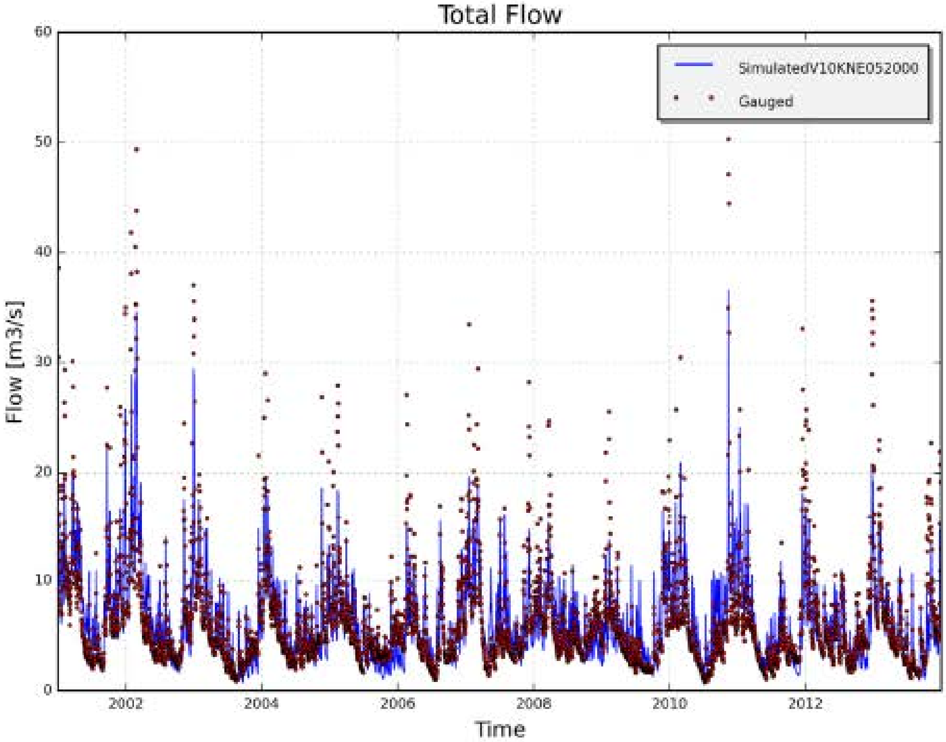


Figure 70 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V10KNE052000, station 5210102 - Kleine Nete; Grobbendonk (2001-2013)

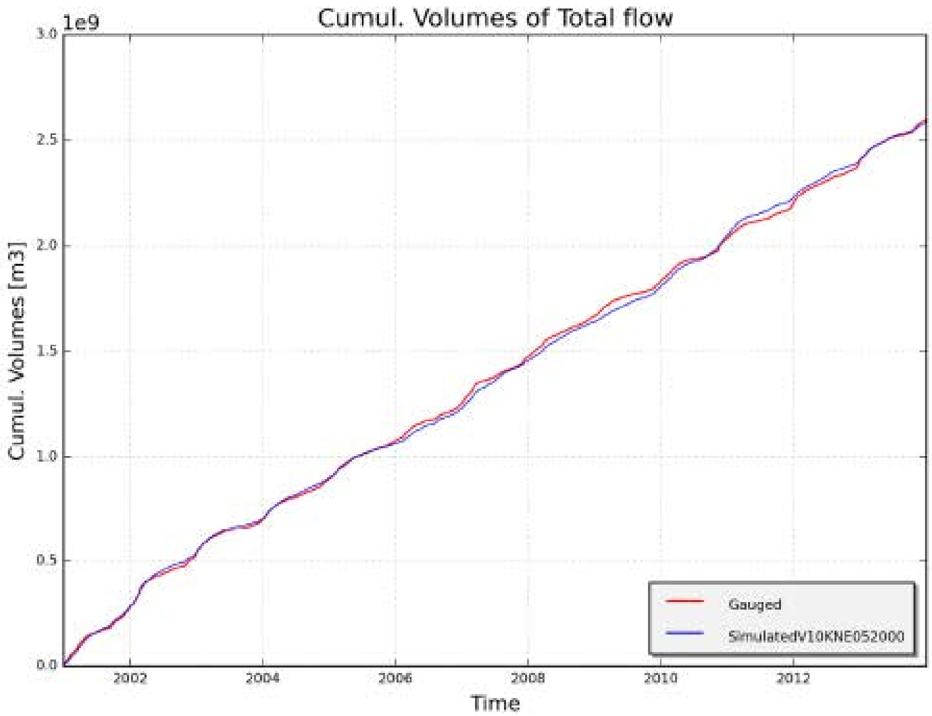


Figure 71 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V10KNE052000, station 5210102 - Kleine Nete; Grobbendonk (2001-2013)

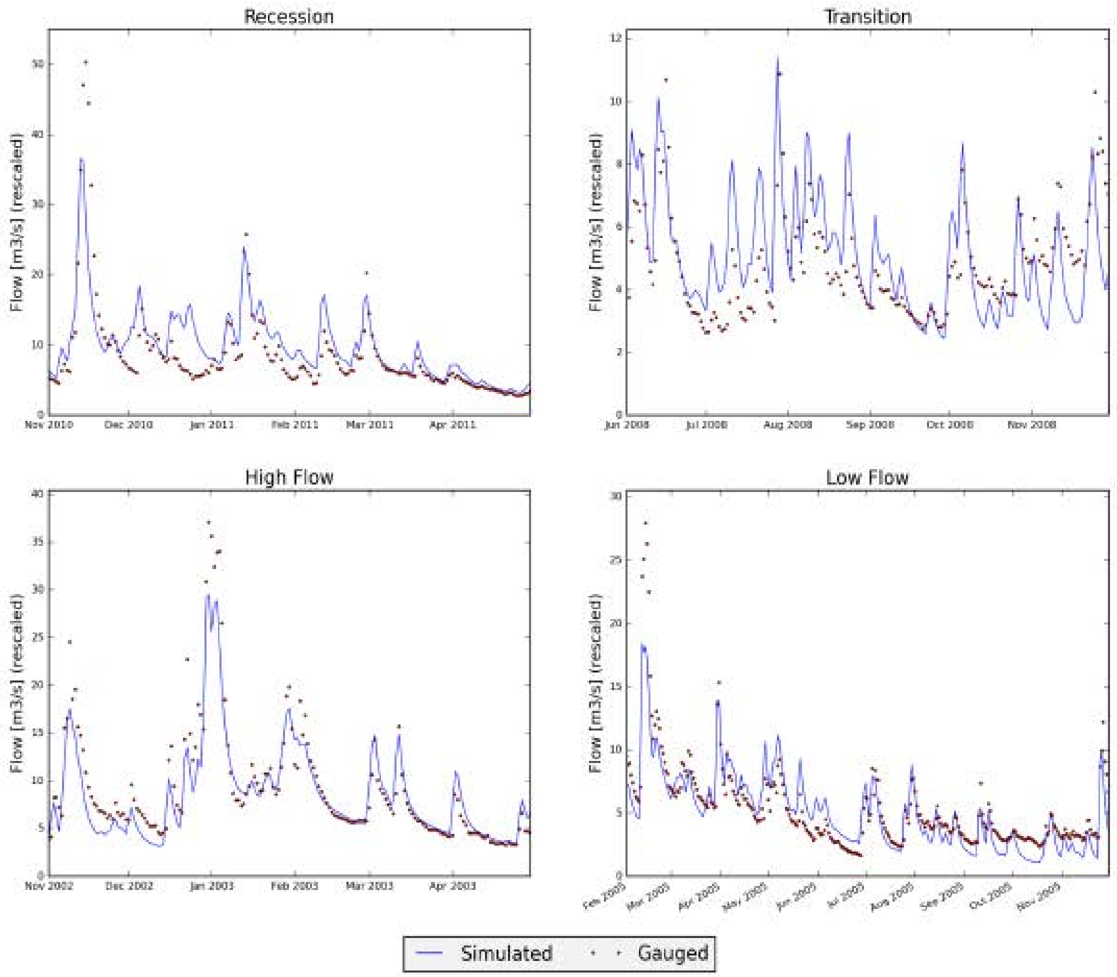


Figure 72 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events

6210102 - Molenbeek, Pulle (V10MOP062140)

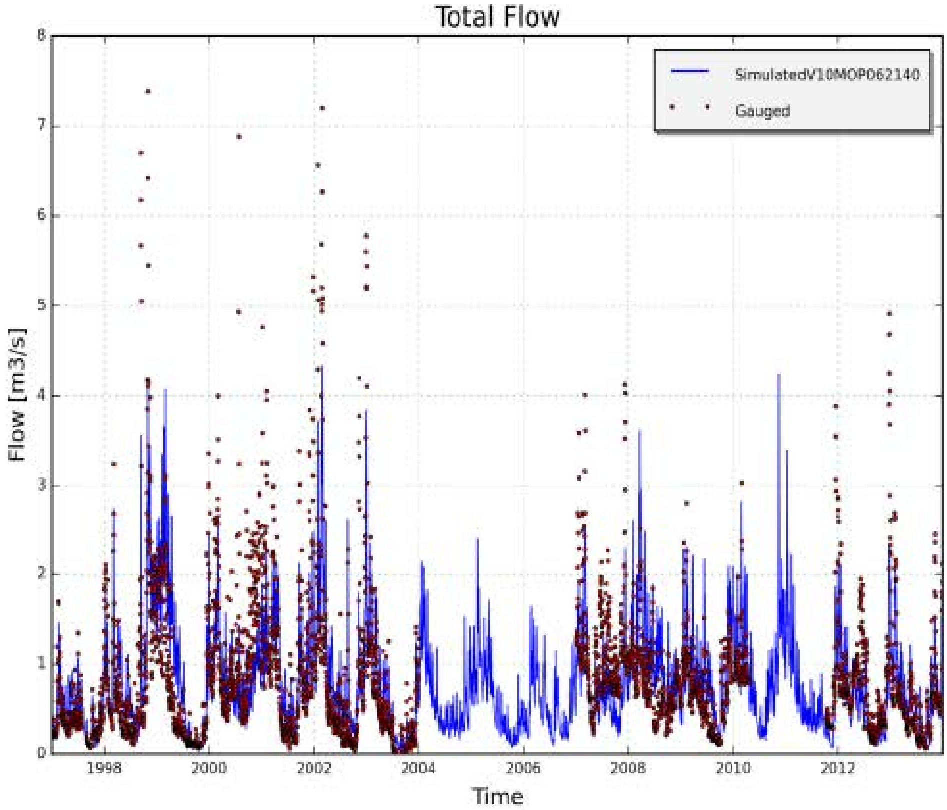


Figure 73 – Measured (red) and simulated (blue) daily discharge [m³/s] on catchment V10MOP062140, station 6210102 - Molenbeek, Pulle (2003-2015)

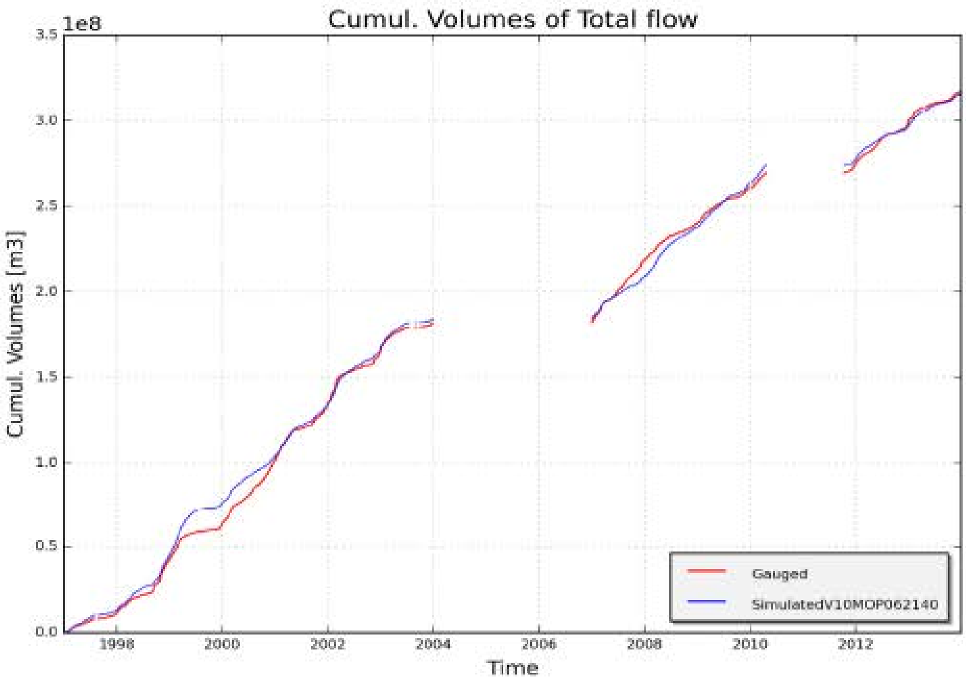


Figure 74 – Measured (red) and simulated (blue) cumulative discharge [m³] on catchment V10MOP062140, station 6210102 - Molenbeek, Pulle (2003-2015)

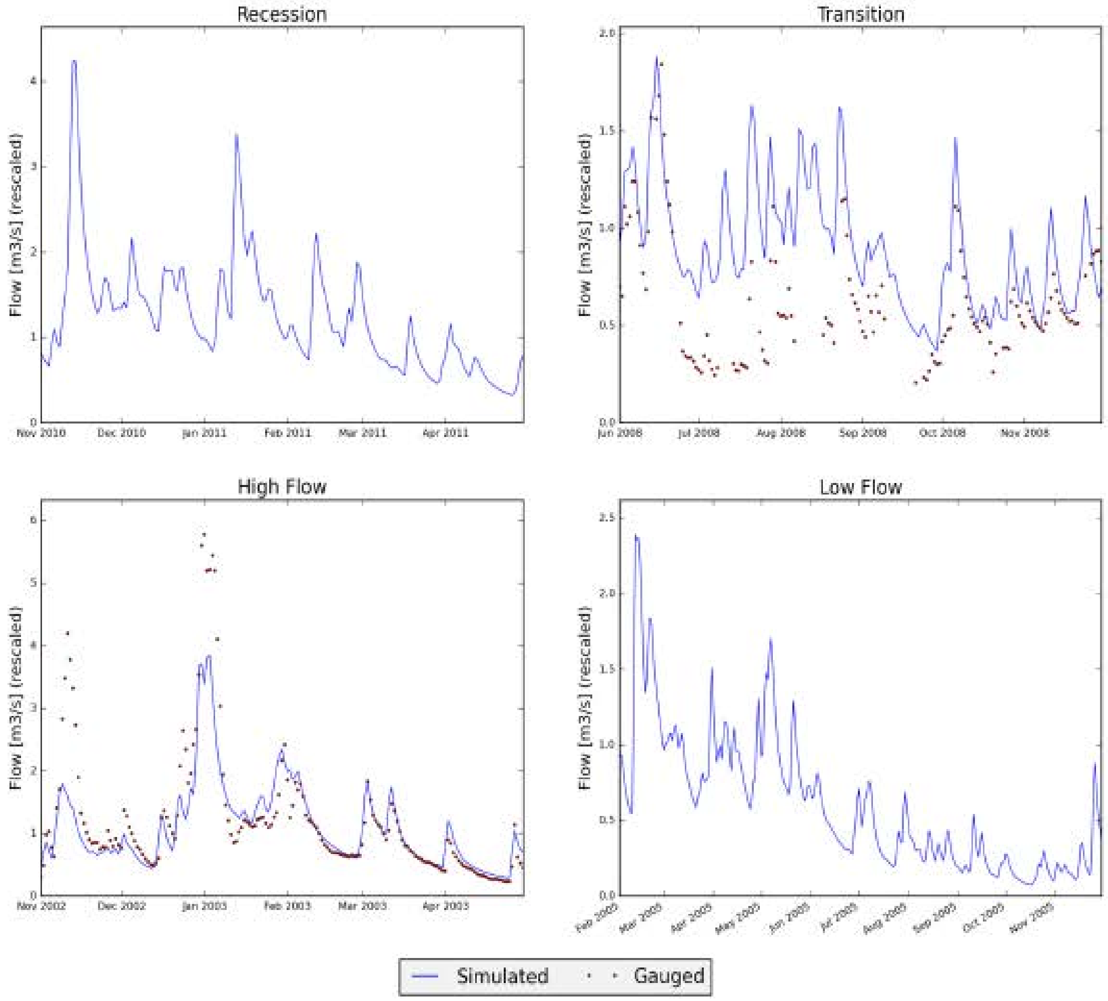


Figure 75 – Measured (red) and simulated (blue) daily discharge [m³/s] during specific low and high flow events on catchment V10MOP062140, station 6210102 - Molenbeek, Pulle

6.13 Maasbekken

6.13.1 Context

The Meuse basin is the second biggest hydrographic district of Belgium (about 20.450 km² in Visé). The Meuse river has its source in France in Pouilly-en Bassigny and enters Belgium in Agimont. The gauging station of Chooz, located in France, is the closest to the Walloon border. The main tributaries of the Walloon Meuse are the Sambre (about 2.700 km²), meeting the Meuse in Namur, and the Ourthe (about 3.600 km²) in Liège.

Figure 1 (on the next page) shows a map of the Meuse basin in Wallonia, with a first selection of flow measuring stations (yellow dots) and their corresponding catchments. The catchment delineation was based on the GIS resources of the Walloon region (SPW). The surface area calculated based on these polygons matches closely the data published by SPW on the "Infocrue" website for each catchment (when available).

Seven stations were used to calibrate the different tributaries (Table 1). Chooz station (located in France) is considered to measure the entering flow of the Meuse at the French border, while Solre station is recording the entering flow for the Sambre.

The station in Profondeville only provides water level measurements and will be used as control. The station in Amay will also be used as downstream control. A simulated time series for Amay can be constructed, aggregating together all simulation results from the 5 catchments upstream Amay ('F11MAA8702', 'W11SAM7319', 'W11MEH5820', 'W11HOY5990') and ungauged zone upstream Amay ('W11MAA0030').

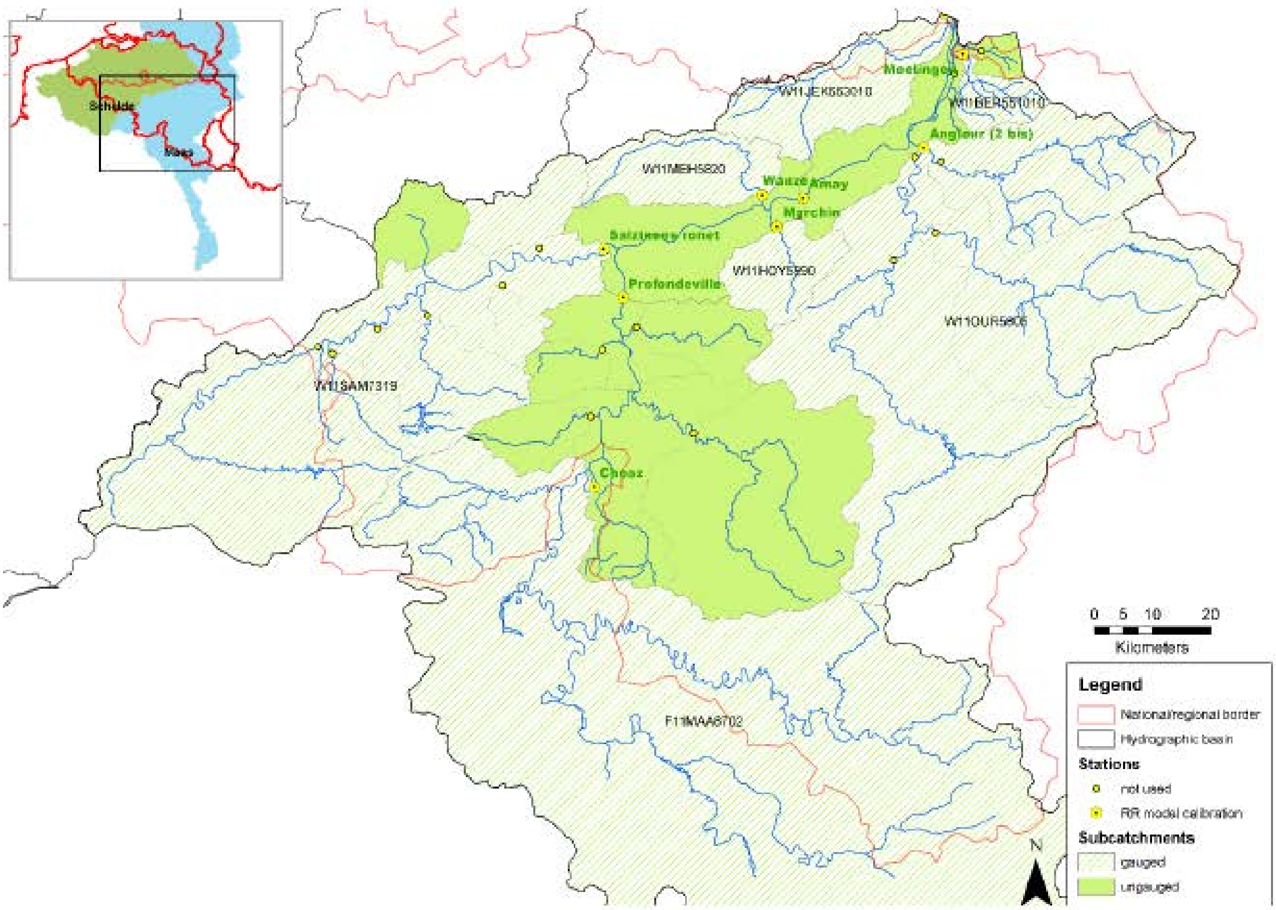


Figure 76 – Subcatchments and measure points for the Meuse basin

6.13.2 Model performance

3Table 25 and Table 26 present the general performance statistics for the gauged catchments of the Nete basin. Graphs of simulations of the catchments with code **W11OUR5805** (best model performance) and **W11HOY5990** (worst model performance) are presented below (Figure 77 to Figure 82). For more detailed results on the other subcatchments is referred to Annex 13.

While the simulated cumulative total flow for **W11HOY5990** is really close to the gauged one, the simulated low flow is not correspondant to the gauged one. In fact, there are many slopes that weren't supposed to happen.

For the catchment **W11OUR5805**, the overall simulated flows are similar to the gauged ones.

For several subcatchments, limited time series of observed discharge are available. No validation is therefore possible on distinct years of data for those stations. This is the case for **W11HOY5990**, **W11MEH5820** and **W11SAM7319**. Control stations downstream (Profondeville and Amay) are thus useful to validate the models of the subcatchments more upstream.

Table 25 – Overview of calibration results for gauged catchments on the Meuse basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr(%)	Calibration period
Chooz, Meuse	F11MAA8702	10120	0.705	0.764	-0.7	2002 – 2013
Moelingen, Berwijn	W11BER551010	128	0.622	0.646	0.3	1994- 2006
Marchin, Hoyoux	W11HOY5990	242	0.456	0.688	-0.1	2001 – 2013
Wanze, Mehaigne	W11MEH5820	355.8	0.604	0.579	-1.7	2004 – 2013
Angleur, Ourthe	W11OUR5805	3607	0.706	0.803	0.6	2001 – 2013
Salzinne, Sambre	W11SAM7319	2636	0.728	0.636	-0.5	2007 - 2012

Table 26 – Overview of validation results for gauged catchments on the Meuse basin

Gauging station	Catchment code	Area (km²)	NSE	logNSE	RelErr(%)	Validation period
Chooz, Meuse	F11MAA8702	10120	0.705	0.775	2.5	1990 – 2013
Moelingen, Berwijn	W11BER551010	128	0.511	0.304	5.5	1992 - 2013
Marchin, Hoyoux	W11HOY5990	242	0.45	0.683	-0.8	2001 - 2013
Wanze, Mehaigne	W11MEH5820	12585	0.618	0.64	-14.6	2001 - 2013
Angleur, Ourthe	W11OUR5805	3607	0.706	0.79	1.9	1974 - 2013
Salzinne, Sambre	W11SAM7319	2636	0.713	0.607	-1.8	2007 - 2013

Angleur, Ourthe (W11OUR5805)

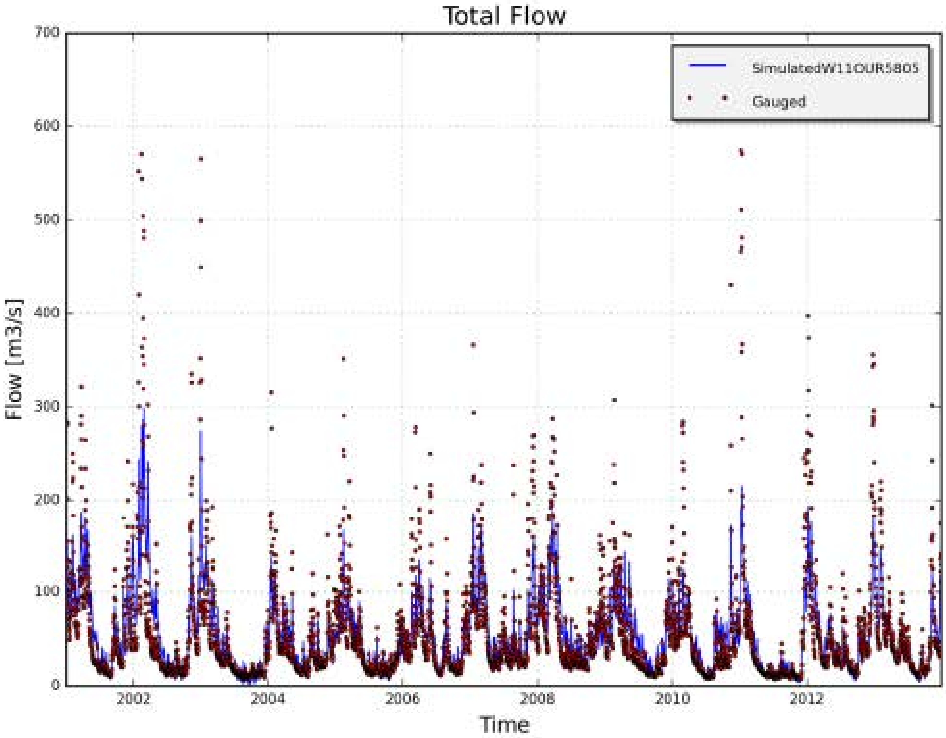


Figure 77 – Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11OUR5805, station Ourthe, Angleur 2 bis(2001-2013)

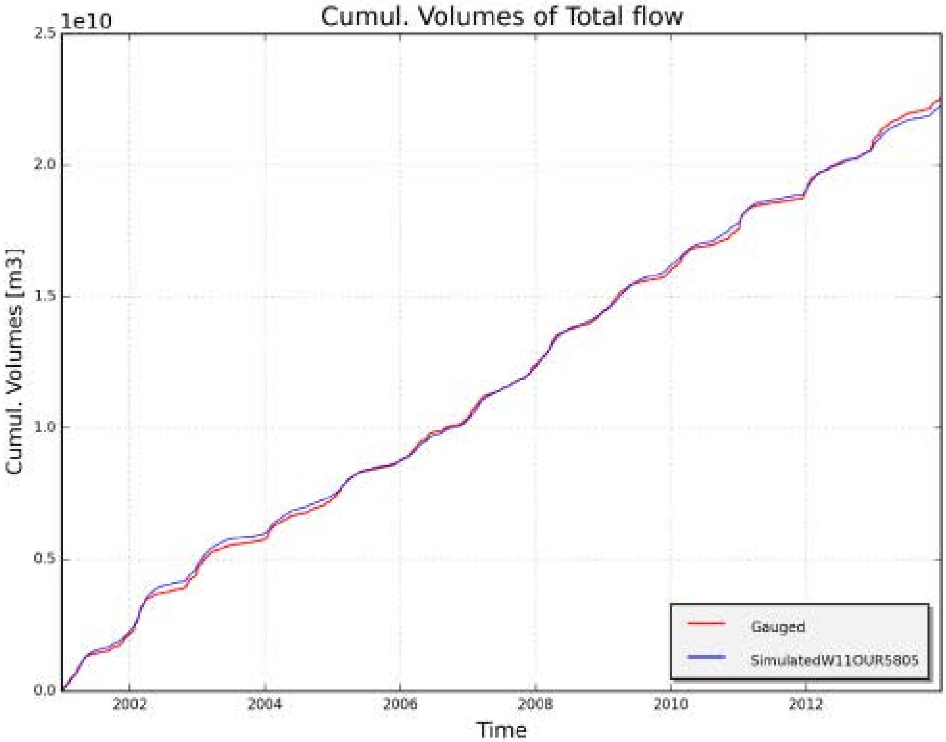


Figure 78 – Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11OUR5805, station Ourthe, Angleur 2 bis (calibration period)

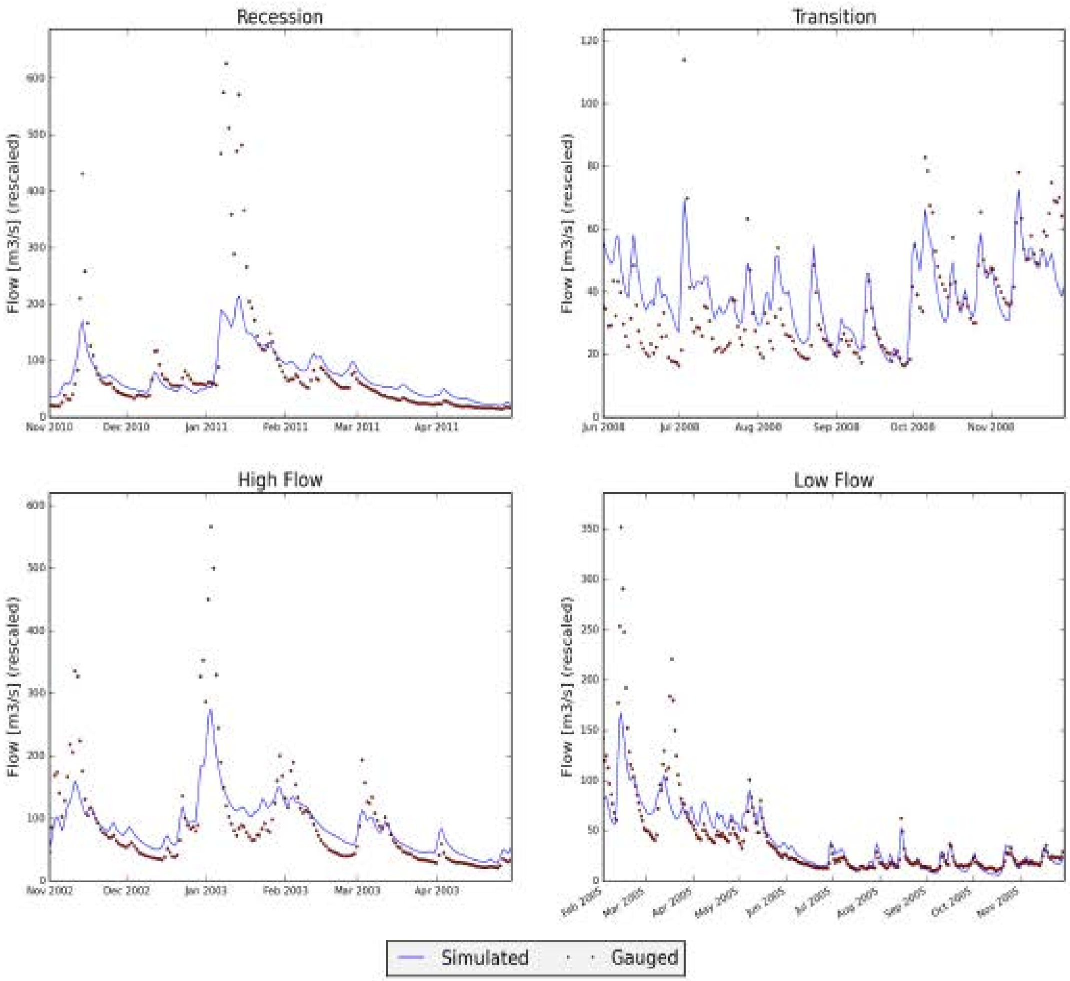


Figure 79 – Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11OUR5805, station Ourthe, Angleur 2 bis

Marchin, Hoyoux (W11HOY5990)

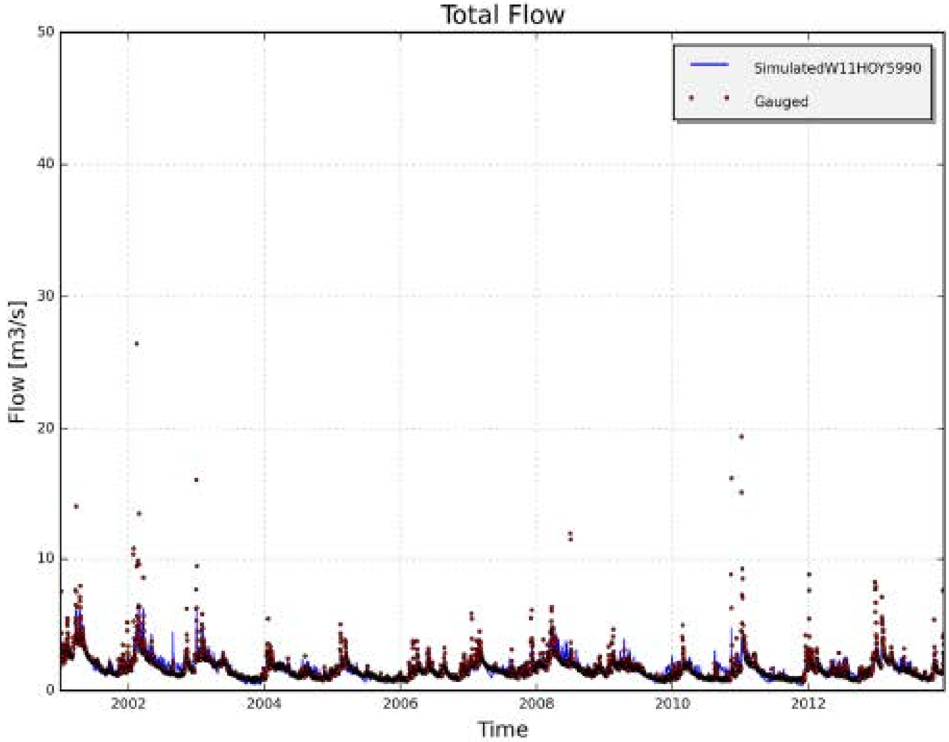


Figure 80 – Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11HOY5990, station Hoyoux, Marchin(2001-2013)

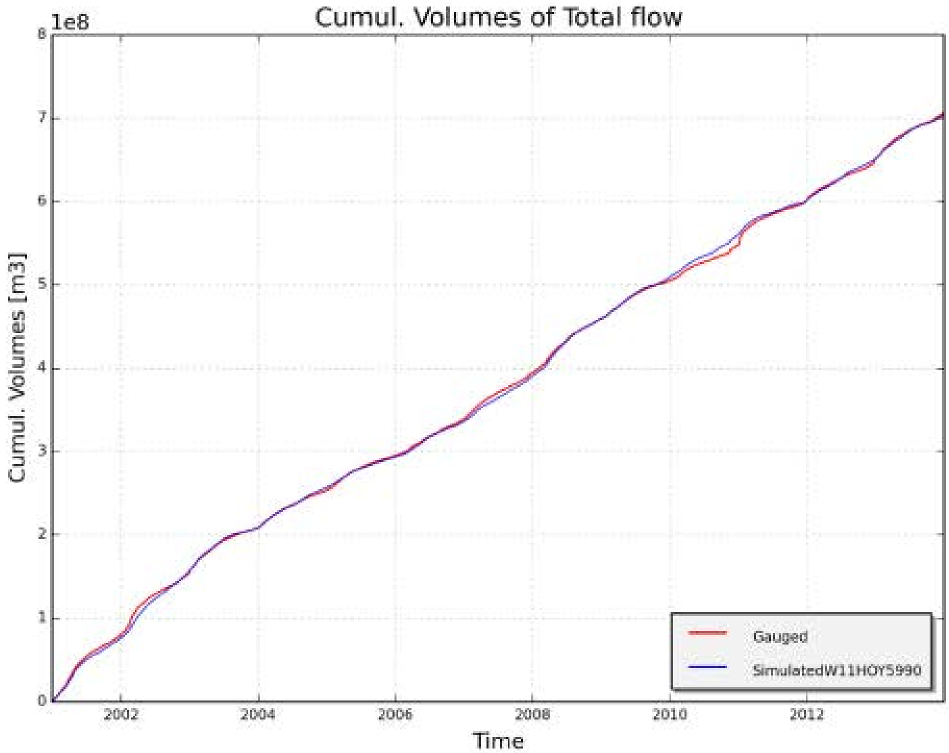


Figure 81 – Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11HOY5990, station Hoyoux, Marchin (calibration period)

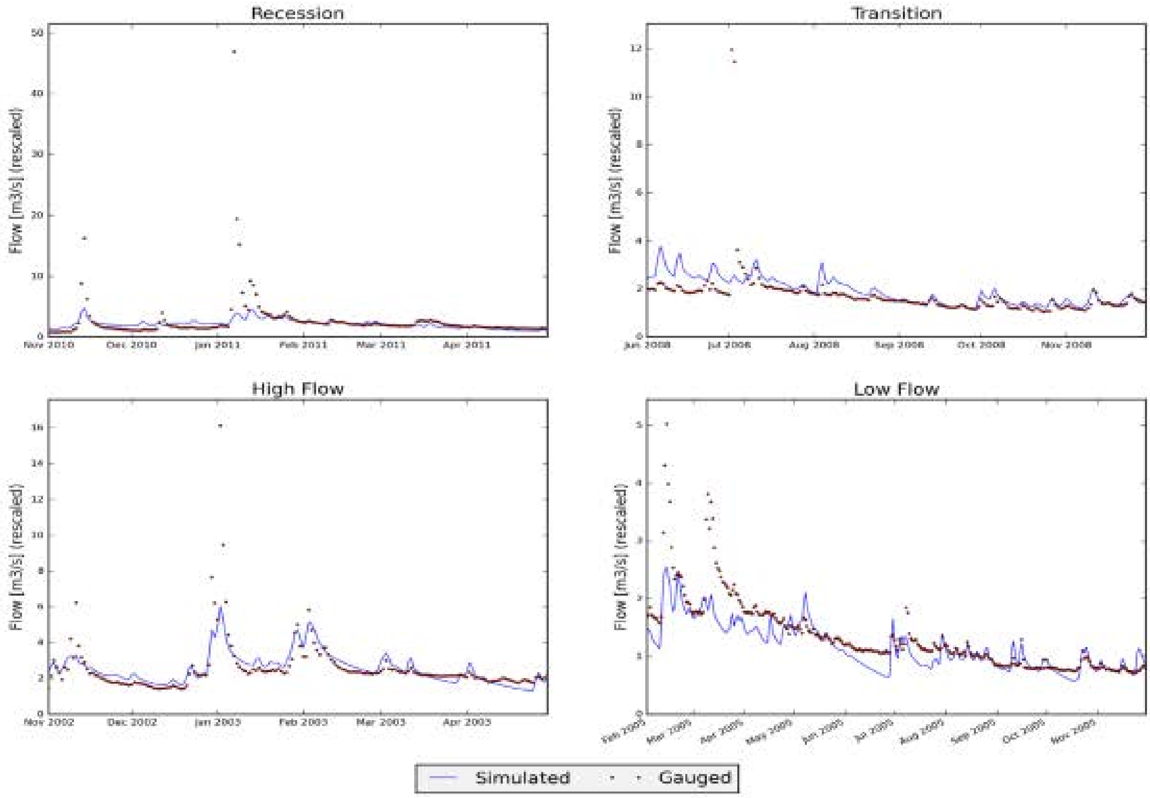


Figure 82 – Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11HOY5990, station Hoyoux, Marchin

7 Summary

As stated before, the comprehensive results for each of the calibrated subcatchments, are attached from Annex 3 to Annex 12. In these Annexes the calibration summary, graphs and statistics are listed.

To give a quick overview of the overall result for the calibrated hydrological VHM models, a geographical summary is given in Annex 13 and Annex 15. Based on the statistics for each of the VHM models, a reclassification is performed to result in a quotation for the overall model performance. This quotation is then incorporated in a general map for the study area.

8 Conclusions and recommendations

The water balance model of the Scheldt basin will be used in order to perform low flow forecasts and calculate climate change scenarios. The goal of this subtask of the project 'Modelling water availability and water allocation strategies in the Scheldt basin', is to define the most appropriate hydrological models for the water balance model of the Scheldt basin in order to meet this prerequisite. Therefore, different hydrological models for each of the subcatchments in the study area are set up and evaluated on their appropriateness for low flow forecasting and climate change scenarios. The regarded models are NAM (©DHI), PDM (©Innovyze), VHM (©Willems, P.) and Wetspa (©VUB).

This subreport covers the recalibration and evaluation of the VHM models. Hydrological VHM models for the gauged catchments (i.e. catchments upstream of a gauging station) were recalibrated whereby the focus is mainly on low flows.

A slight modification in the calibration procedure for VHM was inserted. A manual calibration round, based on the visual observation, was introduced to scan for initial parameters.

The VHM manual calibration tool, developed by K.U. Leuven - Hydraulics Laboratory, allowed to perform an initial (sensitivity) analysis of the parameters to quantify their influence on the flow series. This step allowed to identify key parameters for calibration, and to estimate right intervals for the parameters.

Subsequently, the automatic optimization procedure followed by a visual control was carried out. During the optimization routine the best parameters set is selected for each catchment based on 2 criteria: (1) absolute error on cumulated total flow at each time step, and (2) logarithmic Nash-Sutcliff efficiency. The first criterion aims to model the global flow pattern, the latter focuses mainly on the low flows. As a result, for each of the hydrological catchments, the VHM parameters are updated.

As the final performance of the water balance model is directly dependent on its hydrological input, it is important to have insight in the performance of these hydrological input models. This is also the case when using the hydrological (e.g. VHM) models as input for simulations with the water balance model. The summarized results for each of the gauged subcatchments within the study area, allow the user to get insight in the performance of the VHM model for each of the involved subcatchments. Based on this information and the evaluation of the PDM, NAM and Wetspa models, the user will be able to make a well-grounded decision on which model to use for the considered objective. Therefore, this summarizing report should be consulted by any user applying the corresponding VHM models. In this way, the user gains insight in the uncertainties and performance of the hydrological models for each of the considered subcatchments.

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Appendix 1 List of optimized parameters for gauged catchments

Catchment	Area	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
F01IJZ468000	3.93E+08	398.424	206.257	2.949	1.198	1	-8.481	6.207	-4.651	4.996	13.401	105.226	1807.625
F05LEI386999	2.98E+09	424.003	233.443	2.108	0.834	1	-5.764	1.924	-3.611	3	13.895	46.137	883.192
F06BOS325001	5.22E+09	435.296	176.445	1.978	0.535	1	-5.651	2.182	-3.806	2.873	12.769	61.402	1060.449
F11MAA8702	1.01E+10	380.852	221.526	3.998	1.854	1	-6	0.044	-4.042	3	11.607	86.477	1512.078
V01HAN488180	78558940	386.043	197.997	2.262	1.006	1	-4.195	5	-5.294	2.511	12.26	100.086	836.658
V01IEP495080	63423128	443.328	164.879	1.926	0.363	1	-5.579	2.822	-3.648	3	13.526	56.261	1207.336
V01KEM492060	73892930	426.138	164.191	2.395	1.76	1	-5.127	4.649	-2.978	3	14.4	69.647	476.183
V01MAR496120	76136621	396.831	280.951	3.244	1.143	1	-7.316	4.953	-5.378	4.994	13.44	80.36	1068.09
V01POP491030	84868207	434.223	182.348	2.401	0.993	1	-5.208	4.434	-3.756	3	11.548	76.389	449.512
V01SSV499140	16095000	431.566	175.266	2.174	1.086	1	-4.531	4.998	-3.888	2.979	12.512	52.448	719.349
V02EDE442120	45489177	432.439	198.335	2.926	1.042	1	-7.889	6.92	-5.735	4.962	13.234	71.854	875.453
V02HER426010	77272201	474.903	246.053	2.353	0.783	1	-7.484	4.165	-4.438	4.354	10.37	72.624	1318.31
V02KER422030	62718738	379.334	312.644	2.709	0.991	1	-8.363	0.857	-2.887	5	16.595	67.135	1487.405
V02RIV425020	63980423	406.929	200.918	2.156	0.741	1	-6.022	3.097	-3.54	3.612	14.869	66.76	1497.41
V03POE446000	1.07E+08	402.3	213.381	3.316	1.151	1	-9.571	3.029	-5.79	4.984	12.726	75.962	945.31
V04MOL036110	32561957	413.573	248.059	2.156	0.662	1	-9.378	3.145	-4.553	4.327	12.443	28.522	1199.148
V04MOM037100	67301328	532.439	159.892	1.984	0.827	1	-4.588	1.636	-2.82	2.425	11.651	62.18	932.596
V05HEU403210	91912331	325.847	206.155	3.277	1.086	1	-5.906	1.771	-3.976	3	12.09	77.69	700.135
V05MAN401230	2.58E+08	440.53	177.614	2.073	0.946	1	-4.486	4.975	-3.242	3	12.688	48.99	763.412
V06MAA347160	48678191	524.498	175.36	2.31	0.903	1	-3.584	3.671	-6	3	12.246	62.583	673.143
V06ZWA342190	1.12E+08	448.247	168.144	2.114	1.422	1	-3.72	2.1	-4.12	2.993	14.342	59.701	707.373
V07BEL285070	88641710	445.773	216.214	2.124	0.67	1	-5.347	4.518	-4.949	4.584	14.282	62.727	1156.989
V07MAR289015	1.74E+08	410.737	170.845	2.233	0.916	1	-4.593	5	-4.351	2.89	10.788	58.395	1154.769
V07MOE282100	46367171	350.39	161.765	3.413	2.223	1	-6.668	10	-5.384	3.612	16.514	82.361	1339.911
V07MOG288020	23093628	537.953	193.11	2.122	0.584	1	-5.347	4.924	-4.253	2.991	14.137	60.637	683.236
V08BAR111370	70079800	409.725	286.703	2.1	0.647	1	-5.928	0.95	-3.693	3	15	75.43	1222.596
V08DIJ093400	8.61E+08	464.141	158.535	1.781	0.1	1	-3.318	1.055	-2.784	0.712	11.876	64.339	703.735
V08ZUU233100	64771005	406.288	156.165	2.094	0.678	1	-5.101	5	-4.184	2.992	12.783	57.912	780.787

Catchment	Area	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V09DEM136000	2.56E+08	477605	260394	1.932	0.446	1	-5.153	3.034	-3.954	2.725	14.994	55.767	1199.932
V09GET152080	8E+08	409.122	158.804	1.972	0.493	1	-5.797	1.603	-3.979	3	8.783	57.477	1802.8
V09HER163010	2.75E+08	499.412	168.005	1.974	0.562	1	-6	5	-4.032	3	14.711	59.359	915.528
V09HUL147150	80130245	455.968	224.427	2.674	2.859	1	-4.792	4.789	-3.018	1.279	12.948	65.717	1245.015
V09LOS143300	15176294	505.985	178.842	2.054	0.33	1	-5.611	3.962	-4.541	2.569	14.053	90.579	1248.245
V09MAN161040	1.03E+08	418.733	156.654	1.892	0.713	1	-4.234	4.033	-3.287	0.829	13.162	86.997	1050.4
V09MOT144270	33590217	473.158	168.337	1.947	0.781	1	-5.018	4.771	-3.911	5.034	12.482	65.501	1198.004
V09VEL145100	96801128	415.16	213.385	2.132	0.632	1	-6.506	5.105	-4.155	3.804	9.948	81.749	1498.364
V09WIN141310	64739169	471.292	165.374	1.991	0.566	1	-4.059	3.558	-4.057	2.896	10.536	81.959	722.891
V09ZWA148120	96514800	451.617	158.476	1.82	0.477	1	-5.289	5	-3.585	2.852	15.016	49.622	724.812
V10GLA086020	62621236	417.766	253.394	1.655	0.225	1	-7.846	4.499	-4.457	4.499	14.377	83.552	1503.004
V10GNE076999	3.6E+08	436.306	233.73	1.834	0.538	1	-5.951	2.377	-3.753	3	13.875	66.581	1622.999
V10KNE052000	5.85E+08	474.646	202.351	2.101	1.088	1	-6	0.779	-3.091	3	14.082	56.305	1103.01
V10MOP062140	77319091	426.358	210.633	2.181	0.688	1	-5.977	0.1	-4.157	3	10.648	62.237	667.199
V10WIM082050	65701200	446.852	145.607	1.969	0.551	1	-4.925	3.42	-3.635	3	11.004	88.592	872.115
W06RHOL54100	1.62E+08	482.876	156.593	1.958	0.466	1	-3.793	2.711	-3.433	2.064	11.917	88.245	739.98
W07DENLES004	5.12E+08	457.102	153.781	1.952	0.463	1	-4.693	1.091	-3.498	2.867	12.546	83.764	1085.747
W08SAMRON000	1.34E+08	502.86	162.74	1.938	0.521	1	-3.796	2.557	-3.703	3	13.187	85.807	1324.266
W08SENRON010	70364773	620.988	142.631	1.951	0.57	1	-3.897	2.642	-3.473	2.761	10.525	58.058	1183.917
W08SENTUB030	2.16E+08	456.473	189.157	2.389	1.227	1	-6.496	7.397	-4.059	4.511	14.235	55.639	1750.88
W11BER551010	1.28E+08	321.196	242.149	2.395	1.006	1	-6.038	6.777	-4.667	2.59	13.959	62.959	1223.534
W11HOY5990	2.42E+08	601.374	144.461	1.962	0.79	1	-5.439	5	-4.937	3	13.643	77.388	1193.899
W11JEK553010	4.65E+08	522.029	159.03	1.878	0.1	1	-4.016	0.558	-6	0.417	14.395	60.28	1101.528
W11MAAPROF	1.26E+10	447.896	192.092	3.049	2.133	1	-6	0	-3.723	3	14.274	69.697	1148.394
W11MEH5820	3.56E+08	396.67	169.923	20.35	0.447	1	-5.25	3.132	-4.245	2.919	12.366	82.495	1074.659
W11OUR5805	3.61E+09	472.913	134.841	2.252	1.646	1	-5.885	4.397	-3.127	3	11.825	70.318	752.44
W11SAM7319	2.64E+09	421.949	253.865	2.655	0.993	1	-6	0.29	-3.387	3	12.919	87.594	1836.688

Appendix 2 List of transferred parameters for ungauged catchments

Catchment	Associated gauged catchment	Area (m²)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
F01YSE468000	F01IJZ468000	361120000	398.4	206.3	2.95	1.20	1	-8.48	6.21	-4.65	5.00	13.4	105	1808
F05AAA000010	F05LEI386999	248452728	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05AAA571000	F05LEI386999	374113103	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05BEC386023	F05LEI386999	80086039	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05BEC386025	F05LEI386999	68930969	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05BOU386005	F05LEI386999	255392628	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05CLA386017	F05LEI386999	36547273	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05CLA386020	F05LEI386999	226006473	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386040	F05LEI386999	448818370	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386050	F05LEI386999	74083951	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386060	F05LEI386999	116669136	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386080	F05LEI386999	57192180	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386090	F05LEI386999	12829199	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386110	F05LEI386999	16919150	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386120	F05LEI386999	39450392	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386130	F05LEI386999	21724484	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386140	F05LEI386999	7480581	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386150	F05LEI386999	39193251	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386160	F05LEI386999	27005232	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05HEM000020	F05LEI386999	134010959	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LAW386018	F05LEI386999	102249474	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LAW386030	F05LEI386999	188699853	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LOI386035	F05LEI386999	113093218	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LYS386000	F05LEI386999	375288119	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LYS386010	F05LEI386999	73860338	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LYS386015	F05LEI386999	28126242	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LYS386115	F05LEI386999	168458564	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05MAR386070	F05LEI386999	200520118	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05MAR386100	F05LEI386999	26635692	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883

Catchment	Associated gauged catchment	Area (m²)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
F06BOS325000	F06BOS325001	775406341	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06BOS325015	F06BOS325001	107626587	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06BOS325016	F06BOS325001	142957003	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06BOS325017	F06BOS325001	33675779	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06BOS325018	F06BOS325001	16911203	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06BOS325019	F06BOS325001	36767530	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06ECA325050	F06BOS325001	191873673	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06ERC325030	F06BOS325001	167654904	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06HOG325070	F06BOS325001	208230656	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06RHO325060	F06BOS325001	80974476	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06SCA325020	F06BOS325001	464156652	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06SCA325025	F06BOS325001	805680274	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06SEL325040	F06BOS325001	201664095	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06SEN325010	F06BOS325001	599787214	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
N03BRA000160	W11BER551010	55104620	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
N11MAA000060	V09MOT144270	12970329080	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V01HAN000160	V01MAR496120	92888613	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V01HEI468010	F01IJZ468000	31890879	398.4	206.3	2.95	1.20	1	-8.48	6.21	-4.65	5.00	13.4	105	1808
V01IEP000090	V04MOL036110	3609701	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V01IEP000100	V05HEU403210	24028123	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V01IEP000110	V05HEU403210	6682382	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V01IJZ000020	V01KEM492060	46105467	426.1	164.2	2.40	1.76	1	-5.13	4.65	-2.98	3.00	14.4	70	476
V01KEM000070	V01KEM492060	12910514	426.1	164.2	2.40	1.76	1	-5.13	4.65	-2.98	3.00	14.4	70	476
V01MAR000130	V01MAR496120	27537367	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V01POP000040	V01MAR496120	34370958	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V01POP000050	V04MOL036110	14704818	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V01SSV000150	V01MAR496120	49650230	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V02AFL000140	V02EDE442120	20916085	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V02BRU000110	W11BER551010	5853310	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V02IVA000220	W08SAMRON000	23089888	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V02JAB000040	V02KER422030	24576621	379.3	312.6	2.71	0.99	1	-8.36	0.86	-5.04	5.00	16.6	67	1487
V02KAT000100	W08SAMRON000	11553682	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V02KGO000000	V03POE446000	159793077	402.3	213.4	3.32	1.15	1	-9.57	3.03	-5.79	4.98	12.7	76	945

Catchment	Associated gauged catchment	Area (m²)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V02KGO000080	V02EDE442120	11937762	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V02KWE000050	W08SAMRON000	16546999	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V02LPK000170	V02RIV425020	46643041	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V02LPK000180	W08SAMRON000	31449434	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V02LPK000190	W11BER551010	35092186	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V02MOE000160	V02EDE442120	44401888	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V02NOO000150	V02EDE442120	9234592	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V02NWG000210	W08SAMRON000	12358385	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V02RIV000070	V02EDE442120	5447570	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V02STE000090	V02KER422030	27293881	379.3	312.6	2.71	0.99	1	-8.36	0.86	-5.04	5.00	16.6	67	1487
V02STE000115	W11BER551010	17760000	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V02ZUI000060	V02RIV425020	24223288	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V02ZUI000130	V02RIV425020	45783008	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V02ZWI000200	W08SAMRON000	34471720	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V03AFL000010	V04MOL036110	41215066	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V03AFL000070	V02EDE442120	56667175	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03BOS000200	V02EDE442120	26155768	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03DUR000290	V02EDE442120	6434651	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03GEN000030	W08SAMRON000	38982516	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V03HON000250	V02EDE442120	20326328	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03KAL000020	V02RIV425020	43880593	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V03KAL000180	V02EDE442120	32685177	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03KEI000280	V02EDE442120	28337740	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03KGO000050	V02EDE442120	12903199	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03KGT000080	W11BER551010	46966621	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V03KGT000100	V05HEU403210	70017789	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V03KRU000120	V02EDE442120	5007912	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03LAN000190	V02EDE442120	14793221	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03LIE000060	V02EDE442120	9399755	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03LPK000130	V02EDE442120	40778180	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03LPK000140	V04MOM037100	50278956	532.4	159.9	1.98	0.83	1	-4.59	1.64	-2.82	2.43	11.7	62	933
V03MOP000260	V02EDE442120	31902535	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03RIE000040	V07MOG288020	6140607	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683

Catchment	Associated gauged catchment	Area (m^2)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V03ROD000110	V02EDE442120	6937269	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03SLE000090	V02RIV425020	44159840	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V03SPL000210	V02EDE442120	5101420	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03STE000240	V02EDE442120	10519358	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03VAL000220	V02EDE442120	19542165	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03WEE000230	V02EDE442120	24038269	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03ZSB000170	V03POE446000	37827245	402.3	213.4	3.32	1.15	1	-9.57	3.03	-5.79	4.98	12.7	76	945
V03ZWS000150	V02EDE442120	34937521	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V04BES000160	V06ZWA342190	184850804	448.2	168.1	2.11	1.42	1	-3.72	2.10	-4.12	2.99	14.3	60	707
V04BES000170	W11BER551010	18766706	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V04BES000180	W08SAMRON000	67663418	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V04BES000185	W11BER551010	28326405	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V04BES000190	V09DEM136000	361066506	477.6	260.4	1.93	0.45	1	-5.15	3.03	-3.95	2.73	15.0	56	1200
V04BES000200	V07MAR289015	180989113	410.7	170.8	2.23	0.92	1	-4.59	5.00	-4.35	2.89	10.8	58	1155
V04BES000210	W11BER551010	37352188	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V04DUR000080	V04MOL036110	13115959	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V04DUR000090	V09MOT144270	12911826	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V04LED000045	V02EDE442120	10731840	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V04LEDBOR040	V02EDE442120	33815271	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V04LOK000060	V09MOT144270	12937291	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V04RUP000150	W08SAMRON000	28627814	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V04SCH000000	V09MOT144270	21348172	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V04SCH000010	V09HER163010	232467654	499.4	168.0	1.97	0.56	1	-6.00	5.00	-4.03	3.00	14.7	59	916
V04SCH000020	V03POE446000	42342683	402.3	213.4	3.32	1.15	1	-9.57	3.03	-5.79	4.98	12.7	76	945
V04SCH000030	V09WIN141310	55558393	471.3	165.4	1.99	0.57	1	-4.06	3.56	-4.06	2.90	10.5	82	723
V04SCH000070	V09HER163010	97843094	499.4	168.0	1.97	0.56	1	-6.00	5.00	-4.03	3.00	14.7	59	916
V04VLI000140	V09MAN161040	65737530	418.7	156.7	1.89	0.71	1	-4.23	4.03	-3.29	0.83	13.2	87	1050
V04ZEL000050	V04MOL036110	24207851	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V04ZIE000120	V04MOL036110	52125854	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V04ZWA000130	V08BAR111370	20223736	409.7	286.7	2.10	0.65	1	-5.93	0.95	-3.69	3.00	15.0	75	1223
V05GAV000260	V05HEU403210	137842273	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V05GEL000200	V05HEU403210	47783349	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V05HEU000220	V09MOT144270	16883706	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198

Catchment	Associated gauged catchment	Area (m^2)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V05LEI000190	V01KEM492060	108826195	426.1	164.2	2.40	1.76	1	-5.13	4.65	-2.98	3.00	14.4	70	476
V05LEI000240	V09MOT144270	21304814	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V05LEI000250	V09MOT144270	29836282	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V05LEI000280	V03POE446000	97730942	402.3	213.4	3.32	1.15	1	-9.57	3.03	-5.79	4.98	12.7	76	945
V05LEI000290	V02EDE442120	47172616	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V05LEI000300	V02RIV425020	39155357	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V05LEI386180	F05LEI386999	82706606	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
V05MAN000270	V01SSV499140	13017615	431.6	175.3	2.17	1.09	1	-4.53	5.00	-3.89	2.98	12.5	52	719
V06BEI000150	V07MOG288020	19134016	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V06KBK000130	W08SAMRON000	8261974	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V06MAA000170	V07MOG288020	4955439	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V06SCH000140	V07BEL285070	56084506	445.8	216.2	2.12	0.67	1	-5.35	4.52	-4.95	4.58	14.3	63	1157
V06SCH000180	W08SAMRON000	87618176	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V06SCH000210	V05HEU403210	81083174	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V06SCH000220	V02HER426010	77342171	474.9	246.1	2.35	0.78	1	-7.48	4.17	-4.44	4.35	10.4	73	1318
V06ZWA000200	V09MOT144270	867129	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V07BEL000080	V04MOL036110	11538072	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V07DEN000025	V07MOG288020	27908996	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V07DEN000060	V01MAR496120	73022161	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V07DEN000110	V05HEU403210	97824902	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V07GRA000090	V09MOT144270	28283573	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V07MOE000120	V07MOG288020	8585990	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V07MOL000030	V08BAR111370	53711139	409.7	286.7	2.10	0.65	1	-5.93	0.95	-3.69	3.00	15.0	75	1223
V07MOL000050	V07MOE282100	52610014	350.4	161.8	3.41	2.22	1	-6.67	10.00	-5.38	3.61	16.5	82	1340
V07MOL000130	V09MOT144270	22215247	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V07WOL000040	V05HEU403210	49430997	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V08AAB000360	V01MAR496120	60451204	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V08BEY000240	V09MOT144270	6114323	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08BRO000175	V07MOG288020	6262734	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08BRU000180	W11BER551010	16024099	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08DIJ000430	V04MOL036110	16839367	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V08DIJ000455	V09MOT144270	9419886	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08DRO000230	V07MOG288020	1754271	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683

Catchment	Associated gauged catchment	Area (m^2)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V08GLA000450	V09MOT144270	29900000	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08GRO000070	W11BER551010	13748809	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08HAL000080	W11BER551010	10431011	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08HAR000250	W11BER551010	4183063	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08HER000120	V07MOG288020	15606705	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08LEI000420	V04MOL036110	61999329	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V08LOB000300	W11BER551010	1727027	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08LOT000110	W08SAMRON000	16677869	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V08MAA000190	W11BER551010	25513368	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08MAA000320	V07BEL285070	41562062	445.8	216.2	2.12	0.67	1	-5.35	4.52	-4.95	4.58	14.3	63	1157
V08MAR000270	W11BER551010	2655242	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08MEC000390	V04MOL036110	2184480	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V08MEC000440	V04MOL036110	21167200	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V08MOB000090	V08BAR111370	52906589	409.7	286.7	2.10	0.65	1	-5.93	0.95	-3.69	3.00	15.0	75	1223
V08MOJ000220	W11BER551010	24744883	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08NEE000140	V07MOG288020	24418401	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08PAR000210	V07MOG288020	10526023	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08SAS000350	V09MOT144270	11122038	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08STA000060	V07MOG288020	8939127	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08TAN000290	W11BER551010	8645642	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08TAN000330	W11BER551010	1728251	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08TAN000340	W11BER551010	4308051	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08TRA000280	W11BER551010	6403090	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08UKK000160	V09MOT144270	16556510	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08VIL000310	W11BER551010	2859650	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08VLE000150	W11BER551010	4942825	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08VOR000170	W11BER551010	4176350	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08VRO000460	V10MOP062140	125593344	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V08VUN000435	V09MOT144270	25988270	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08WEE000410	V09MOT144270	68292349	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08WOL000260	W11BER551010	46369269	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08WOLBRU200	V09WIN141310	49508996	471.3	165.4	1.99	0.57	1	-4.06	3.56	-4.06	2.90	10.5	82	723
V08ZUU000130	V07BEL285070	25927026	445.8	216.2	2.12	0.67	1	-5.35	4.52	-4.95	4.58	14.3	63	1157

Catchment	Associated gauged catchment	Area (m²)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V09ALB000010	V09MOT144270	9868911	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09ALB000020	V09MOT144270	678840	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09BEG000160	V09MOT144270	52288450	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09DEM000030	V09MAN161040	111804714	418.7	156.7	1.89	0.71	1	-4.23	4.03	-3.29	0.83	13.2	87	1050
V09DEM000050	W11OUR5805	17224252	472.9	134.8	2.25	1.65	1	-5.89	4.40	-3.13	3.00	11.8	70	752
V09DEM000070	W11BER551010	15263780	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V09GLA000240	V09MOT144270	13893219	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09HEI000290	V09MOT144270	11779955	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09HER000060	V09MOT144270	17904828	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09HER000075	V09MOT144270	4063569	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09HUL000170	V04MOL036110	10167667	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V09LAA000220	V09MOT144270	4843899	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09LEI000180	V09MOT144270	2290158	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09LEU000155	V07MOG288020	8272837	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V09MAN000130	V09MOT144270	2369062	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09MOT000260	V09MOT144270	8633853	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09MOU000280	W11BER551010	4720981	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V09OSS000230	V09MOT144270	12017257	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09VEL000110	V09MOT144270	44224342	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09VOO000090	V09MOT144270	14913966	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09VOS000200	V09MOT144270	6343660	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09WER000250	V04MOL036110	3447994	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V09WIJ000190	V09MOT144270	6951100	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09WIN000320	V09MOT144270	17375263	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09ZWA000140	V09MOT144270	24807586	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09ZWA000210	V10MOP062140	19313232	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10ALB076015	V10GNE076999	24539871	436.3	233.7	1.83	0.54	1	-5.95	2.38	-3.75	3.00	13.9	67	1623
V10BER000100	V09MOT144270	28572454	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V10BEV000120	V10MOP062140	26918434	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10GES000130	V09MOT144270	42189781	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V10GNE076010	V10GNE076999	243532847	436.3	233.7	1.83	0.54	1	-5.95	2.38	-3.75	3.00	13.9	67	1623
V10GOO000080	V10MOP062140	44302117	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10KLA076030	V10GNE076999	54041574	436.3	233.7	1.83	0.54	1	-5.95	2.38	-3.75	3.00	13.9	67	1623

Catchment	Associated gauged catchment	Area (m^2)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V10KRE000110	V09MAN161040	53928737	418.7	156.7	1.89	0.71	1	-4.23	4.03	-3.29	0.83	13.2	87	1050
V10MOL000060	V09ZWA148120	40694619	451.6	158.5	1.82	0.48	1	-5.29	5.00	-3.59	2.85	15.0	50	725
V10MOP000150	V10MOP062140	32418924	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10NET000170	V10MOP062140	66664720	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10NET000180	V09MAN161040	80302347	418.7	156.7	1.89	0.71	1	-4.23	4.03	-3.29	0.83	13.2	87	1050
V10ROL000040	V09ZWA148120	23571007	451.6	158.5	1.82	0.48	1	-5.29	5.00	-3.59	2.85	15.0	50	725
V10STE000070	V09ZWA148120	42571635	451.6	158.5	1.82	0.48	1	-5.29	5.00	-3.59	2.85	15.0	50	725
V10TAP000160	V10MOP062140	46191820	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10WIM000090	V09MOT144270	29330881	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V11ALB000045	W11BER551010	44990800	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V11MAA508050	V10KNE052000	837912122	474.6	202.4	2.10	1.09	1	-6.00	0.78	-3.09	3.00	14.1	56	1103
V11VOE000010	V09VEL145100	59555900	415.2	213.4	2.13	0.63	1	-6.51	5.11	-4.16	3.80	9.9	82	1498
V11WIL508055	V09DEM136000	21849142	477.6	260.4	1.93	0.45	1	-5.15	3.03	-3.95	2.73	15.0	56	1200
W05LYS386170	F05LEI386999	91812026	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
W06BOS325095	F06BOS325001	256772308	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06BOS325105	F06BOS325001	226789872	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06BOS325115	F06BOS325001	111071545	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06HAI325080	F06BOS325001	275201697	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06HAI325085	F06BOS325001	241293103	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06HAI325090	F06BOS325001	273091288	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06HAY000110	V05HEU403210	64102892	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
W06RHO000120	V09MOT144270	7595336	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
W07DENLES010	W07DENOVB005	271049169	457.1	153.8	1.95	0.46	1	-4.69	1.09	-3.50	2.87	12.5	84	1086
W07DOCLES000	W07DENOVB005	127972527	457.1	153.8	1.95	0.46	1	-4.69	1.09	-3.50	2.87	12.5	84	1086
W07DORLES005	W07DENOVB005	196976608	457.1	153.8	1.95	0.46	1	-4.69	1.09	-3.50	2.87	12.5	84	1086
W08HAI000050	V07BEL285070	80826978	445.8	216.2	2.12	0.67	1	-5.35	4.52	-4.95	4.58	14.3	63	1157
W08SEN000020	W08SAMRON000	53081078	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
W08ZEN000040	V07MOG288020	19240238	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
W11IJEK553010	W11MEH5820	463411008	396.7	169.9	2.04	0.45	1	-5.25	3.13	-4.25	2.92	12.4	82	1075
W11MAA0030	W11MEH5820	503217000	396.7	169.9	2.04	0.45	1	-5.25	3.13	-4.25	2.92	12.4	82	1075
W11MAA0040	W11MEH5820	370820000	396.7	169.9	2.04	0.45	1	-5.25	3.13	-4.25	2.92	12.4	82	1075
W11SAM0000	W08SAMRON000	178620000	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324

Catchment	Associated gauged catchment	Area (m²)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
F01YSE468000	F01IJZ468000	361120000	398.4	206.3	2.95	1.20	1	-8.48	6.21	-4.65	5.00	13.4	105	1808
F05AAA000010	F05LEI386999	248452728	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05AAA571000	F05LEI386999	374113103	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05BEC386023	F05LEI386999	80086039	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05BEC386025	F05LEI386999	68930969	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05BOU386005	F05LEI386999	255392628	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05CLA386017	F05LEI386999	36547273	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05CLA386020	F05LEI386999	226006473	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386040	F05LEI386999	448818370	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386050	F05LEI386999	74083951	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386060	F05LEI386999	116669136	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386080	F05LEI386999	57192180	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386090	F05LEI386999	12829199	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386110	F05LEI386999	16919150	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386120	F05LEI386999	39450392	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386130	F05LEI386999	21724484	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386140	F05LEI386999	7480581	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386150	F05LEI386999	39193251	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05DEU386160	F05LEI386999	27005232	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05HEM000020	F05LEI386999	134010959	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LAW386018	F05LEI386999	102249474	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LAW386030	F05LEI386999	188699853	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LOI386035	F05LEI386999	113093218	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LYS386000	F05LEI386999	375288119	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LYS386010	F05LEI386999	75860338	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LYS386015	F05LEI386999	28126242	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05LYS386115	F05LEI386999	168458564	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05MAR386070	F05LEI386999	200520118	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F05MAR386100	F05LEI386999	26635692	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
F06BOS325000	F06BOS325001	775406341	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06BOS325015	F06BOS325001	107626587	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06BOS325016	F06BOS325001	142957003	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060

Catchment	Associated gauged catchment	Area (m^2)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
F06BOS325017	F06BOS325001	33675779	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06BOS325018	F06BOS325001	16911203	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06BOS325019	F06BOS325001	36767530	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06ECA325050	F06BOS325001	191873673	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06ERC325030	F06BOS325001	167654904	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06HOG325070	F06BOS325001	208230636	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06RHO325060	F06BOS325001	80974476	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06SCA325020	F06BOS325001	464156652	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06SCA325025	F06BOS325001	805680274	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06SEL325040	F06BOS325001	201664095	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
F06SEN325010	F06BOS325001	599787214	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
N03BRA000160	W11BER551010	55104620	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
N11MAA000060	V09MOT144270	12970329080	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V01HAN000160	V01MAR496120	92888613	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V01HEI468010	F01IJZ468000	31890879	398.4	206.3	2.95	1.20	1	-8.48	6.21	-4.65	5.00	13.4	105	1808
V01IEP000090	V04MOL036110	3609701	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V01IEP000100	V05HEU403210	24028123	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V01IEP000110	V05HEU403210	6682382	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V01IJZ000020	V01KEM492060	46105467	426.1	164.2	2.40	1.76	1	-5.13	4.65	-2.98	3.00	14.4	70	476
V01KEM000070	V01KEM492060	12910514	426.1	164.2	2.40	1.76	1	-5.13	4.65	-2.98	3.00	14.4	70	476
V01MAR000130	V01MAR496120	27537367	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V01POP000040	V01MAR496120	34370958	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V01POP000050	V04MOL036110	14704818	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V01SSV000150	V01MAR496120	49650230	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V02AFL000140	V02EDE442120	20916085	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V02BRU000110	W11BER551010	5853310	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V02IVA000220	W08SAMRON000	23089888	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V02JAB000040	V02KER422030	24576621	379.3	312.6	2.71	0.99	1	-8.36	0.86	-5.04	5.00	16.6	67	1487
V02KAT000100	W08SAMRON000	11553682	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V02KGO000000	V03POE446000	159793077	402.3	213.4	3.32	1.15	1	-9.57	3.03	-5.79	4.98	12.7	76	945
V02KGO000080	V02EDE442120	11937762	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V02KWE000050	W08SAMRON000	16546999	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V02LPK000170	V02RIV425020	46643041	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497

Catchment	Associated gauged catchment	Area (m^2)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V02LPK000180	W08SAMRON000	31449434	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V02LPK000190	W11BER551010	35092186	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V02MOE000160	V02EDE442120	44401888	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V02NOO000150	V02EDE442120	9234592	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V02NWG000210	W08SAMRON000	12358385	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V02RIV000070	V02EDE442120	5447570	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V02STE000090	V02KER422030	27293881	379.3	312.6	2.71	0.99	1	-8.36	0.86	-5.04	5.00	16.6	67	1487
V02STE000115	W11BER551010	17760000	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V02ZUI000060	V02RIV425020	24223288	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V02ZUI000130	V02RIV425020	45783008	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V02ZWI000200	W08SAMRON000	34471720	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V03AFL000010	V04MOL036110	41215066	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V03AFL000070	V02EDE442120	56667175	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03BOS000200	V02EDE442120	26155768	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03DUR000290	V02EDE442120	6434651	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03GEN000030	W08SAMRON000	38982516	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V03HON000250	V02EDE442120	20326328	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03KAL000020	V02RIV425020	43880593	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V03KAL000180	V02EDE442120	32685177	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03KEI000280	V02EDE442120	28337740	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03KGO000050	V02EDE442120	12903199	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03KGT000080	W11BER551010	46966621	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V03KGT000100	V05HEU403210	70017789	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V03KRU000120	V02EDE442120	5007912	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03LAN000190	V02EDE442120	14793221	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03LIE000060	V02EDE442120	9399755	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03LPK000130	V02EDE442120	40778180	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03LPK000140	V04MOM037100	50278956	532.4	159.9	1.98	0.83	1	-4.59	1.64	-2.82	2.43	11.7	62	933
V03MOP000260	V02EDE442120	31902535	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03RIE000040	V07MOG288020	6140607	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V03ROD000110	V02EDE442120	6937269	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03SLE000090	V02RIV425020	44159840	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V03SPL000210	V02EDE442120	5101420	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875

Catchment	Associated gauged catchment	Area (m^2)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V03STE000240	V02EDE442120	10519358	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03VAL000220	V02EDE442120	19542165	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03WEE000230	V02EDE442120	24038269	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V03ZSB000170	V03POE446000	37827245	402.3	213.4	3.32	1.15	1	-9.57	3.03	-5.79	4.98	12.7	76	945
V03ZWS000150	V02EDE442120	34937521	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V04BES000160	V06ZWA342190	184850804	448.2	168.1	2.11	1.42	1	-3.72	2.10	-4.12	2.99	14.3	60	707
V04BES000170	W11BER551010	18766706	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V04BES000180	W08SAMRON000	67663418	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V04BES000185	W11BER551010	28326405	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V04BES000190	V09DEM136000	361066506	477.6	260.4	1.93	0.45	1	-5.15	3.03	-3.95	2.73	15.0	56	1200
V04BES000200	V07MAR289015	180989113	410.7	170.8	2.23	0.92	1	-4.59	5.00	-4.35	2.89	10.8	58	1155
V04BES000210	W11BER551010	37352188	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V04DUR000080	V04MOL036110	13115959	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V04DUR000090	V09MOT144270	12911826	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V04LED000045	V02EDE442120	10731840	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V04LEDBOR040	V02EDE442120	33815271	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V04LOK000060	V09MOT144270	12937291	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V04RUP000150	W08SAMRON000	28627814	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V04SCH000000	V09MOT144270	21348172	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V04SCH000010	V09HER163010	232467654	499.4	168.0	1.97	0.56	1	-6.00	5.00	-4.03	3.00	14.7	59	916
V04SCH000020	V03POE446000	42342683	402.3	213.4	3.32	1.15	1	-9.57	3.03	-5.79	4.98	12.7	76	945
V04SCH000030	V09WIN141310	55558393	471.3	165.4	1.99	0.57	1	-4.06	3.56	-4.06	2.90	10.5	82	723
V04SCH000070	V09HER163010	97843094	499.4	168.0	1.97	0.56	1	-6.00	5.00	-4.03	3.00	14.7	59	916
V04VLI000140	V09MAN161040	65737530	418.7	156.7	1.89	0.71	1	-4.23	4.03	-3.29	0.83	13.2	87	1050
V04ZEL000050	V04MOL036110	24207851	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V04ZIE000120	V04MOL036110	52125854	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V04ZWA000130	V08BAR111370	20223736	409.7	286.7	2.10	0.65	1	-5.93	0.95	-3.69	3.00	15.0	75	1223
V05GAV000260	V05HEU403210	137842273	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V05GEL000200	V05HEU403210	47783349	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V05HEU000220	V09MOT144270	16883706	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V05LEI000190	V01KEM492060	108826195	426.1	164.2	2.40	1.76	1	-5.13	4.65	-2.98	3.00	14.4	70	476
V05LEI000240	V09MOT144270	21304814	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V05LEI000250	V09MOT144270	29836282	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198

Catchment	Associated gauged catchment	Area (m^2)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V05LEI000280	V03POE446000	97730942	402.3	213.4	3.32	1.15	1	-9.57	3.03	-5.79	4.98	12.7	76	945
V05LEI000290	V02EDE442120	47172616	432.4	198.3	2.93	1.04	1	-7.89	6.92	-5.74	4.96	13.2	72	875
V05LEI000300	V02RIV425020	39155357	406.9	200.9	2.16	0.74	1	-6.02	3.10	-3.54	3.61	14.9	67	1497
V05LEI386180	F05LEI386999	82706606	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
V05MAN000270	V01SSV499140	13017615	431.6	175.3	2.17	1.09	1	-4.53	5.00	-3.89	2.98	12.5	52	719
V06BEI000150	V07MOG288020	19134016	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V06KBK000130	W08SAMRON000	8261974	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V06MAA000170	V07MOG288020	4955439	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V06SCH000140	V07BEL285070	56084506	445.8	216.2	2.12	0.67	1	-5.35	4.52	-4.95	4.58	14.3	63	1157
V06SCH000180	W08SAMRON000	87618176	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V06SCH000210	V05HEU403210	81083174	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V06SCH000220	V02HER426010	77342171	474.9	246.1	2.35	0.78	1	-7.48	4.17	-4.44	4.35	10.4	73	1318
V06ZWA000200	V09MOT144270	867129	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V07BEL000080	V04MOL036110	11538072	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V07DEN000025	V07MOG288020	27908996	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V07DEN000060	V01MAR496120	73022161	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V07DEN000110	V05HEU403210	97824902	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V07GRA000090	V09MOT144270	28283573	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V07MOE000120	V07MOG288020	8585990	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V07MOL000030	V08BAR111370	53711139	409.7	286.7	2.10	0.65	1	-5.93	0.95	-3.69	3.00	15.0	75	1223
V07MOL000050	V07MOE282100	52610014	350.4	161.8	3.41	2.22	1	-6.67	10.00	-5.38	3.61	16.5	82	1340
V07MOL000130	V09MOT144270	22215247	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V07WOL000040	V05HEU403210	49430997	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
V08AAB000360	V01MAR496120	60451204	396.8	281.0	3.24	1.14	1	-7.32	4.95	-5.38	4.99	13.4	80	1068
V08BEY000240	V09MOT144270	6114323	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08BRO000175	V07MOG288020	6262734	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08BRU000180	W11BER551010	16024099	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08DIJ000430	V04MOL036110	16839367	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V08DIJ000455	V09MOT144270	9419886	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08DRO000230	V07MOG288020	1754271	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08GLA000450	V09MOT144270	29900000	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08GRO000070	W11BER551010	13748809	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08HAL000080	W11BER551010	10431011	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224

Catchment	Associated gauged catchment	Area (m^2)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V08HAR000250	W11BER551010	4183063	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08HER000120	V07MOG288020	15606705	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08LEI000420	V04MOL036110	61999329	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V08LOB000300	W11BER551010	1727027	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08LOT000110	W08SAMRON000	16677869	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
V08MAA000190	W11BER551010	25513368	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08MAA000320	V07BEL285070	41562062	445.8	216.2	2.12	0.67	1	-5.35	4.52	-4.95	4.58	14.3	63	1157
V08MAR000270	W11BER551010	2655242	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08MEC000390	V04MOL036110	2184480	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V08MEC000440	V04MOL036110	21167200	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V08MOB000090	V08BAR111370	52906589	409.7	286.7	2.10	0.65	1	-5.93	0.95	-3.69	3.00	15.0	75	1223
V08MOJ000220	W11BER551010	24744883	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08NEE000140	V07MOG288020	24418401	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08PAR000210	V07MOG288020	10526023	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08SAS000350	V09MOT144270	11122038	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08STA000060	V07MOG288020	8939127	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V08TAN000290	W11BER551010	8645642	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08TAN000330	W11BER551010	1728251	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08TAN000340	W11BER551010	4308051	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08TRA000280	W11BER551010	6403090	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08UKK000160	V09MOT144270	16556510	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08VIL000310	W11BER551010	2859650	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08VLE000150	W11BER551010	4942825	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08VOR000170	W11BER551010	4176350	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08VRO000460	V10MOP062140	125593344	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V08VUN000435	V09MOT144270	25988270	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08WEE000410	V09MOT144270	68292349	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V08WOL000260	W11BER551010	46369269	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V08WOLBRU200	V09WIN141310	49508996	471.3	165.4	1.99	0.57	1	-4.06	3.56	-4.06	2.90	10.5	82	723
V08ZUU000130	V07BEL285070	25927026	445.8	216.2	2.12	0.67	1	-5.35	4.52	-4.95	4.58	14.3	63	1157
V09ALB000010	V09MOT144270	9868911	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09ALB000020	V09MOT144270	678840	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09BEG000160	V09MOT144270	52288450	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198

Catchment	Associated gauged catchment	Area (m^2)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V09DEM000030	V09MAN161040	111804714	418.7	156.7	1.89	0.71	1	-4.23	4.03	-3.29	0.83	13.2	87	1050
V09DEM000050	W11OUR5805	17224252	472.9	134.8	2.25	1.65	1	-5.89	4.40	-3.13	3.00	11.8	70	752
V09DEM000070	W11BER551010	15263780	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V09GLA000240	V09MOT144270	13893219	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09HEI000290	V09MOT144270	11779955	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09HER000060	V09MOT144270	17904828	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09HER000075	V09MOT144270	4063569	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09HUL000170	V04MOL036110	10167667	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V09LAA000220	V09MOT144270	4843899	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09LEI000180	V09MOT144270	2290158	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09LEU000155	V07MOG288020	8272837	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
V09MAN000130	V09MOT144270	2369062	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09MOT000260	V09MOT144270	8633853	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09MOU000280	W11BER551010	4720981	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V09OSS000230	V09MOT144270	12017257	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09VEL000110	V09MOT144270	44224342	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09VOO000090	V09MOT144270	14913966	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09VOS000200	V09MOT144270	6343660	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09WER000250	V04MOL036110	3447994	413.6	248.1	2.16	0.66	1	-9.38	3.15	-4.55	4.33	12.4	29	1199
V09WIJ000190	V09MOT144270	6951100	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09WIN000320	V09MOT144270	17375263	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09ZWA000140	V09MOT144270	24807586	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V09ZWA000210	V10MOP062140	19313232	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10ALB076015	V10GNE076999	24539871	436.3	233.7	1.83	0.54	1	-5.95	2.38	-3.75	3.00	13.9	67	1623
V10BER000100	V09MOT144270	28572454	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V10BEV000120	V10MOP062140	26918434	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10GES000130	V09MOT144270	42189781	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V10GNE076010	V10GNE076999	243532847	436.3	233.7	1.83	0.54	1	-5.95	2.38	-3.75	3.00	13.9	67	1623
V10GOO000080	V10MOP062140	44302117	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10KLA076030	V10GNE076999	54041574	436.3	233.7	1.83	0.54	1	-5.95	2.38	-3.75	3.00	13.9	67	1623
V10KRE000110	V09MAN161040	53928737	418.7	156.7	1.89	0.71	1	-4.23	4.03	-3.29	0.83	13.2	87	1050
V10MOL000060	V09ZWA148120	40694619	451.6	158.5	1.82	0.48	1	-5.29	5.00	-3.59	2.85	15.0	50	725
V10MOP000150	V10MOP062140	32418924	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667

Catchment	Associated gauged catchment	Area (m²)	SMmax	SMevap	c1	c2	c3	cOF1	cOF2	cIF1	cIF2	CKOF	CKIF	CKBF
V10NET000170	V10MOP062140	66664720	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10NET000180	V09MAN161040	80302347	418.7	156.7	1.89	0.71	1	-4.23	4.03	-3.29	0.83	13.2	87	1050
V10ROL000040	V09ZWA148120	23571007	451.6	158.5	1.82	0.48	1	-5.29	5.00	-3.59	2.85	15.0	50	725
V10STE000070	V09ZWA148120	42571635	451.6	158.5	1.82	0.48	1	-5.29	5.00	-3.59	2.85	15.0	50	725
V10TAP000160	V10MOP062140	46191820	426.4	210.6	2.18	0.69	1	-5.98	0.10	-4.16	3.00	10.6	62	667
V10WIM000090	V09MOT144270	29330881	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
V11ALB000045	W11BER551010	44990800	321.2	242.1	2.40	1.01	1	-6.04	6.78	-4.67	2.59	14.0	63	1224
V11MAA508050	V10KNE052000	837912122	474.6	202.4	2.10	1.09	1	-6.00	0.78	-3.09	3.00	14.1	56	1103
V11VOE000010	V09VEL145100	59555900	415.2	213.4	2.13	0.63	1	-6.51	5.11	-4.16	3.80	9.9	82	1498
V11WIL508055	V09DEM136000	21849142	477.6	260.4	1.93	0.45	1	-5.15	3.03	-3.95	2.73	15.0	56	1200
W05LYS386170	F05LEI386999	91812026	424.0	233.4	2.11	0.83	1	-5.76	1.92	-3.61	3.00	13.9	46	883
W06BOS325095	F06BOS325001	256772308	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06BOS325105	F06BOS325001	226789872	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06BOS325115	F06BOS325001	111071545	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06HAI325080	F06BOS325001	275201697	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06HAI325085	F06BOS325001	241293103	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06HAI325090	F06BOS325001	273091288	435.3	176.4	1.98	0.54	1	-5.65	2.18	-3.81	2.87	12.8	61	1060
W06HAY000110	V05HEU403210	64102892	325.8	206.2	3.28	1.09	1	-5.91	1.77	-3.98	3.00	12.1	78	700
W06RHO000120	V09MOT144270	7595336	473.2	168.3	1.95	0.78	1	-5.02	4.77	-3.91	5.03	12.5	66	1198
W07DENLES010	W07DENOVB005	271049169	457.1	153.8	1.95	0.46	1	-4.69	1.09	-3.50	2.87	12.5	84	1086
W07DOCLES000	W07DENOVB005	127972527	457.1	153.8	1.95	0.46	1	-4.69	1.09	-3.50	2.87	12.5	84	1086
W07DORLES005	W07DENOVB005	196976608	457.1	153.8	1.95	0.46	1	-4.69	1.09	-3.50	2.87	12.5	84	1086
W08HAI000050	V07BEL285070	80826978	445.8	216.2	2.12	0.67	1	-5.35	4.52	-4.95	4.58	14.3	63	1157
W08SEN000020	W08SAMRON000	53081078	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324
W08ZEN000040	V07MOG288020	19240238	538.0	193.1	2.12	0.58	1	-5.35	4.92	-4.25	2.99	14.1	61	683
W11IJEK553010	W11MEH5820	463411008	396.7	169.9	2.04	0.45	1	-5.25	3.13	-4.25	2.92	12.4	82	1075
W11MAA0030	W11MEH5820	503217000	396.7	169.9	2.04	0.45	1	-5.25	3.13	-4.25	2.92	12.4	82	1075
W11MAA0040	W11MEH5820	370820000	396.7	169.9	2.04	0.45	1	-5.25	3.13	-4.25	2.92	12.4	82	1075
W11SAM0000	W08SAMRON000	178620000	502.9	162.7	1.94	0.52	1	-3.80	2.56	-3.70	3.00	13.2	86	1324

Appendix 3 Ijzer

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "F01IJZ468000" (IJZER)

1.1 Input data

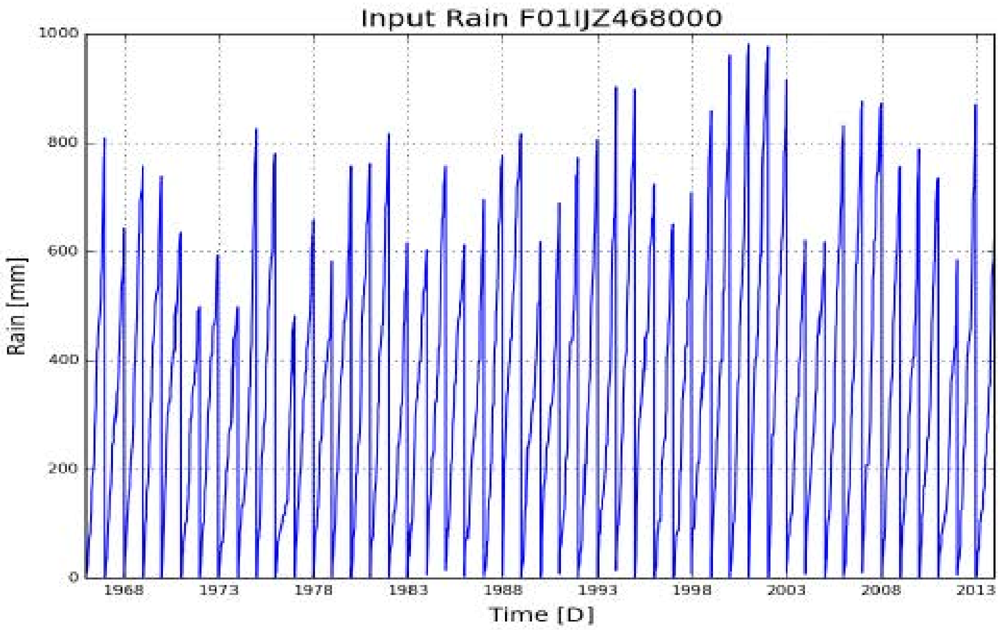


Figure 1: Cumulative precipitation on catchment F01IJZ468000 (IJzer)

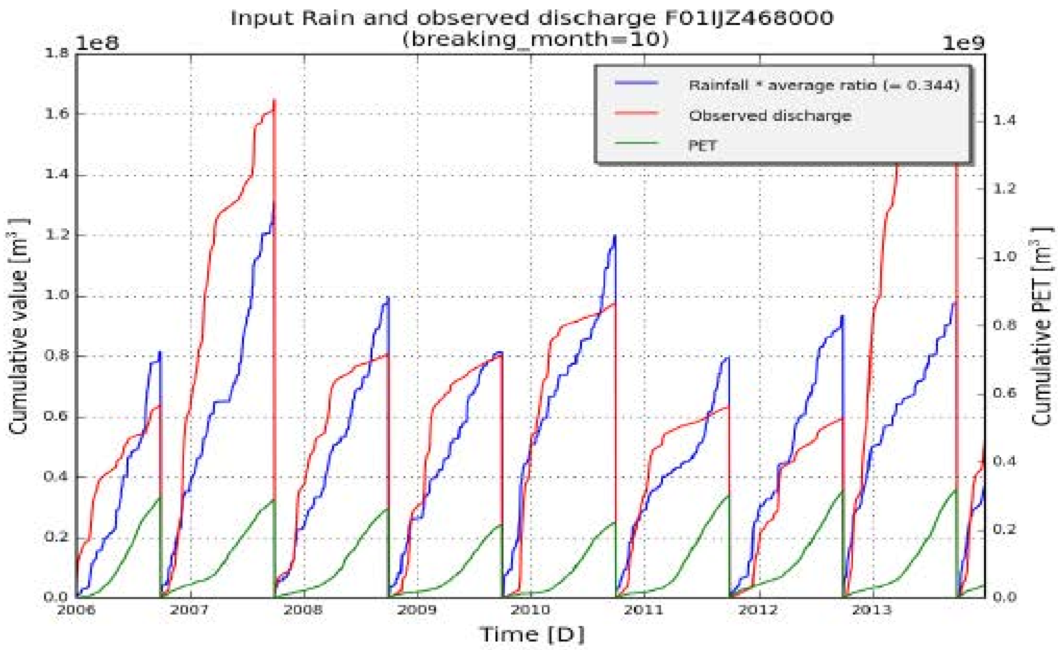


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment F01IJZ468000 (IJzer)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	F01IJZ468000
subcatchment_area [m2]	393007000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 398.42), ('SMevap', 206.26), ('c1', 2.95), ('c2', 1.2), ('c3', 1.0), ('cOF1', -8.48), ('cOF2', 6.21), ('cIF1', -4.65), ('cIF2', 5.0), ('CQOF', 13.4), ('CKIF', 105.23), ('CKBF', 1807.63)]

Table 1: Goodness of fit for calibration period (2005 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-3.2 %	43.8 %	-15.2 %
NS	0.605	0.466	0.563
NS_log	0.522	-0.629	0.687
NS_rel	0.091	0.358	0.179
KGE	0.527	0.385	0.462

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	7.5 %	26.1 %	0.6 %
NS	0.698	0.442	0.73
NS_log	0.529	-0.23	0.704
NS_rel	-0.061	0.061	0.134
KGE	0.659	0.491	0.685

1.3 Observed and simulated timeseries for optimum parameters

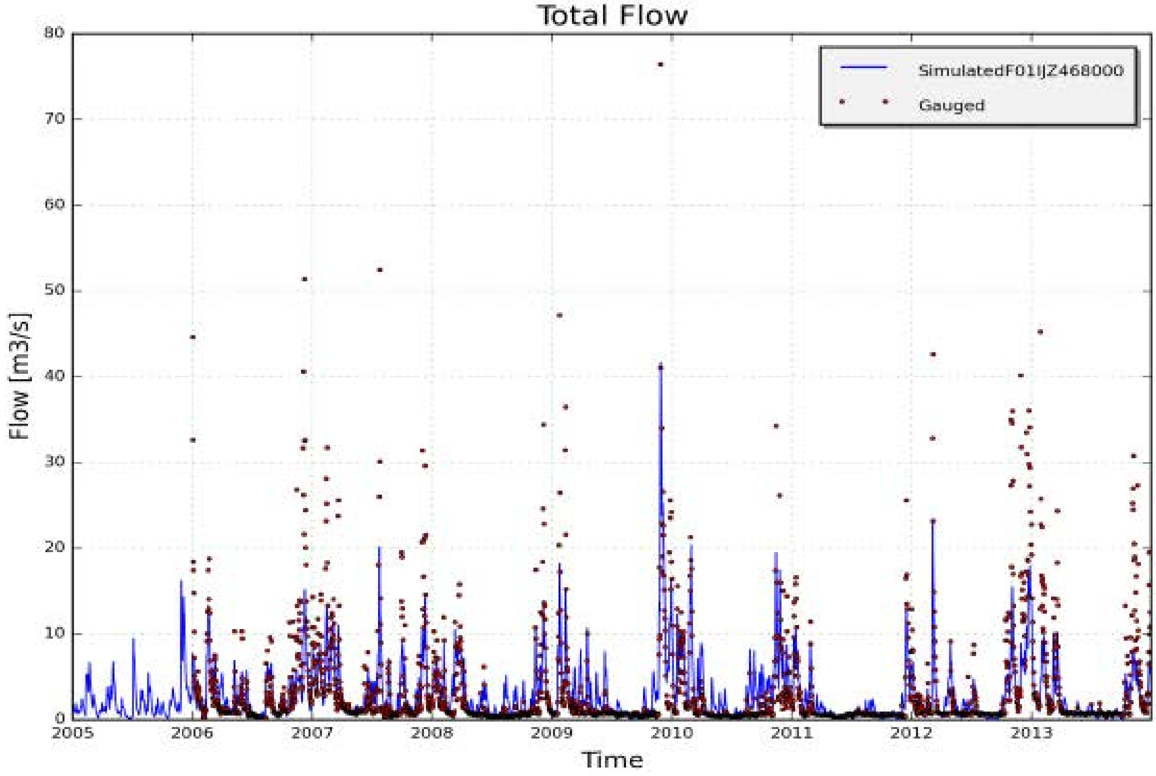


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment F01IJZ468000, station 46810102 - Ijzer; Haringe(calibration period)

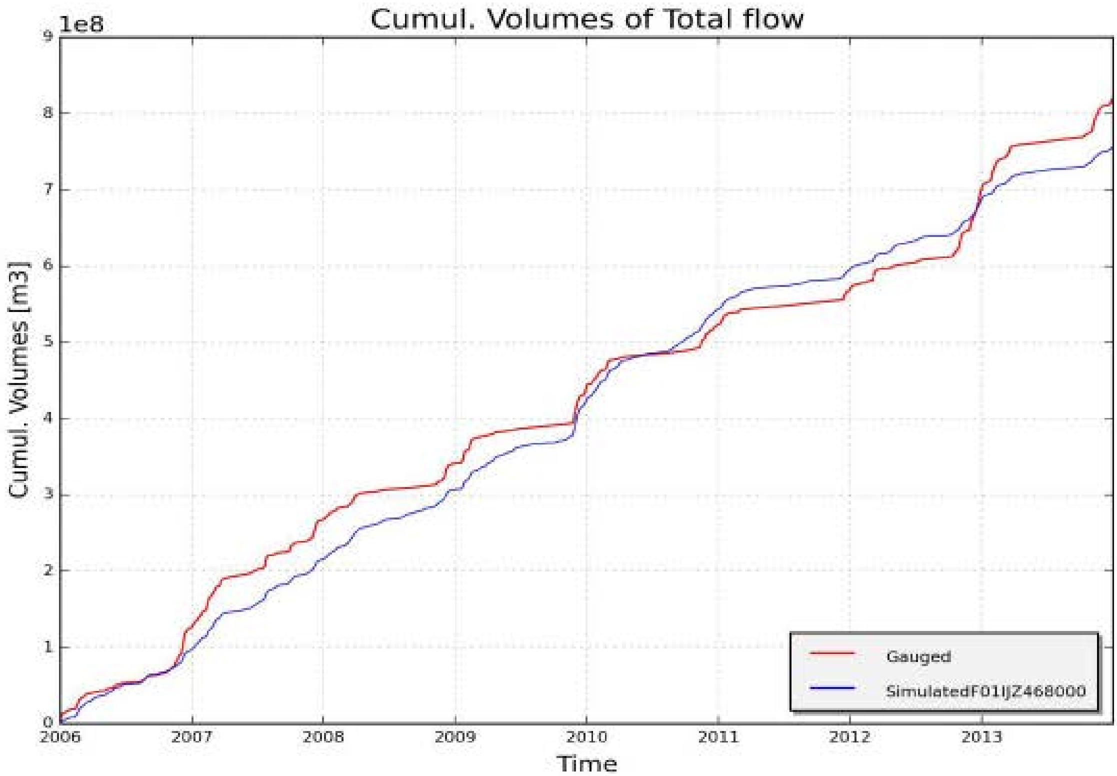


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment F01IJZ468000, station 46810102 - Ijzer; Haringe (calibration period)

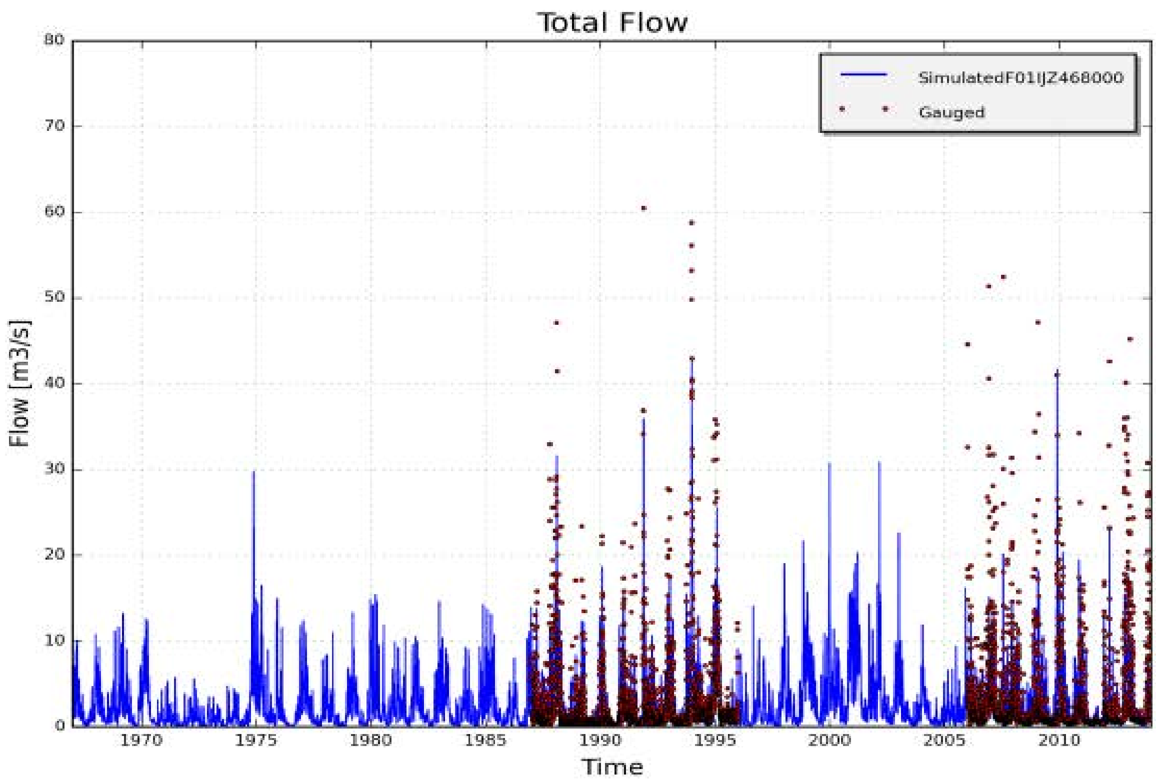


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment F01IJZ468000, station 46810102 - Ijzer; Haringe (validation period)

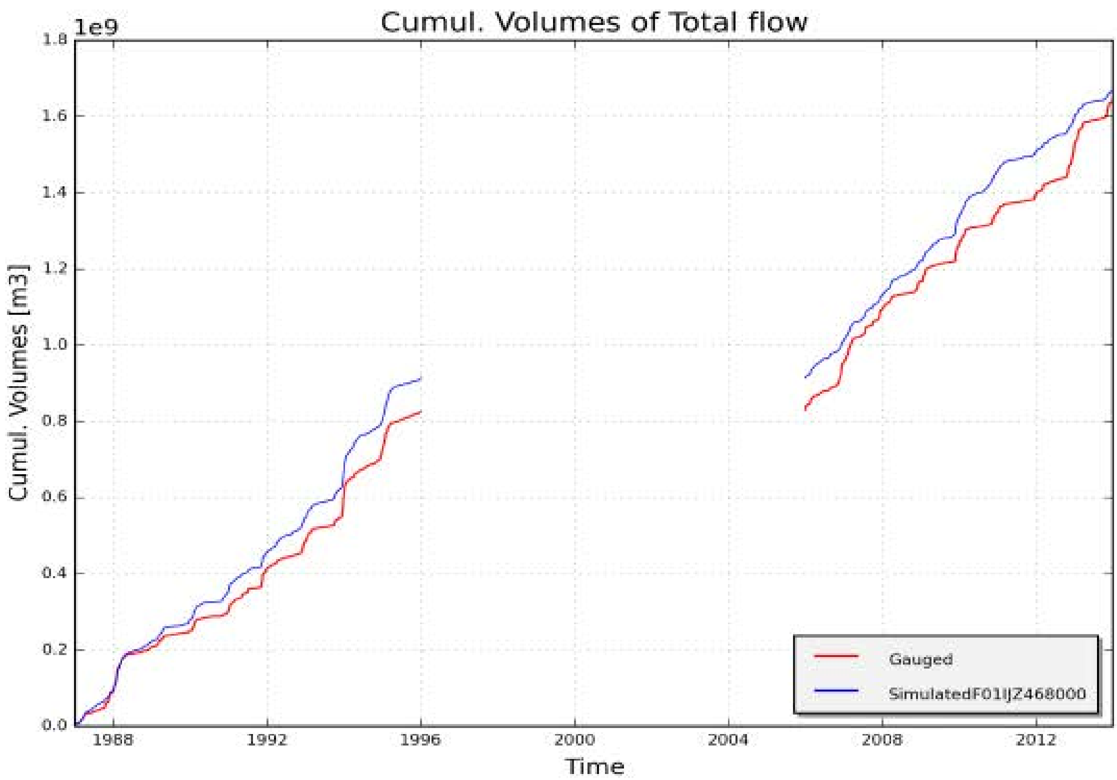


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment F01IJZ468000, station 46810102 - Ijzer; Haringe (validation period)

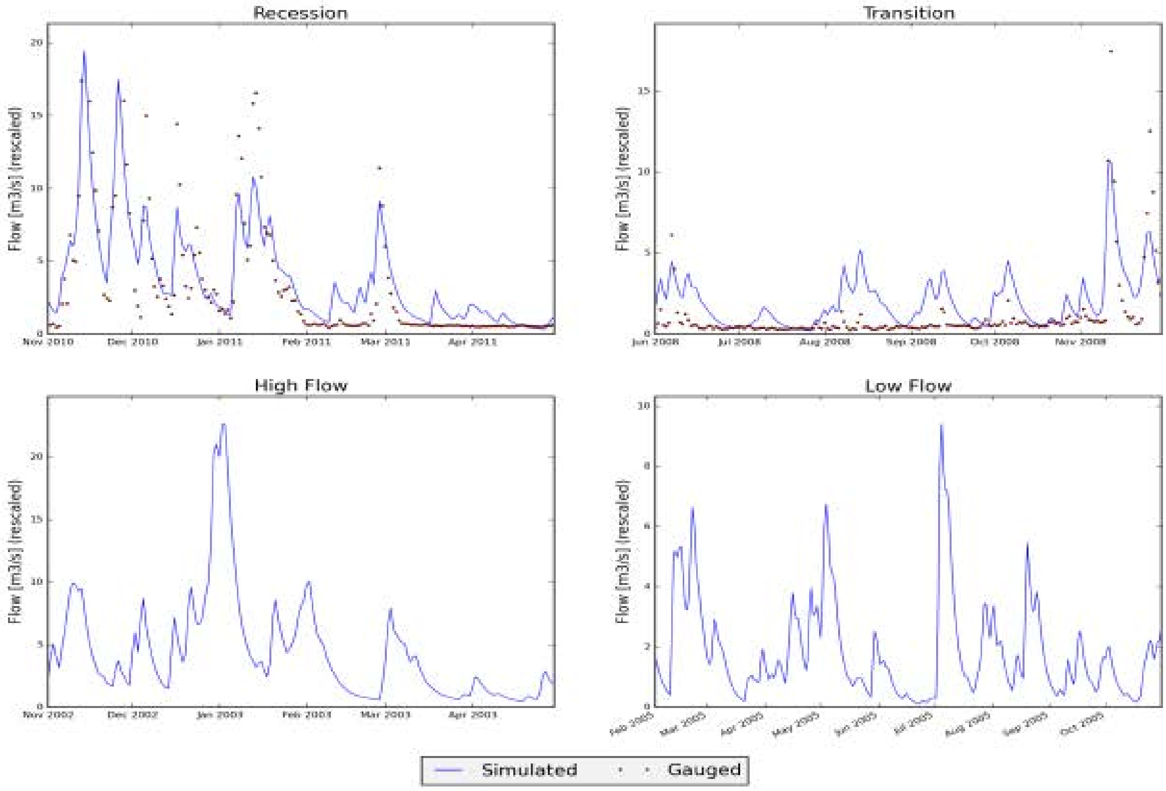


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment F01IJZ468000, station 46810102 - Ijzer; Haringe

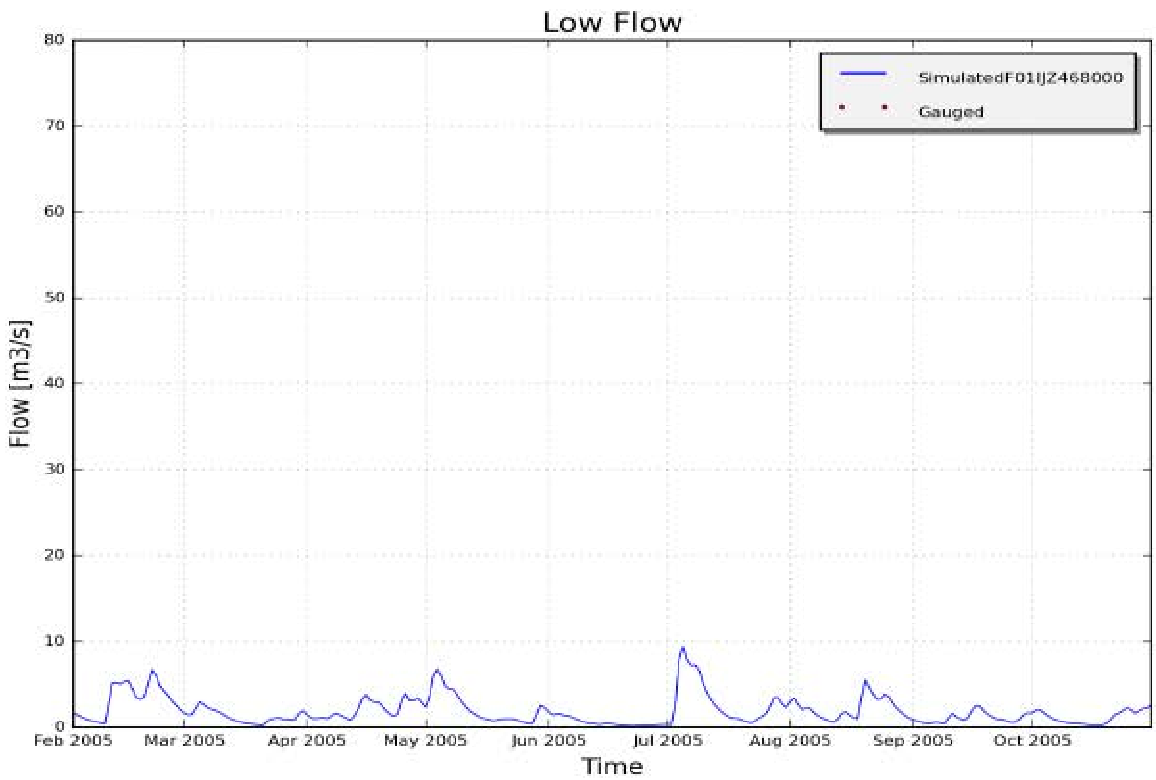


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment F01IJZ468000, station 46810102 - Ijzer; Haringe

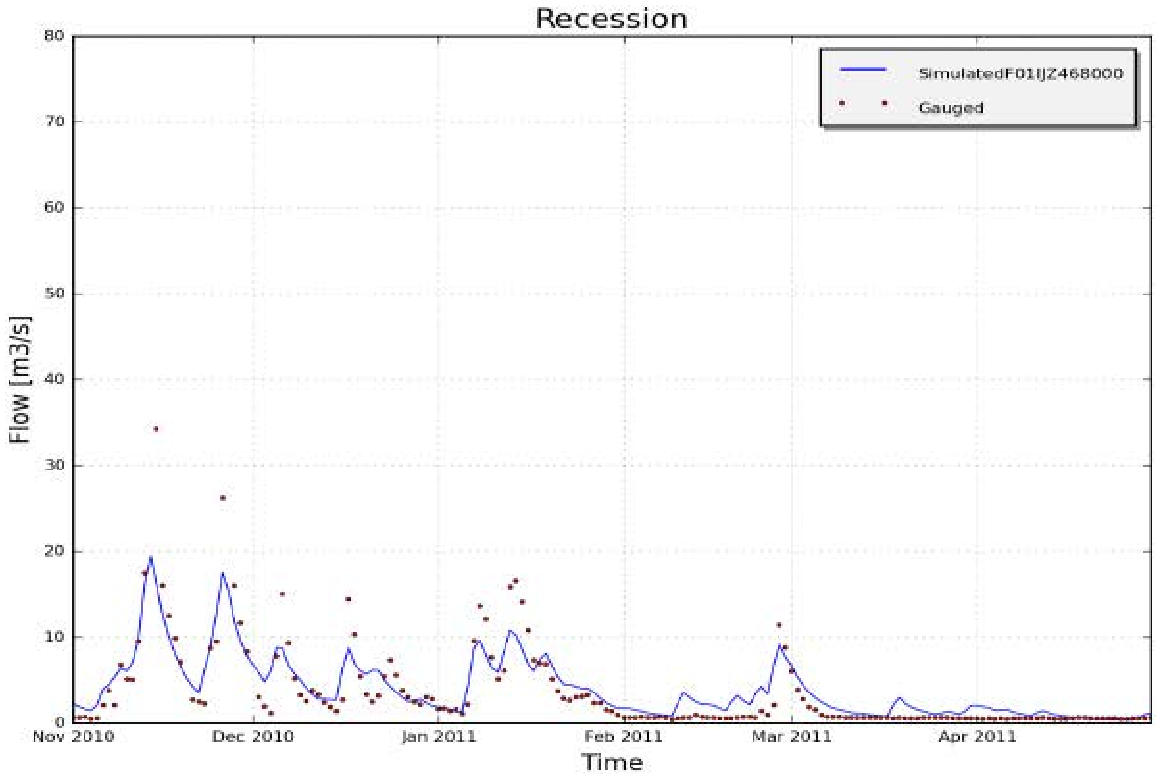


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment F01IJZ468000, station 46810102 - Ijzer; Haringe

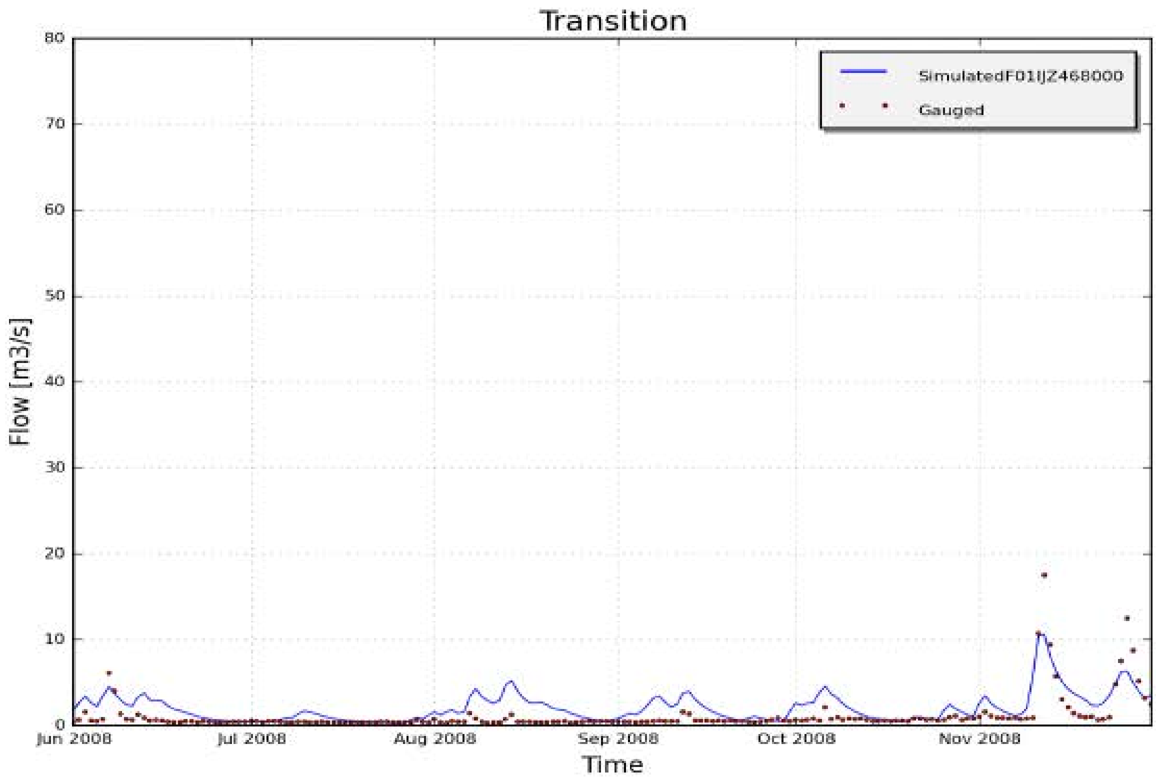


Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment F01IJZ468000, station 46810102 - Ijzer; Haringe

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V01HAN488180" (IJZER)

1.1 Input data

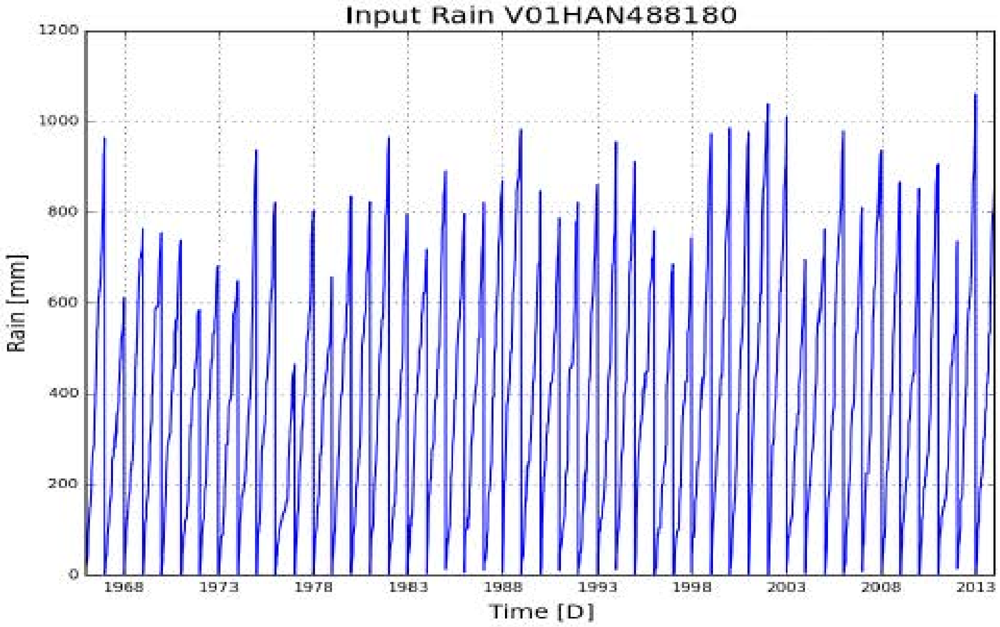


Figure 1: Cumulative precipitation on catchment V01HAN488180 (IJzer)

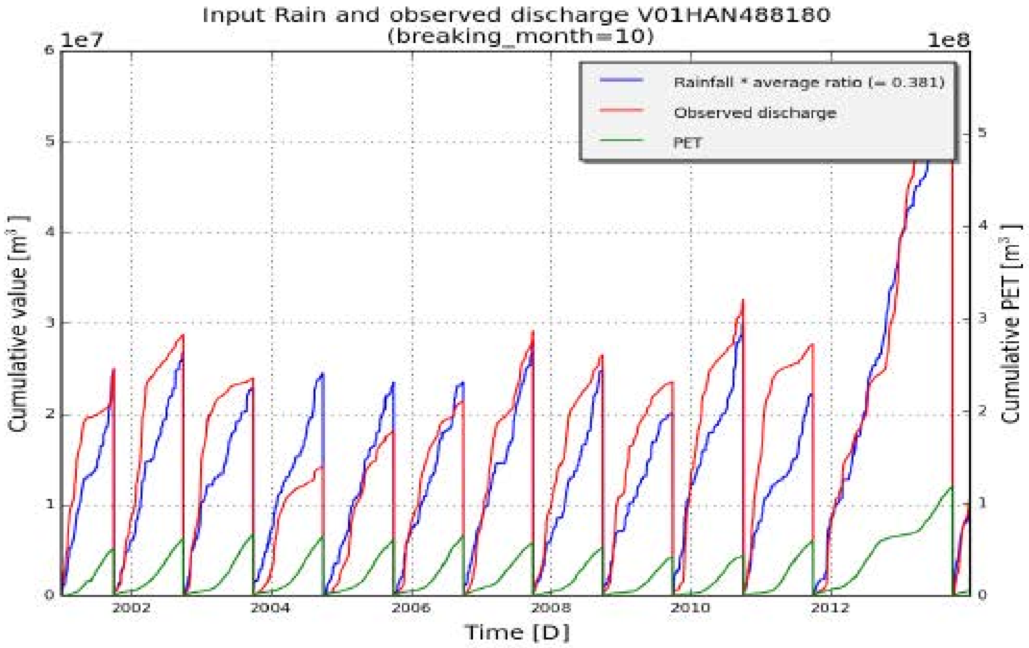


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V01HAN488180 (IJzer)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V01HAN488180
subcatchment_area [m2]	78558940
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 386.04), ('SMevap', 198.0), ('c1', 2.26), ('c2', 1.01), ('c3', 1.0), ('cOF1', -4.2), ('cOF2', 5.0), ('cIF1', -5.29), ('cIF2', 2.51), ('CQOF', 12.26), ('CKIF', 100.09), ('CKBF', 836.66)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	2.0 %	9.4 %	-1.9 %
NS	0.703	0.534	0.67
NS_log	0.735	0.526	0.732
NS_rel	0.565	0.613	0.711
KGE	0.778	0.628	0.812

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	3.5 %	14.6 %	-0.5 %
NS	0.712	0.506	0.689
NS_log	0.736	0.457	0.764
NS_rel	0.508	0.485	0.711
KGE	0.781	0.643	0.812

1.3 Observed and simulated timeseries for optimum parameters

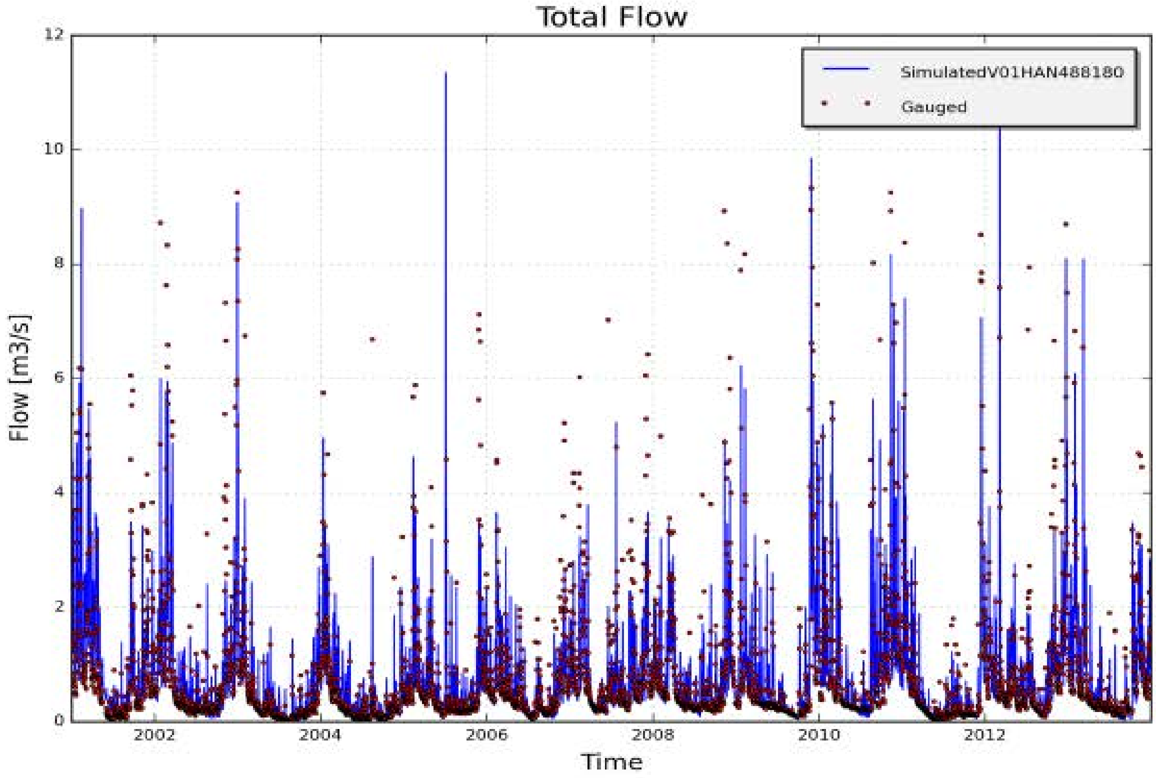


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01HAN488180, station 48810102 - Krekelbeek; Kortemark(calibration period)

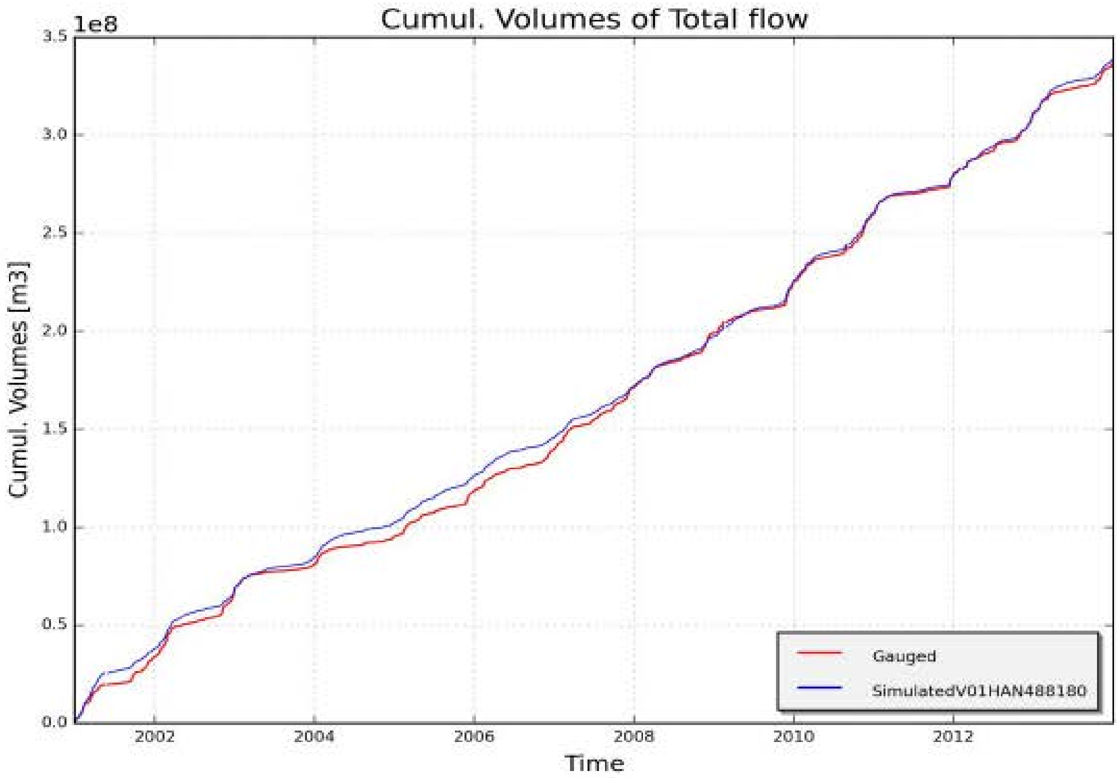


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01HAN488180, station 48810102 - Krekelbeek; Kortemark (calibration period)

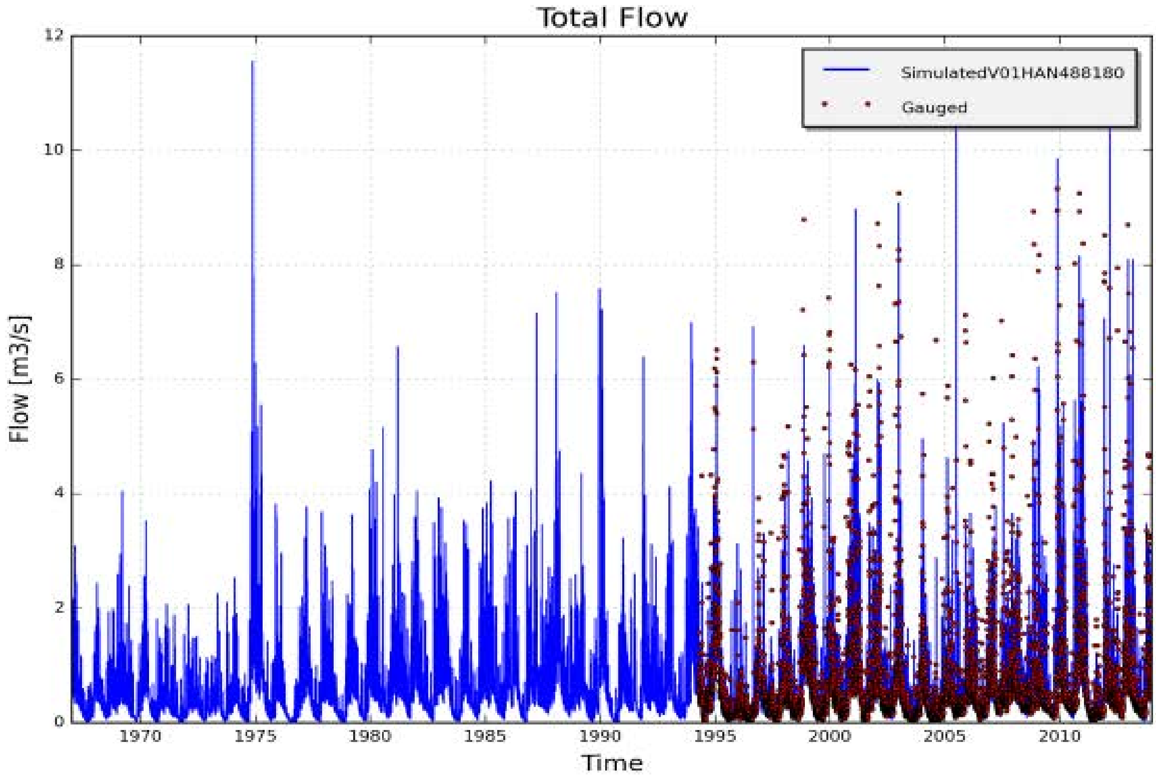


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01HAN488180, station 48810102 - Krekelbeek; Kortemark (validation period)

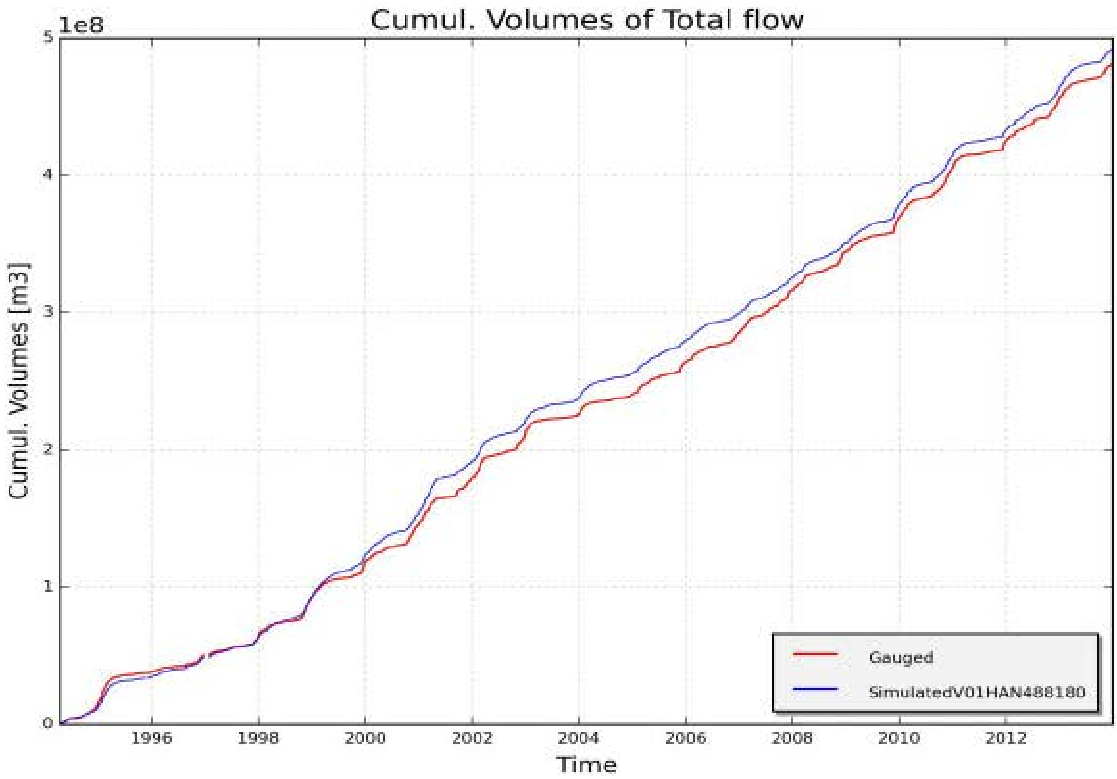


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01HAN488180, station 48810102 - Krekelbeek; Kortemark (validation period)

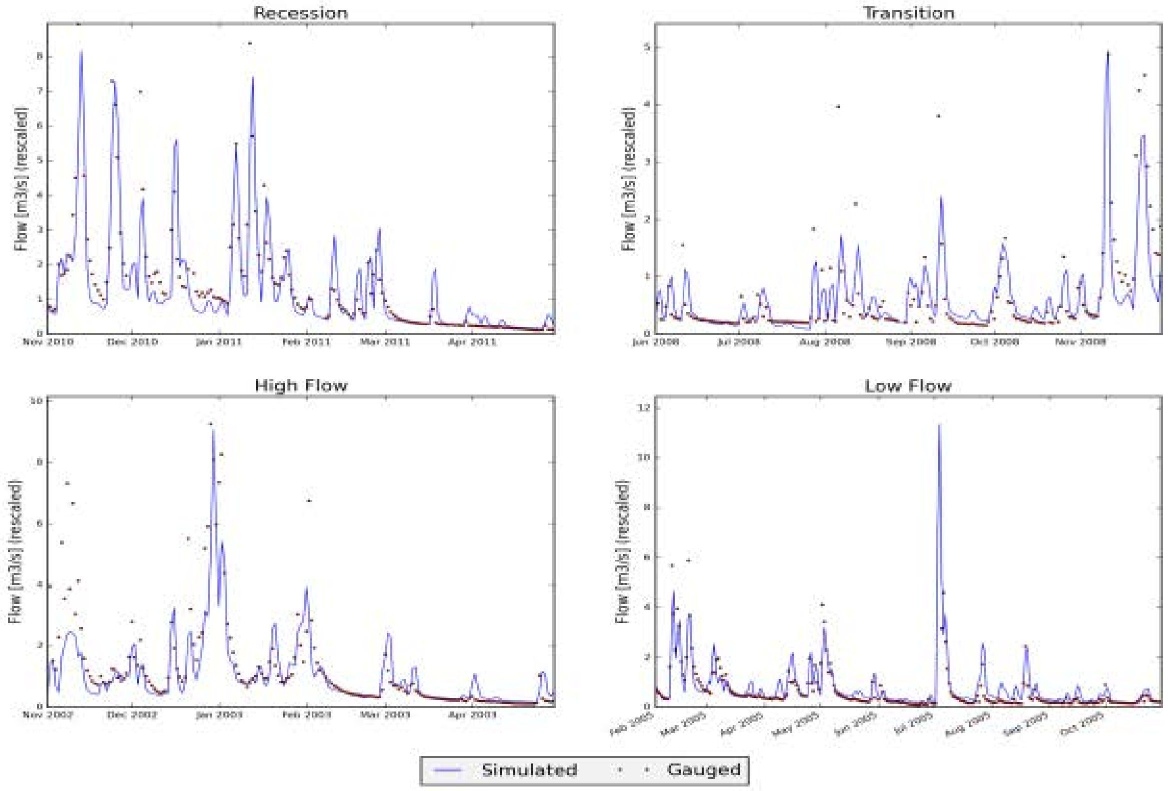


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V01HAN488180, station 48810102 - Krekelbeek; Kortemark

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V01IEP495080" (IJZER)

1.1 Input data

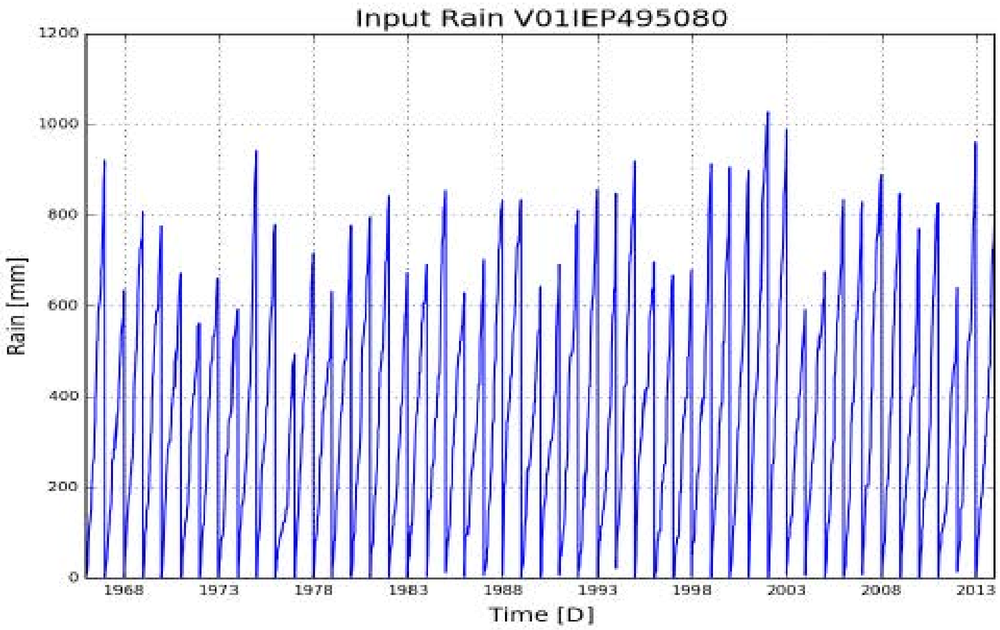


Figure 1: Cumulative precipitation on catchment V01IEP495080 (IJzer)

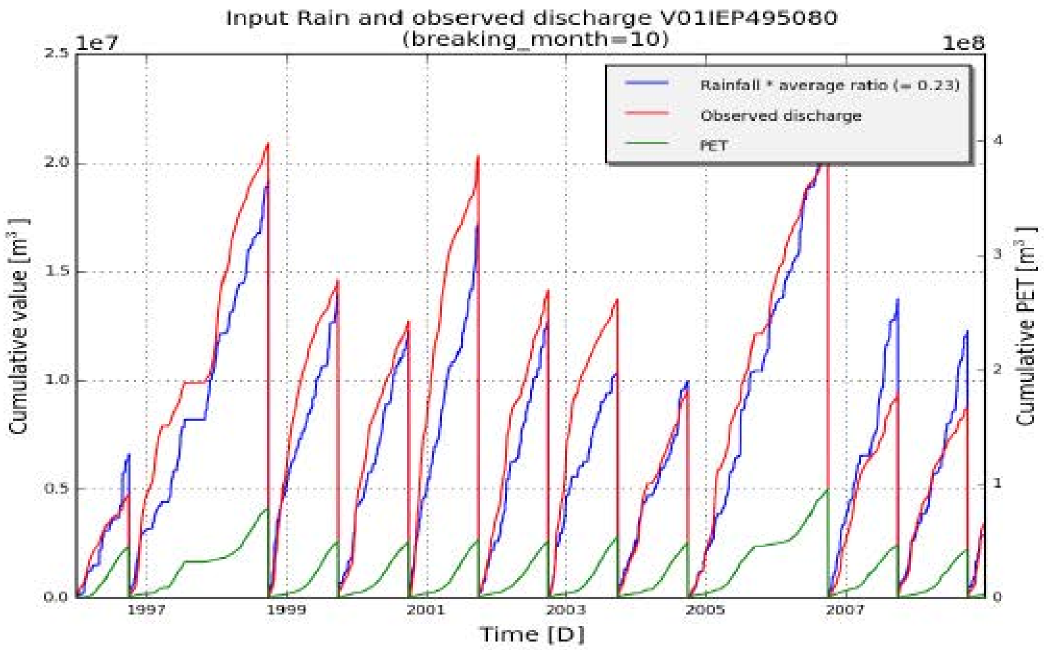


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V01IEP495080 (IJzer)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V01IEP495080
subcatchment_area [m2]	63423128
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 443.33), ('SMevap', 164.88), ('c1', 1.93), ('c2', 0.36), ('c3', 1.0), ('cOF1', -5.58), ('cOF2', 2.82), ('cIF1', -3.65), ('cIF2', 3.0), ('CQOF', 13.53), ('CKIF', 56.26), ('CKBF', 1207.34)]

Table 1: Goodness of fit for calibration period (1996 - 2008)

	Full year	**Summer**	**Winter**
RelErr	-3.6 %	11.2 %	-15.9 %
NS	0.554	0.551	0.594
NS_log	0.452	0.117	0.533
NS_rel	-7.669	-26.871	0.713
KGE	0.669	0.654	0.719

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-27.5 %	-5.9 %	-41.0 %
NS	0.487	0.588	0.284
NS_log	0.501	0.301	0.132
NS_rel	-3.089	-11.37	0.529
KGE	0.538	0.648	0.499

1.3 Observed and simulated timeseries for optimum parameters

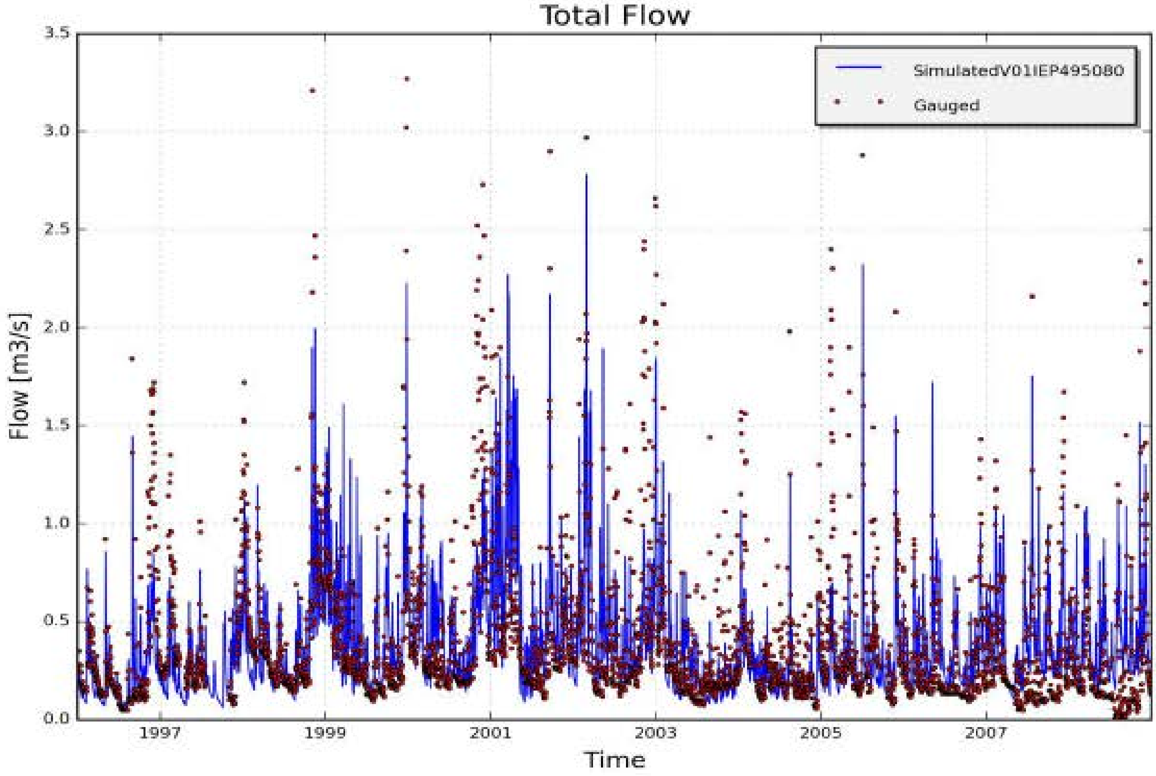


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote(calibration period)

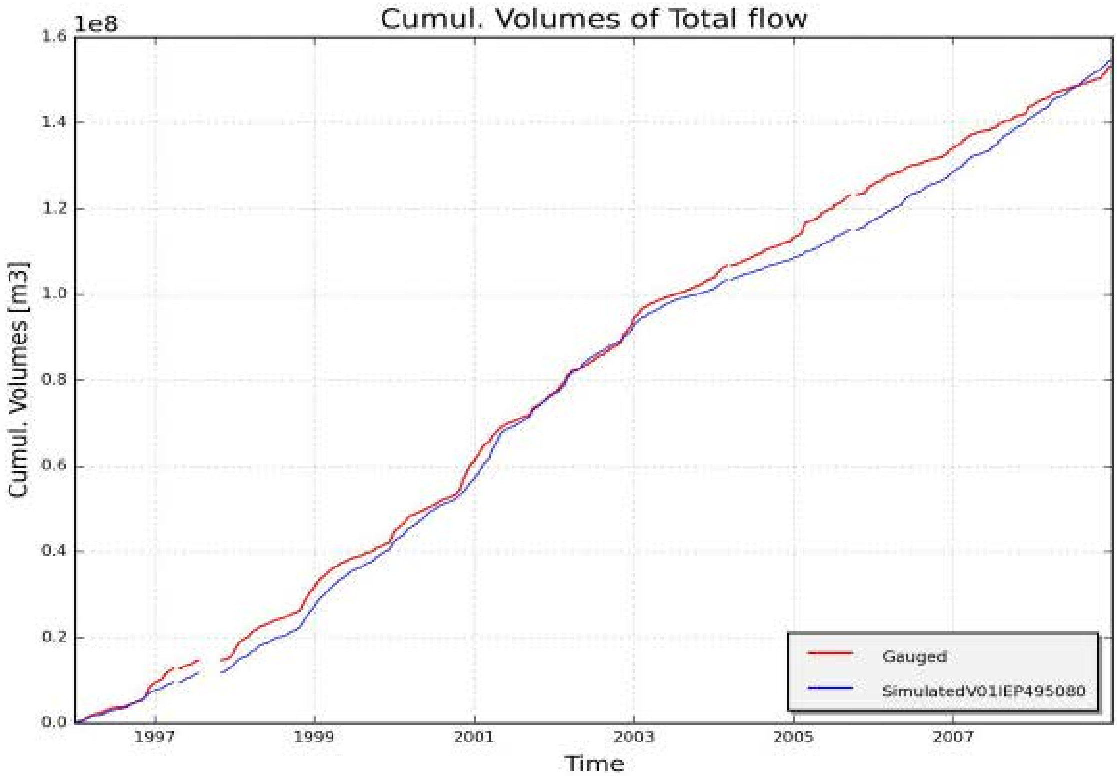


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote (calibration period)

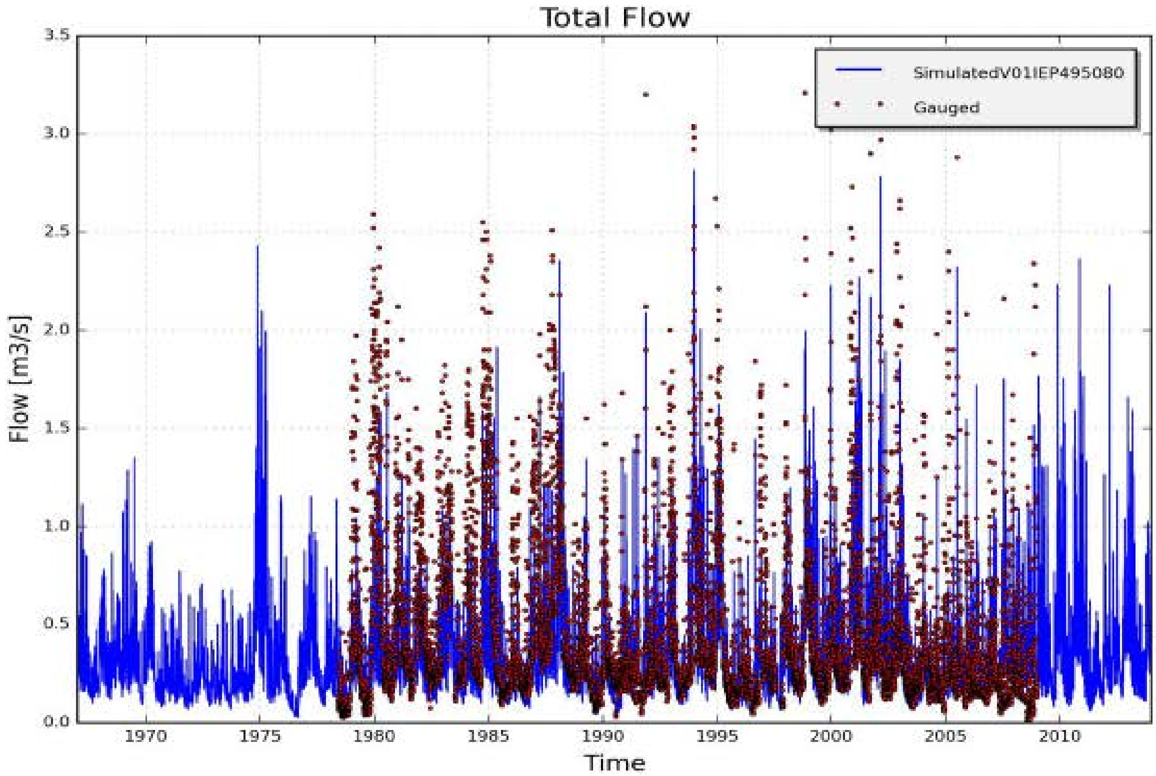


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote (validation period)

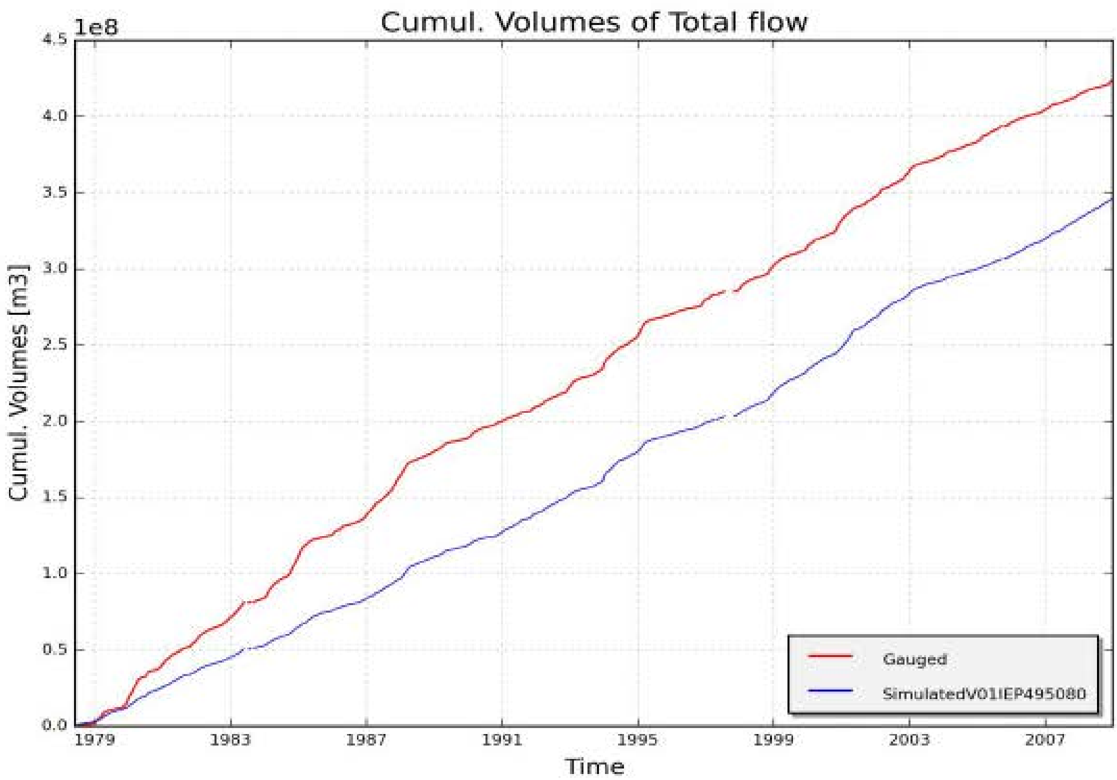


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote (validation period)

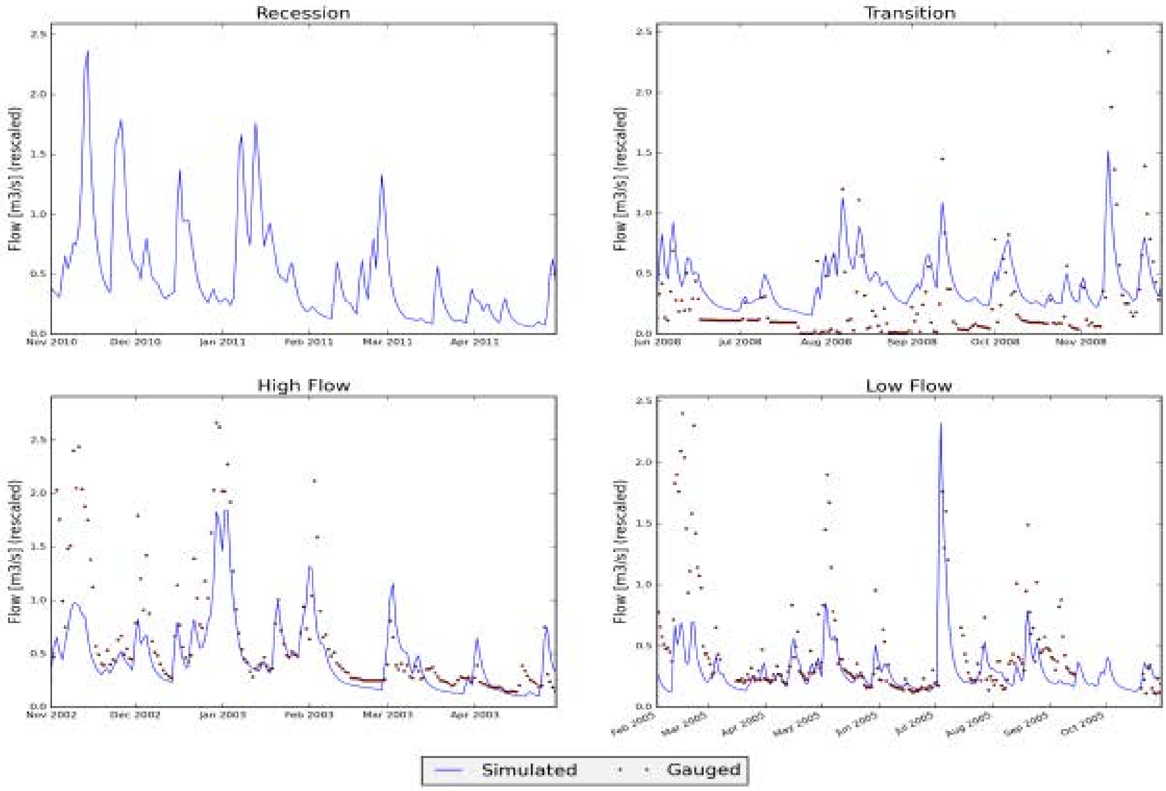


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote

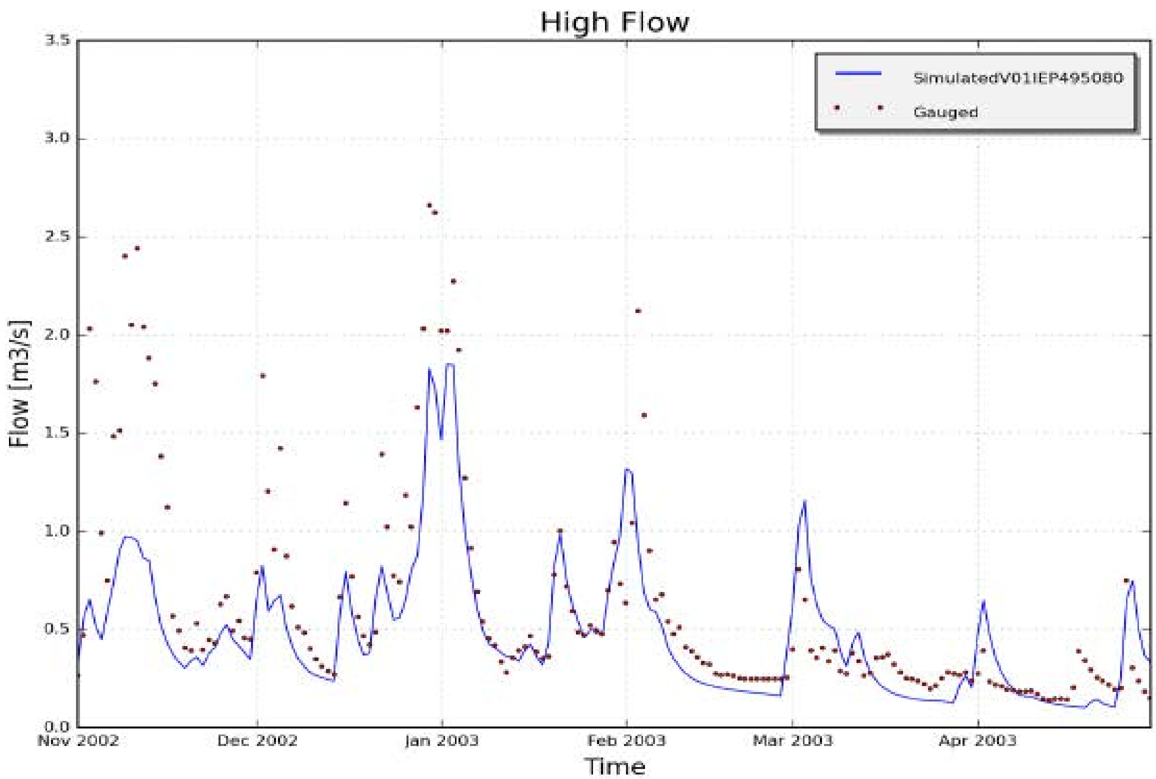


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote

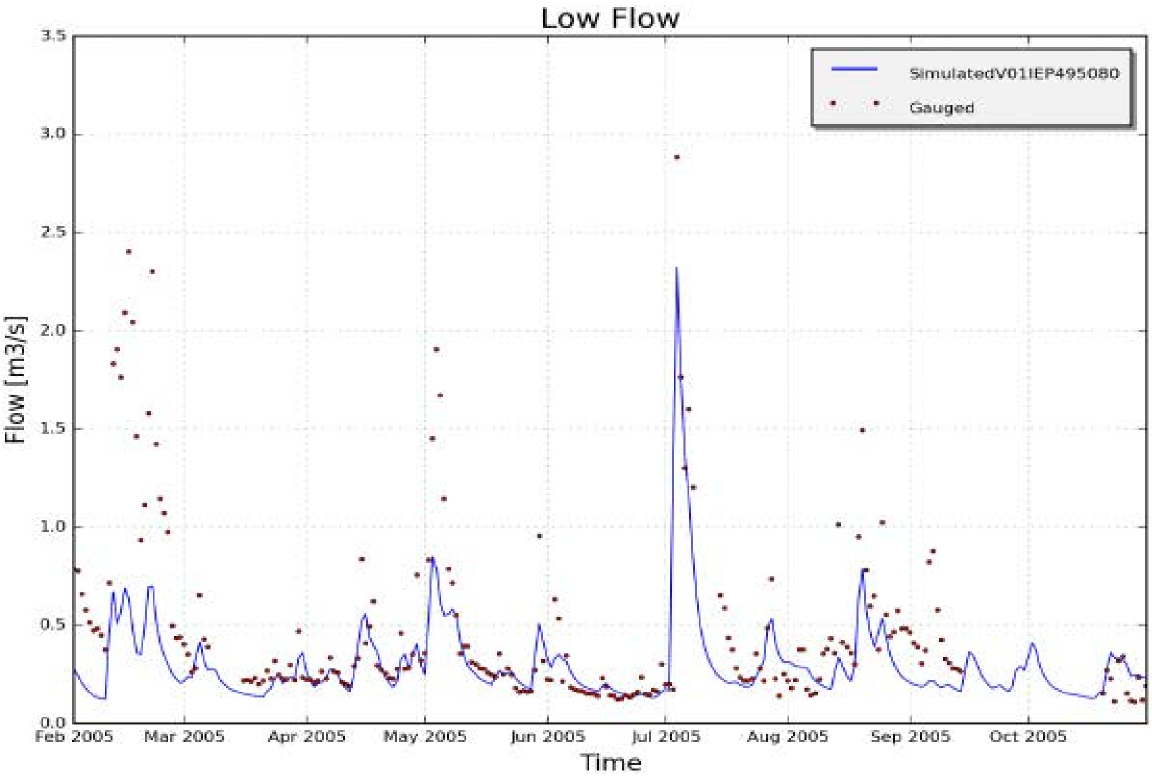


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote

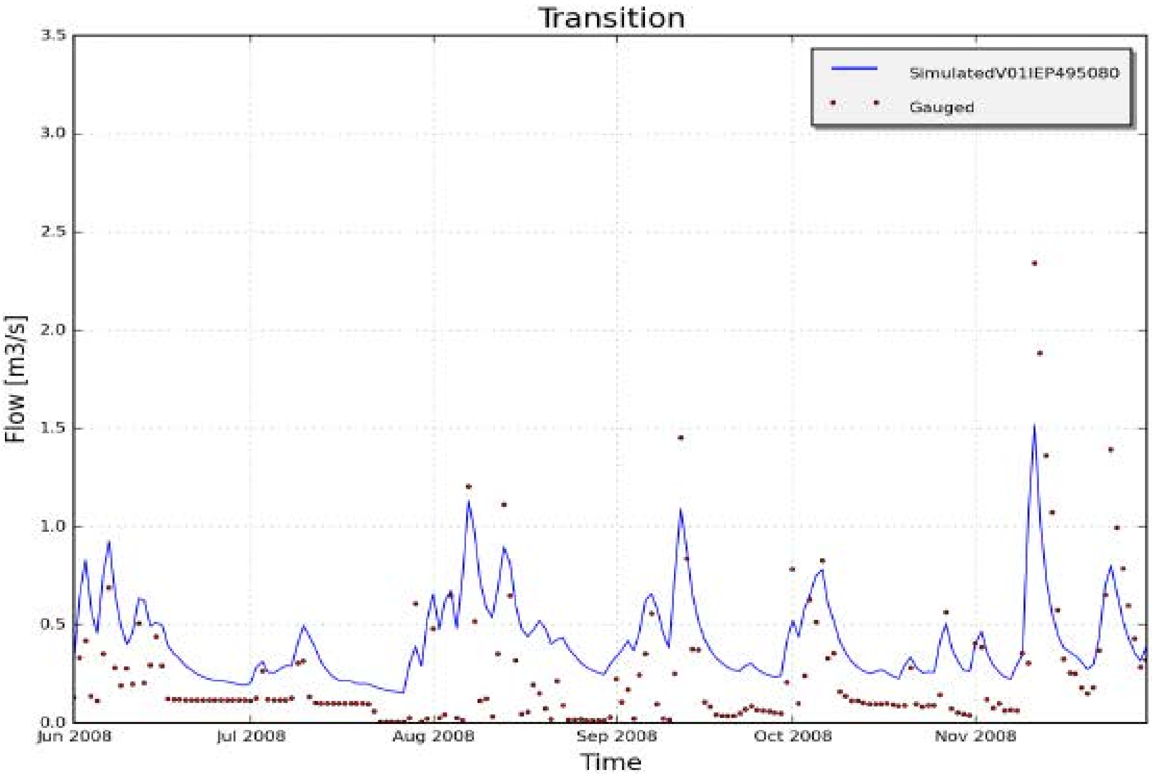


Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V01IEP495080, station 49510102 - Ieperlee; Zuidschote

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V01KEM492060" (IJZER)

1.1 Input data

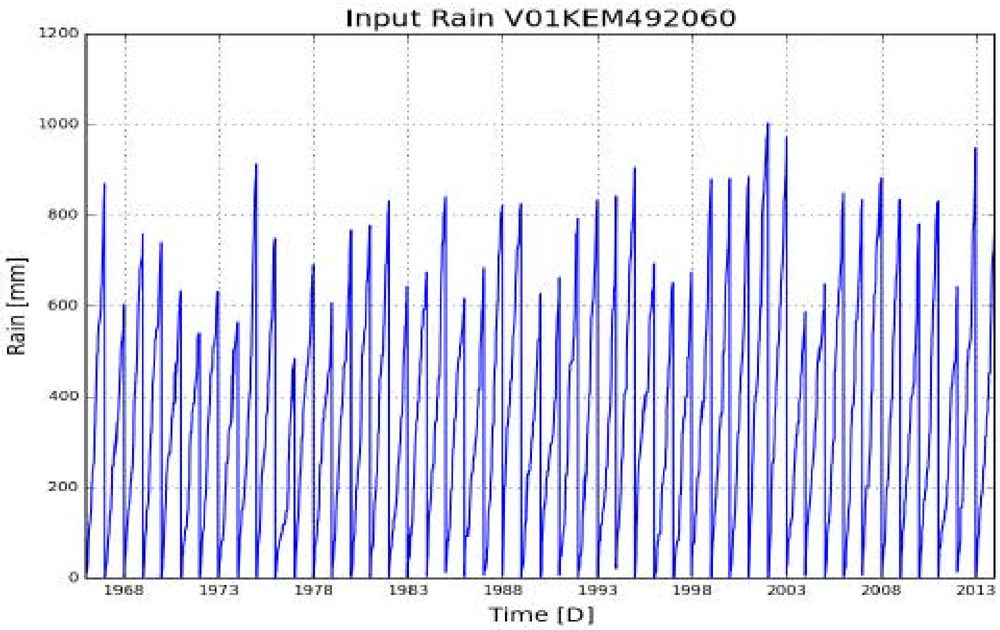


Figure 1: Cumulative precipitation on catchment V01KEM492060 (IJzer)

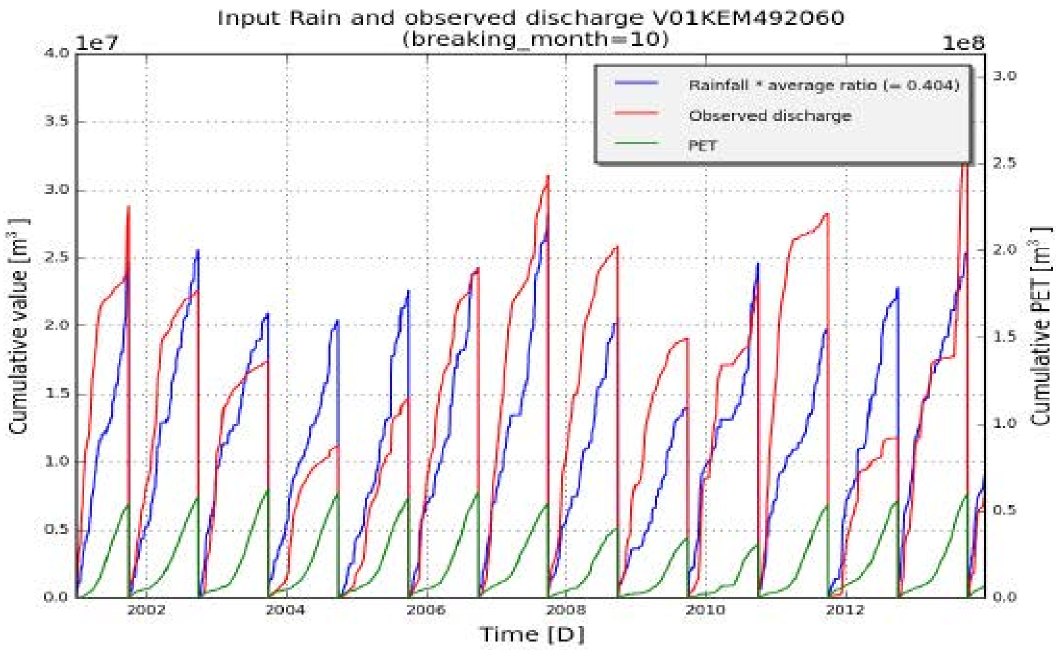


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V01KEM492060 (IJzer)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V01KEM492060
subcatchment_area [m2]	73892930
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 426.14), ('SMevap', 164.19), ('c1', 2.4), ('c2', 1.76), ('c3', 1.0), ('cOF1', -5.13), ('cOF2', 4.65), ('cIF1', -2.98), ('cIF2', 3.0), ('CQOF', 14.4), ('CKIF', 69.65), ('CKBF', 476.18)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	2.0 %	25.3 %	-5.7 %
NS	0.575	0.257	0.604
NS_log	0.484	0.086	0.496
NS_rel	-21.572	-18.683	-1.051
KGE	0.581	0.301	0.563

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	10.5 %	33.5 %	3.9 %
NS	0.562	0.287	0.587
NS_log	0.481	0.067	0.538
NS_rel	-12.195	-13.079	-0.126
KGE	0.546	0.356	0.527

1.3 Observed and simulated timeseries for optimum parameters

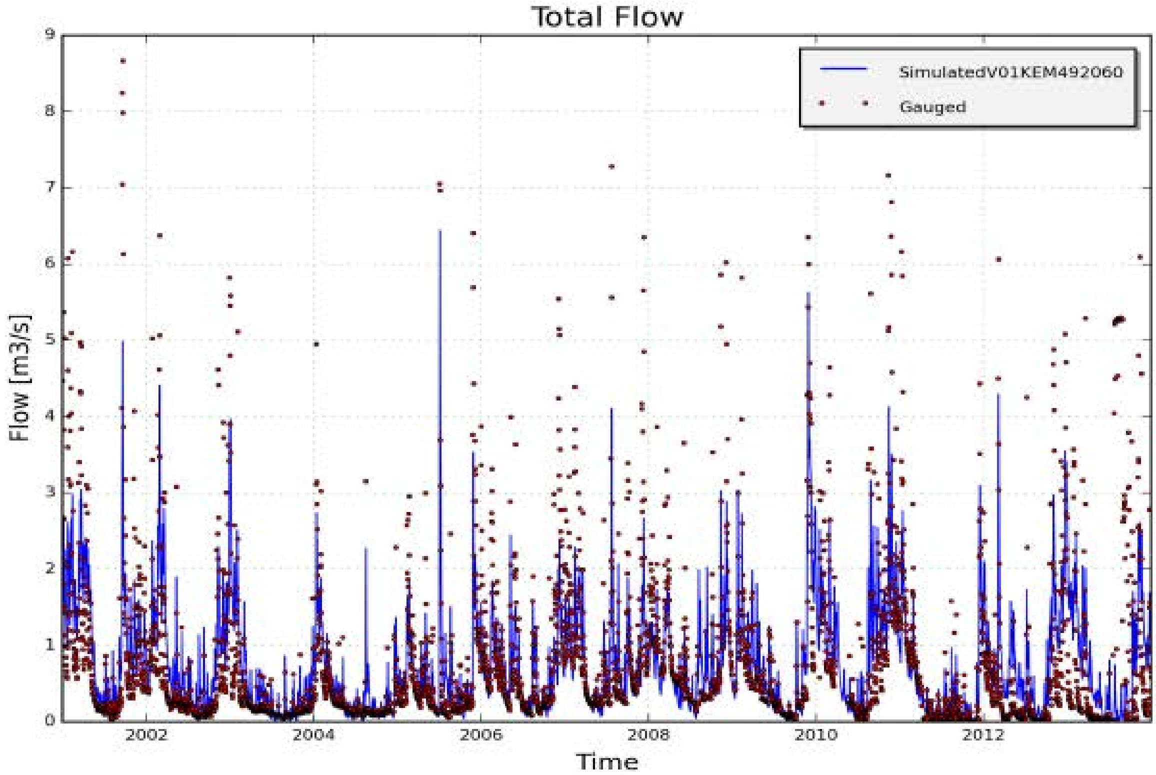


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01KEM492060, station 49270102 -Kemmelbeek; Boezinge(calibration period)

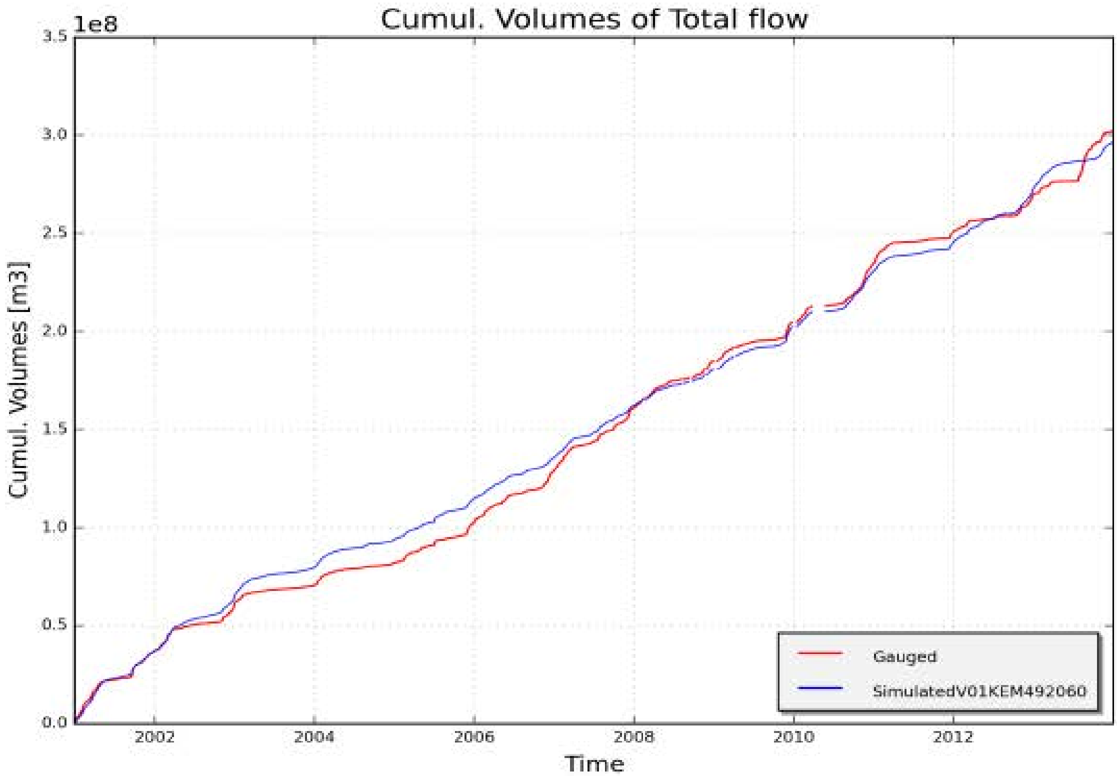


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01KEM492060, station 49270102 -Kemmelbeek; Boezinge (calibration period)

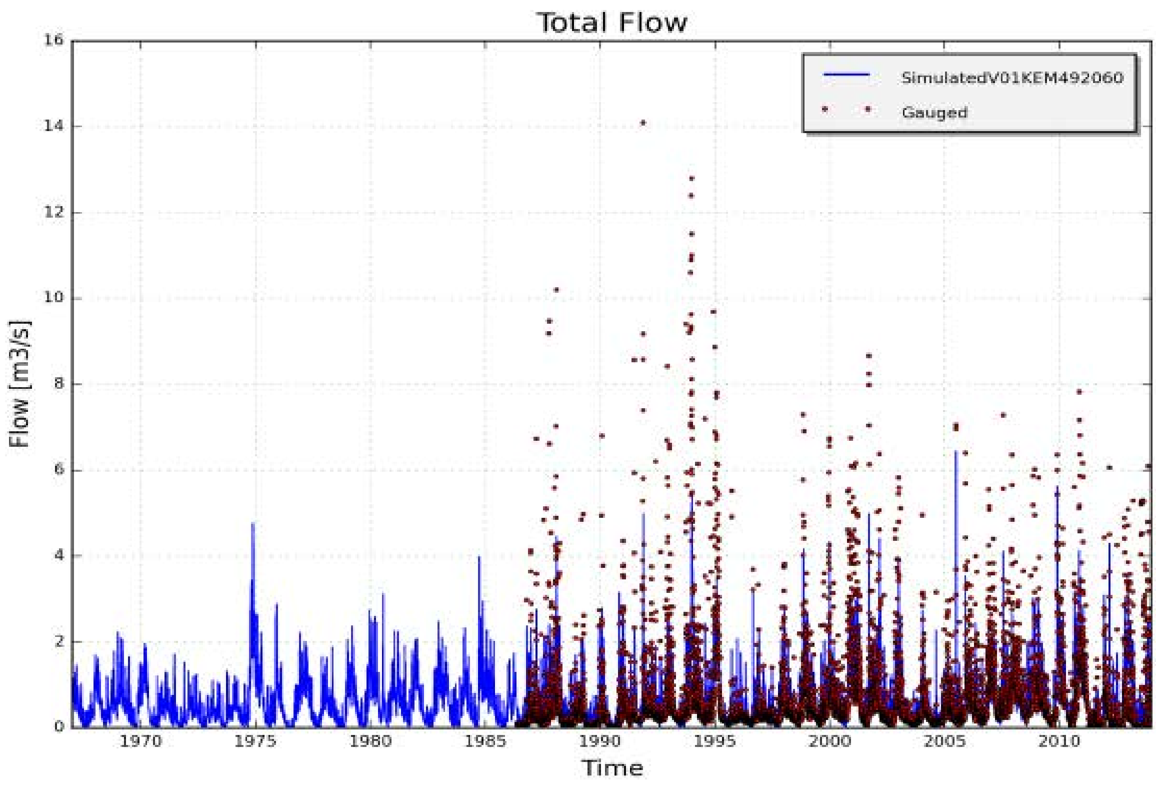


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01KEM492060, station 49270102 -Kemmelbeek; Boezinge (validation period)

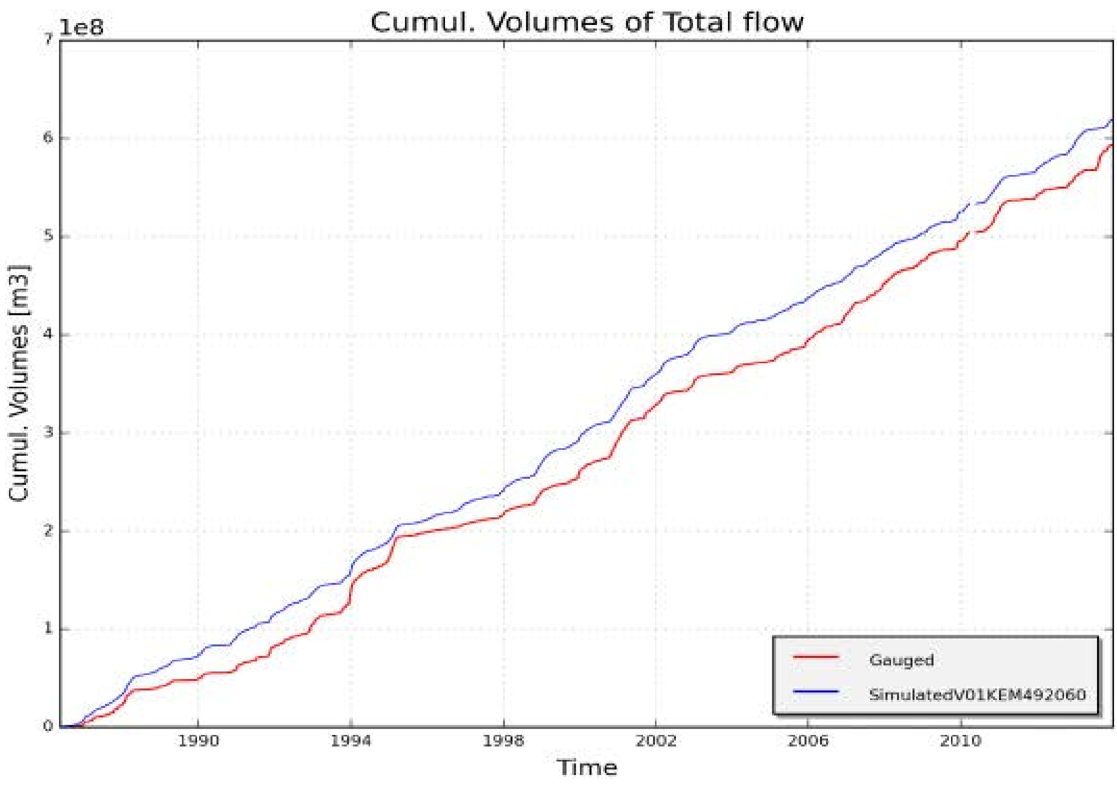


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01KEM492060, station 49270102 -Kemmelbeek; Boezinge (validation period)

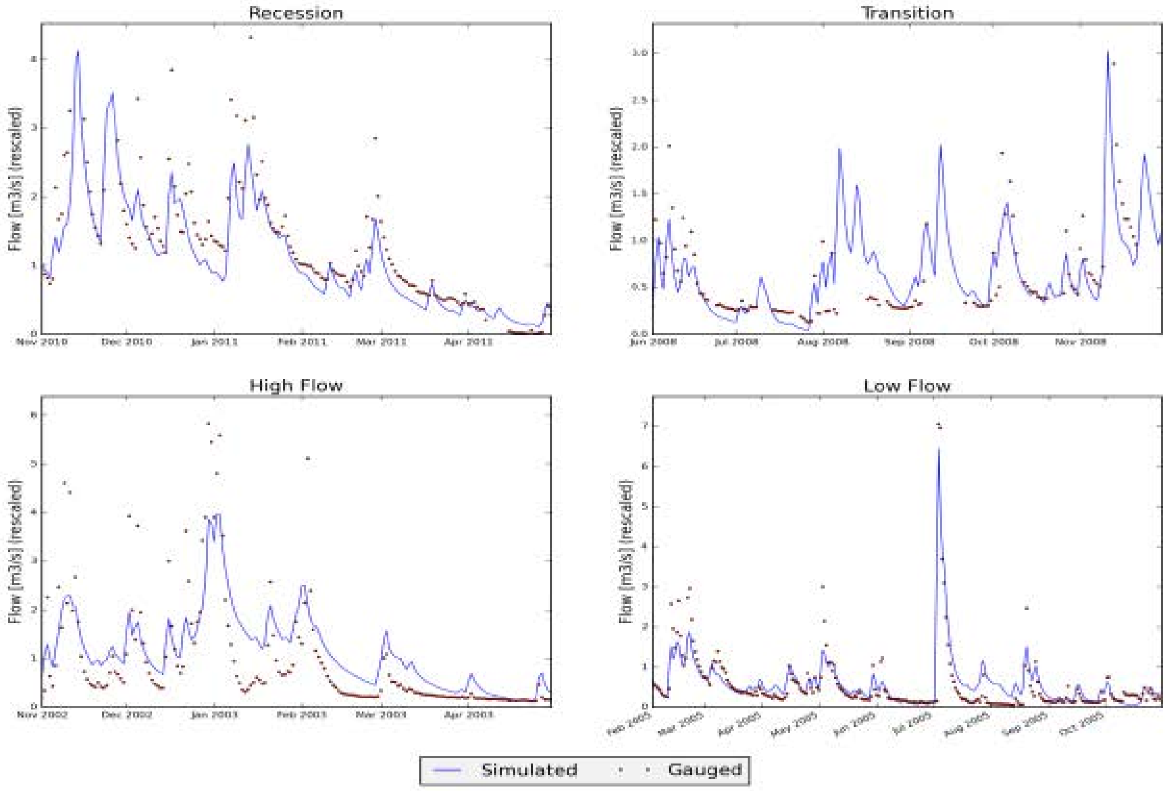


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V01KEM492060, station 49270102 -Kemmelbeek; Boezinge

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V01MAR496120" (IJZER)

1.1 Input data

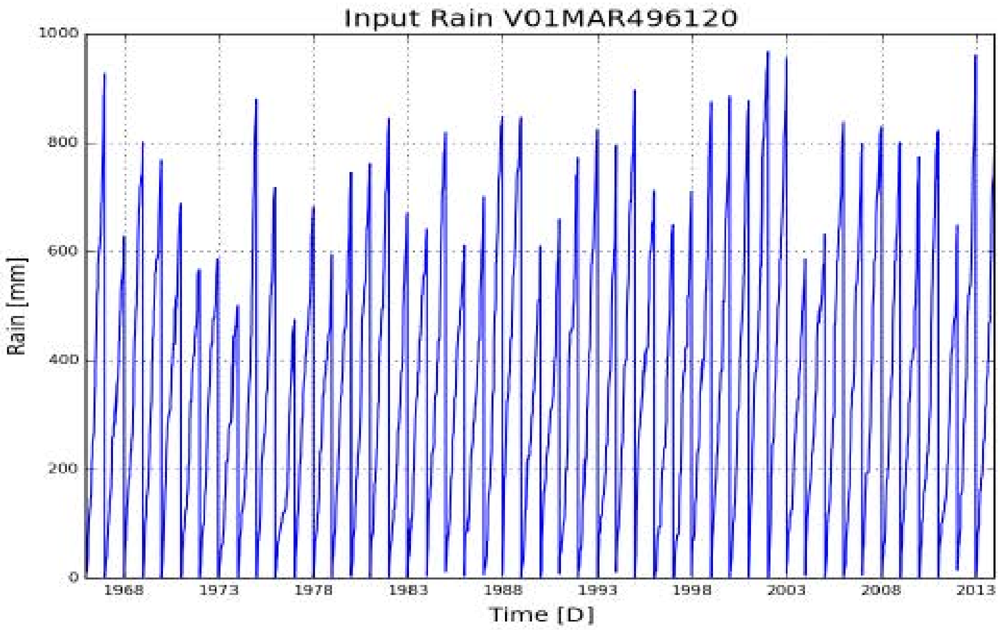


Figure 1: Cumulative precipitation on catchment V01MAR496120 (IJzer)

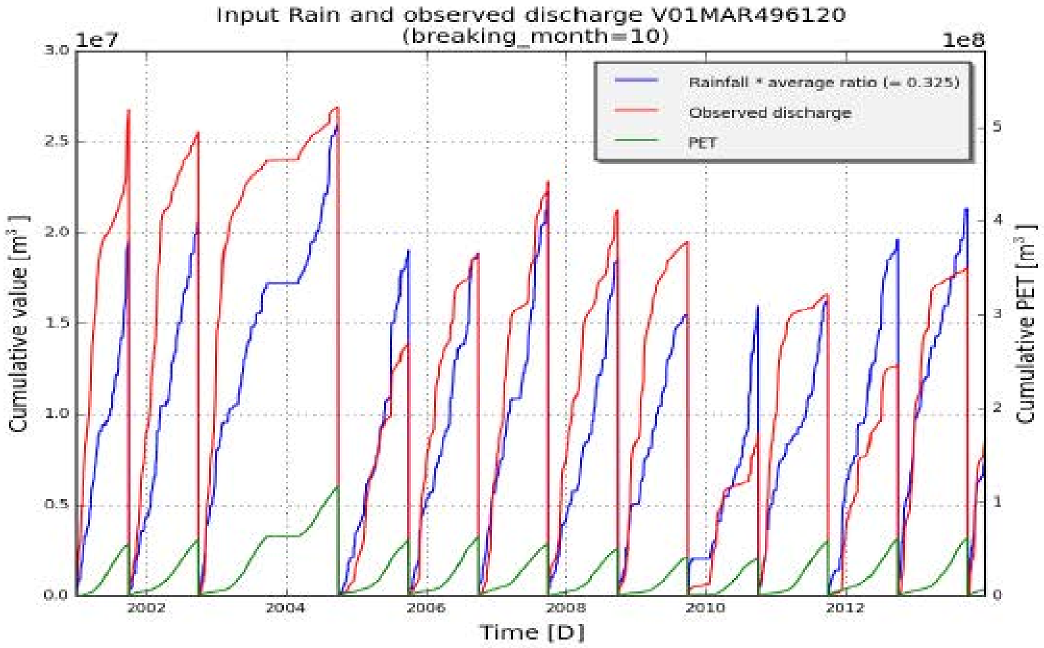


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V01MAR496120 (IJzer)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V01MAR496120
subcatchment_area [m2]	76136621
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 396.83), ('SMevap', 280.95), ('c1', 3.24), ('c2', 1.14), ('c3', 1.0), ('cOF1', -7.32), ('cOF2', 4.95), ('cIF1', -5.38), ('cIF2', 4.99), ('CQOF', 13.44), ('CKIF', 80.36), ('CKBF', 1068.09)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-2.0 %	21.8 %	-6.9 %
NS	0.673	0.407	0.727
NS_log	0.606	0.185	0.657
NS_rel	-2.105	-2.512	0.333
KGE	0.743	0.585	0.771

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	2.8 %	13.9 %	-1.5 %
NS	0.679	0.451	0.715
NS_log	0.596	0.28	0.67
NS_rel	-6.28	-2.099	-0.445
KGE	0.73	0.64	0.775

1.3 Observed and simulated timeseries for optimum parameters

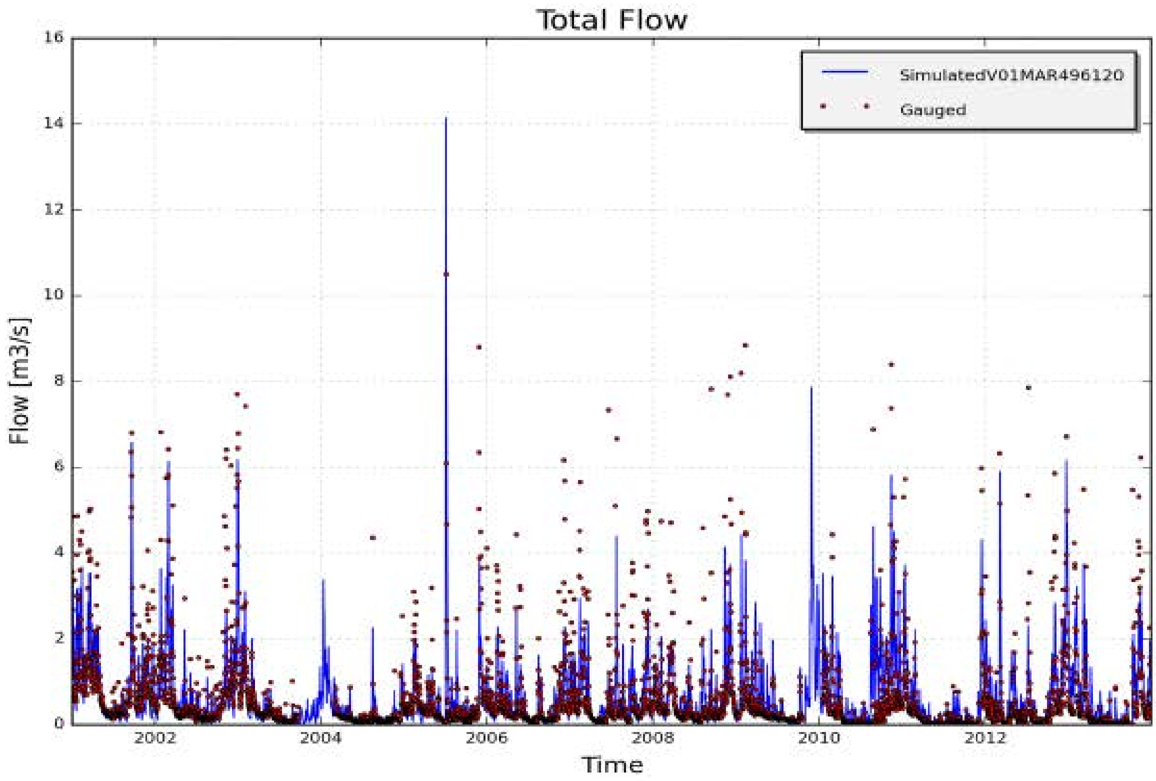


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01MAR496120, station 49610102 - St. Jansbeek; Merkem(calibration period)

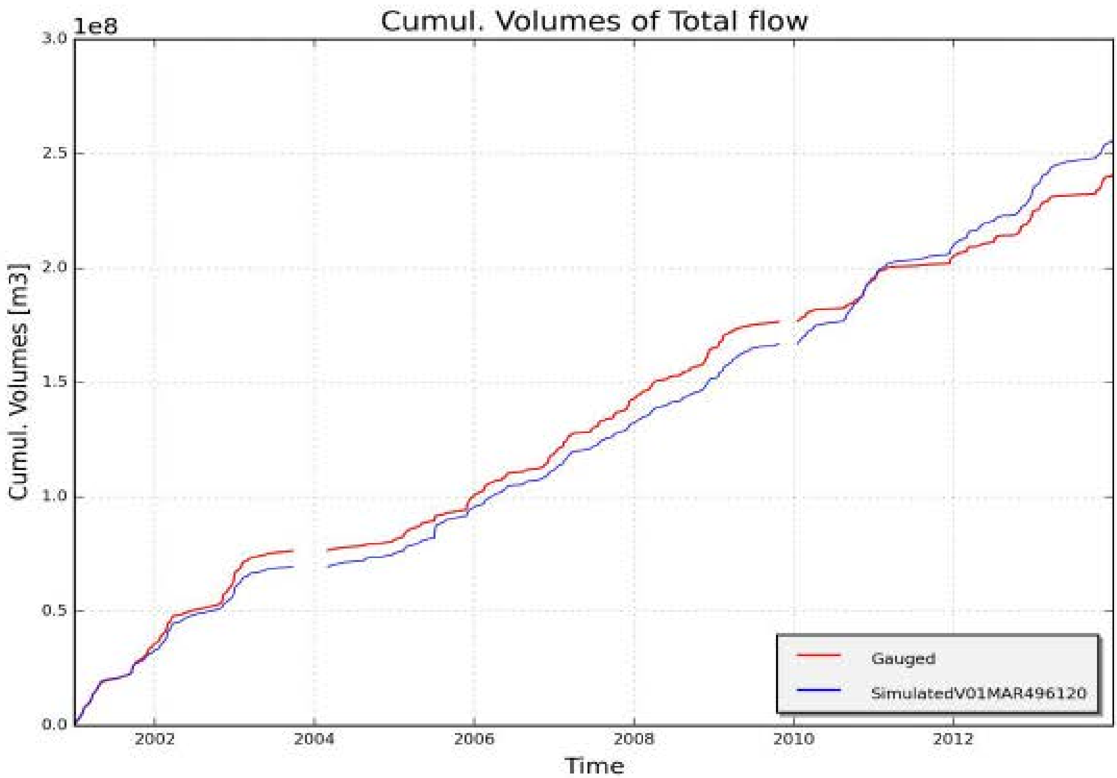


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01MAR496120, station 49610102 - St. Jansbeek; Merkem (calibration period)

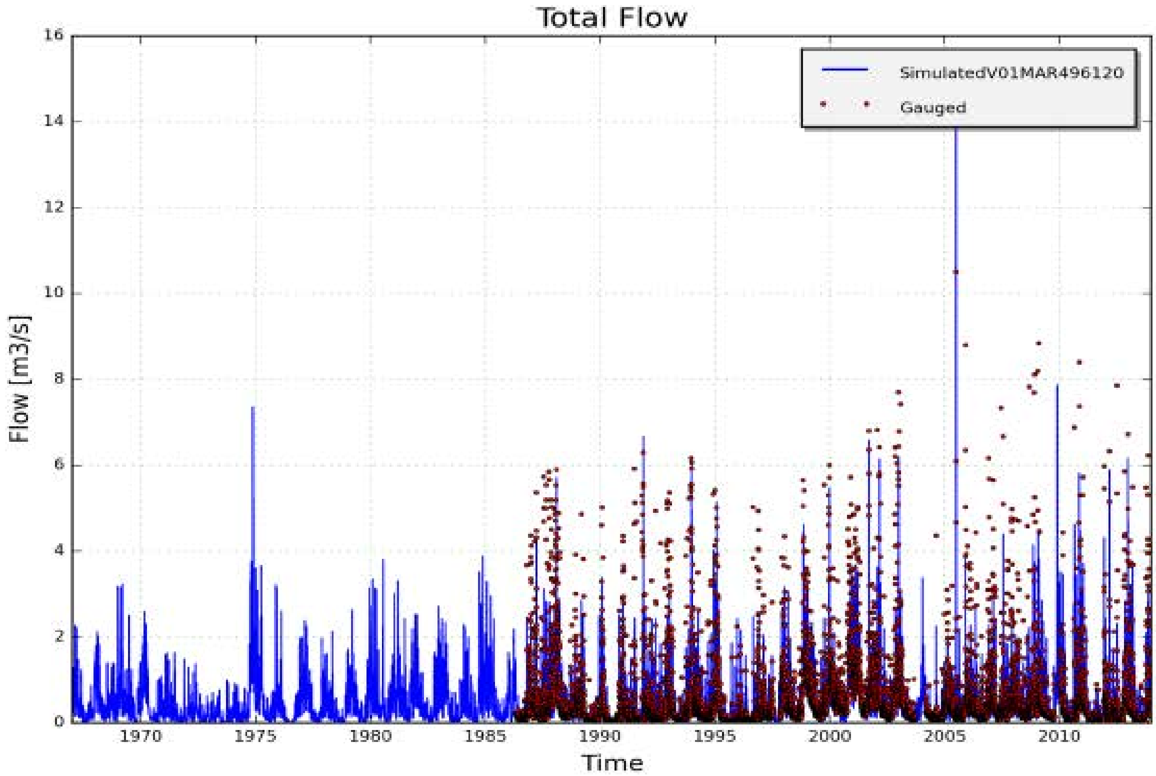


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01MAR496120, station 49610102 - St. Jansbeek; Merkem (validation period)

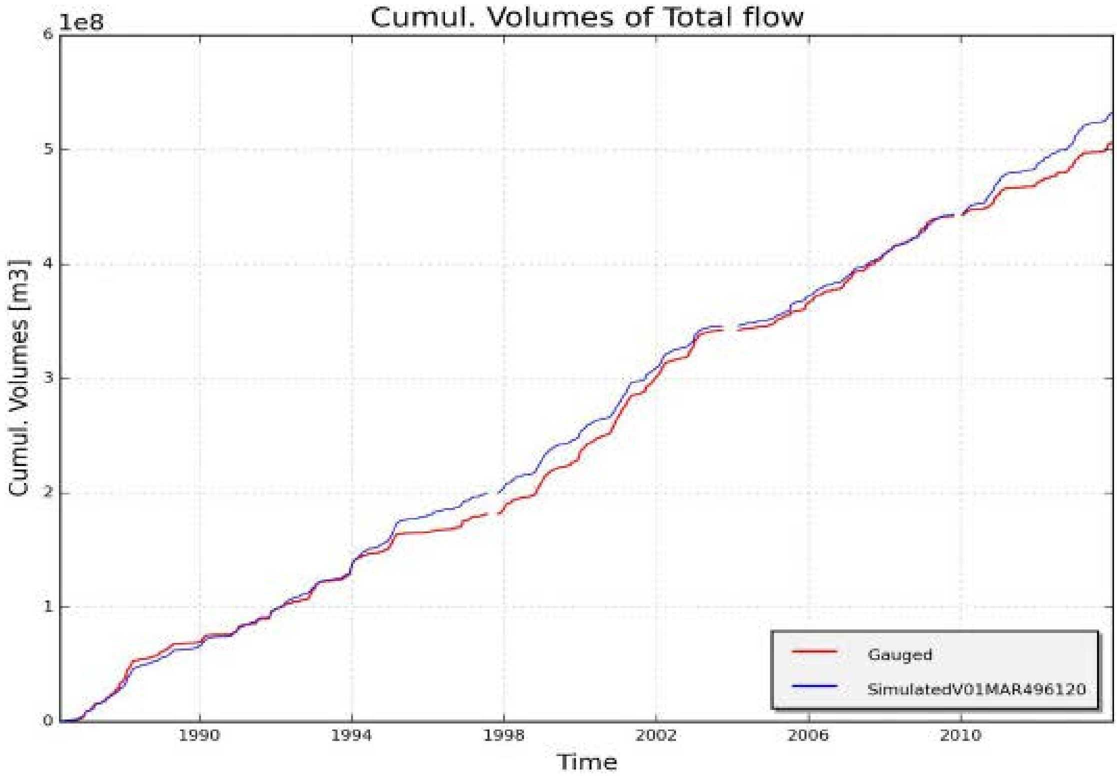


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01MAR496120, station 49610102 - St. Jansbeek; Merkem (validation period)

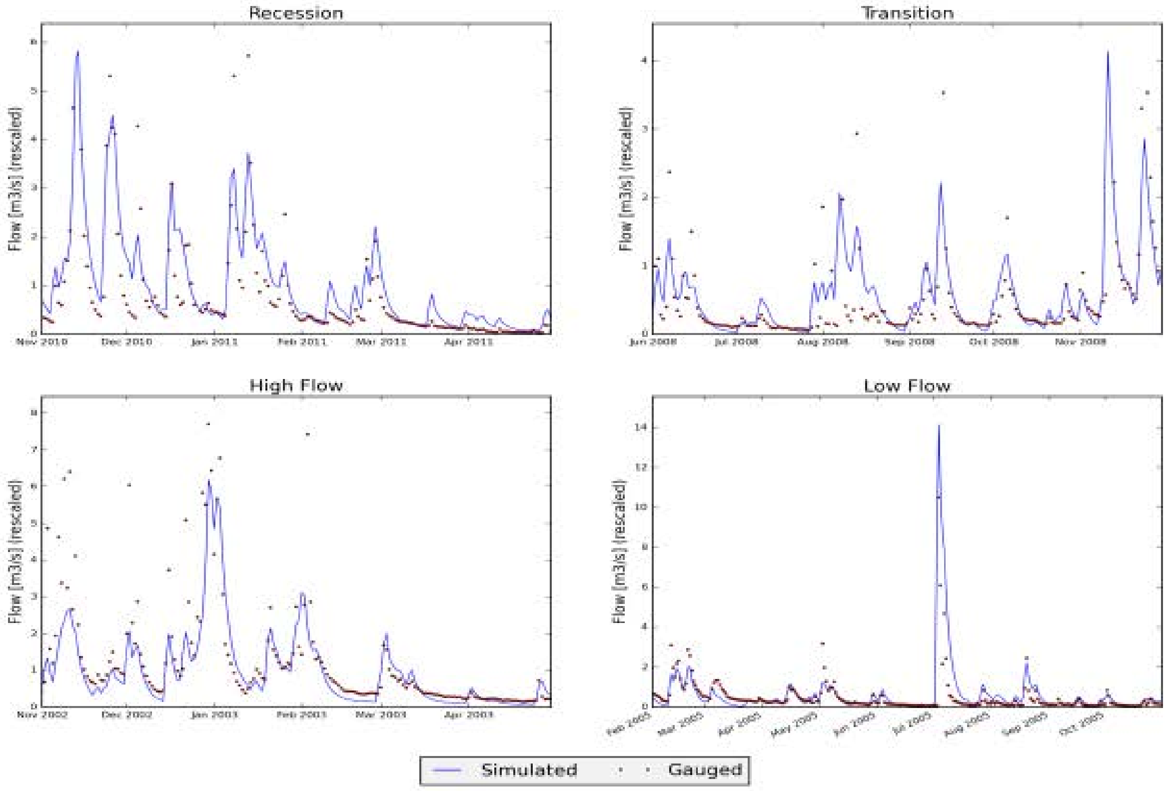


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V01MAR496120, station 49610102 - St. Jansbeek; Merkem

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V01POP491030" (IJZER)

1.1 Input data

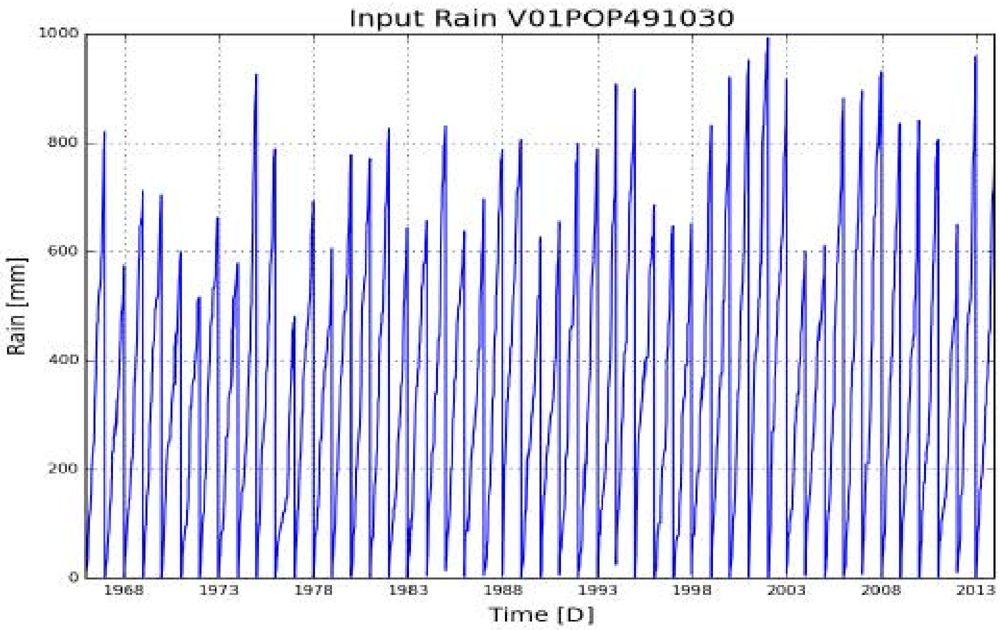


Figure 1: Cumulative precipitation on catchment V01POP491030 (IJzer)

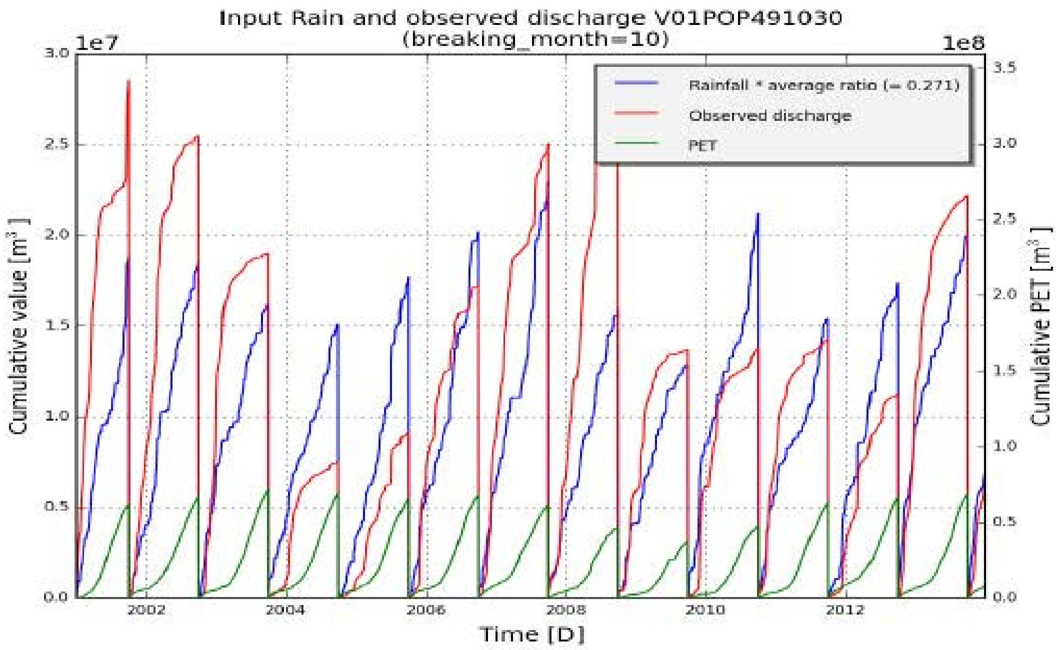


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V01POP491030 (IJzer)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V01POP491030
subcatchment_area [m2]	84868207
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 434.22), ('SMevap', 182.35), ('c1', 2.4), ('c2', 0.99), ('c3', 1.0), ('cOF1', -5.21), ('cOF2', 4.43), ('cIF1', -3.76), ('cIF2', 3.0), ('CQOF', 11.55), ('CKIF', 76.39), ('CKBF', 449.51)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-1.5 %	9.2 %	-8.8 %
NS	0.584	0.628	0.616
NS_log	0.618	0.178	0.676
NS_rel	-0.507	0.033	0.545
KGE	0.581	0.505	0.589

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-14.9 %	-2.5 %	-18.0 %
NS	0.574	0.558	0.594
NS_log	0.578	-0.052	0.661
NS_rel	-0.144	0.21	-0.233
KGE	0.552	0.504	0.582

1.3 Observed and simulated timeseries for optimum parameters

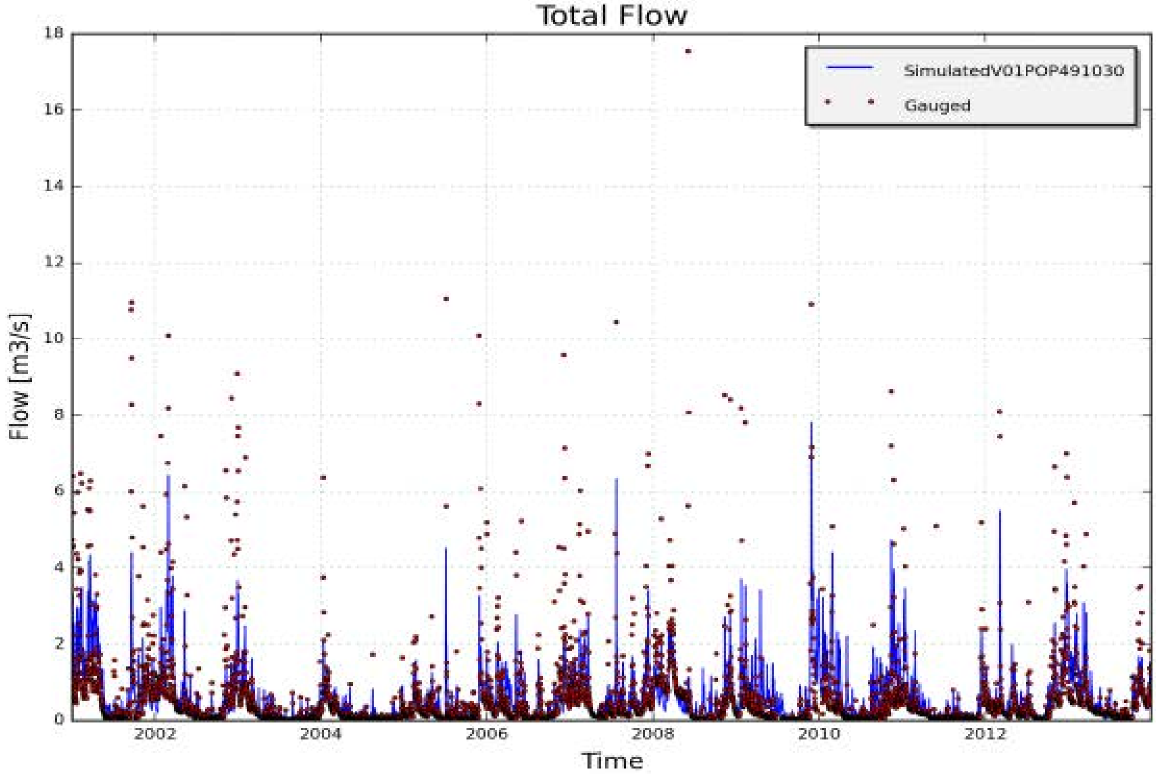


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01POP491030, station 49110102-Poperingevaart; Oostvleteren(calibration period)

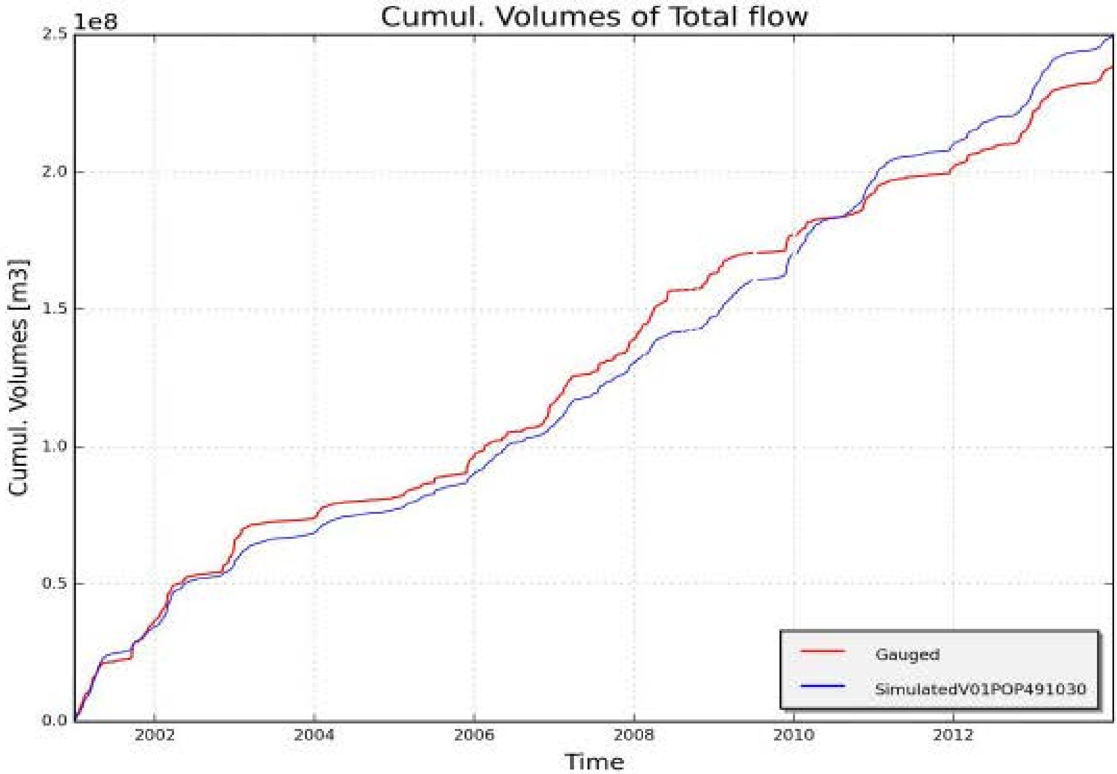


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01POP491030, station 49110102-Poperingevaart; Oostvleteren (calibration period)

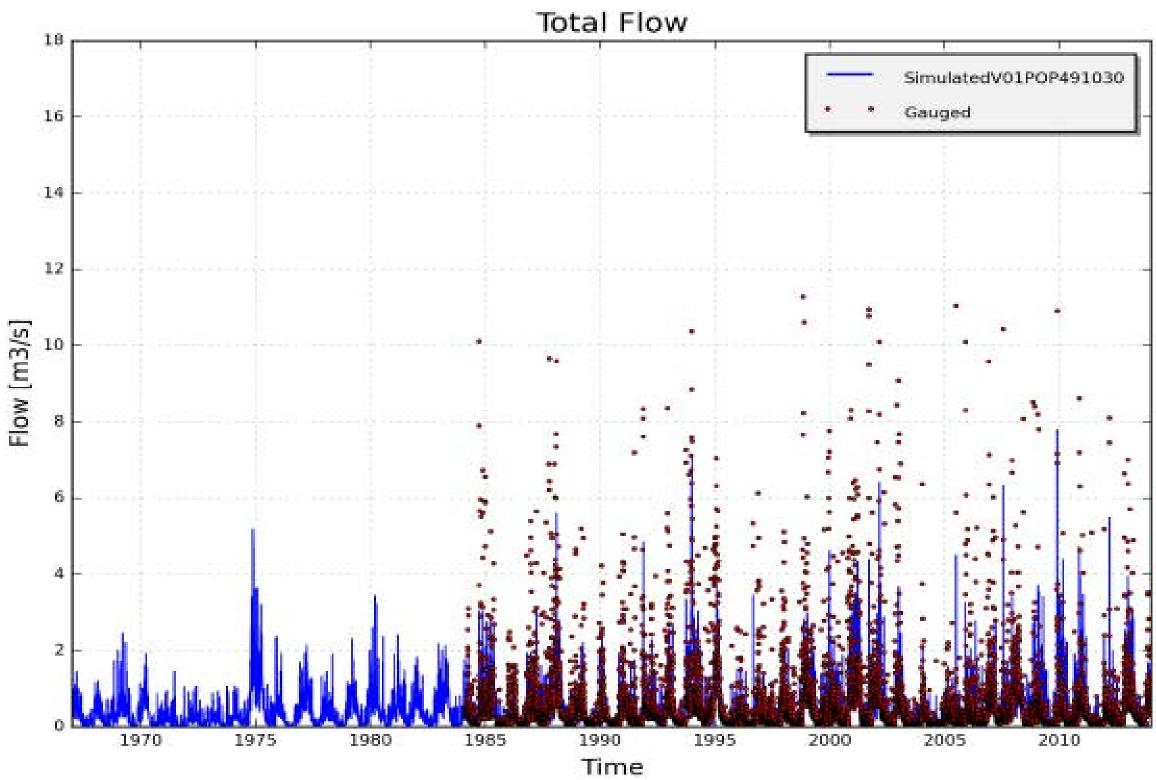


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01POP491030, station 49110102-Poperingevaart; Oostvleteren (validation period)

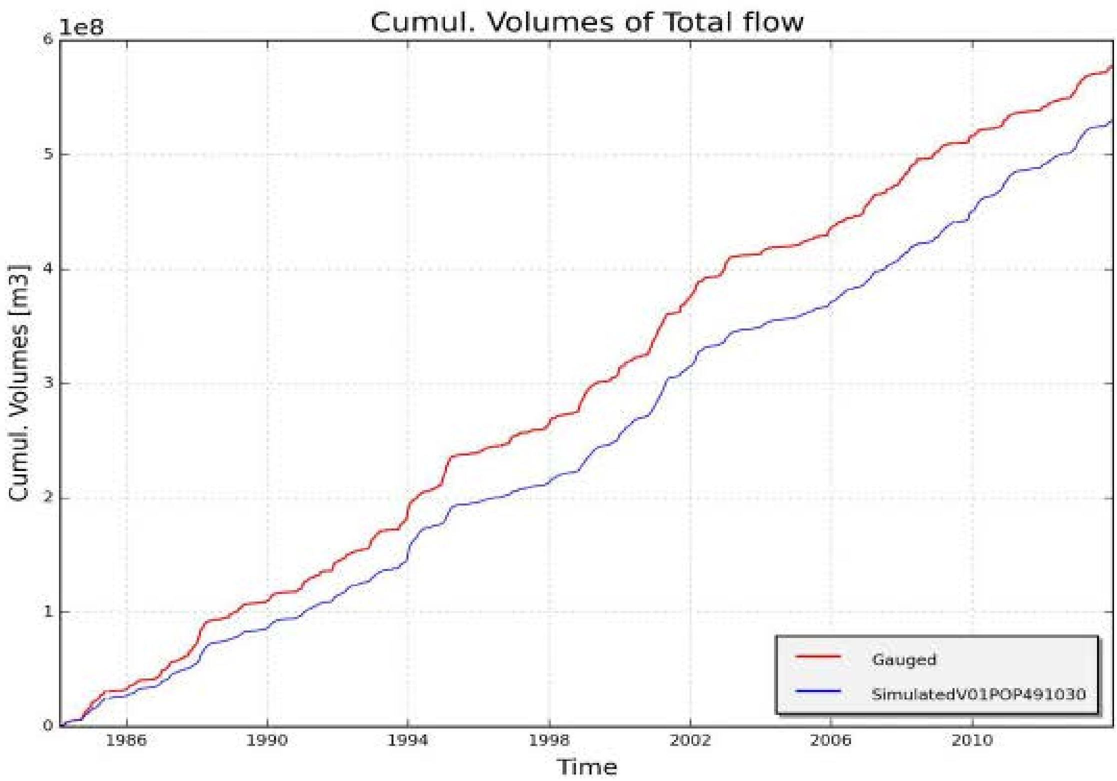


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01POP491030, station 49110102-Poperingevaart; Oostvleteren (validation period)

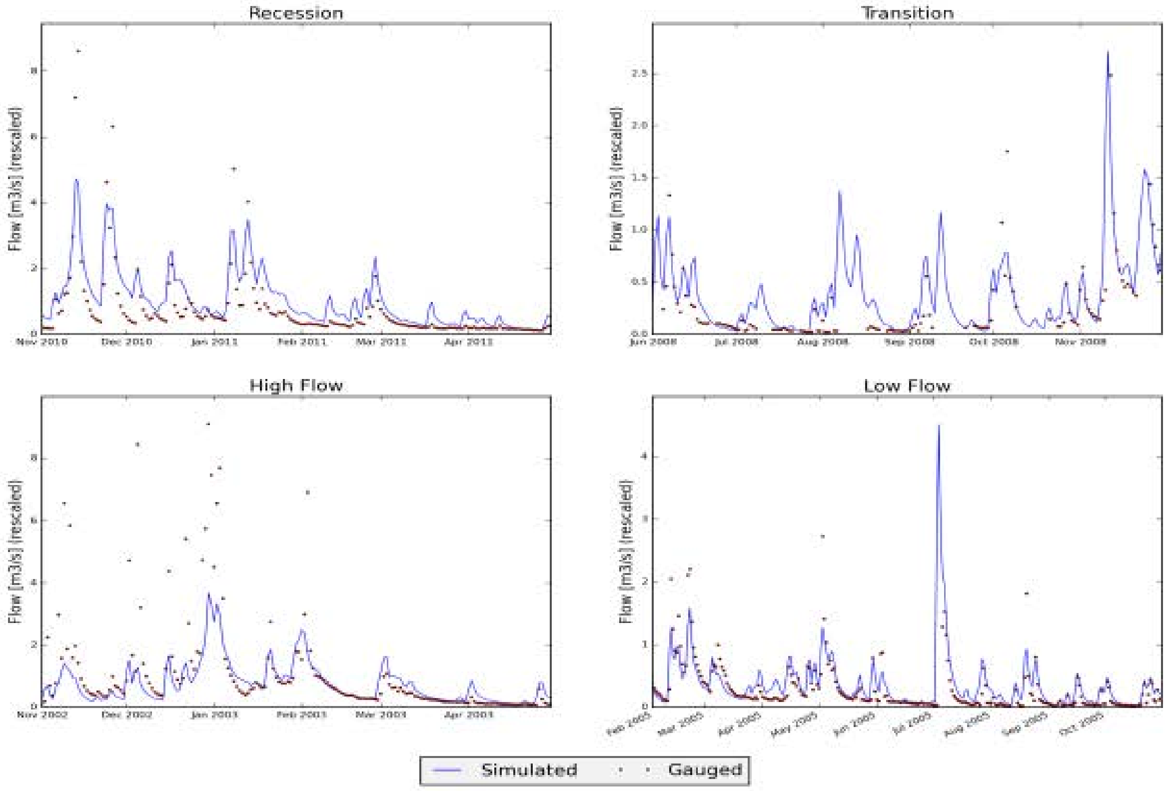


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V01POP491030, station 49110102-Poperingevaart; Oostvleteren

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V01SSV499140" (IJZER)

1.1 Input data

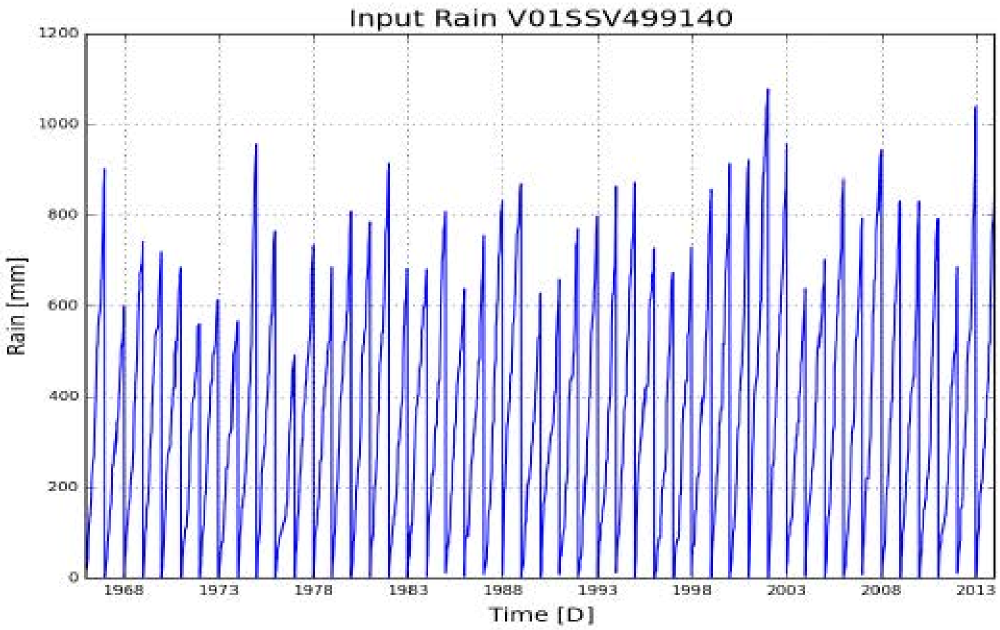


Figure 1: Cumulative precipitation on catchment V01SSV499140 (IJzer)

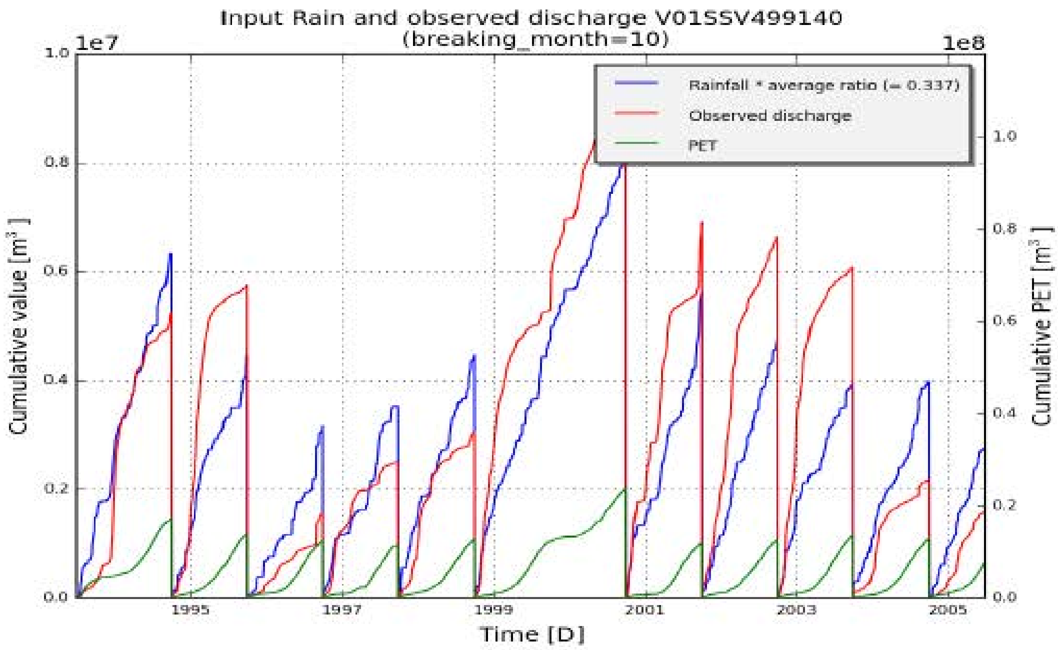


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V01SSV499140 (IJzer)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V01SSV499140
subcatchment_area [m2]	16095000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 431.57), ('SMevap', 175.27), ('c1', 2.17), ('c2', 1.09), ('c3', 1.0), ('cOF1', -4.53), ('cOF2', 5.0), ('cIF1', -3.89), ('cIF2', 2.98), ('CQOF', 12.51), ('CKIF', 52.45), ('CKBF', 719.35)]

Table 1: Goodness of fit for calibration period (1993 - 2005)

	Full year	Summer	Winter
RelErr	0.7 %	2.3 %	-7.9 %
NS	0.607	0.552	0.649
NS_log	0.619	0.293	0.729
NS_rel	0.193	0.625	0.42
KGE	0.547	0.422	0.546

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	Summer	Winter
RelErr	-2.4 %	-14.9 %	-6.9 %
NS	0.59	0.477	0.644
NS_log	0.601	0.352	0.677
NS_rel	0.128	0.5	0.181
KGE	0.53	0.367	0.548

1.3 Observed and simulated timeseries for optimum parameters

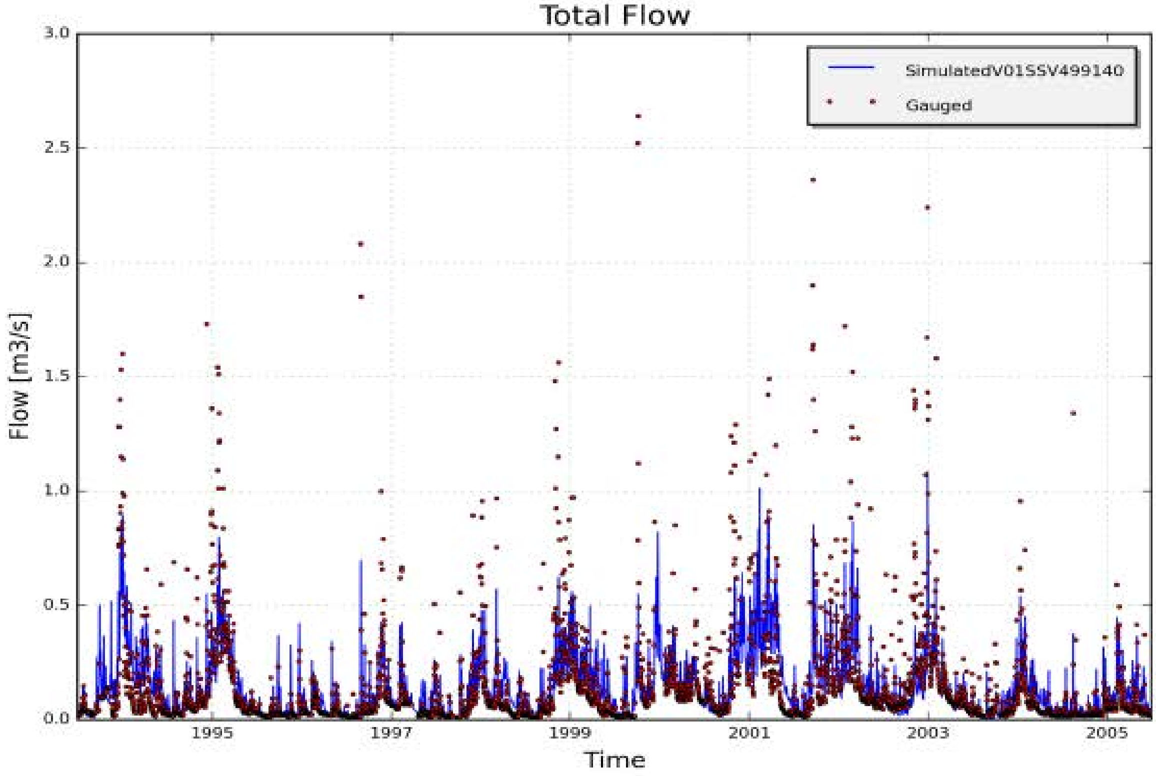


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01SSV499140, station 49910102 - Steenbeek; Merkem(calibration period)

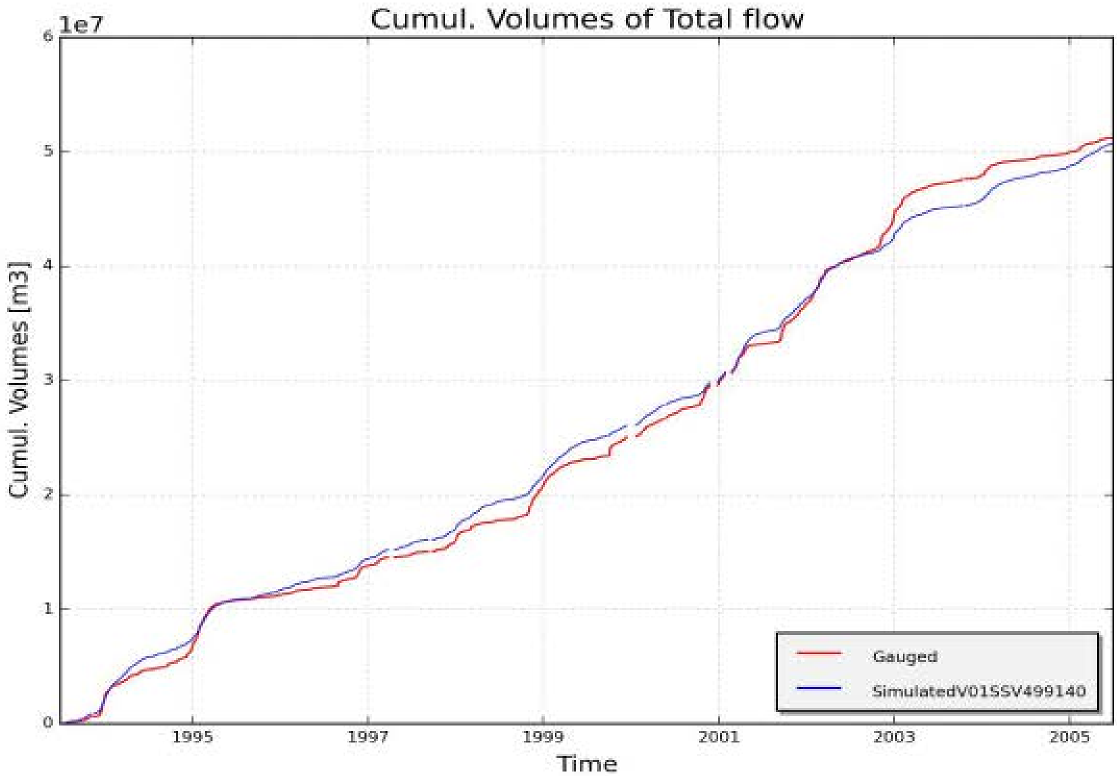


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01SSV499140, station 49910102 - Steenbeek; Merkem (calibration period)

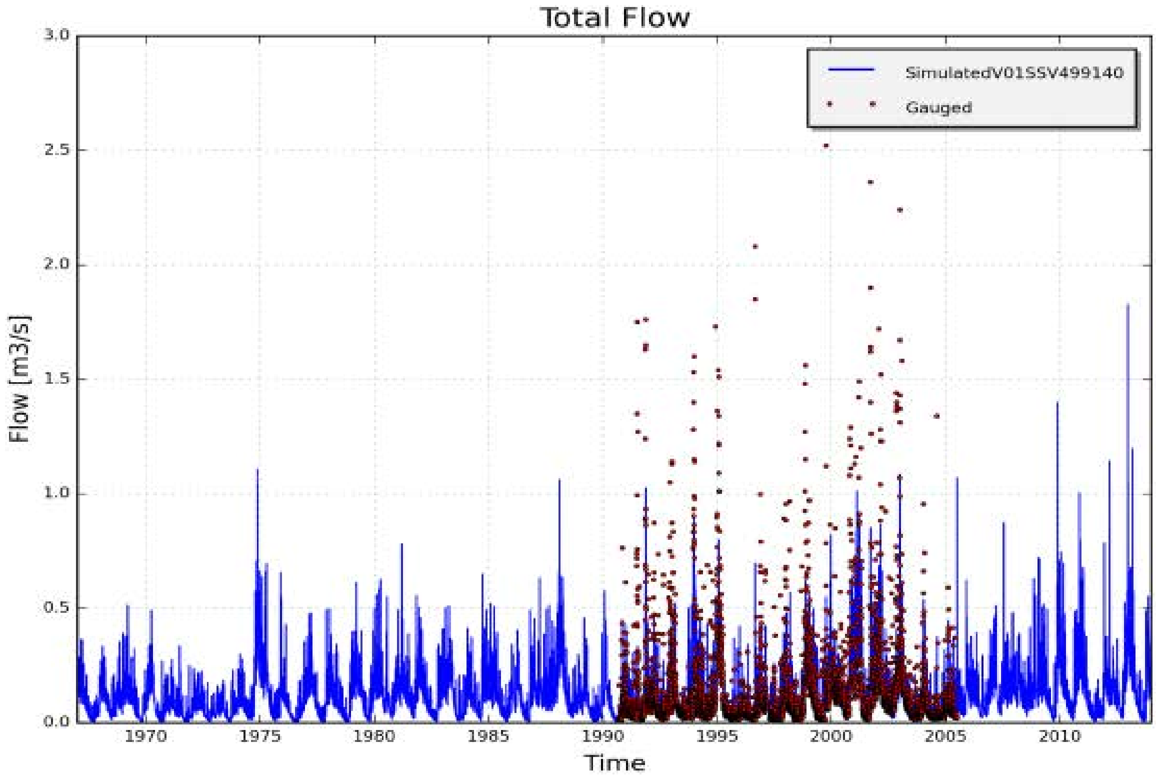


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V01SSV499140, station 49910102 - Steenbeek; Merkem (validation period)

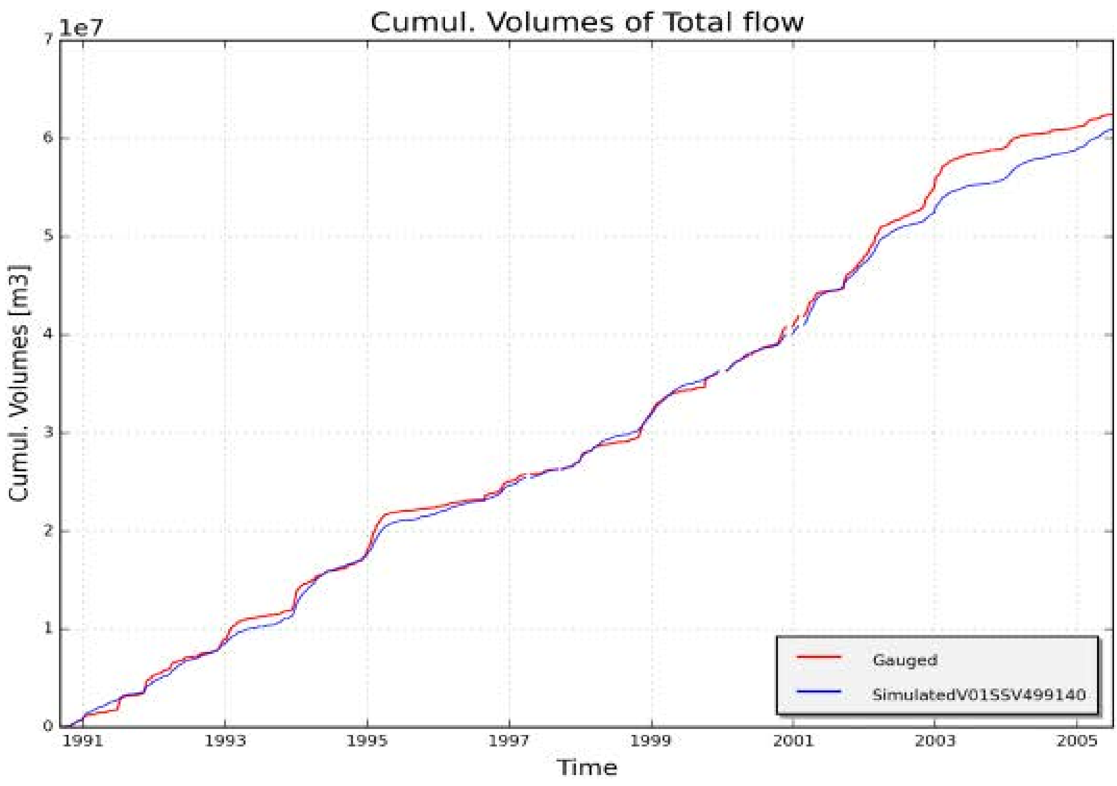


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V01SSV499140, station 49910102 - Steenbeek; Merkem (validation period)

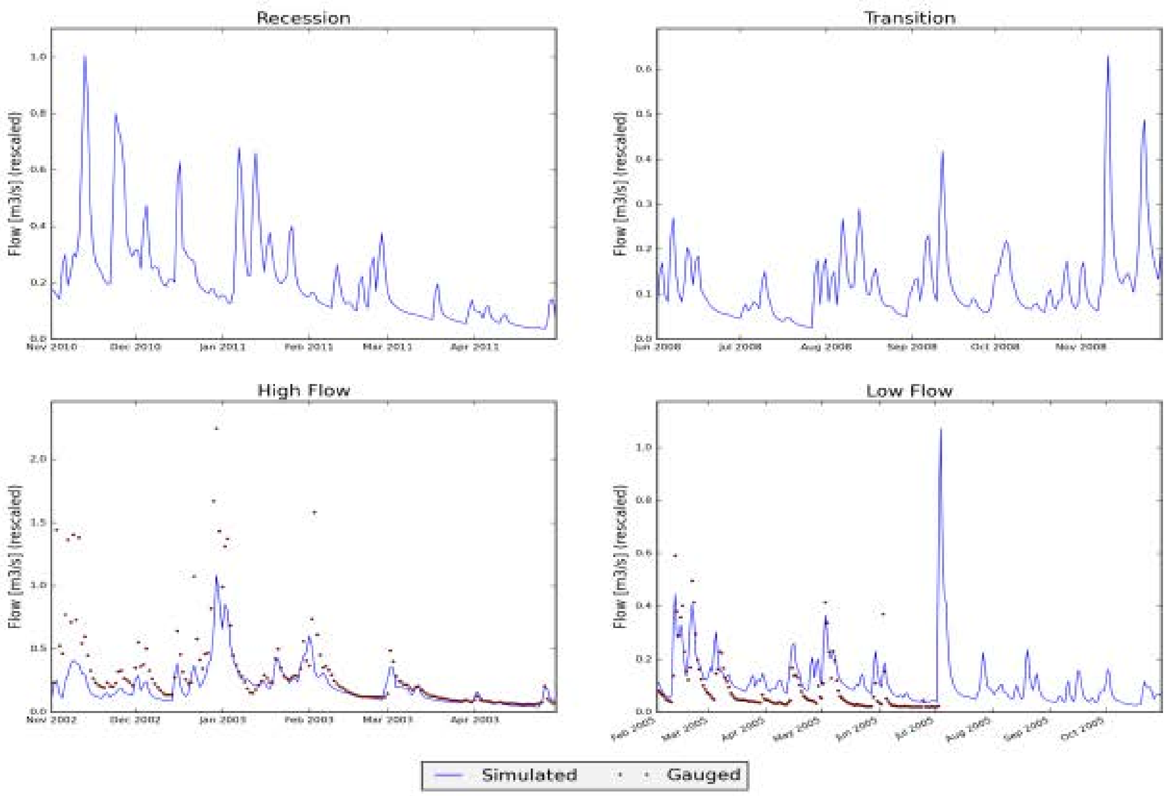


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V01SSV499140, station 49910102 - Steenbeek; Merkem

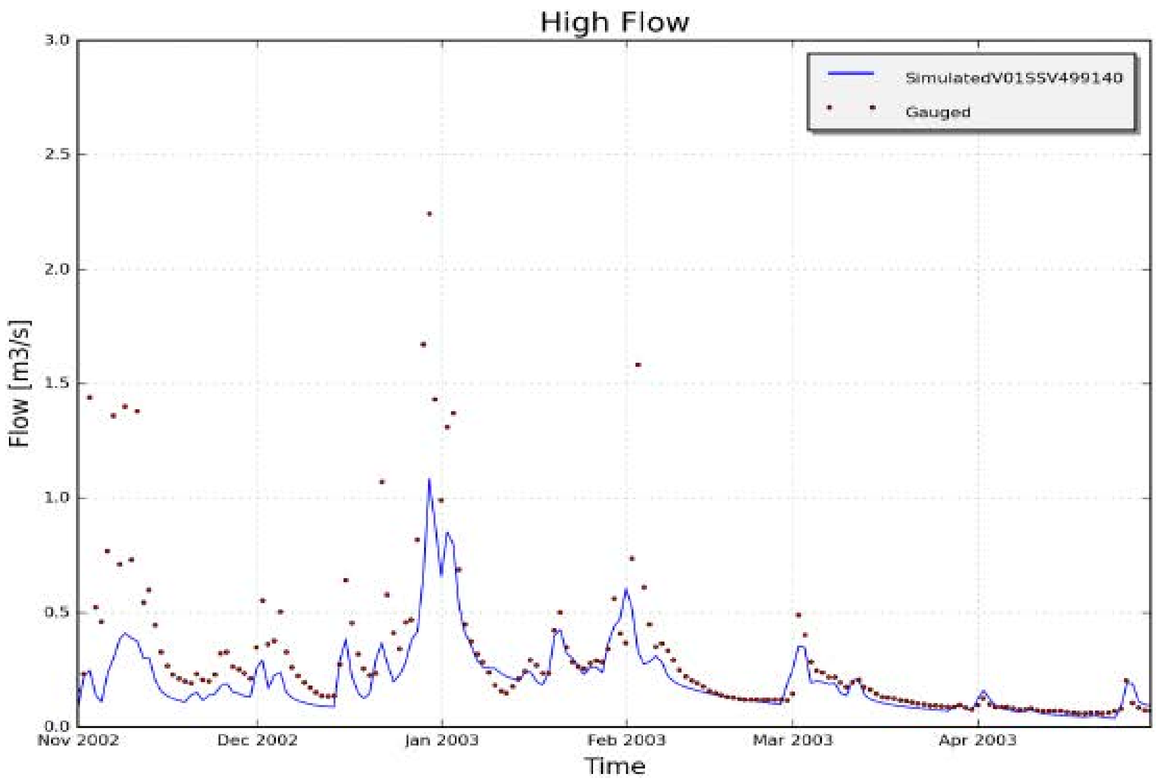


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V01SSV499140, station 49910102 - Steenbeek; Merkem

Appendix 4 Brugse Polders

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V02EDE442120" (BRUGSE POLDERS)

1.1 Input data

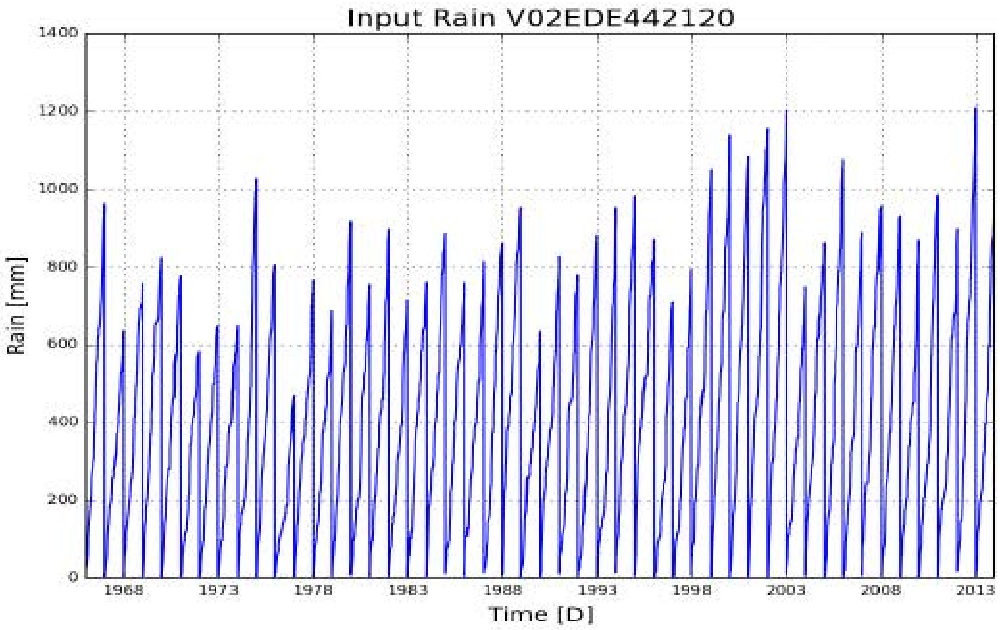


Figure 1: Cumulative precipitation on catchment V02EDE442120 (Brugse Polders)

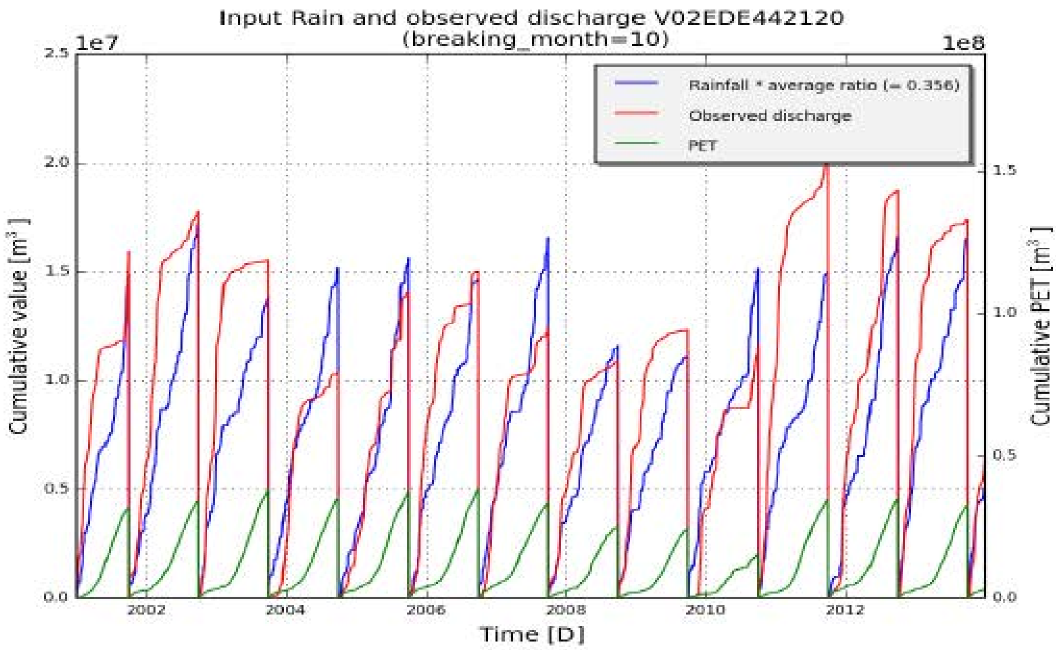


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V02EDE442120 (Brugse Polders)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V02EDE442120
subcatchment_area [m2]	45489177
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 432.44), ('SMevap', 198.34), ('c1', 2.93), ('c2', 1.04), ('c3', 1.0), ('cOF1', -7.89), ('cOF2', 6.92), ('cIF1', -5.74), ('cIF2', 4.96), ('CQOF', 13.23), ('CKIF', 71.85), ('CKBF', 875.45)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	0.9 %	-8.3 %	5.9 %
NS	0.722	0.617	0.753
NS_log	0.634	0.587	0.688
NS_rel	-44.338	-1.271	0.22
KGE	0.771	0.522	0.853

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-5.1 %	11.9 %	-6.0 %
NS	0.725	0.631	0.737
NS_log	0.592	0.328	0.63
NS_rel	-24.306	-3.875	-0.992
KGE	0.779	0.565	0.857

1.3 Observed and simulated timeseries for optimum parameters

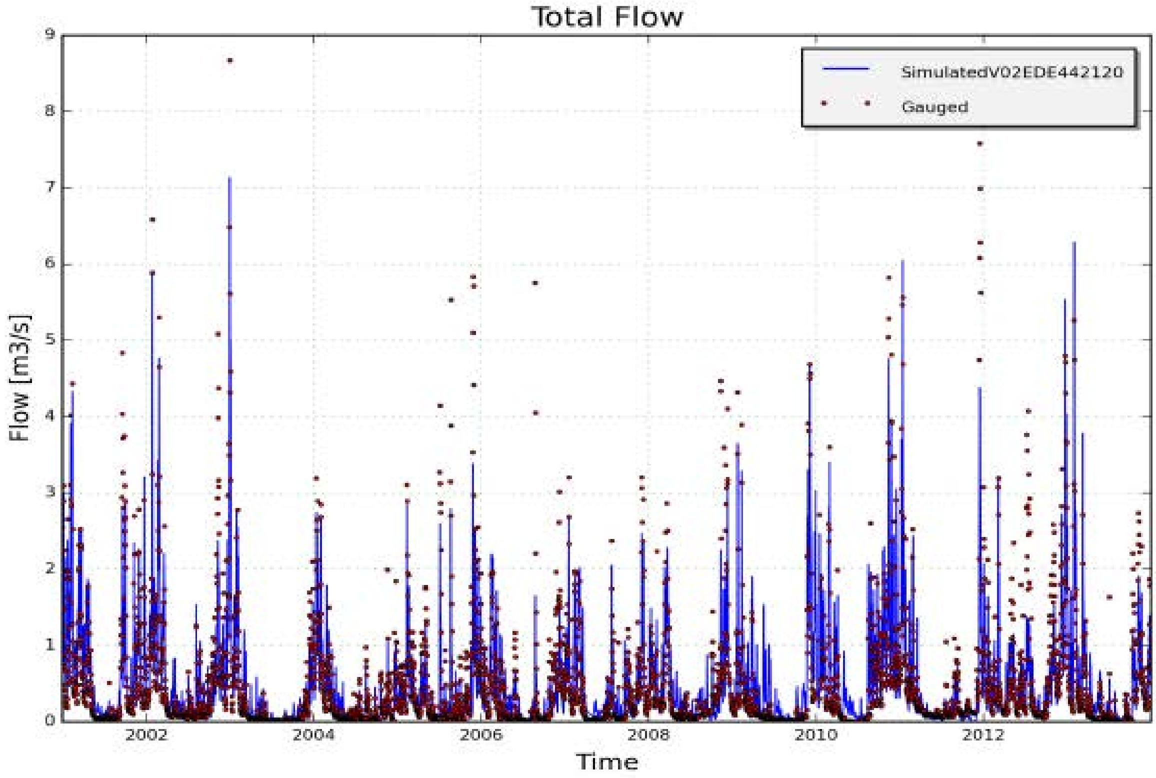


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V02EDE442120, station 44210102 - Maldegem(calibration period)

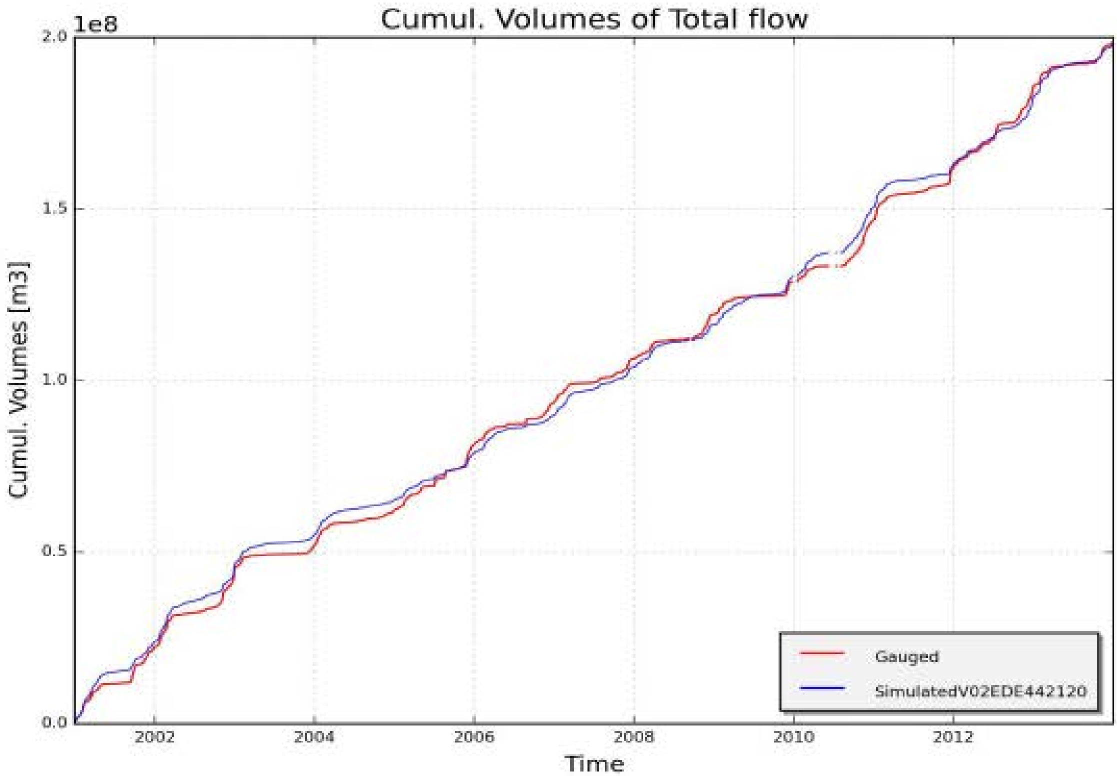


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V02EDE442120, station 44210102 - Maldegem (calibration period)

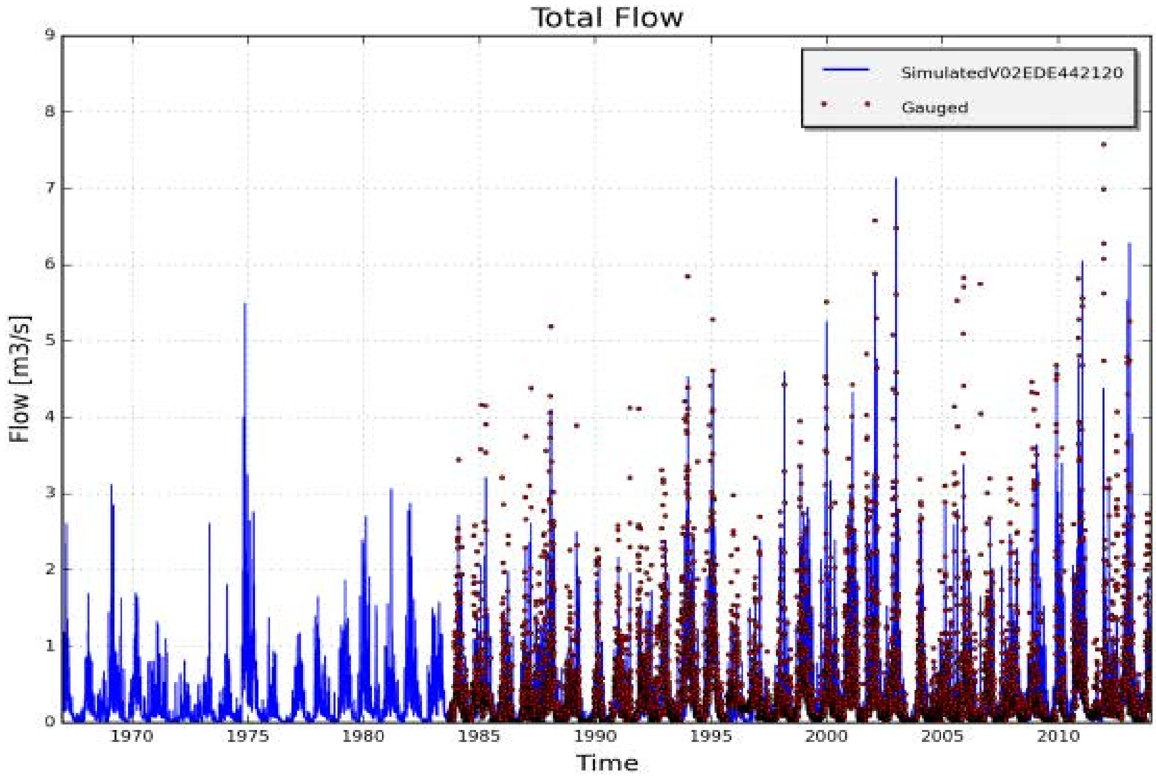


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V02EDE442120, station 44210102 - Maldegem (validation period)

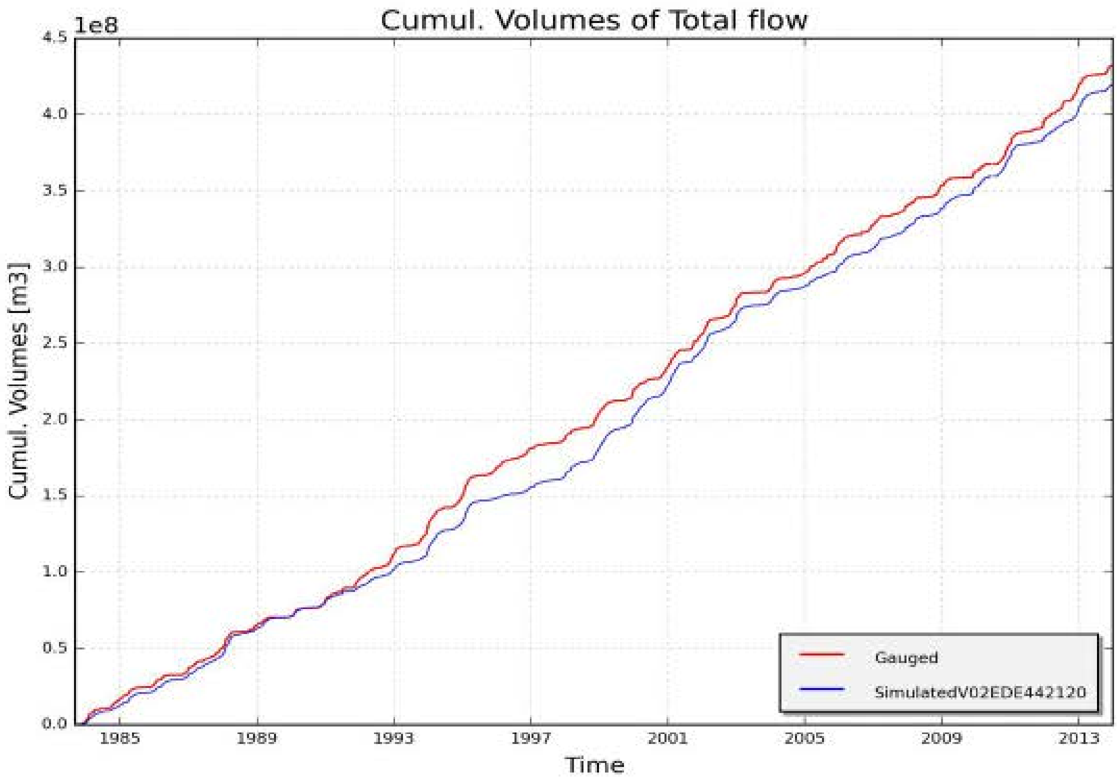


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V02EDE442120, station 44210102 - Maldegem (validation period)

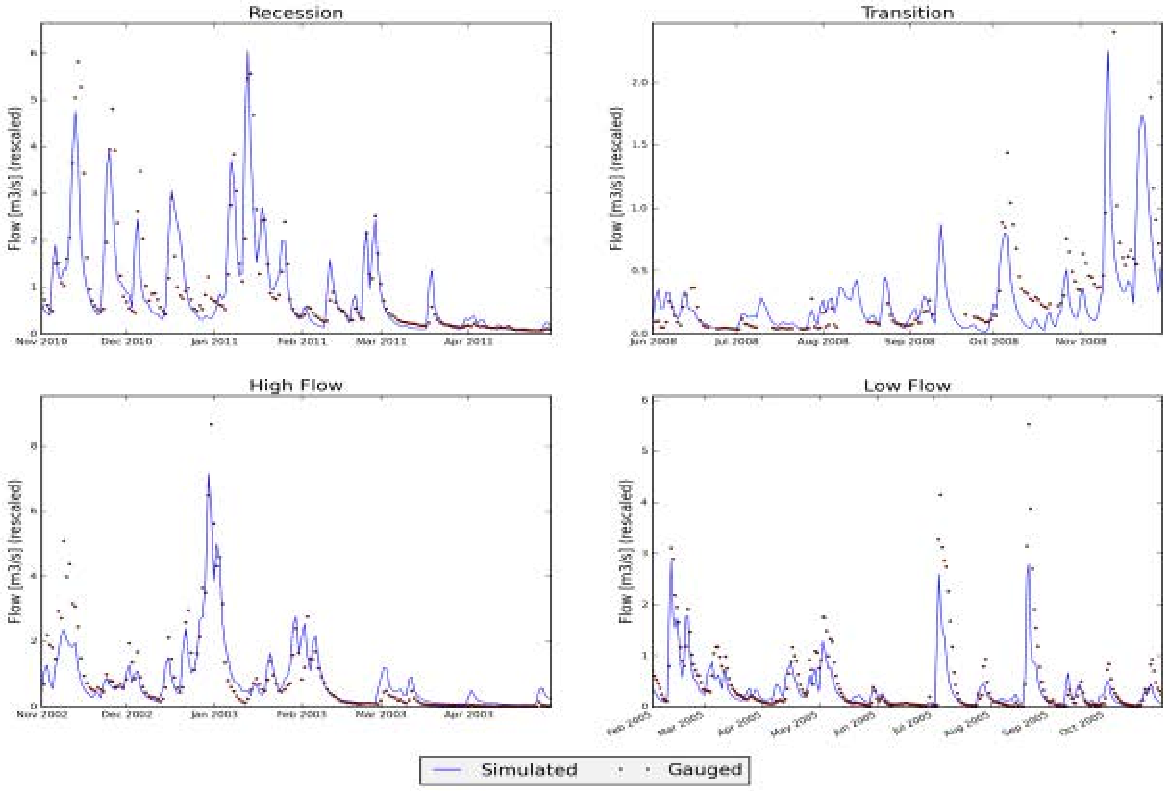


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V02EDE442120, station 44210102 - Maldegem

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V02HER426010" (BRUGSE POLDERS)

1.1 Input data

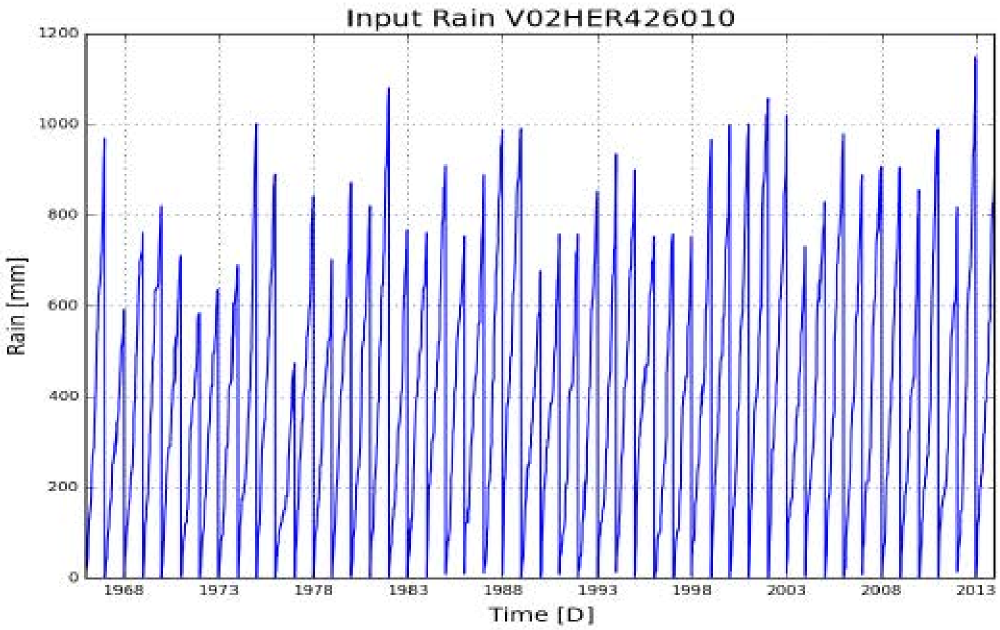


Figure 1: Cumulative precipitation on catchment V02HER426010 (Brugse Polders)

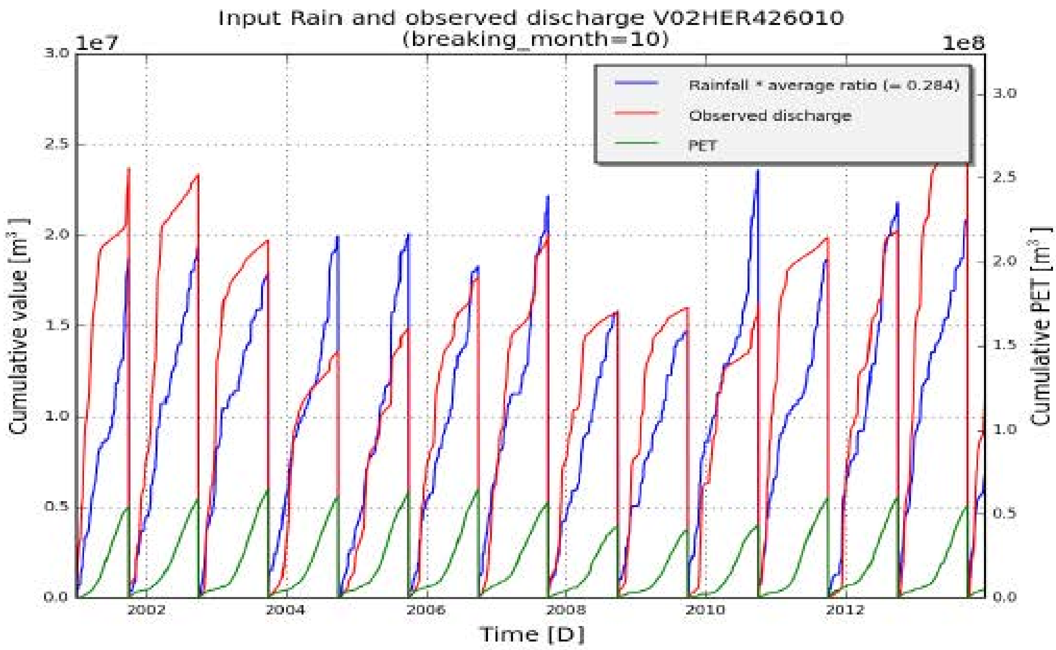


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V02HER426010 (Brugse Polders)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V02HER426010
subcatchment_area [m2]	77272201
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 474.9), ('SMevap', 246.05), ('c1', 2.35), ('c2', 0.78), ('c3', 1.0), ('cOF1', -7.48), ('cOF2', 4.17), ('cIF1', -4.44), ('cIF2', 4.35), ('CQOF', 10.37), ('CKIF', 72.62), ('CKBF', 1318.31)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.2 %	32.0 %	-10.0 %
NS	0.653	0.571	0.686
NS_log	0.549	-0.107	0.709
NS_rel	-0.037	0.296	0.227
KGE	0.664	0.476	0.714

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-4.8 %	46.3 %	-16.5 %
NS	0.662	0.541	0.685
NS_log	0.595	0.159	0.671
NS_rel	-0.874	-1.35	0.434
KGE	0.658	0.481	0.685

1.3 Observed and simulated timeseries for optimum parameters

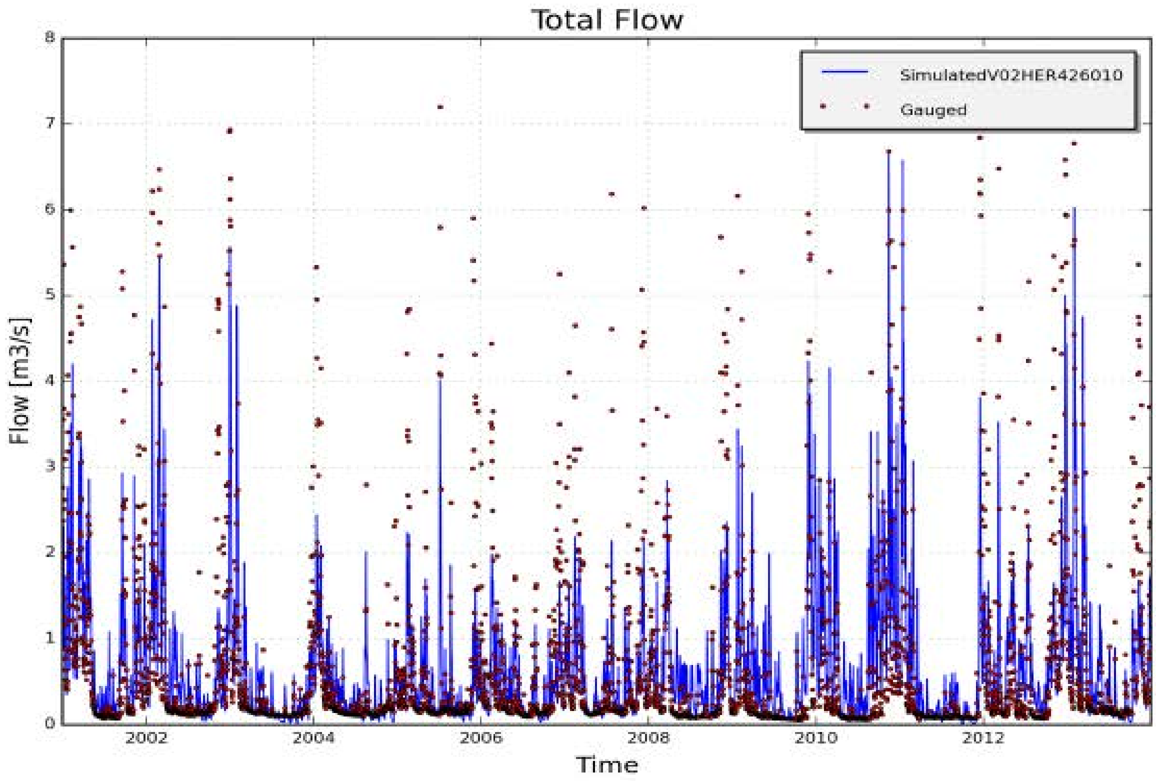


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V02HER426010, station 42610102 - Hertsbergebeek; Oostkamp(calibration period)

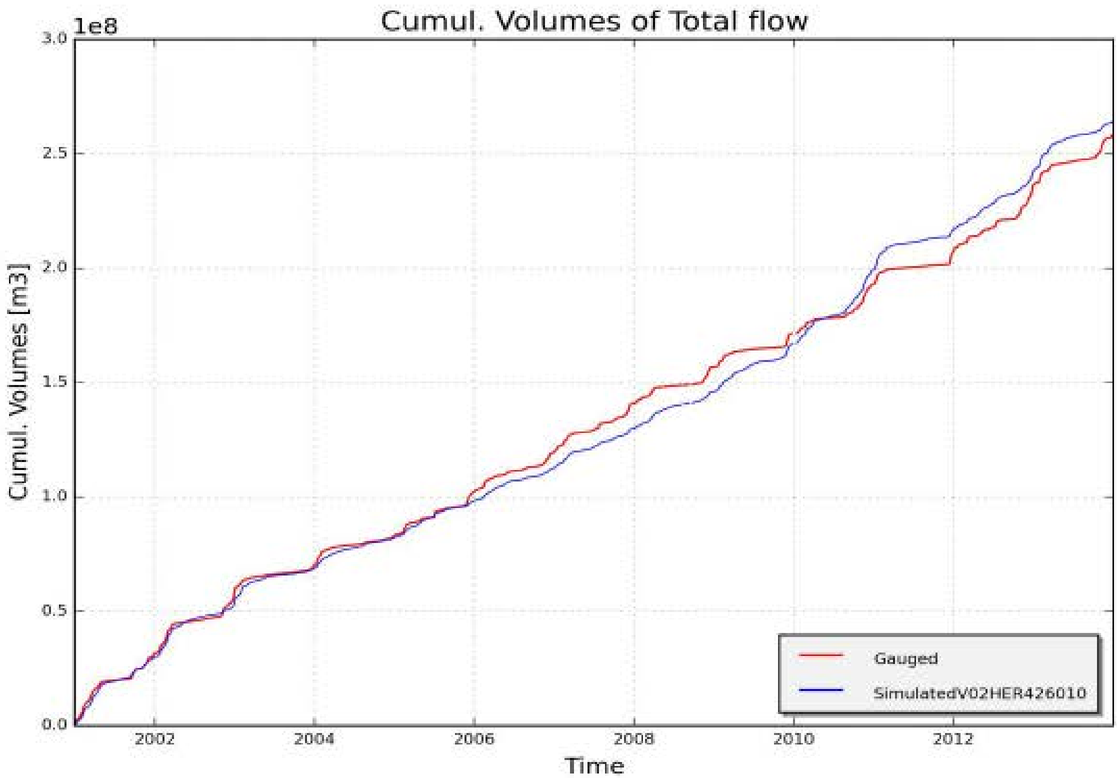


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V02HER426010, station 42610102 - Hertsbergebeek; Oostkamp (calibration period)

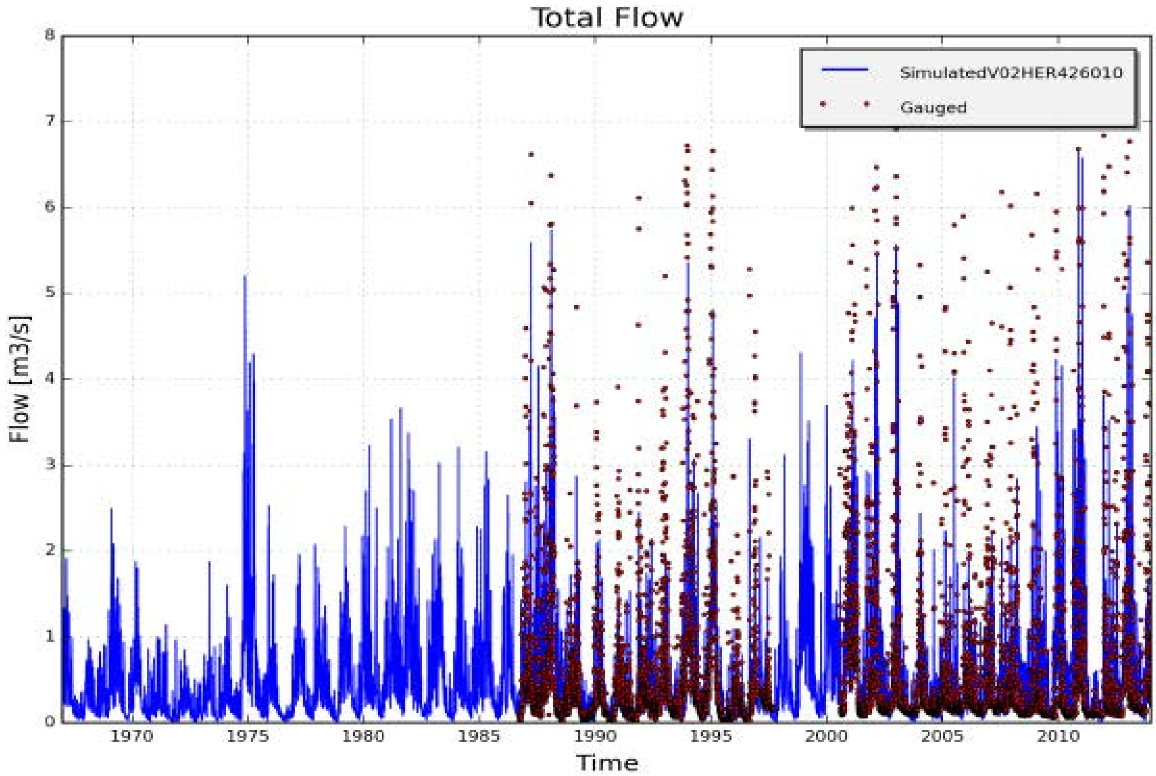


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V02HER426010, station 42610102 - Hertsbergebeek; Oostkamp (validation period)

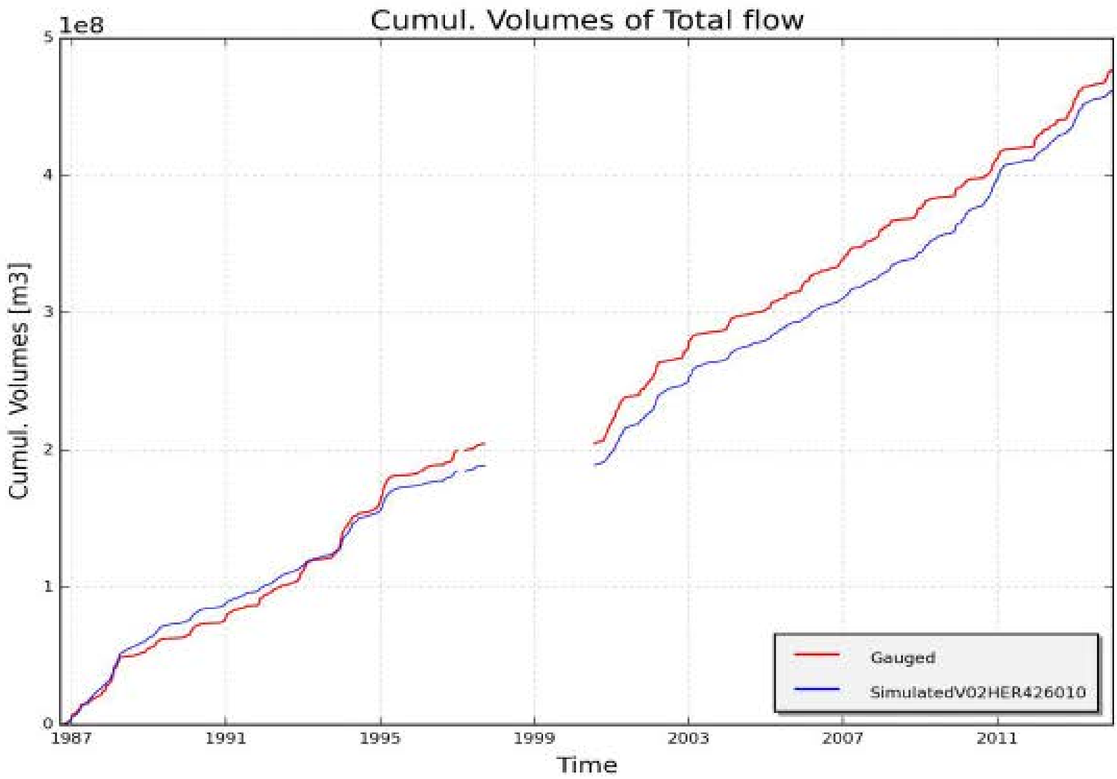


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V02HER426010, station 42610102 - Hertsbergebeek; Oostkamp (validation period)

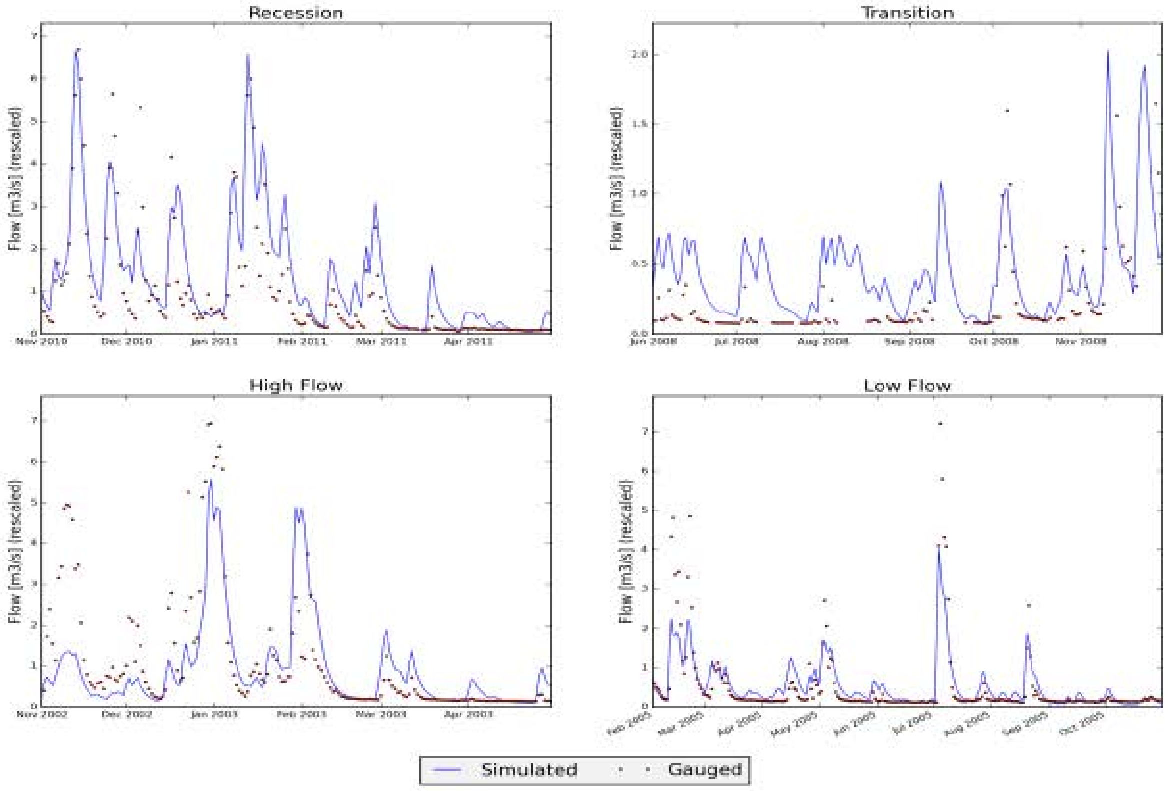


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V02HER426010, station 42610102 - Hertsbergebeek; Oostkamp

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V02KER422030" (BRUGSE POLDERS)

1.1 Input data

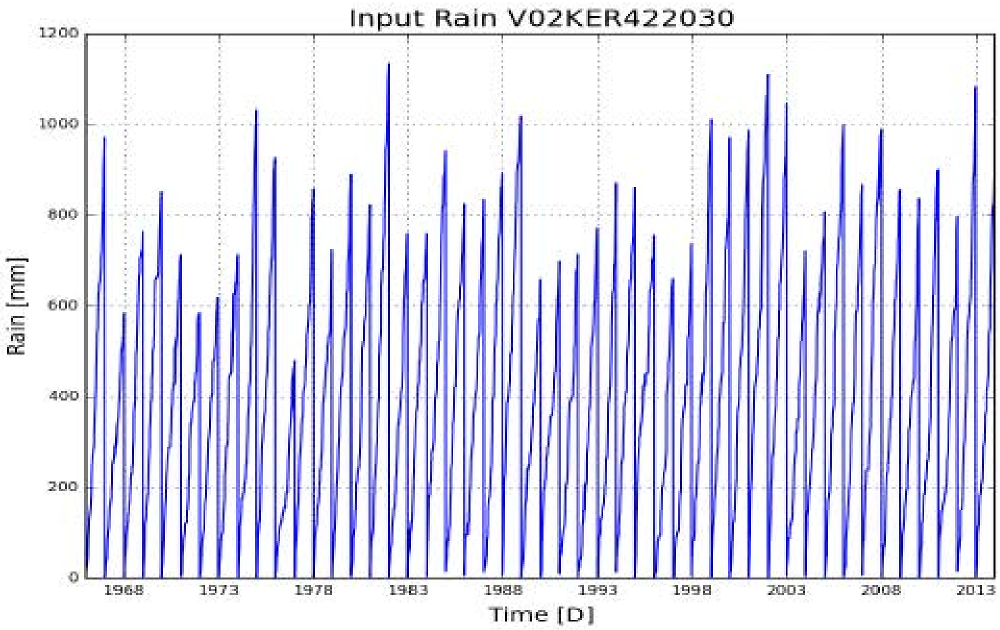


Figure 1: Cumulative precipitation on catchment V02KER422030 (Brugse Polders)

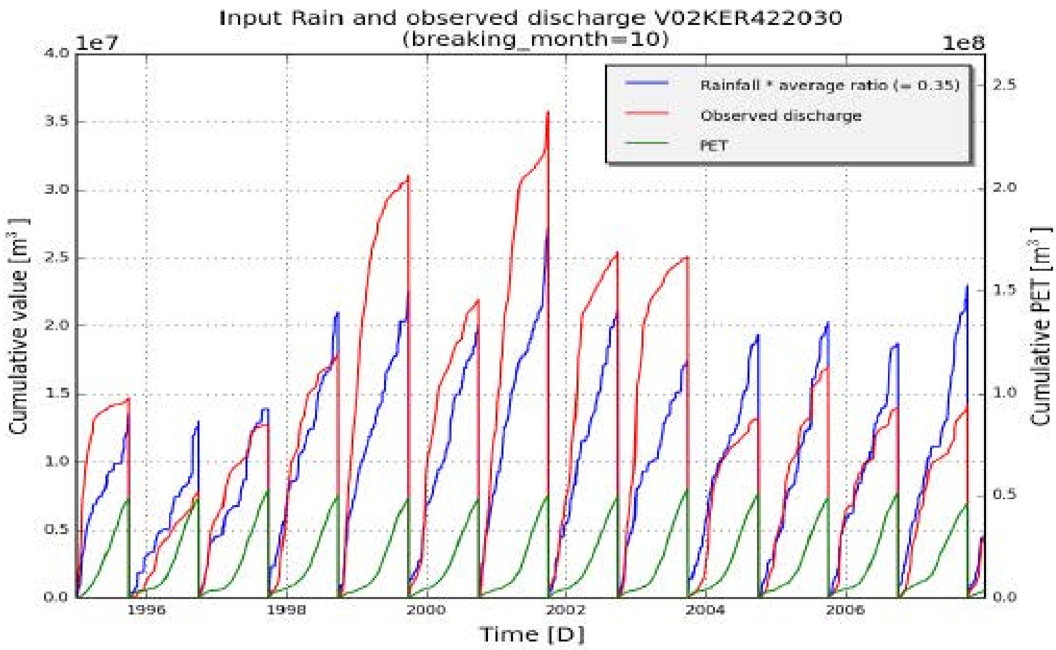


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V02KER422030 (Brugse Polders)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V02KER422030
subcatchment_area [m2]	62718738
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 379.33), ('SMevap', 312.64), ('c1', 2.71), ('c2', 0.99), ('c3', 1.0), ('cOF1', -8.36), ('cOF2', 0.86), ('cIF1', -2.89), ('cIF2', 5.0), ('CQOF', 16.59), ('CKIF', 67.14), ('CKBF', 1487.4)]

Table 1: Goodness of fit for calibration period (1995 - 2007)

	Full year	**Summer**	**Winter**
RelErr	613.5 %	724.2 %	598.4 %
NS	-53.918	-73.228	-69.669
NS_log	-2.331	-4.606	-3.686
NS_rel	-174.431	-51.027	-921.971
KGE	-7.699	-10.352	-7.437

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	558.0 %	755.3 %	521.8 %
NS	-42.658	-66.105	-54.227
NS_log	-1.919	-4.007	-3.085
NS_rel	-146.609	-109.894	-487.85
KGE	-6.858	-9.753	-6.628

1.3 Observed and simulated timeseries for optimum parameters

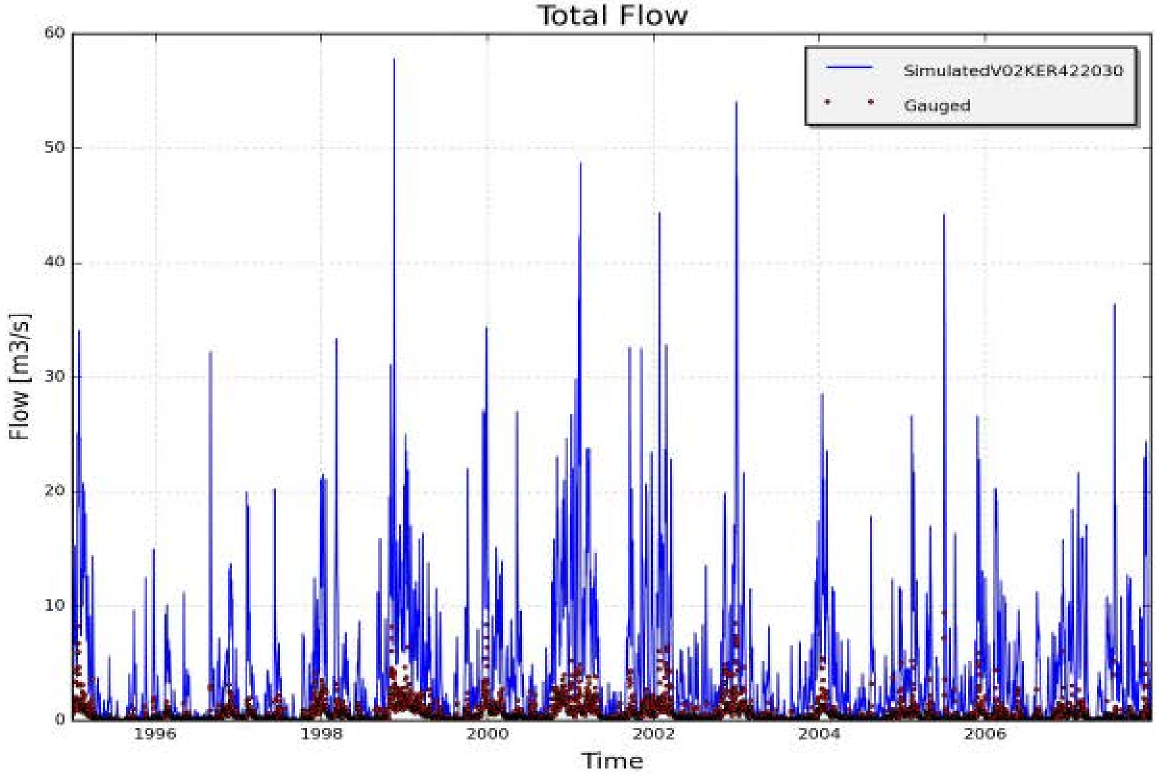


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V02KER422030, station 4220102 - Kerkebeek, Sint-Michiels(calibration period)

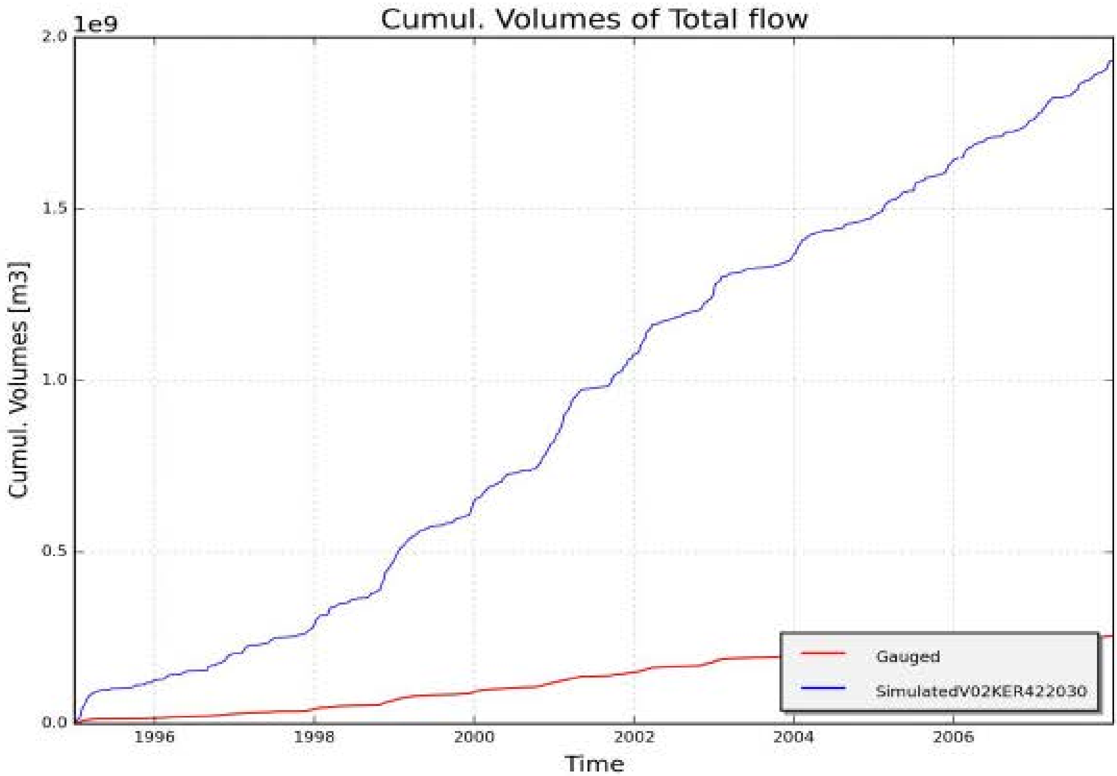


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V02KER422030, station 4220102 - Kerkebeek, Sint-Michiels (calibration period)

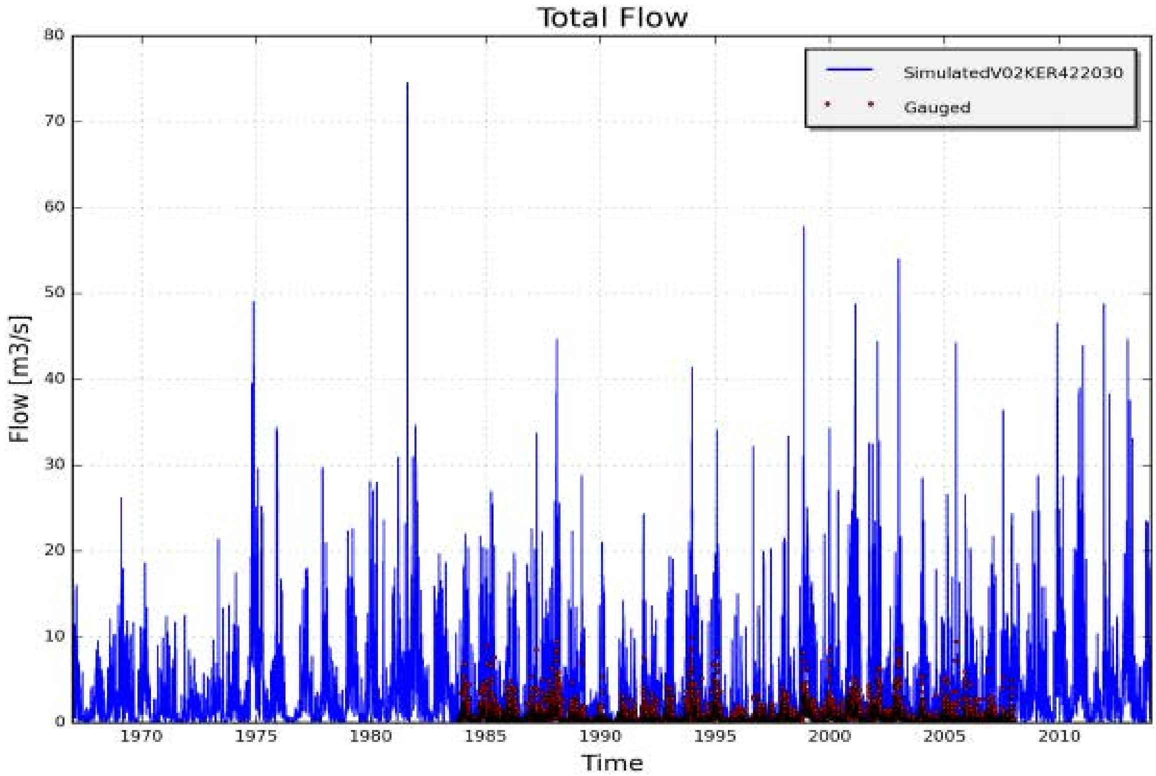


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V02KER422030, station 4220102 - Kerkebeek, Sint-Michiels (validation period)

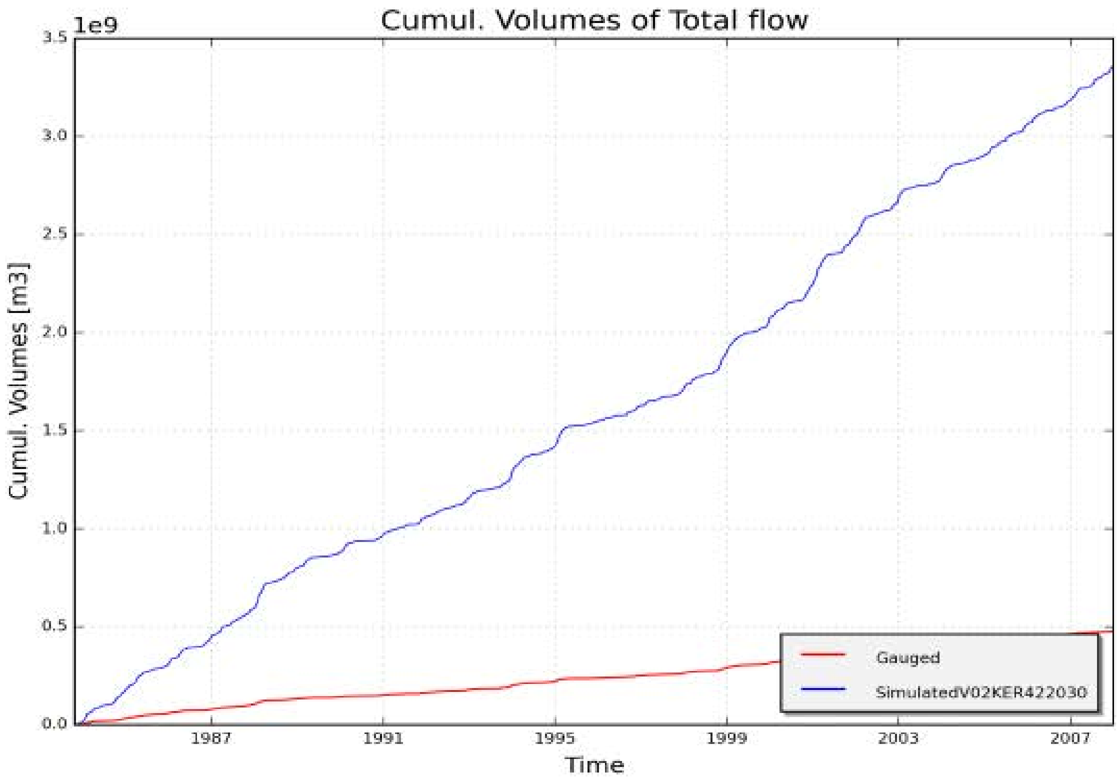


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V02KER422030, station 4220102 - Kerkebeek, Sint-Michiels (validation period)

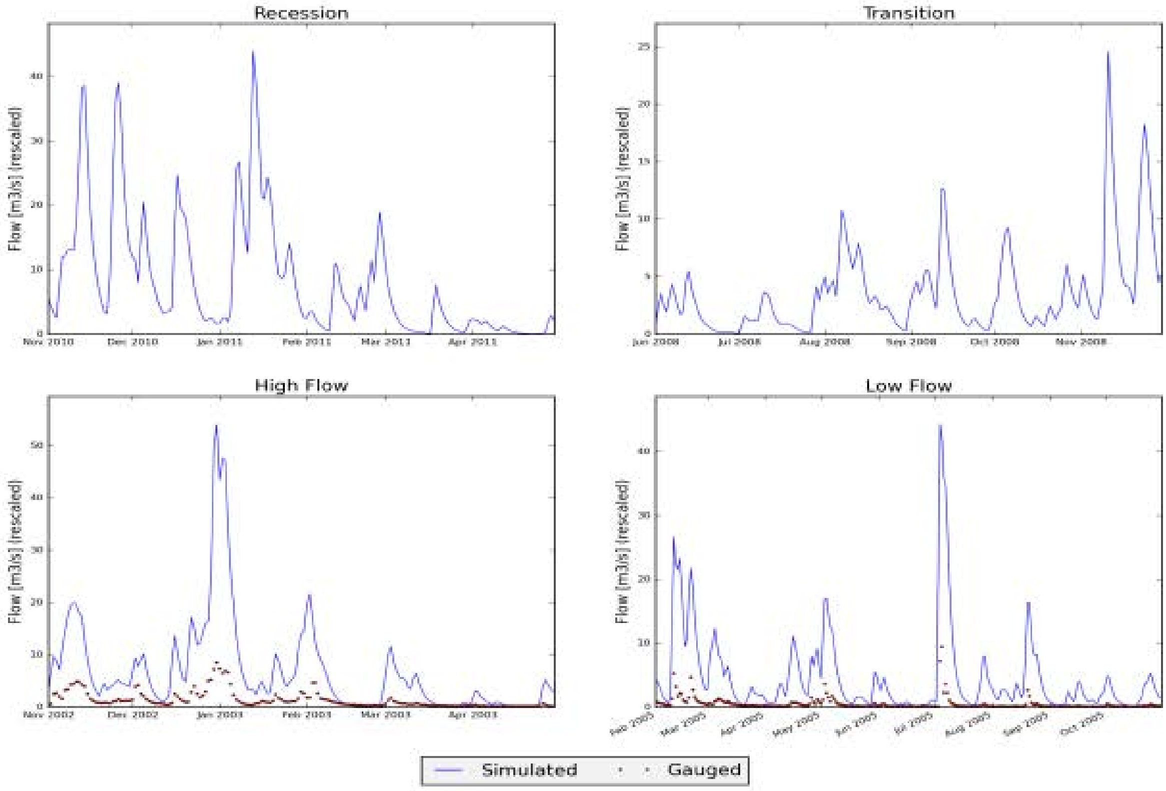


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V02KER422030, station 4220102 - Kerkebeek, Sint-Michiels

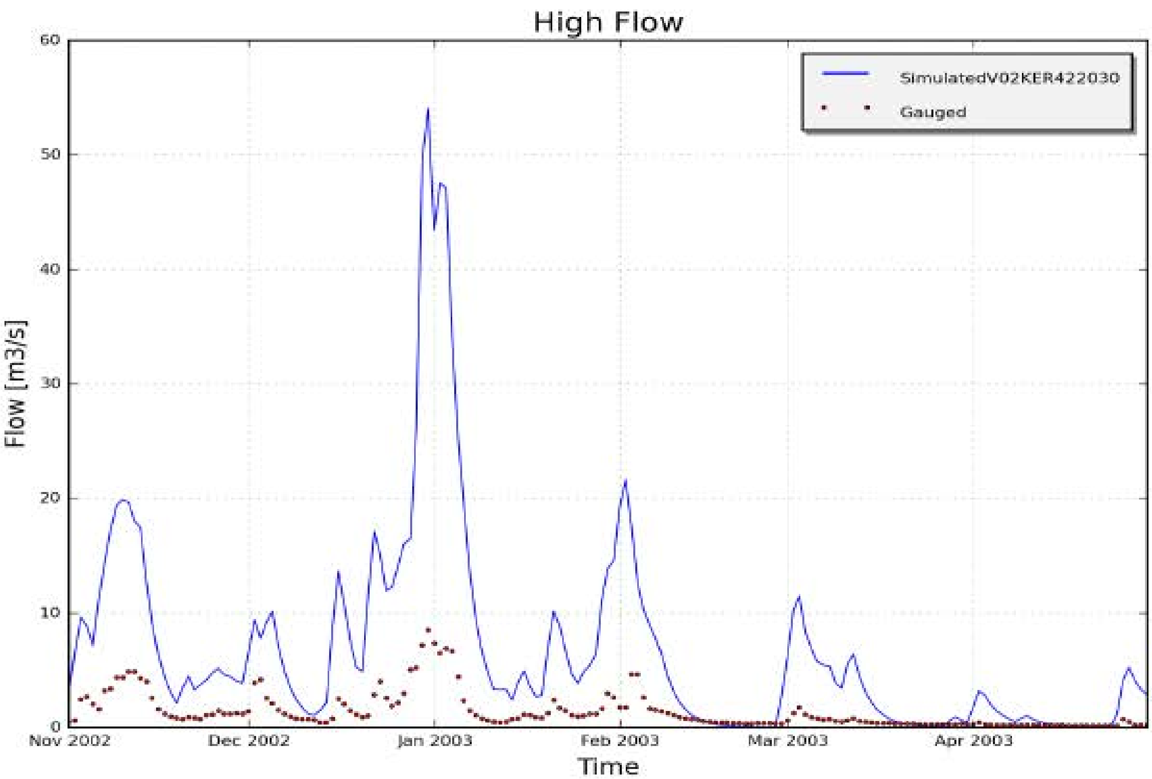


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V02KER422030, station 4220102 - Kerkebeek, Sint-Michiels

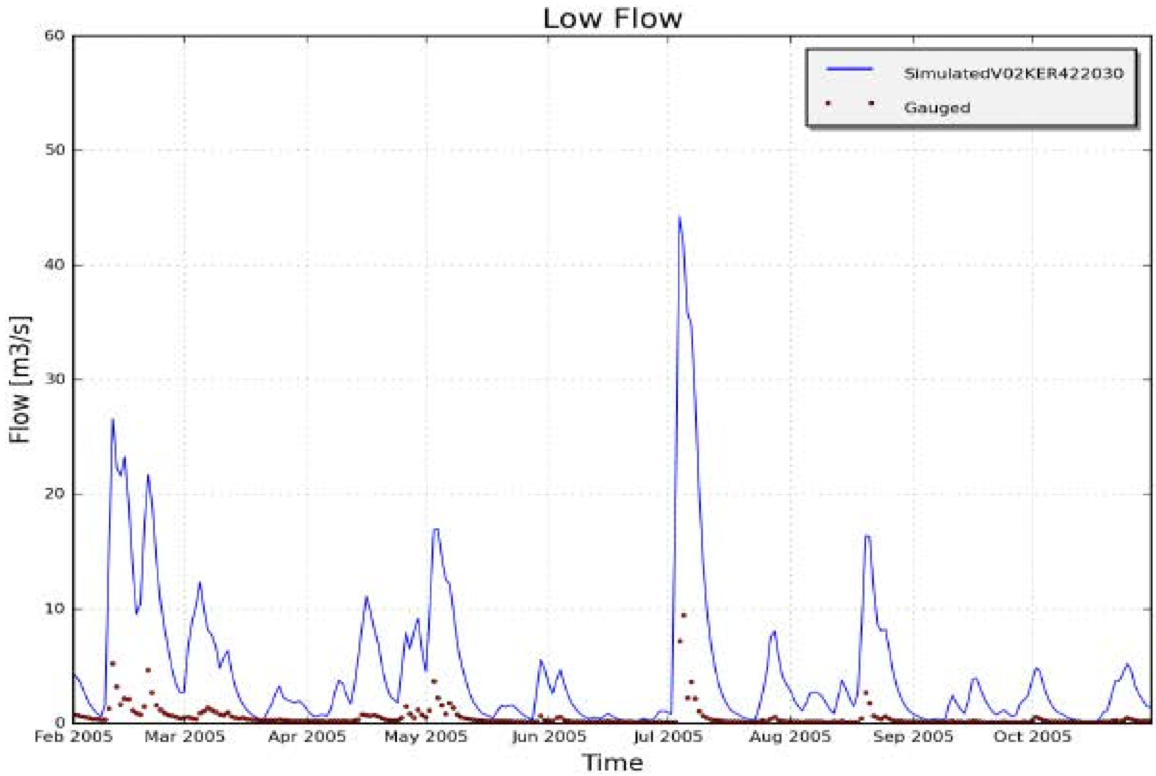


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V02KER422030, station 4220102 - Kerkebeek, Sint-Michiels

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V02RIV425020" (BRUGSE POLDERS)

1.1 Input data

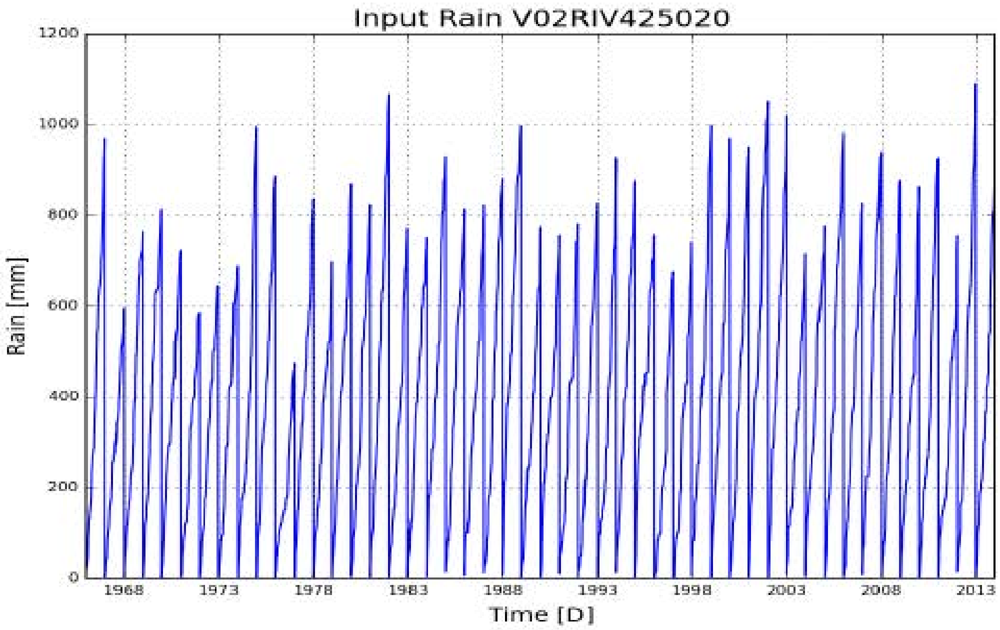


Figure 1: Cumulative precipitation on catchment V02RIV425020 (Brugse Polders)

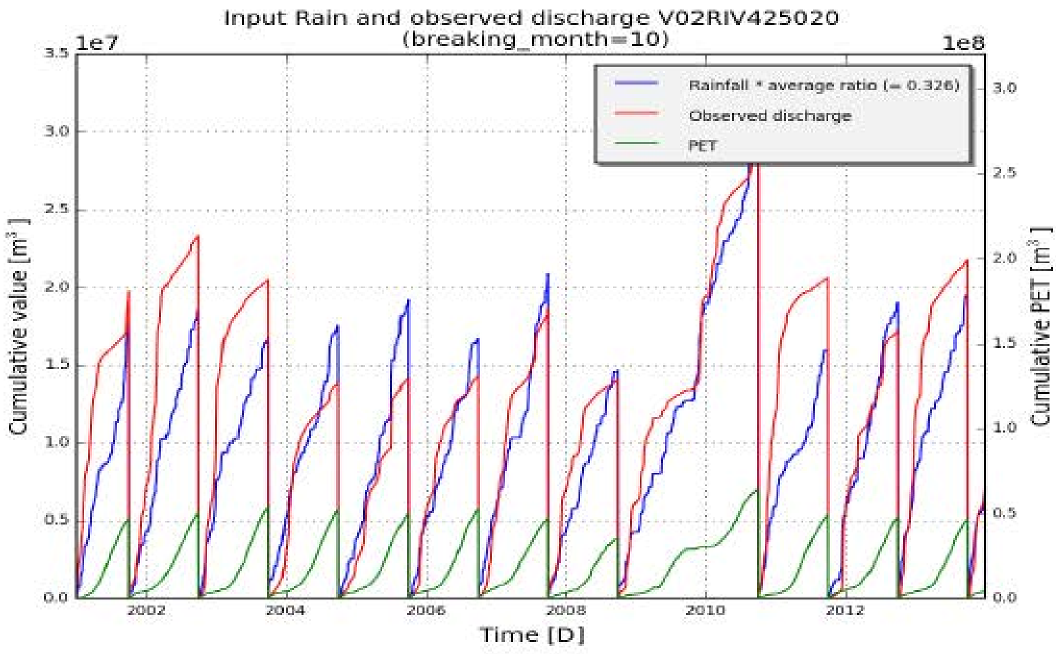


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V02RIV425020 (Brugse Polders)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V02RIV425020
subcatchment_area [m2]	63980423
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 406.93), ('SMevap', 200.92), ('c1', 2.16), ('c2', 0.74), ('c3', 1.0), ('cOF1', -6.02), ('cOF2', 3.1), ('cIF1', -3.54), ('cIF2', 3.61), ('CQOF', 14.87), ('CKIF', 66.76), ('CKBF', 1497.41)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-1.5 %	30.3 %	-13.3 %
NS	0.649	0.518	0.656
NS_log	0.616	-0.01	0.729
NS_rel	-4.922	0.601	0.63
KGE	0.612	0.443	0.599

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-6.0 %	47.0 %	-20.3 %
NS	0.639	0.507	0.624
NS_log	0.552	0.005	0.644
NS_rel	-3.418	-2.013	0.626
KGE	0.591	0.443	0.56

1.3 Observed and simulated timeseries for optimum parameters

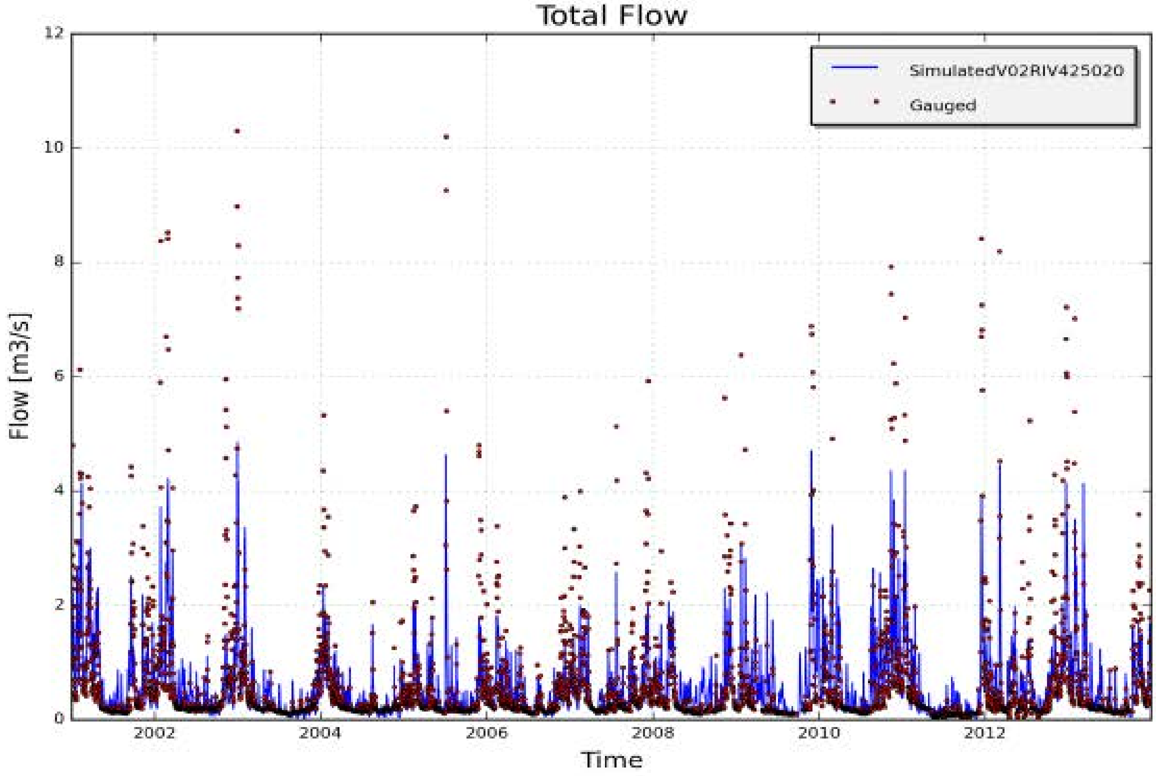


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V02RIV425020, station 42510102- Rivierbeek; Oostkamp(calibration period)

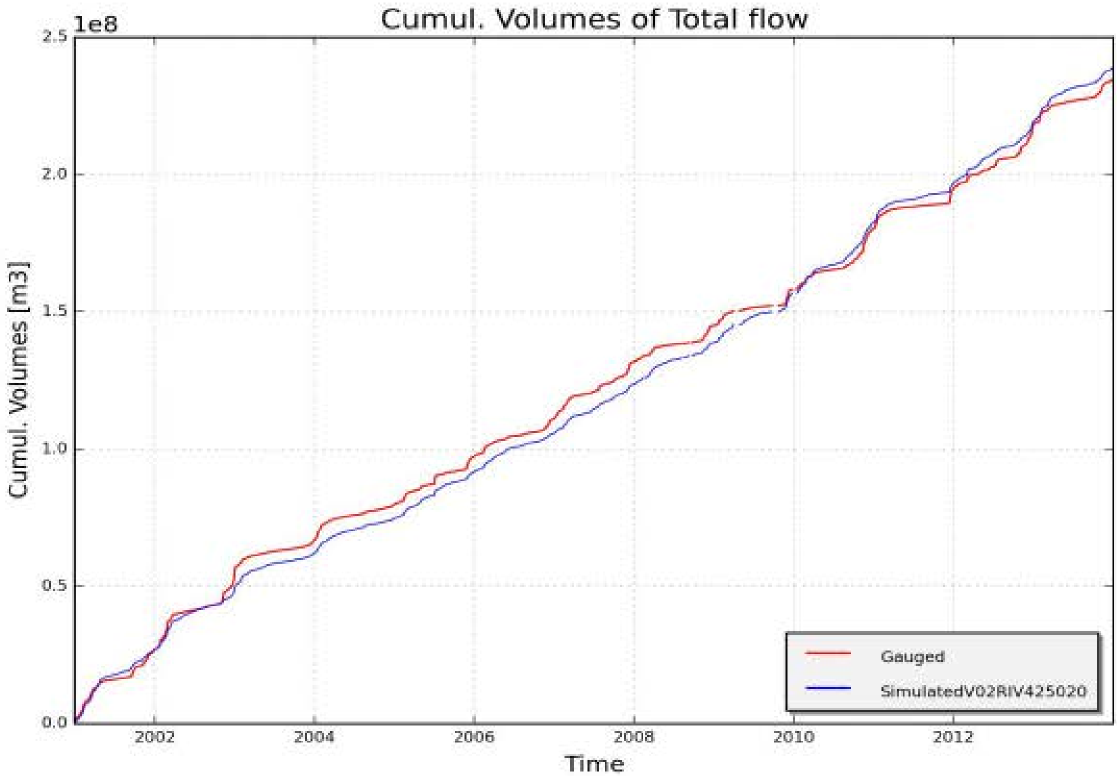


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V02RIV425020, station 42510102- Rivierbeek; Oostkamp (calibration period)

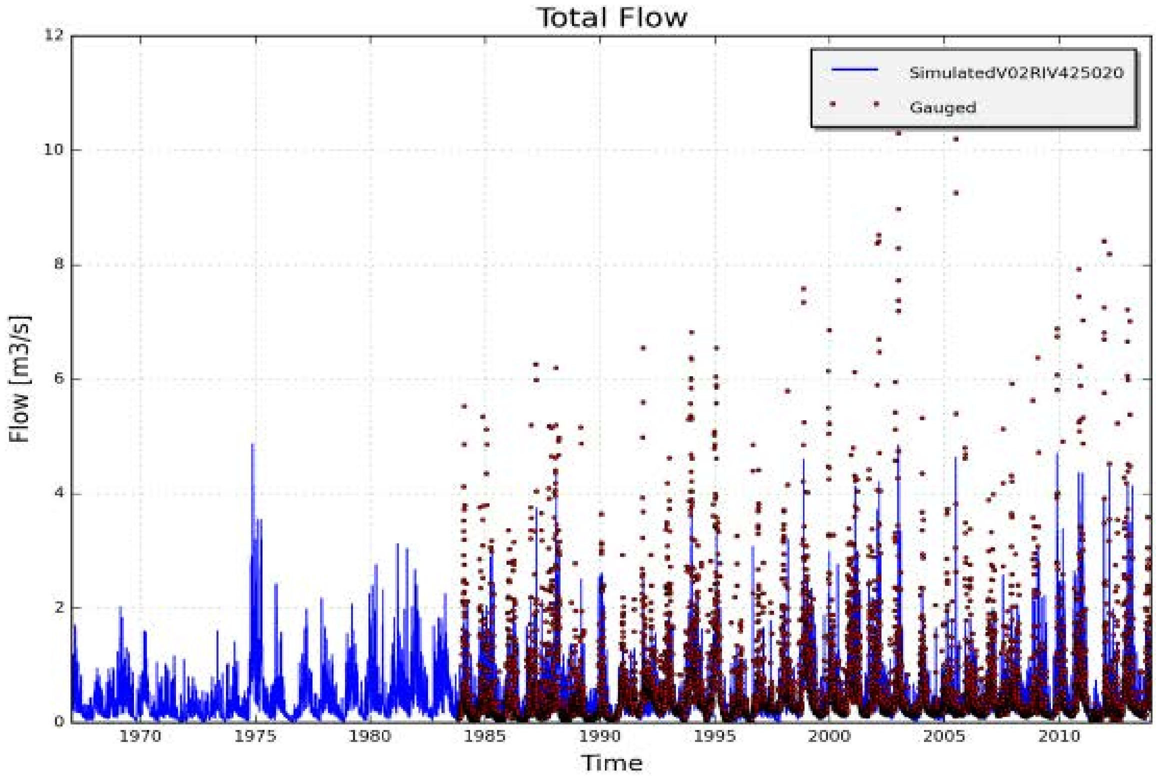


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V02RIV425020, station 42510102- Rivierbeek; Oostkamp (validation period)

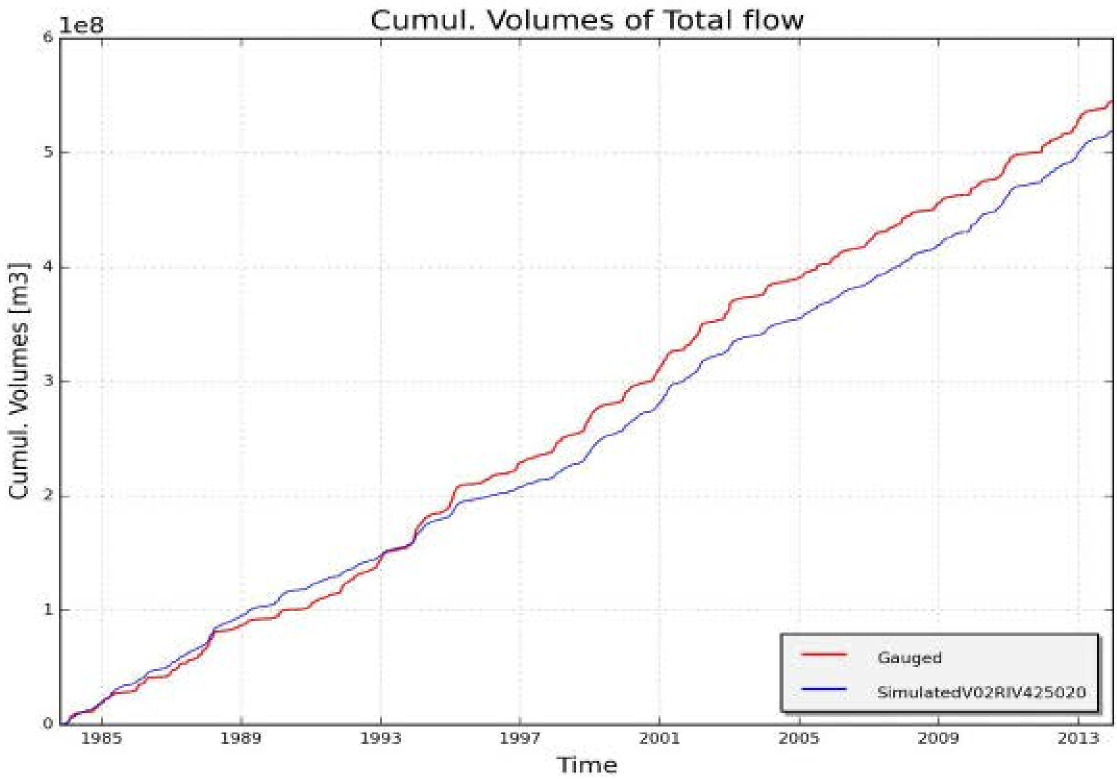


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V02RIV425020, station 42510102- Rivierbeek; Oostkamp (validation period)

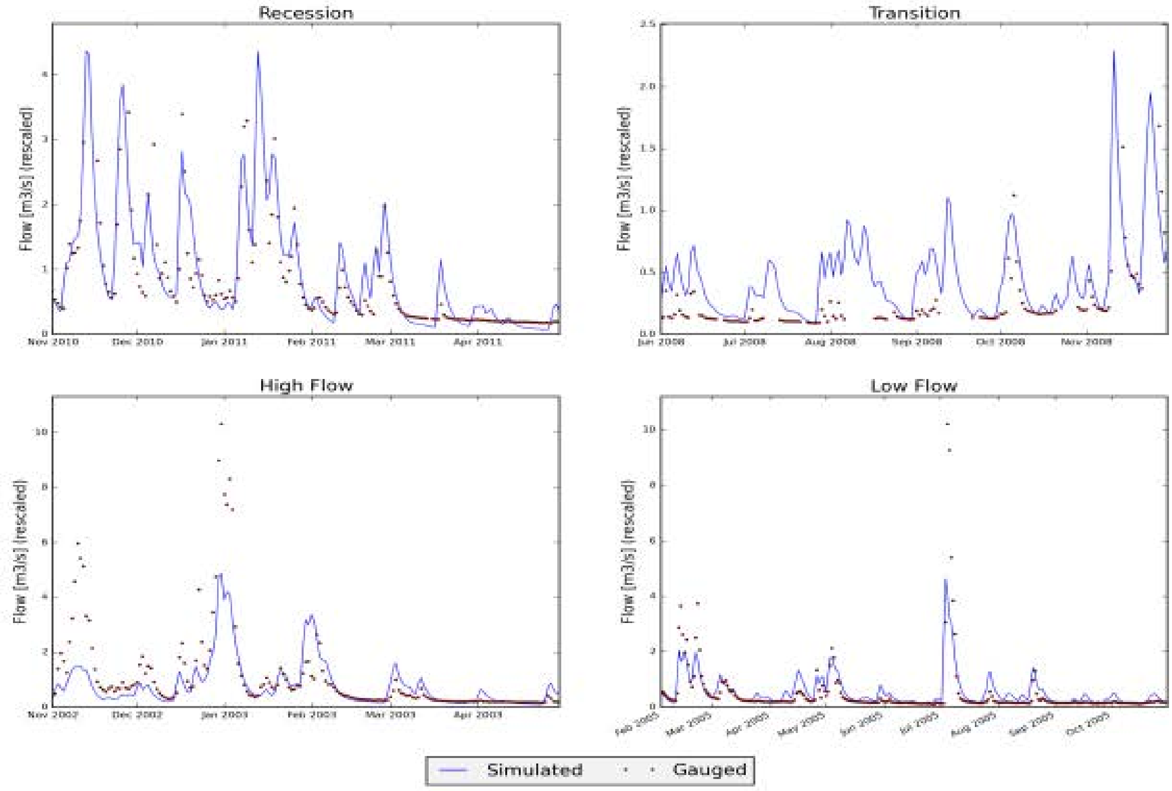


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V02RIV425020, station 42510102- Rivierbeek; Oostkamp

Appendix 5 Gentse Kanalen

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V03POE446000" (GENTSE KANALEN)

1.1 Input data

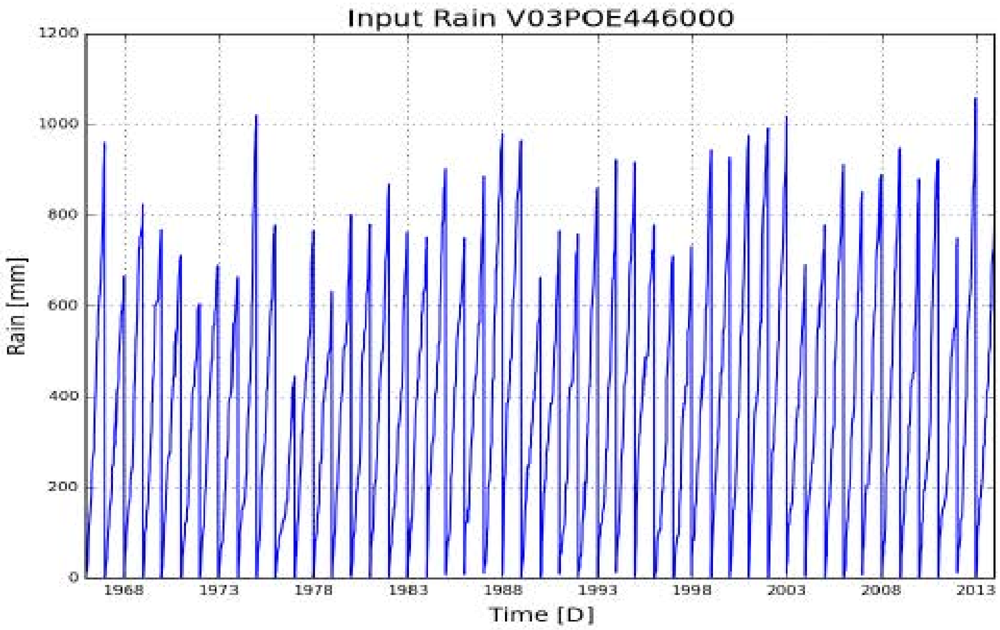


Figure 1: Cumulative precipitation on catchment V03POE446000 (Gentse Kanalen)

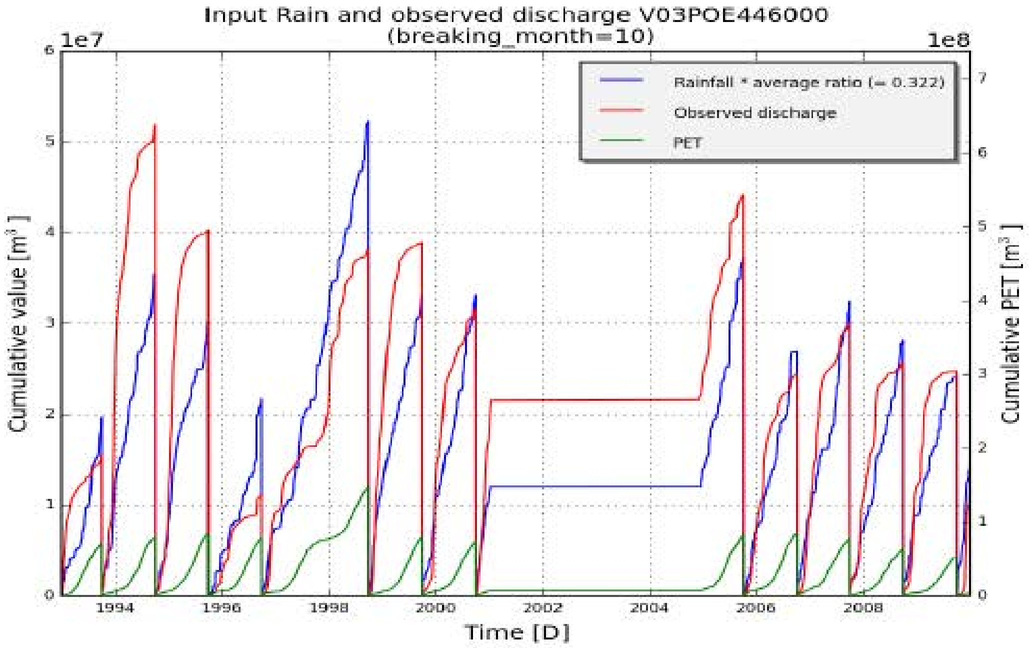


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V03POE446000 (Gentse Kanalen)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V03POE446000
subcatchment_area [m2]	106836849
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 402.3), ('SMevap', 213.38), ('c1', 3.32), ('c2', 1.15), ('c3', 1.0), ('cOF1', -9.57), ('cOF2', 3.03), ('cIF1', -5.79), ('cIF2', 4.98), ('CQOF', 12.73), ('CKIF', 75.96), ('CKBF', 945.31)]

Table 1: Goodness of fit for calibration period (1993 - 2009)

	Full year	**Summer**	**Winter**
RelErr	-0.5 %	16.7 %	-4.9 %
NS	0.724	0.579	0.696
NS_log	0.645	0.338	0.658
NS_rel	-5.148	-3.456	0.137
KGE	0.672	0.565	0.596

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	8.1 %	49.0 %	-2.6 %
NS	0.727	0.502	0.698
NS_log	0.669	0.33	0.659
NS_rel	-2.901	-2.126	0.178
KGE	0.687	0.516	0.614

1.3 Observed and simulated timeseries for optimum parameters

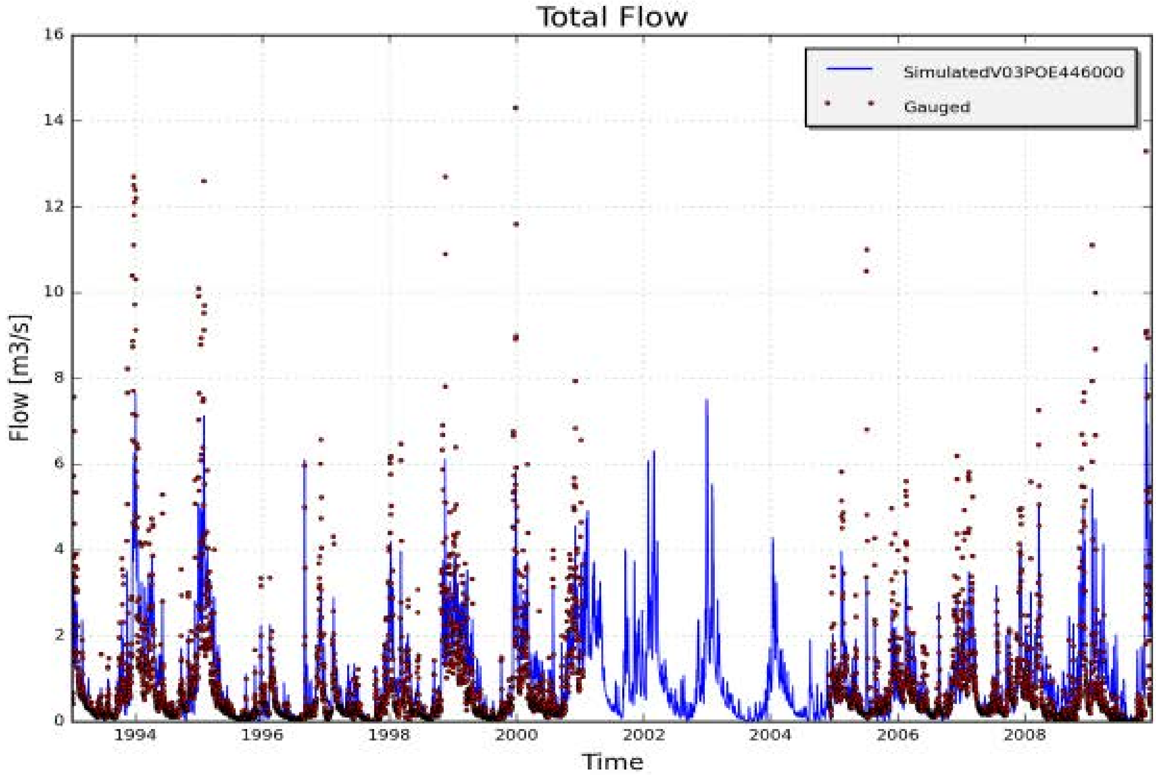


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V03POE446000, station 44656122 - Poekebeek; Nevele(calibration period)

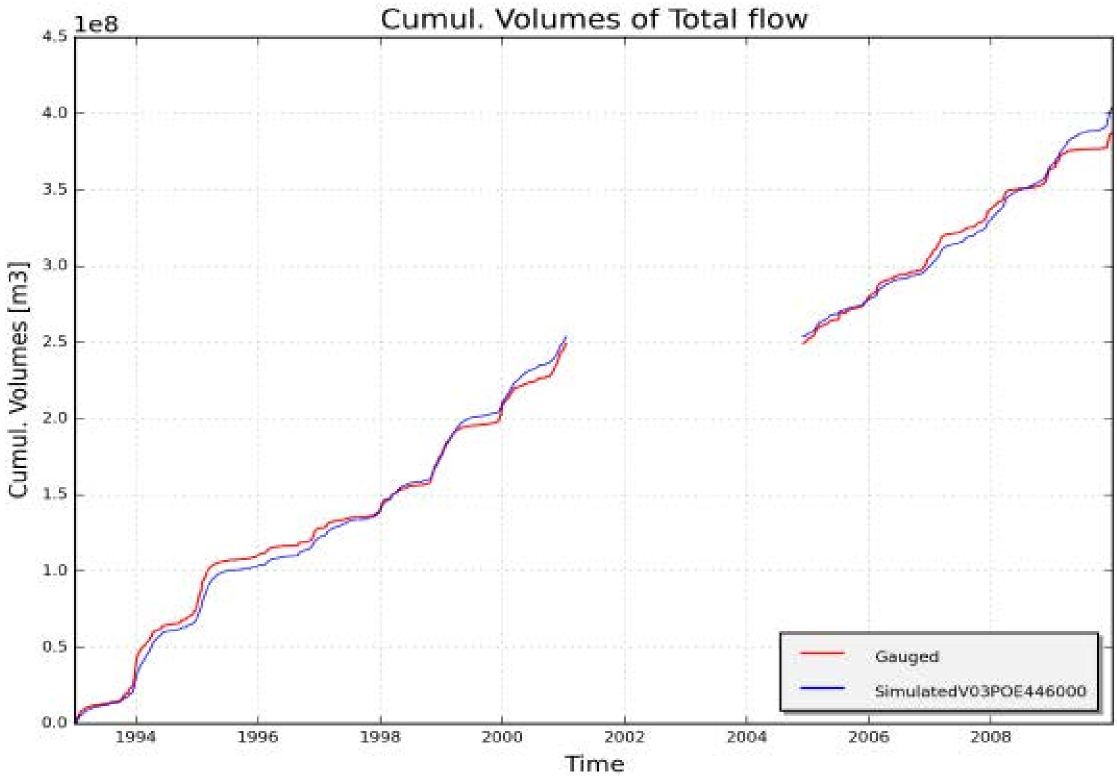


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V03POE446000, station 44656122 - Poekebeek; Nevele (calibration period)

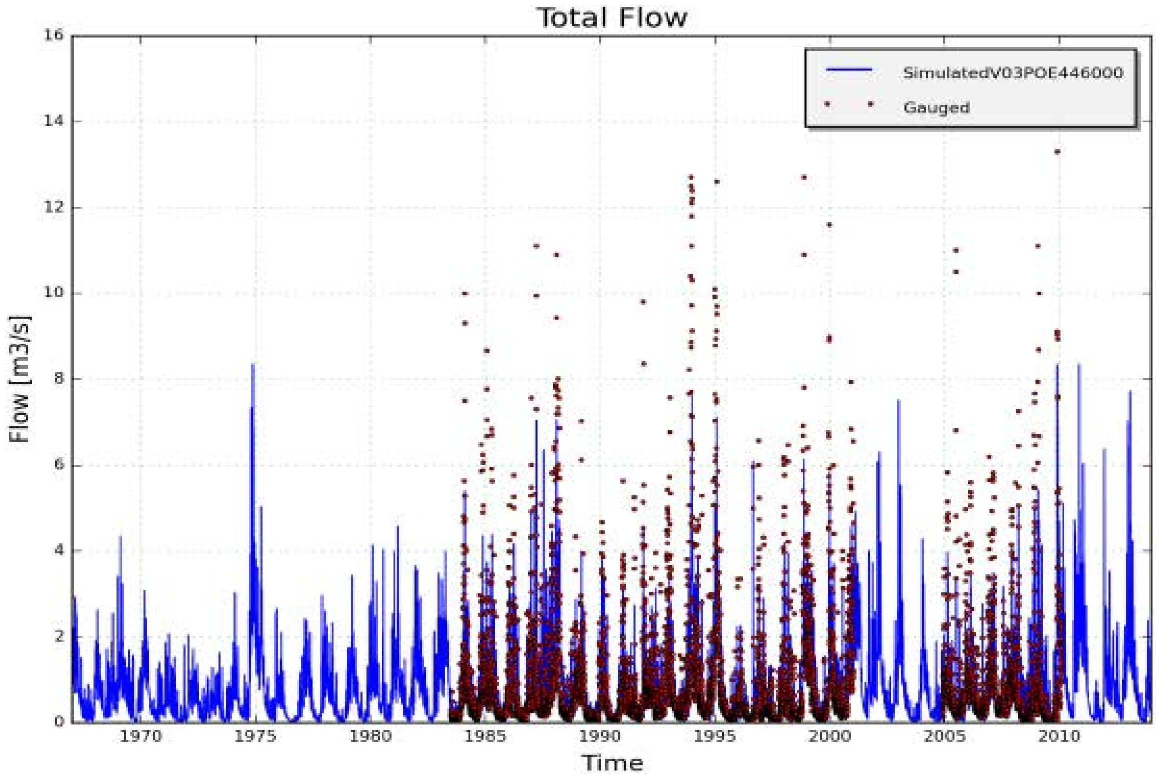


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V03POE446000, station 44656122 - Poekebeek; Nevele (validation period)

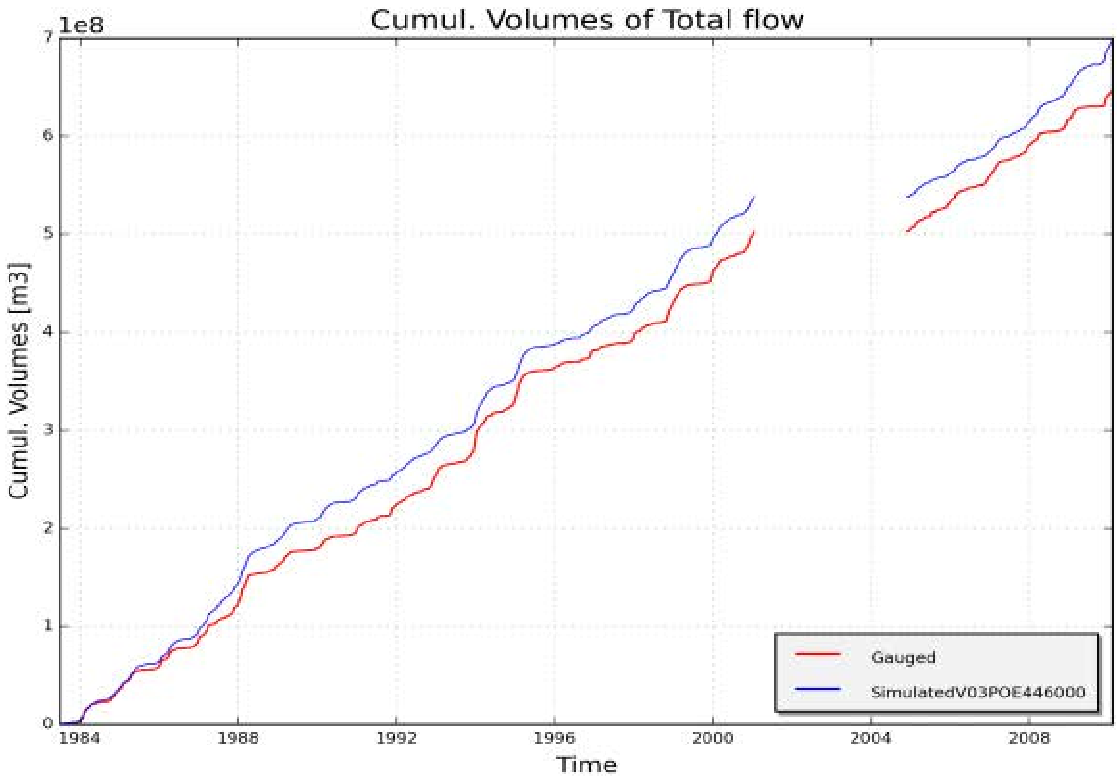


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V03POE446000, station 44656122 - Poekebeek; Nevele (validation period)

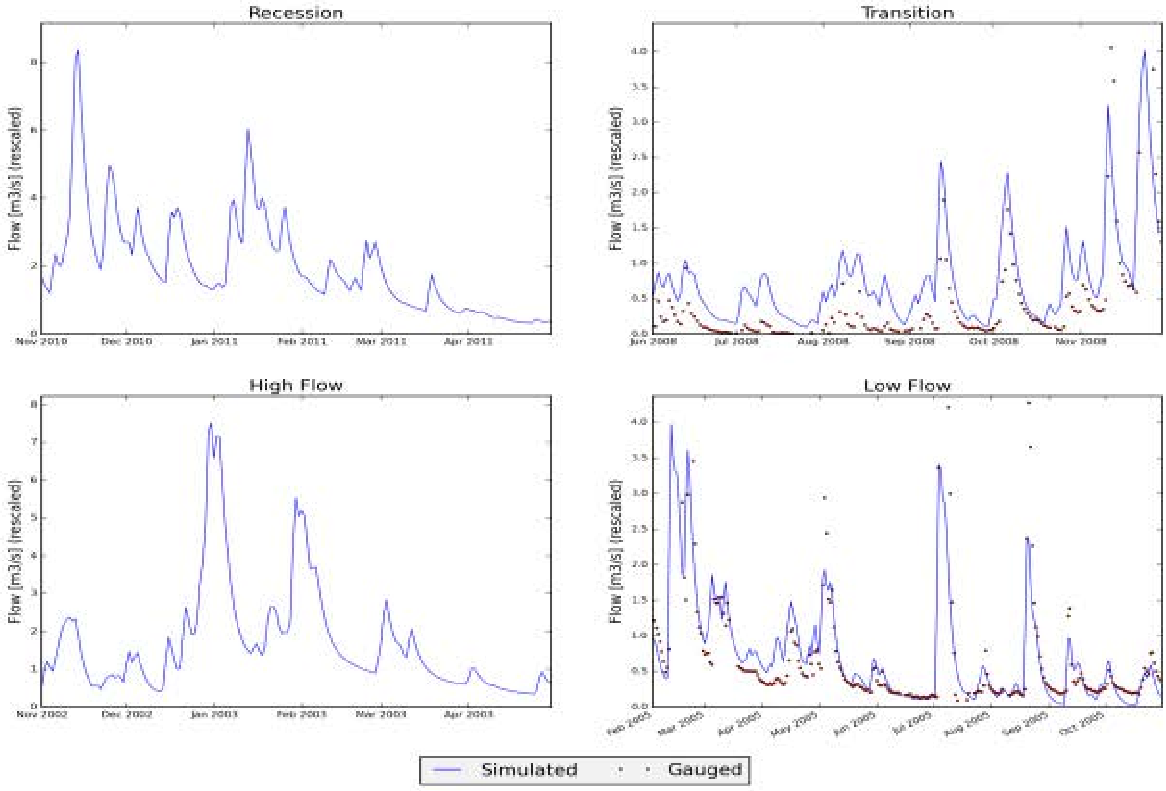


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V03POE446000, station 44656122 - Poekebeek; Nevele

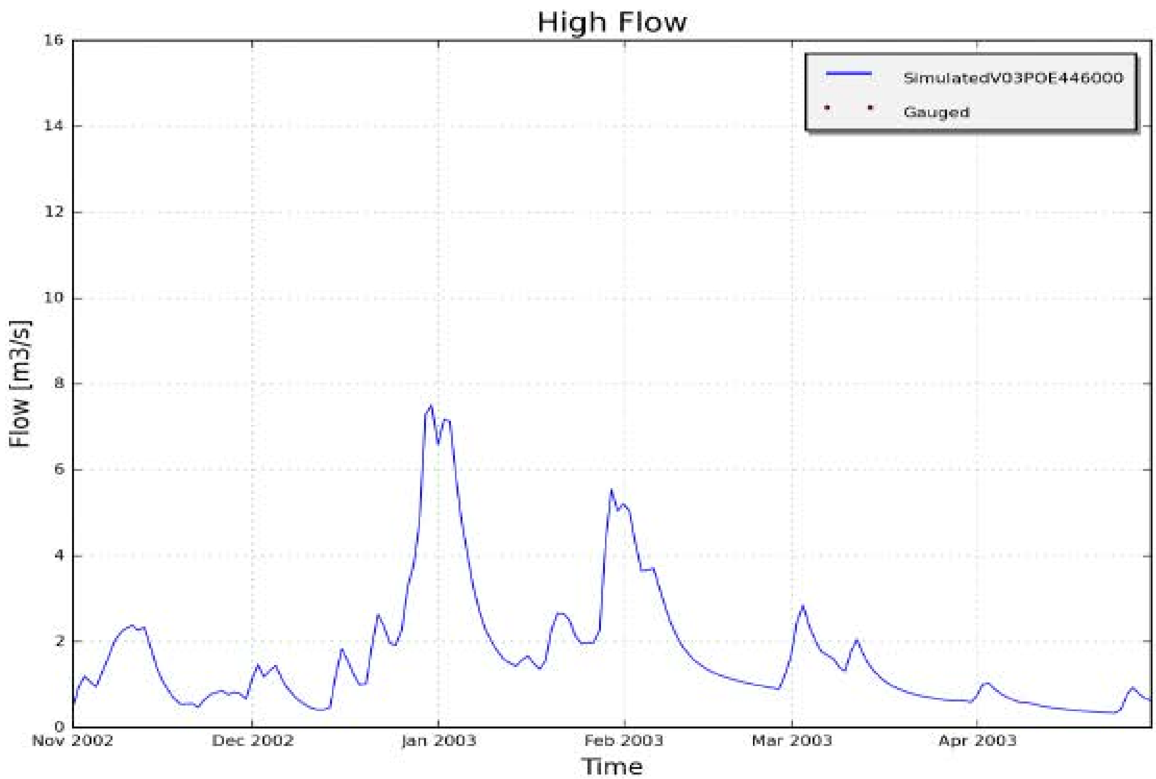


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V03POE446000, station 44656122 - Poekebeek; Nevele

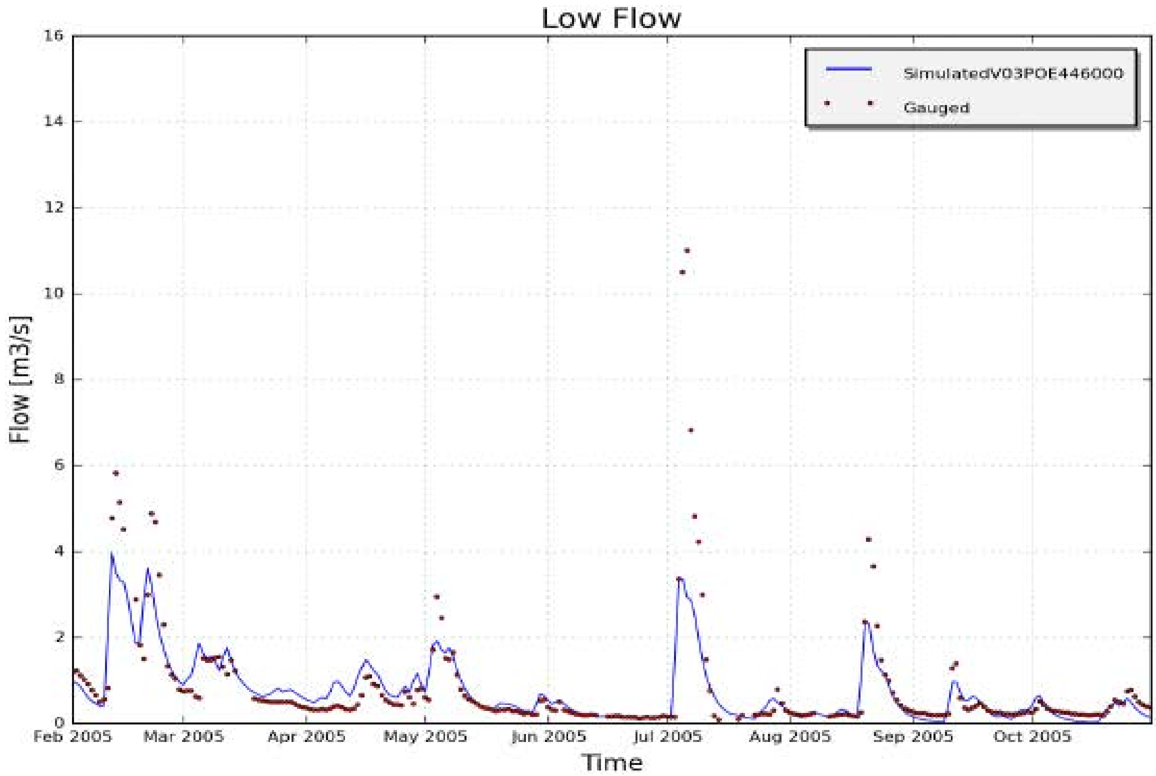


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V03POE446000, station 44656122 - Poekebeek; Nevele

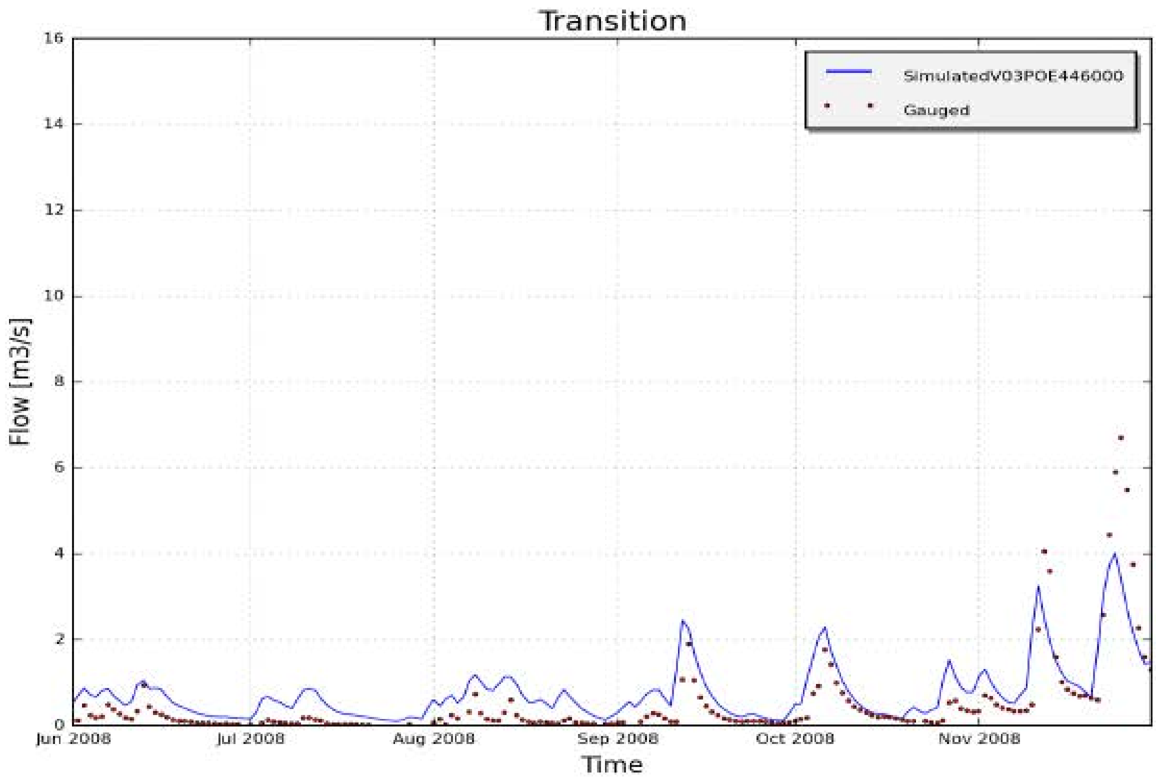


Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V03POE446000, station 44656122 - Poekebeek; Nevele

Appendix 6 Benedenschelde

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V04MOL036110" (BENEDENSCHELDE)

1.1 Input data

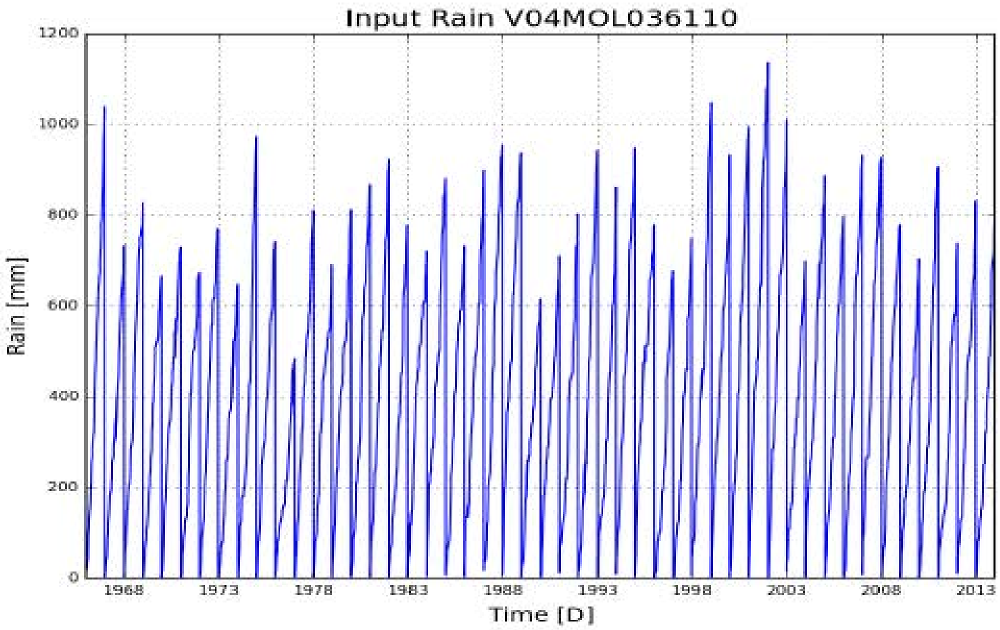


Figure 1: Cumulative precipitation on catchment V04MOL036110 (Benedenschelde)

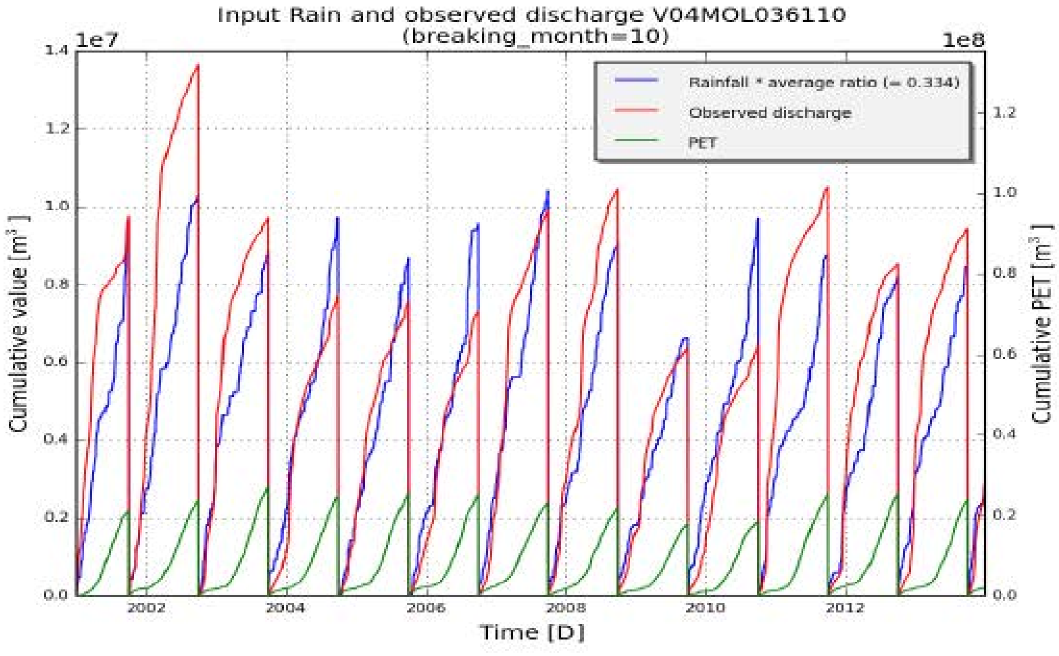


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V04MOL036110 (Benedenschelde)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V04MOL036110
subcatchment_area [m2]	32561957
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 413.57), ('SMevap', 248.06), ('c1', 2.16), ('c2', 0.66), ('c3', 1.0), ('cOF1', -9.38), ('cOF2', 3.15), ('cIF1', -4.55), ('cIF2', 4.33), ('CQOF', 12.44), ('CKIF', 28.52), ('CKBF', 1199.15)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.5 %	27.5 %	-13.7 %
NS	0.559	0.54	0.507
NS_log	0.668	0.293	0.574
NS_rel	0.742	0.407	0.77
KGE	0.614	0.597	0.57

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	12.5 %	85.0 %	-9.3 %
NS	0.612	0.358	0.574
NS_log	0.57	-0.166	0.619
NS_rel	-0.708	-2.33	0.765
KGE	0.704	0.274	0.687

1.3 Observed and simulated timeseries for optimum parameters

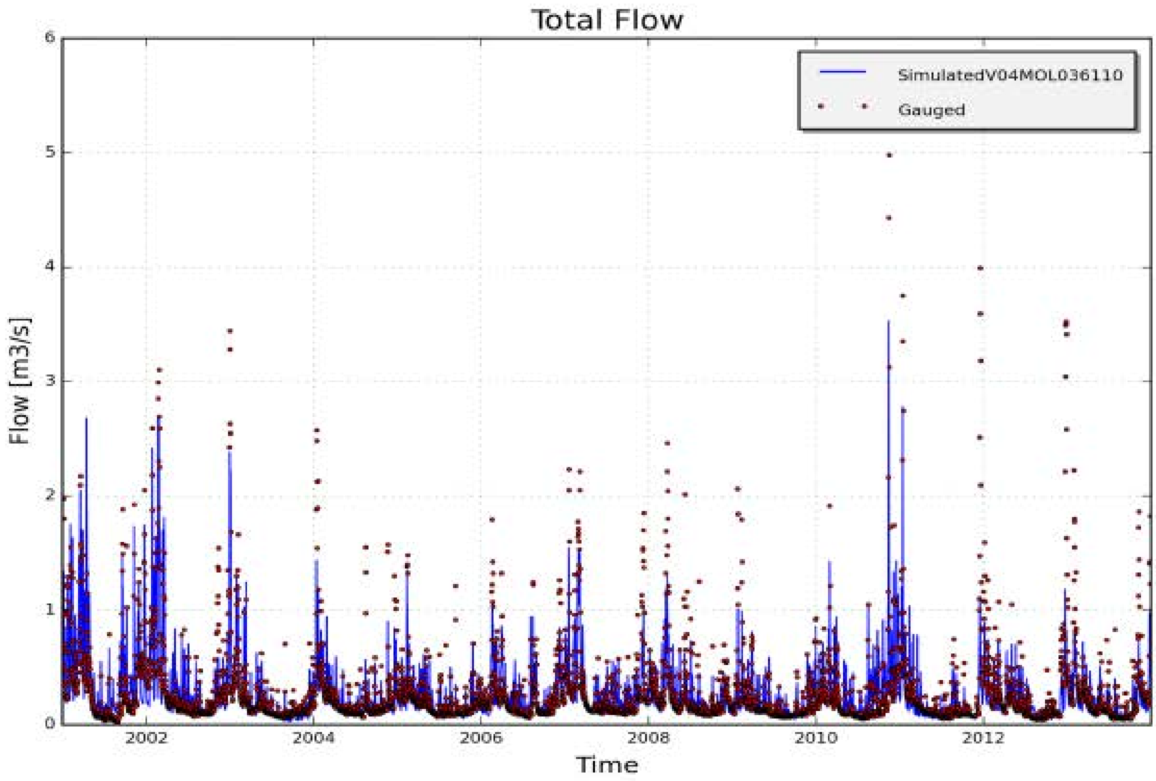


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V04MOL036110, station 3610102 - Kleine Molenbeek, Liezele(calibration period)

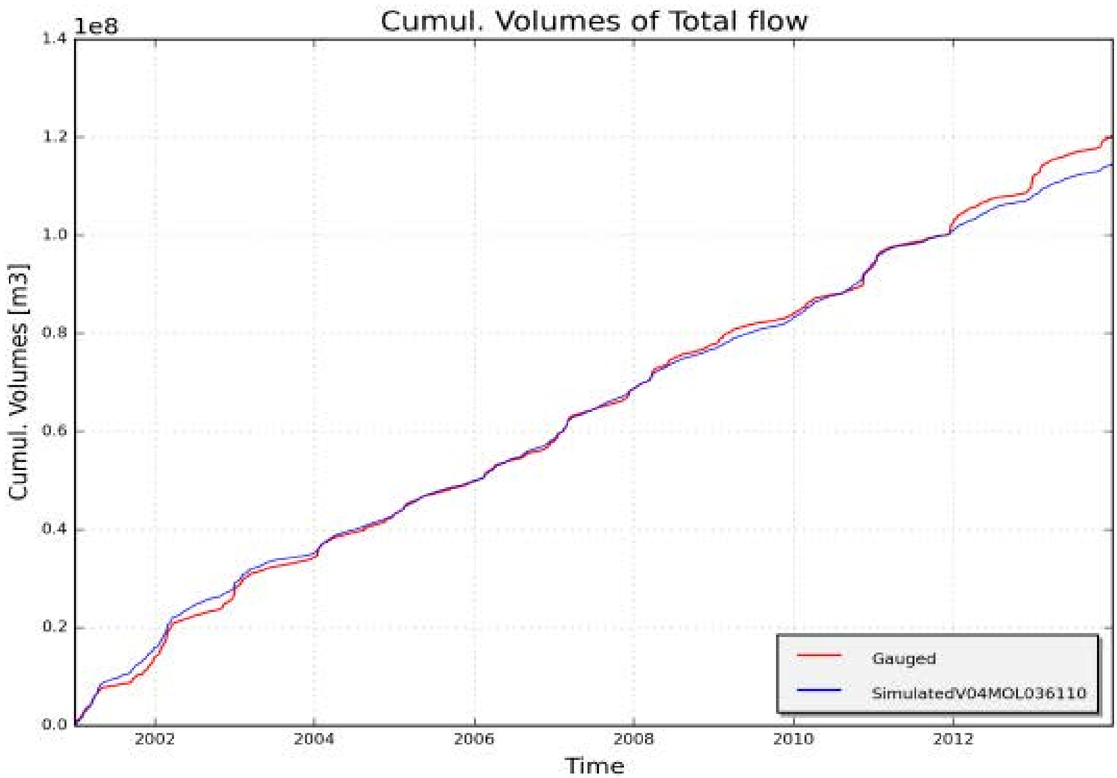


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V04MOL036110, station 3610102 - Kleine Molenbeek, Liezele (calibration period)

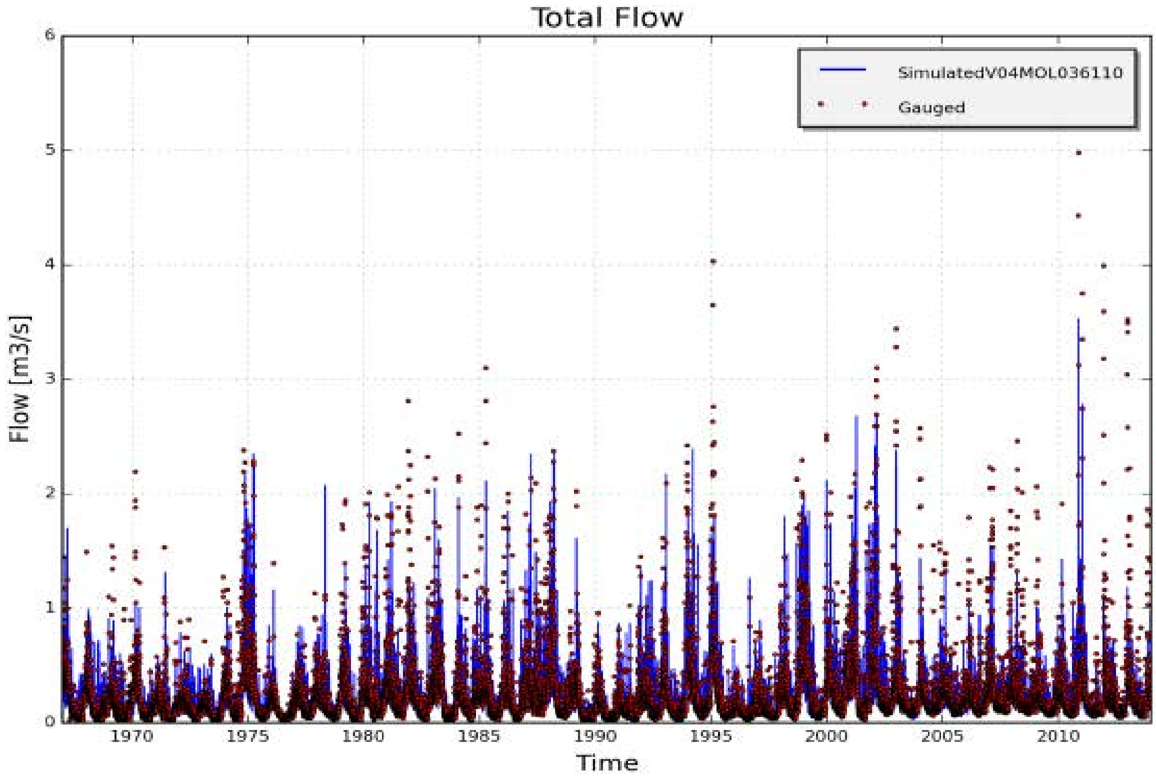


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V04MOL036110, station 3610102 - Kleine Molenbeek, Liezele (validation period)

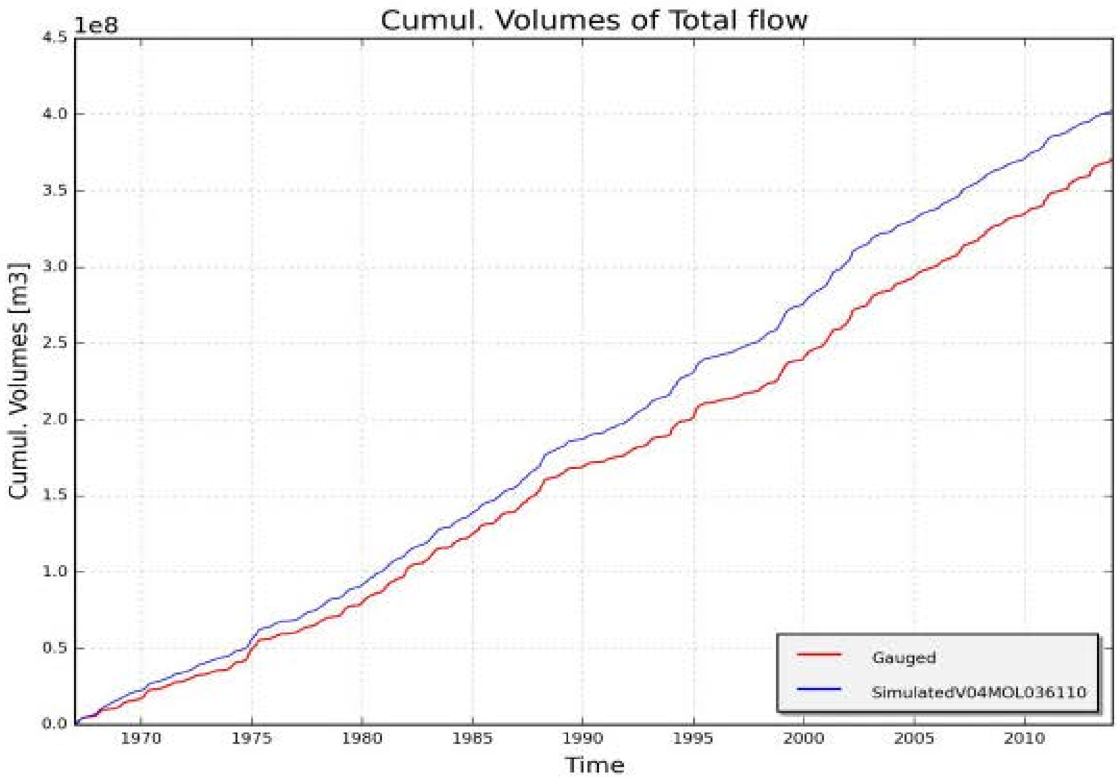


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V04MOL036110, station 3610102 - Kleine Molenbeek, Liezele (validation period)

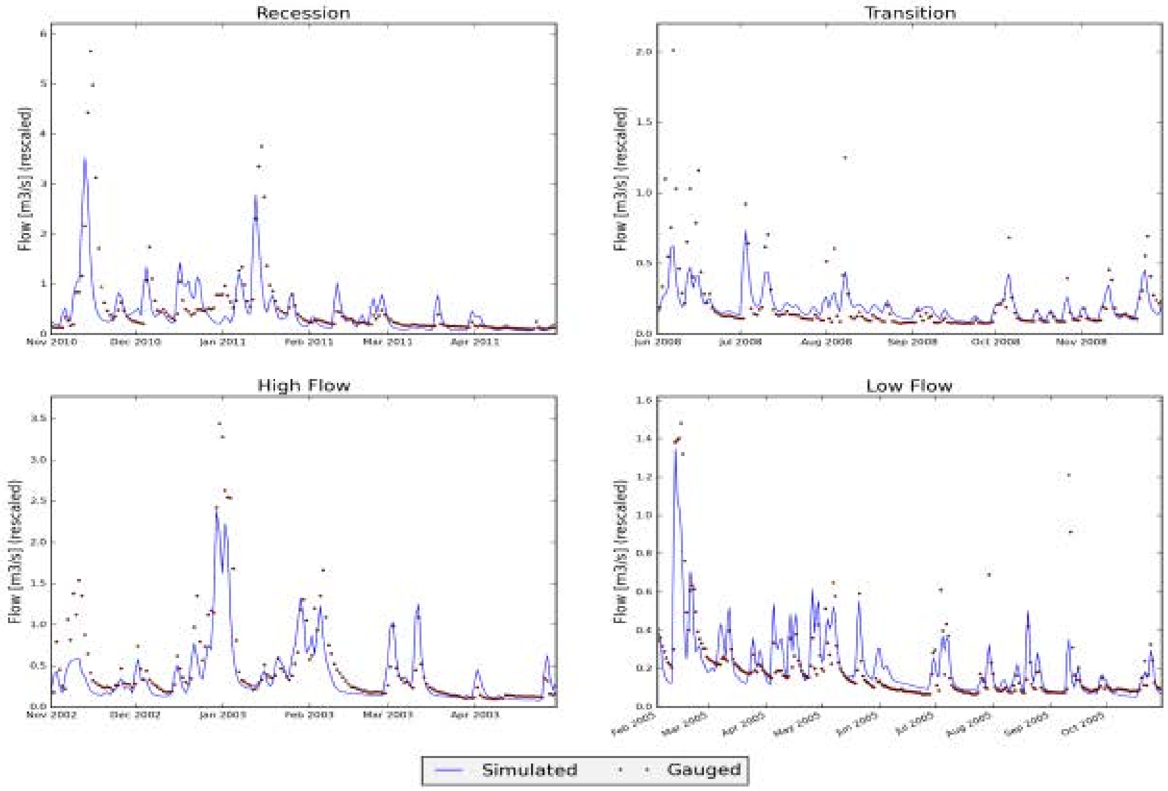


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V04MOL036110, station 3610102 - Kleine Molenbeek, Liezele

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V04MOM037100" (BENEDENSCHELDE)

1.1 Input data

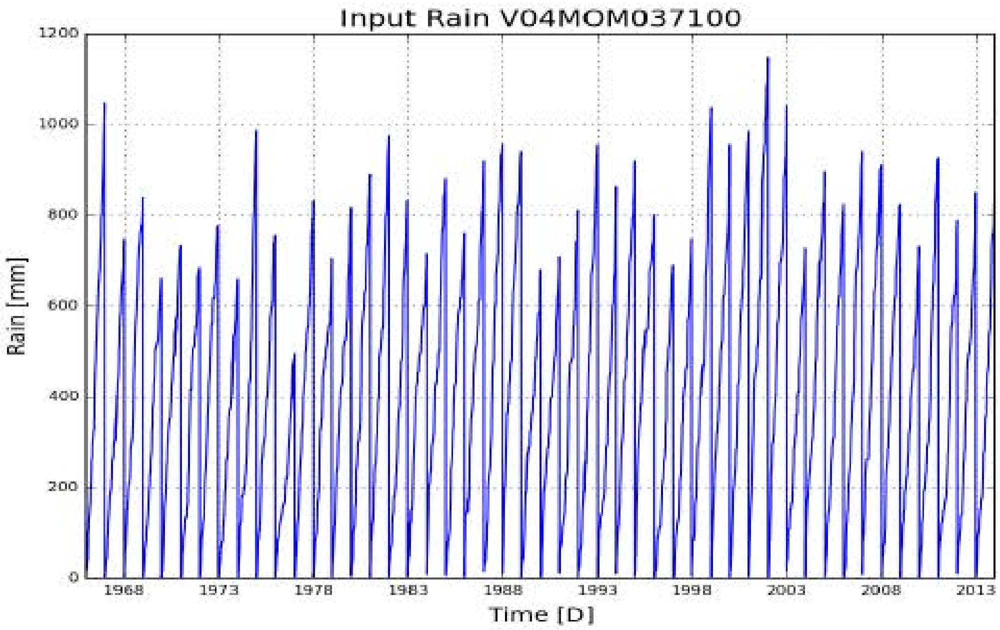


Figure 1: Cumulative precipitation on catchment V04MOM037100 (Benedenschelde)

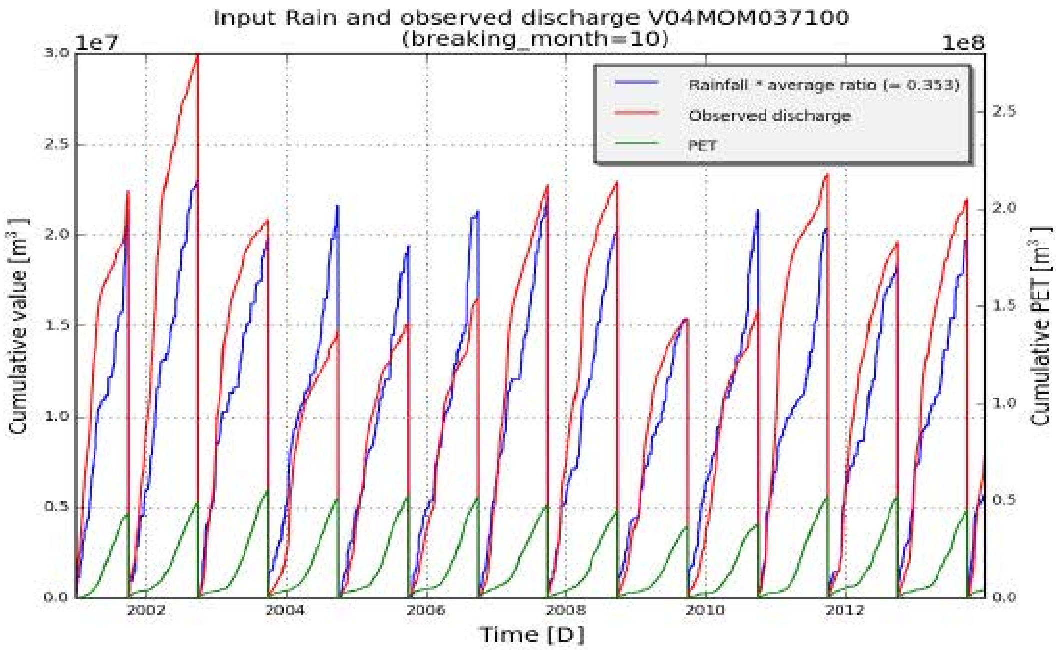


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V04MOM037100 (Benedenschelde)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V04MOM037100
subcatchment_area [m2]	67301328
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 532.44), ('SMevap', 159.89), ('c1', 1.98), ('c2', 0.83), ('c3', 1.0), ('cOF1', -4.59), ('cOF2', 1.64), ('cIF1', -2.82), ('cIF2', 2.42), ('CQOF', 11.65), ('CKIF', 62.18), ('CKBF', 932.6)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	1.1 %	52.4 %	-20.2 %
NS	0.67	0.478	0.545
NS_log	0.653	0.137	0.596
NS_rel	0.411	-0.173	0.801
KGE	0.634	0.48	0.536

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	15.6 %	82.0 %	-11.0 %
NS	0.651	0.204	0.644
NS_log	0.567	-0.195	0.743
NS_rel	-0.431	-2.07	0.821
KGE	0.642	0.228	0.588

1.3 Observed and simulated timeseries for optimum parameters

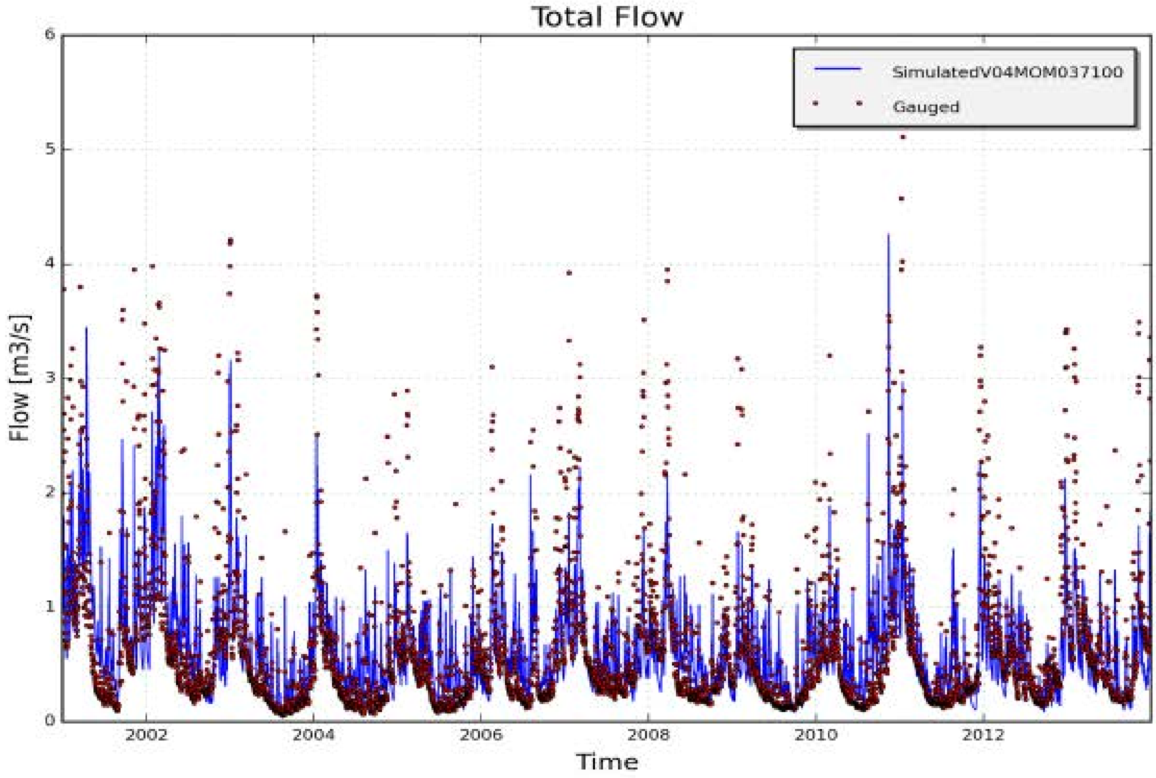


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V04MOM037100, station 3710102 - Grote Molenbeek, Malderen(calibration period)

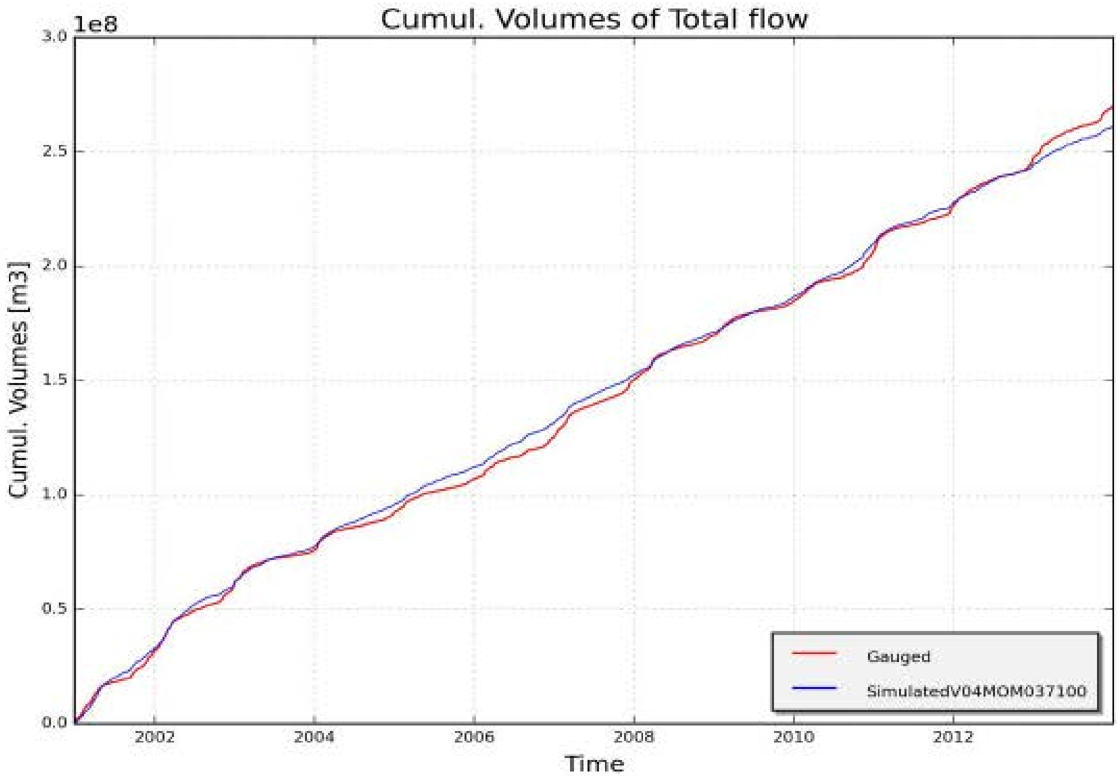


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V04MOM037100, station 3710102 - Grote Molenbeek, Malderen (calibration period)

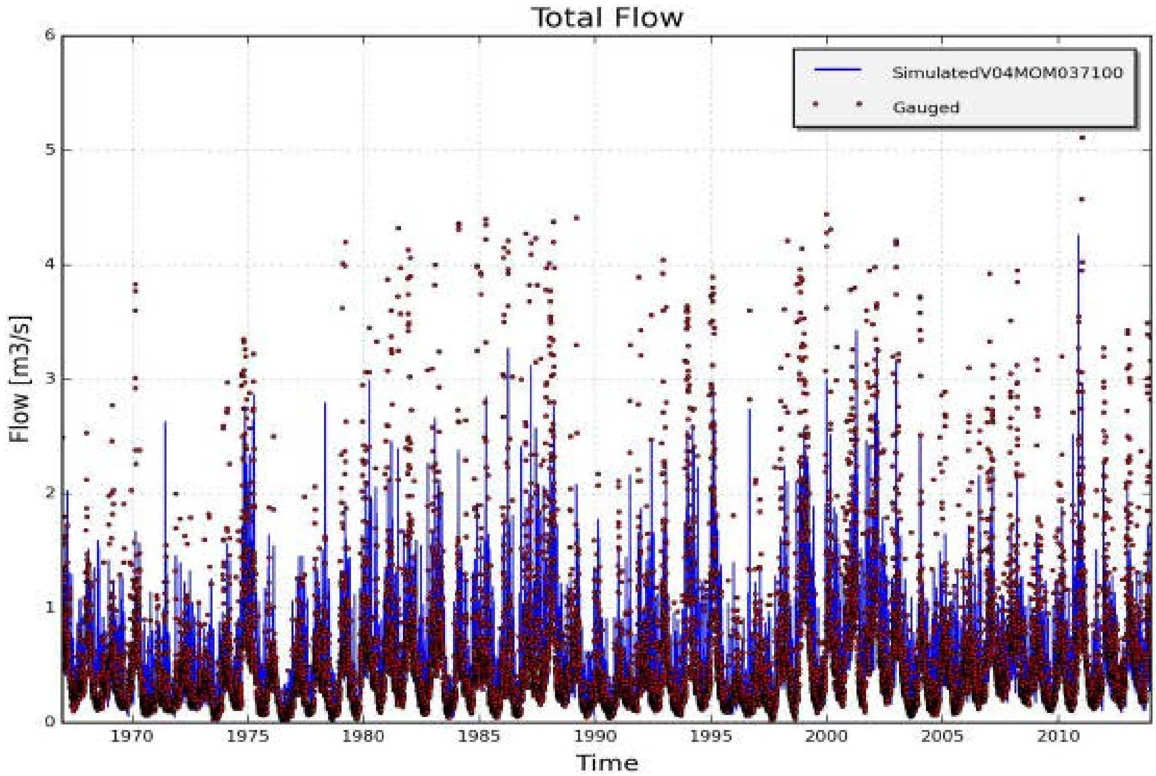


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V04MOM037100, station 3710102 - Grote Molenbeek, Malderen (validation period)

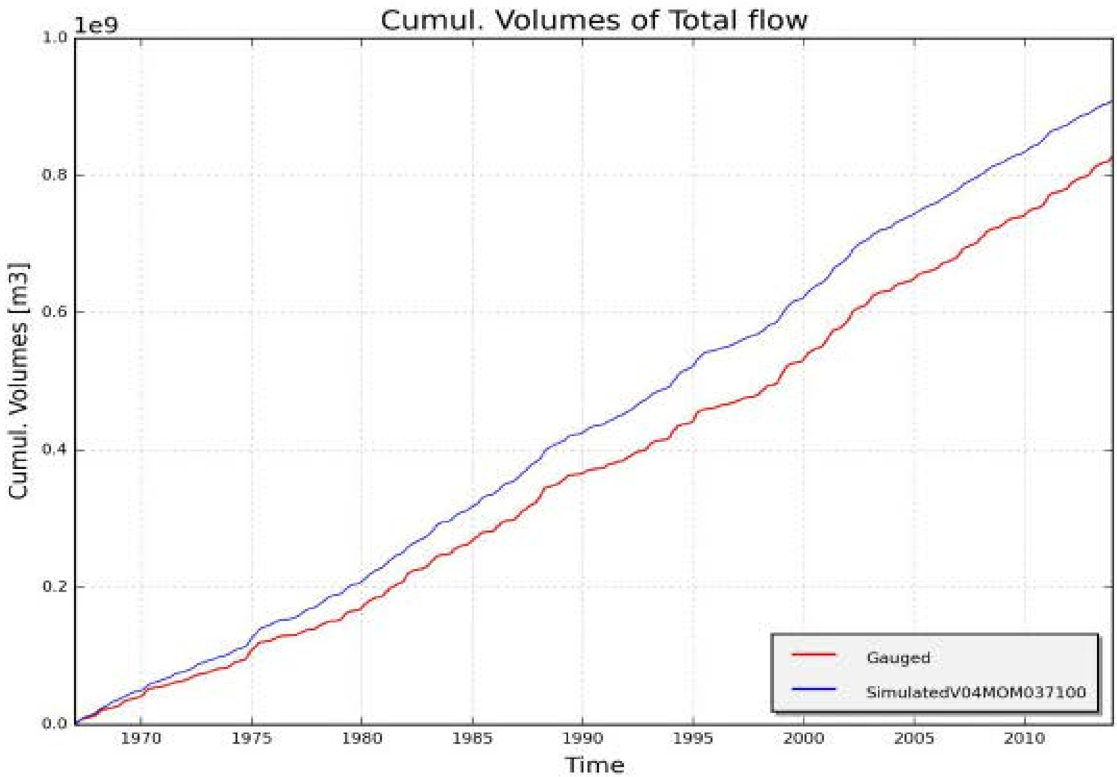


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V04MOM037100, station 3710102 - Grote Molenbeek, Malderen (validation period)

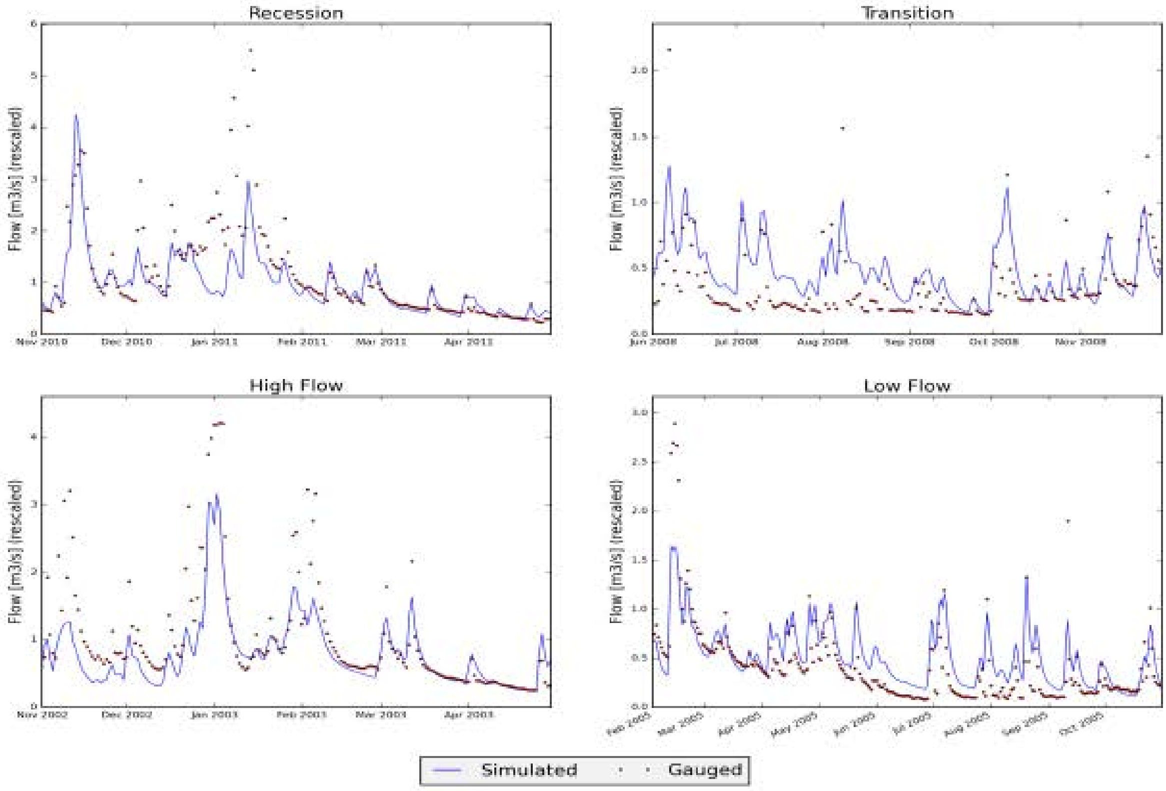


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V04MOM037100, station 3710102 - Grote Molenbeek, Malderen

Appendix 7 Leie

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "F05LEI386999" (LEIEBEKKEN)

1.1 Input data

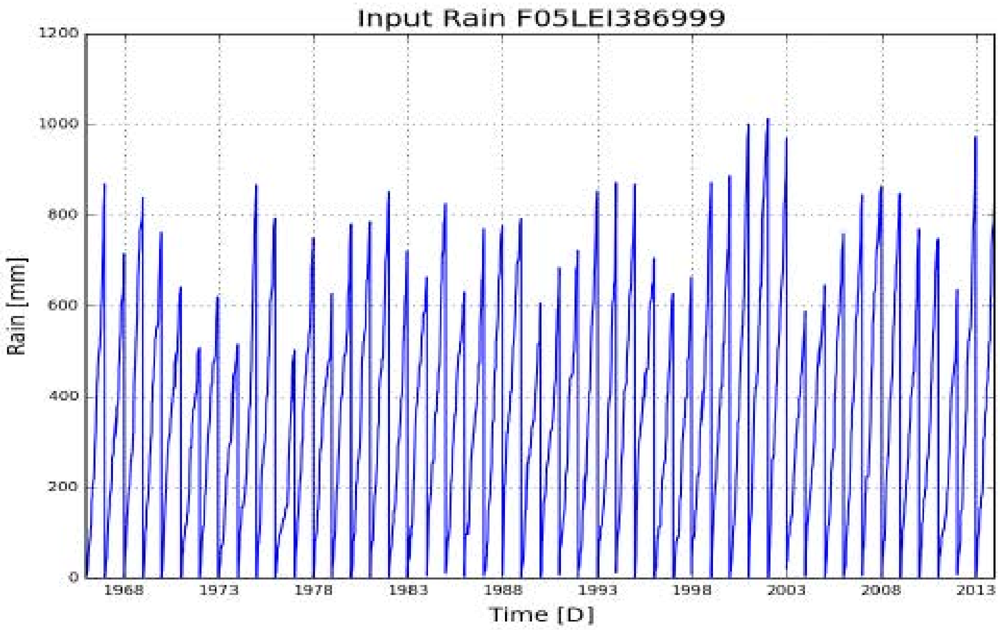


Figure 1: Cumulative precipitation on catchment F05LEI386999 (Leiebekken)

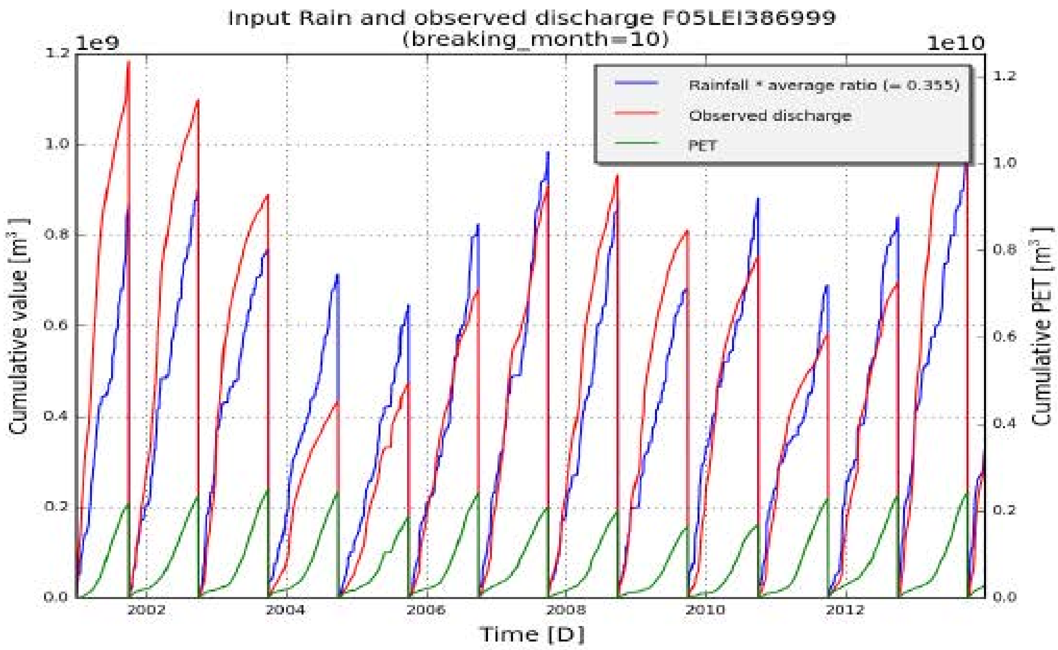


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment F05LEI386999 (Leiebekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	F05LEI386999
subcatchment_area [m2]	2981779554
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 424.0), ('SMevap', 233.44), ('c1', 2.11), ('c2', 0.83), ('c3', 1.0), ('cOF1', -5.76), ('cOF2', 1.92), ('cIF1', -3.61), ('cIF2', 3.0), ('CQOF', 13.89), ('CKIF', 46.14), ('CKBF', 883.19)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-1.3 %	9.5 %	-10.4 %
NS	0.794	0.695	0.749
NS_log	0.803	0.537	0.846
NS_rel	0.796	0.644	0.898
KGE	0.746	0.72	0.663

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.6 %	11.0 %	-8.3 %
NS	0.8	0.685	0.748
NS_log	0.814	0.531	0.845
NS_rel	0.802	0.637	0.893
KGE	0.752	0.727	0.671

1.3 Observed and simulated timeseries for optimum parameters

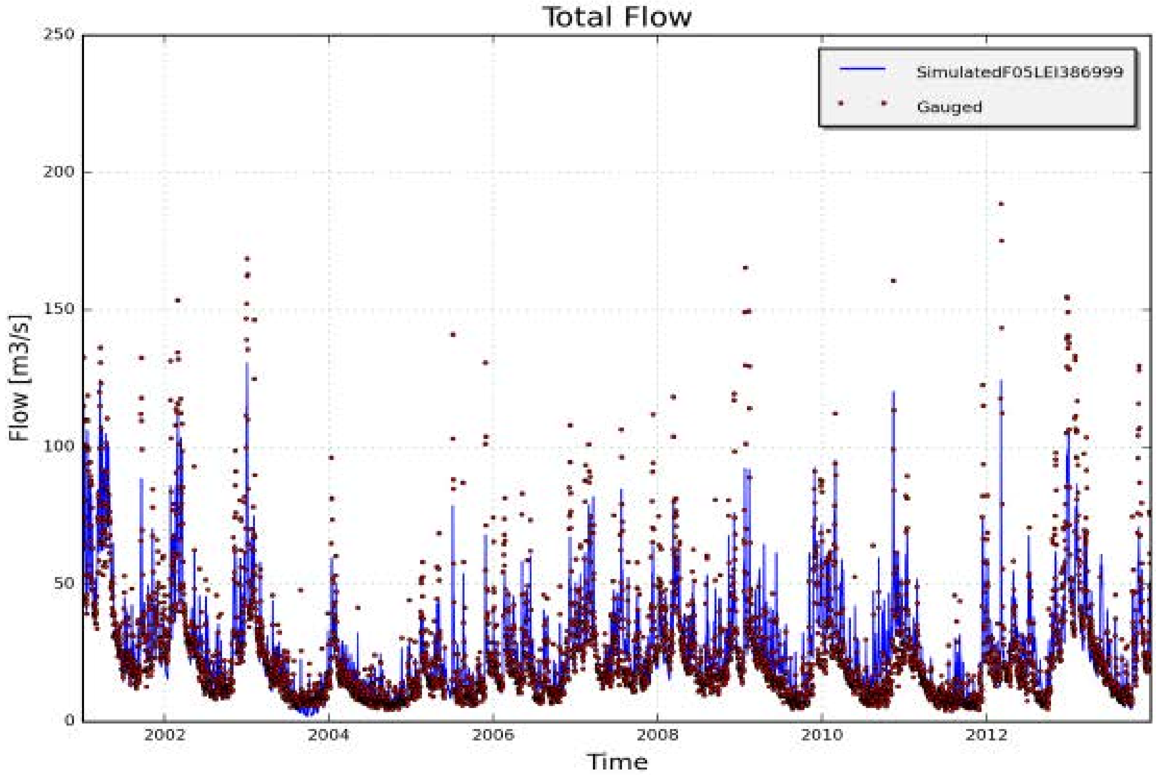


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment F05LEI386999, station unkown(calibration period)

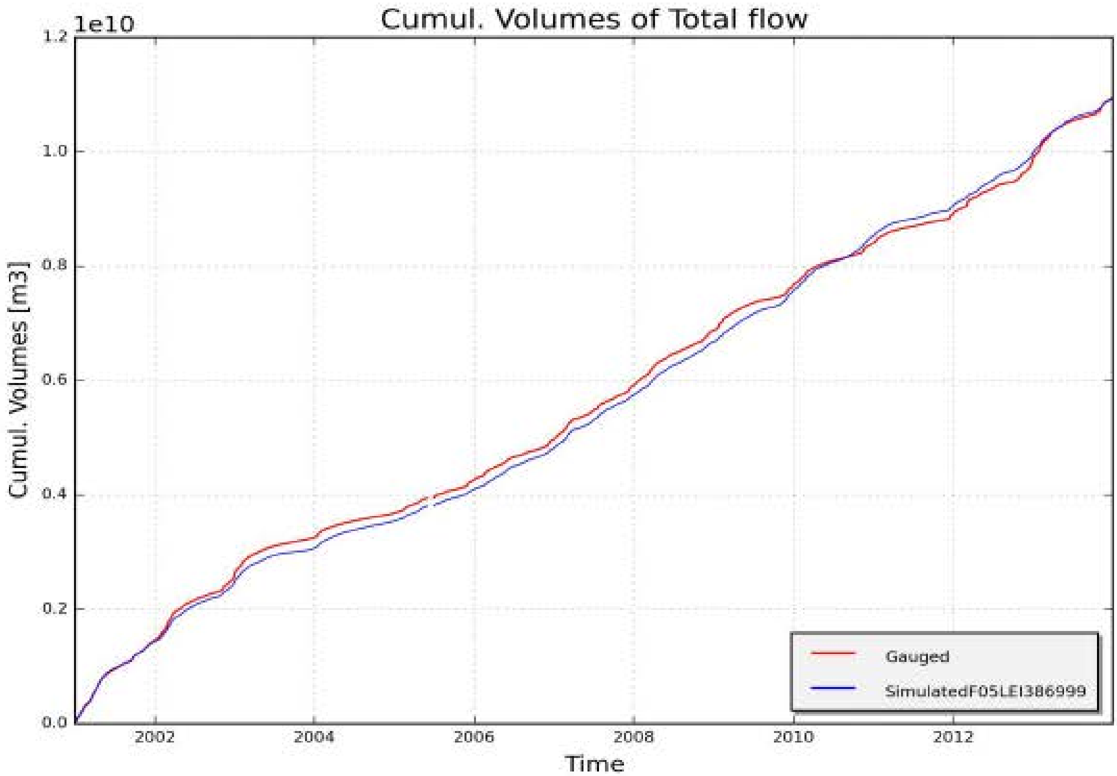


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment F05LEI386999, station unkown (calibration period)

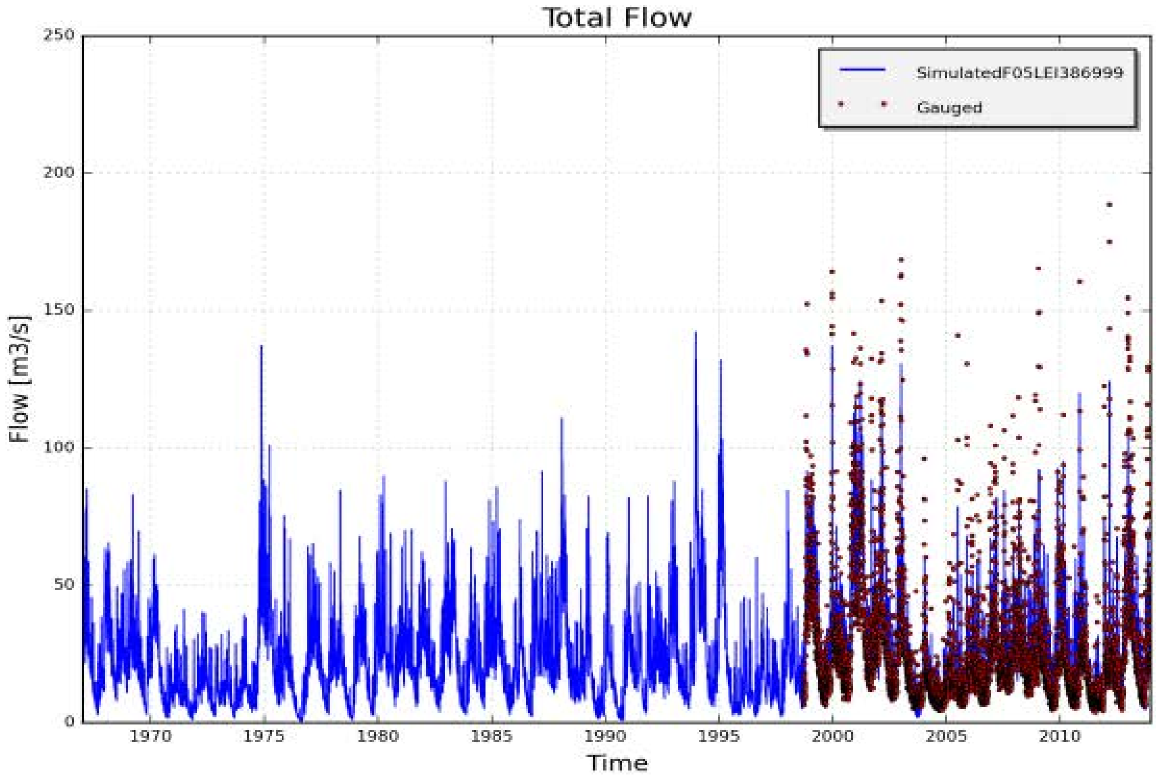


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment F05LEI386999, station unkown (validation period)

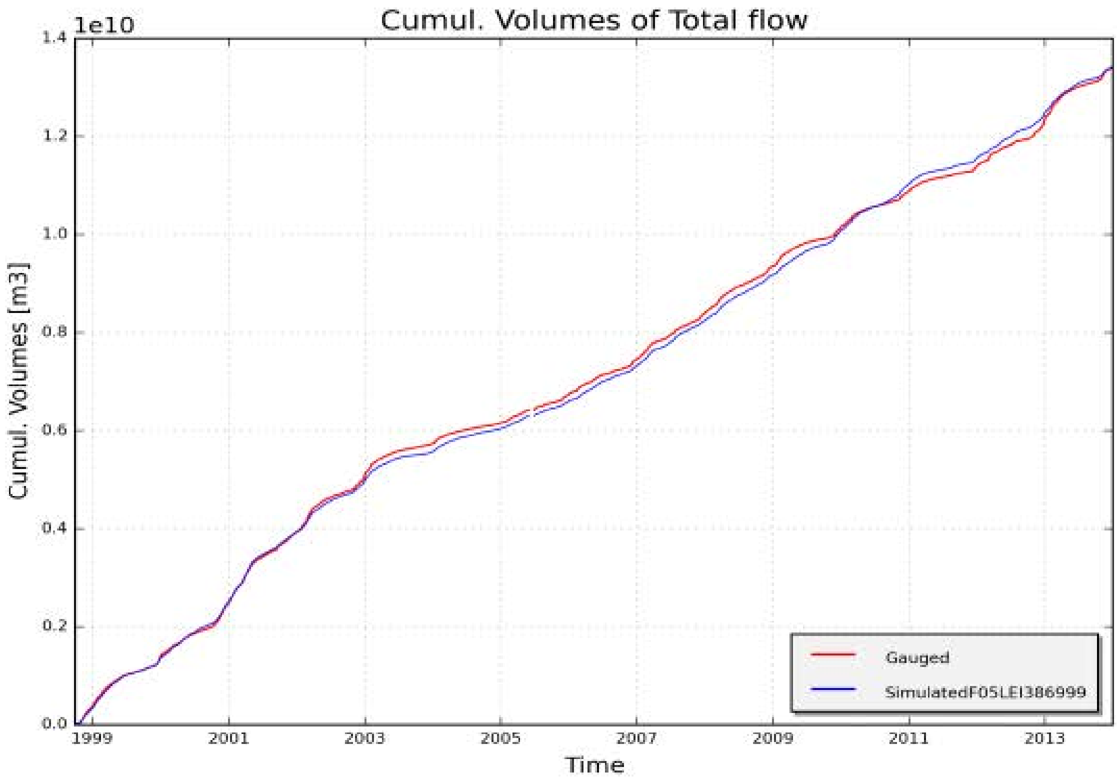


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment F05LEI386999, station unkown (validation period)

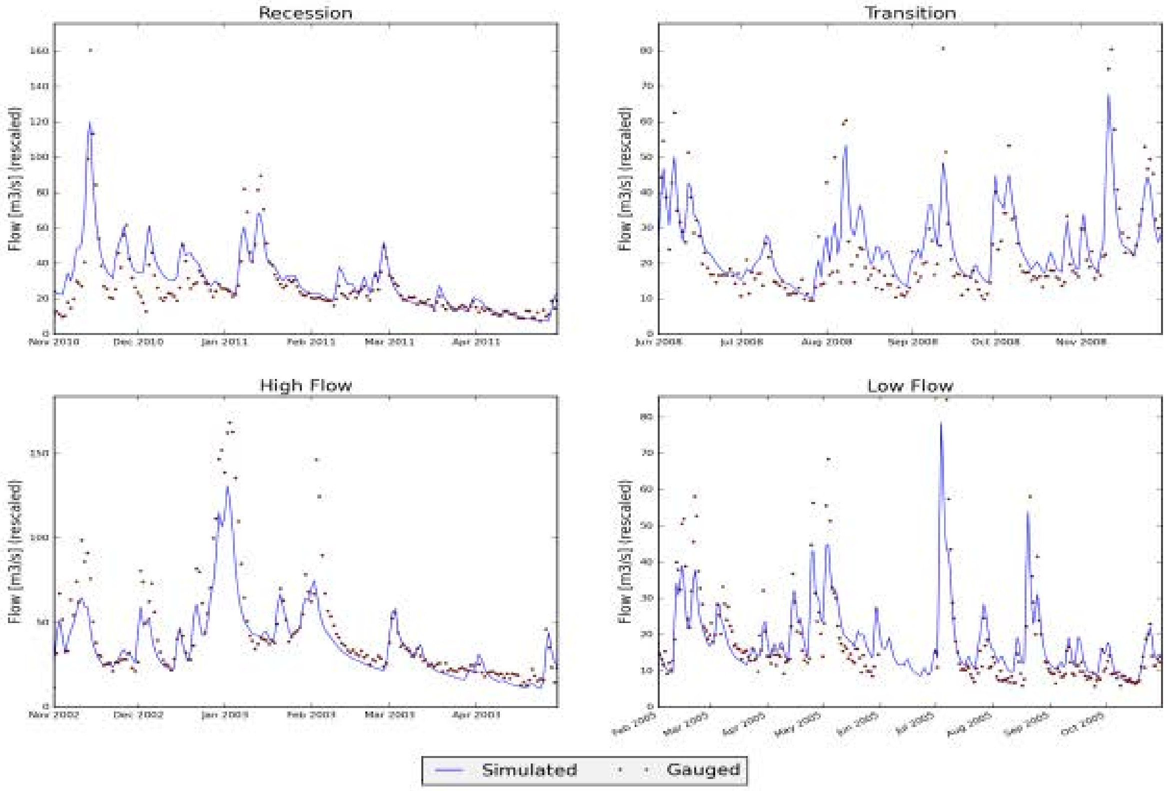


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment F05LEI386999, station unkown

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V05HEU403210" (LEIEBEKKEN)

1.1 Input data

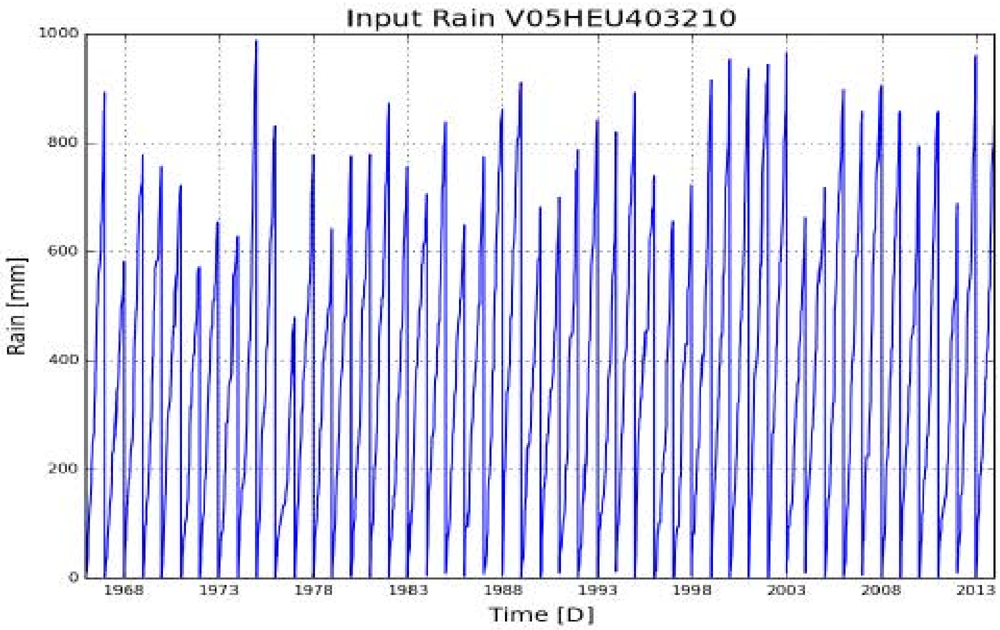


Figure 1: Cumulative precipitation on catchment V05HEU403210 (Leiebekken)

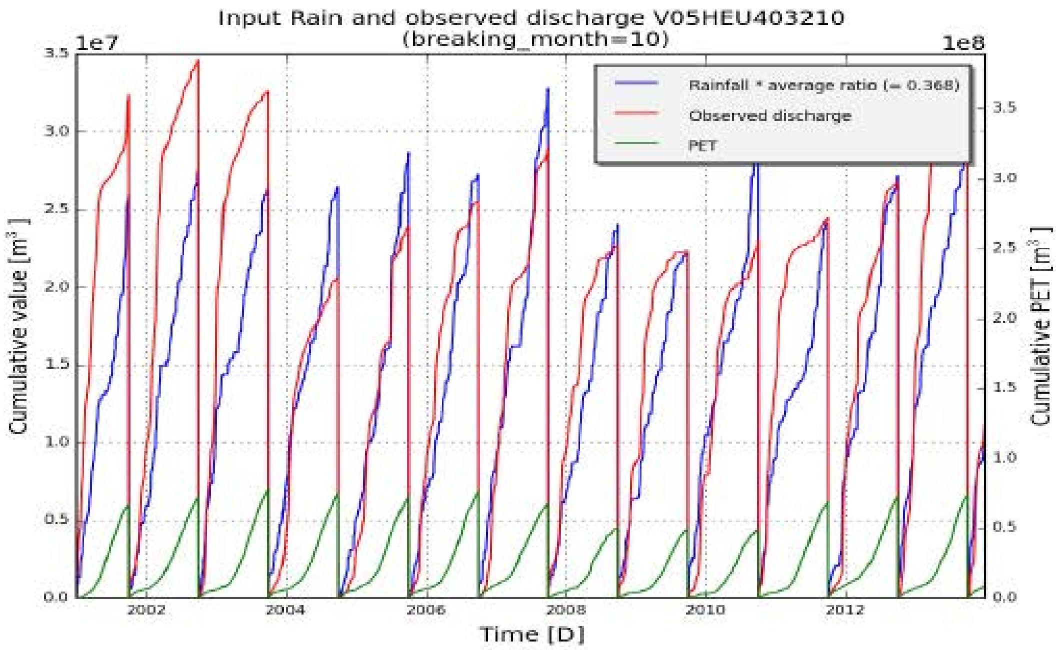


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V05HEU403210 (Leiebekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V05HEU403210
subcatchment_area [m2]	91912331
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 325.85), ('SMevap', 206.16), ('c1', 3.28), ('c2', 1.09), ('c3', 1.0), ('cOF1', -5.91), ('cOF2', 1.77), ('cIF1', -3.98), ('cIF2', 3.0), ('CQOF', 12.09), ('CKIF', 77.69), ('CKBF', 700.13)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-2.9 %	17.8 %	-8.4 %
NS	0.761	0.735	0.708
NS_log	0.662	0.318	0.704
NS_rel	-27.68	-47.716	0.634
KGE	0.698	0.672	0.606

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-6.0 %	1.6 %	-8.9 %
NS	0.75	0.706	0.707
NS_log	0.623	0.242	0.724
NS_rel	-9.235	-19.045	0.705
KGE	0.683	0.742	0.621

1.3 Observed and simulated timeseries for optimum parameters

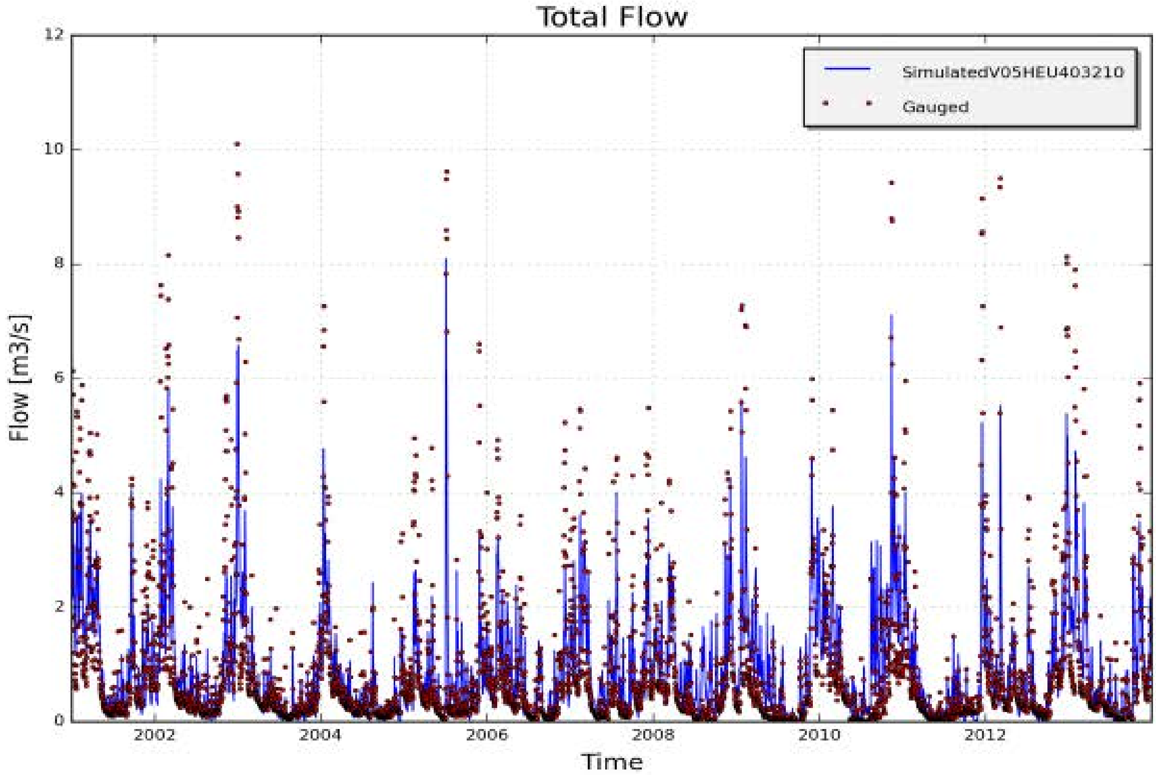


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V05HEU403210, station 40310102 - Heulebeek; Heule(calibration period)

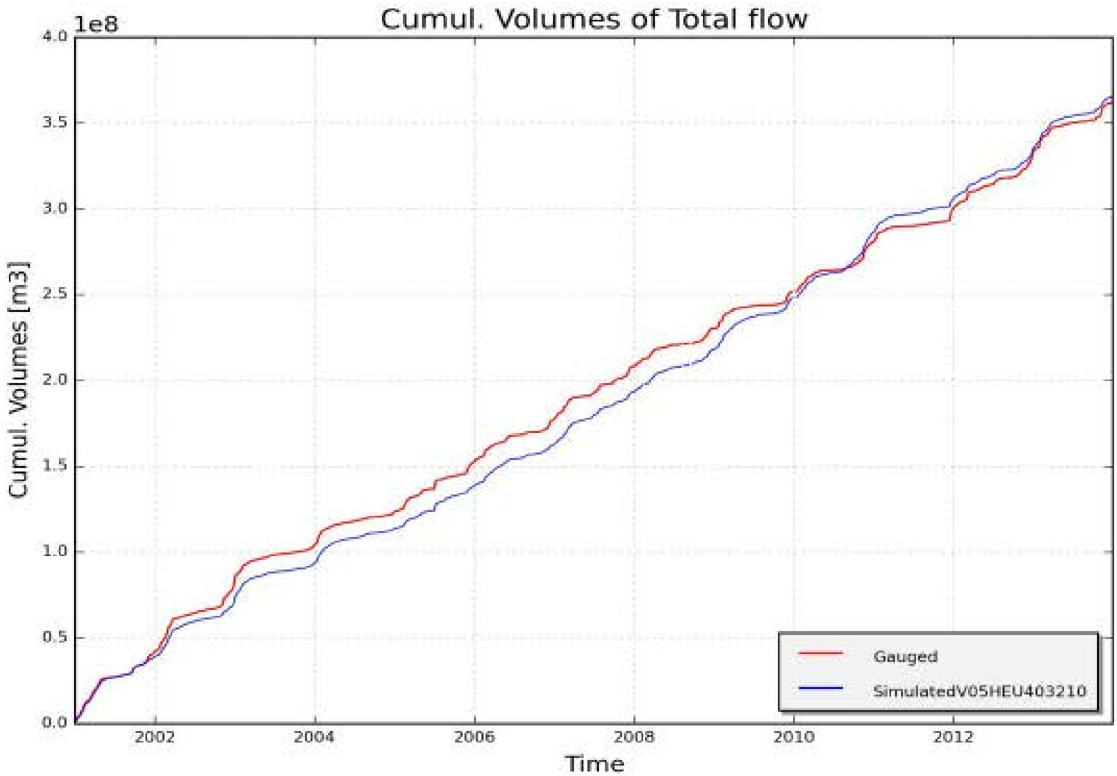


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V05HEU403210, station 40310102 - Heulebeek; Heule (calibration period)

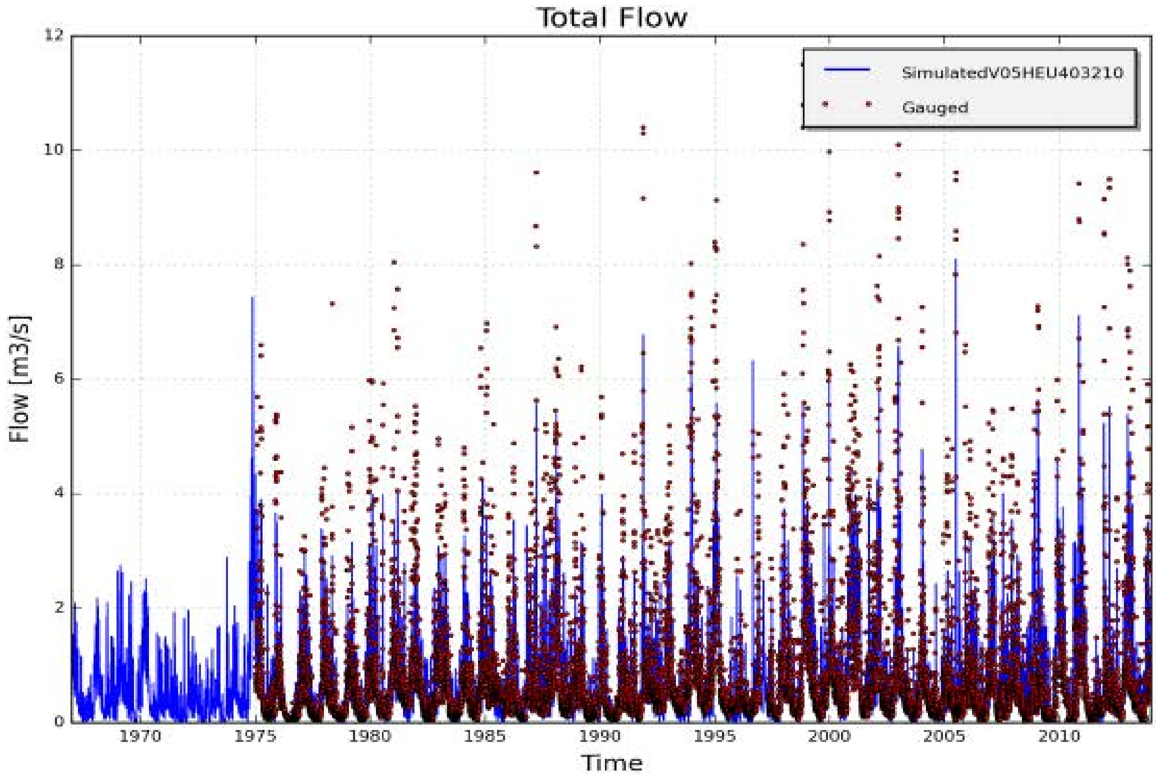


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V05HEU403210, station 40310102 - Heulebeek; Heule (validation period)

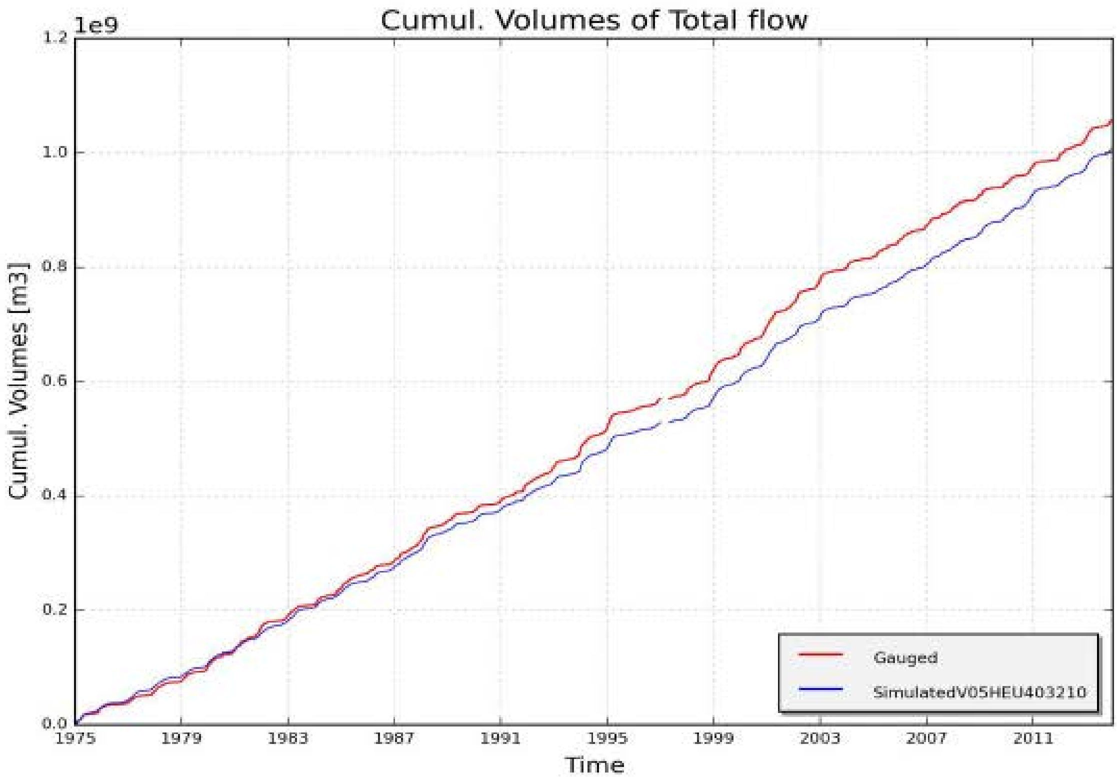


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V05HEU403210, station 40310102 - Heulebeek; Heule (validation period)

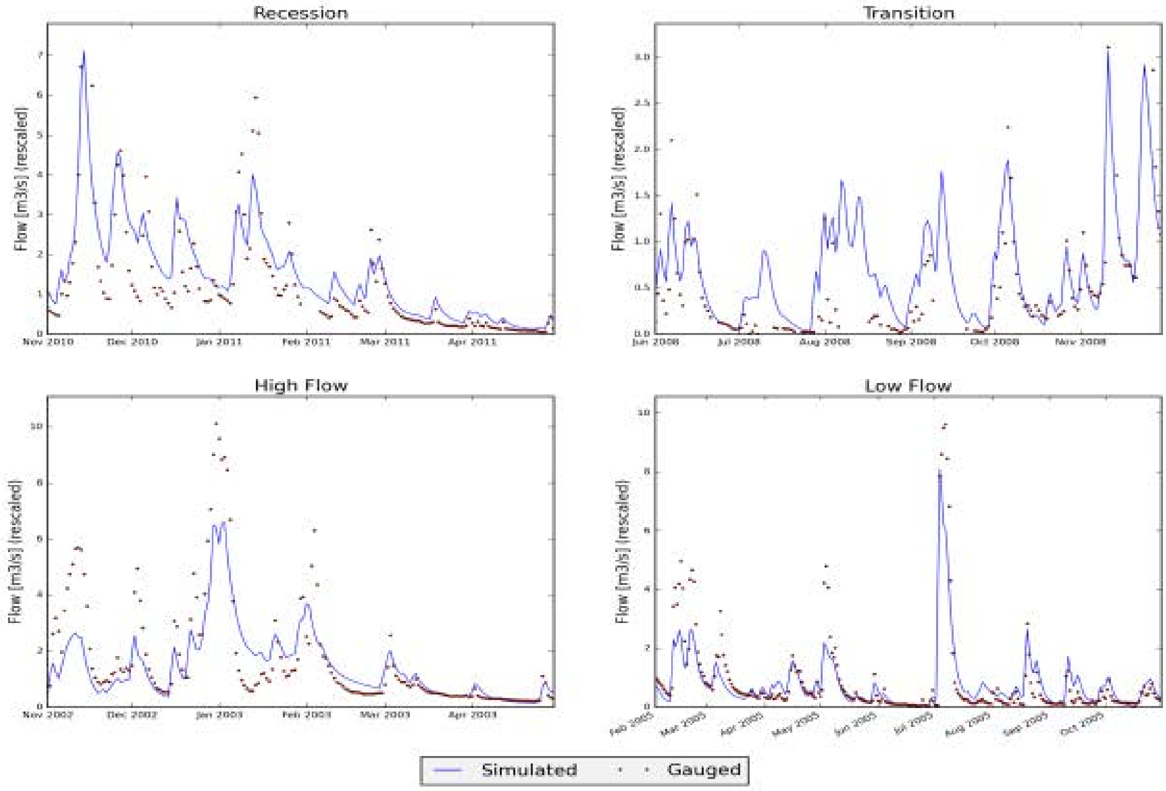


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V05HEU403210, station 40310102 - Heulebeek; Heule

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V05MAN401230" (LEIEBEKKEN)

1.1 Input data

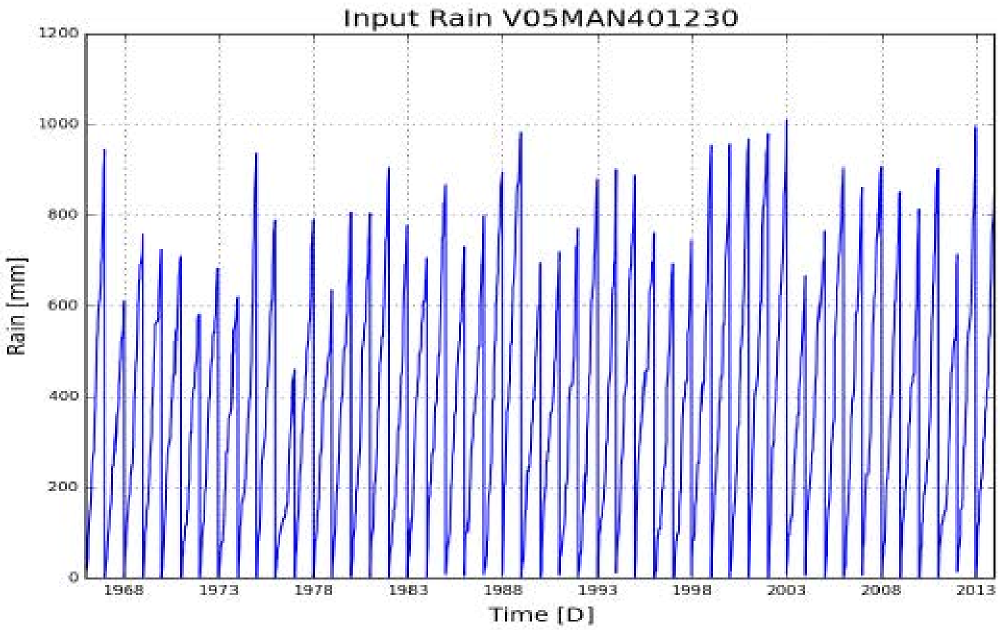


Figure 1: Cumulative precipitation on catchment V05MAN401230 (Leiebekken)

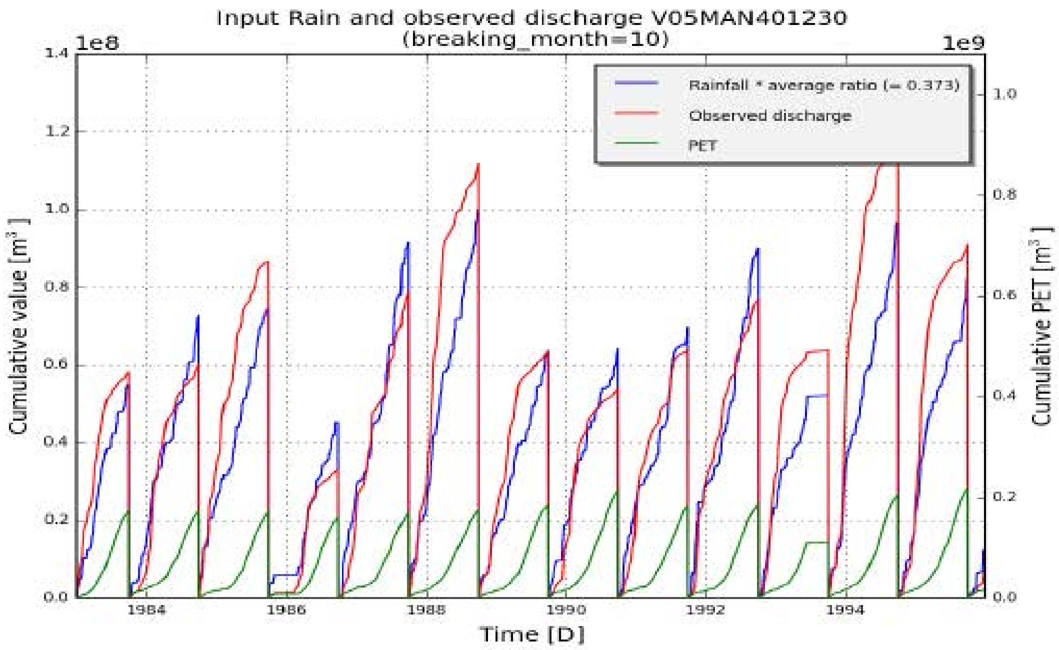


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V05MAN401230 (Leiebekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V05MAN401230
subcatchment_area [m2]	258441818
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 440.53), ('SMevap', 177.61), ('c1', 2.07), ('c2', 0.95), ('c3', 1.0), ('cOF1', -4.49), ('cOF2', 4.97), ('cIF1', -3.24), ('cIF2', 3.0), ('CQOF', 12.69), ('CKIF', 48.99), ('CKBF', 763.41)]

Table 1: Goodness of fit for calibration period (1983 - 1995)

	Full year	**Summer**	**Winter**
RelErr	0.5 %	26.1 %	-17.6 %
NS	0.748	0.686	0.702
NS_log	0.757	0.553	0.747
NS_rel	0.124	0.605	0.703
KGE	0.69	0.69	0.612

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-2.7 %	33.7 %	-22.2 %
NS	0.71	0.556	0.649
NS_log	0.619	0.096	0.629
NS_rel	-0.947	-2.114	0.523
KGE	0.703	0.535	0.612

1.3 Observed and simulated timeseries for optimum parameters

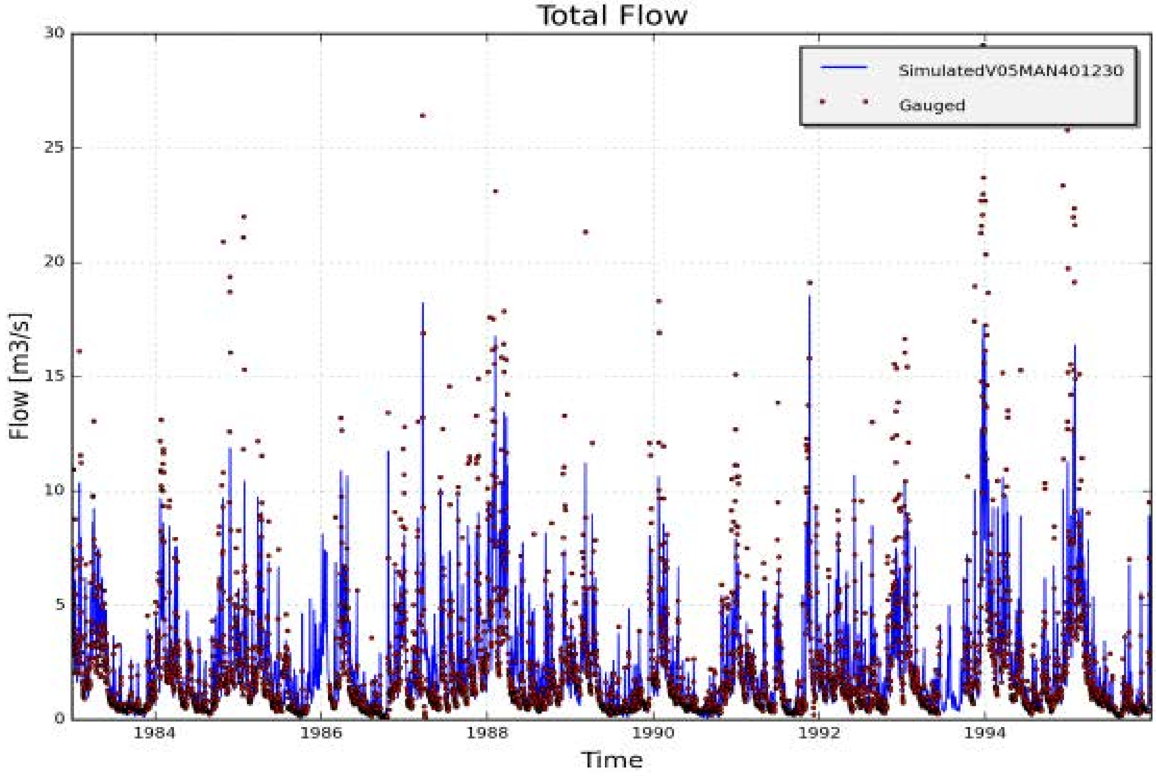


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V05MAN401230, station 40110102 - Mandel; Oostrozebeke(calibration period)

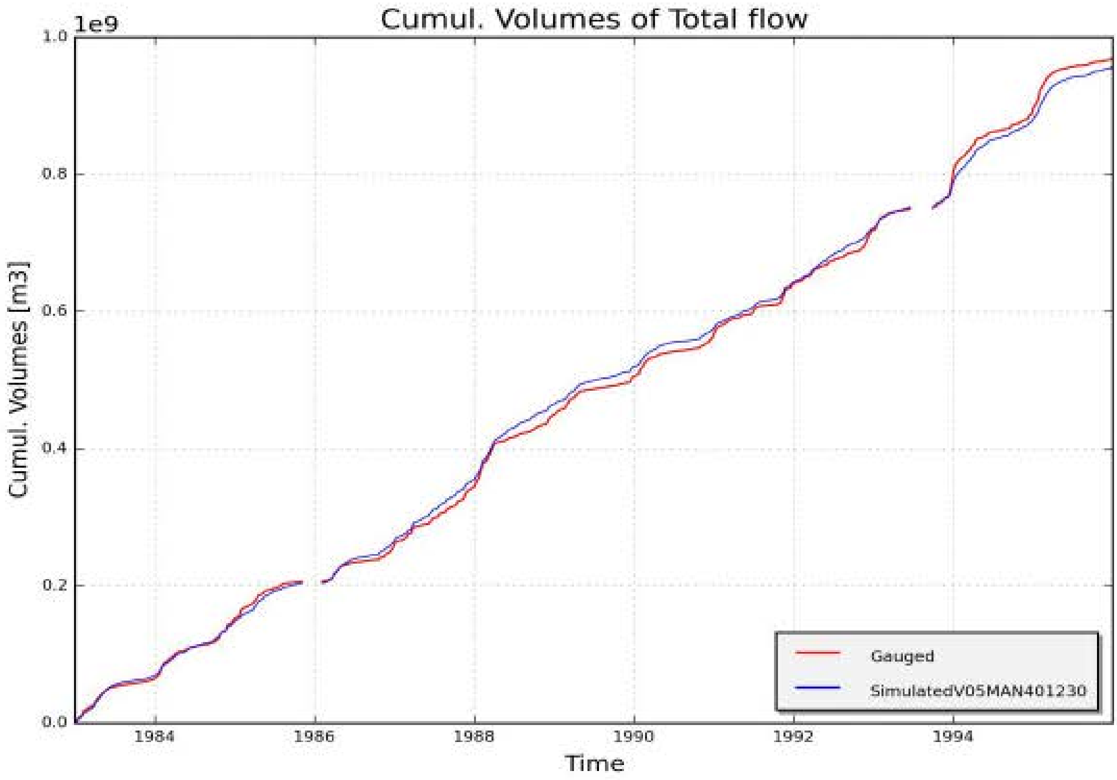


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V05MAN401230, station 40110102 - Mandel; Oostrozebeke (calibration period)

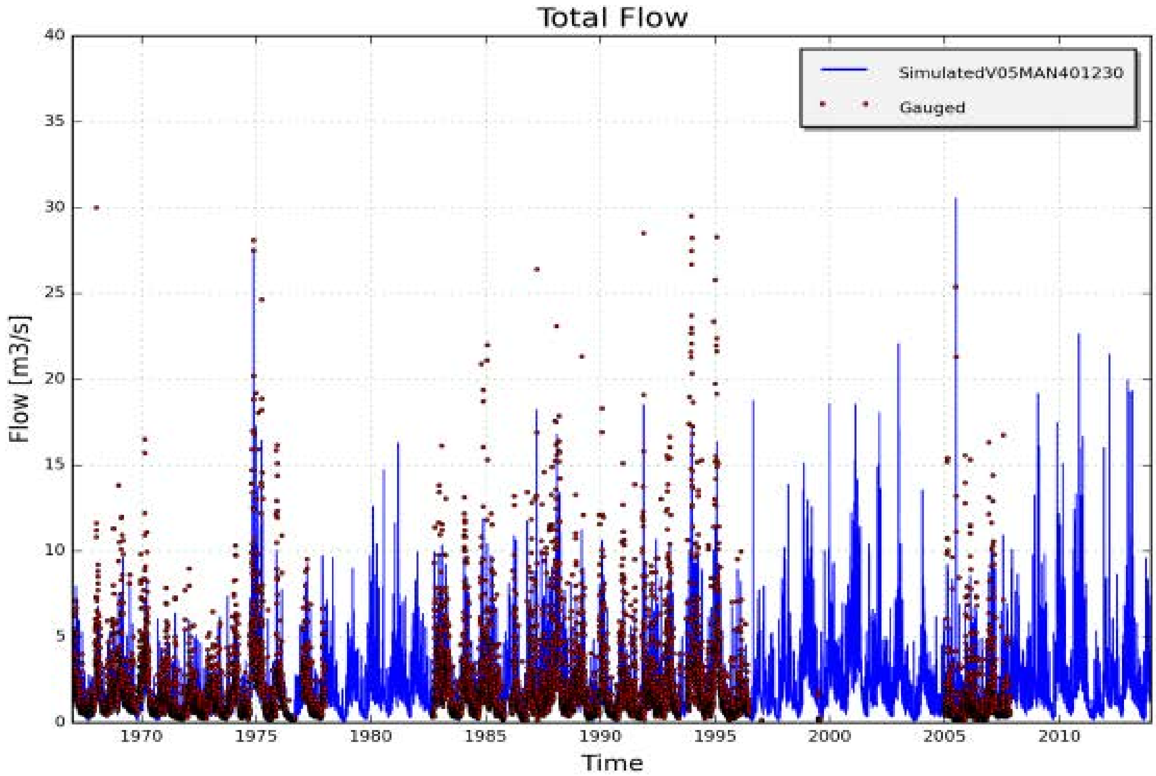


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V05MAN401230, station 40110102 - Mandel; Oostrozebeke (validation period)

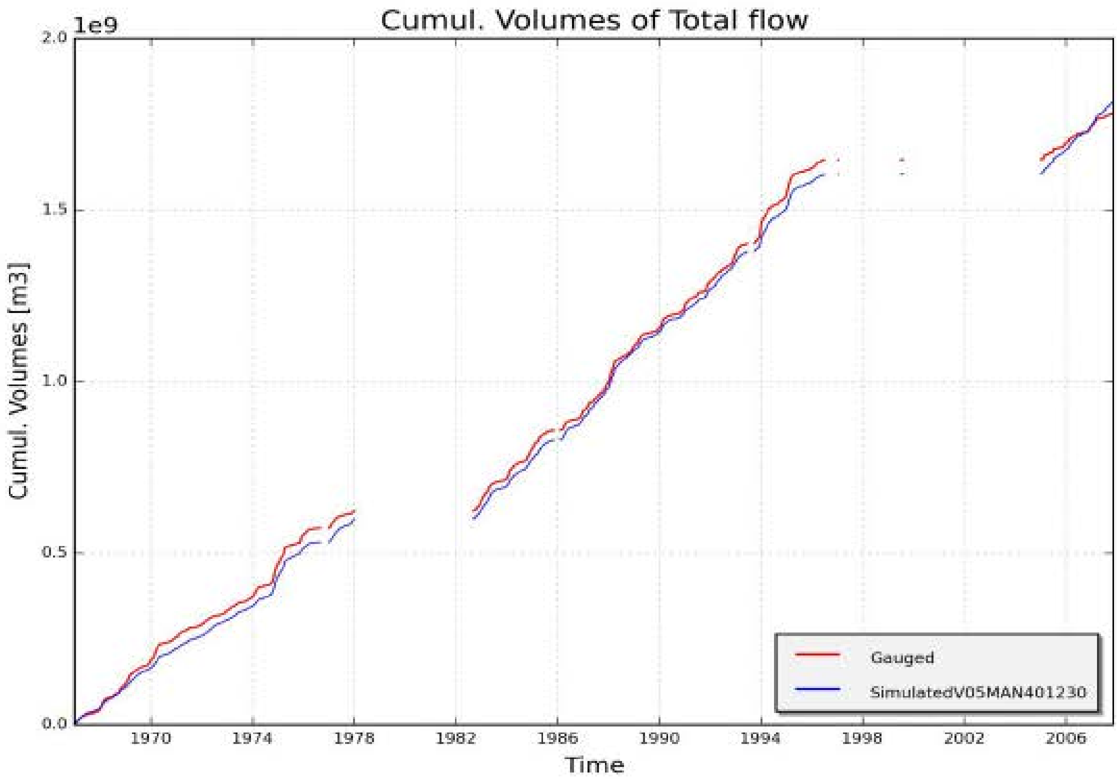


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V05MAN401230, station 40110102 - Mandel; Oostrozebeke (validation period)

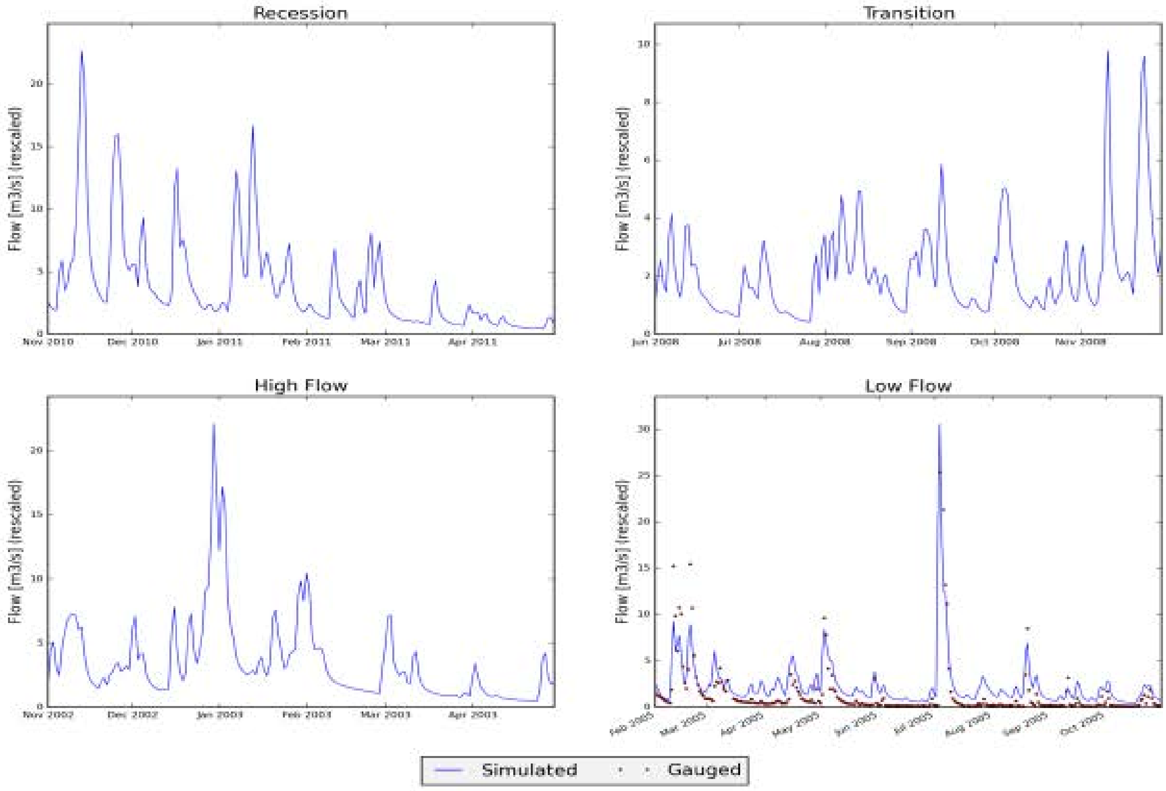


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V05MAN401230, station 40110102 - Mandel; Oostrozebeke

Appendix 8 Bovenschelde

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "F06BOS325001" (BOVENSCHELDE)

1.1 Input data

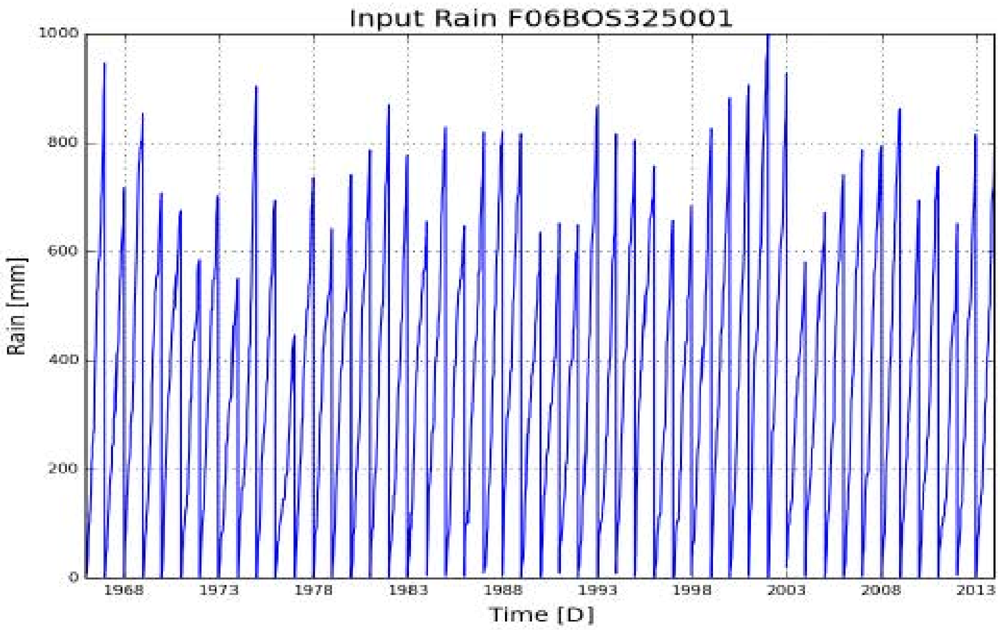


Figure 1: Cumulative precipitation on catchment F06BOS325001 (Bovenschelde)

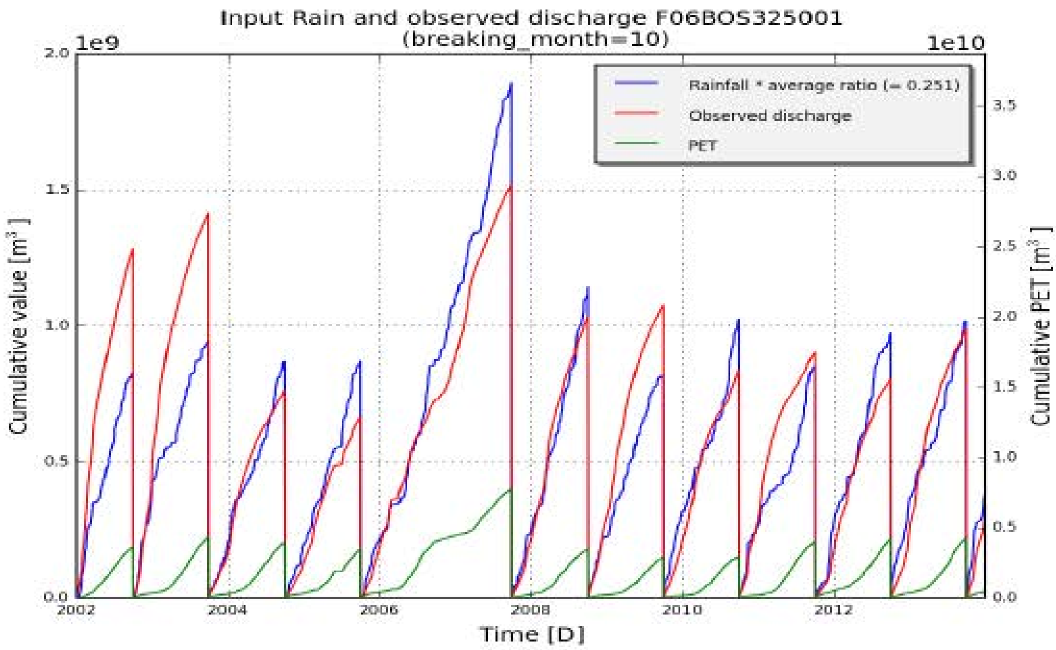


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment F06BOS325001 (Bovenschelde)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	F06BOS325001
subcatchment_area [m2]	5217586196
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 435.3), ('SMevap', 176.44), ('c1', 1.98), ('c2', 0.54), ('c3', 1.0), ('cOF1', -5.65), ('cOF2', 2.18), ('cIF1', -3.81), ('cIF2', 2.87), ('CQOF', 12.77), ('CKIF', 61.4), ('CKBF', 1060.45)]

Table 1: Goodness of fit for calibration period (2002 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-4.5 %	14.9 %	-16.4 %
NS	0.718	0.217	0.696
NS_log	0.626	0.006	0.733
NS_rel	0.674	-0.144	0.836
KGE	0.709	0.609	0.644

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-5.3 %	13.8 %	-16.7 %
NS	0.719	0.298	0.693
NS_log	0.637	0.054	0.732
NS_rel	0.677	-0.029	0.835
KGE	0.703	0.622	0.64

1.3 Observed and simulated timeseries for optimum parameters

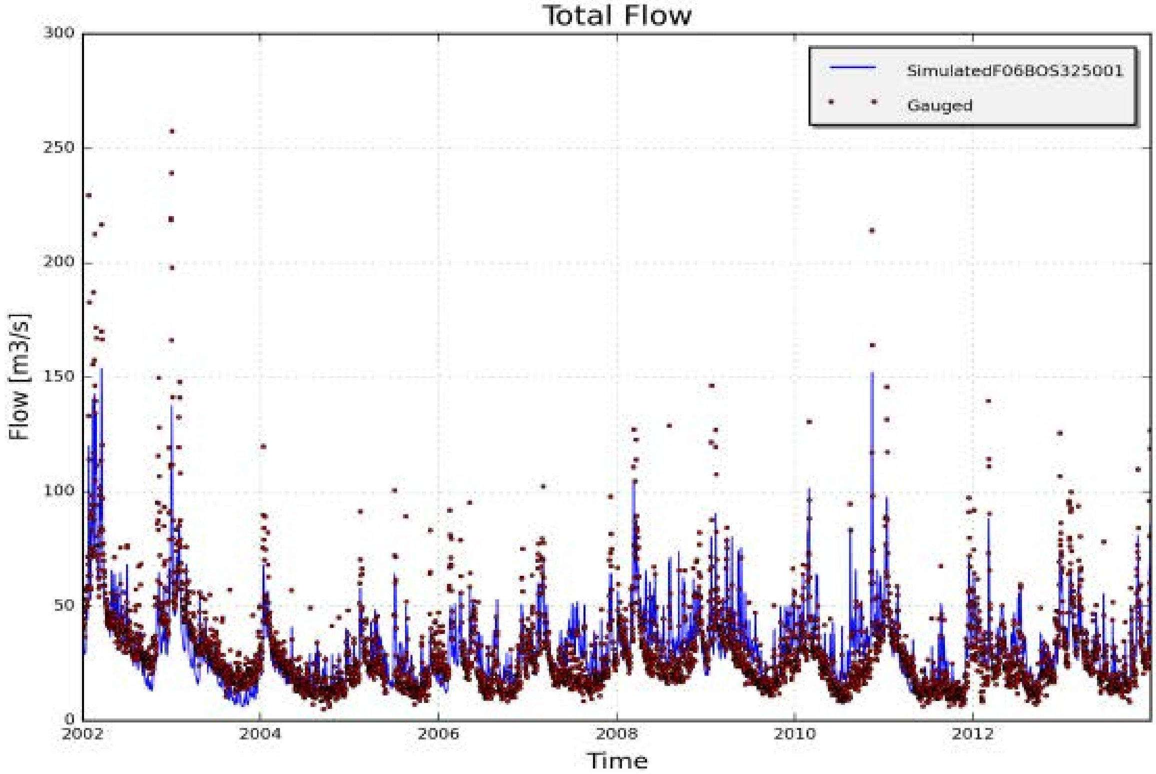


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment F06BOS325001, station unkown(calibration period)

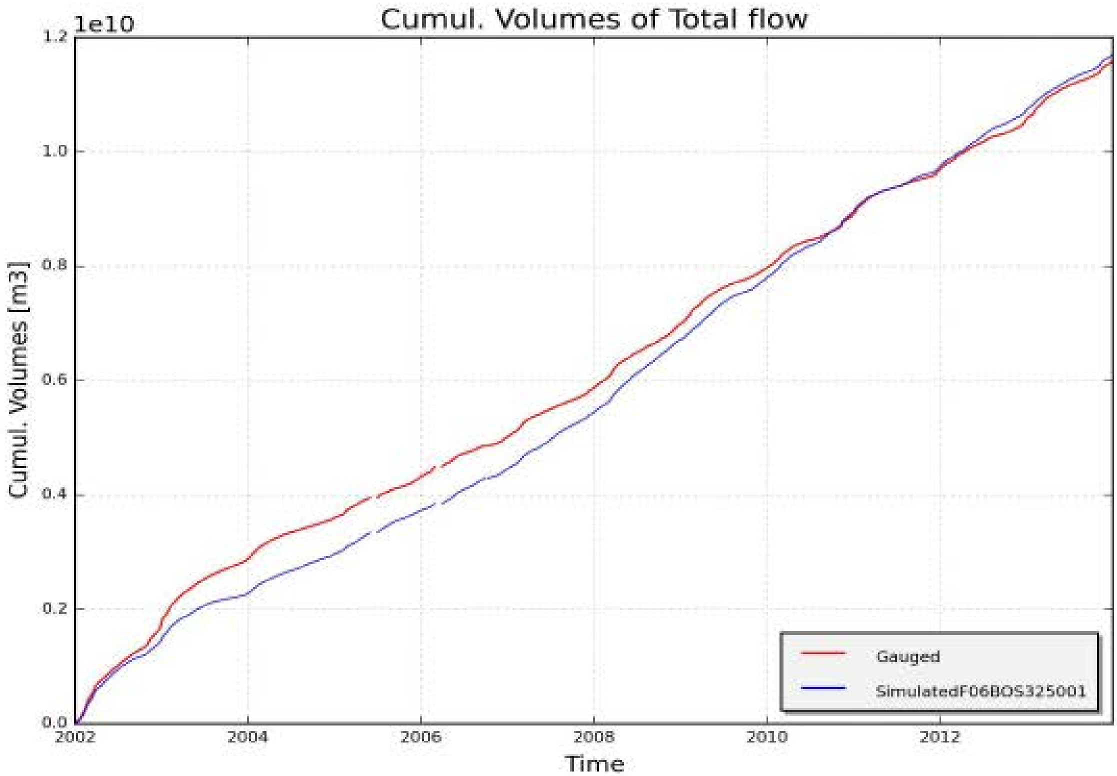


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment F06BOS325001, station unkown (calibration period)

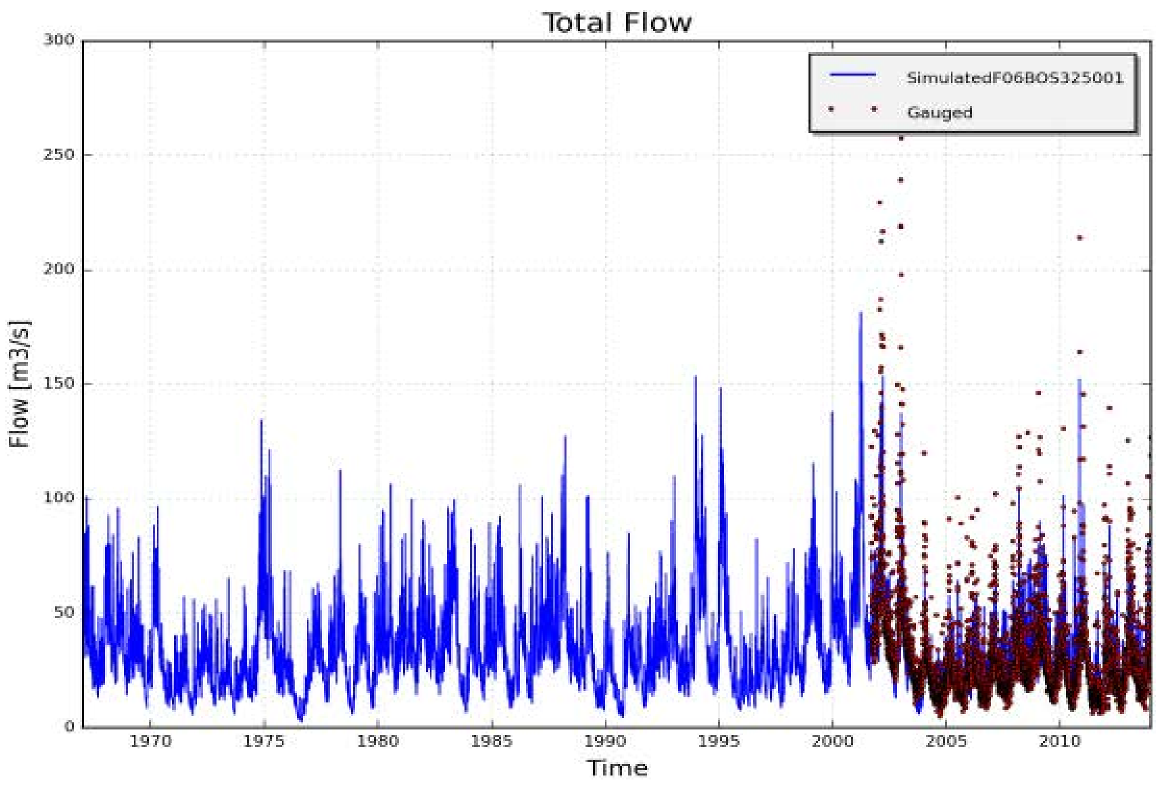


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment F06BOS325001, station unkown (validation period)

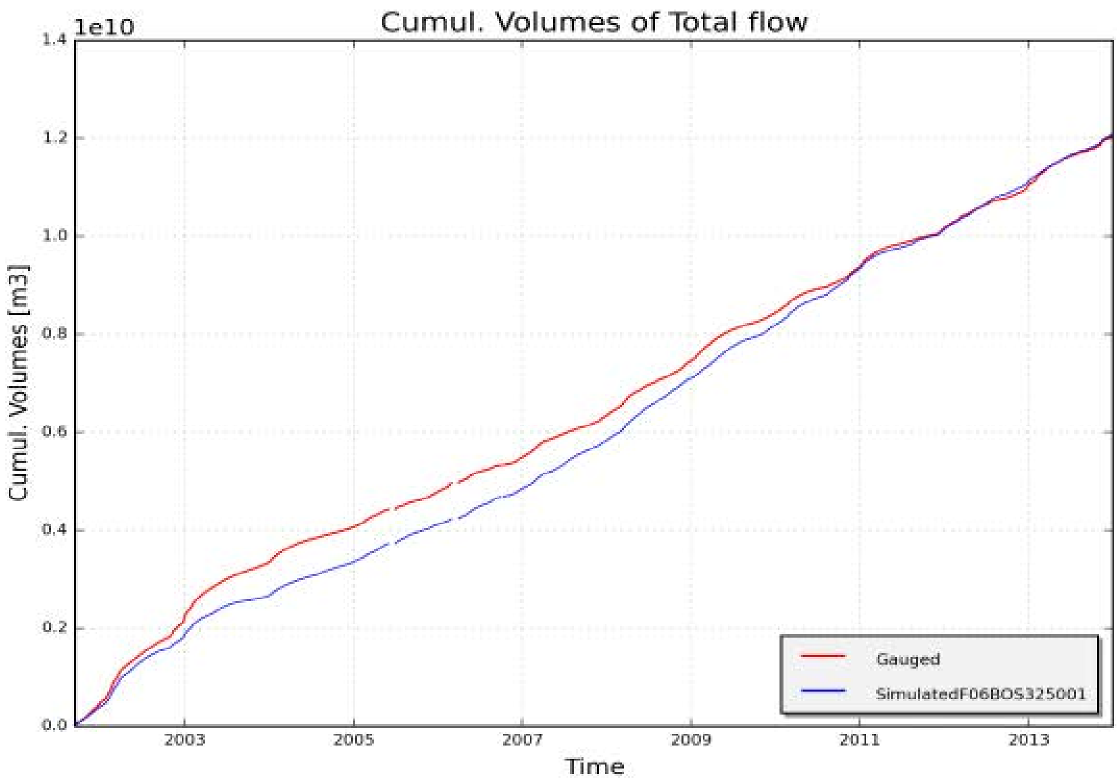


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment F06BOS325001, station unkown (validation period)

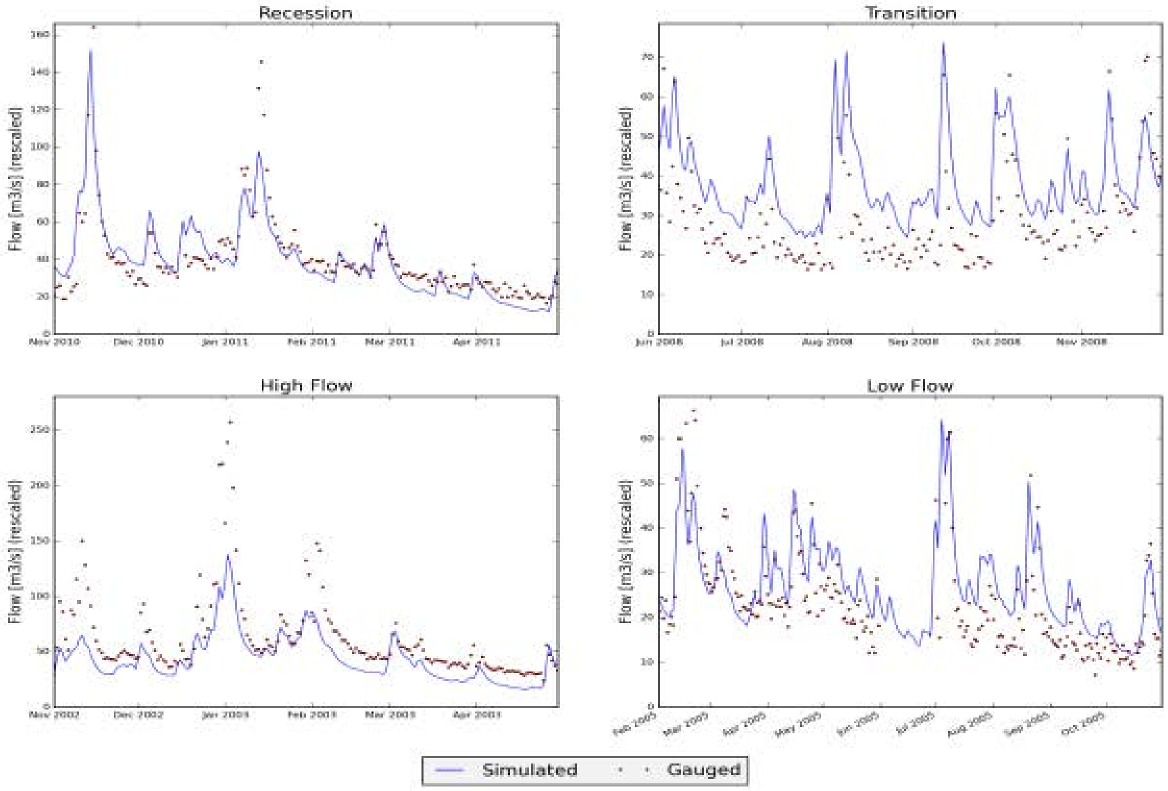


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment F06BOS325001, station unkown

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V06MAA347160" (BOVENSCHELDE)

1.1 Input data

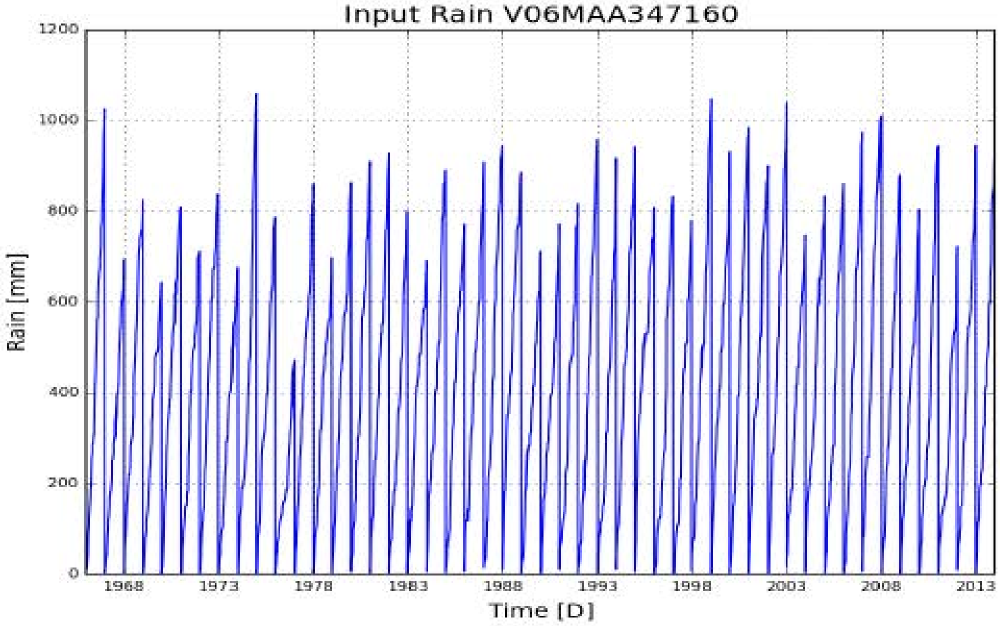


Figure 1: Cumulative precipitation on catchment V06MAA347160 (Bovenschelde)

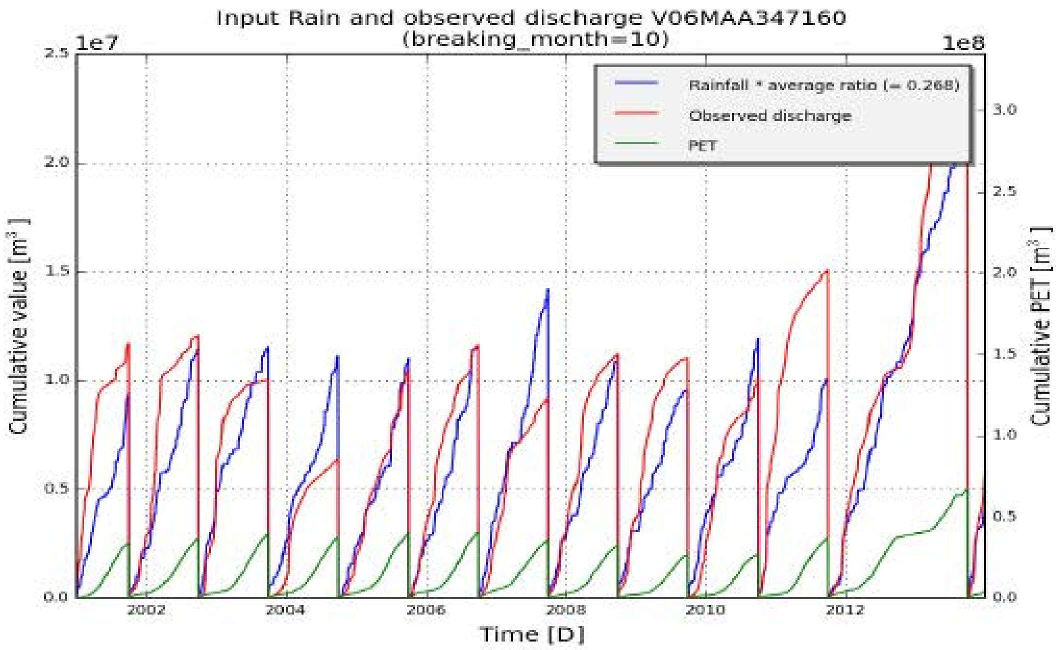


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V06MAA347160 (Bovenschelde)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V06MAA347160
subcatchment_area [m2]	48678191
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 524.5), ('SMevap', 175.36), ('c1', 2.31), ('c2', 0.9), ('c3', 1.0), ('cOF1', -3.58), ('cOF2', 3.67), ('cIF1', -6.0), ('cIF2', 3.0), ('CQOF', 12.25), ('CKIF', 62.58), ('CKBF', 673.14)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.4 %	14.0 %	-12.6 %
NS	0.58	0.346	0.572
NS_log	nan	nan	0.138
NS_rel	-inf	-inf	0.644
KGE	0.655	0.499	0.613

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-17.5 %	-2.8 %	-25.6 %
NS	0.55	0.398	0.521
NS_log	nan	nan	-0.294
NS_rel	-inf	-inf	0.487
KGE	0.615	0.643	0.565

1.3 Observed and simulated timeseries for optimum parameters

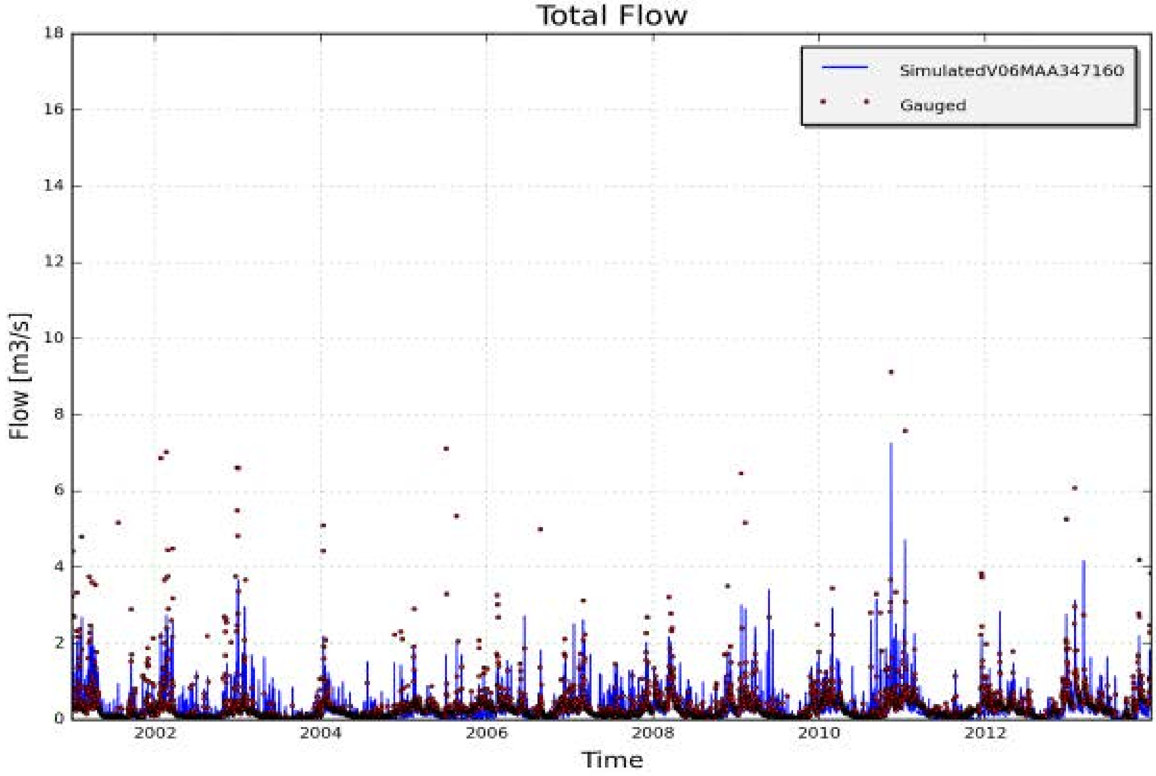


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V06MAA347160, station 34710102 - Maarkebeek; Etikhove(calibration period)

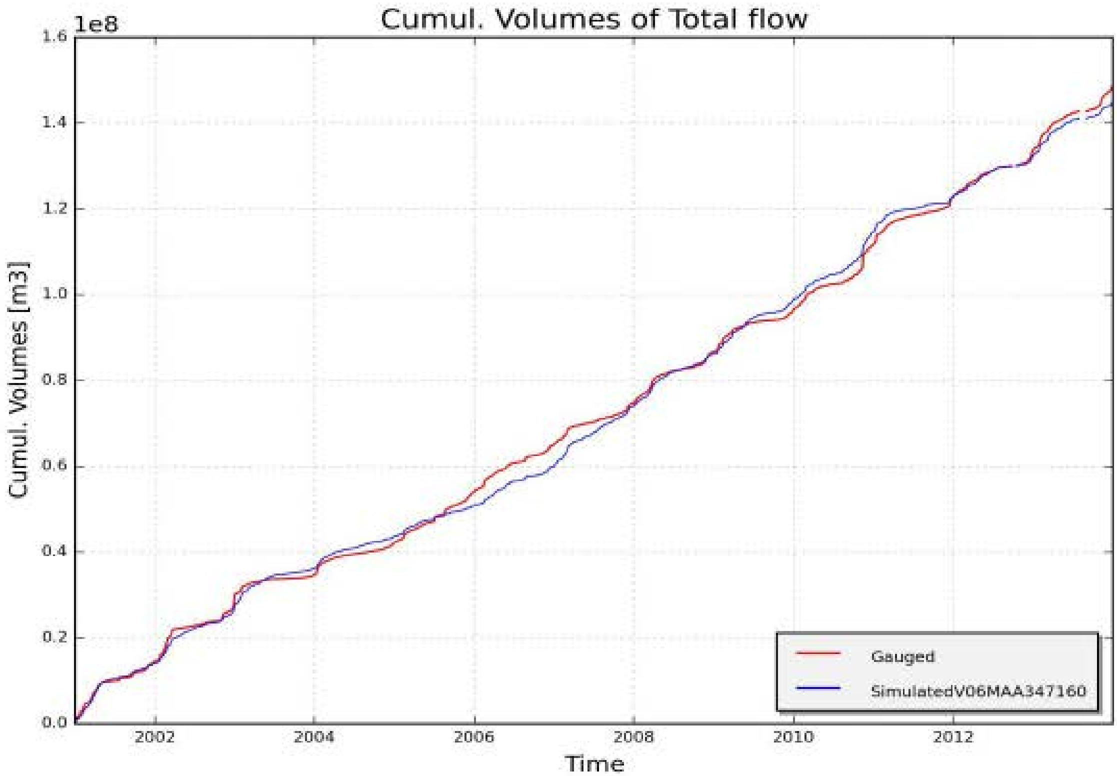


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V06MAA347160, station 34710102 - Maarkebeek; Etikhove (calibration period)

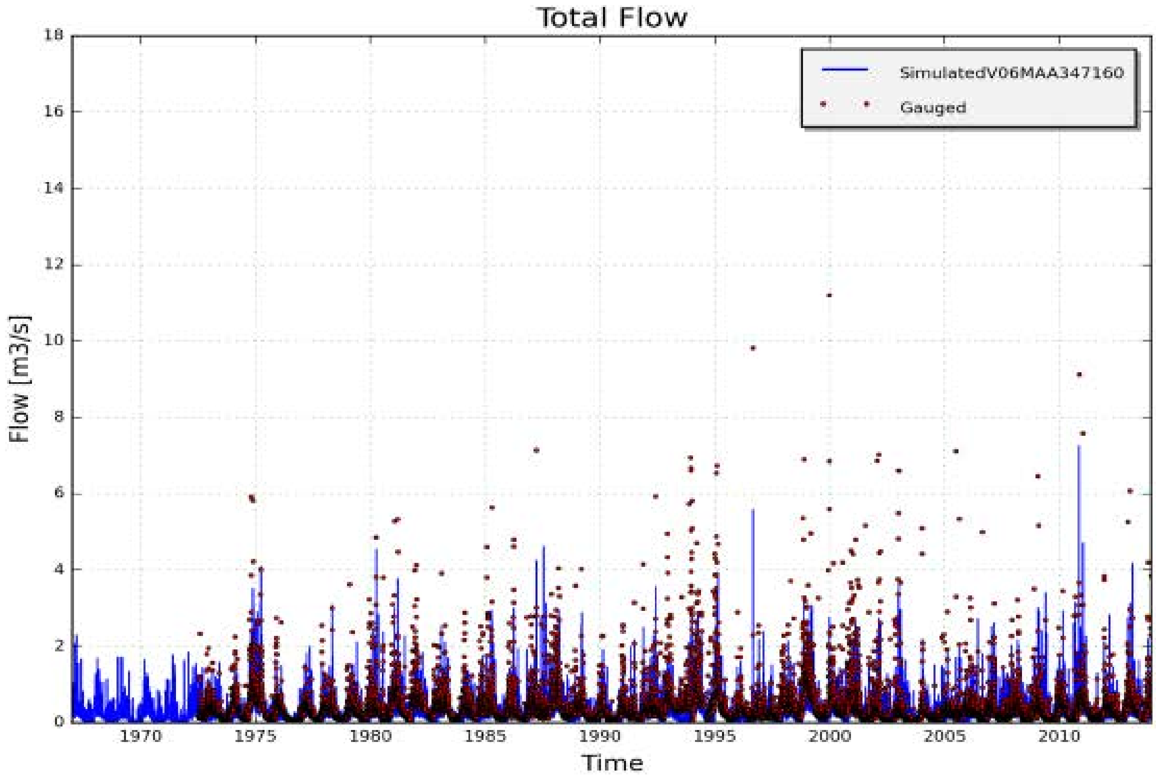


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V06MAA347160, station 34710102 - Maarkebeek; Etikhove (validation period)

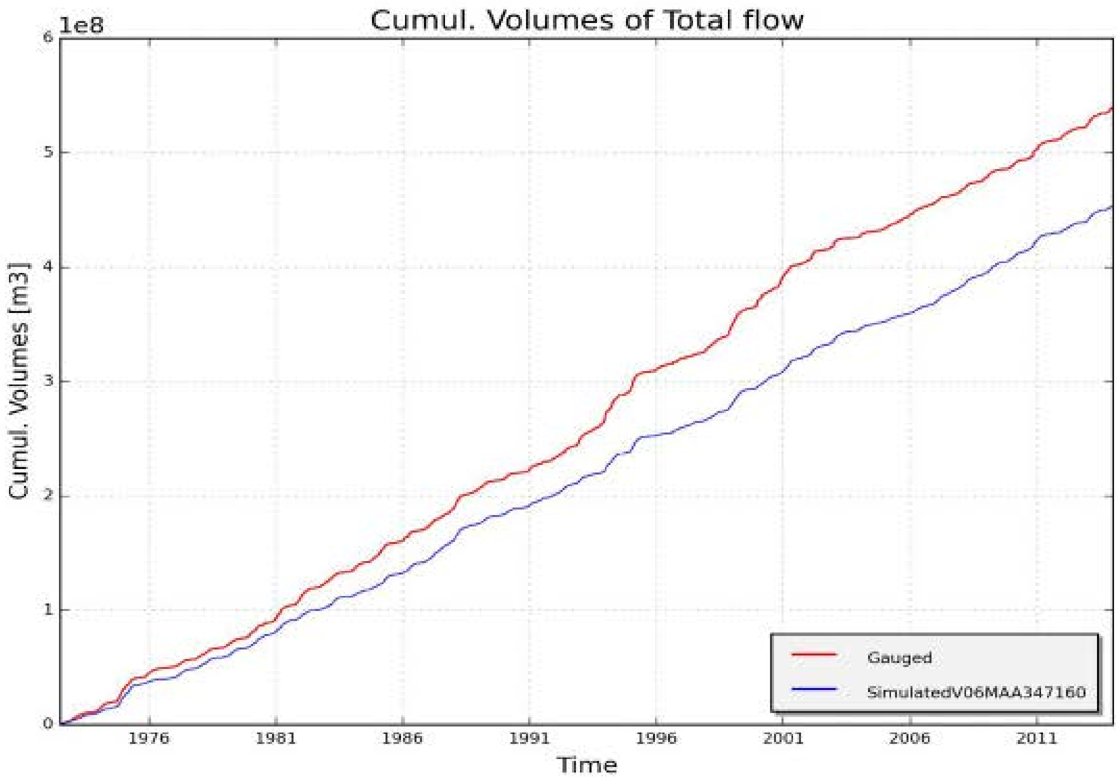


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V06MAA347160, station 34710102 - Maarkebeek; Etikhove (validation period)

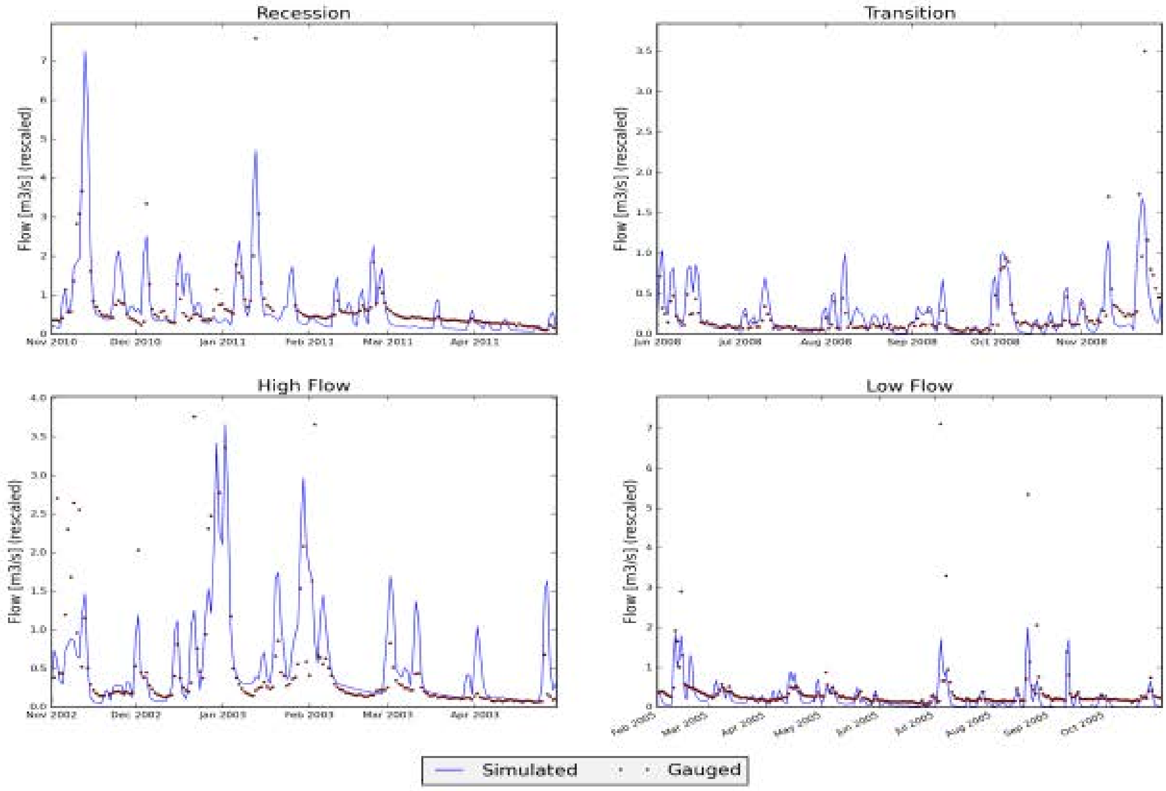


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V06MAA347160, station 34710102 - Maarkebeek; Etikhove

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V06ZWA342190" (BOVENSCHELDE)

1.1 Input data

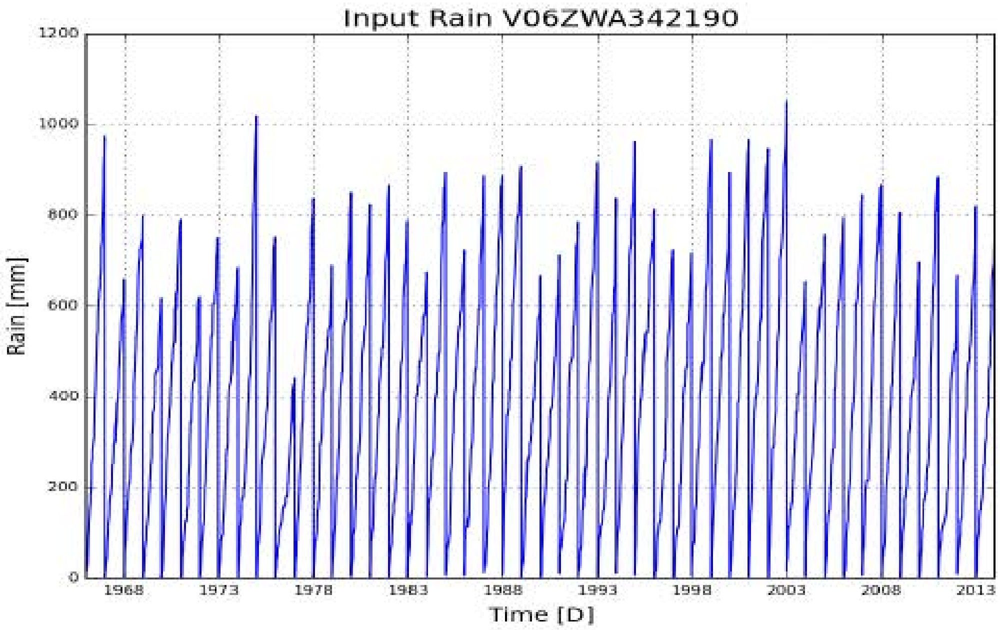


Figure 1: Cumulative precipitation on catchment V06ZWA342190 (Bovenschelde)

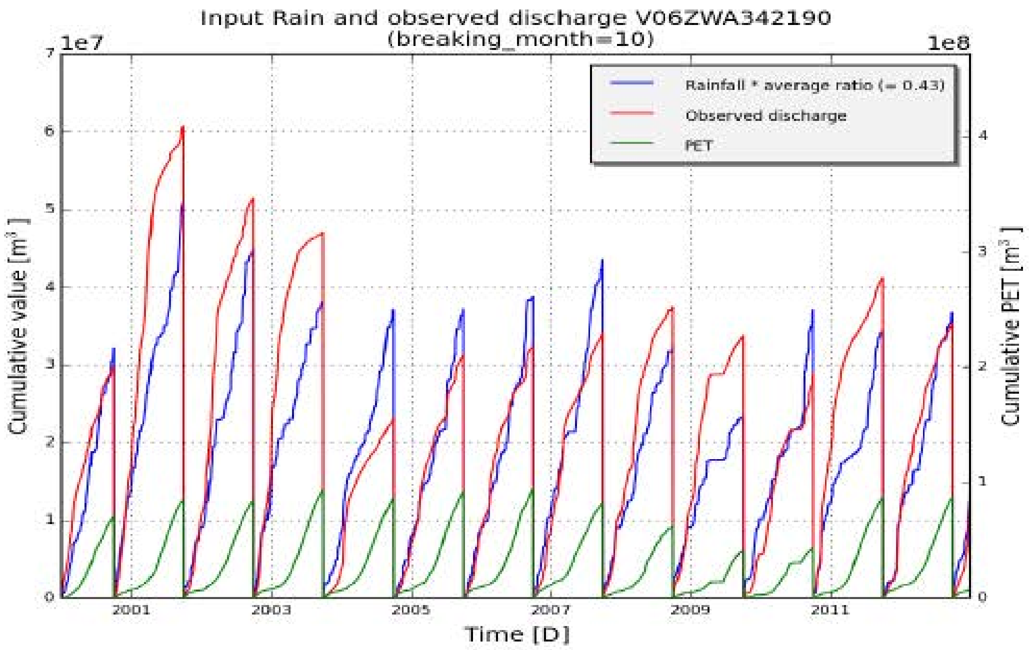


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V06ZWA342190 (Bovenschelde)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V06ZWA342190
subcatchment_area [m2]	112117540
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 448.25), ('SMevap', 168.14), ('c1', 2.11), ('c2', 1.42), ('c3', 1.0), ('cOF1', -3.72), ('cOF2', 2.1), ('cIF1', -4.12), ('cIF2', 2.99), ('CQOF', 14.34), ('CKIF', 59.7), ('CKBF', 707.37)]

Table 1: Goodness of fit for calibration period (2000 - 2012)

	Full year	**Summer**	**Winter**
RelErr	-1.0 %	23.6 %	-13.9 %
NS	0.489	0.386	0.366
NS_log	0.617	0.238	0.591
NS_rel	0.67	0.619	0.773
KGE	0.429	0.374	0.284

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	2.3 %	8.5 %	-8.2 %
NS	0.455	0.236	0.395
NS_log	0.487	0.128	0.573
NS_rel	-32.295	-6.057	0.694
KGE	0.437	0.287	0.342

1.3 Observed and simulated timeseries for optimum parameters

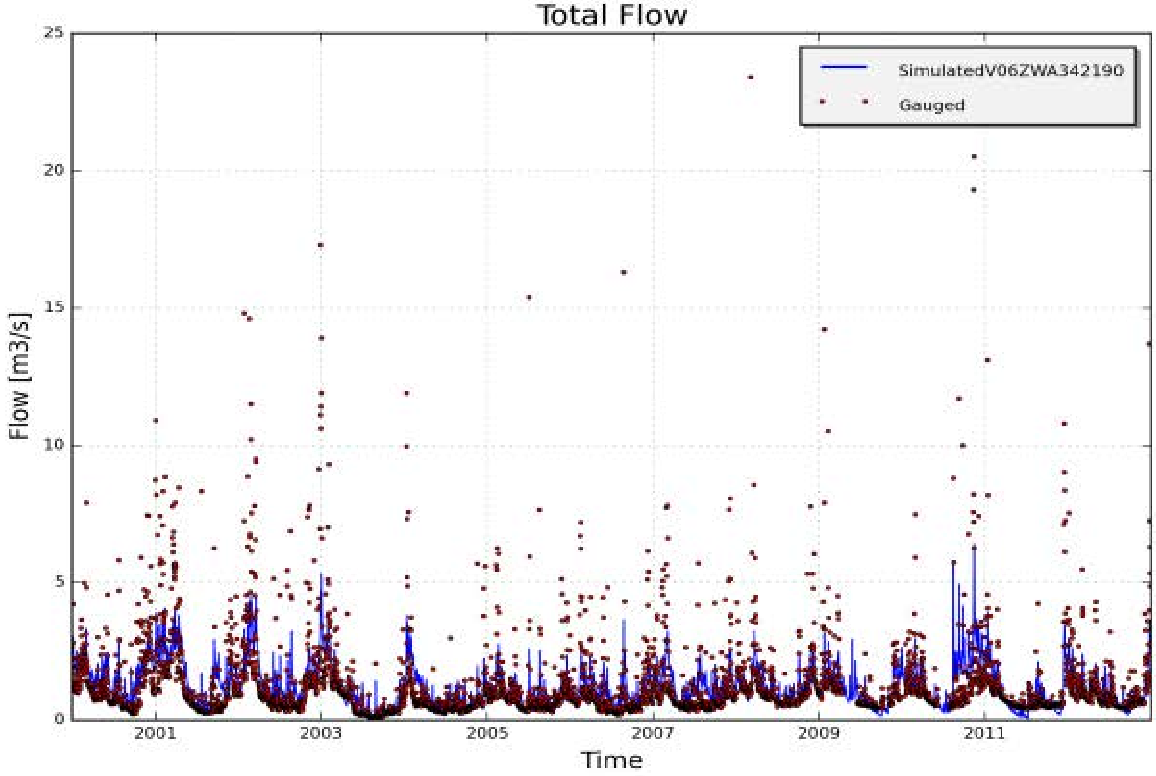


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V06ZWA342190, station 34210102 - Zwalm; Nederzwalm(calibration period)

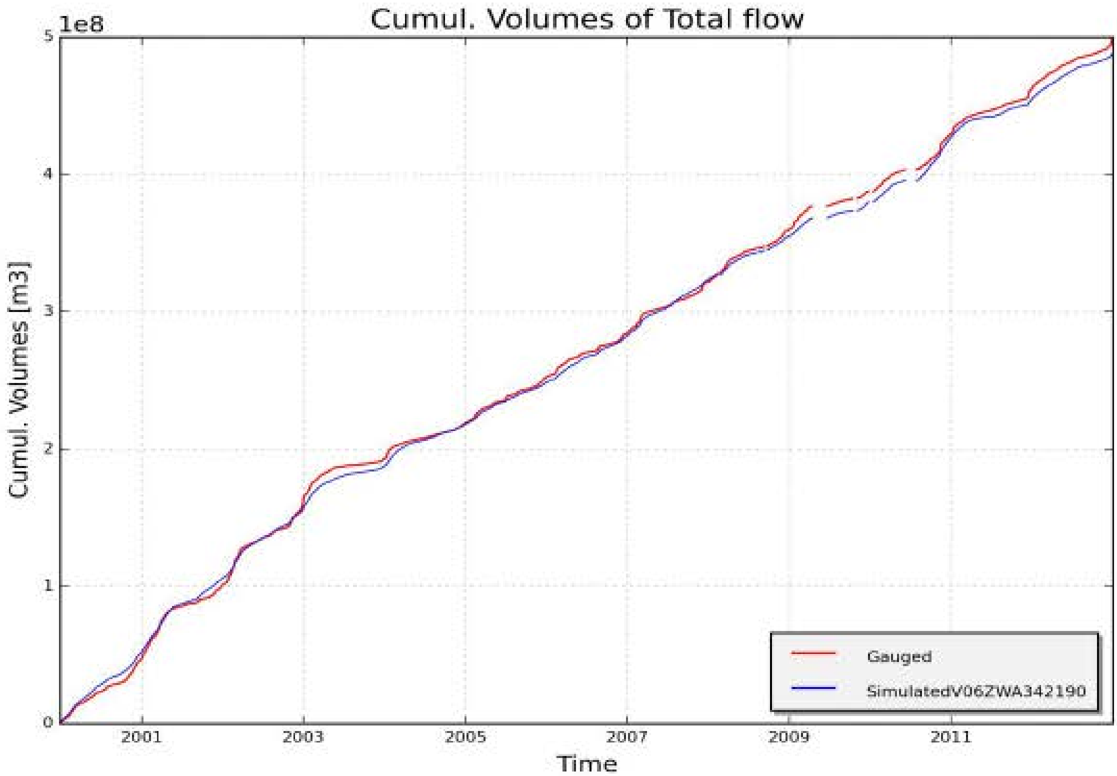


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V06ZWA342190, station 34210102 - Zwalm; Nederzwalm (calibration period)

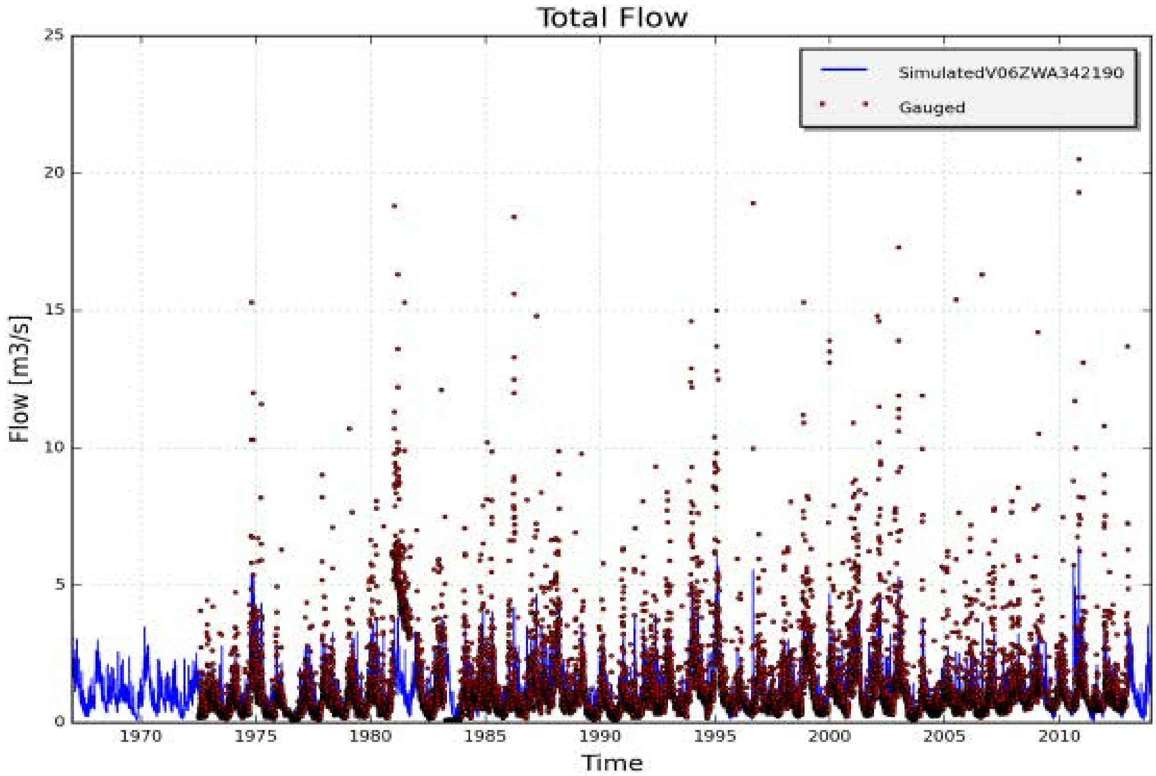


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V06ZWA342190, station 34210102 - Zwalm; Nederzwalm (validation period)

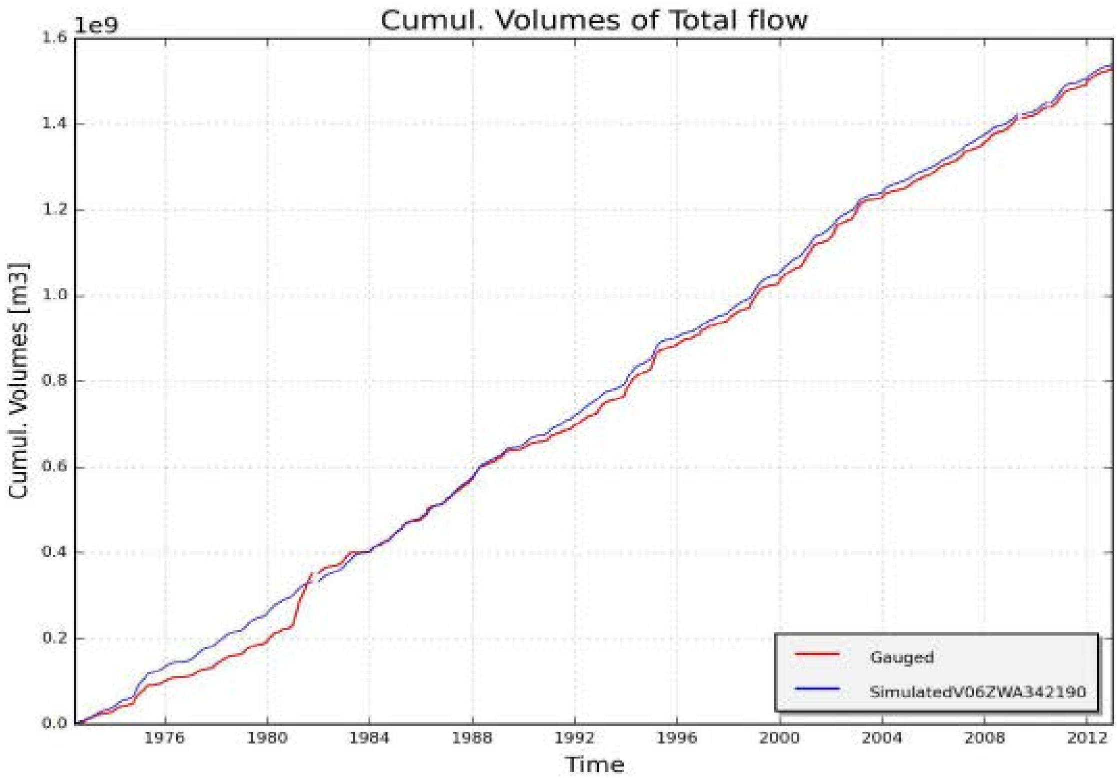


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V06ZWA342190, station 34210102 - Zwalm; Nederzwalm (validation period)

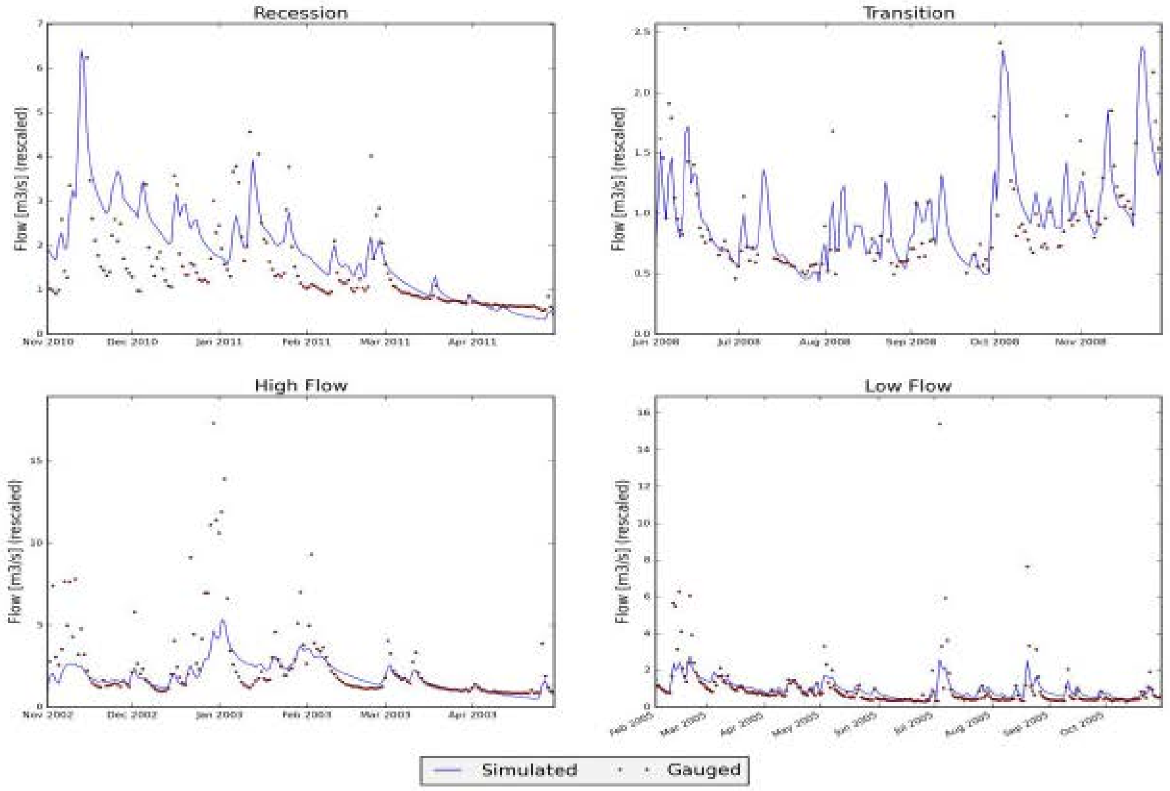


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V06ZWA342190, station 34210102 - Zwalm; Nederzwalm

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W06RHOL54100" (BOVENSCHELDE)

1.1 Input data

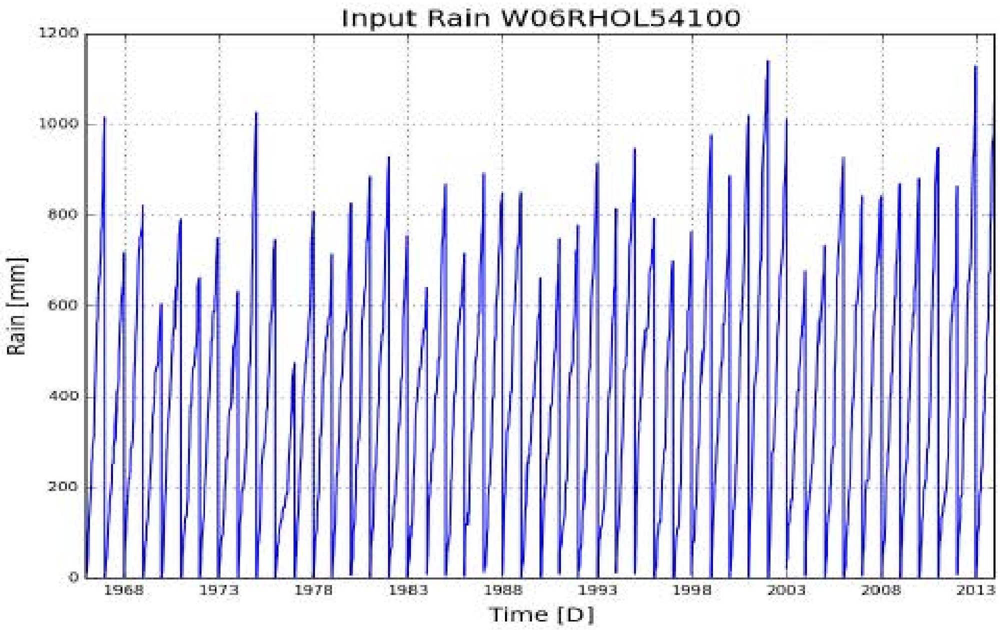


Figure 1: Cumulative precipitation on catchment W06RHOL54100 (Bovenschelde)

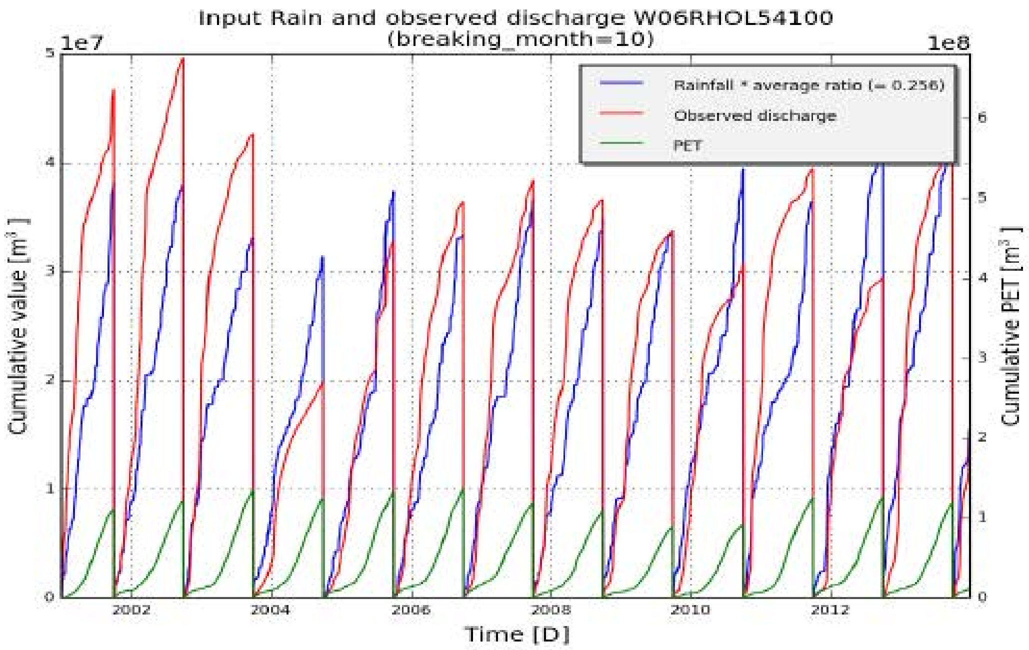


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W06RHOL54100 (Bovenschelde)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W06RHOL54100
subcatchment_area [m2]	161928446
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 482.88), ('SMevap', 156.59), ('c1', 1.96), ('c2', 0.47), ('c3', 1.0), ('cOF1', -3.79), ('cOF2', 2.71), ('cIF1', -3.43), ('cIF2', 2.06), ('CQOF', 11.92), ('CKIF', 88.25), ('CKBF', 739.98)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.9 %	50.4 %	-27.1 %
NS	0.555	0.228	0.53
NS_log	0.383	-0.603	0.497
NS_rel	-0.688	-1.701	0.774
KGE	0.574	0.11	0.467

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-1.2 %	48.0 %	-26.8 %
NS	0.551	0.244	0.528
NS_log	0.398	-0.52	0.5
NS_rel	-0.67	-1.738	0.781
KGE	0.566	0.149	0.463

1.3 Observed and simulated timeseries for optimum parameters

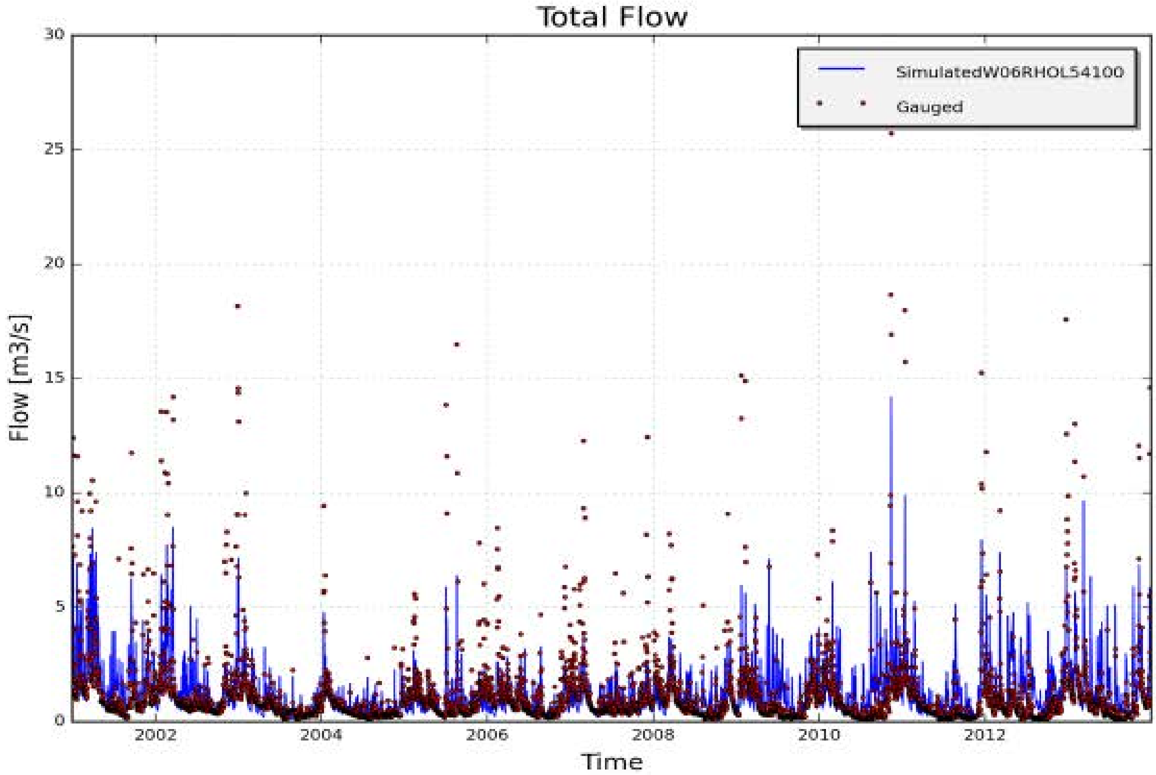


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W06RHOL54100, station L5412 Amougies - Rhosnes(calibration period)

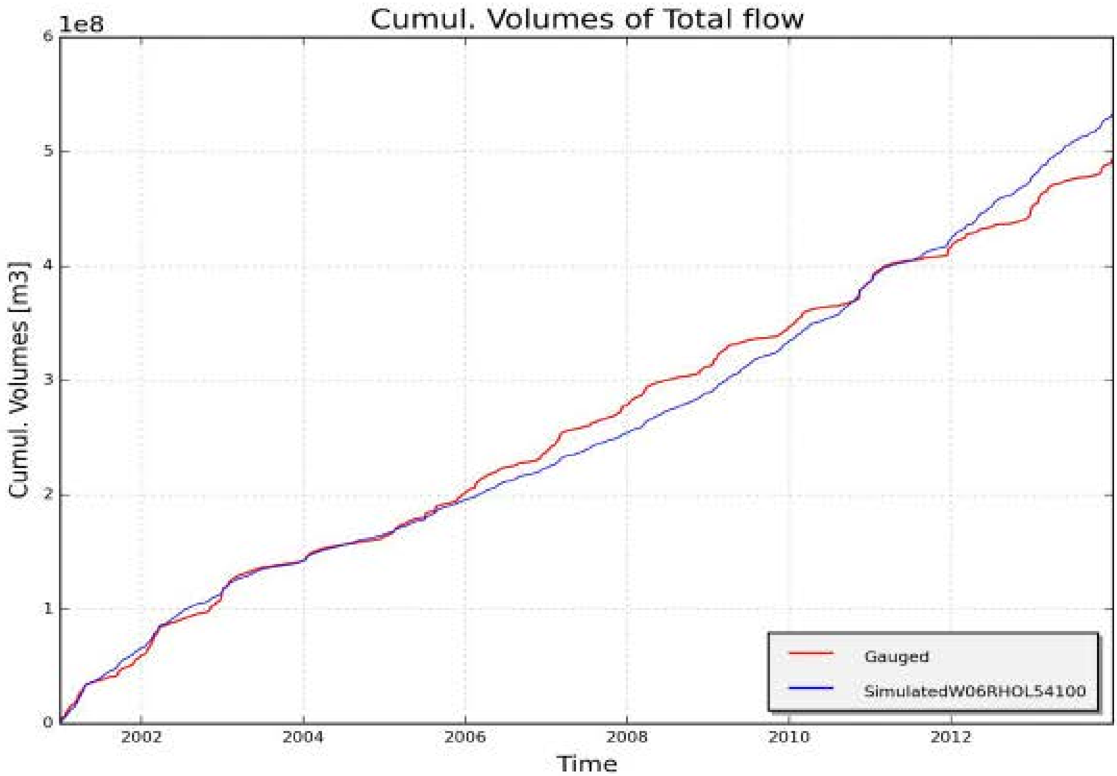


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W06RHOL54100, station L5412 Amougies - Rhosnes (calibration period)

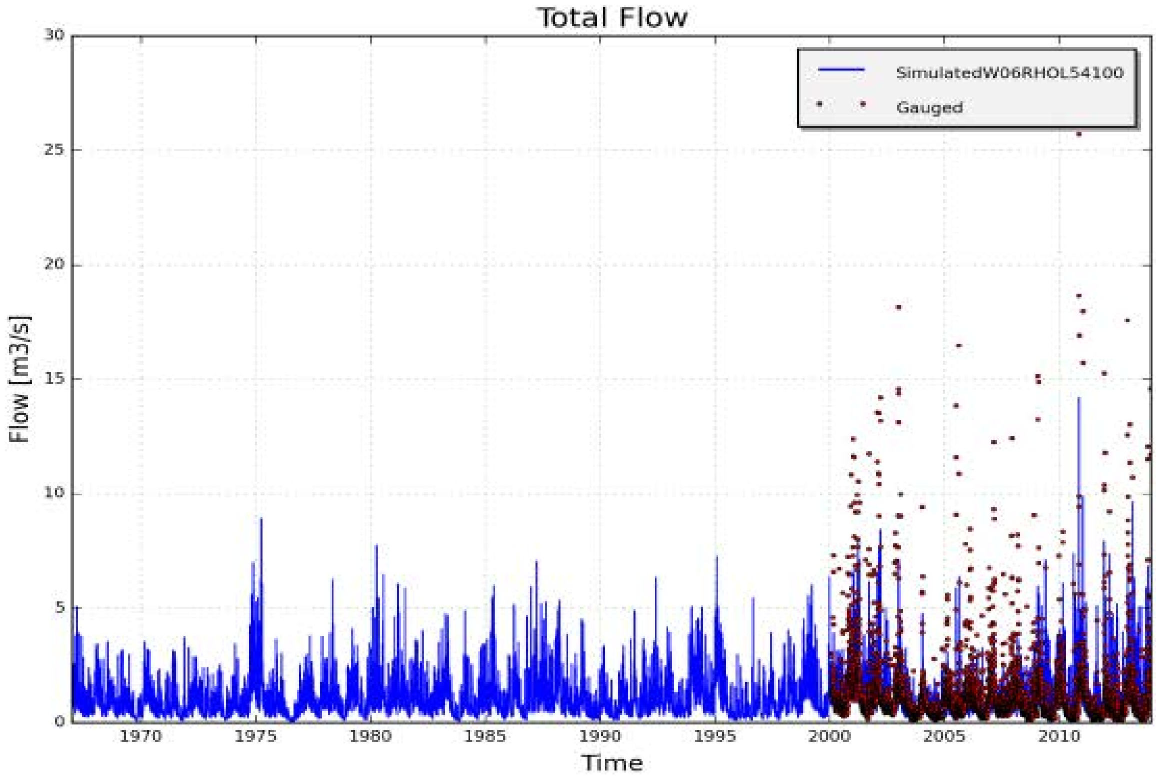


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W06RHOL54100, station L5412 Amougies - Rhosnes (validation period)

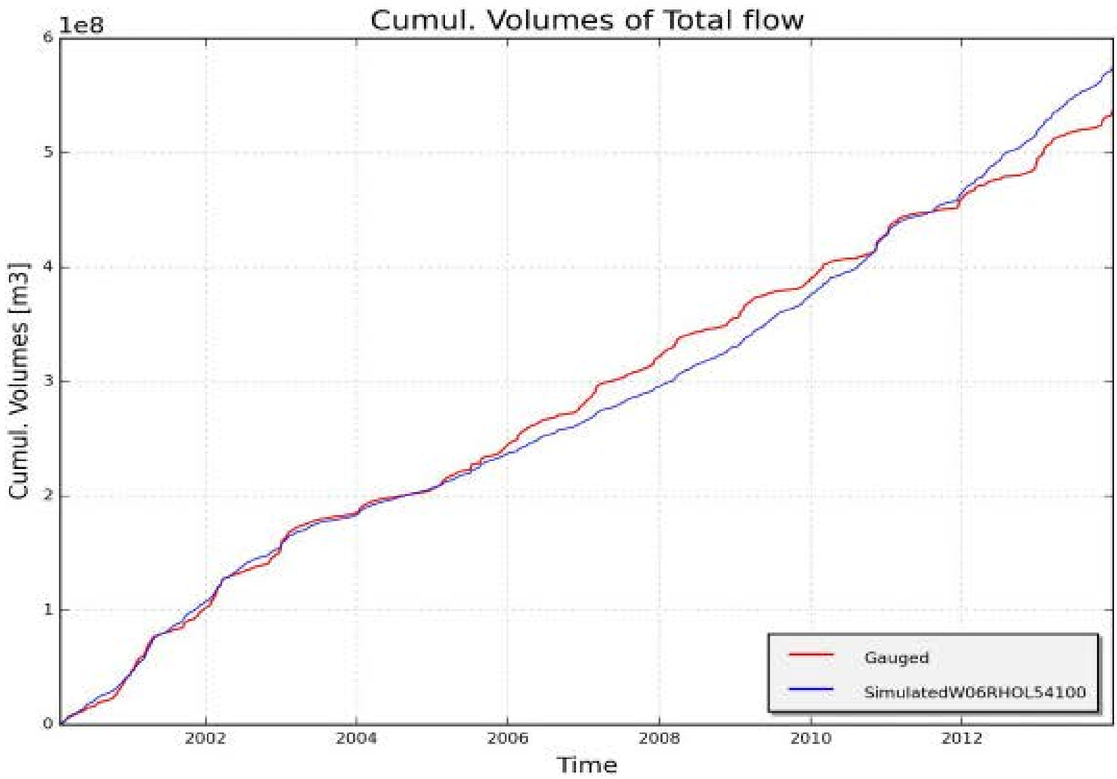


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W06RHOL54100, station L5412 Amougies - Rhosnes (validation period)

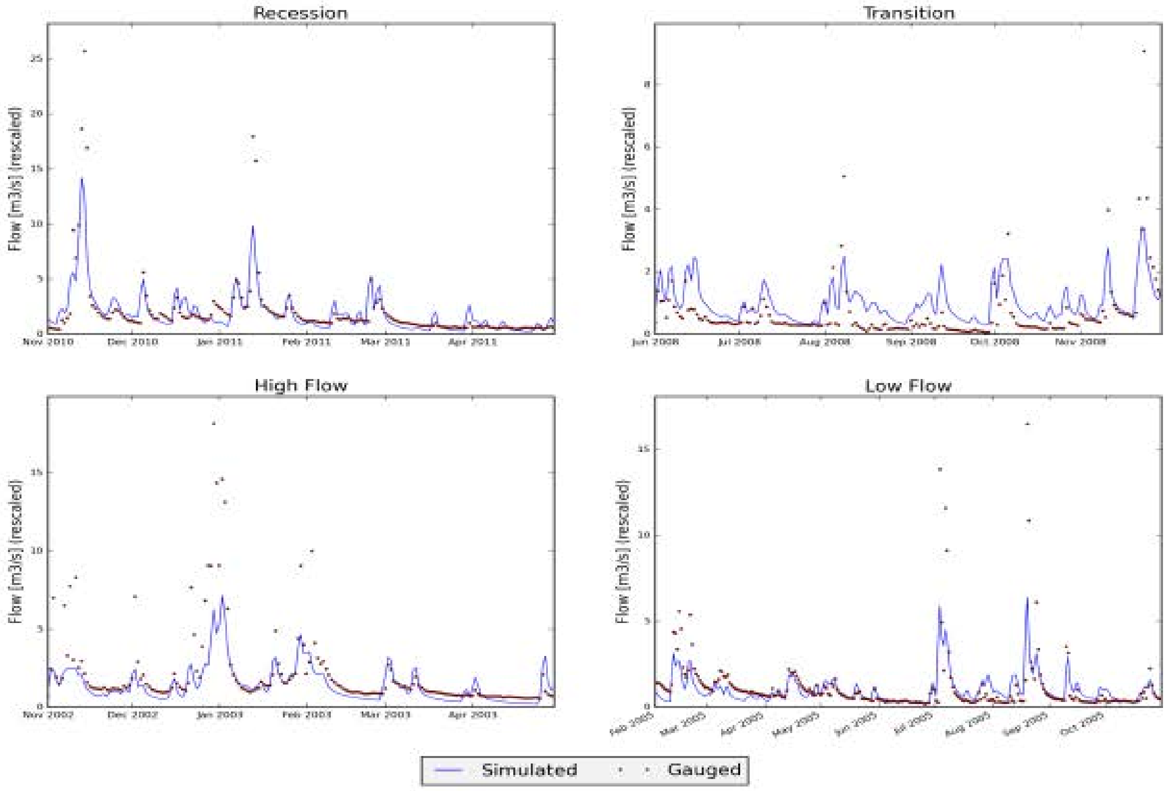


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W06RHOL54100, station L5412 Amougies - Rhosnes

Appendix 9 Dender

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V07BEL285070" (DENDERBEKKEN)

1.1 Input data

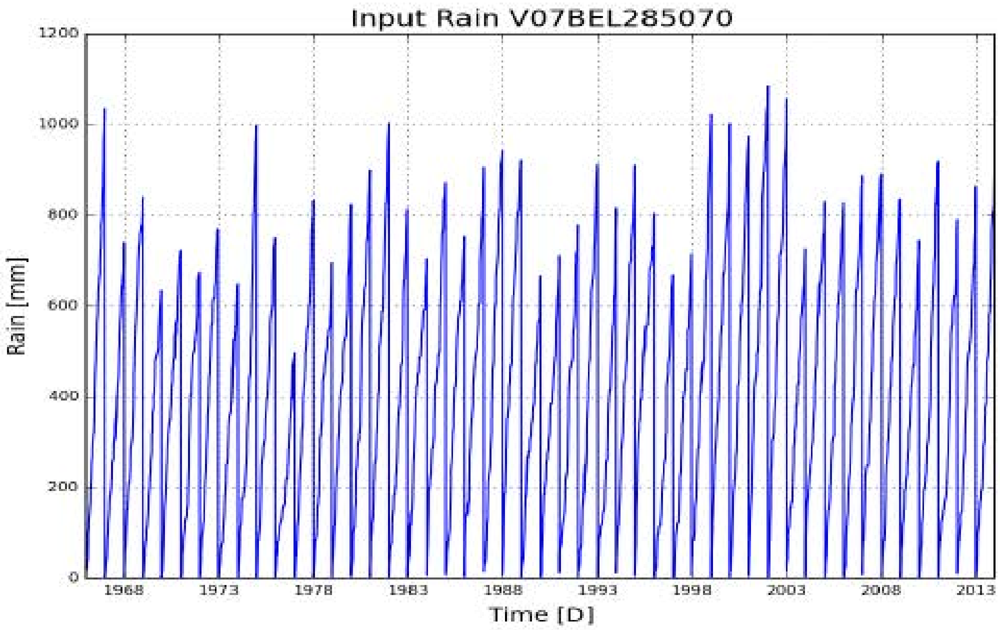


Figure 1: Cumulative precipitation on catchment V07BEL285070 (Denderbekken)

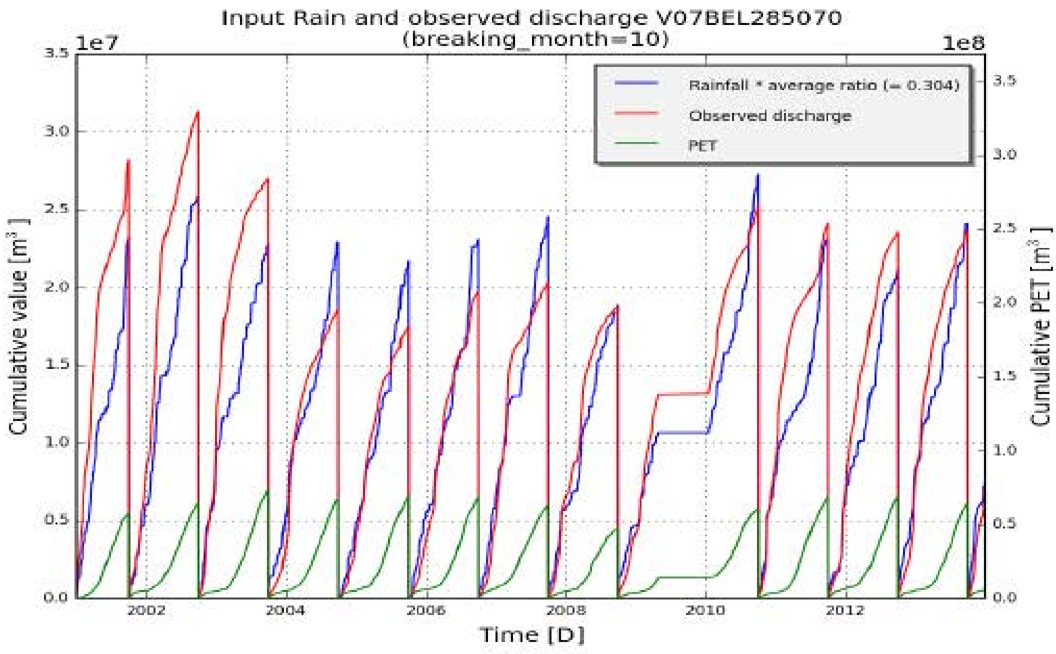


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V07BEL285070 (Denderbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V07BEL285070
subcatchment_area [m2]	88641710
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 445.77), ('SMevap', 216.21), ('c1', 2.12), ('c2', 0.67), ('c3', 1.0), ('cOF1', -5.35), ('cOF2', 4.52), ('cIF1', -4.95), ('cIF2', 4.58), ('CQOF', 14.28), ('CKIF', 62.73), ('CKBF', 1156.99)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	1.1 %	10.1 %	-5.9 %
NS	0.707	0.519	0.7
NS_log	0.699	0.435	0.68
NS_rel	0.73	0.617	0.8
KGE	0.773	0.493	0.758

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-6.1 %	13.7 %	-11.9 %
NS	0.601	0.47	0.581
NS_log	0.605	0.291	0.594
NS_rel	-42.62	-15.34	0.551
KGE	0.669	0.472	0.684

1.3 Observed and simulated timeseries for optimum parameters

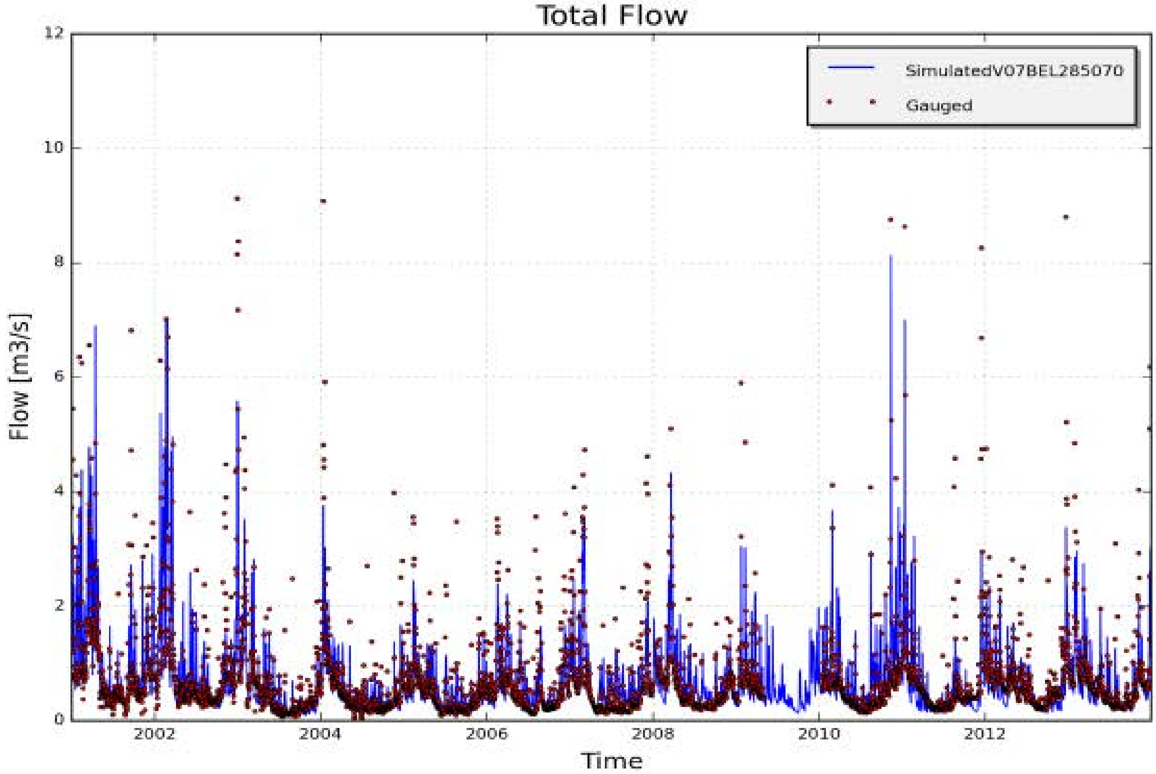


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V07BEL285070, station 28510102 - Bellebeek, Essene(calibration period)

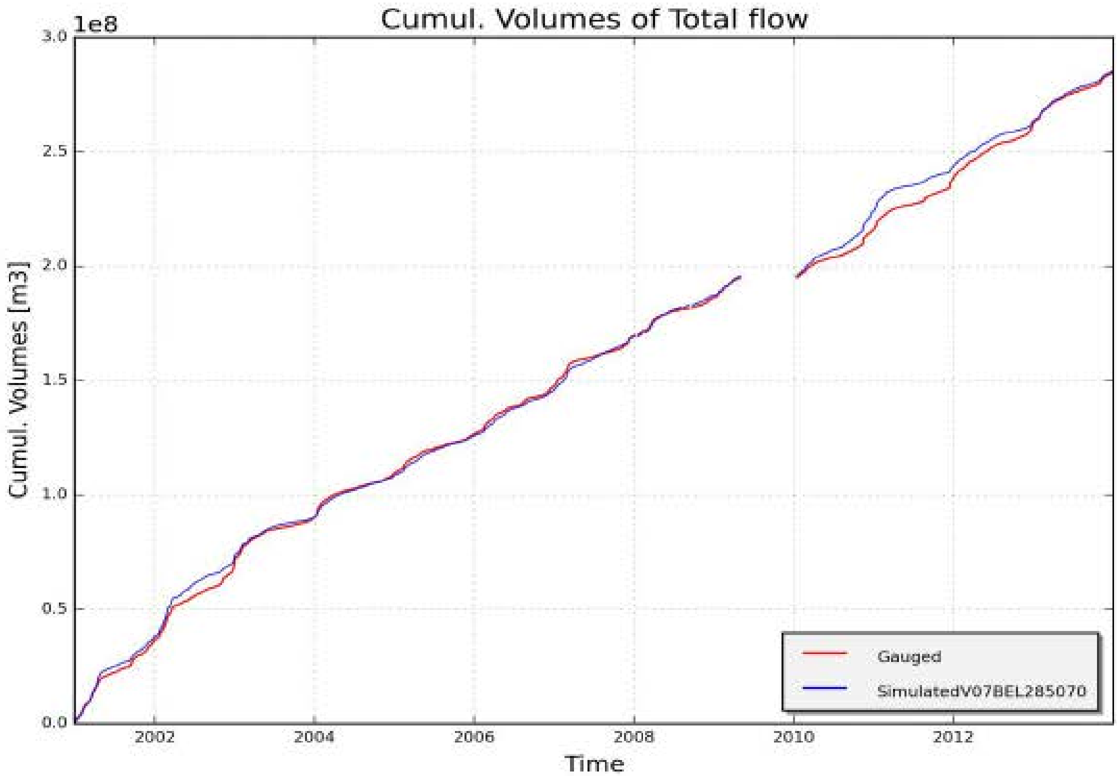


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V07BEL285070, station 28510102 - Bellebeek, Essene (calibration period)

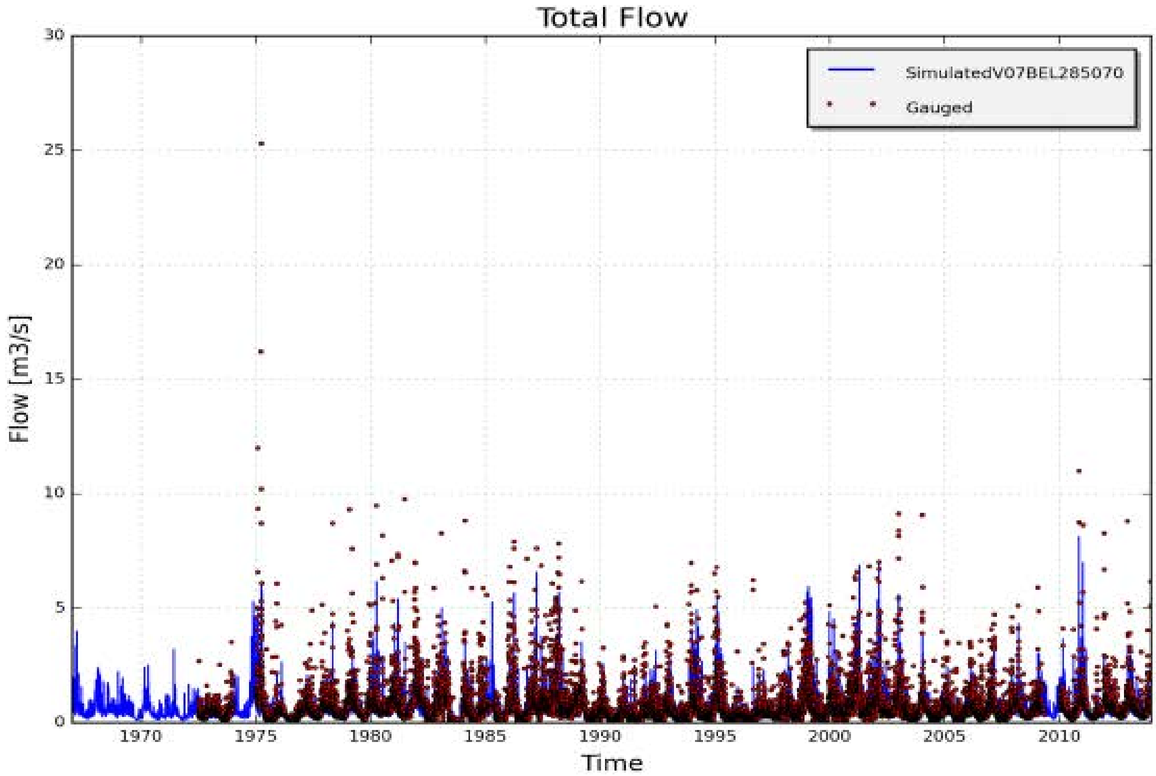


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V07BEL285070, station 28510102 - Bellebeek, Essene (validation period)

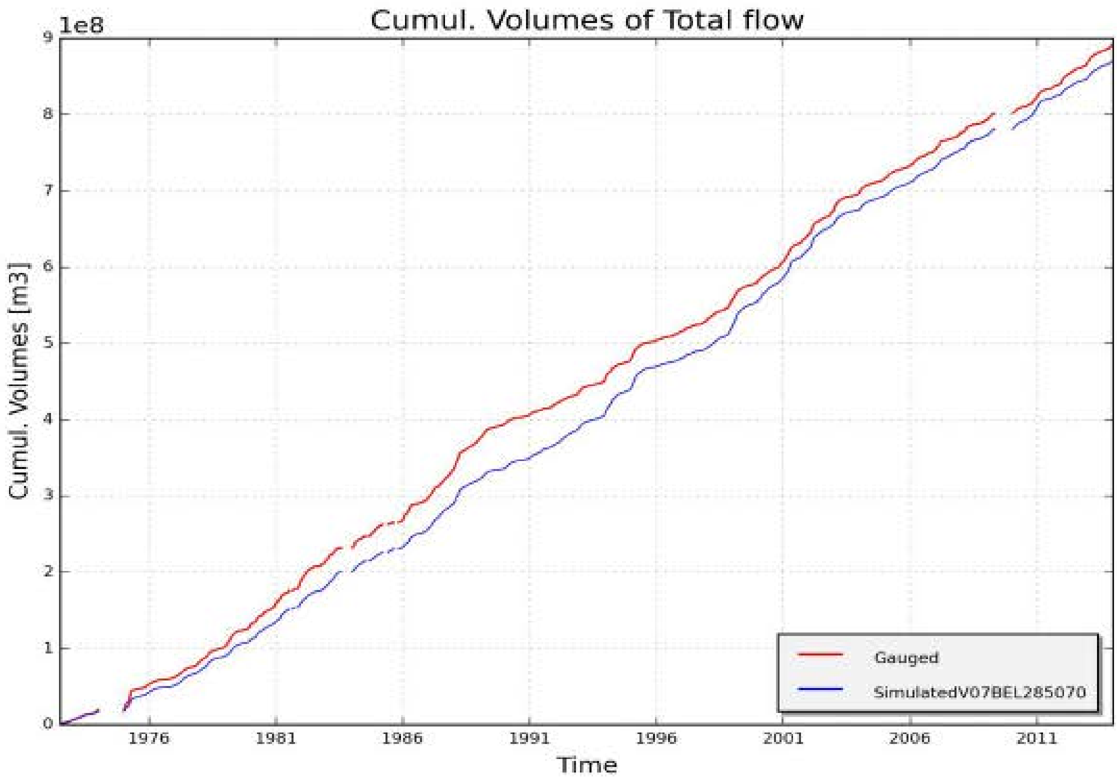


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V07BEL285070, station 28510102 - Bellebeek, Essene (validation period)

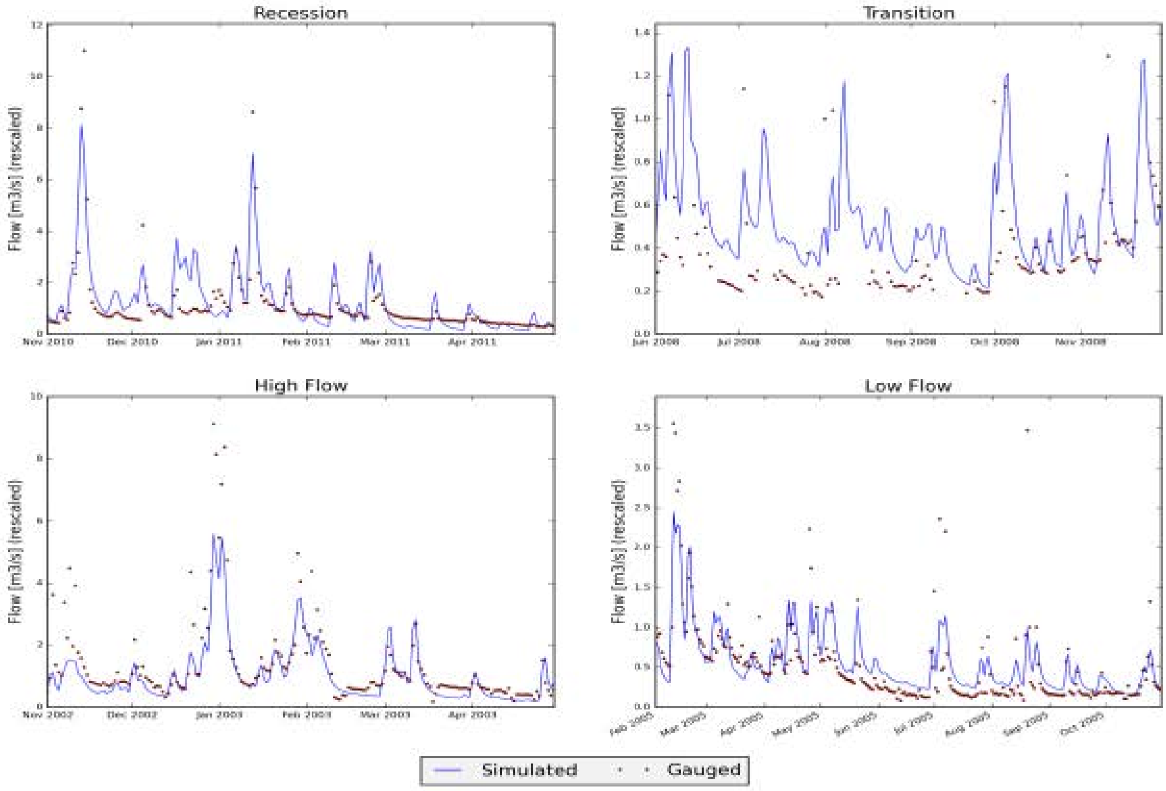


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V07BEL285070, station 28510102 - Bellebeek, Essene

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V07MAR289015" (DENDERBEKKEN)

1.1 Input data

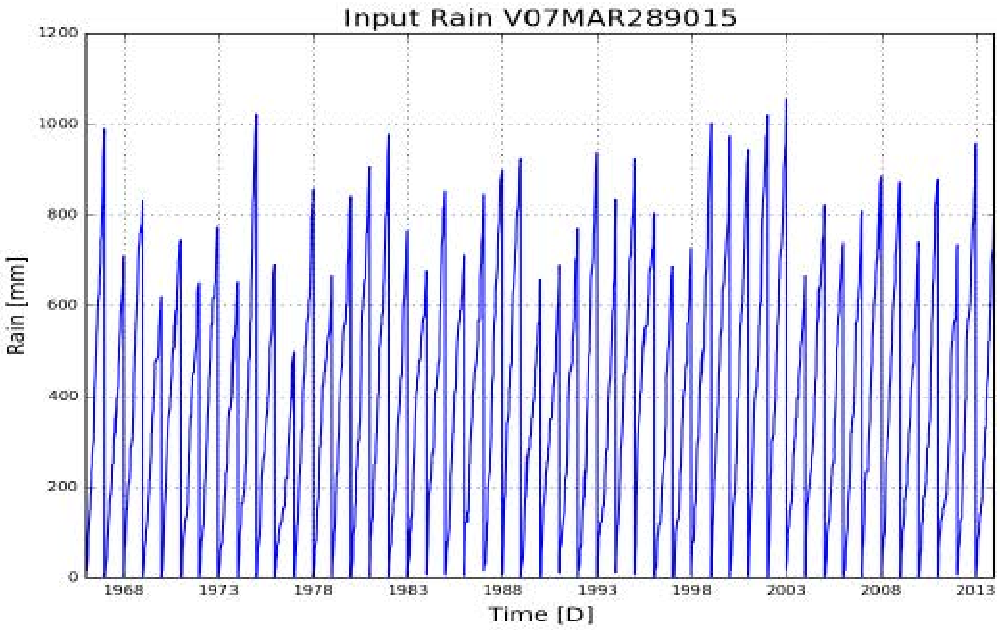


Figure 1: Cumulative precipitation on catchment V07MAR289015 (Denderbekken)

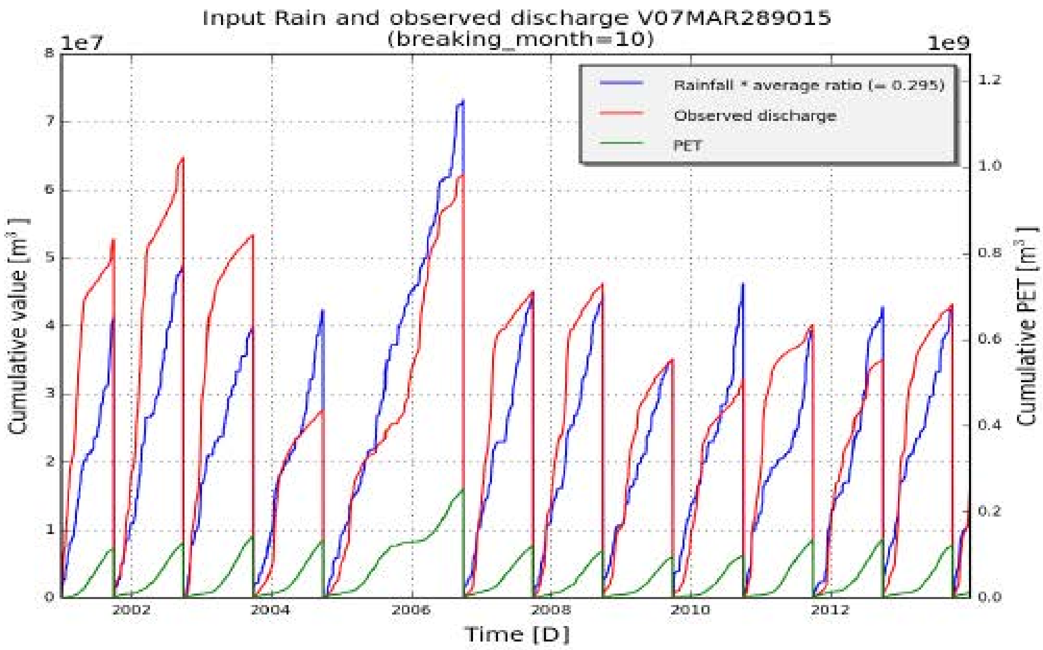


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V07MAR289015 (Denderbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V07MAR289015
subcatchment_area [m2]	173908791
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 410.74), ('SMevap', 170.84), ('c1', 2.23), ('c2', 0.92), ('c3', 1.0), ('cOF1', -4.59), ('cOF2', 5.0), ('cIF1', -4.35), ('cIF2', 2.89), ('CQOF', 10.79), ('CKIF', 58.4), ('CKBF', 1154.77)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	0.4 %	31.0 %	-14.5 %
NS	0.688	0.017	0.717
NS_log	0.532	-0.338	0.67
NS_rel	-0.124	-0.488	0.728
KGE	0.771	0.319	0.761

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	8.4 %	52.1 %	-12.1 %
NS	0.694	0.338	0.717
NS_log	0.482	-0.169	0.679
NS_rel	-17.06	-32.585	0.479
KGE	0.755	0.363	0.756

1.3 Observed and simulated timeseries for optimum parameters

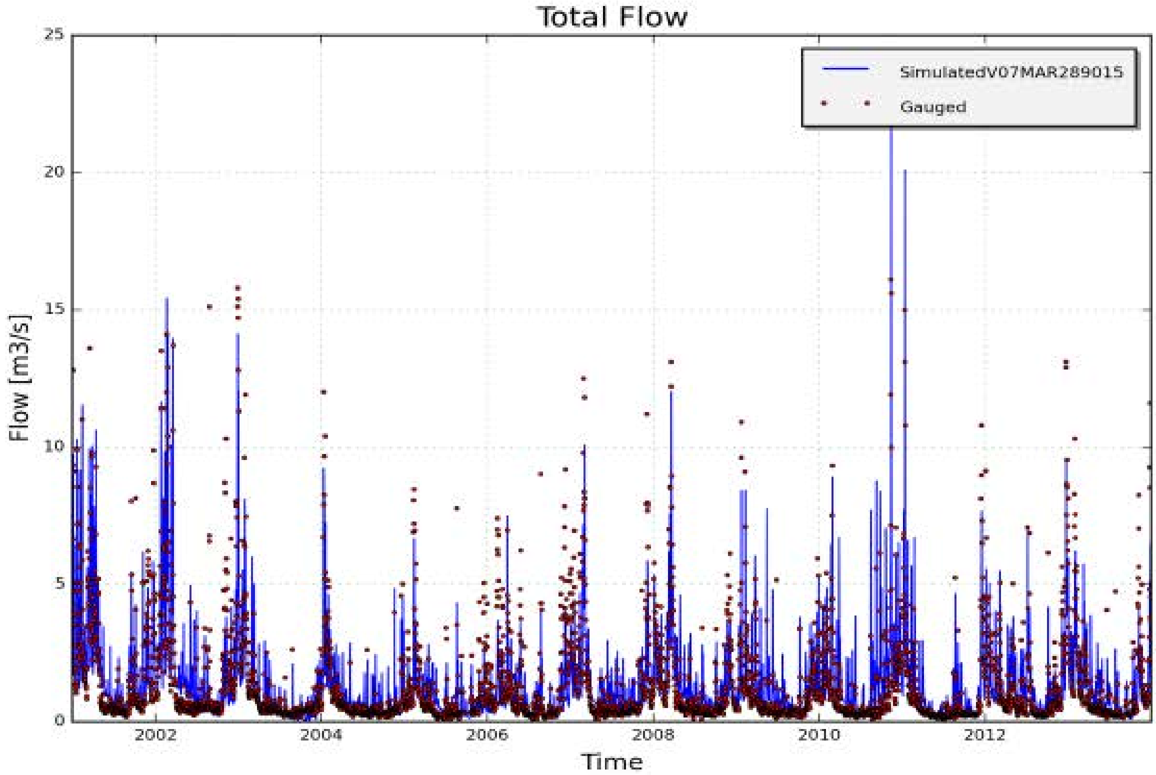


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V07MAR289015, station 28970102 - Marke, Viane(calibration period)

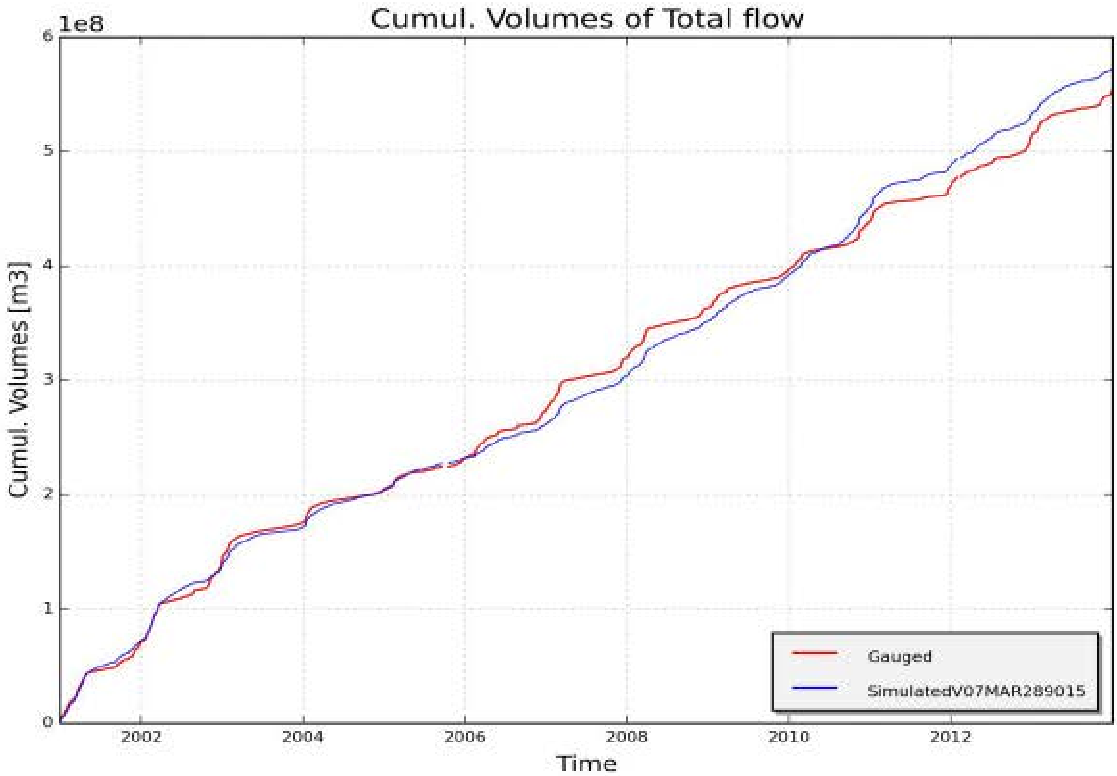


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V07MAR289015, station 28970102 - Marke, Viane (calibration period)

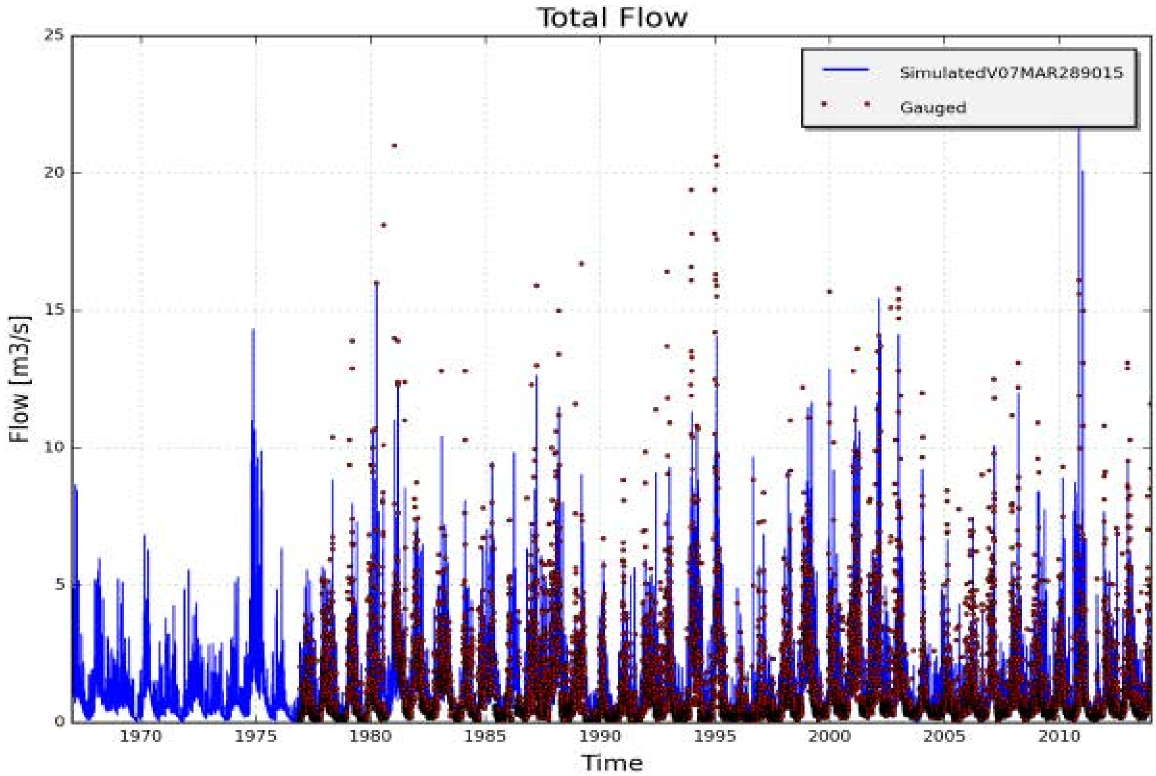


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V07MAR289015, station 28970102 - Marke, Viane (validation period)

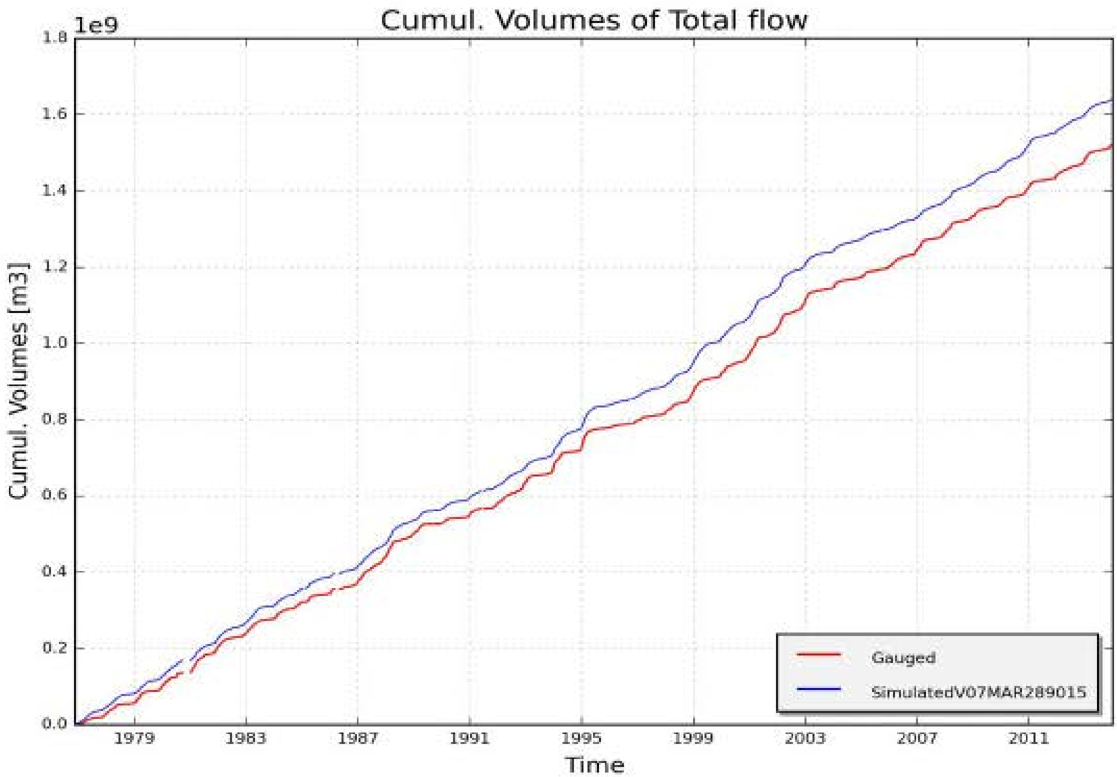


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V07MAR289015, station 28970102 - Marke, Viane (validation period)

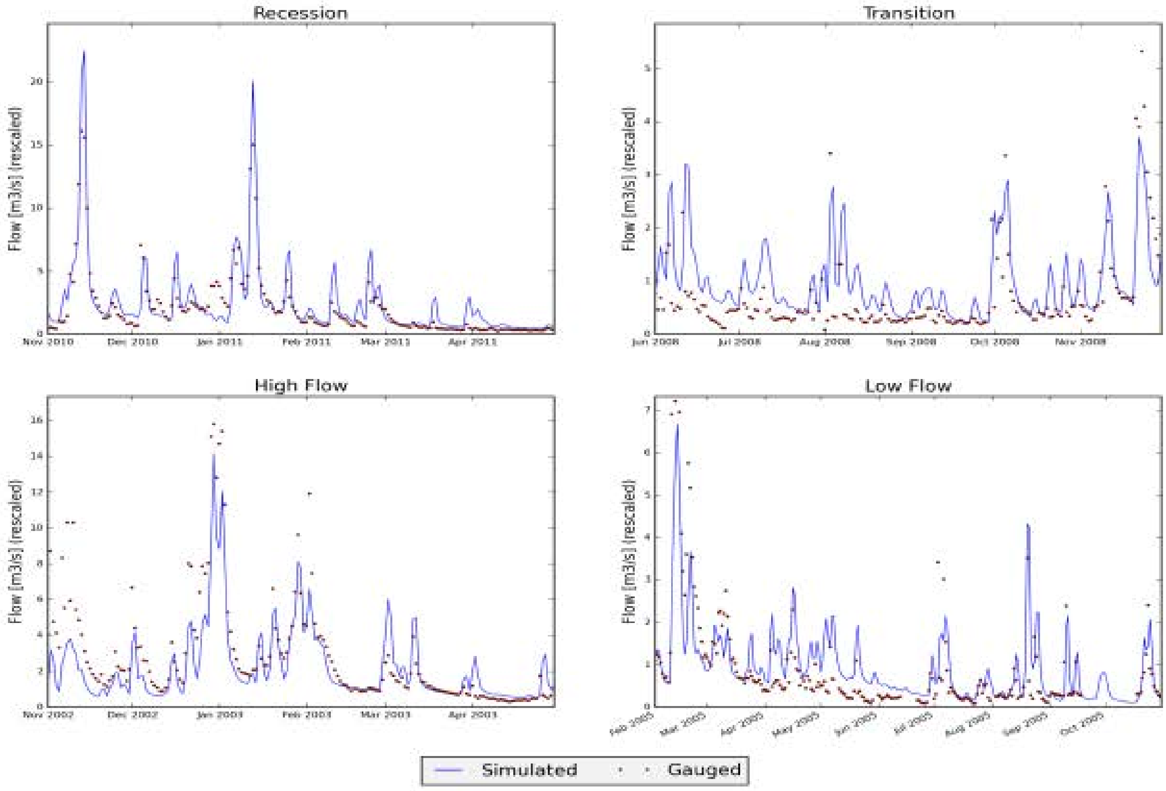


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V07MAR289015, station 28970102 - Marke, Viane

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V07MOE282100" (DENDERBEKKEN)

1.1 Input data

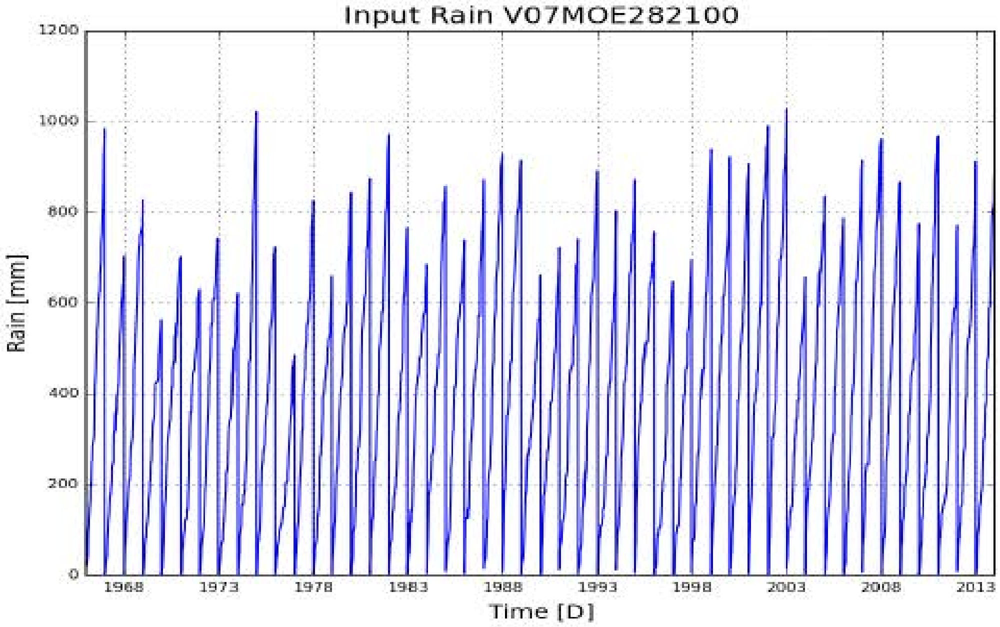


Figure 1: Cumulative precipitation on catchment V07MOE282100 (Denderbekken)

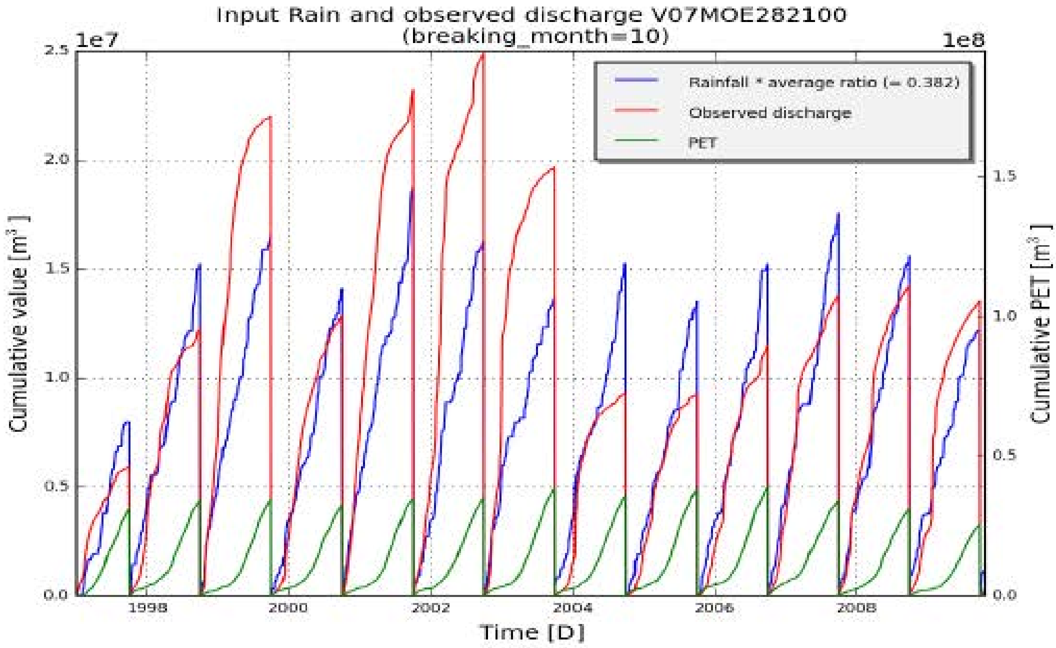


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V07MOE282100 (Denderbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V07MOE282100
subcatchment_area [m2]	46367171
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 350.39), ('SMevap', 161.76), ('c1', 3.41), ('c2', 2.22), ('c3', 1.0), ('cOF1', -6.67), ('cOF2', 10.0), ('cIF1', -5.38), ('cIF2', 3.61), ('CQOF', 16.51), ('CKIF', 82.36), ('CKBF', 1339.91)]

Table 1: Goodness of fit for calibration period (1997 - 2009)

	Full year	**Summer**	**Winter**
RelErr	-0.5 %	26.2 %	-10.6 %
NS	0.511	0.331	0.395
NS_log	0.709	0.281	0.624
NS_rel	0.736	0.495	0.834
KGE	0.492	0.521	0.319

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	8.4 %	23.4 %	0.4 %
NS	0.556	0.385	0.45
NS_log	0.691	0.336	0.662
NS_rel	0.7	0.652	0.805
KGE	0.581	0.606	0.401

1.3 Observed and simulated timeseries for optimum parameters

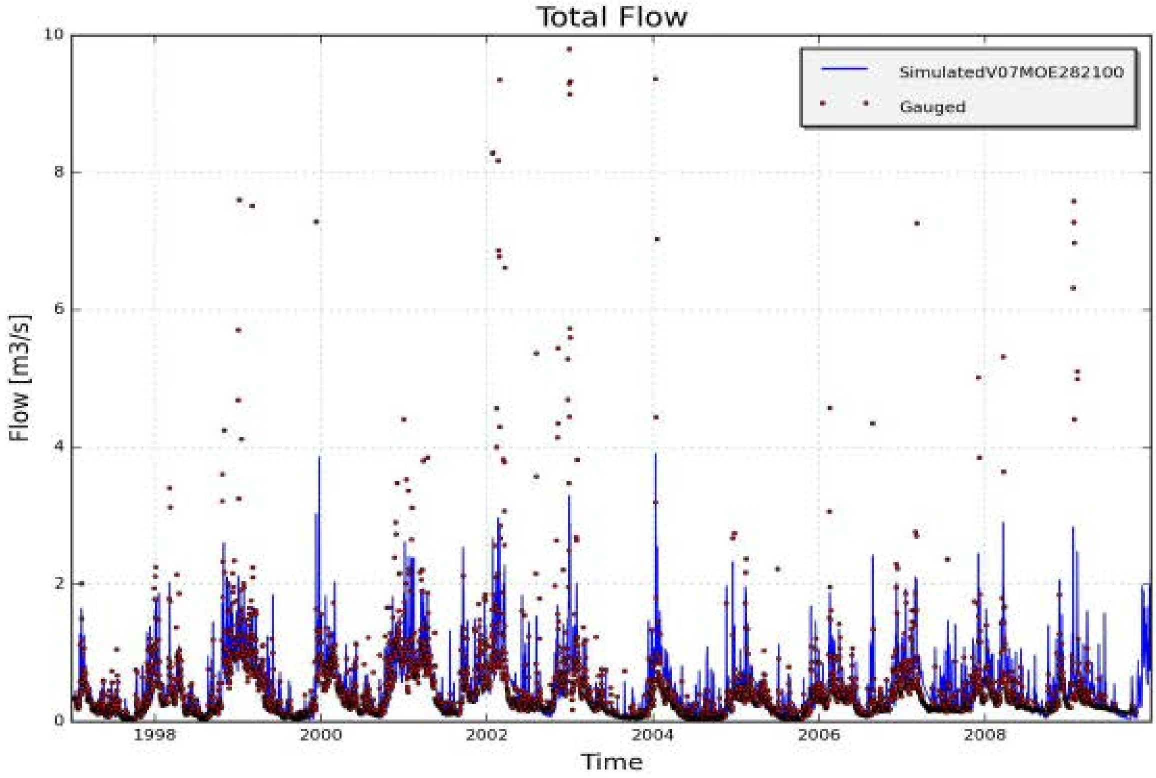


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V07MOE282100, station 28210102 - Molenbeek, Erpe Mere(calibration period)

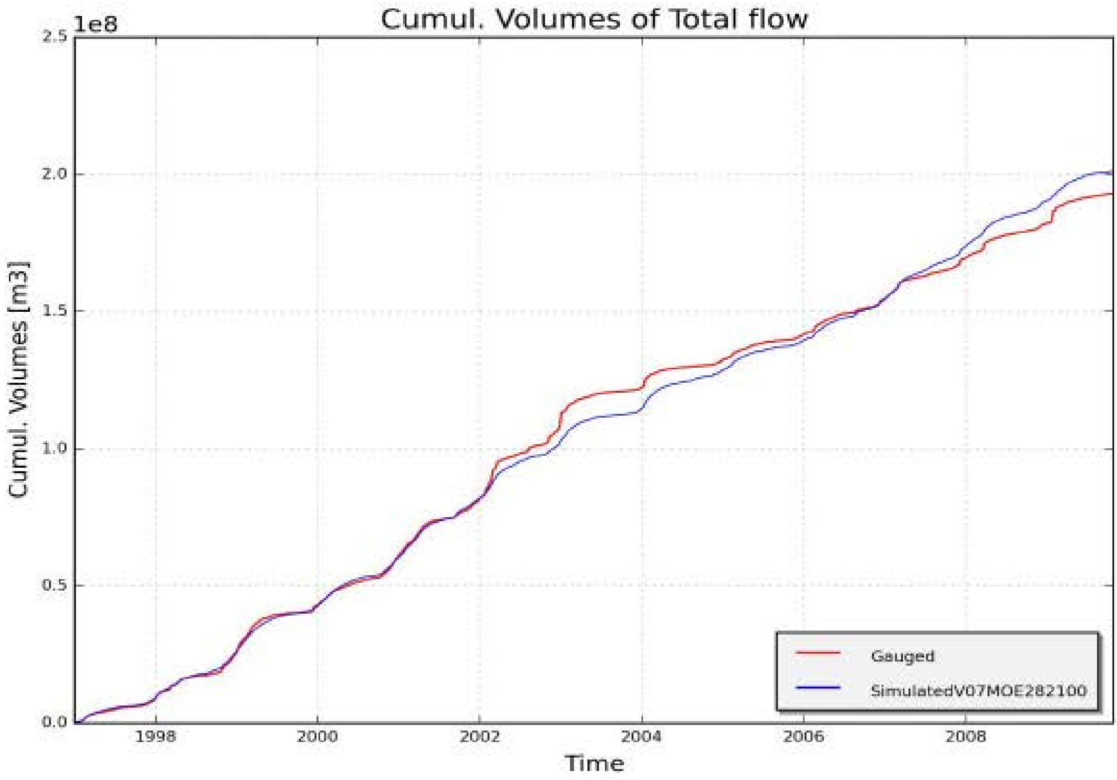


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V07MOE282100, station 28210102 - Molenbeek, Erpe Mere (calibration period)

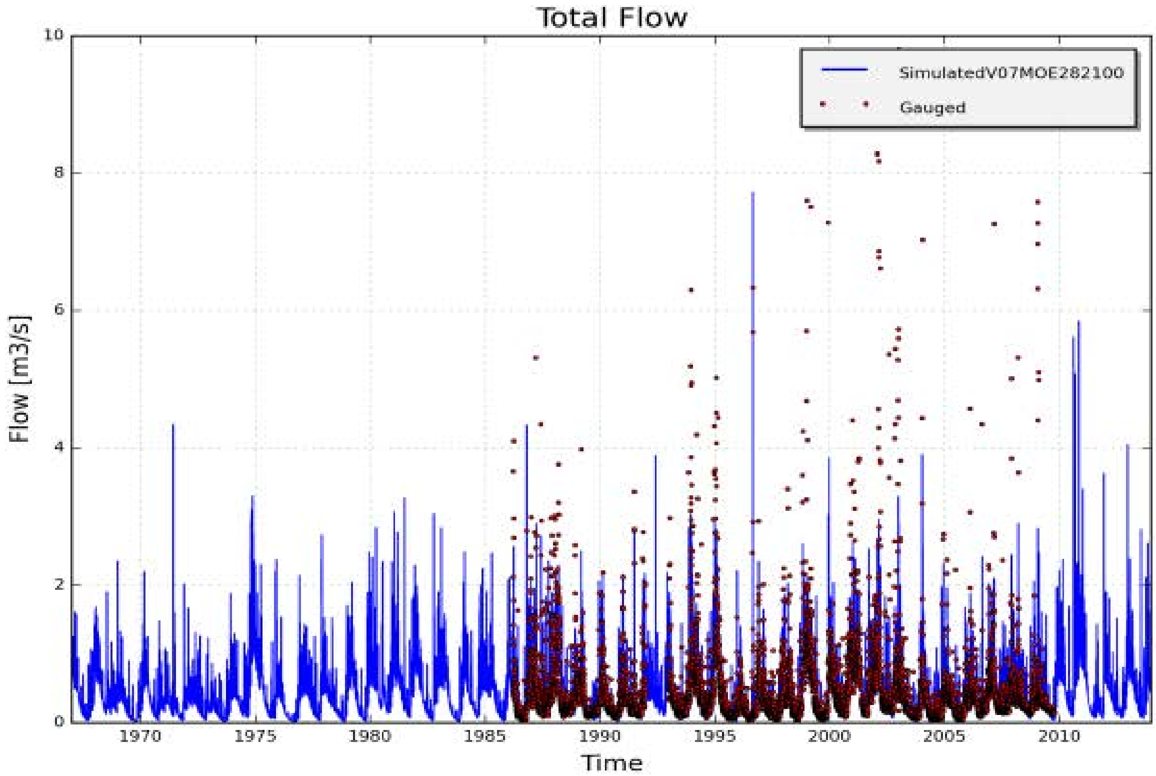


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V07MOE282100, station 28210102 - Molenbeek, Erpe Mere (validation period)

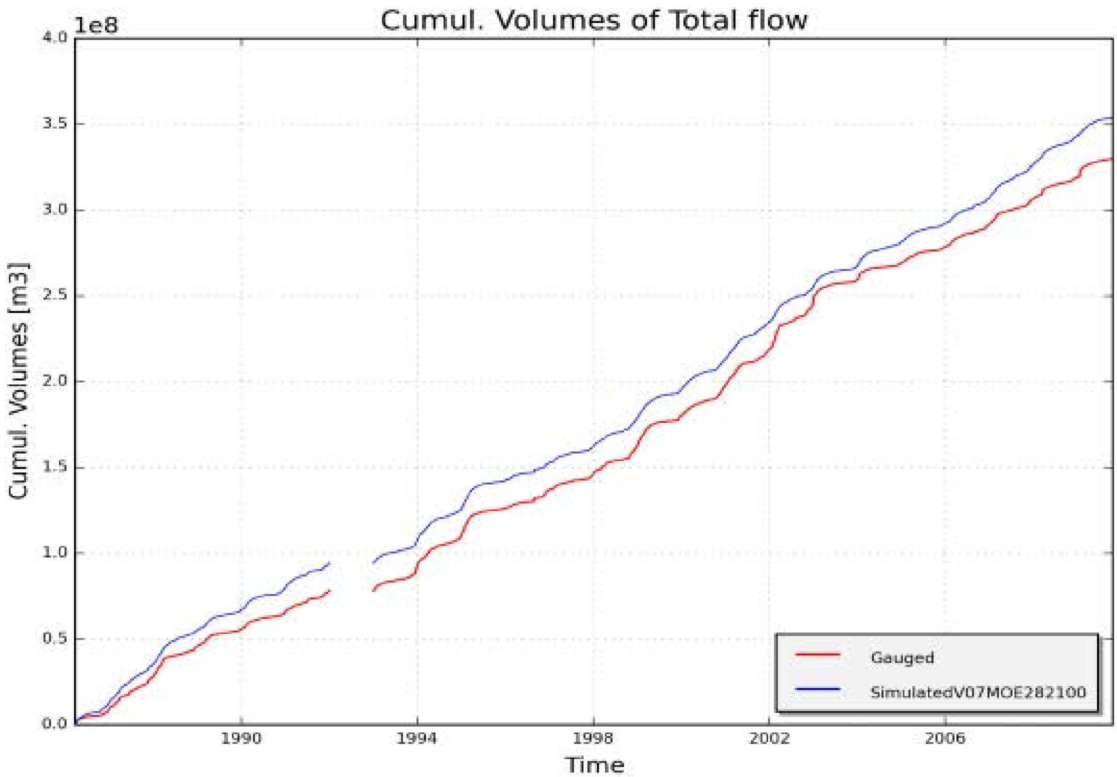


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V07MOE282100, station 28210102 - Molenbeek, Erpe Mere (validation period)

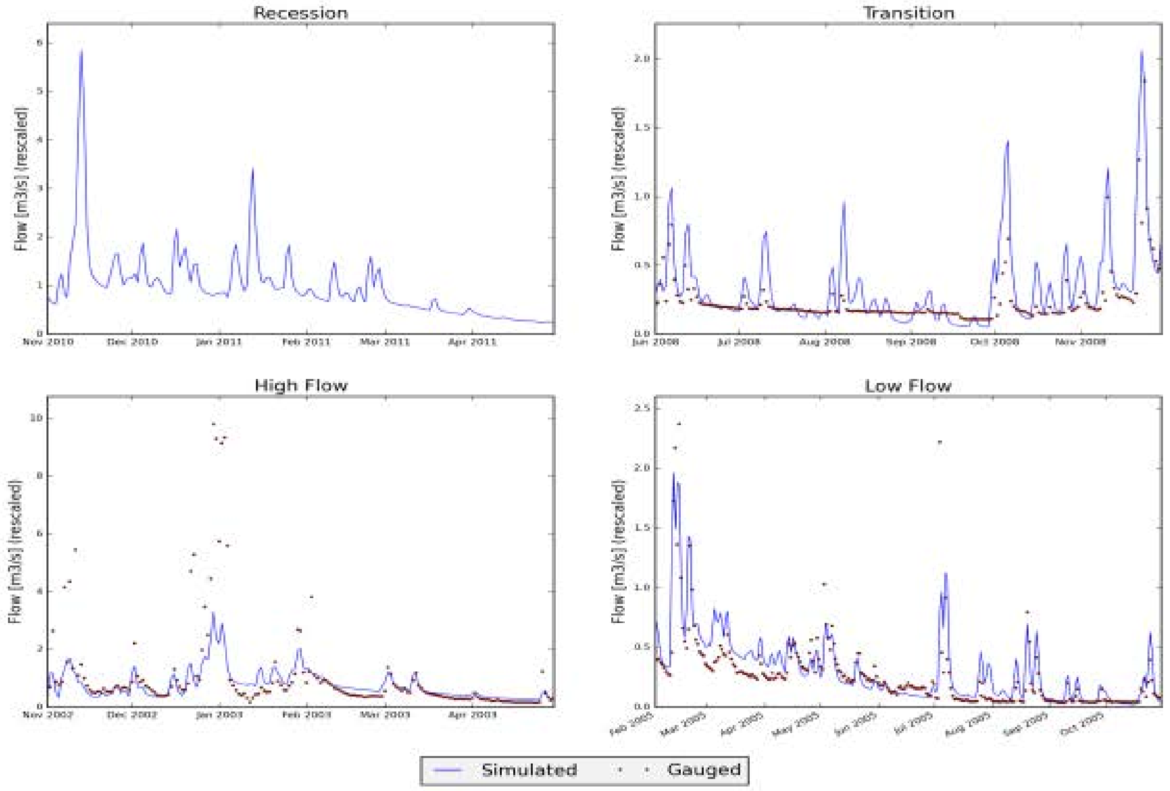


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V07MOE282100, station 28210102 - Molenbeek, Erpe Mere

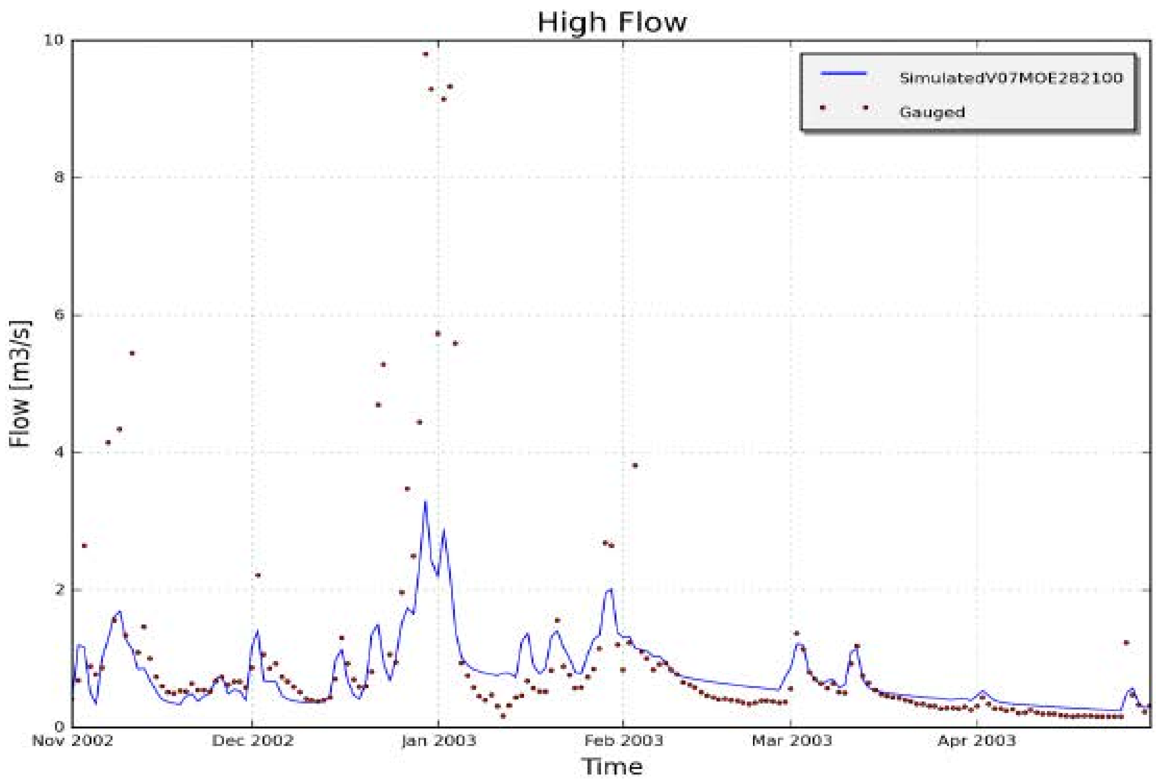


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V07MOE282100, station 28210102 - Molenbeek, Erpe Mere

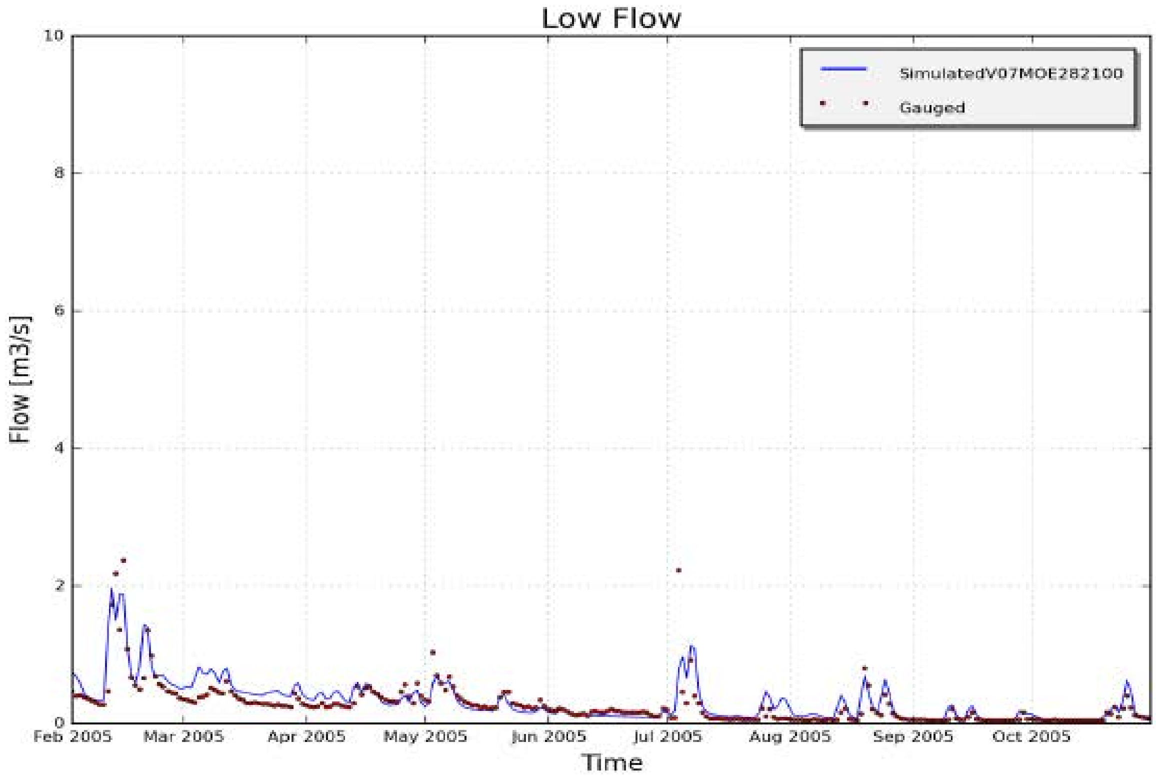


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V07MOE282100, station 28210102 - Molenbeek, Erpe Mere

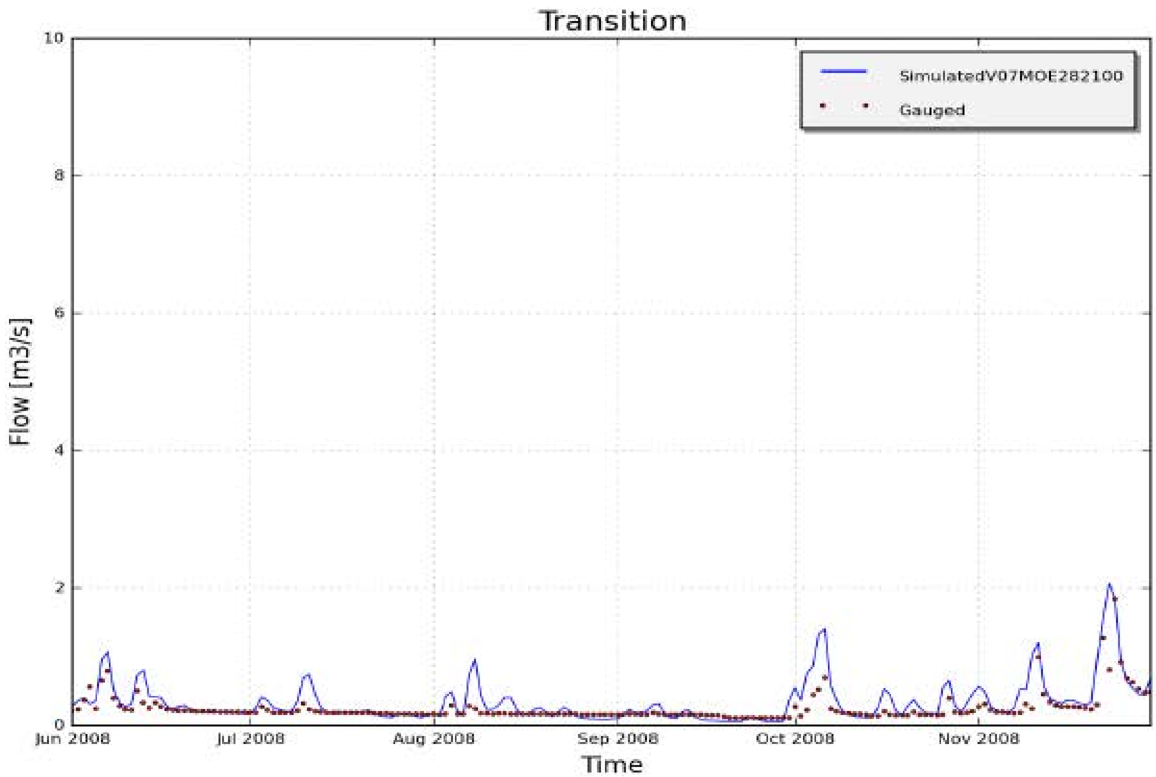


Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V07MOE282100, station 28210102 - Molenbeek, Erpe Mere

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V07MOG288020" (DENDERBEKKEN)

1.1 Input data

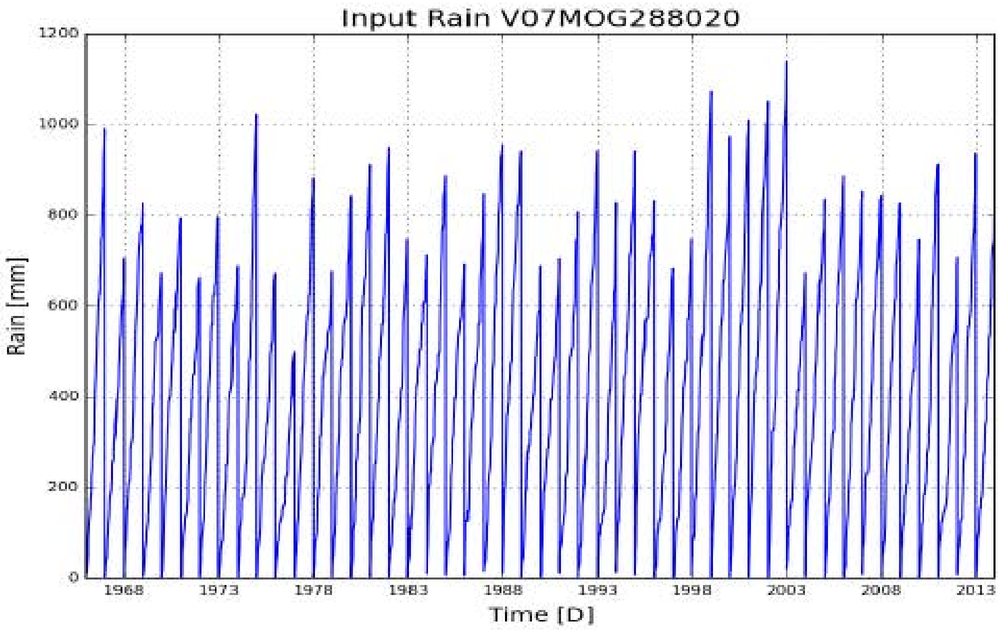


Figure 1: Cumulative precipitation on catchment V07MOG288020 (Denderbekken)

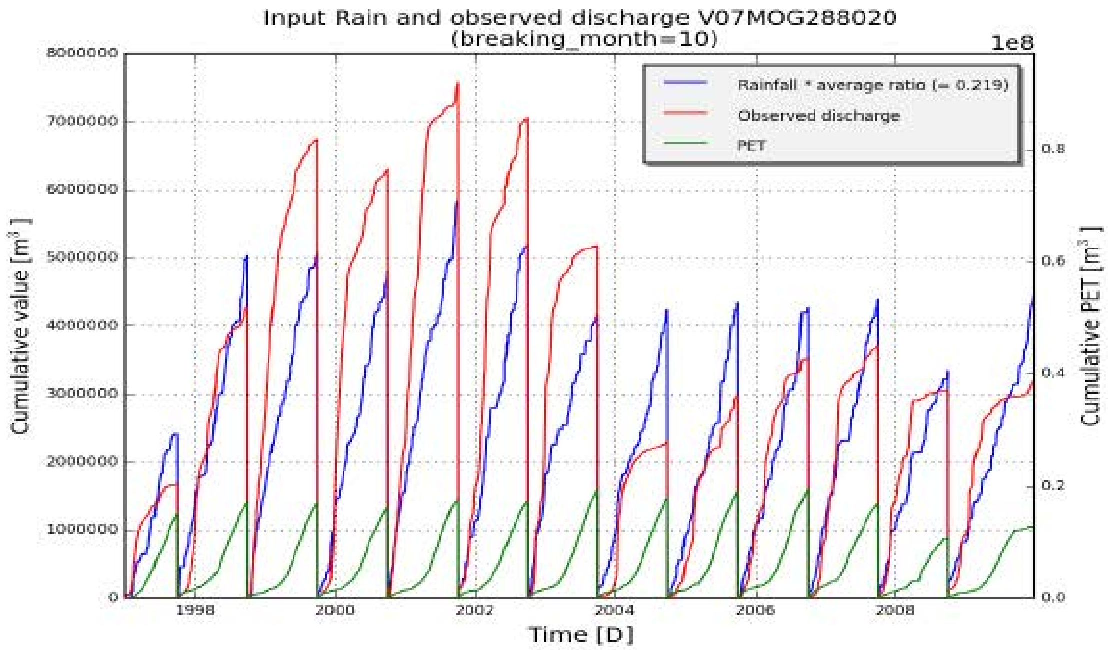


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V07MOG288020 (Denderbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V07MOG288020
subcatchment_area [m2]	23093628
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 537.95), ('SMevap', 193.11), ('c1', 2.12), ('c2', 0.58), ('c3', 1.0), ('cOF1', -5.35), ('cOF2', 4.92), ('cIF1', -4.25), ('cIF2', 2.99), ('CQOF', 14.14), ('CKIF', 60.64), ('CKBF', 683.24)]

Table 1: Goodness of fit for calibration period (1997 - 2009)

	Full year	**Summer**	**Winter**
RelErr	0.3 %	91.2 %	-25.5 %
NS	0.543	0.226	0.499
NS_log	0.5	-0.375	0.607
NS_rel	-2.314	-5.13	0.753
KGE	0.585	0.016	0.472

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-8.9 %	55.4 %	-26.9 %
NS	0.525	0.148	0.506
NS_log	0.45	-0.138	0.544
NS_rel	-2.508	-5.877	0.727
KGE	0.594	0.247	0.52

1.3 Observed and simulated timeseries for optimum parameters

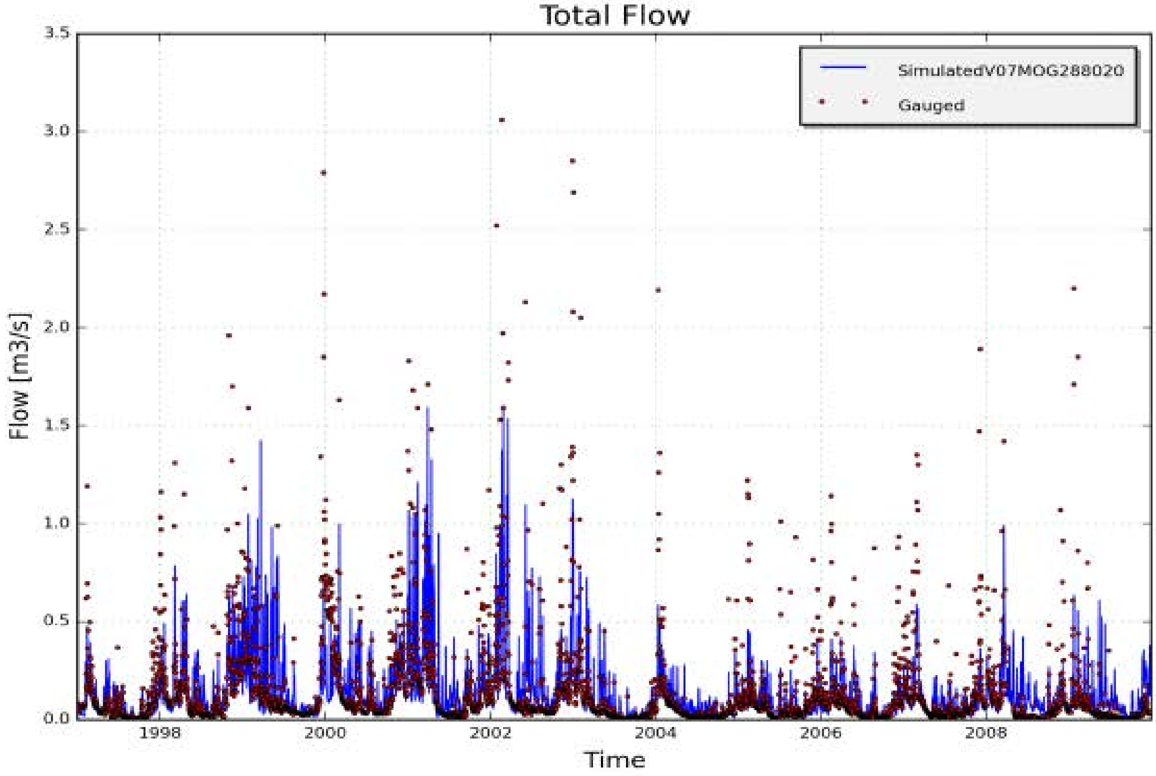


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen(calibration period)

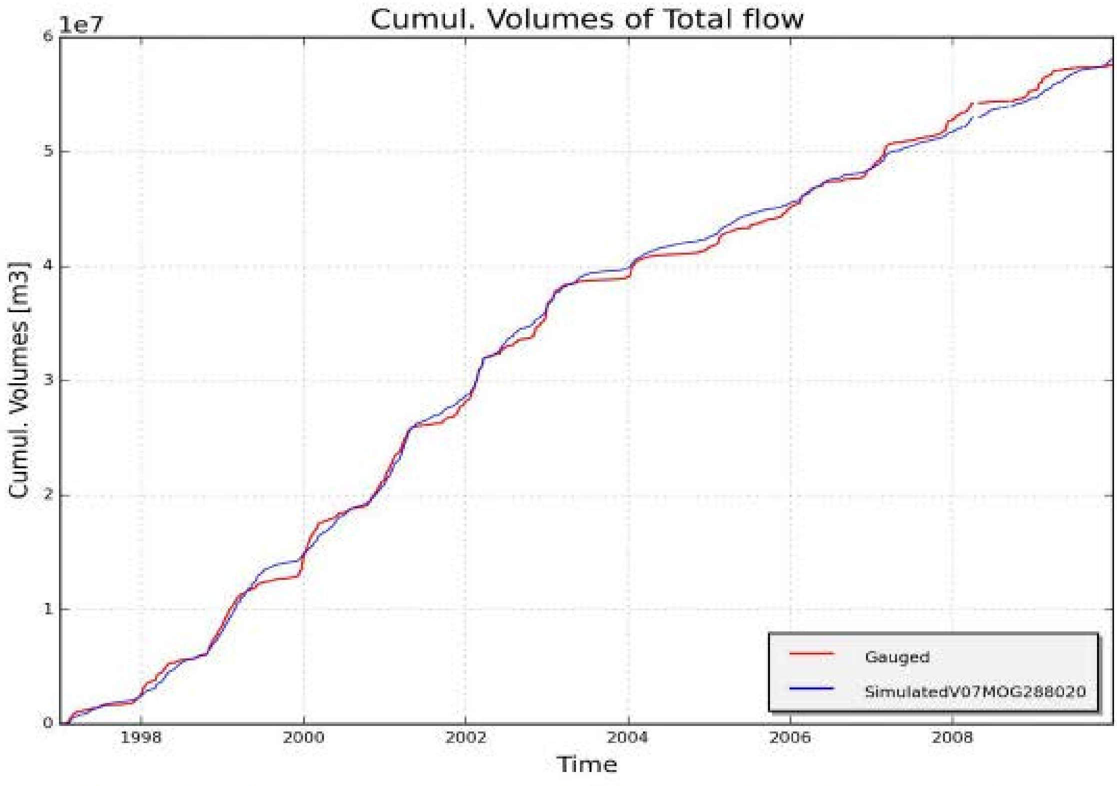


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen (calibration period)

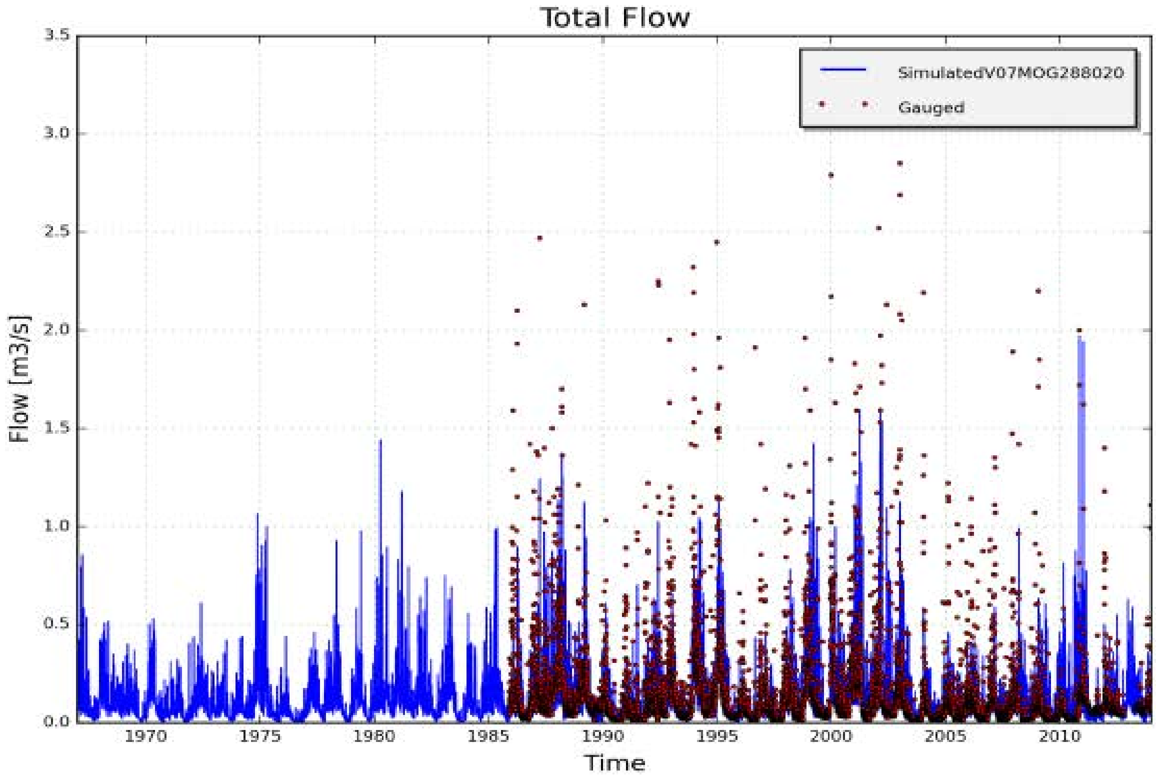


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen (validation period)

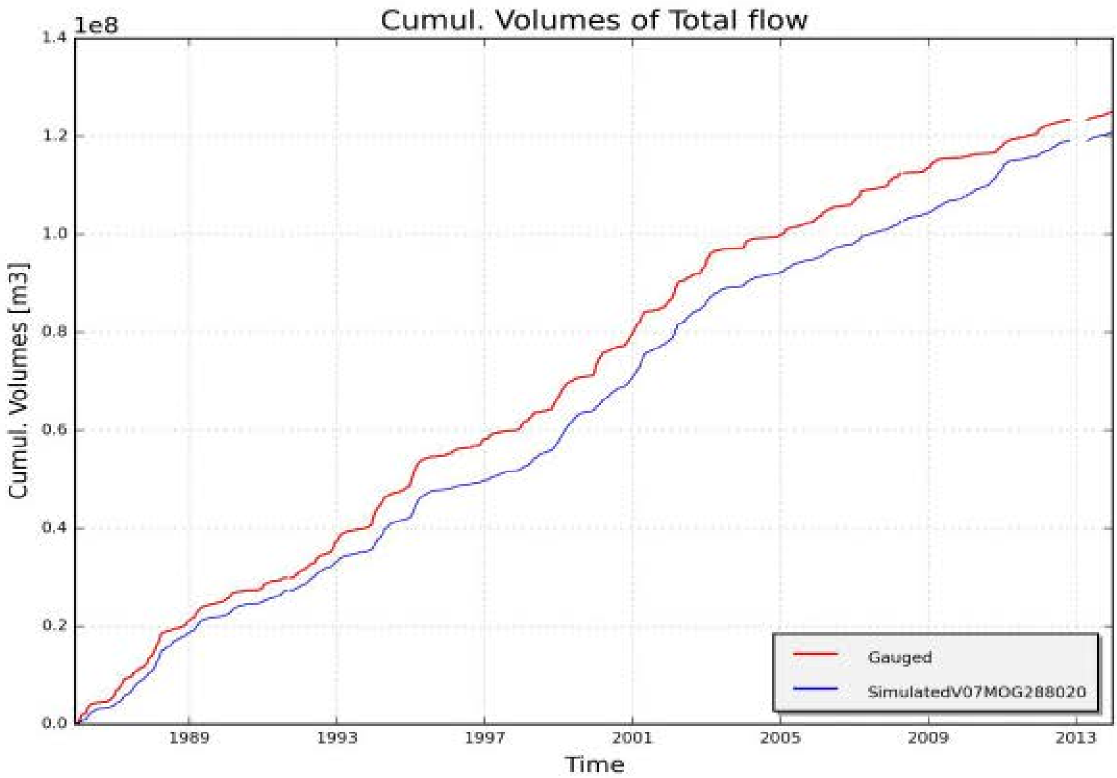


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen (validation period)

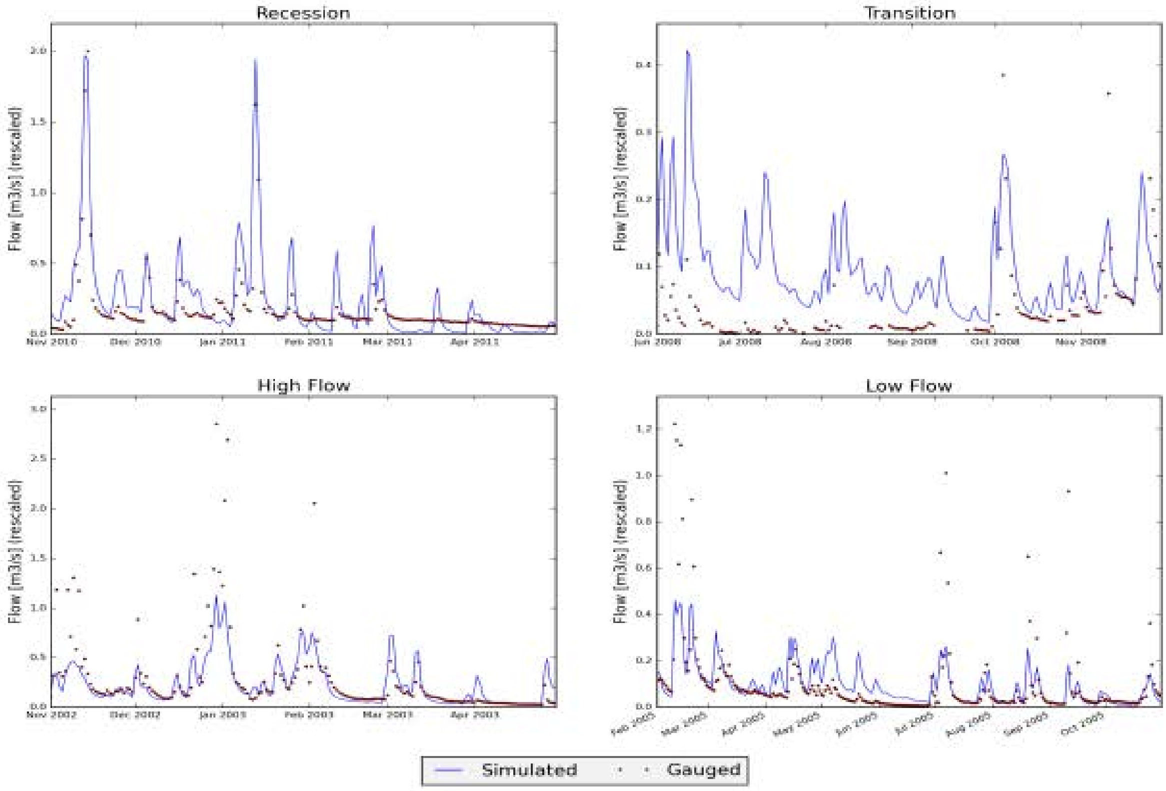


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen

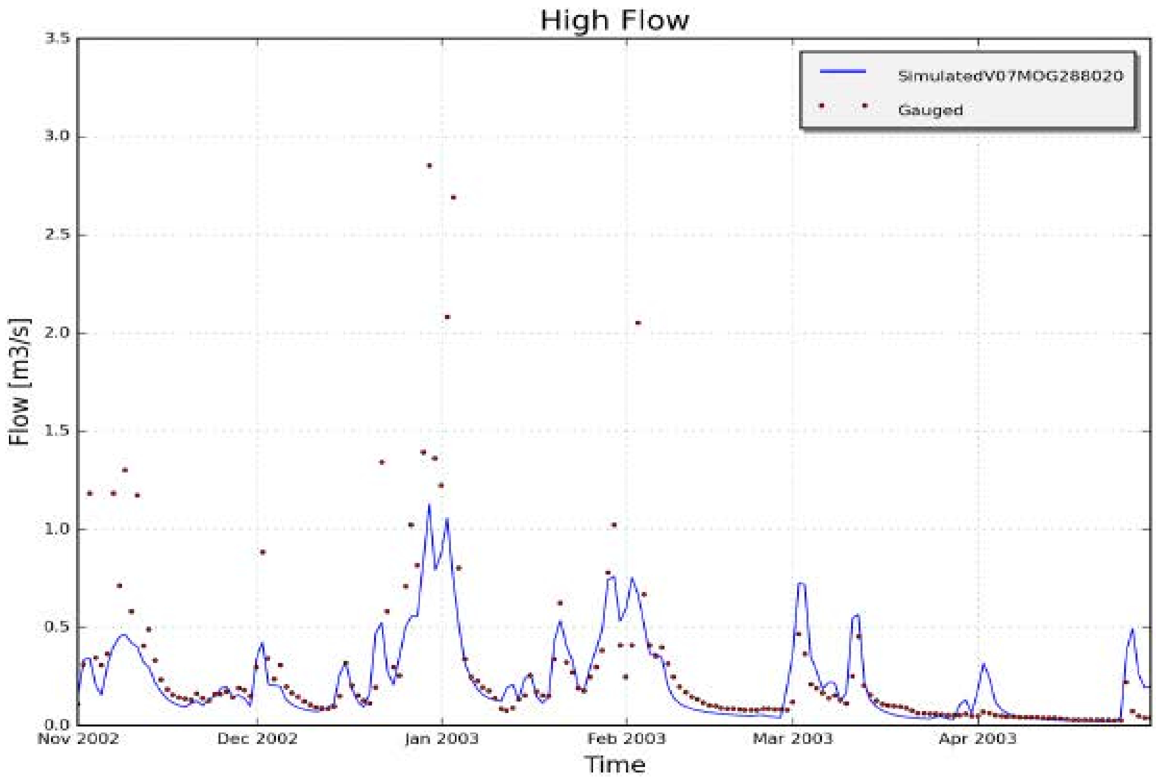


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen

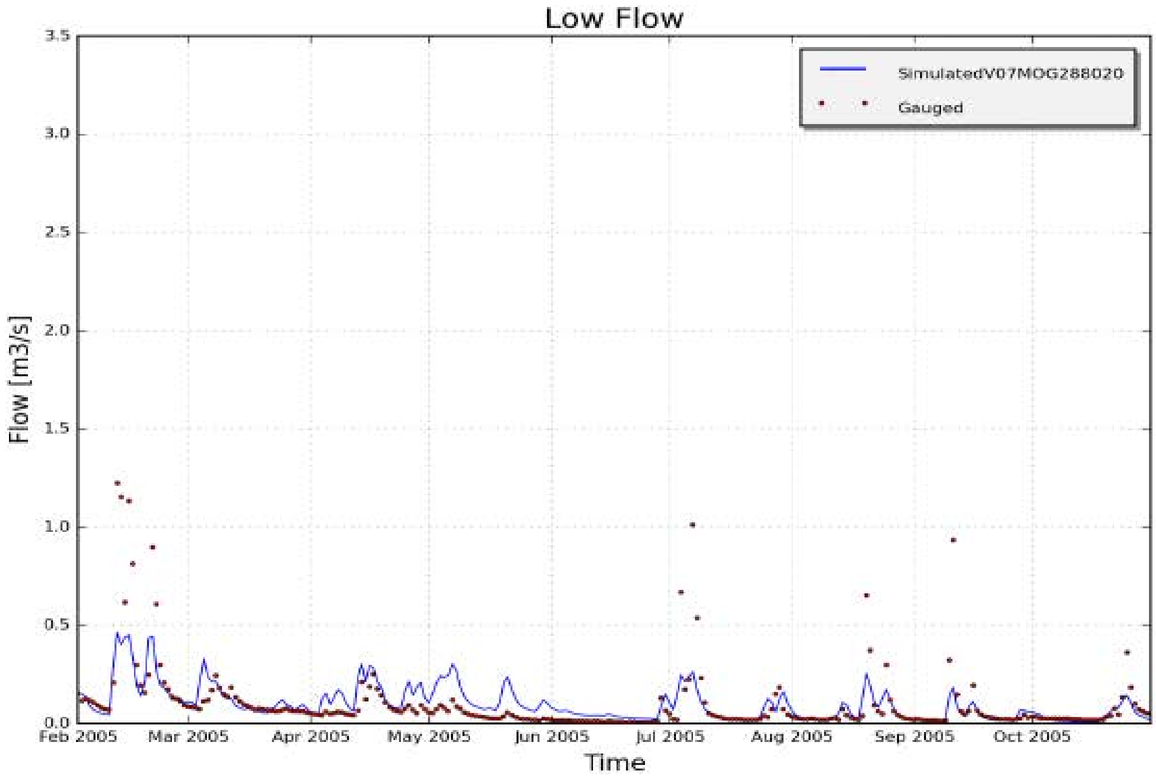


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen

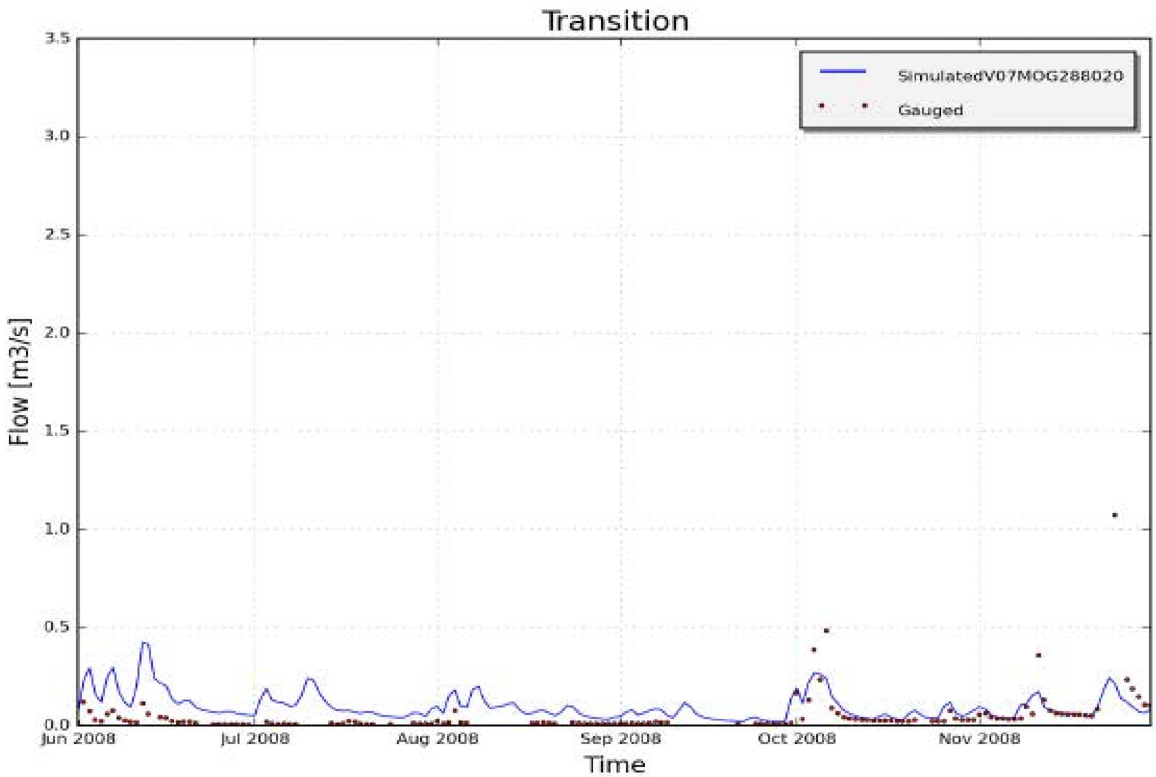


Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V07MOG288020, station 28810102 - Molenbeek, Geraardsbergen

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W07DENLES004" (DENDERBEKKEN)

1.1 Input data

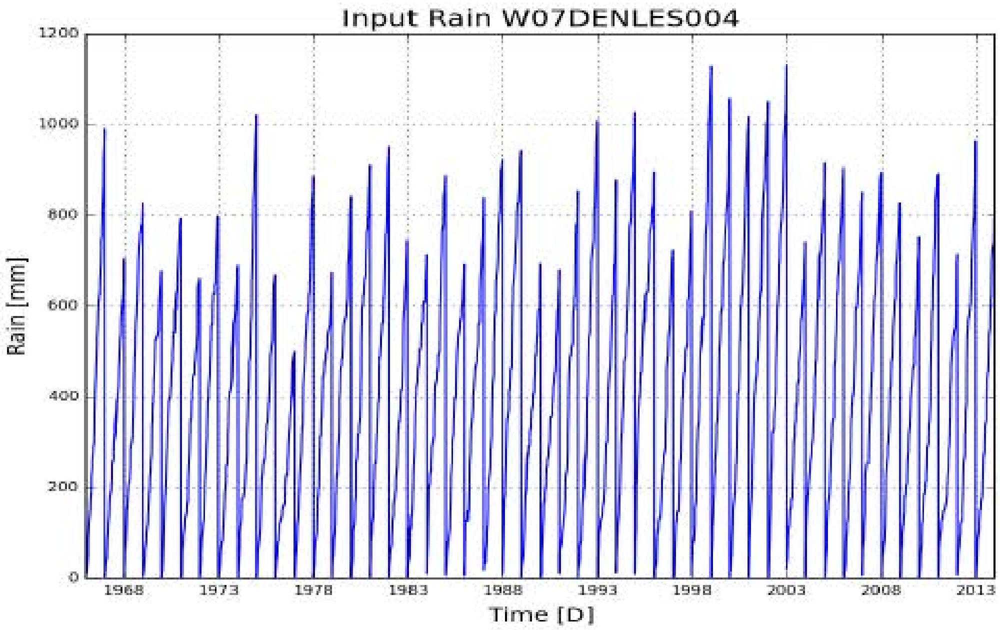


Figure 1: Cumulative precipitation on catchment W07DENLES004 (Denderbekken)

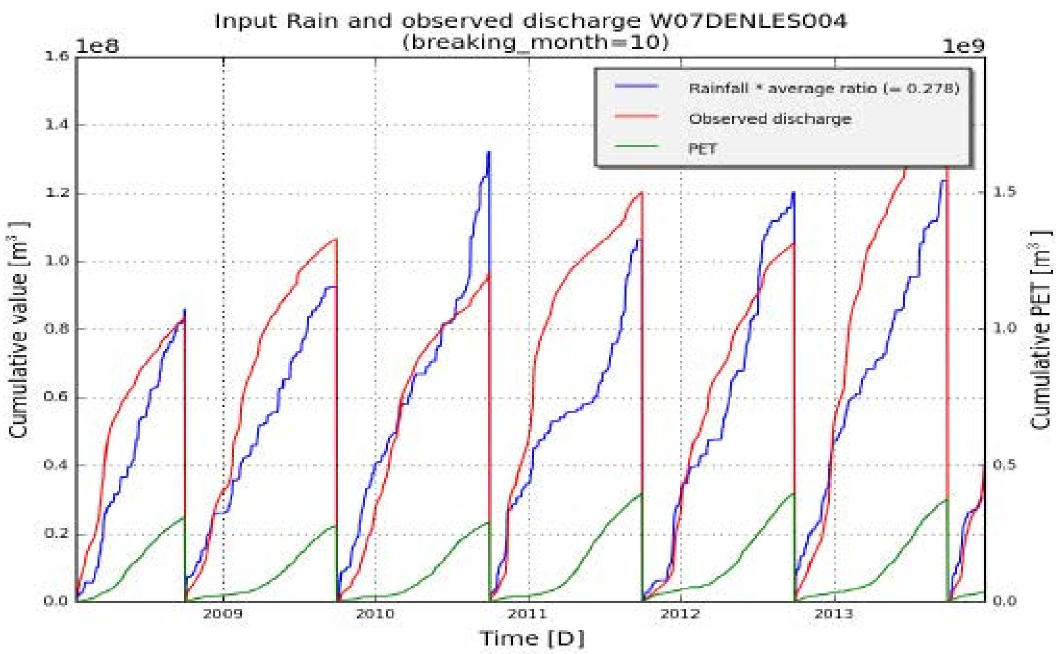


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W07DENLES004 (Denderbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W07DENLES004
subcatchment_area [m2]	511840662
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 457.1), ('SMevap', 153.78), ('c1', 1.95), ('c2', 0.46), ('c3', 1.0), ('cOF1', -4.69), ('cOF2', 1.09), ('cIF1', -3.5), ('cIF2', 2.87), ('CQOF', 12.55), ('CKIF', 83.76), ('CKBF', 1085.75)]

Table 1: Goodness of fit for calibration period (2008 - 2013)

	Full year	Summer	Winter
RelErr	-0.0 %	69.2 %	-32.1 %
NS	0.519	-0.394	0.377
NS_log	0.536	-0.809	0.472
NS_rel	0.646	-0.186	0.839
KGE	0.466	0.207	0.31

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	Summer	Winter
RelErr	-0.8 %	68.1 %	-32.8 %
NS	0.518	-0.385	0.373
NS_log	0.537	-0.791	0.46
NS_rel	0.65	-0.174	0.836
KGE	0.463	0.212	0.308

1.3 Observed and simulated timeseries for optimum parameters

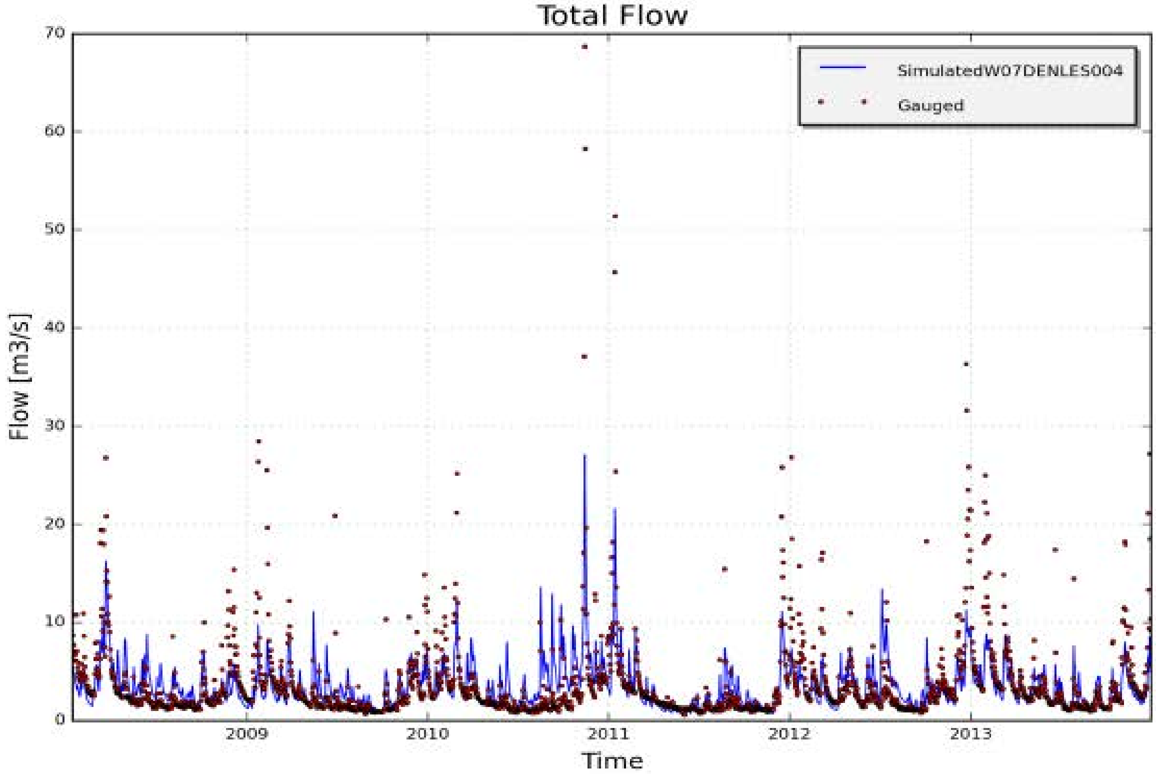


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W07DENLES004, station Lessines(calibration period)

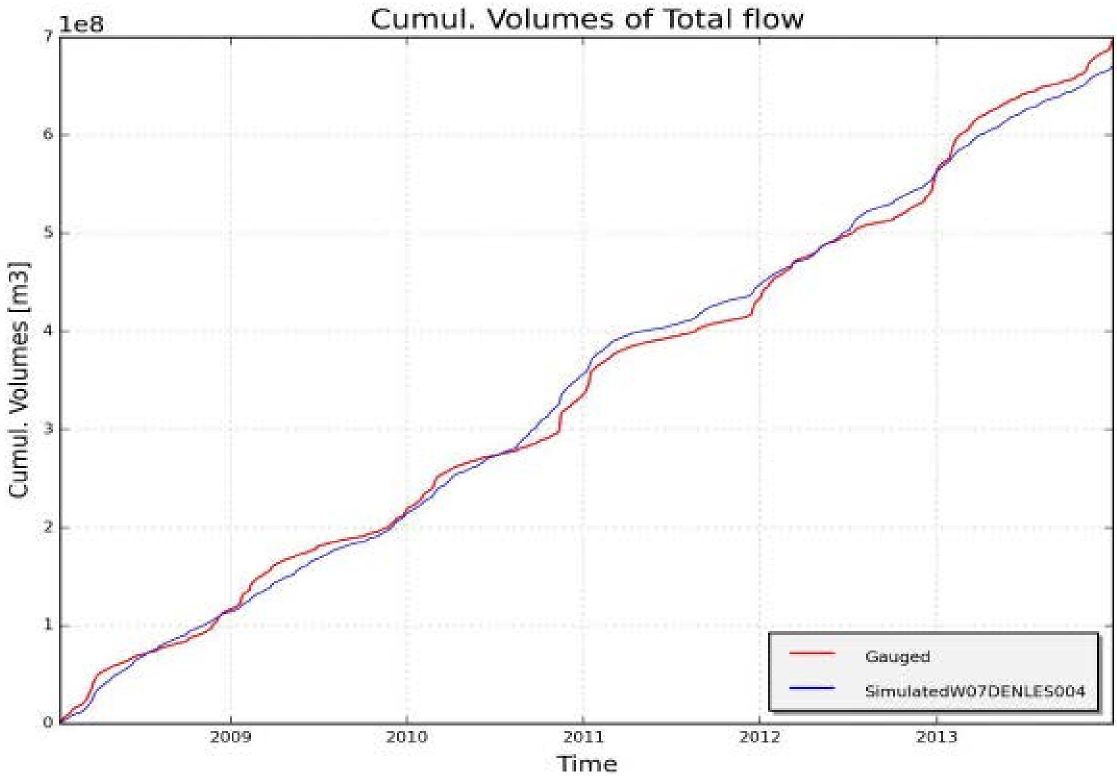


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W07DENLES004, station Lessines (calibration period)

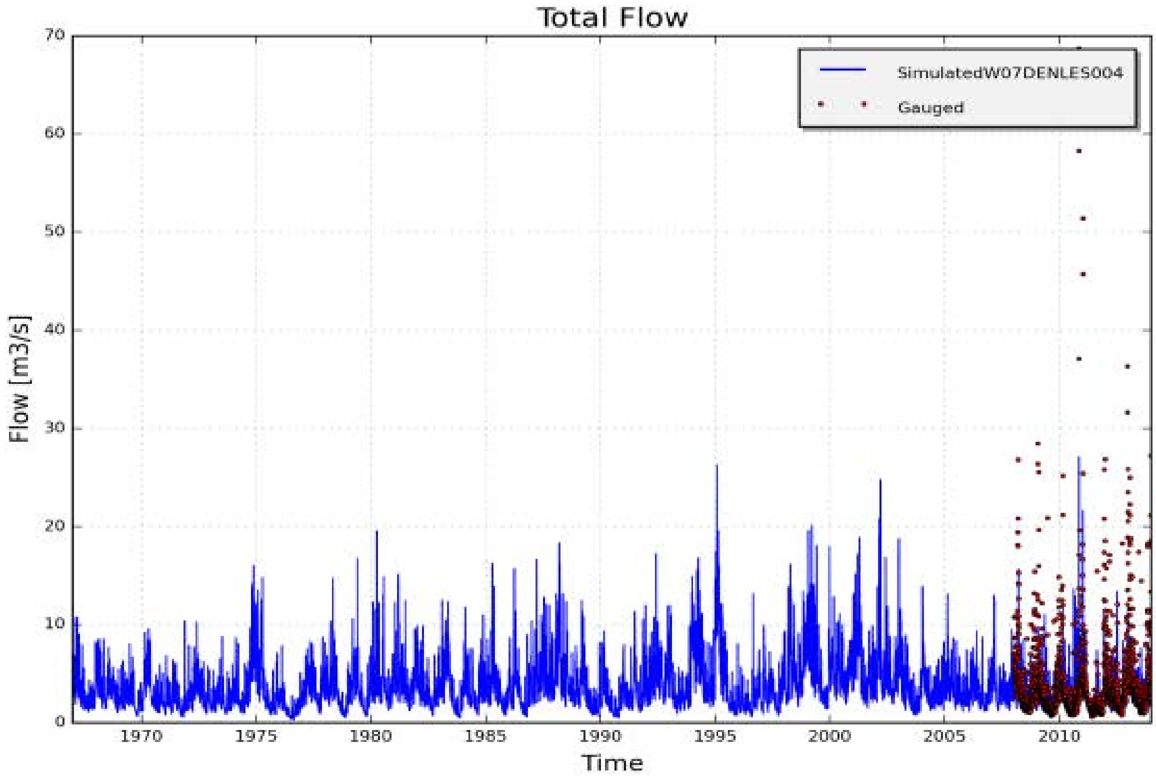


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W07DENLES004, station Lessines (validation period)

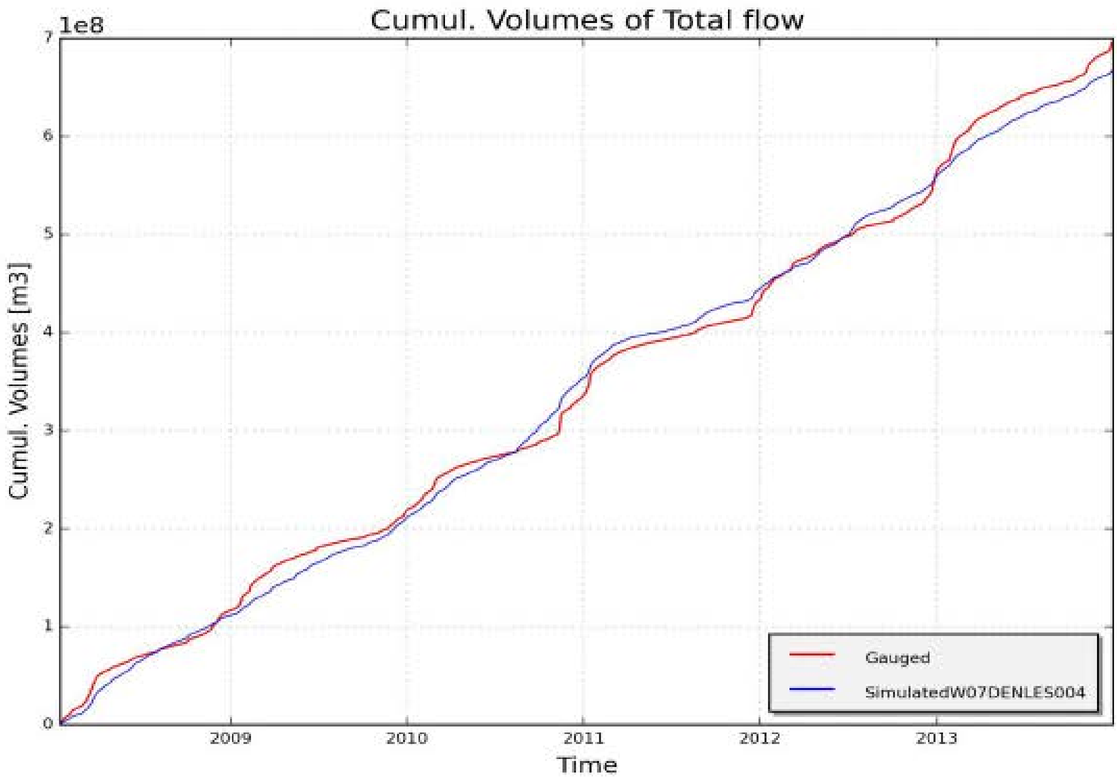


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W07DENLES004, station Lessines (validation period)

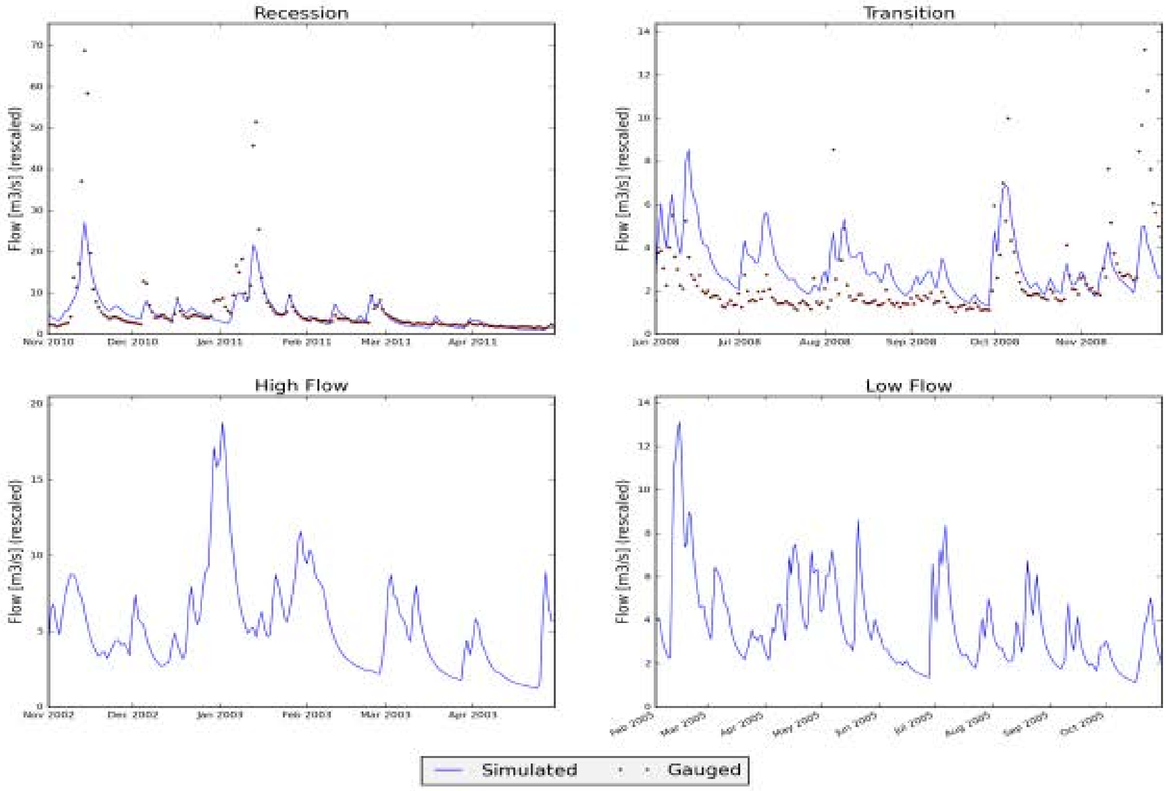


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W07DENLES004, station Lessines

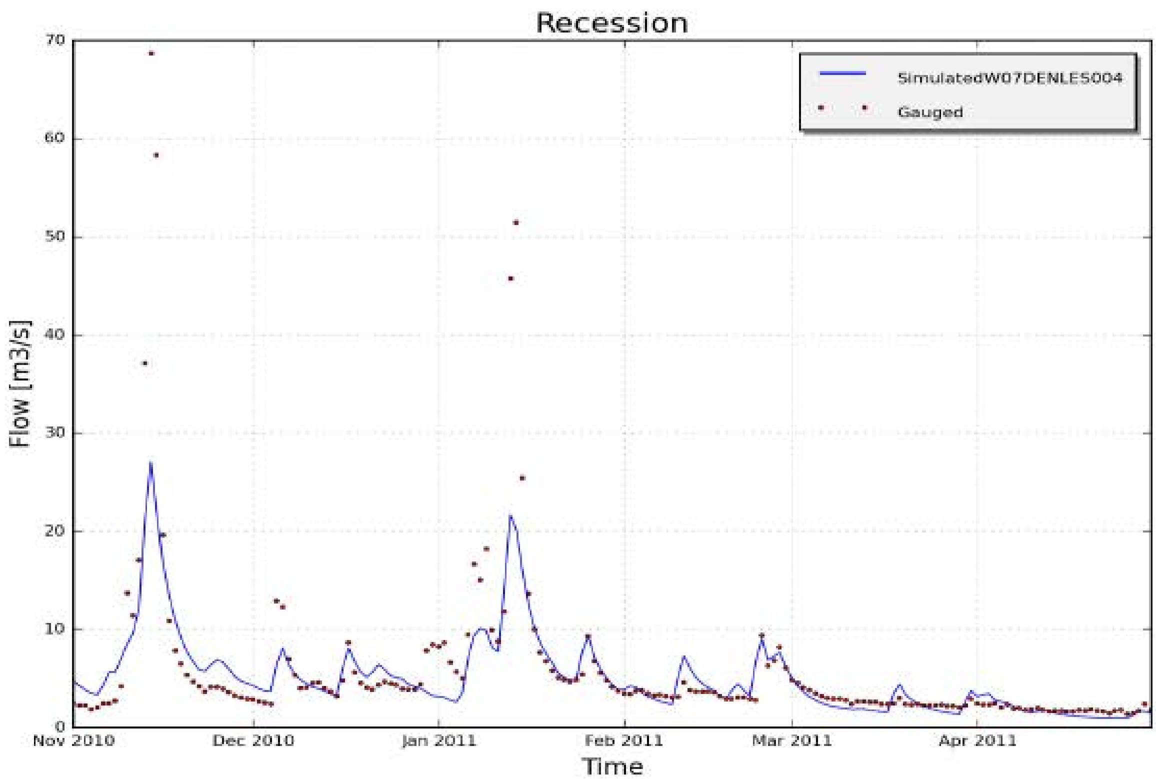


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W07DENLES004, station Lessines

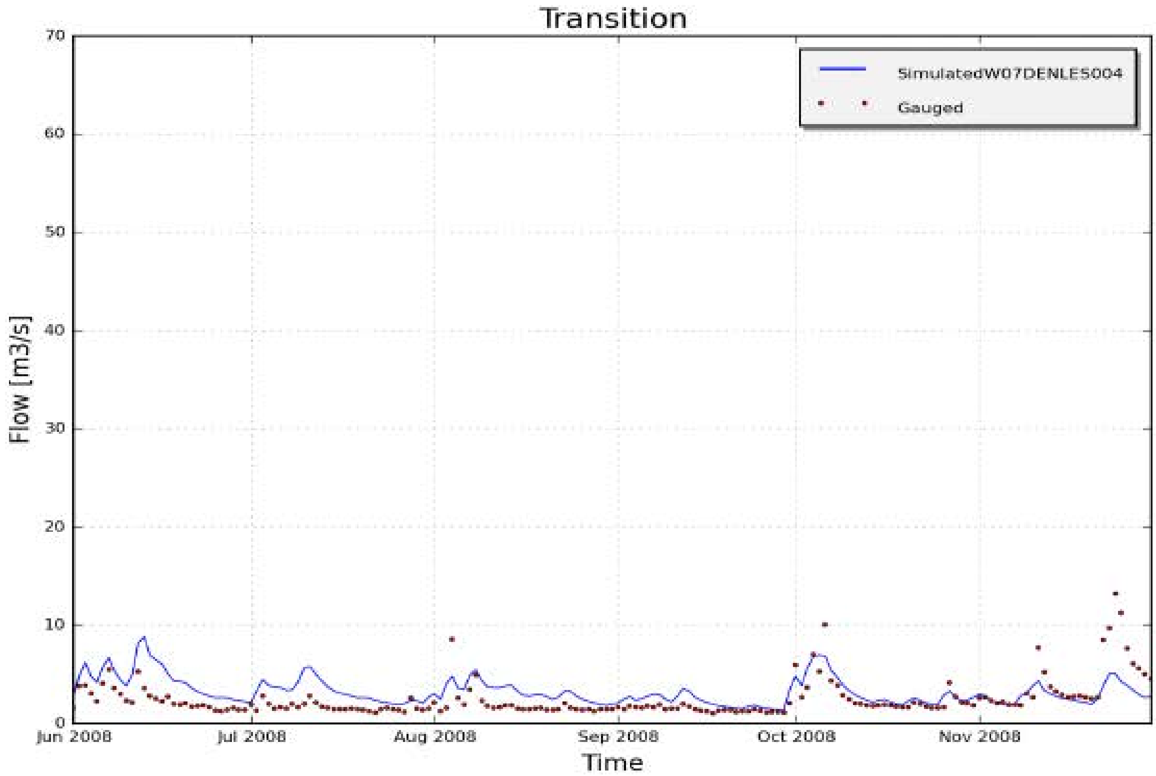


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W07DENLES004, station Lessines

Appendix 10 Dijle and Zenne

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V08BAR111370" (DIJLE/ZENNEBEKKEN)

1.1 Input data

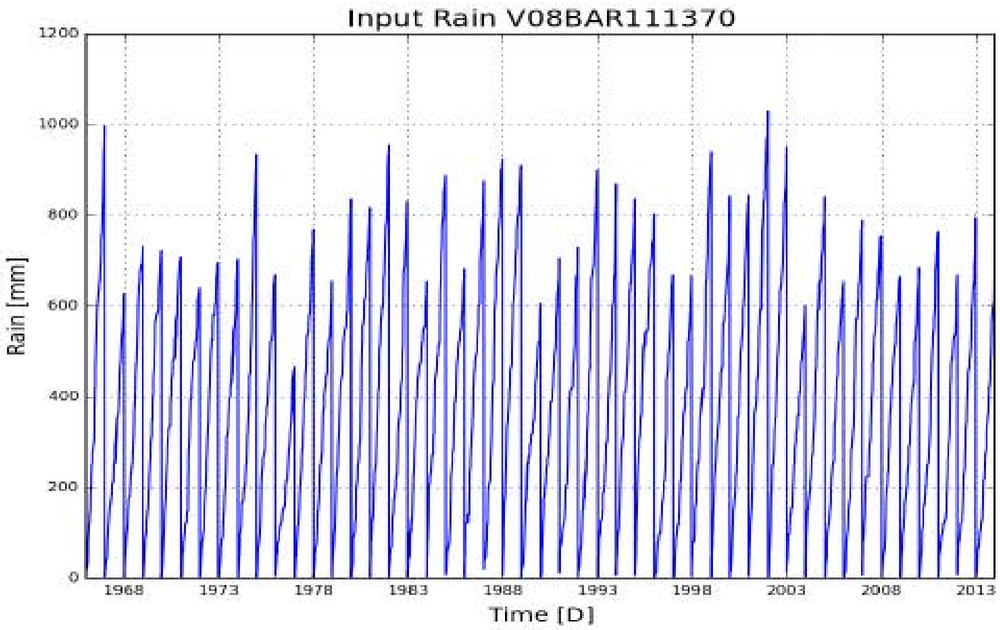


Figure 1: Cumulative precipitation on catchment V08BAR111370 (Dijle/Zennebekken)

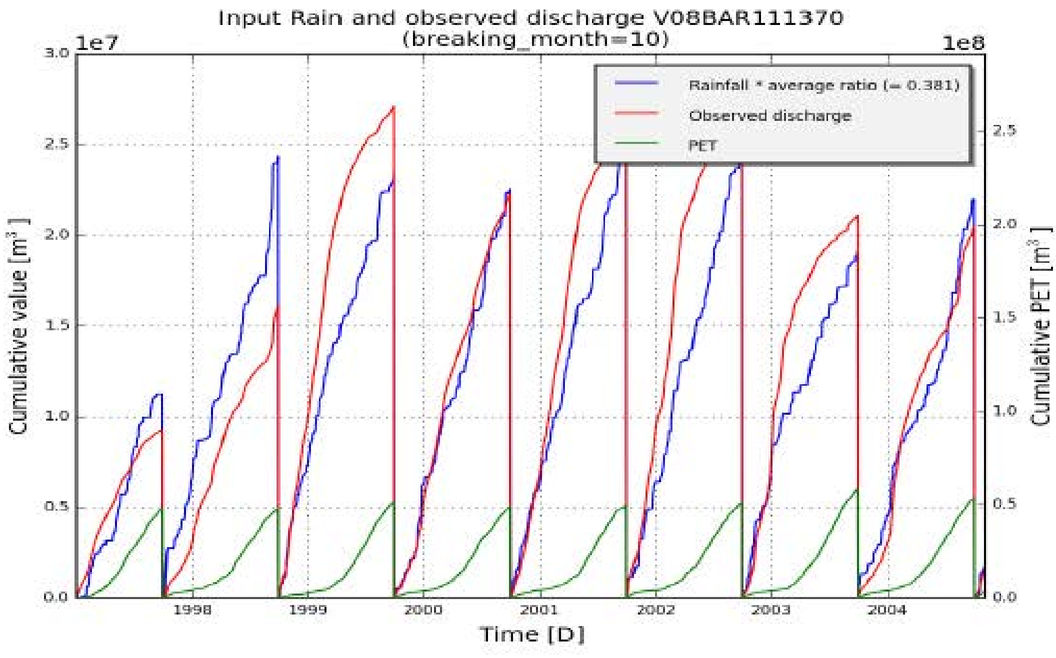


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V08BAR111370 (Dijle/Zennebekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V08BAR111370
subcatchment_area [m2]	70079800
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 409.73), ('SMevap', 286.7), ('c1', 2.1), ('c2', 0.65), ('c3', 1.0), ('cOF1', -5.93), ('cOF2', 0.95), ('cIF1', -3.69), ('cIF2', 3.0), ('CQOF', 15.0), ('CKIF', 75.43), ('CKBF', 1222.6)]

Table 1: Goodness of fit for calibration period (1997 - 2004)

	Full year	**Summer**	**Winter**
RelErr	1.5 %	22.4 %	-7.0 %
NS	0.742	0.632	0.678
NS_log	0.754	0.617	0.729
NS_rel	0.706	0.607	0.856
KGE	0.736	0.615	0.682

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	1.4 %	22.3 %	-7.2 %
NS	0.742	0.632	0.678
NS_log	0.754	0.618	0.727
NS_rel	0.707	0.608	0.856
KGE	0.736	0.615	0.682

1.3 Observed and simulated timeseries for optimum parameters

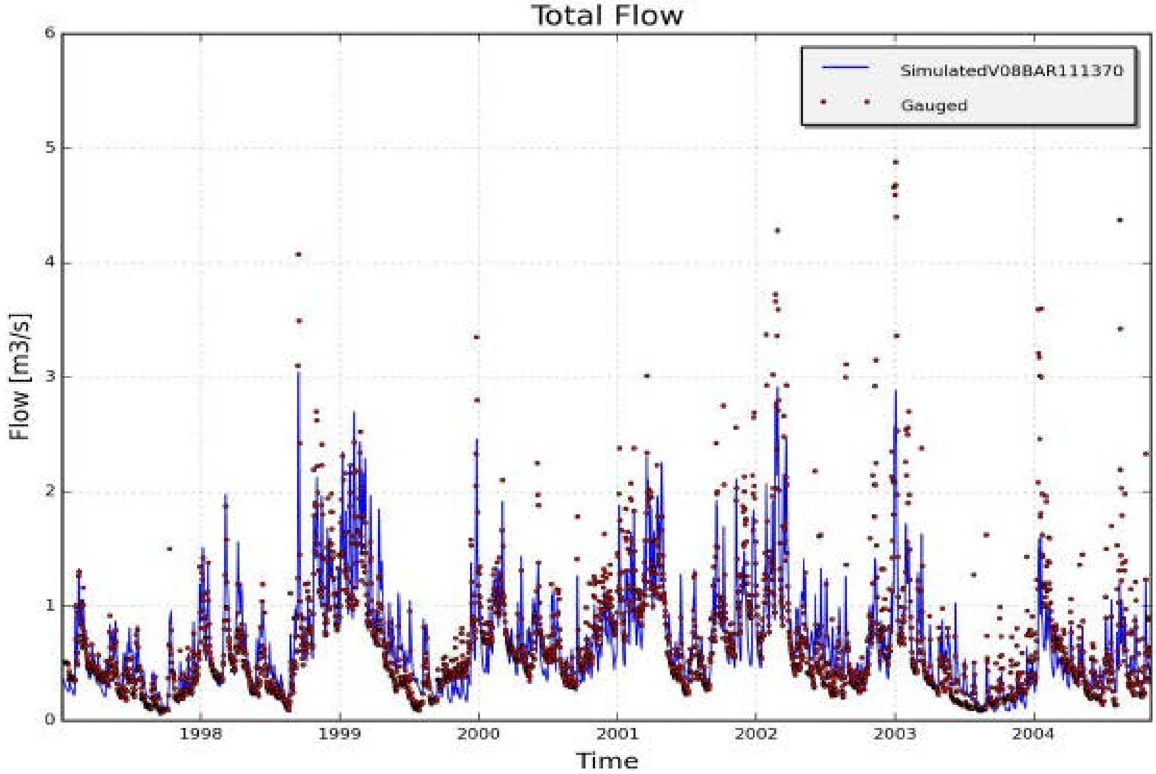


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V08BAR111370, station 11110102-Barebeek(calibration period)

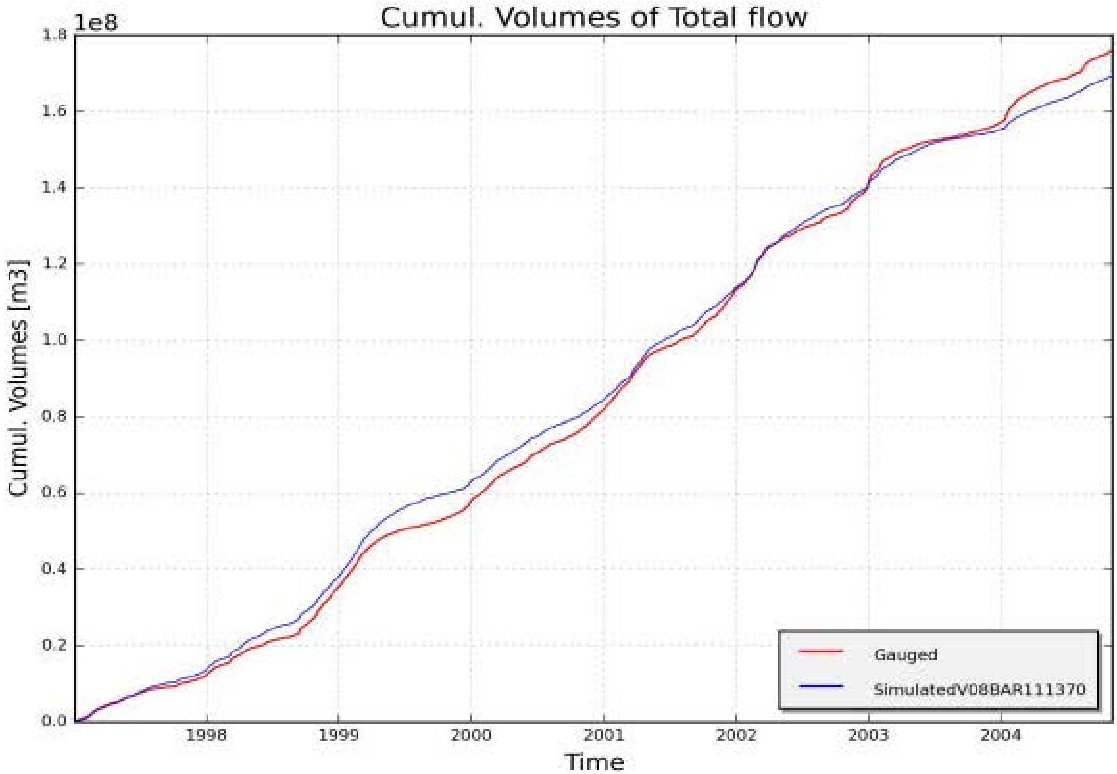


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V08BAR111370, station 11110102-Barebeek (calibration period)

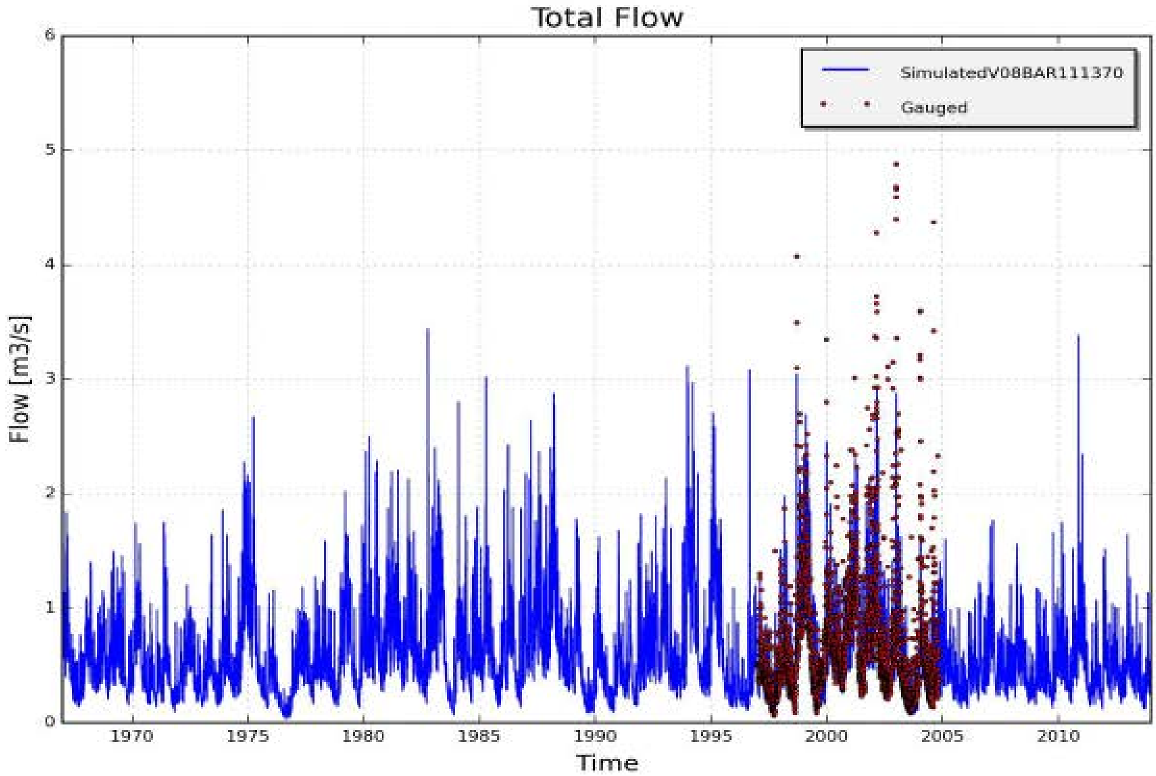


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V08BAR111370, station 11110102-Barebeek (validation period)

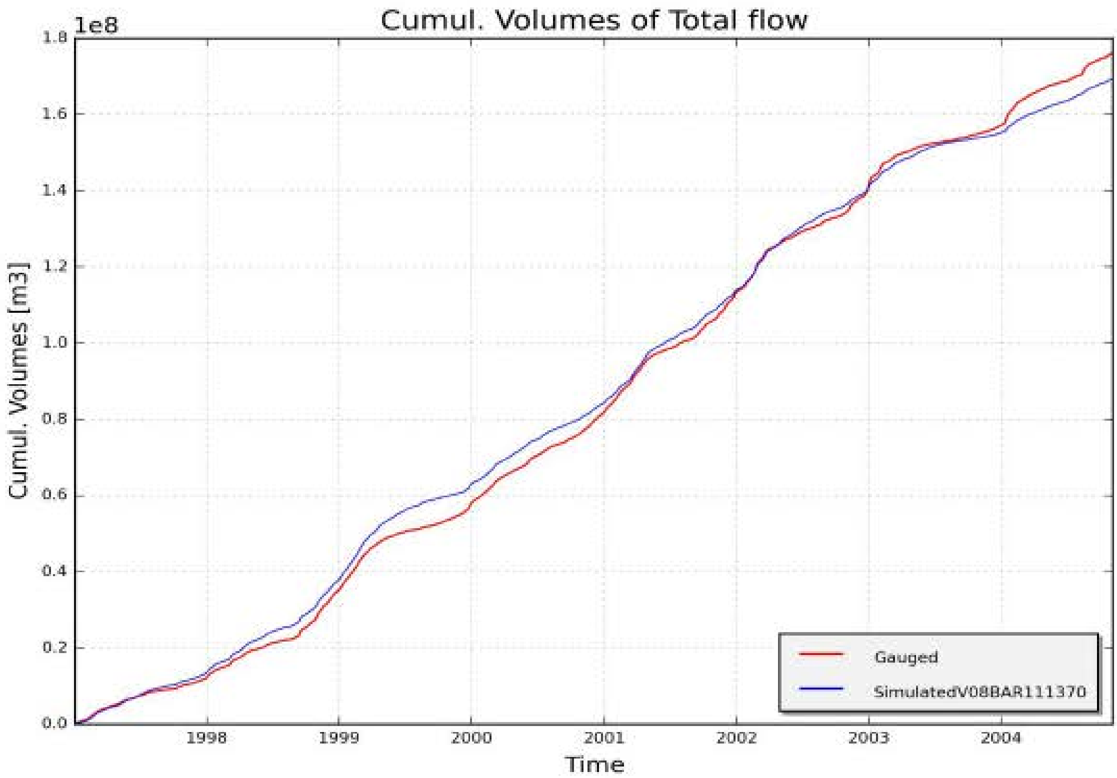


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V08BAR111370, station 11110102-Barebeek (validation period)

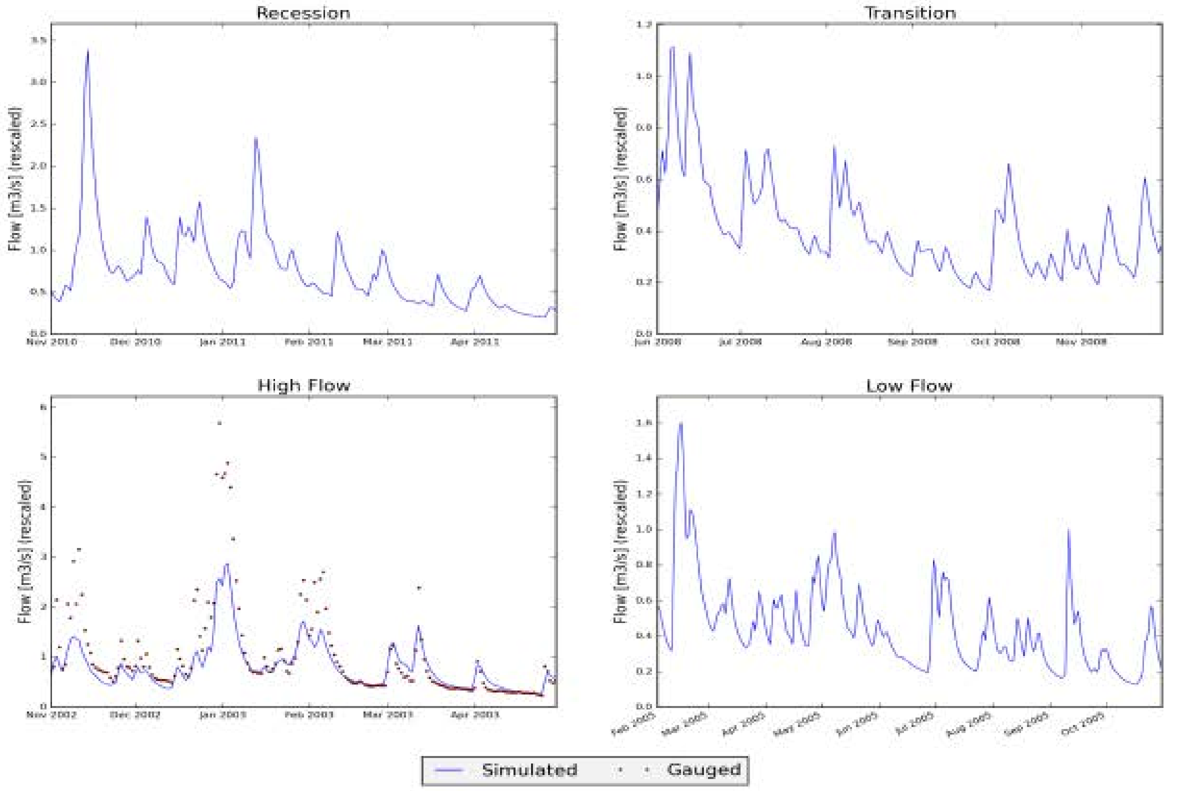


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V08BAR111370, station 11110102-Barebeek

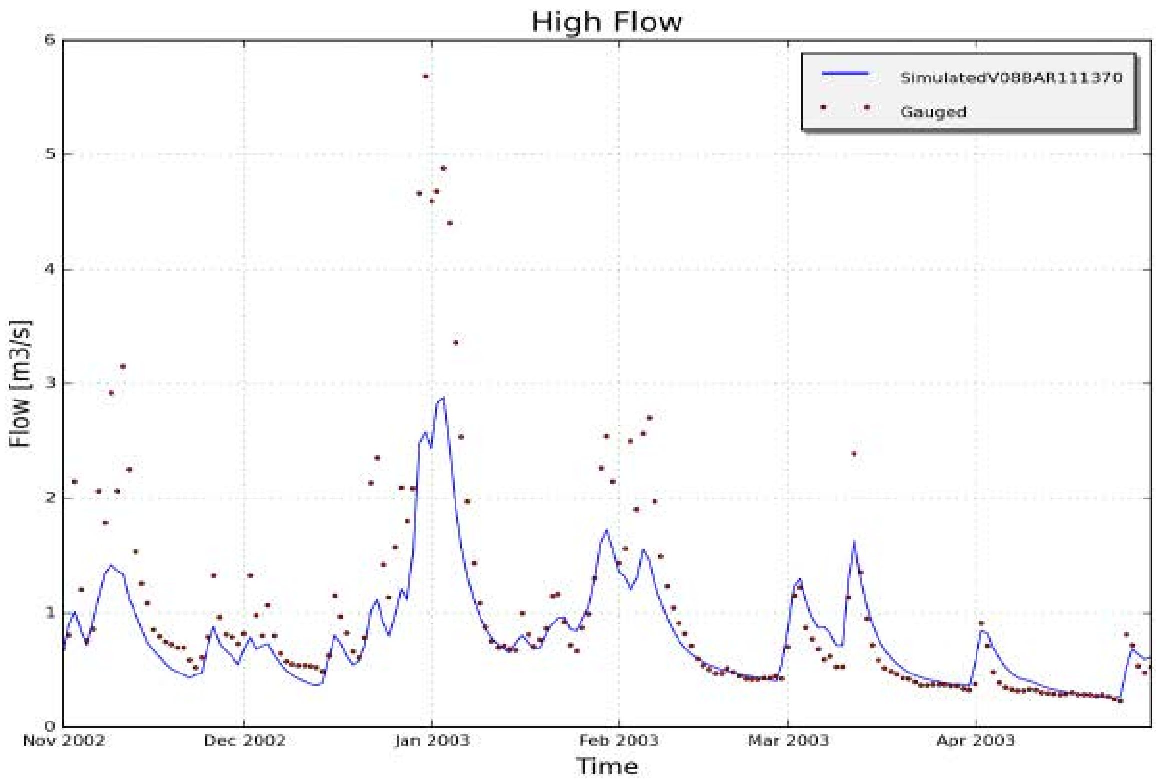


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V08BAR111370, station 11110102-Barebeek

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V08DIJ093400" (DIJLE/ZENNEBEKKEN)

1.1 Input data

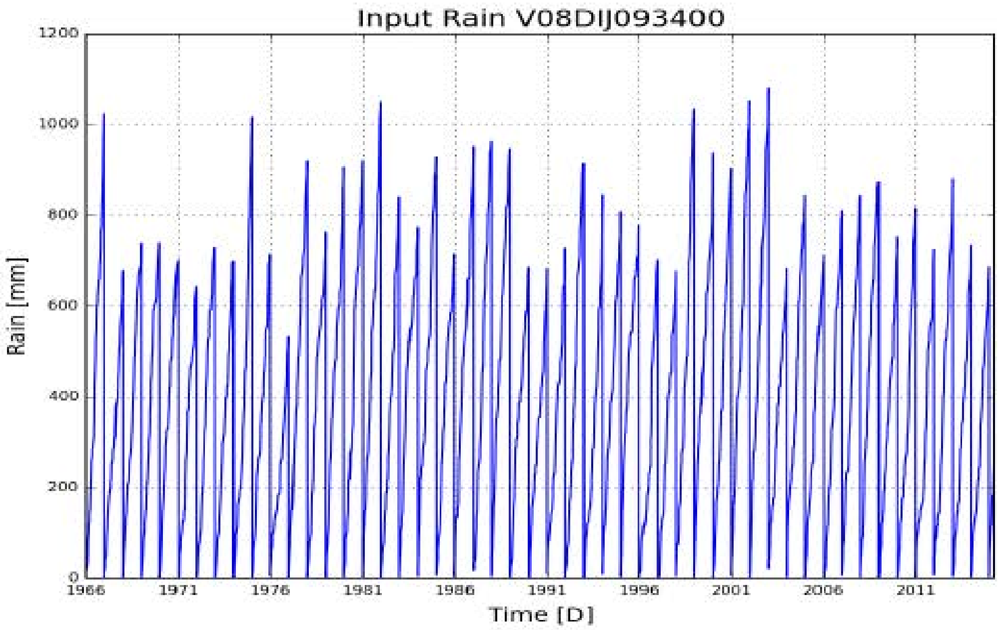


Figure 1: Cumulative precipitation on catchment V08DIJ093400 (Dijle/Zennebekken)

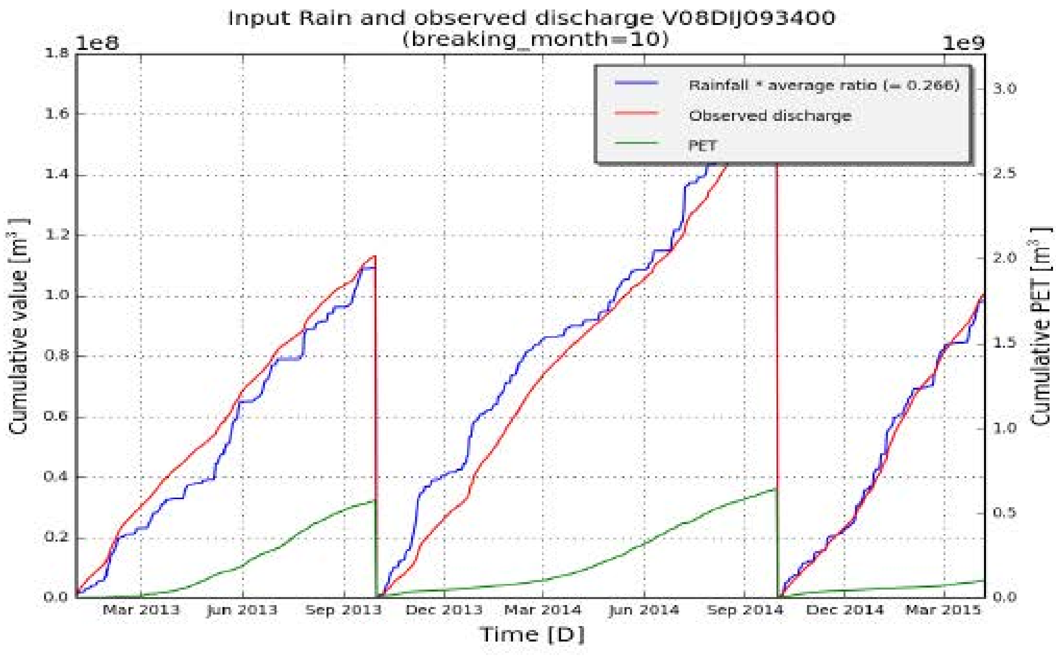


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V08DIJ093400 (Dijle/Zennebekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V08DIJ093400
subcatchment_area [m2]	861413000
Validation start_date	01-01-1967
Validation end_date	08-04-2015
frequency	daily

Optimal parameter set:[('SMmax', 464.14), ('SMevap', 158.53), ('c1', 1.78), ('c2', 0.1), ('c3', 1.0), ('cOF1', -3.32), ('cOF2', 1.05), ('cIF1', -2.78), ('cIF2', 0.71), ('CQOF', 11.88), ('CKIF', 64.34), ('CKBF', 703.74)]

Table 1: Goodness of fit for calibration period (2013 - 2015)

	Full year	**Summer**	**Winter**
RelErr	1.7 %	-0.3 %	0.3 %
NS	0.606	0.75	0.7
NS_log	0.157	0.48	0.328
NS_rel	0.588	0.77	0.61
KGE	0.723	0.862	0.783

Table 2 :Goodness of fit for validation period (1967 - 2015)

	Full year	**Summer**	**Winter**
RelErr	-2.6 %	-0.8 %	0.1 %
NS	0.595	0.737	0.747
NS_log	-0.004	0.494	0.442
NS_rel	0.569	0.747	0.672
KGE	0.718	0.84	0.795

1.3 Observed and simulated timeseries for optimum parameters

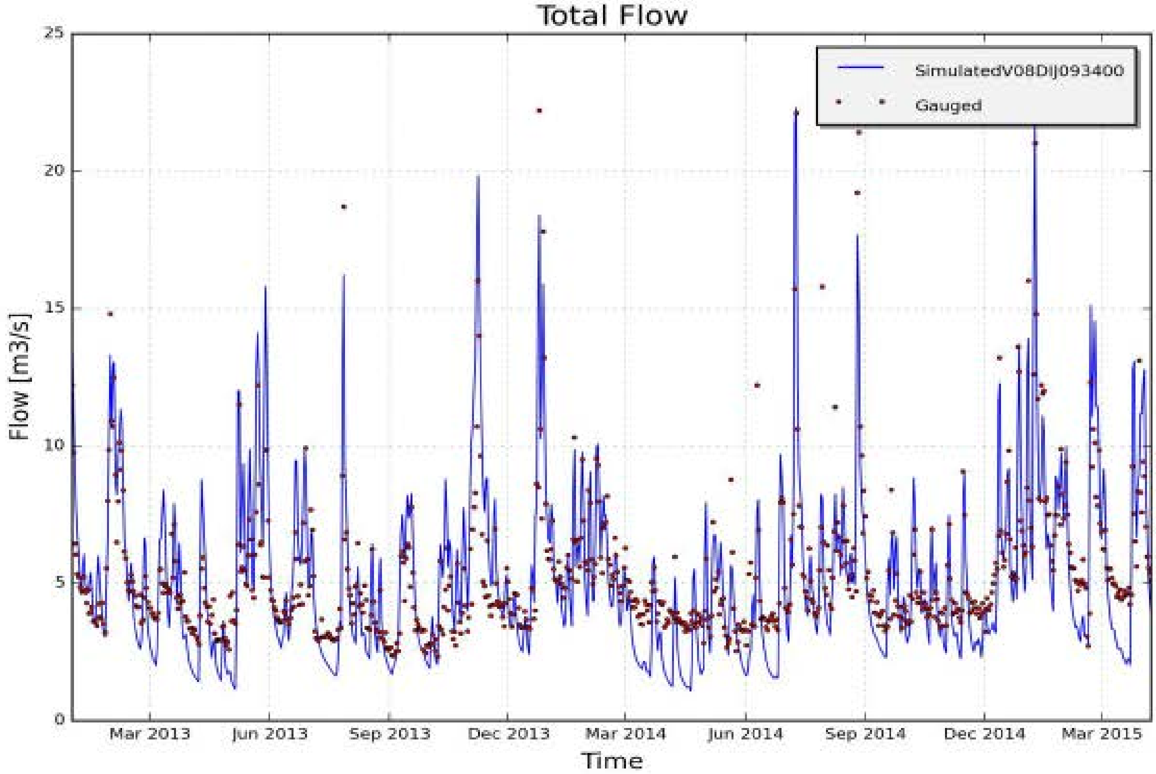


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V08DIJ093400, station 9310102 - Dijle, Wilsele (calibration period)

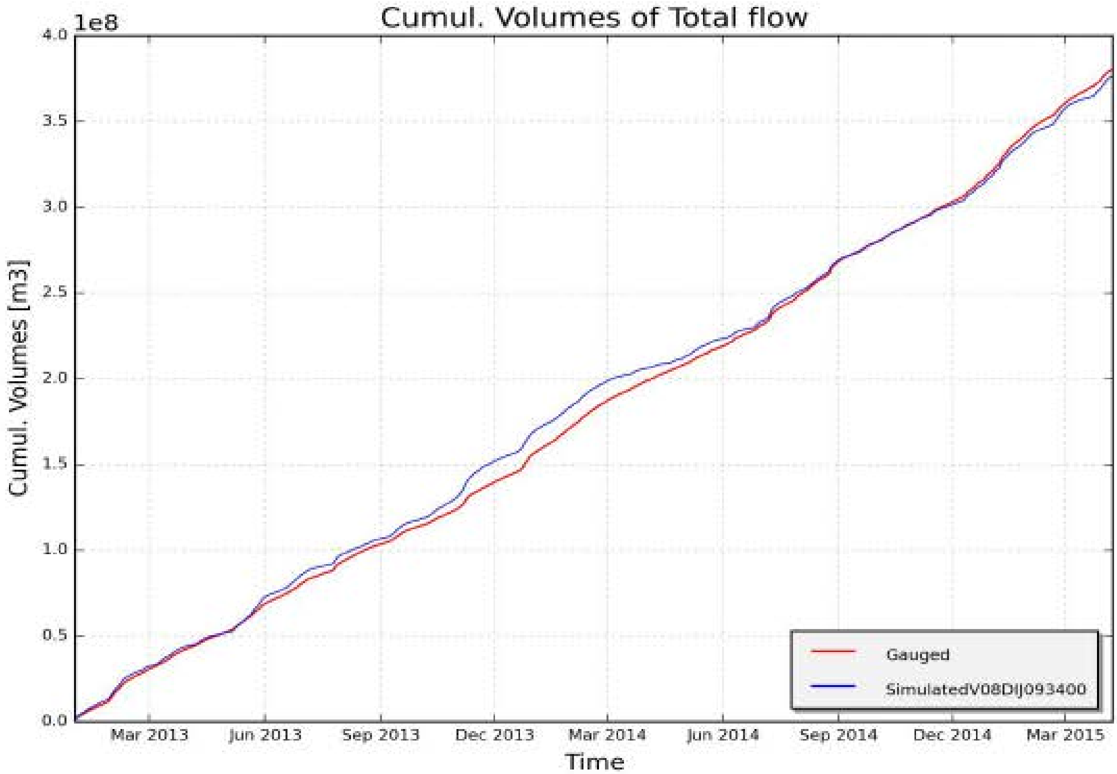


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V08DIJ093400, station 9310102 - Dijle, Wilsele (calibration period)

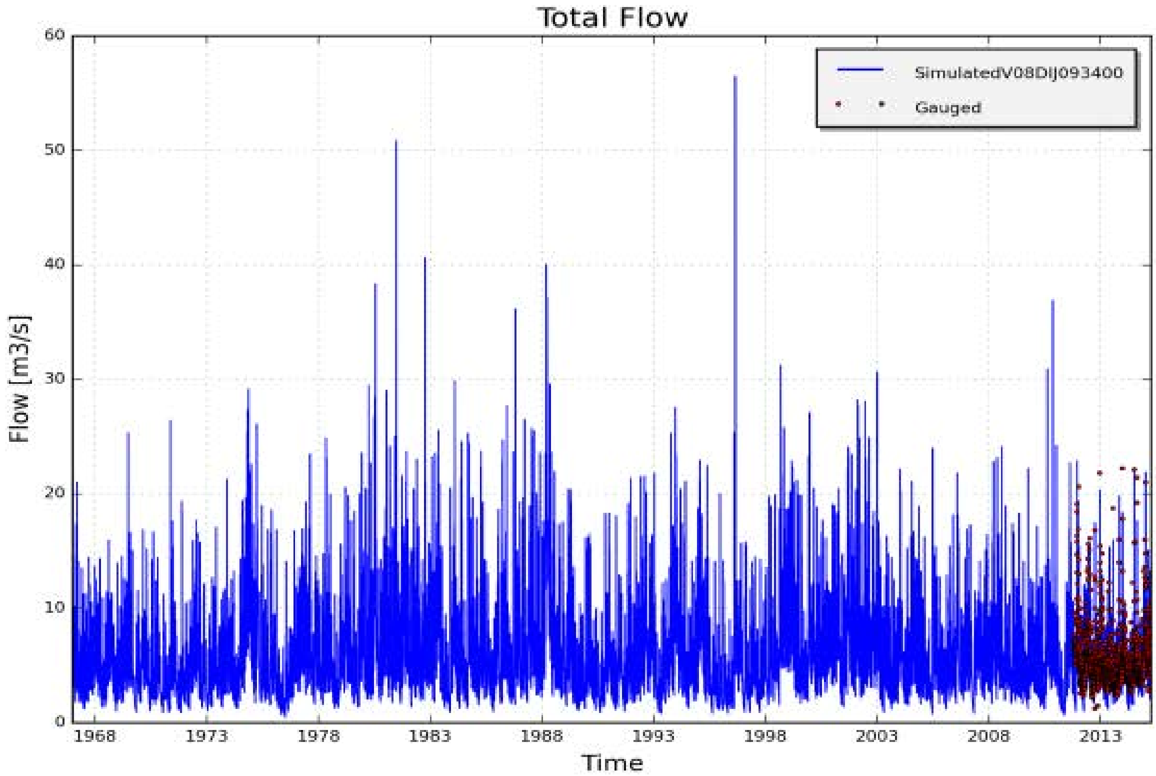


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V08DIJ093400, station 9310102 - Dijle, Wilsele (validation period)

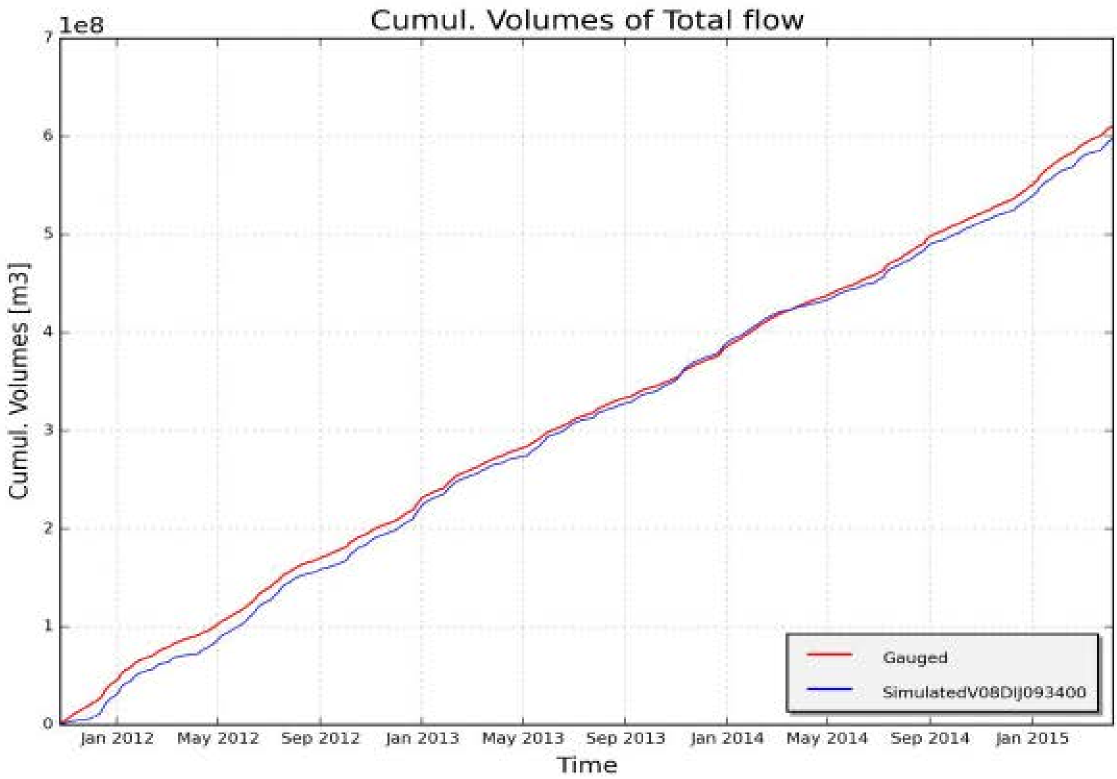


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V08DIJ093400, station 9310102 - Dijle, Wilsele (validation period)

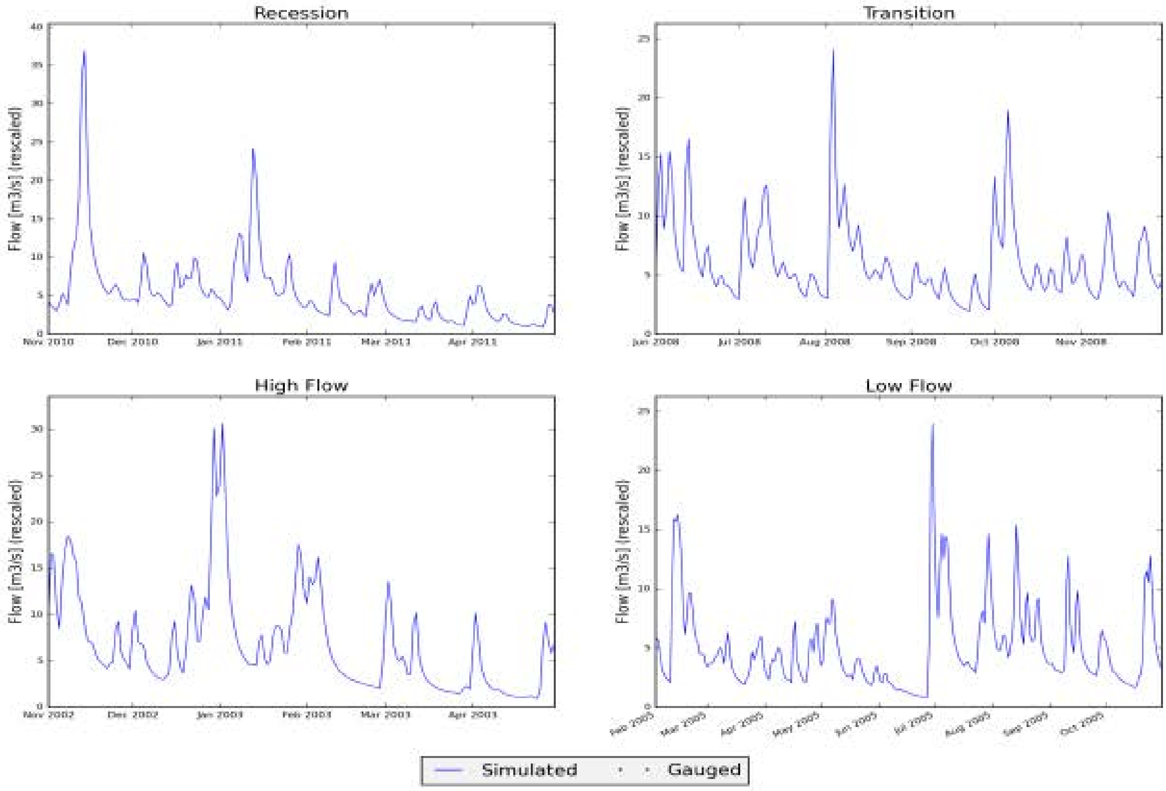


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V08DIJ093400, station 9310102 - Dijle, Wilsele

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V08ZUU233100" (DIJLE/ZENNEBEKKEN)

1.1 Input data

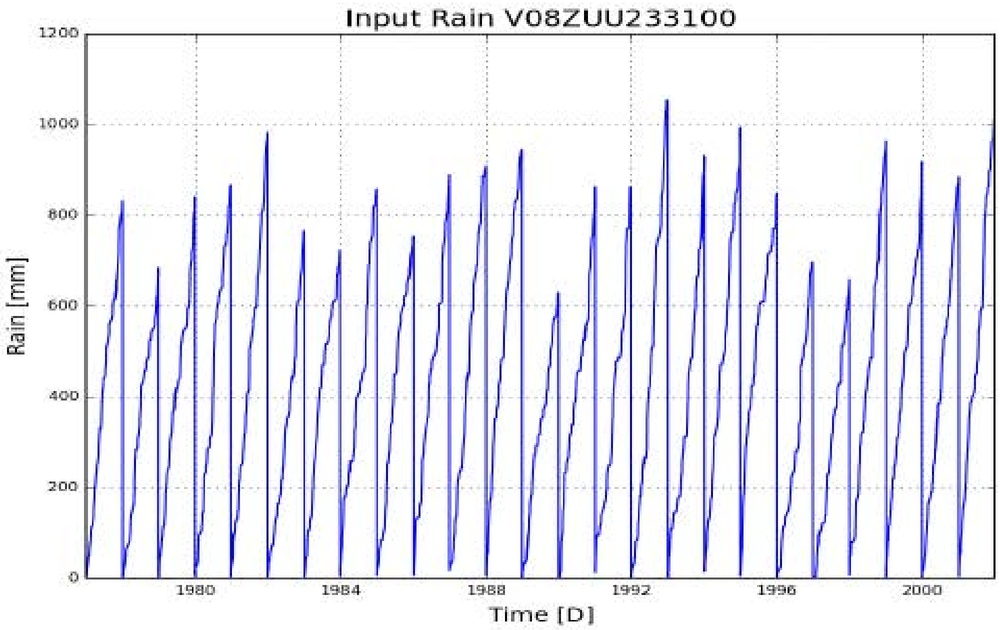


Figure 1: Cumulative precipitation on catchment V08ZUU233100 (Dijle/Zennebekken)

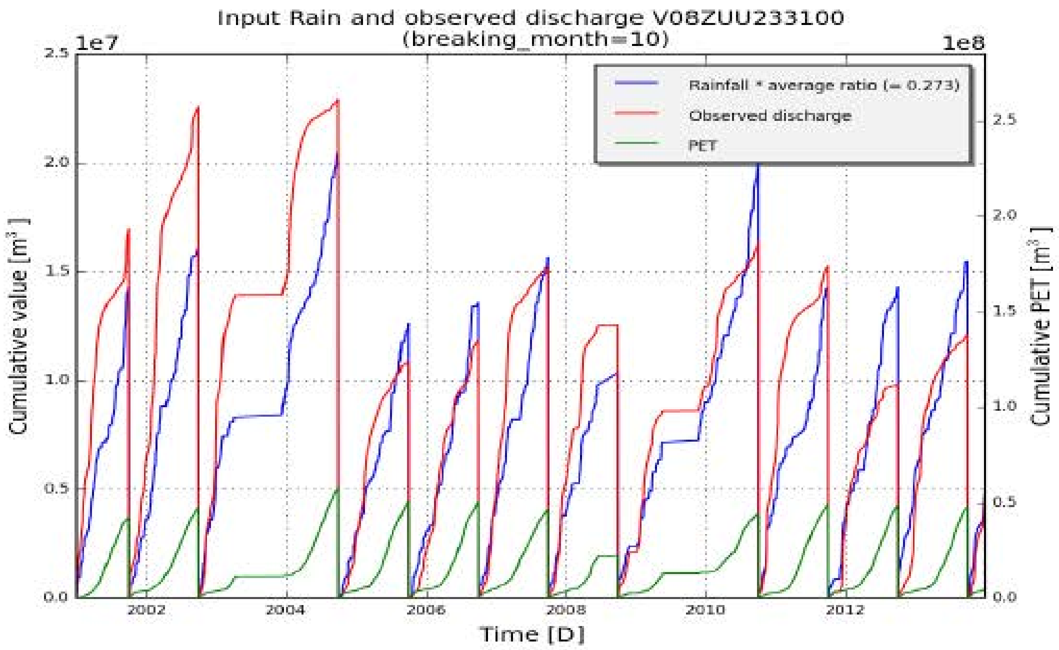


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V08ZUU233100 (Dijle/Zennebekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V08ZUU233100
subcatchment_area [m2]	64771005
Validation start_date	01-01-1978
Validation end_date	31-12-2001
frequency	daily

Optimal parameter set:[('SMmax', 406.29), ('SMevap', 156.16), ('c1', 2.09), ('c2', 0.68), ('c3', 1.0), ('cOF1', -5.1), ('cOF2', 5.0), ('cIF1', -4.18), ('cIF2', 2.99), ('CQOF', 12.78), ('CKIF', 57.91), ('CKBF', 780.79)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.5 %	25.5 %	-11.7 %
NS	0.627	0.236	0.632
NS_log	0.542	-0.137	0.603
NS_rel	-0.241	-0.846	0.645
KGE	0.664	0.224	0.663

Table 2 :Goodness of fit for validation period (1978 - 2001)

	Full year	**Summer**	**Winter**
RelErr	29.8 %	111.2 %	6.0 %
NS	0.586	0.081	0.639
NS_log	0.48	-0.239	0.689
NS_rel	-3.966	-4.451	0.231
KGE	0.68	0.046	0.806

1.3 Observed and simulated timeseries for optimum parameters

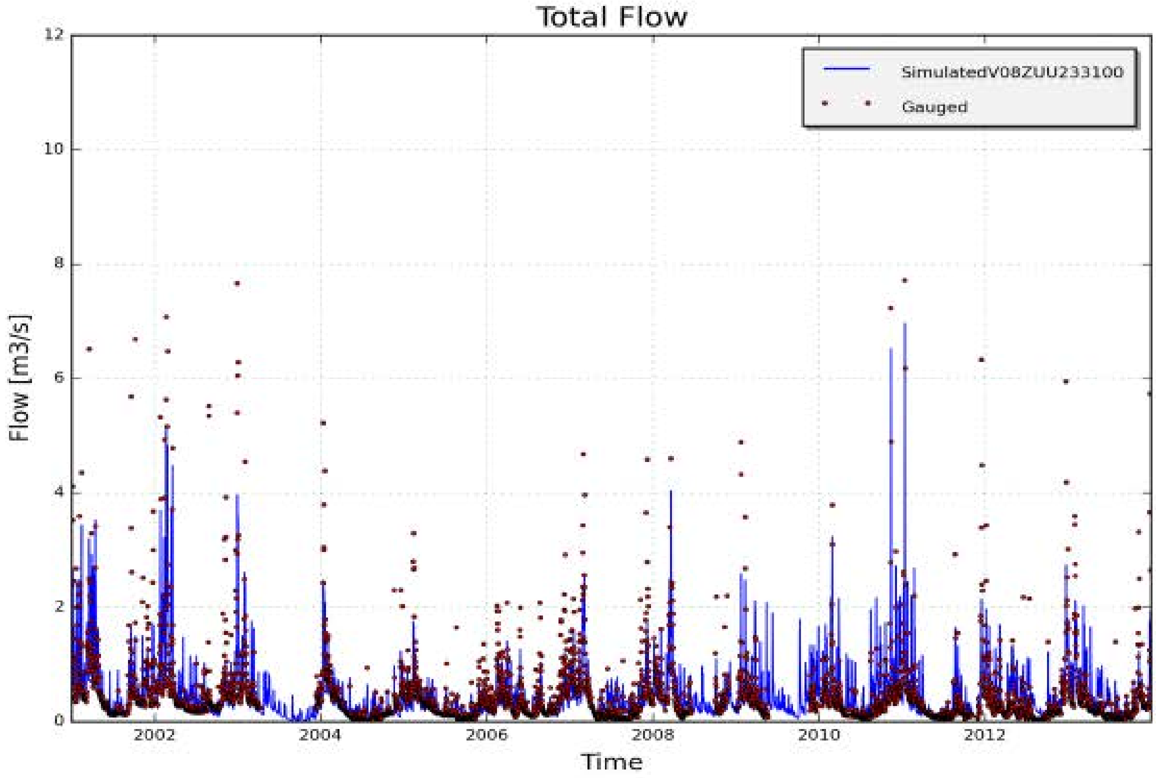


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V08ZUU233100, station 23310102 - Zuunbeek, St Pietersleeuw(calibration period)

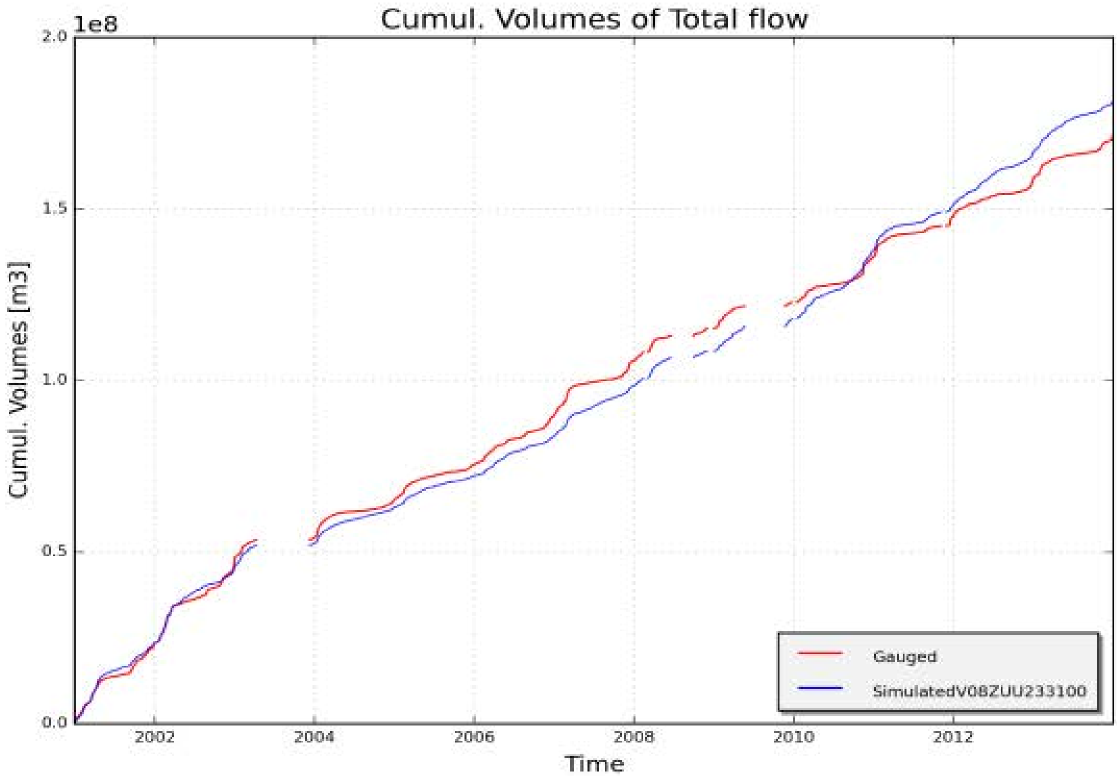


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V08ZUU233100, station 23310102 - Zuunbeek, St Pietersleeuw (calibration period)

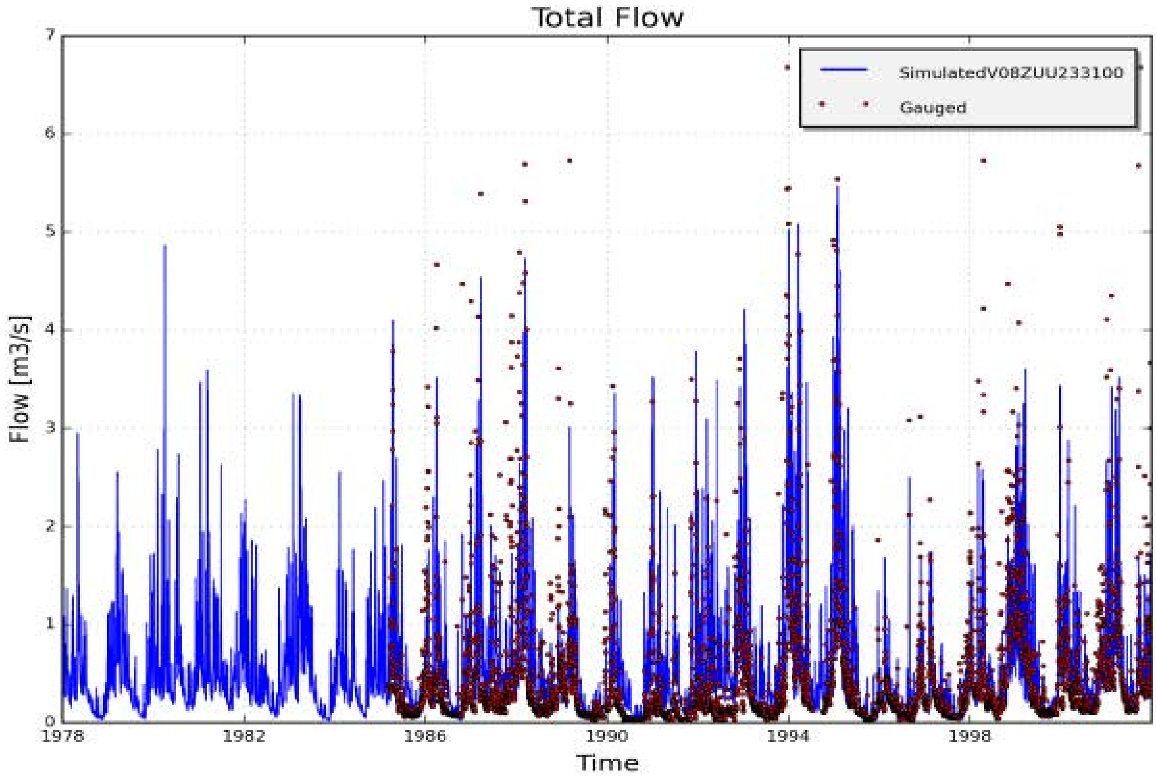


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V08ZUU233100, station 23310102 - Zuunbeek, St Pietersleeuw (validation period)

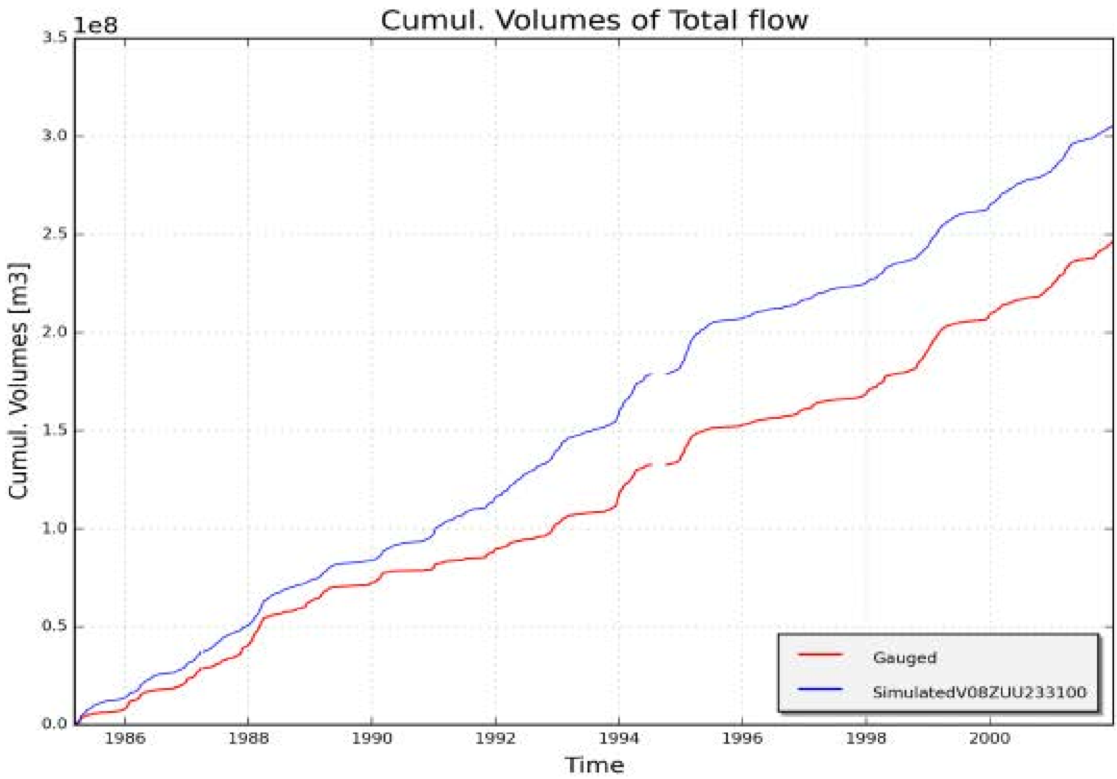


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V08ZUU233100, station 23310102 - Zuunbeek, St Pietersleeuw (validation period)

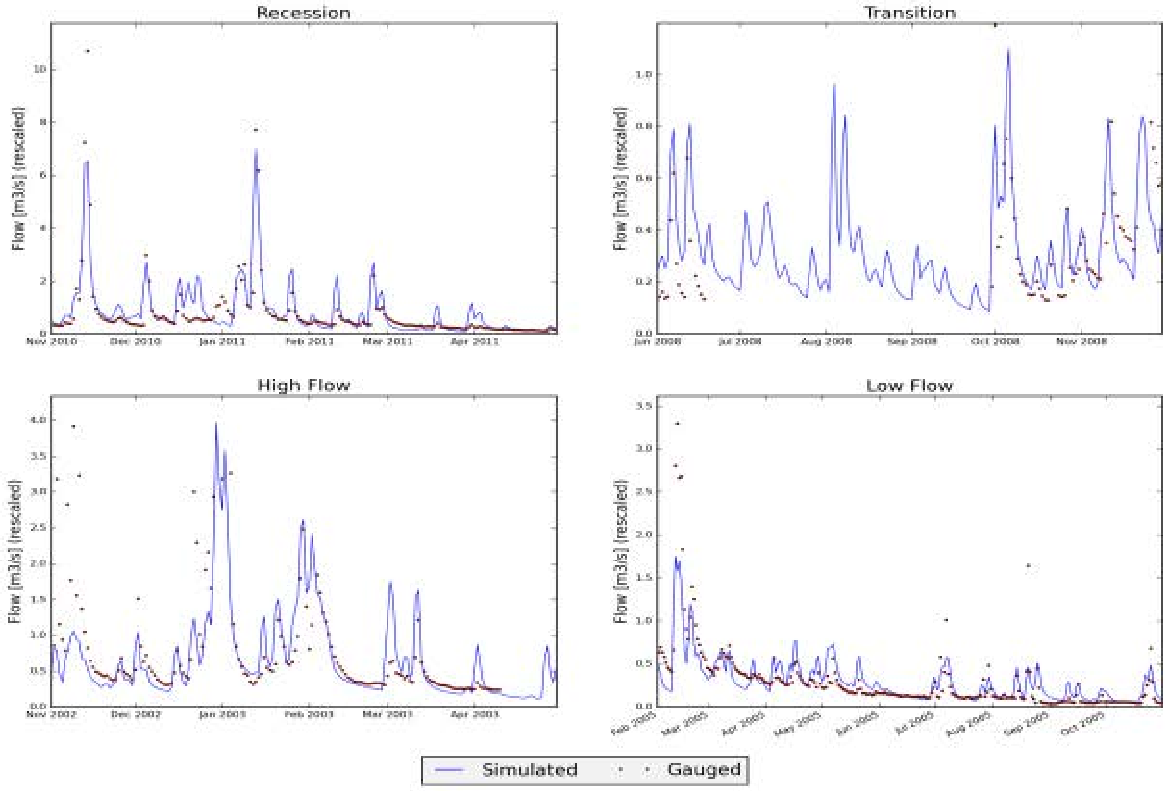


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V08ZUU233100, station 23310102 - Zuunbeek, St Pietersleeuw

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W08SAMRON000" (DIJLE/ZENNEBEKKEN)

1.1 Input data

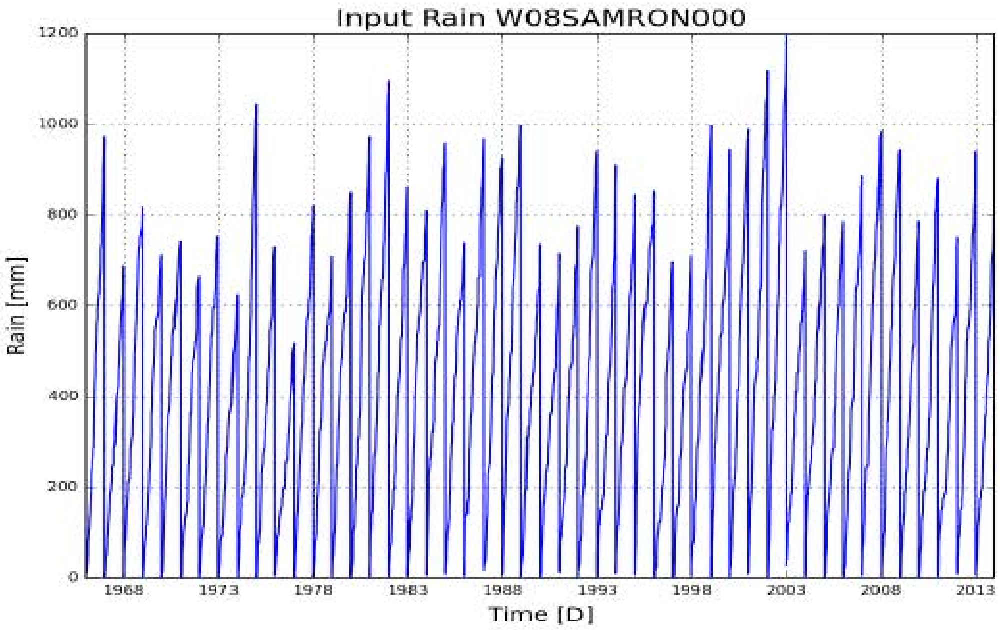


Figure 1: Cumulative precipitation on catchment W08SAMRON000 (Dijle/Zennebekken)

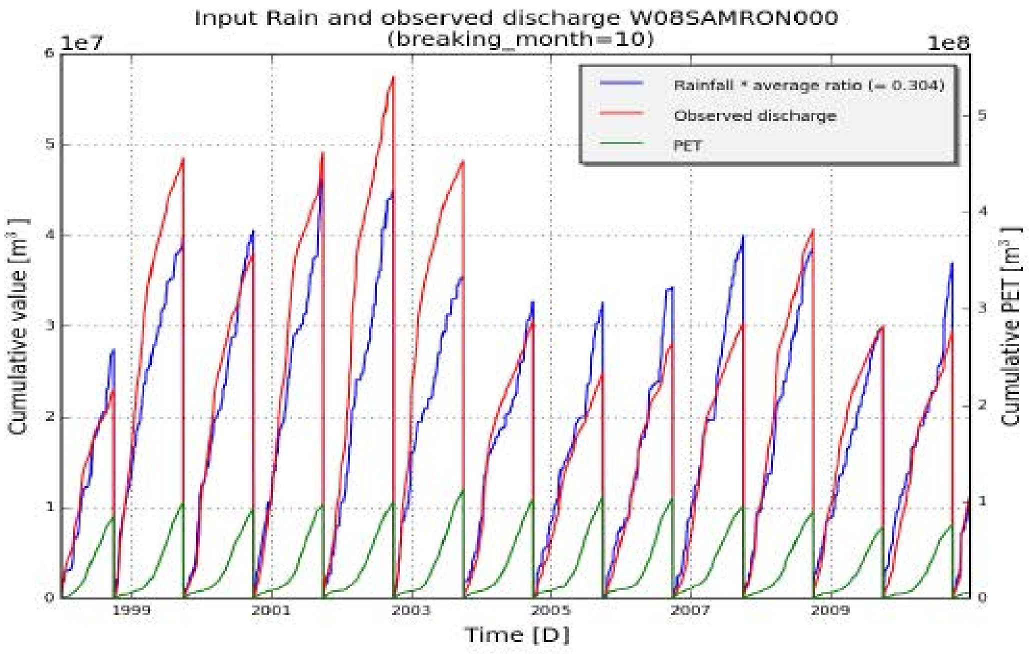


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W08SAMRON000 (Dijle/Zennebekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W08SAMRON000
subcatchment_area [m2]	134097000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 502.86), ('SMevap', 162.74), ('c1', 1.94), ('c2', 0.52), ('c3', 1.0), ('cOF1', -3.8), ('cOF2', 2.56), ('cIF1', -3.7), ('cIF2', 3.0), ('CQOF', 13.19), ('CKIF', 85.81), ('CKBF', 1324.27)]

Table 1: Goodness of fit for calibration period (1998 - 2010)

	Full year	**Summer**	**Winter**
RelErr	0.0 %	23.1 %	-12.1 %
NS	0.693	0.548	0.708
NS_log	0.684	0.339	0.754
NS_rel	0.776	0.622	0.89
KGE	0.691	0.611	0.667

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-9.2 %	3.8 %	-17.9 %
NS	0.71	0.596	0.706
NS_log	0.65	0.373	0.643
NS_rel	0.807	0.687	0.858
KGE	0.721	0.707	0.677

1.3 Observed and simulated timeseries for optimum parameters

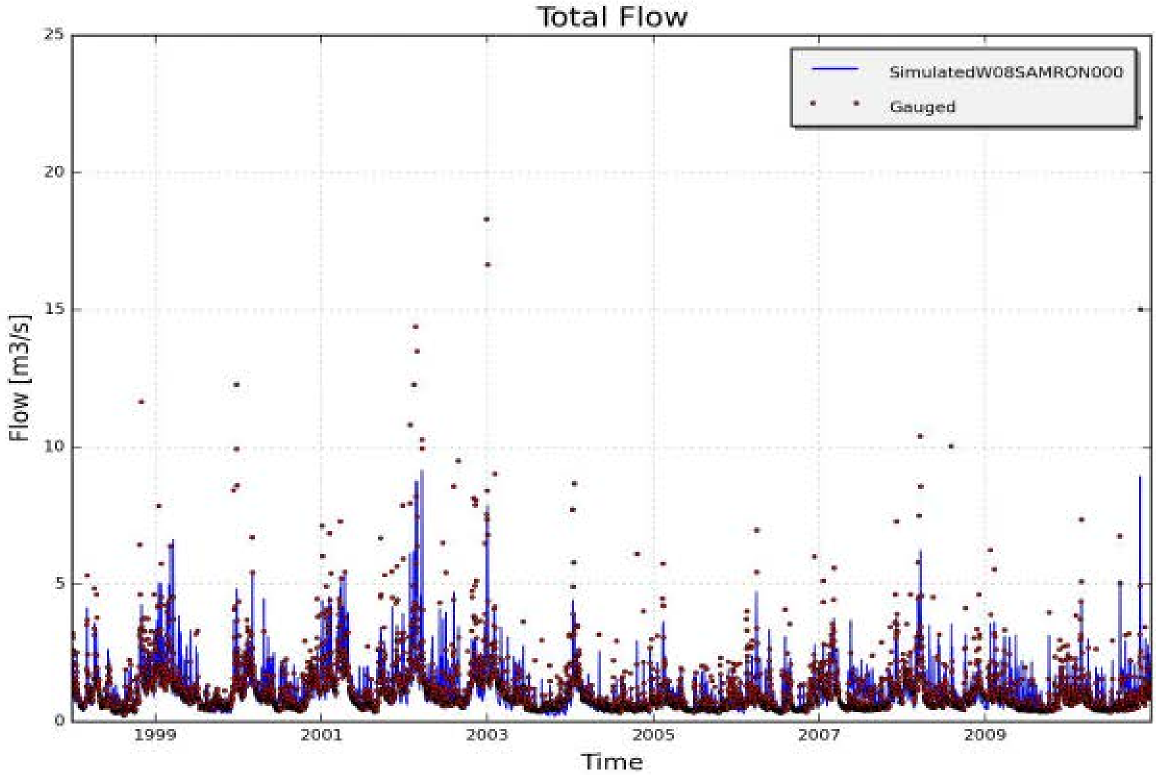


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W08SAMRON000, station 2371-10050 Samme, Ronquieres(calibration period)

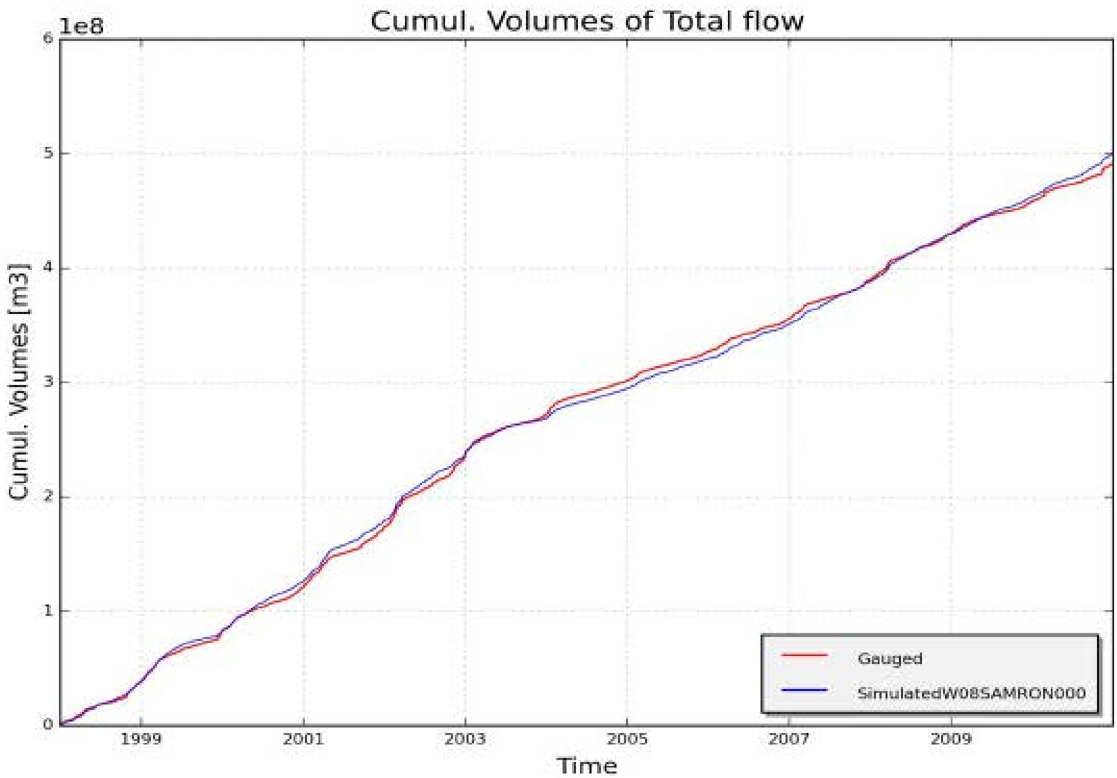


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W08SAMRON000, station 2371-10050 Samme, Ronquieres (calibration period)

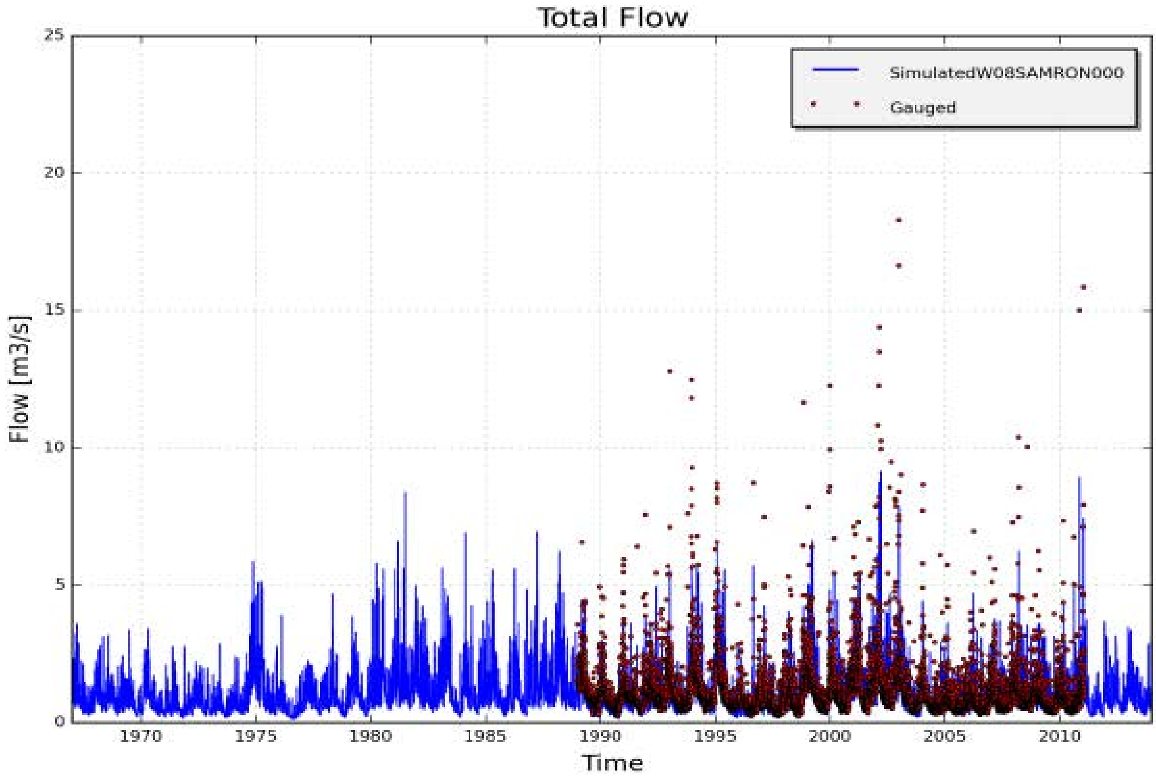


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W08SAMRON000, station 2371-10050 Samme, Ronquieres (validation period)

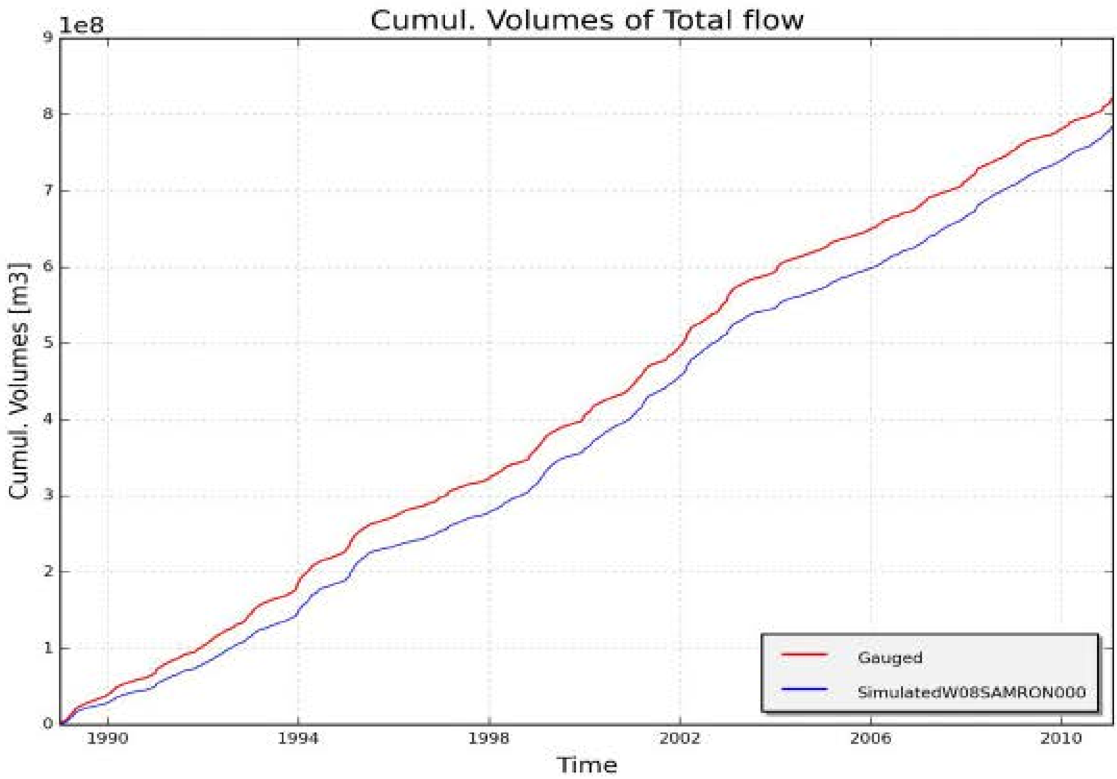


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W08SAMRON000, station 2371-10050 Samme, Ronquieres (validation period)

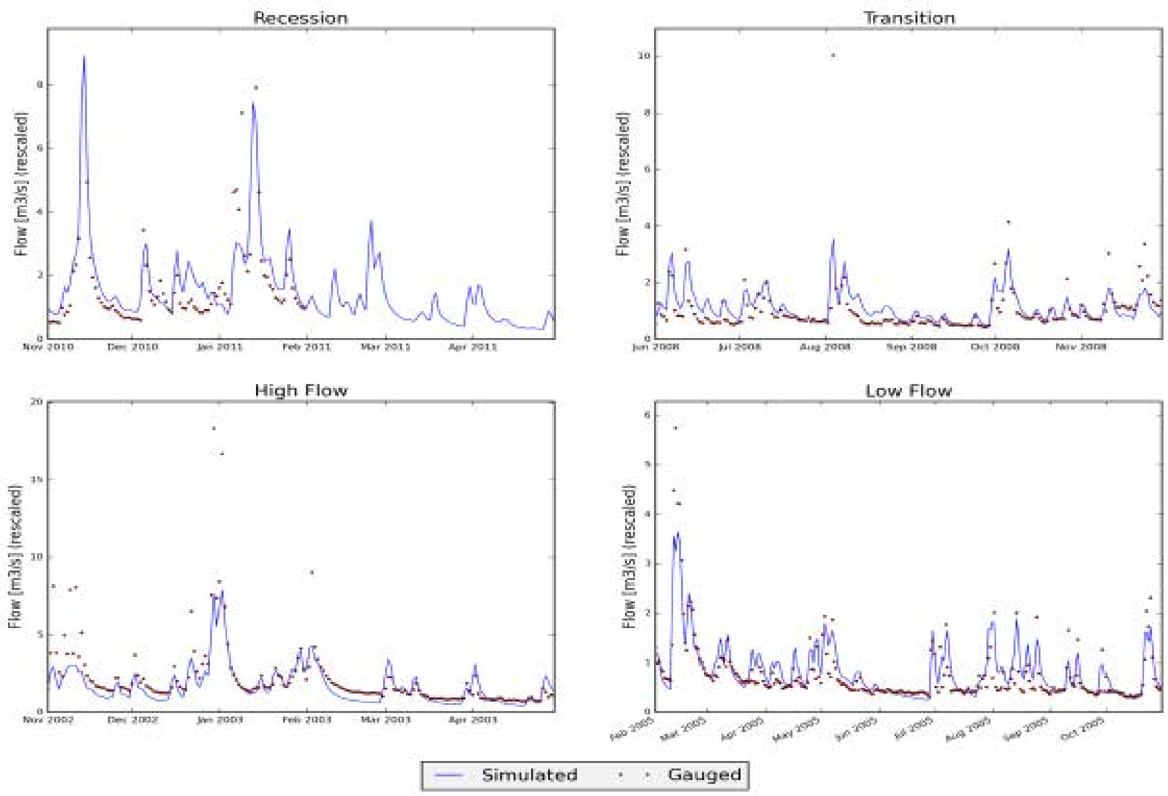


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W08SAMRON000, station 2371-10050 Samme, Ronquieres

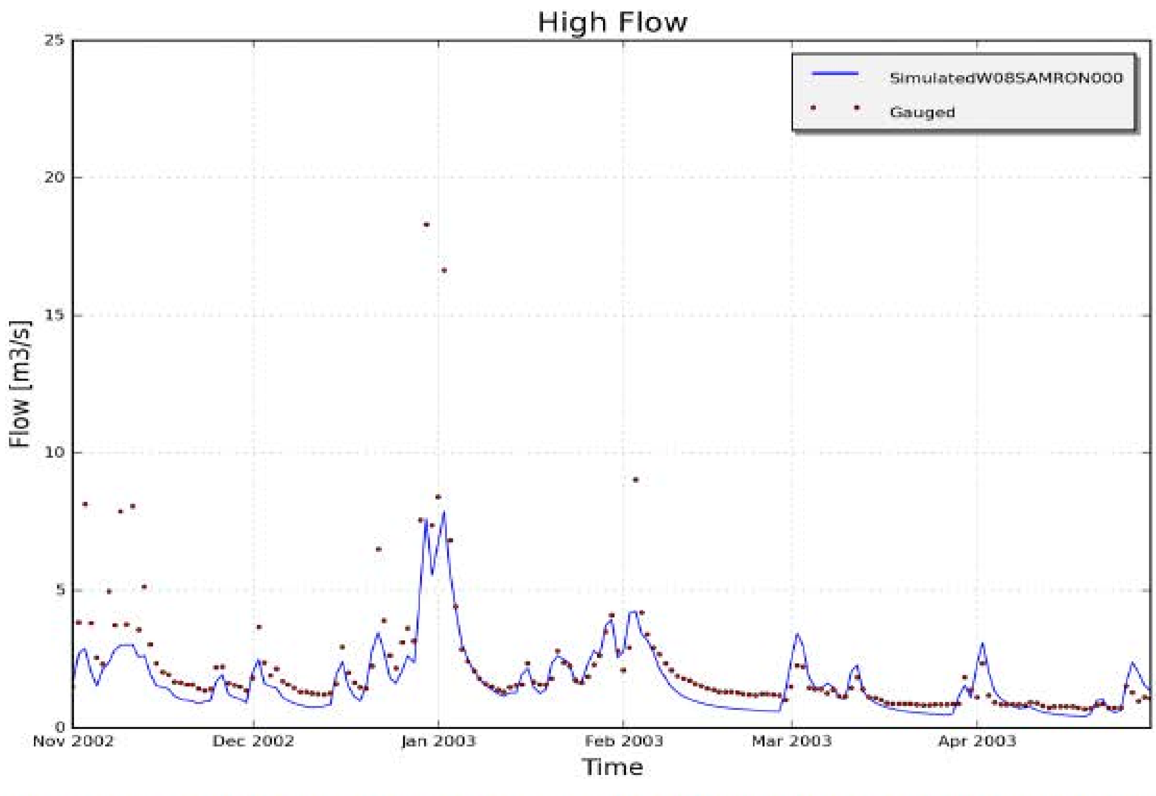


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W08SAMRON000, station 2371-10050 Samme, Ronquieres

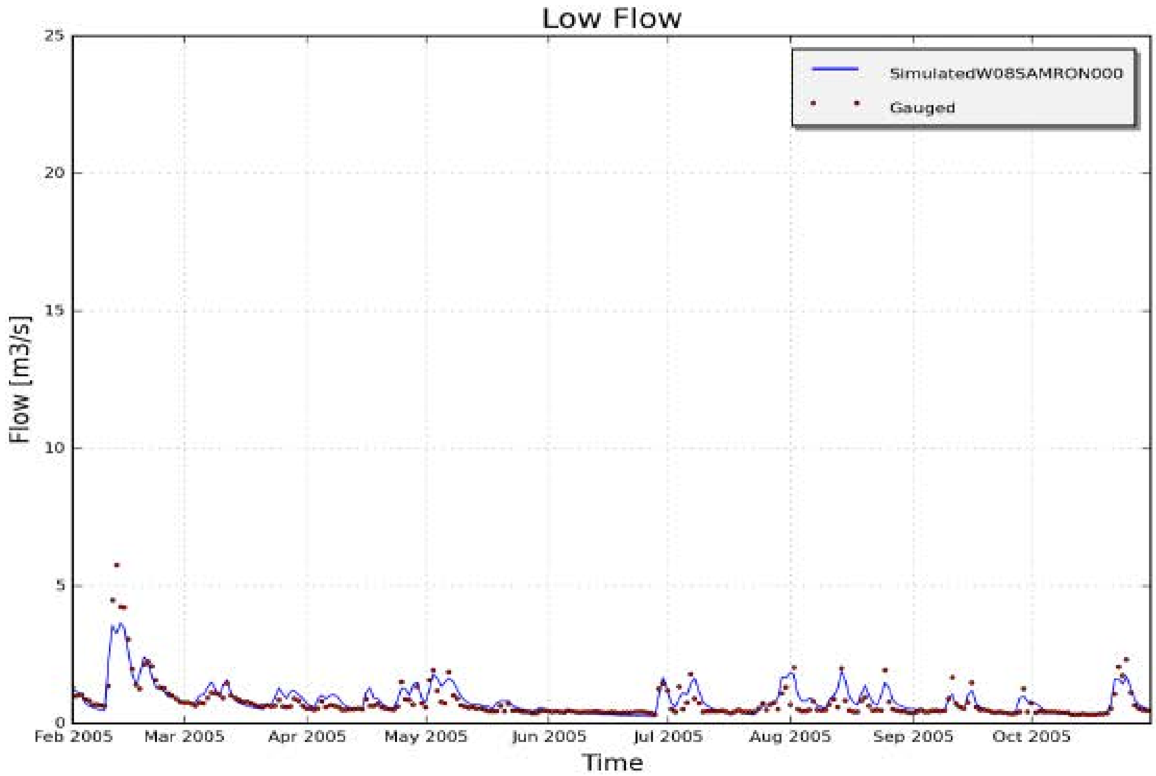


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W08SAMRON000, station 2371-10050 Samme, Ronquieres

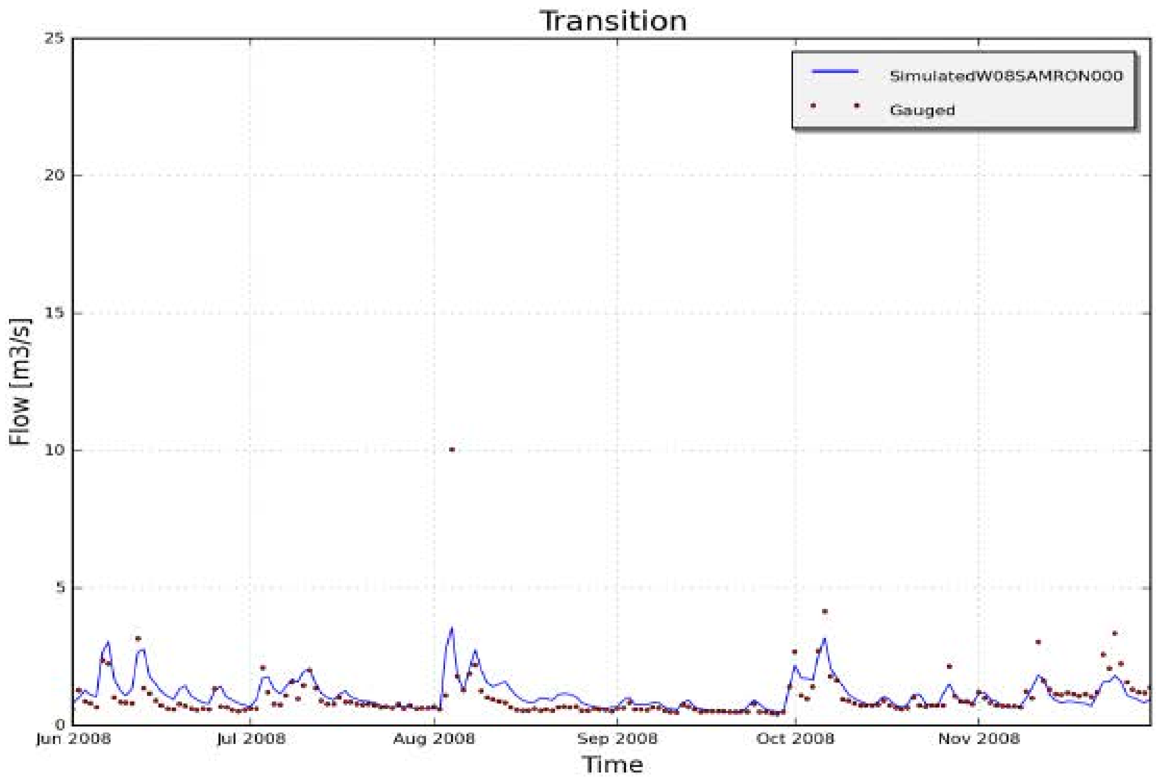


Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W08SAMRON000, station 2371-10050 Samme, Ronquieres

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W08SENRON010" (DIJLE/ZENNEBEKKEN)

1.1 Input data

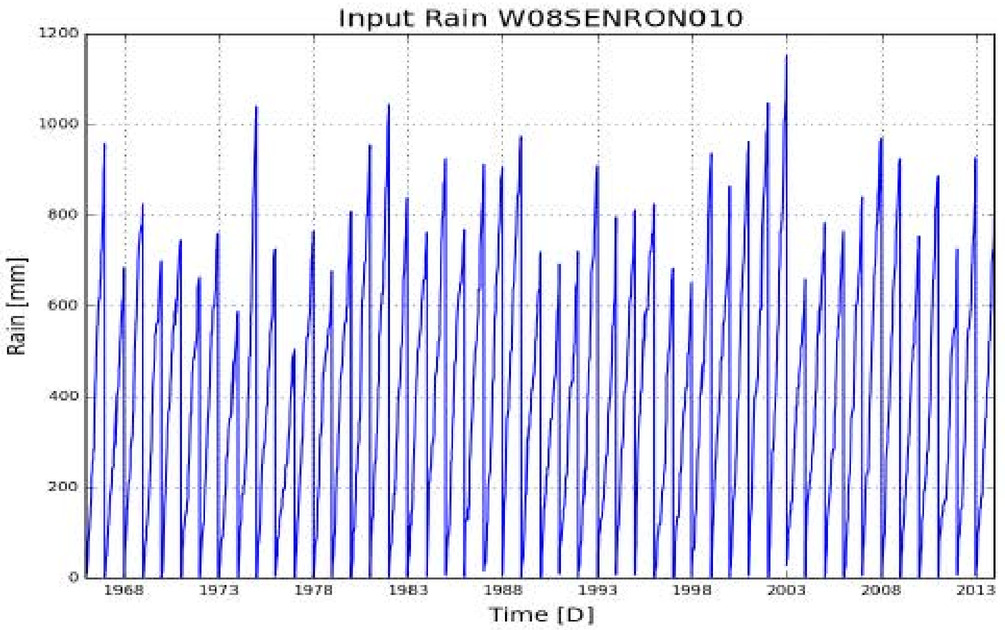


Figure 1: Cumulative precipitation on catchment W08SENRON010 (Dijle/Zennebekken)

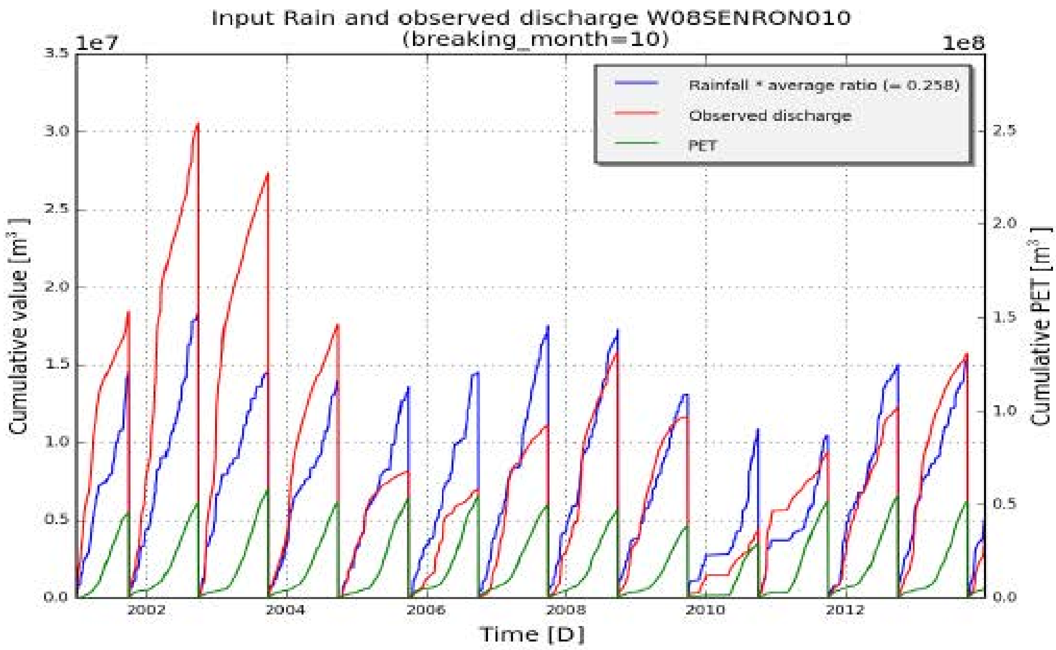


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W08SENRON010 (Dijle/Zennebekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W08SENRON010
subcatchment_area [m2]	70364773
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 620.99), ('SMevap', 142.63), ('c1', 1.95), ('c2', 0.57), ('c3', 1.0), ('cOF1', -3.9), ('cOF2', 2.64), ('cIF1', -3.47), ('cIF2', 2.76), ('CQOF', 10.53), ('CKIF', 58.06), ('CKBF', 1183.92)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-6.6 %	32.8 %	-29.7 %
NS	0.565	0.349	0.535
NS_log	0.36	-0.29	0.708
NS_rel	-0.678	-3.241	0.749
KGE	0.515	0.391	0.398

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-15.6 %	-9.7 %	-33.4 %
NS	0.512	0.4	0.449
NS_log	0.376	-0.004	0.46
NS_rel	-0.052	-1.385	0.739
KGE	0.503	0.519	0.381

1.3 Observed and simulated timeseries for optimum parameters

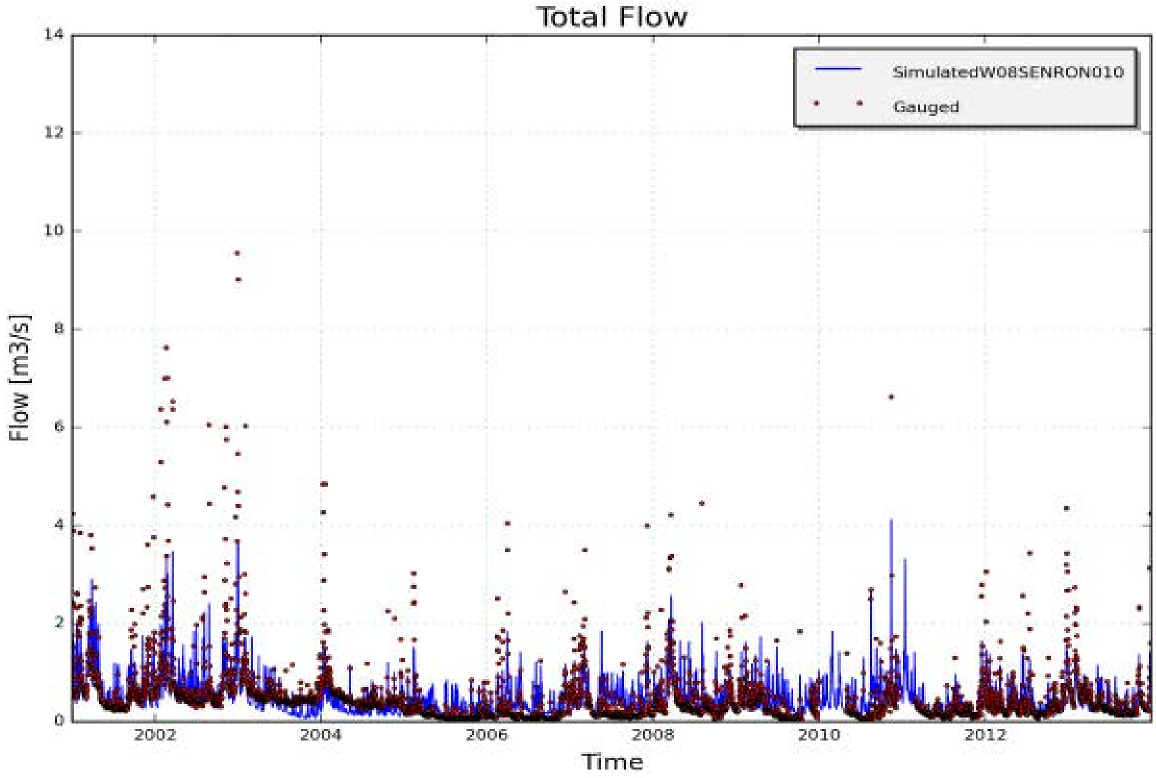


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W08SENRON010, station L5670 -Senette, Ronquieres(calibration period)

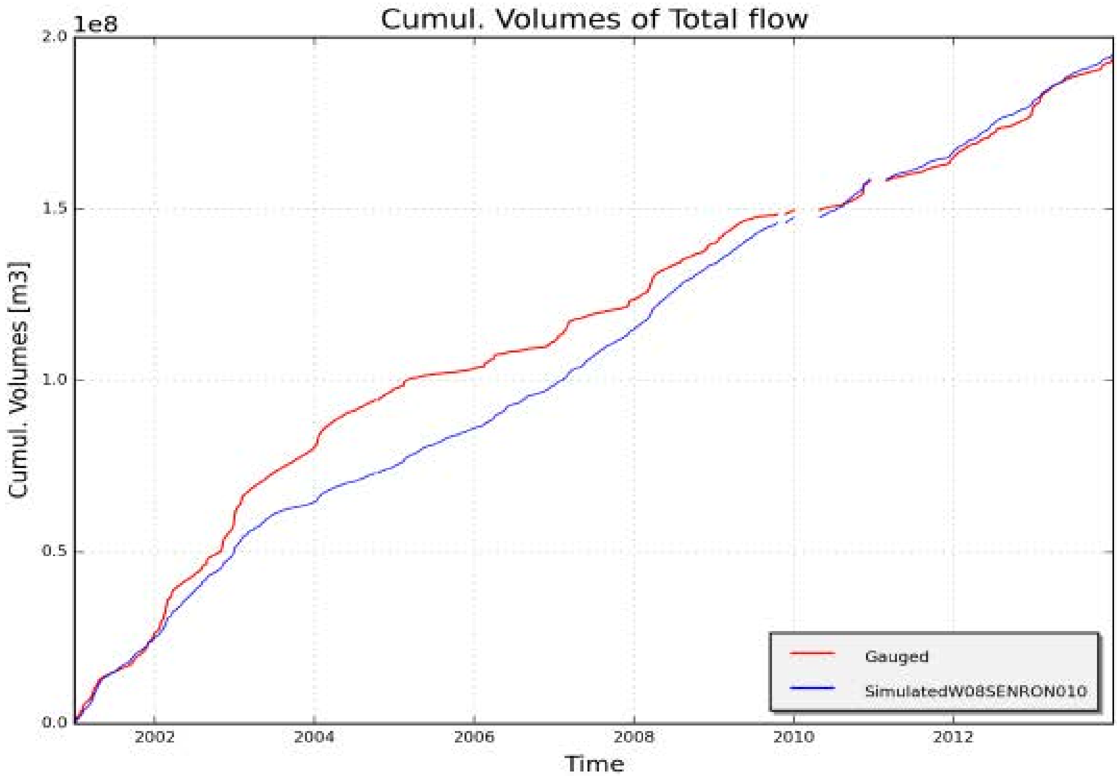


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W08SENRON010, station L5670 -Senette, Ronquieres (calibration period)

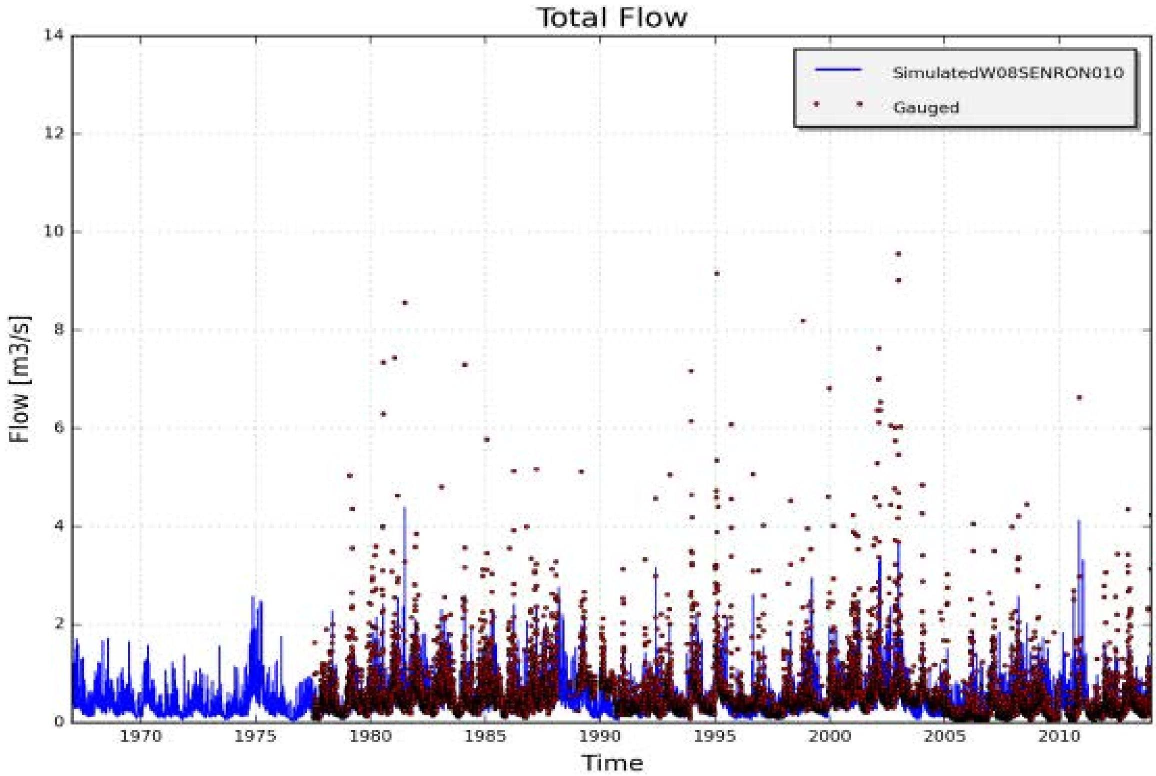


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W08SENRON010, station L5670 -Senette, Ronquieres (validation period)

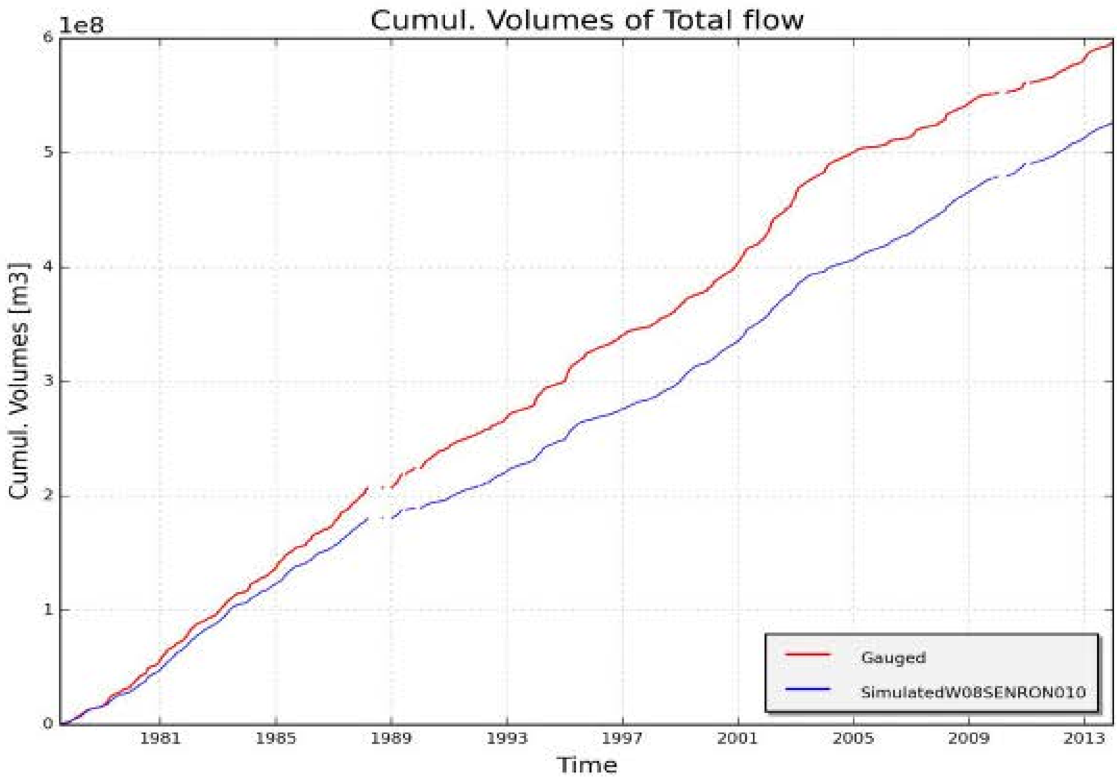


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W08SENRON010, station L5670 -Senette, Ronquieres (validation period)

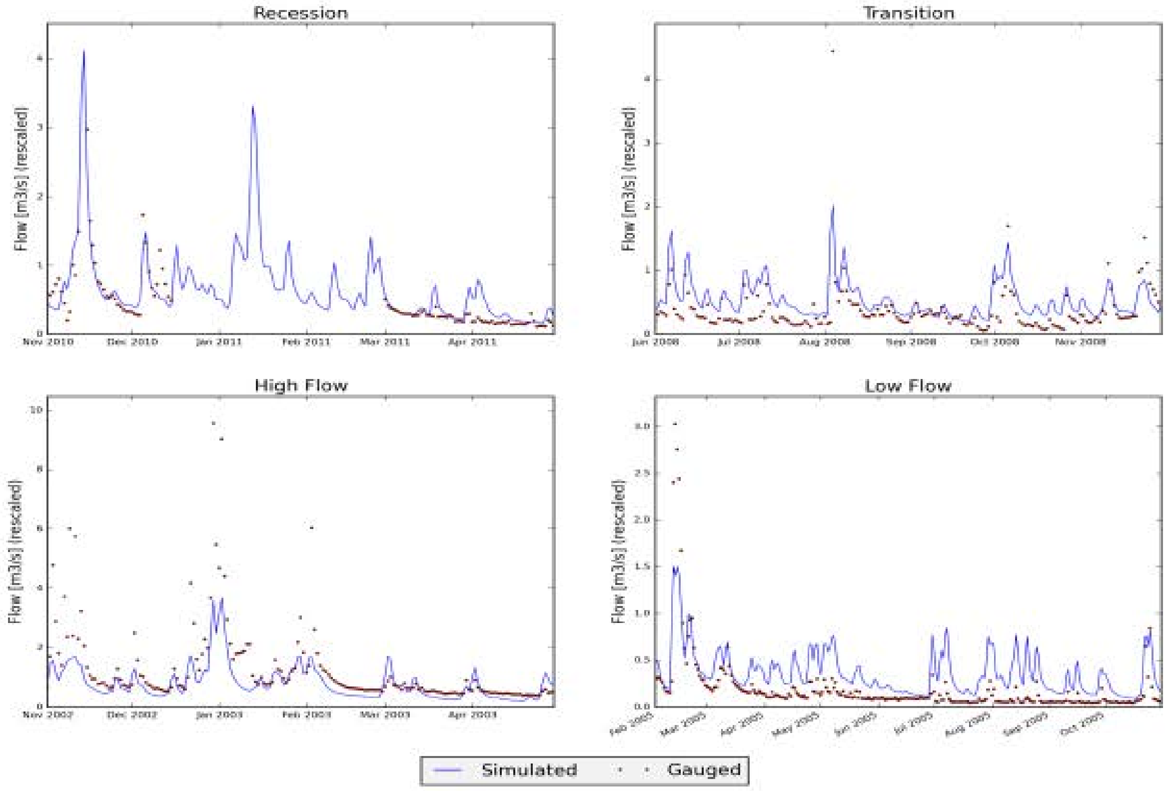


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W08SENRON010, station L5670 -Senette, Ronquieres

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W08SENTUB030" (DIJLE/ZENNEBEKKEN)

1.1 Input data

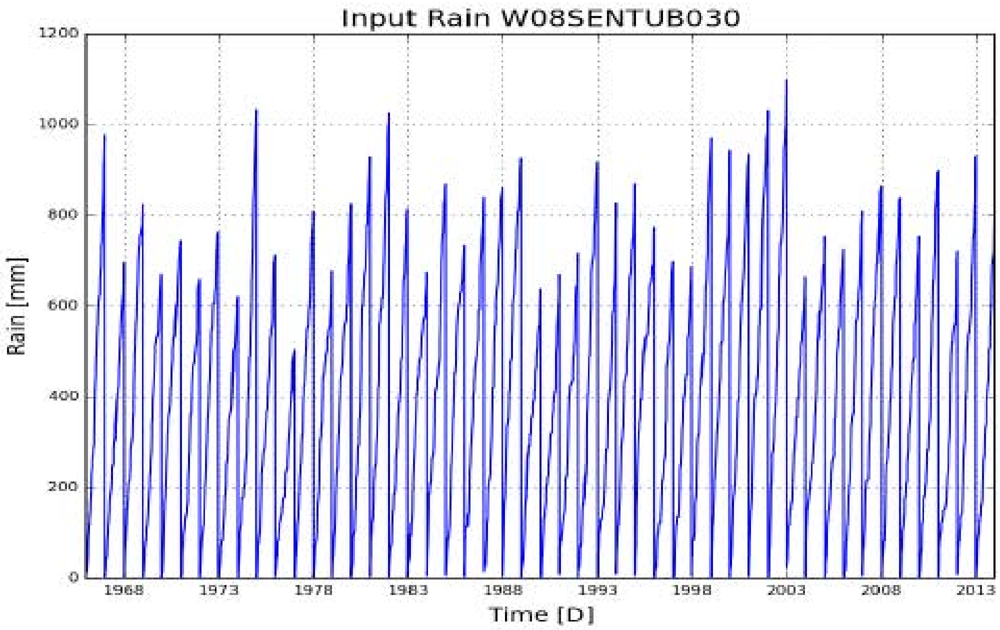


Figure 1: Cumulative precipitation on catchment W08SENTUB030 (Dijle/Zennebekken)

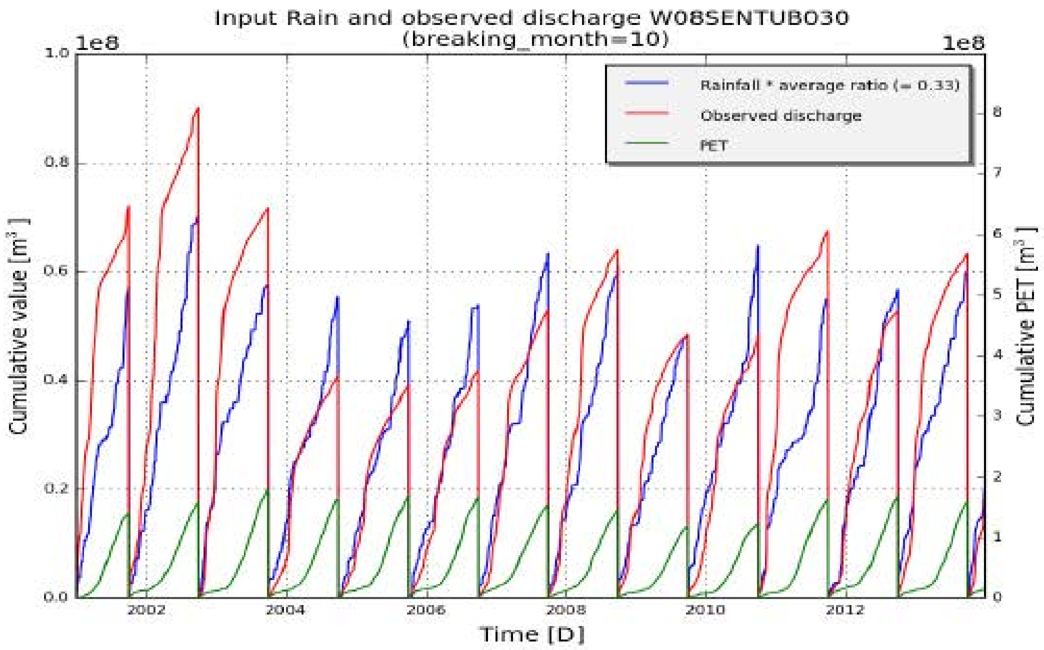


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W08SENTUB030 (Dijle/Zennebekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W08SENTUB030
subcatchment_area [m2]	215911078
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 456.47), ('SMevap', 189.16), ('c1', 2.39), ('c2', 1.23), ('c3', 1.0), ('cOF1', -6.5), ('cOF2', 7.4), ('cIF1', -4.06), ('cIF2', 4.51), ('CQOF', 14.23), ('CKIF', 55.64), ('CKBF', 1750.88)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.2 %	27.0 %	-15.0 %
NS	0.67	0.462	0.636
NS_log	0.621	0.223	0.693
NS_rel	0.821	0.648	0.802
KGE	0.611	0.613	0.541

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-3.5 %	-7.2 %	-14.3 %
NS	0.652	0.578	0.621
NS_log	0.612	0.442	0.674
NS_rel	0.784	0.845	0.791
KGE	0.625	0.571	0.553

1.3 Observed and simulated timeseries for optimum parameters

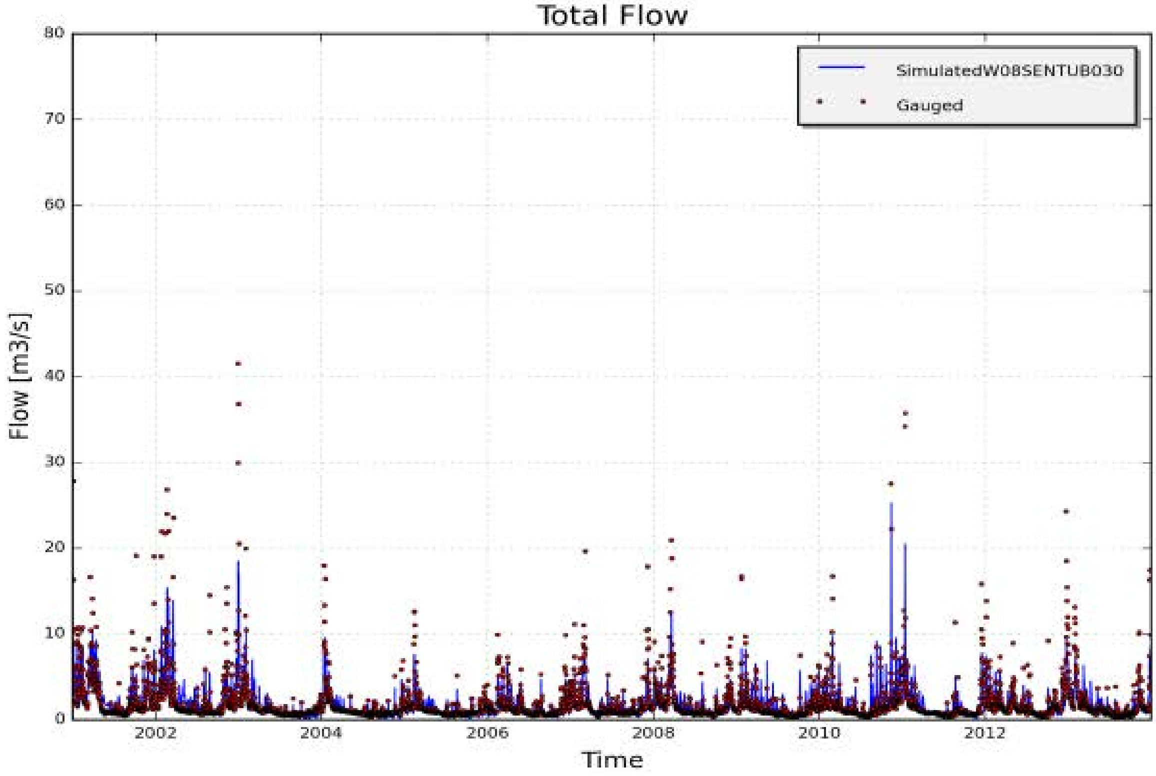


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W08SENTUB030, station 1951-10050 Zenne, Tubize(calibration period)

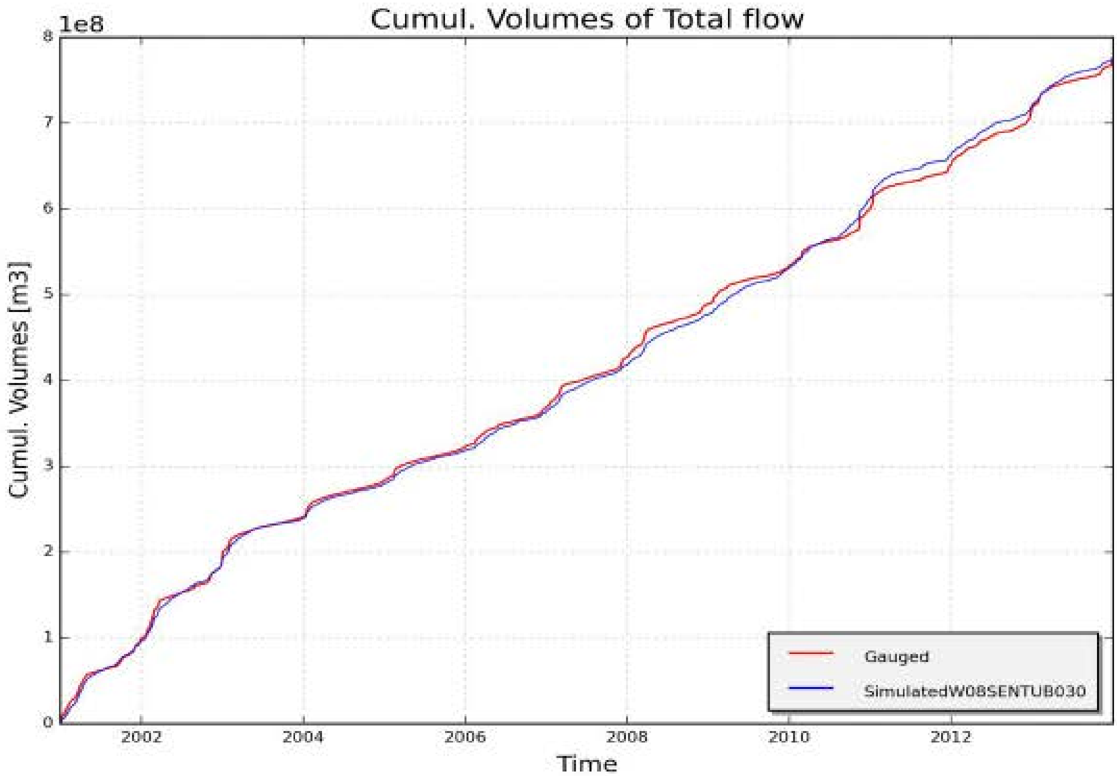


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W08SENTUB030, station 1951-10050 Zenne, Tubize (calibration period)

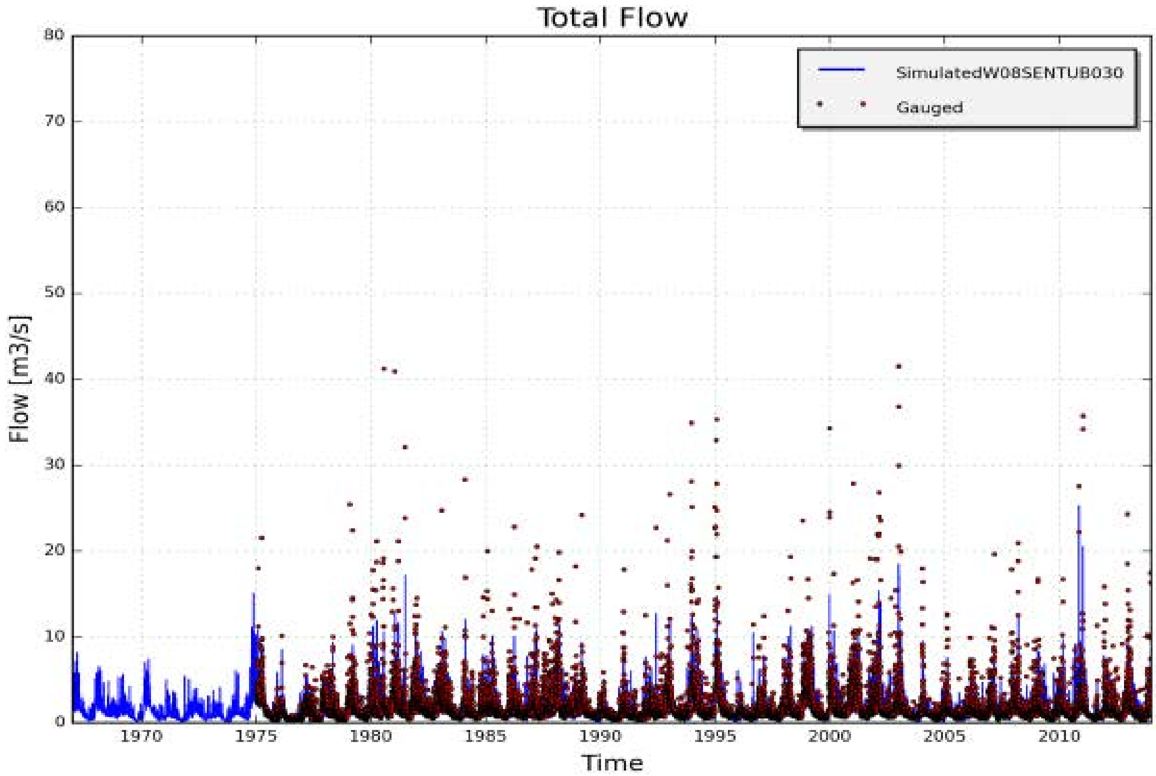


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W08SENTUB030, station 1951-10050 Zenne, Tubize (validation period)

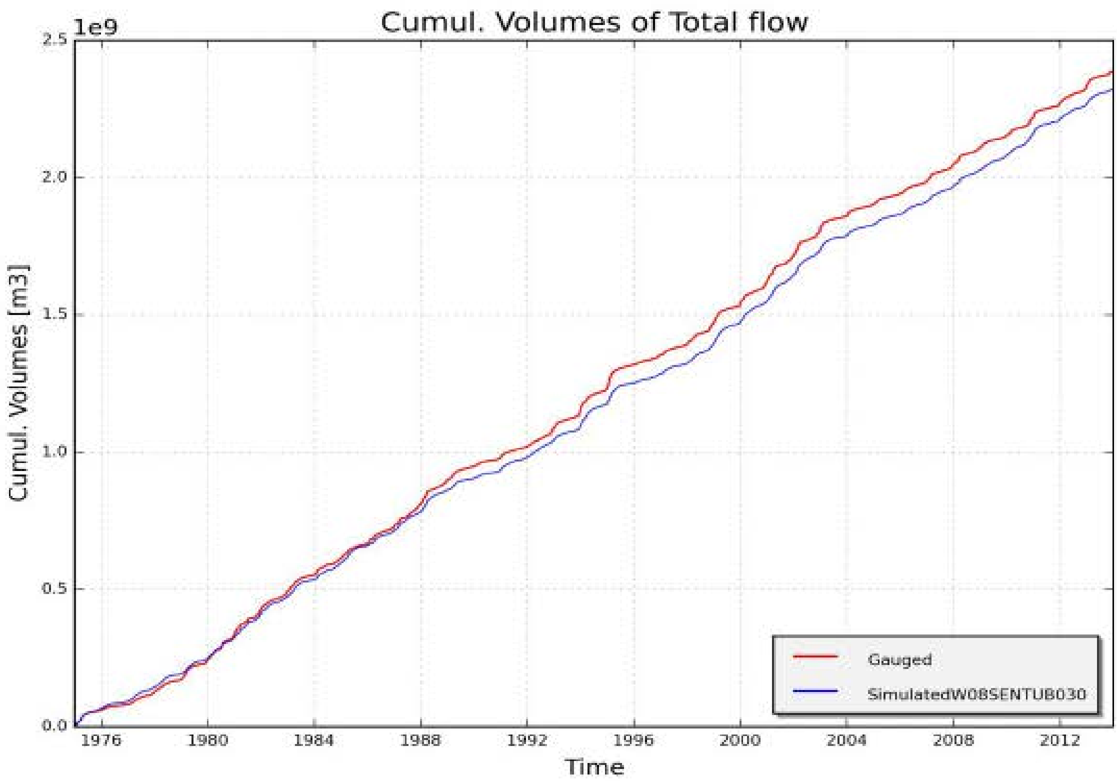


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W08SENTUB030, station 1951-10050 Zenne, Tubize (validation period)

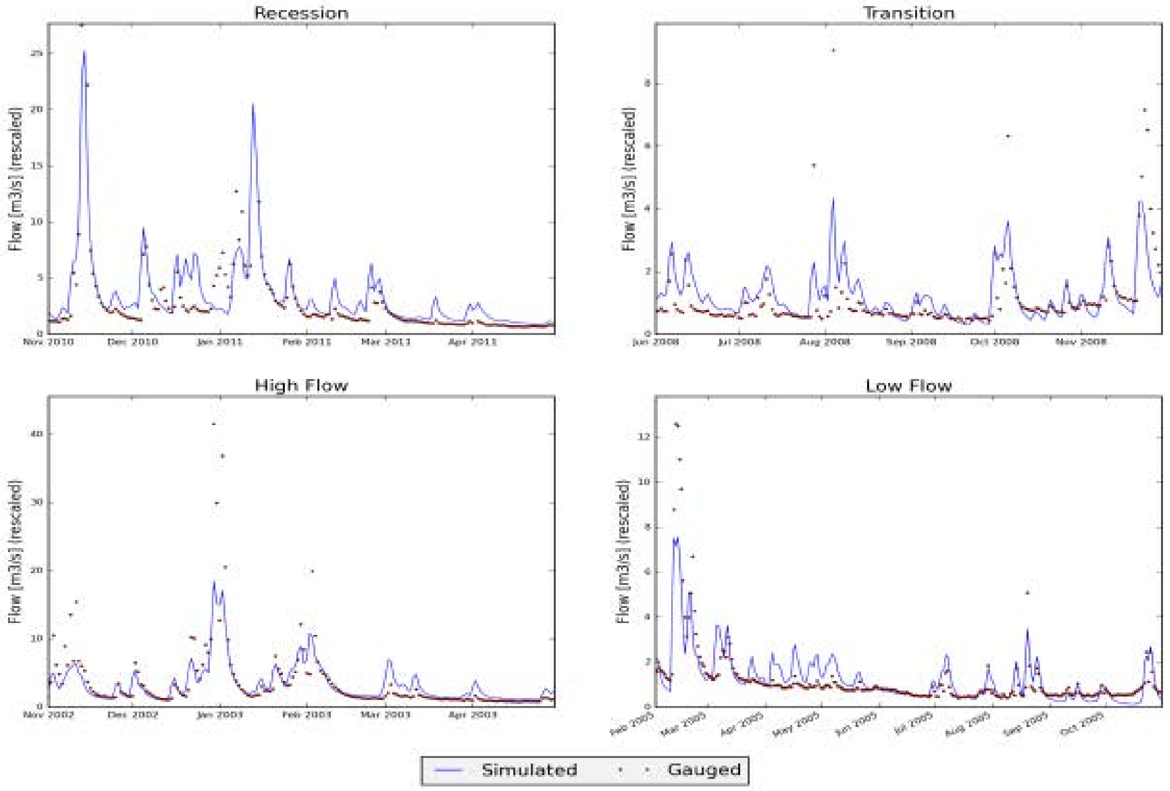


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W08SENTUB030, station 1951-10050 Zenne, Tubize

Appendix 11 Demer

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V09DEM136000" (DEMERBEKKEN)

1.1 Input data

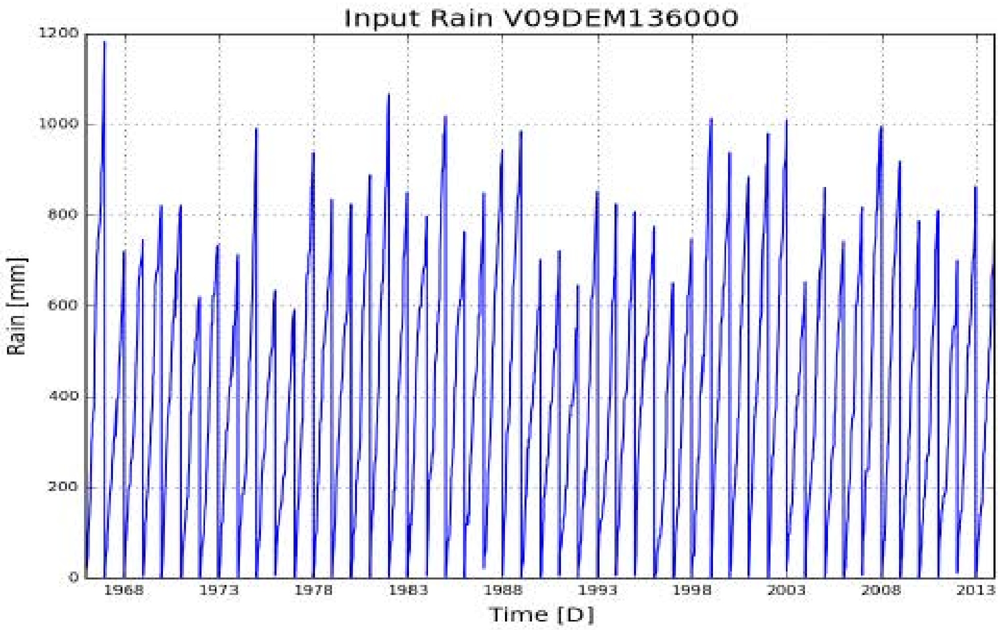


Figure 1: Cumulative precipitation on catchment V09DEM136000 (Demerbekken)

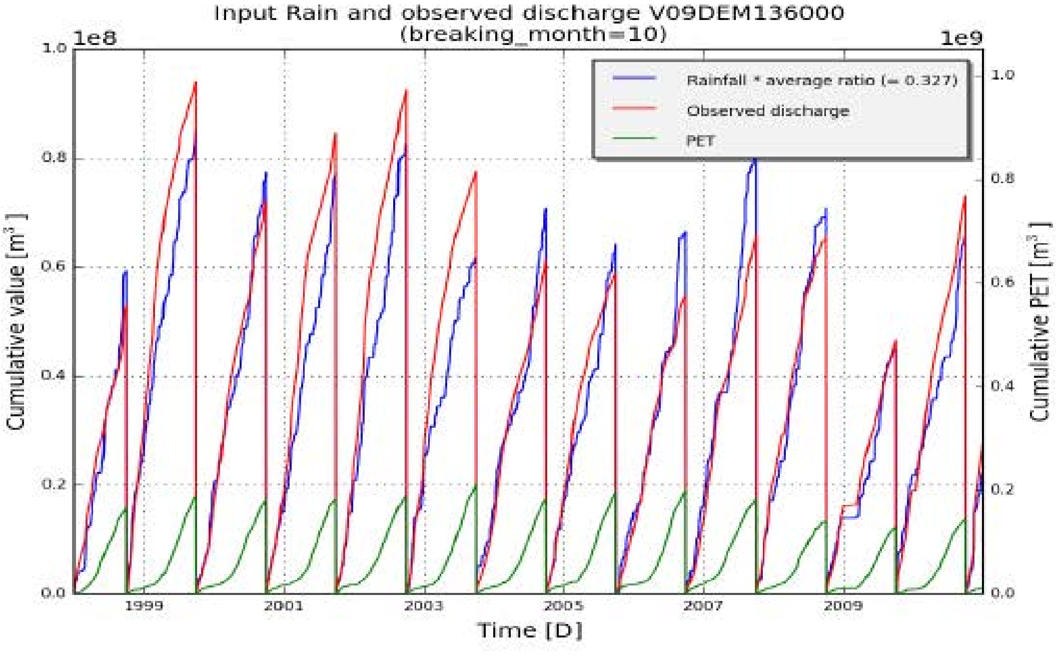


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V09DEM136000 (Demerbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V09DEM136000
subcatchment_area [m2]	255882000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 477605.0), ('SMevap', 260394.0), ('c1', 1.93), ('c2', 0.45), ('c3', 1.0), ('cOF1', -5.15), ('cOF2', 3.03), ('cIF1', -3.95), ('cIF2', 2.73), ('CQOF', 14.99), ('CKIF', 55.77), ('CKBF', 1199.93)]

Table 1: Goodness of fit for calibration period (1998 - 2010)

	Full year	**Summer**	**Winter**
RelErr	40.7 %	103.5 %	3.2 %
NS	0.12	-1.175	0.779
NS_log	-0.106	-1.576	0.771
NS_rel	-0.586	-1.914	0.821
KGE	0.503	-0.13	0.803

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	37.3 %	94.1 %	1.0 %
NS	0.236	-0.692	0.773
NS_log	0.004	-1.085	0.784
NS_rel	-0.332	-1.512	0.85
KGE	0.574	0.116	0.769

1.3 Observed and simulated timeseries for optimum parameters

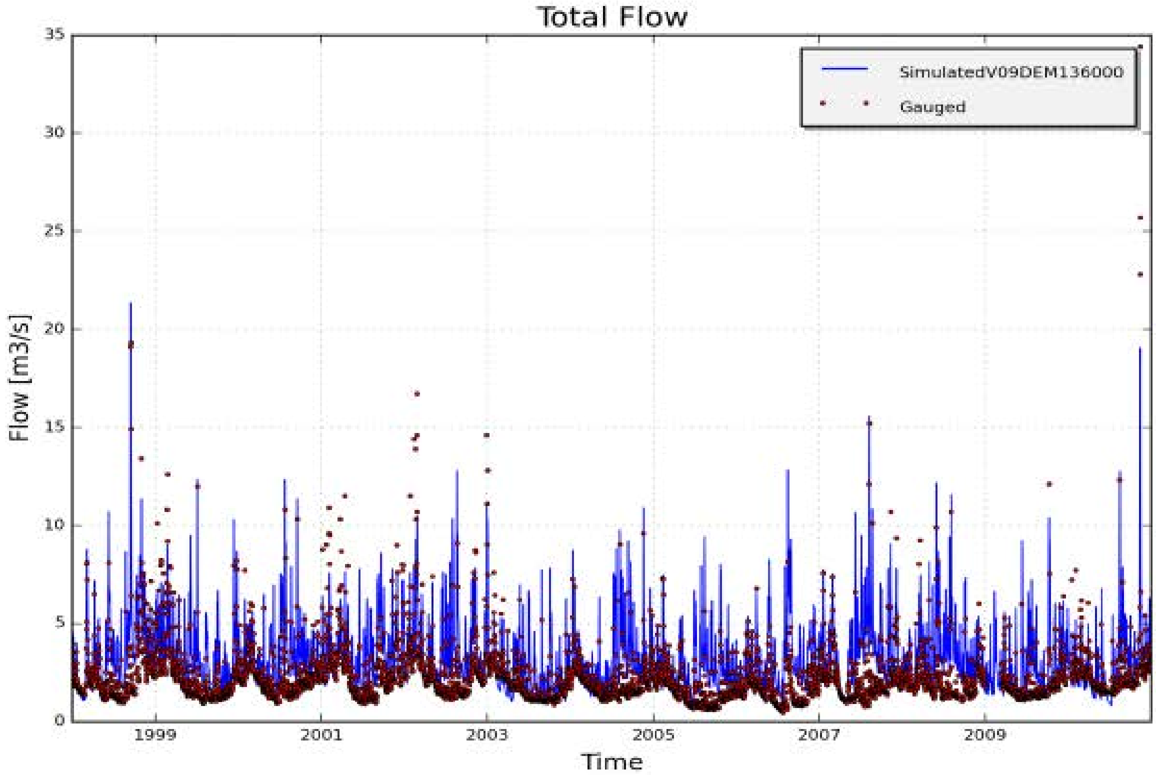


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09DEM136000, station 13610102 - Demer; Hasselt(calibration period)

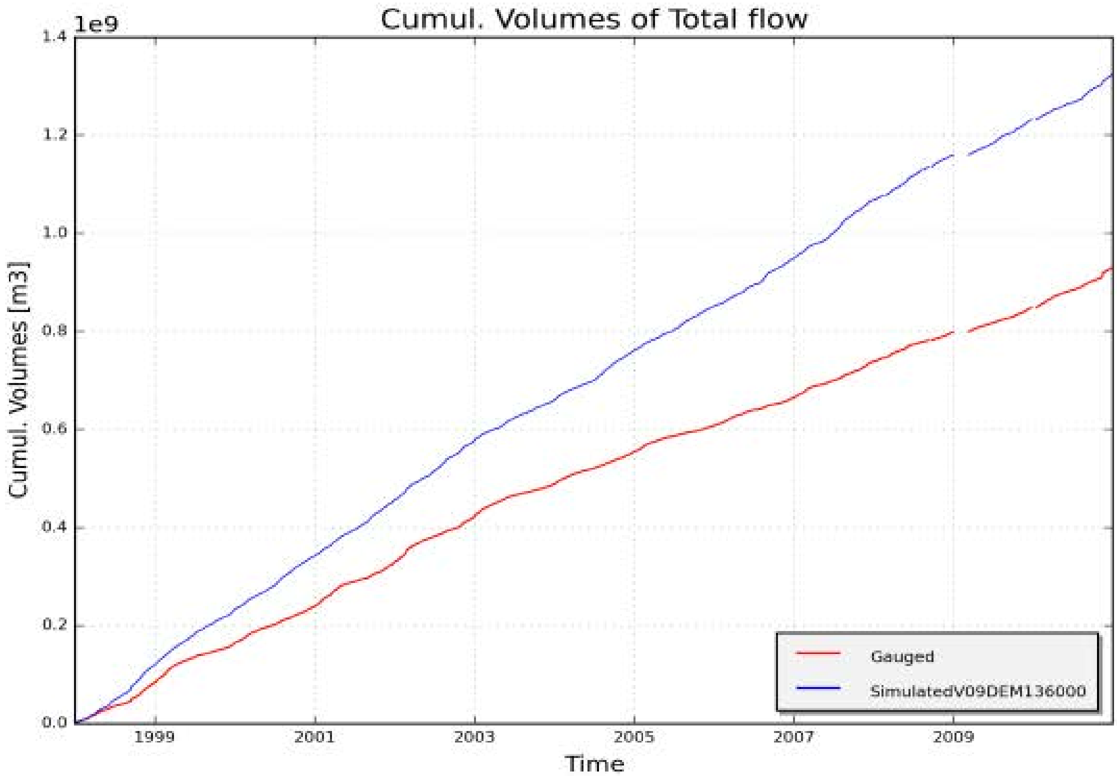


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09DEM136000, station 13610102 - Demer; Hasselt (calibration period)

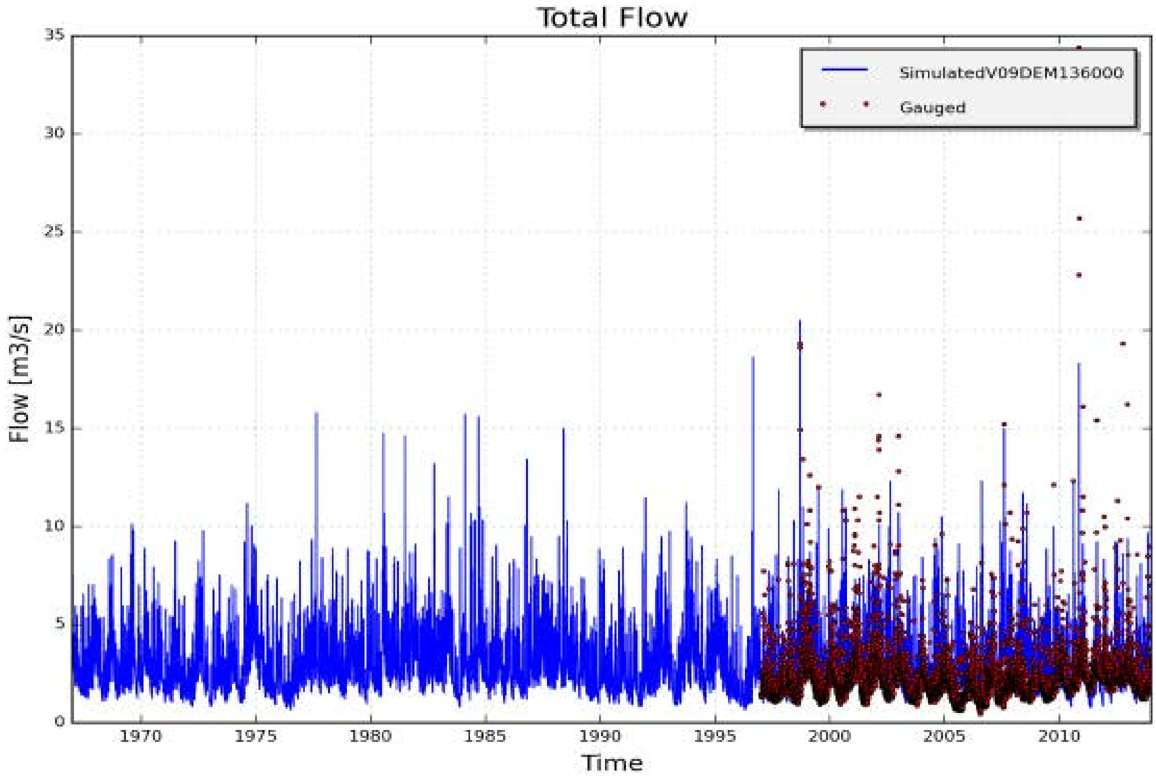


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09DEM136000, station 13610102 - Demer; Hasselt (validation period)

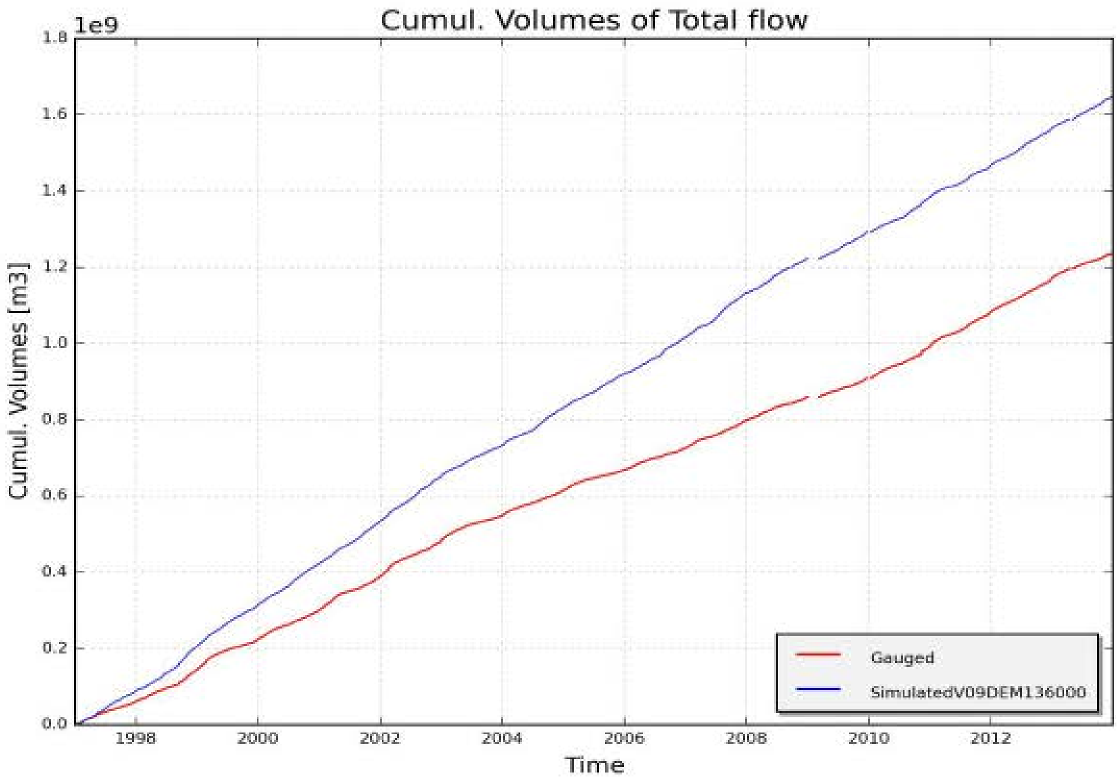


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09DEM136000, station 13610102 - Demer; Hasselt (validation period)

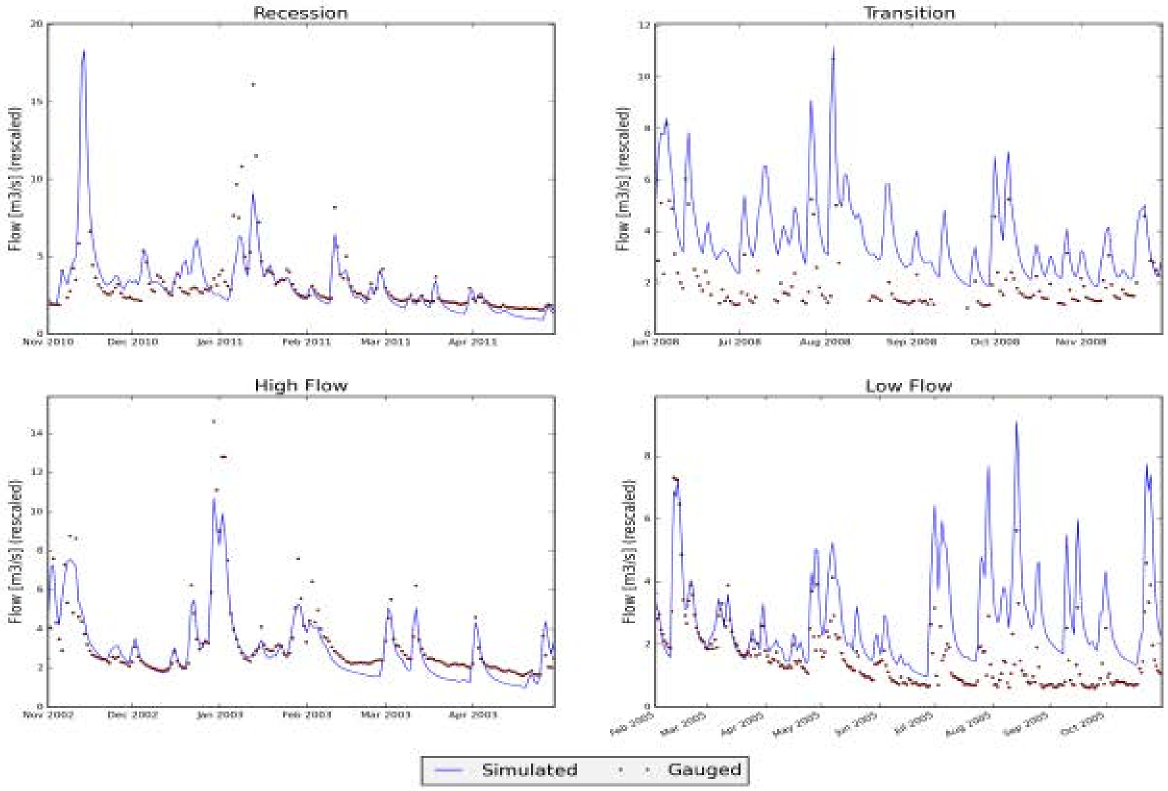


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09DEM136000, station 13610102 - Demer; Hasselt

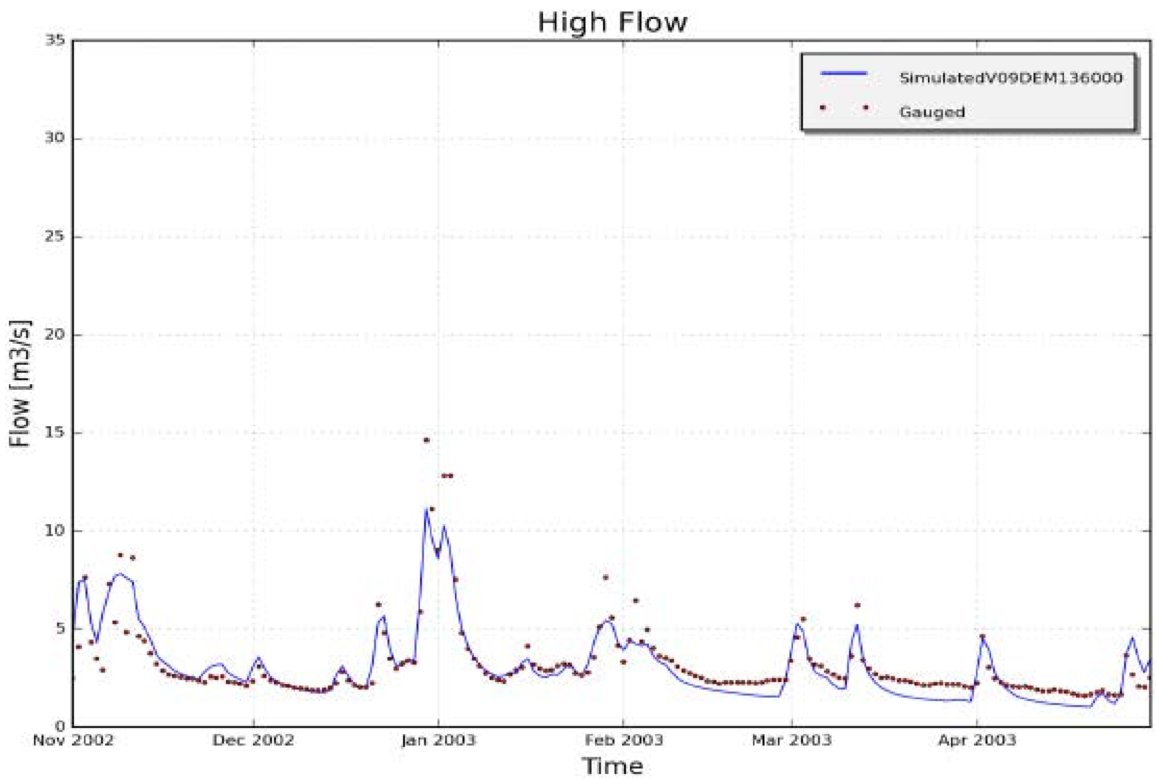


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09DEM136000, station 13610102 - Demer; Hasselt

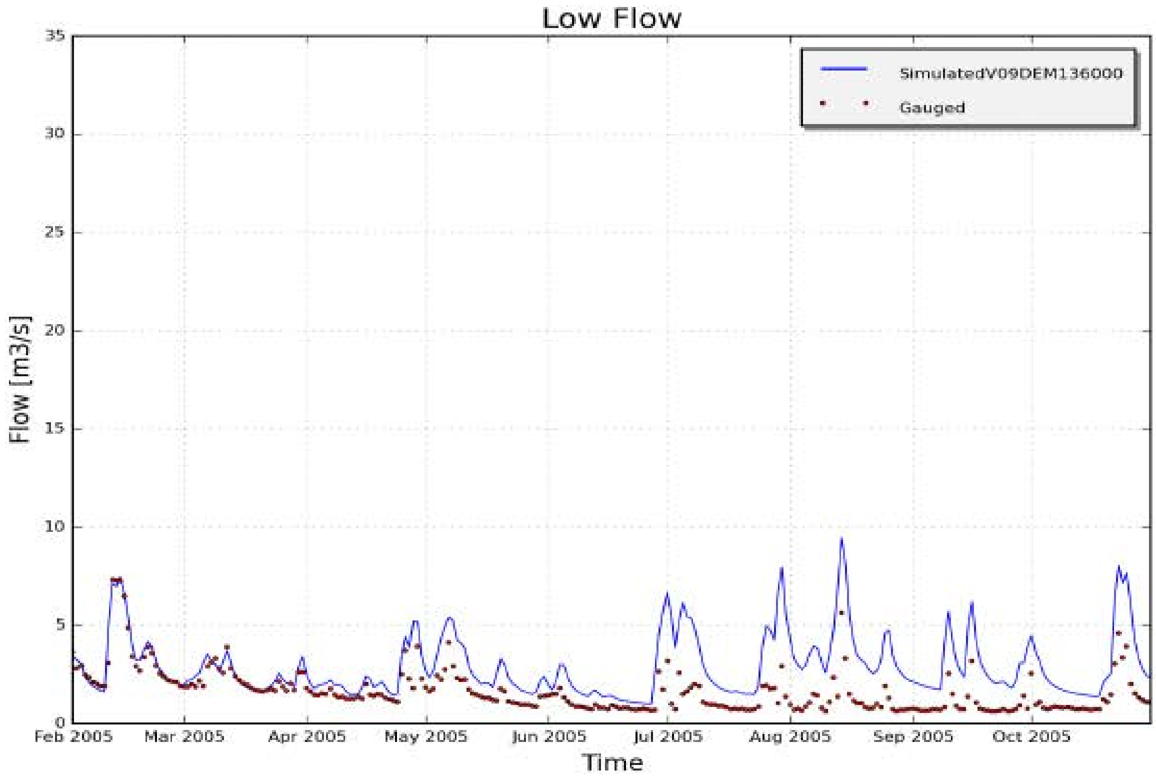


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09DEM136000, station 13610102 - Demer; Hasselt

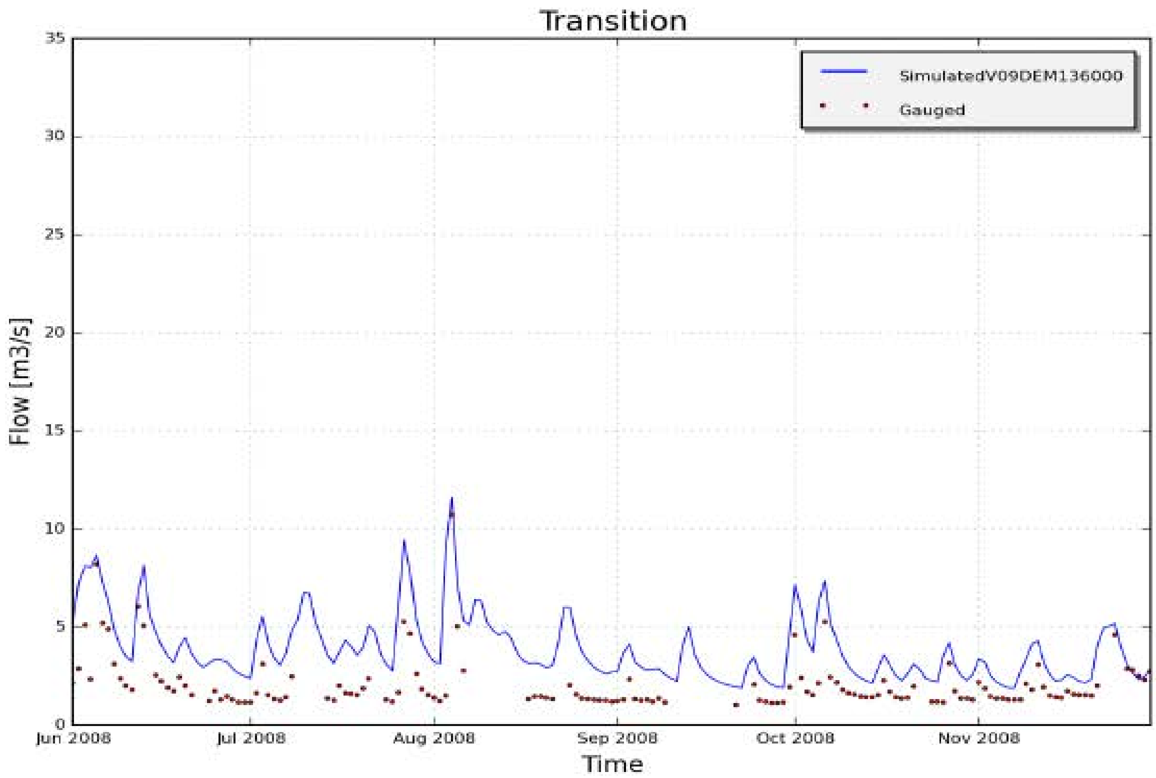


Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09DEM136000, station 13610102 - Demer; Hasselt

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V09GET152080" (DEMERBEKKEN)

1.1 Input data

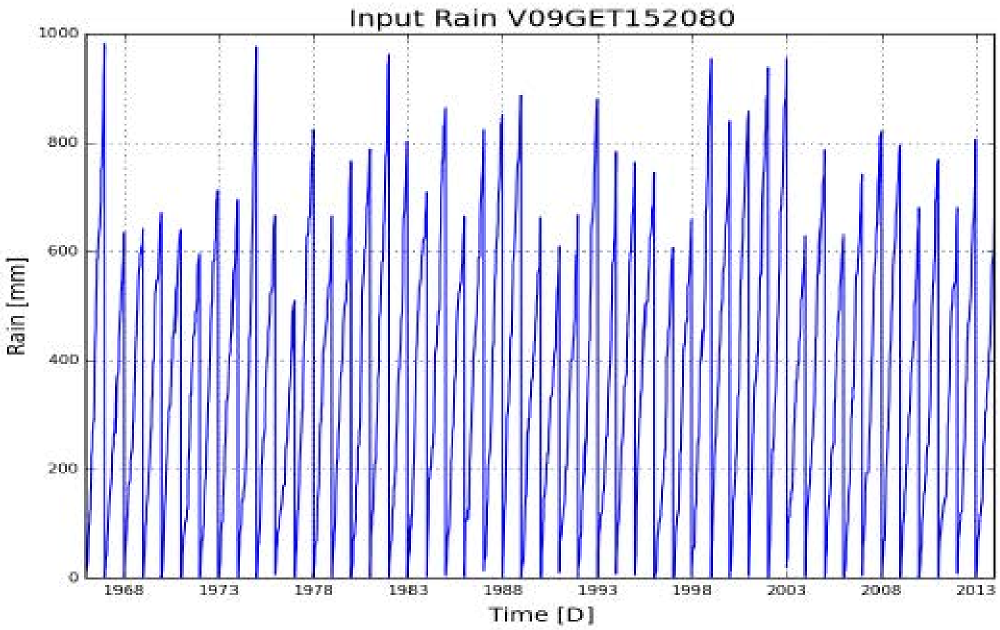


Figure 1: Cumulative precipitation on catchment V09GET152080 (Demerbekken)

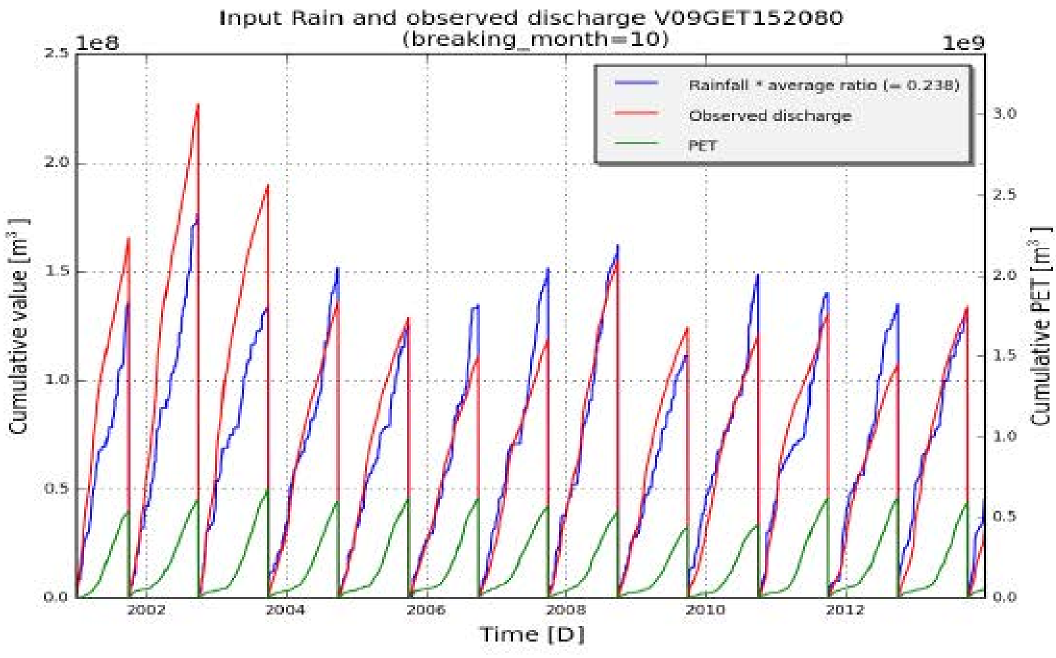


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V09GET152080 (Demerbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V09GET152080
subcatchment_area [m2]	800395376
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 409.12), ('SMevap', 158.8), ('c1', 1.97), ('c2', 0.49), ('c3', 1.0), ('cOF1', -5.8), ('cOF2', 1.6), ('cIF1', -3.98), ('cIF2', 3.0), ('CQOF', 8.78), ('CKIF', 57.48), ('CKBF', 1802.8)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.4 %	10.4 %	-11.4 %
NS	0.712	0.436	0.718
NS_log	0.627	0.235	0.688
NS_rel	0.707	0.301	0.789
KGE	0.782	0.691	0.731

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	6.3 %	34.1 %	-13.4 %
NS	0.661	0.313	0.673
NS_log	0.58	0.035	0.636
NS_rel	0.631	0.209	0.783
KGE	0.793	0.621	0.781

1.3 Observed and simulated timeseries for optimum parameters

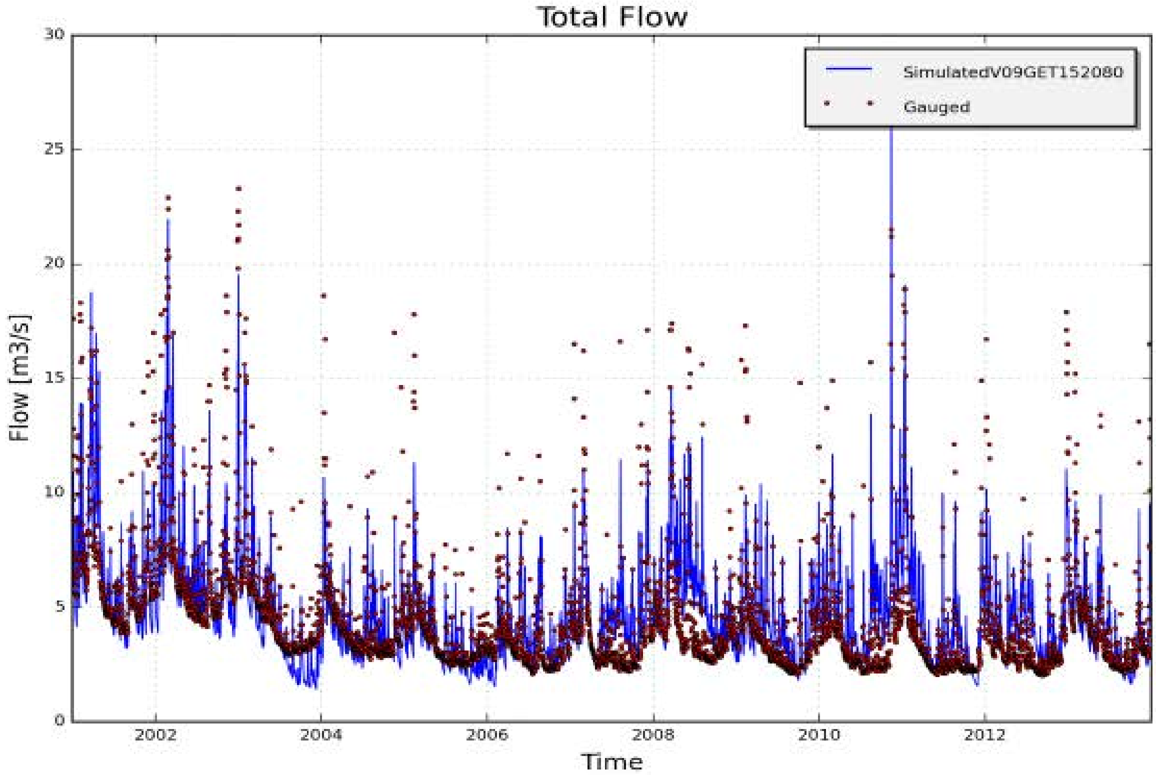


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09GET152080, station 15210102 - Gete; Halen(calibration period)

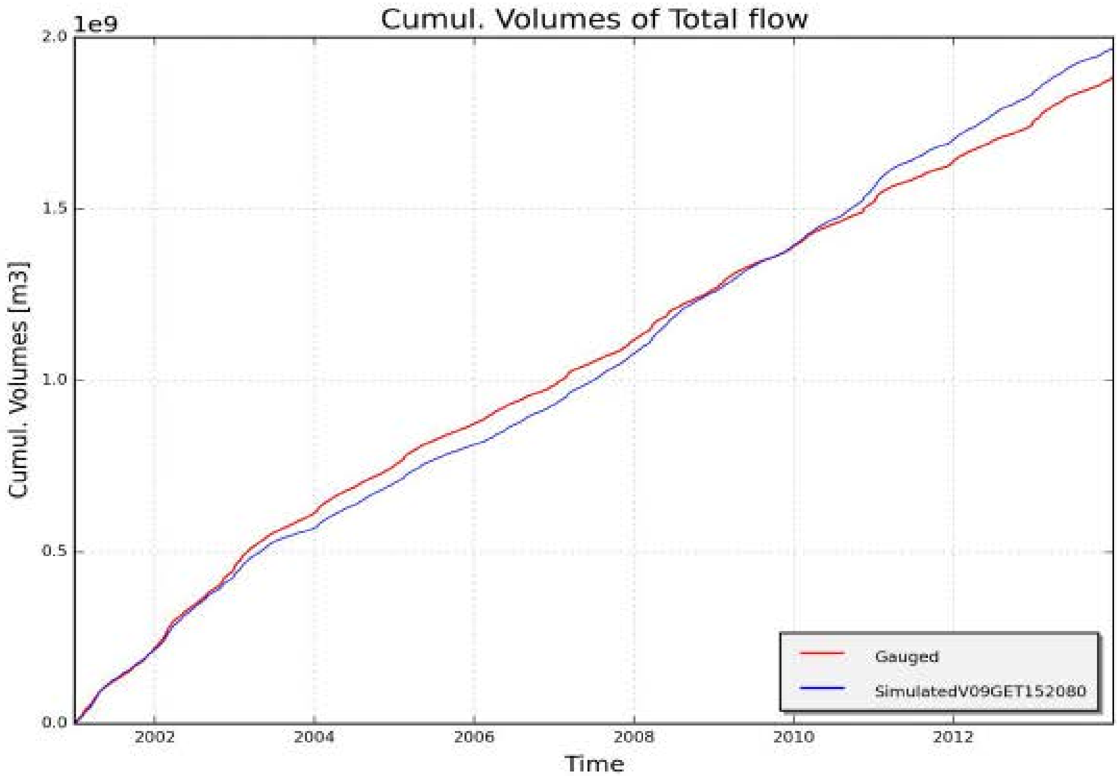


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09GET152080, station 15210102 - Gete; Halen (calibration period)

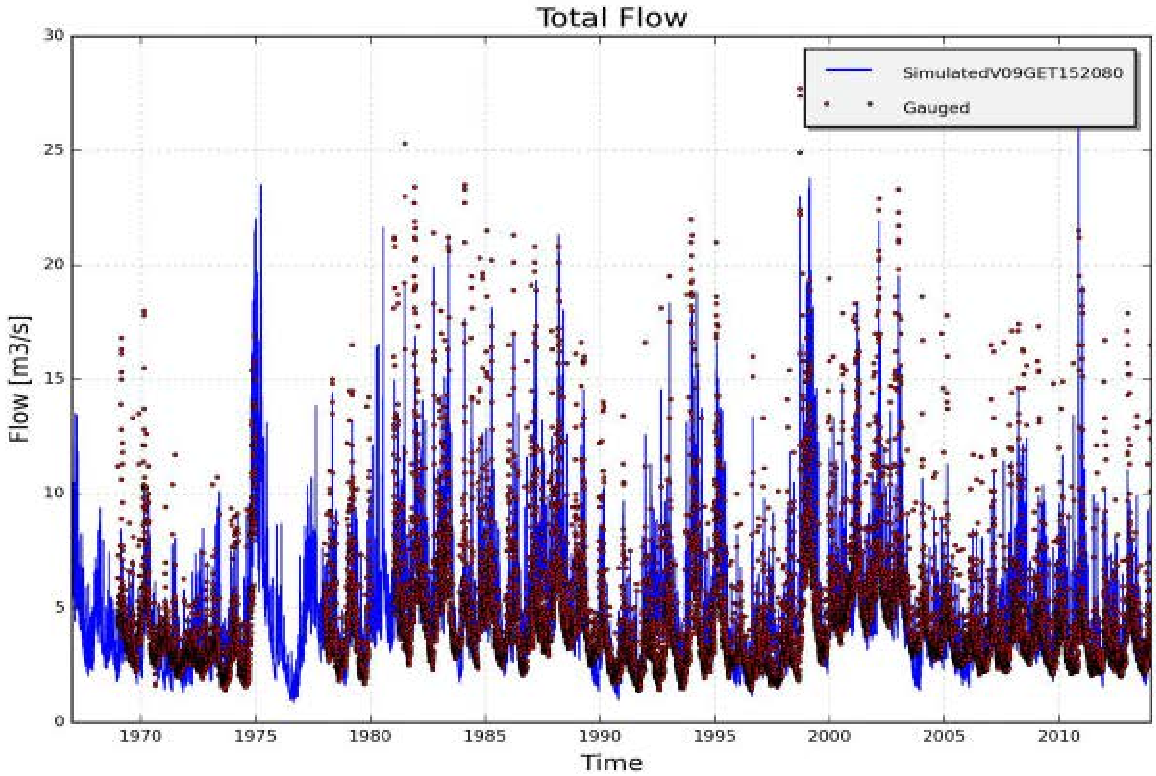


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09GET152080, station 15210102 - Gete; Halen (validation period)

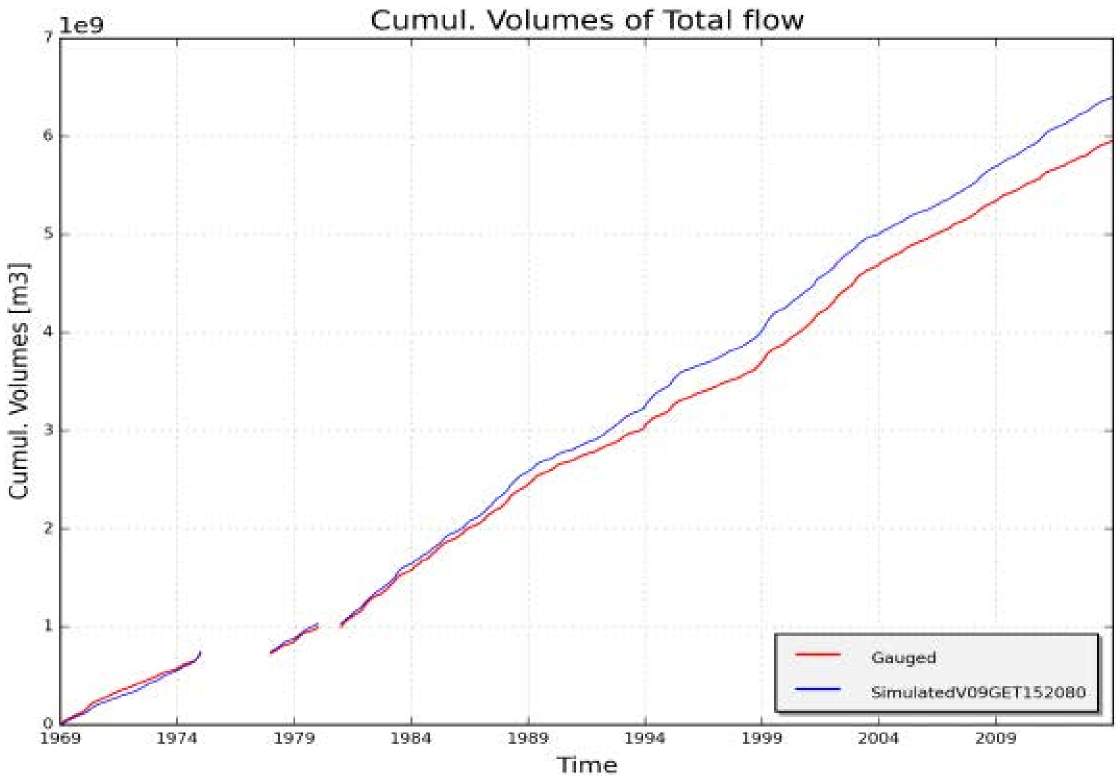


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09GET152080, station 15210102 - Gete; Halen (validation period)

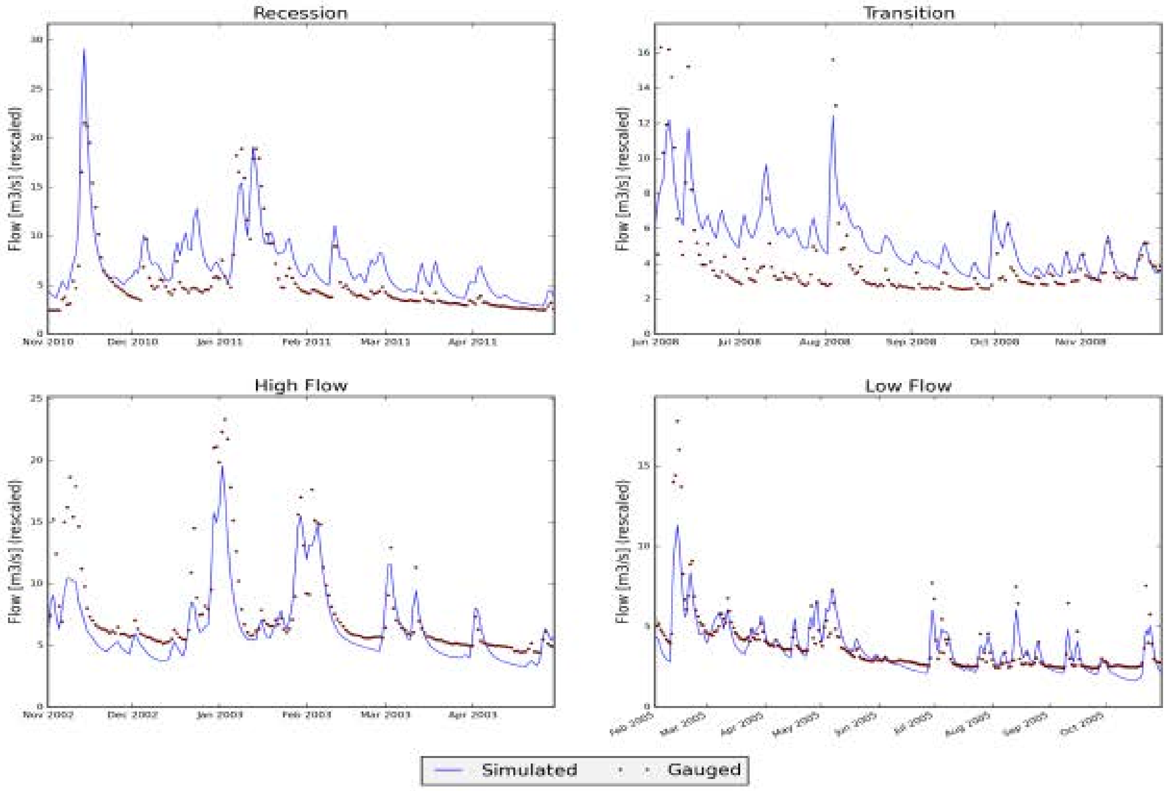


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09GET152080, station 15210102 - Gete; Halen

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V09HER163010" (DEMERBEKKEN)

1.1 Input data

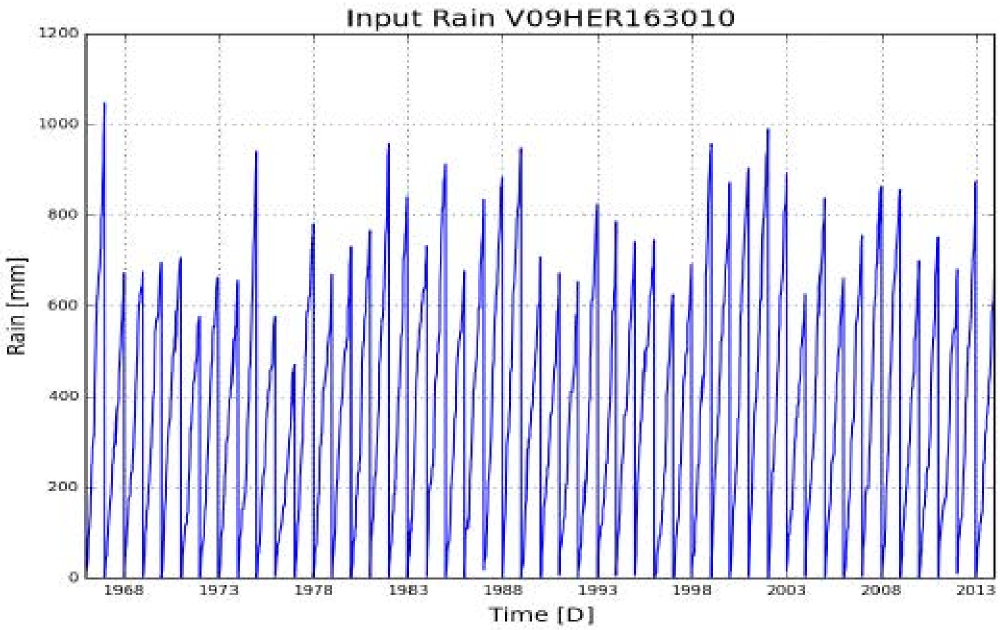


Figure 1: Cumulative precipitation on catchment V09HER163010 (Demerbekken)

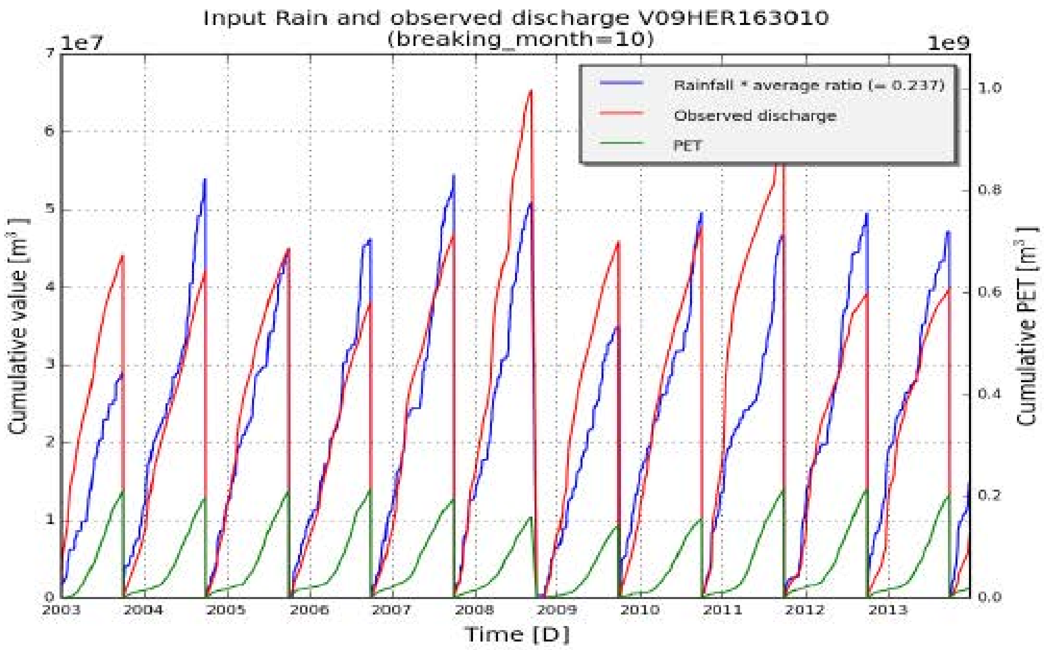


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V09HER163010 (Demerbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V09HER163010
subcatchment_area [m2]	274602221
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 499.41), ('SMevap', 168.0), ('c1', 1.97), ('c2', 0.56), ('c3', 1.0), ('cOF1', -6.0), ('cOF2', 5.0), ('cIF1', -4.03), ('cIF2', 3.0), ('CQOF', 14.71), ('CKIF', 59.36), ('CKBF', 915.53)]

Table 1: Goodness of fit for calibration period (2003 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.3 %	14.1 %	-13.7 %
NS	0.605	0.26	0.549
NS_log	0.54	-0.094	0.672
NS_rel	0.741	0.121	0.85
KGE	0.564	0.598	0.45

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	10.0 %	71.4 %	-18.8 %
NS	0.594	0.273	0.561
NS_log	0.498	-0.3	0.689
NS_rel	0.263	-0.223	0.707
KGE	0.552	0.325	0.477

1.3 Observed and simulated timeseries for optimum parameters

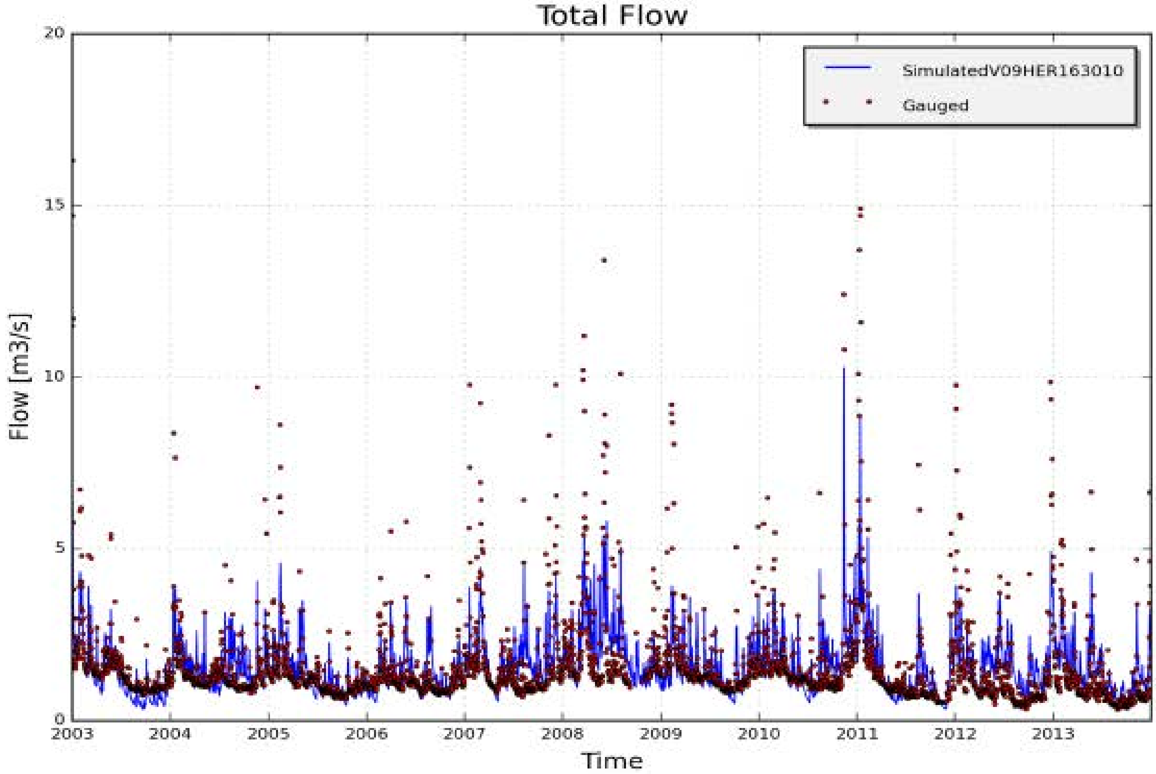


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09HER163010, station 16310102 - Herk, Kermt(calibration period)

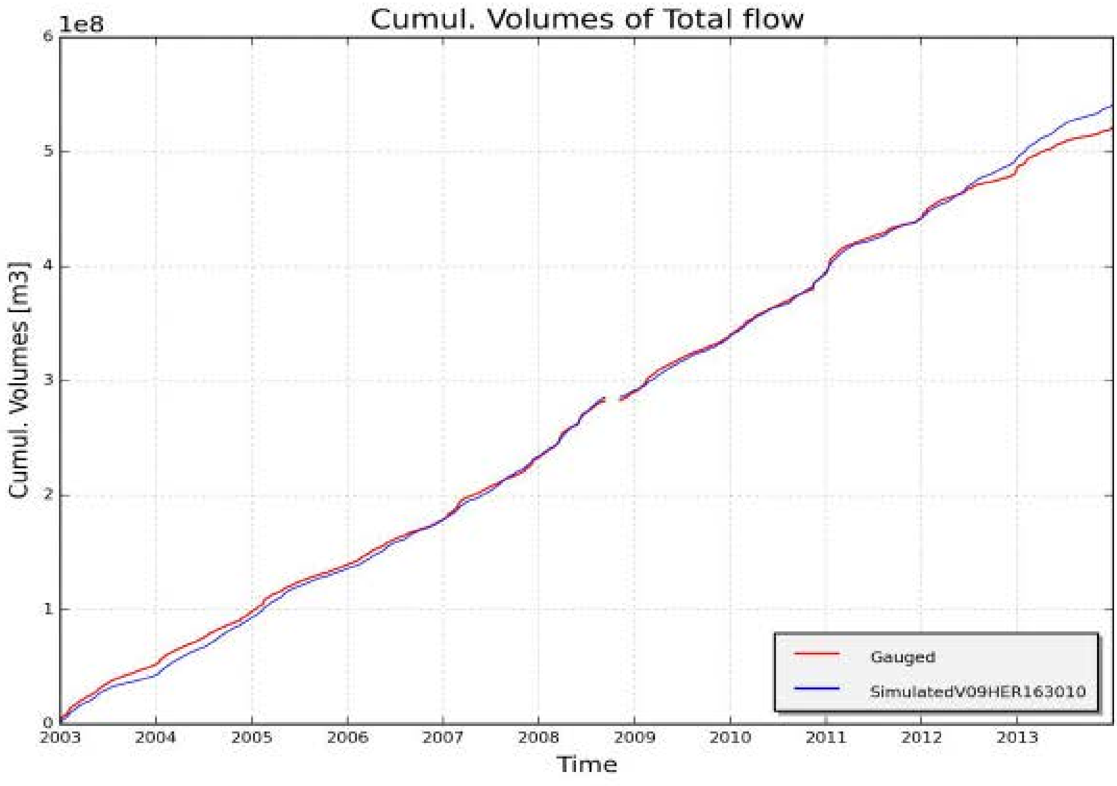


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09HER163010, station 16310102 - Herk, Kermt (calibration period)

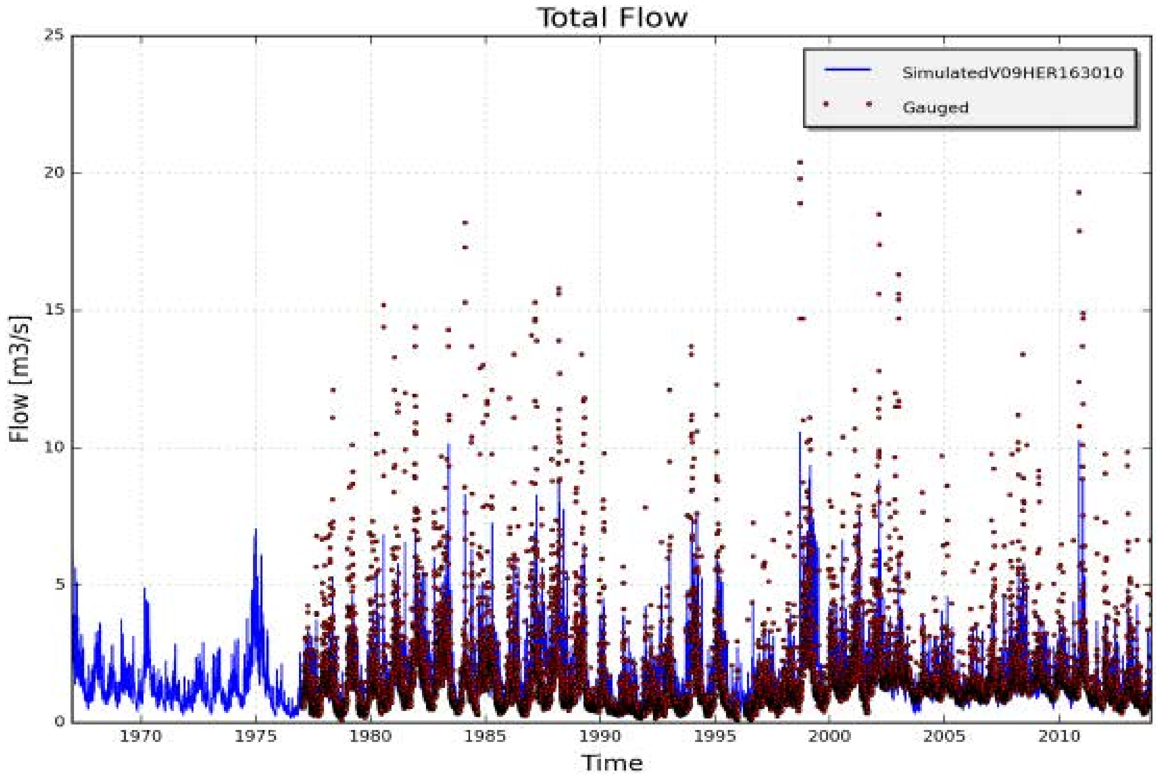


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09HER163010, station 16310102 - Herk, Kermt (validation period)

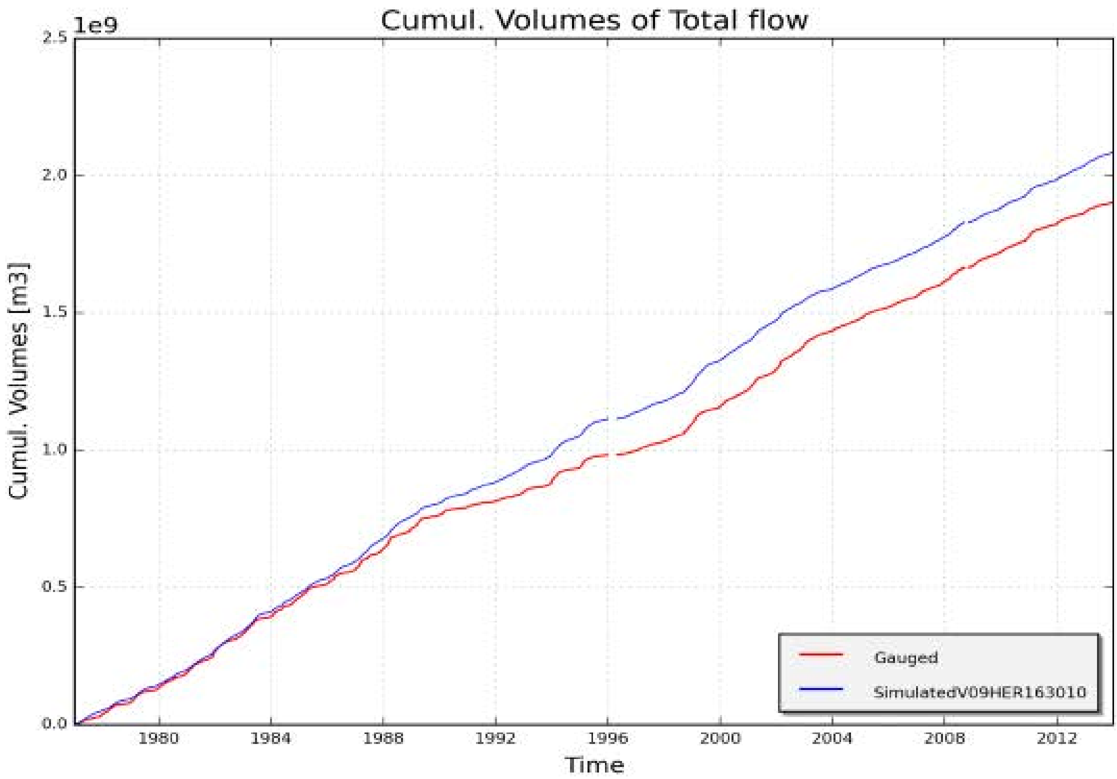


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09HER163010, station 16310102 - Herk, Kermt (validation period)

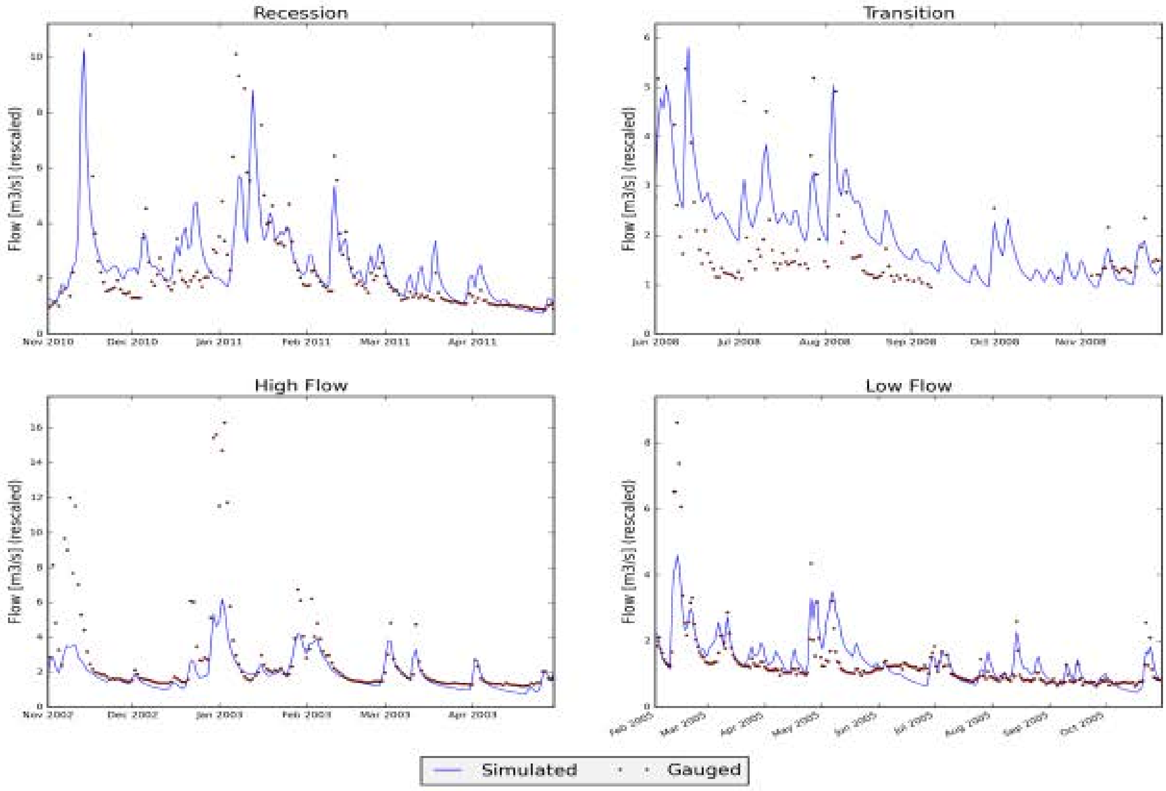


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09HER163010, station 16310102 - Herk, Kermt

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V09HUL147150" (DEMERBEKKEN)

1.1 Input data

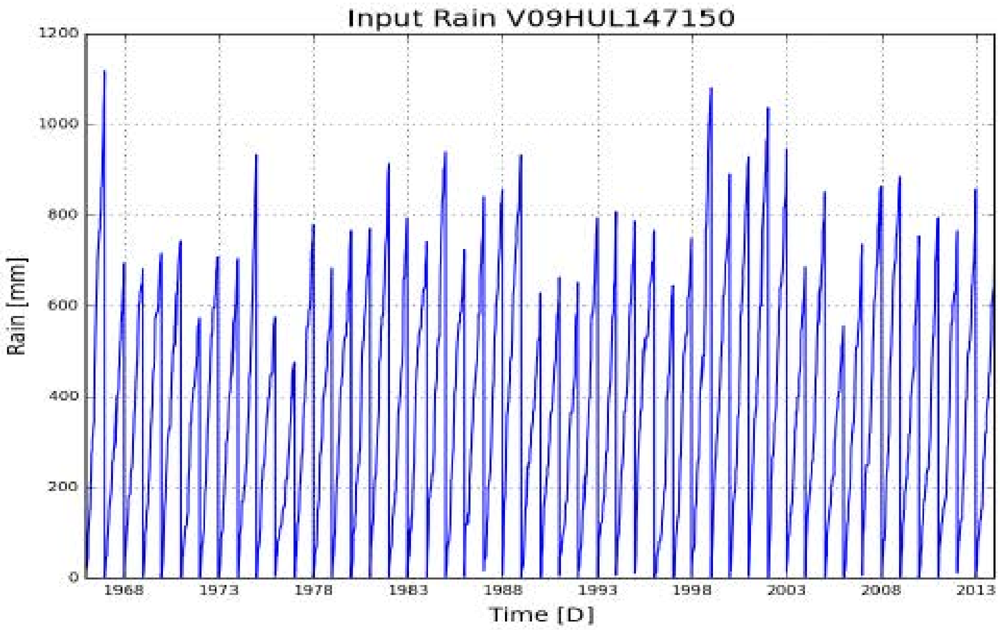


Figure 1: Cumulative precipitation on catchment V09HUL147150 (Demerbekken)

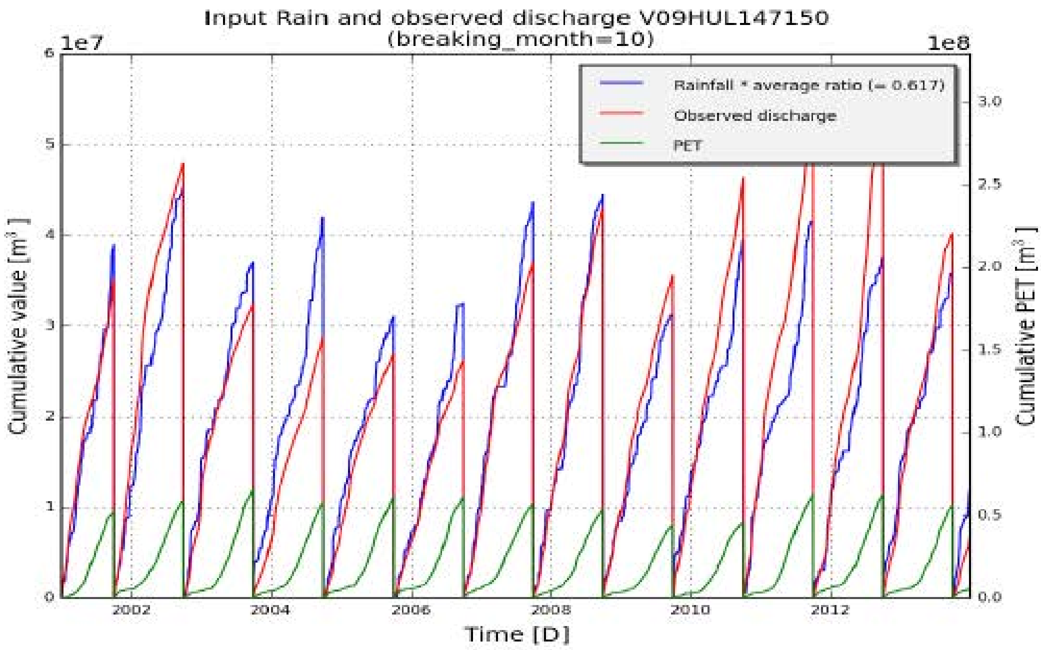


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V09HUL147150 (Demerbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V09HUL147150
subcatchment_area [m2]	80130245
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 455.97), ('SMevap', 224.43), ('c1', 2.67), ('c2', 2.86), ('c3', 1.0), ('cOF1', -4.79), ('cOF2', 4.79), ('cIF1', -3.02), ('cIF2', 1.28), ('CQOF', 12.95), ('CKIF', 65.72), ('CKBF', 1245.02)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-1.5 %	-20.0 %	7.4 %
NS	0.404	-0.028	0.599
NS_log	0.023	-0.571	0.511
NS_rel	0.527	0.481	0.459
KGE	0.611	0.299	0.566

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	10.3 %	-3.2 %	17.2 %
NS	0.436	0.263	0.56
NS_log	0.101	-0.293	0.501
NS_rel	0.392	0.509	0.381
KGE	0.702	0.485	0.663

1.3 Observed and simulated timeseries for optimum parameters

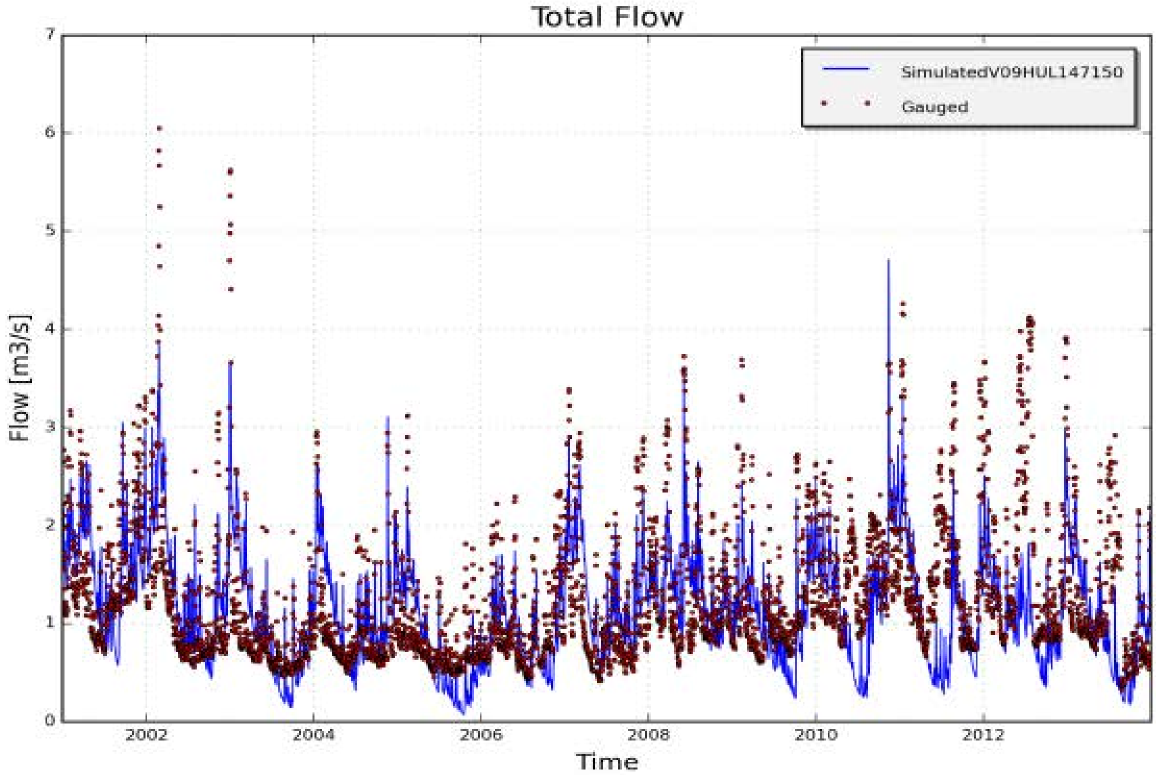


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09HUL147150, station 14710102 - De Hulpe; Molenstede(calibration period)

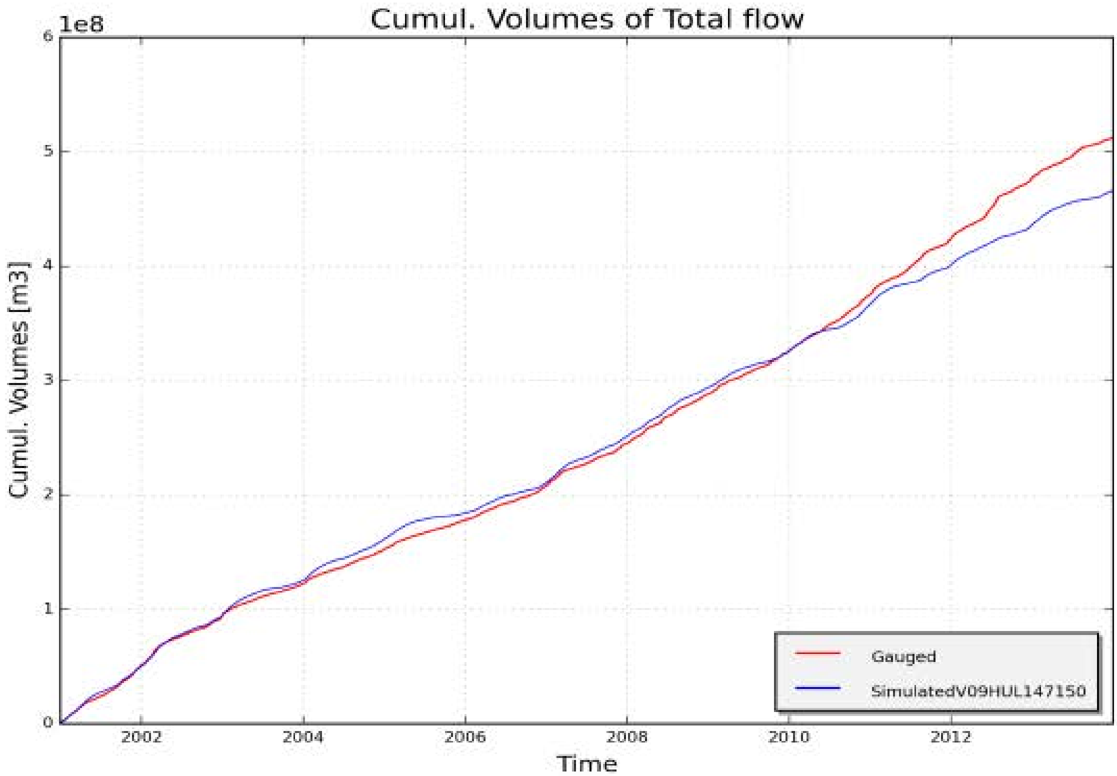


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09HUL147150, station 14710102 - De Hulpe; Molenstede (calibration period)

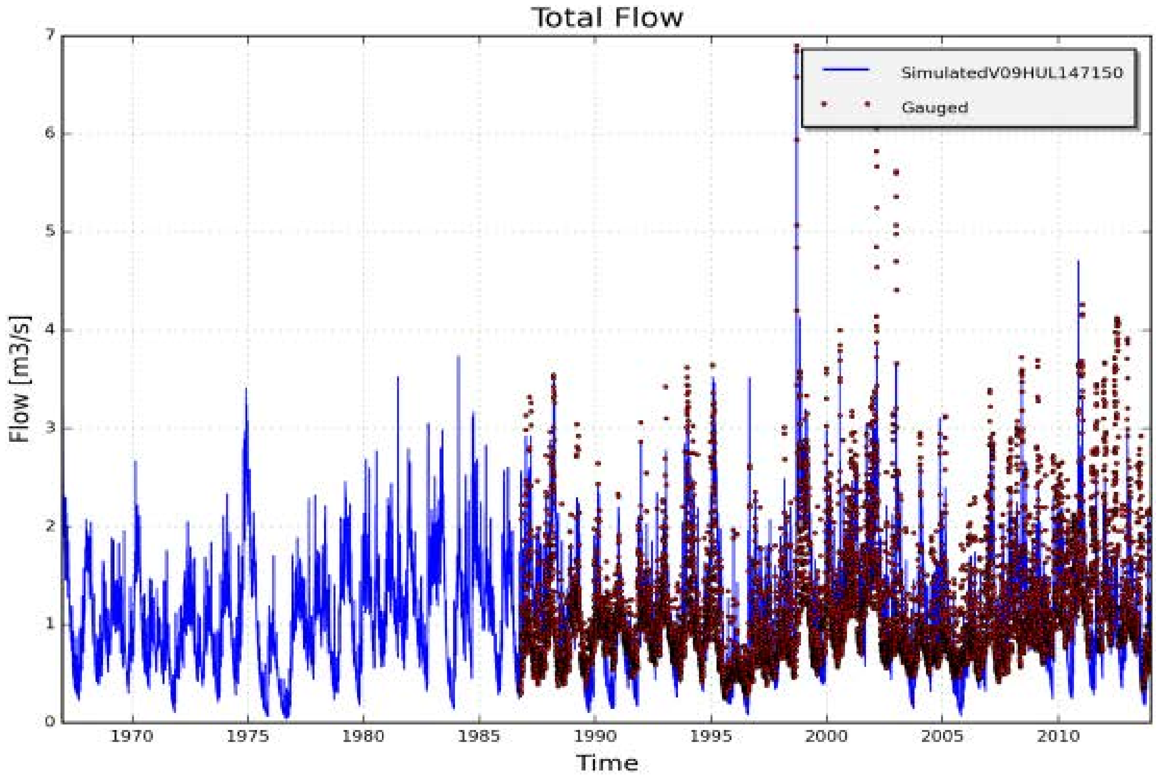


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09HUL147150, station 14710102 - De Hulpe; Molenstede (validation period)

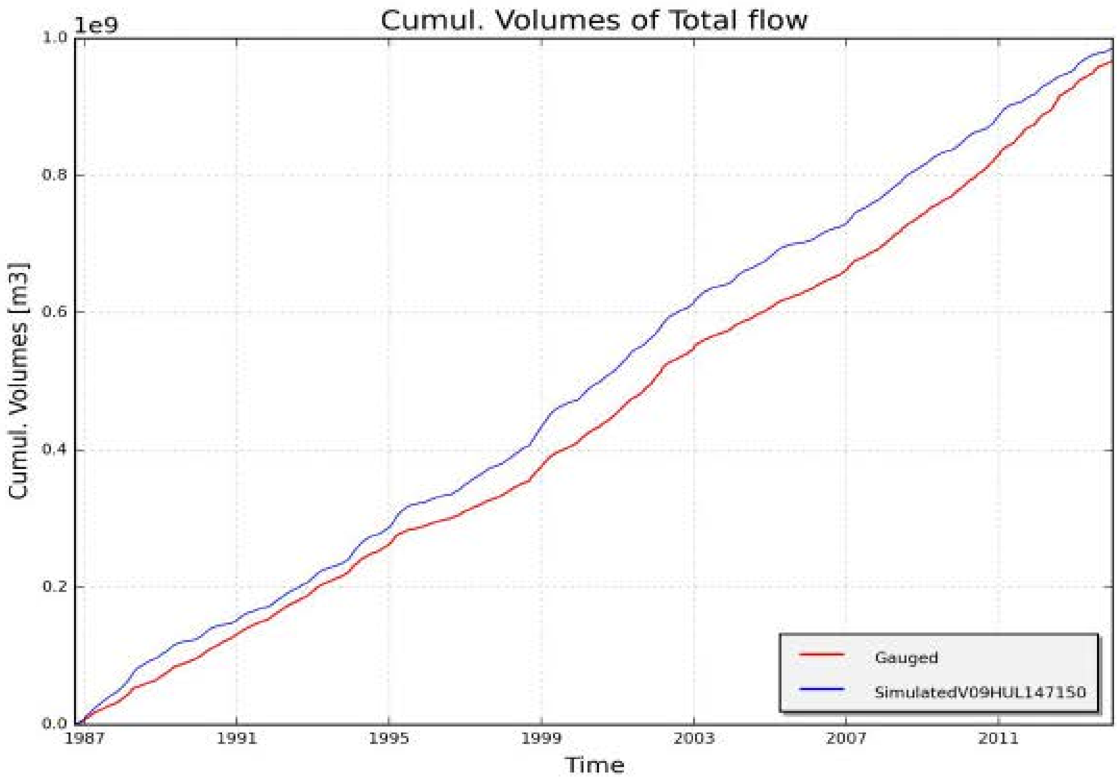


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09HUL147150, station 14710102 - De Hulpe; Molenstede (validation period)

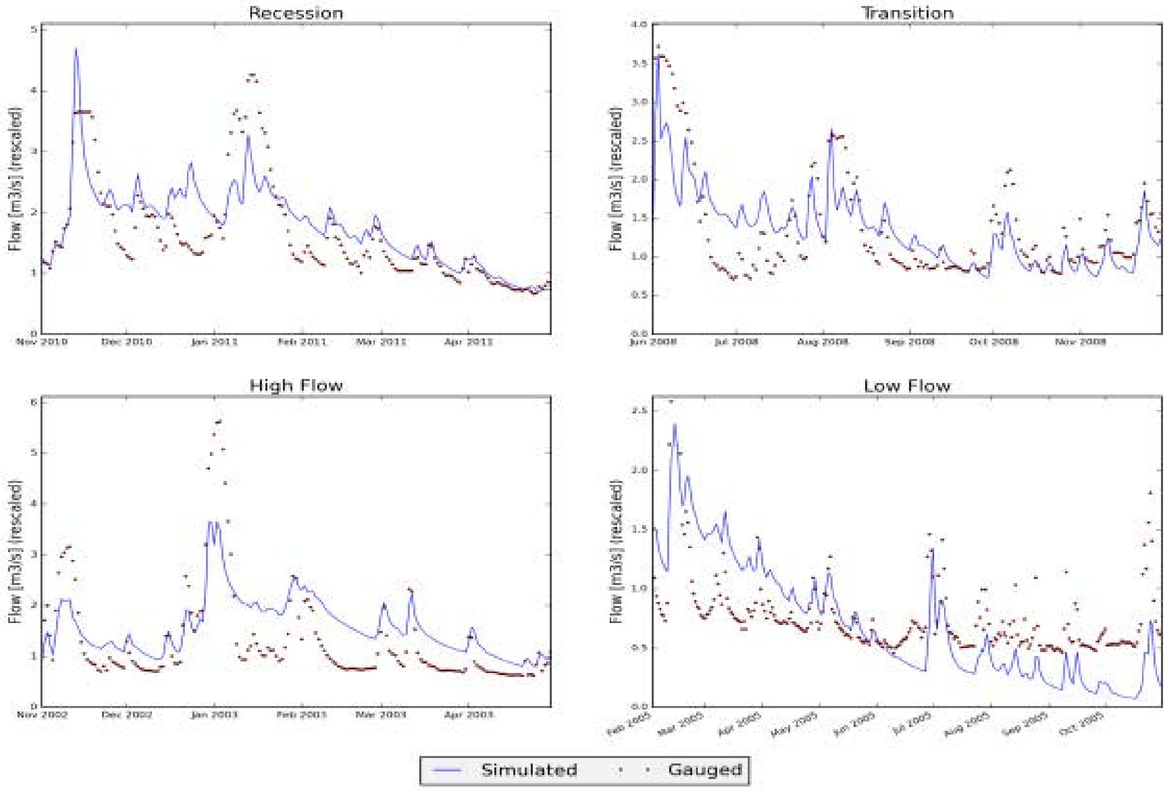


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09HUL147150, station 14710102 - De Hulpe; Molenstede

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V09LOS143300" (DEMERBEKKEN)

1.1 Input data

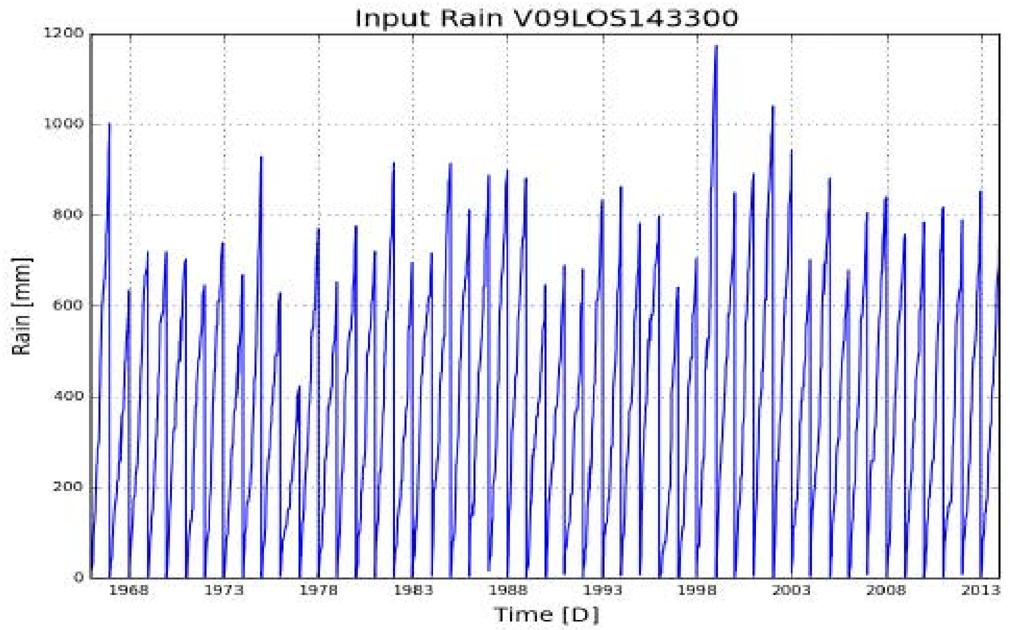


Figure 1: Cumulative precipitation on catchment V09LOS143300 (Demerbekken)

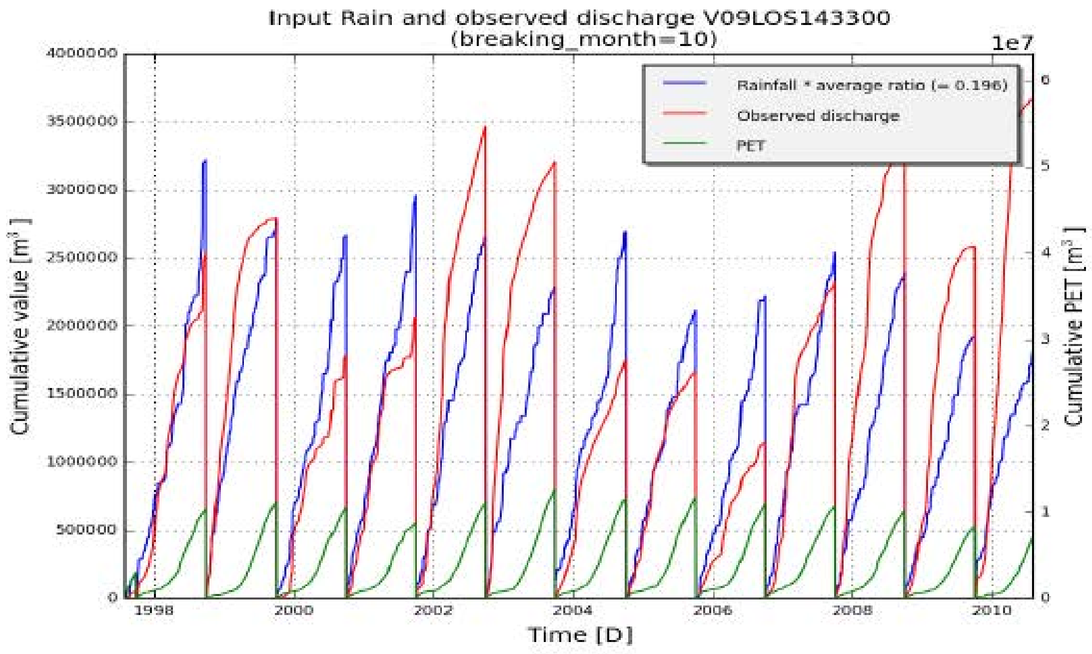


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V09LOS143300 (Demerbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V09LOS143300
subcatchment_area [m2]	15176294
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 505.99), ('SMevap', 178.84), ('c1', 2.05), ('c2', 0.33), ('c3', 1.0), ('cOF1', -5.61), ('cOF2', 3.96), ('cIF1', -4.54), ('cIF2', 2.57), ('CQOF', 14.05), ('CKIF', 90.58), ('CKBF', 1248.24)]

Table 1: Goodness of fit for calibration period (1997 - 2010)

	Full year	**Summer**	**Winter**
RelErr	19.3 %	49.9 %	4.9 %
NS	0.255	0.381	0.1
NS_log	0.246	-0.341	0.248
NS_rel	-21.081	-21.684	0.261
KGE	0.551	0.433	0.498

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	6.7 %	65.6 %	-12.8 %
NS	0.265	0.249	0.168
NS_log	0.299	-0.233	0.077
NS_rel	-12.338	-13.418	0.346
KGE	0.57	0.344	0.54

1.3 Observed and simulated timeseries for optimum parameters

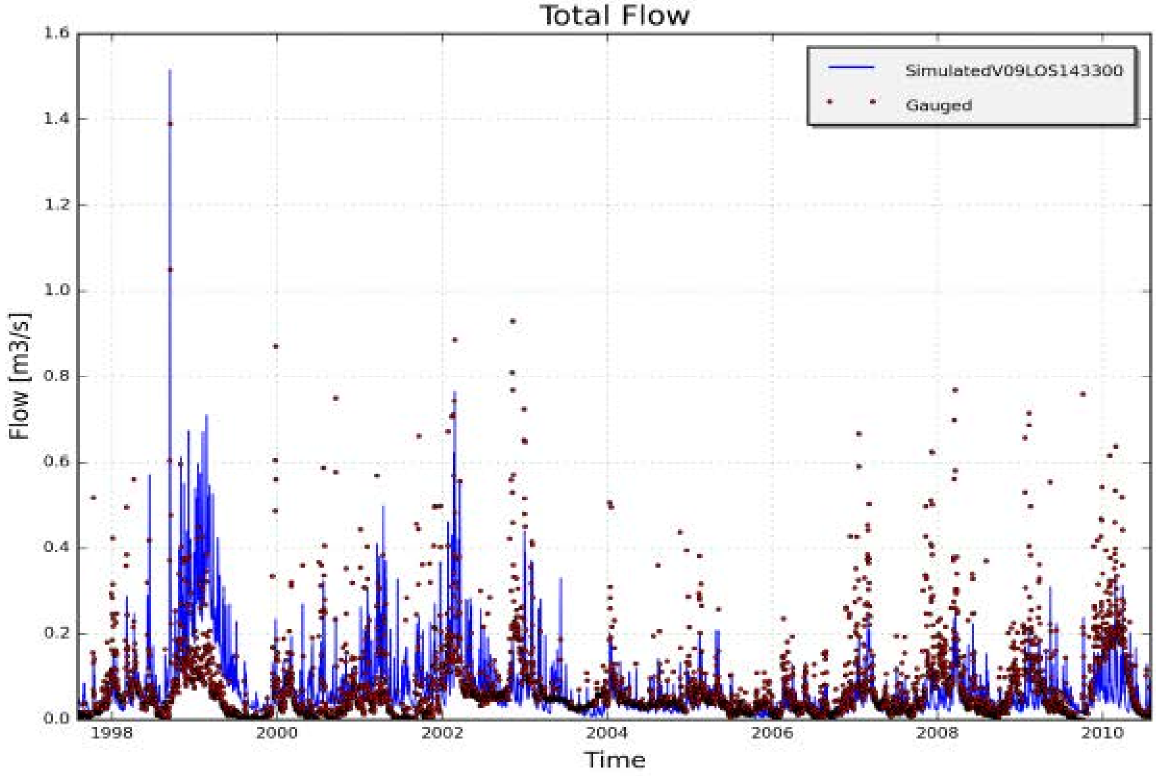


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09LOS143300, station 14310102 - Grote Losting; Wezemaal(calibration period)

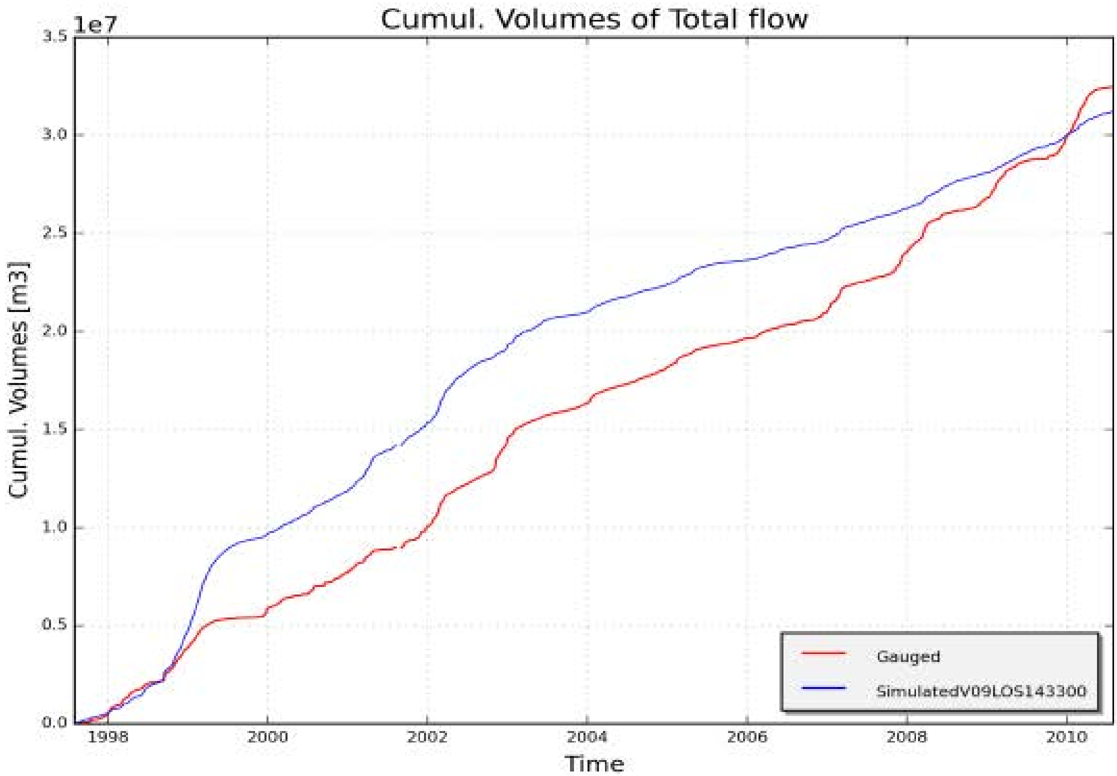


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09LOS143300, station 14310102 - Grote Losting; Wezemaal (calibration period)

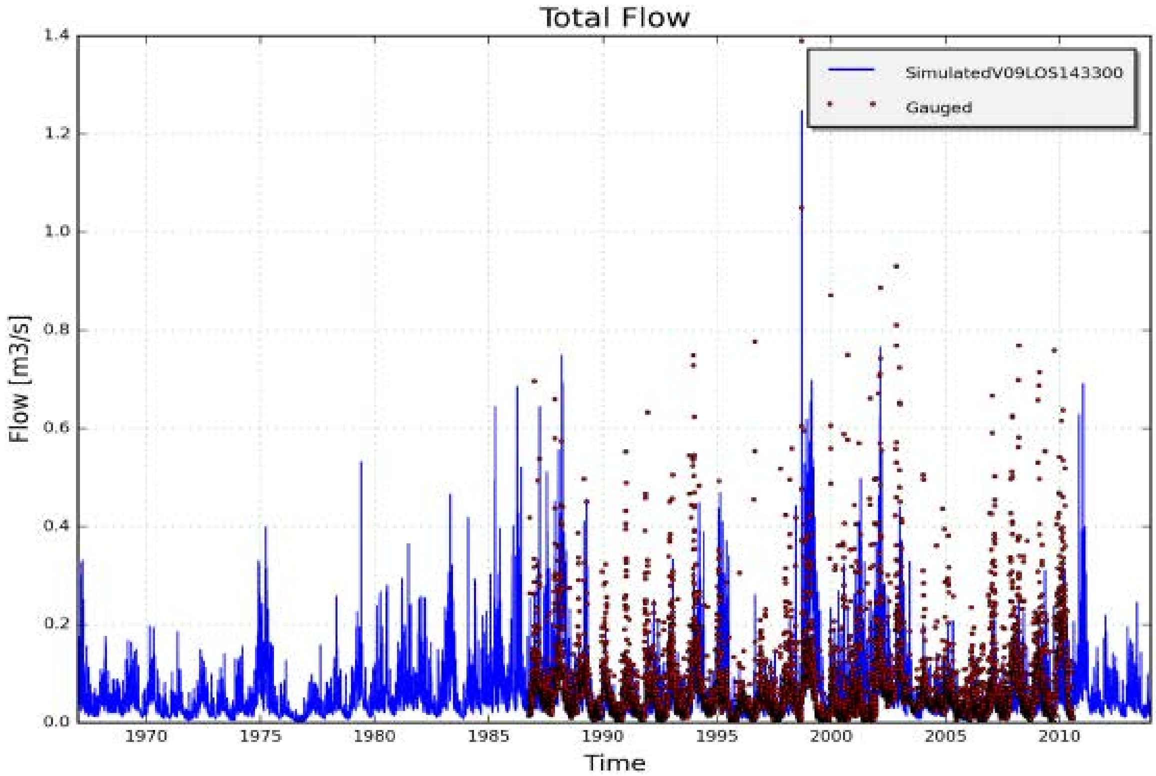


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09LOS143300, station 14310102 - Grote Losting; Wezemaal (validation period)

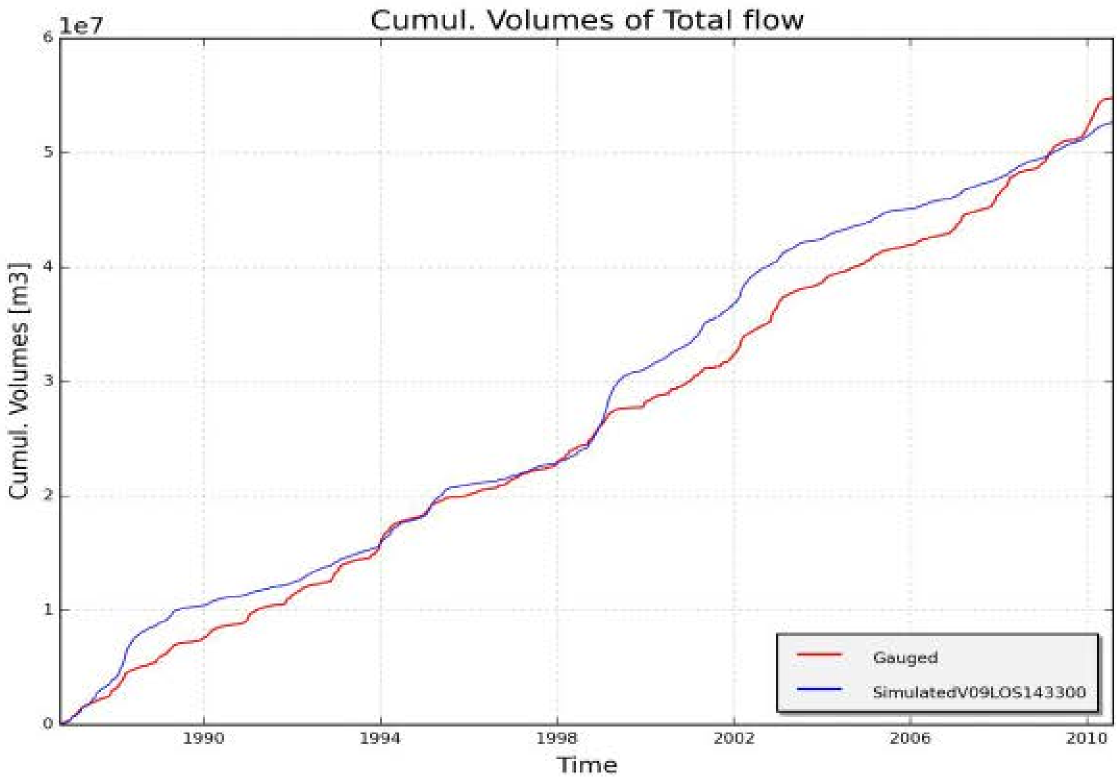


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09LOS143300, station 14310102 - Grote Losting; Wezemaal (validation period)

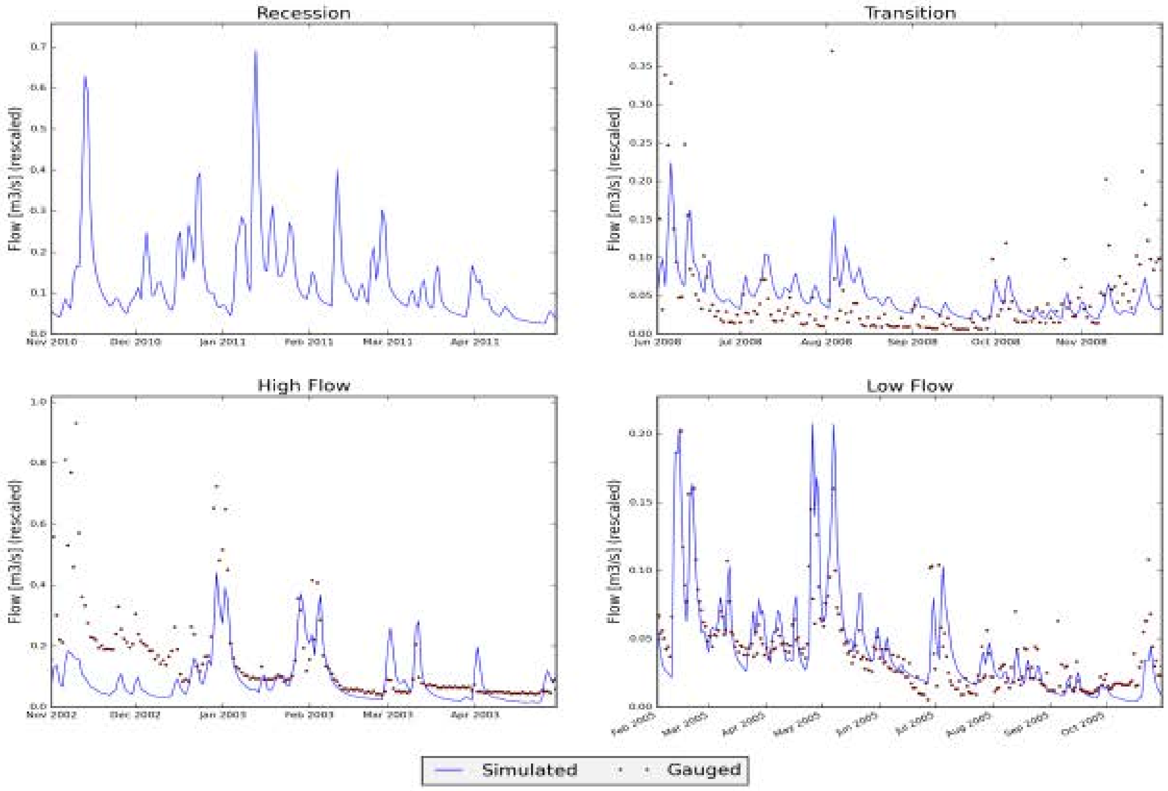


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09LOS143300, station 14310102 - Grote Losting; Wezemaal

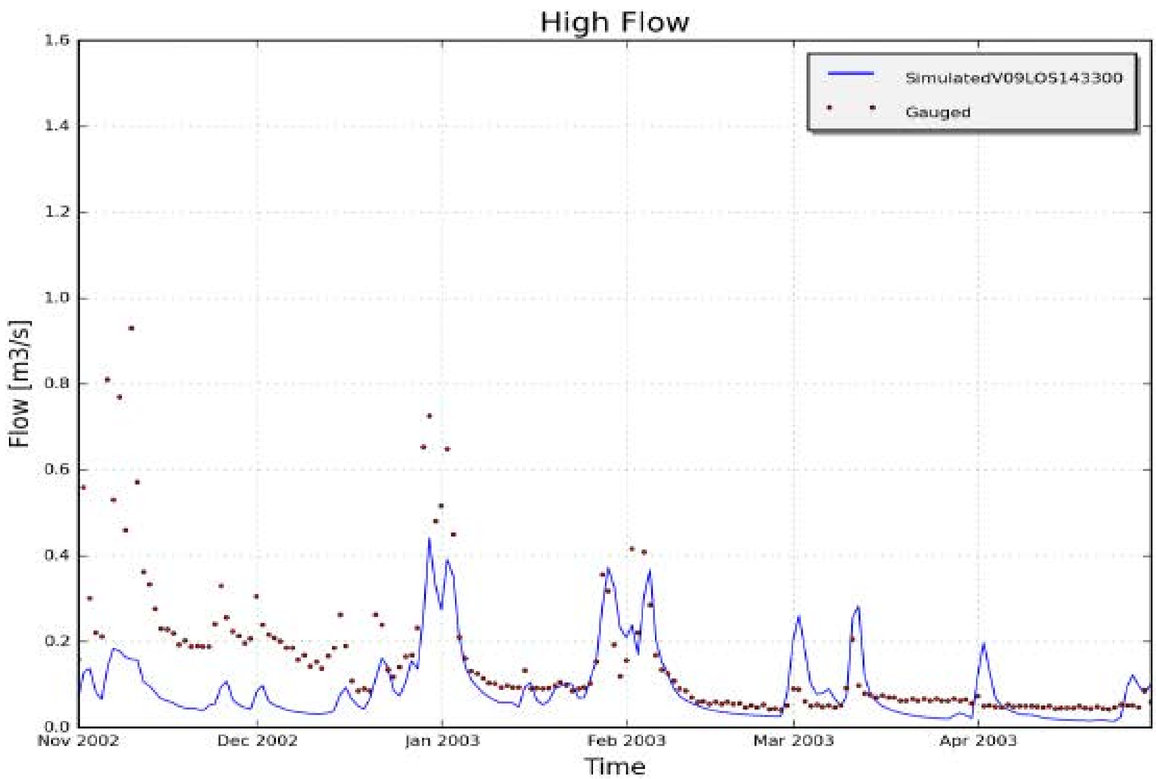


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09LOS143300, station 14310102 - Grote Losting; Wezemaal

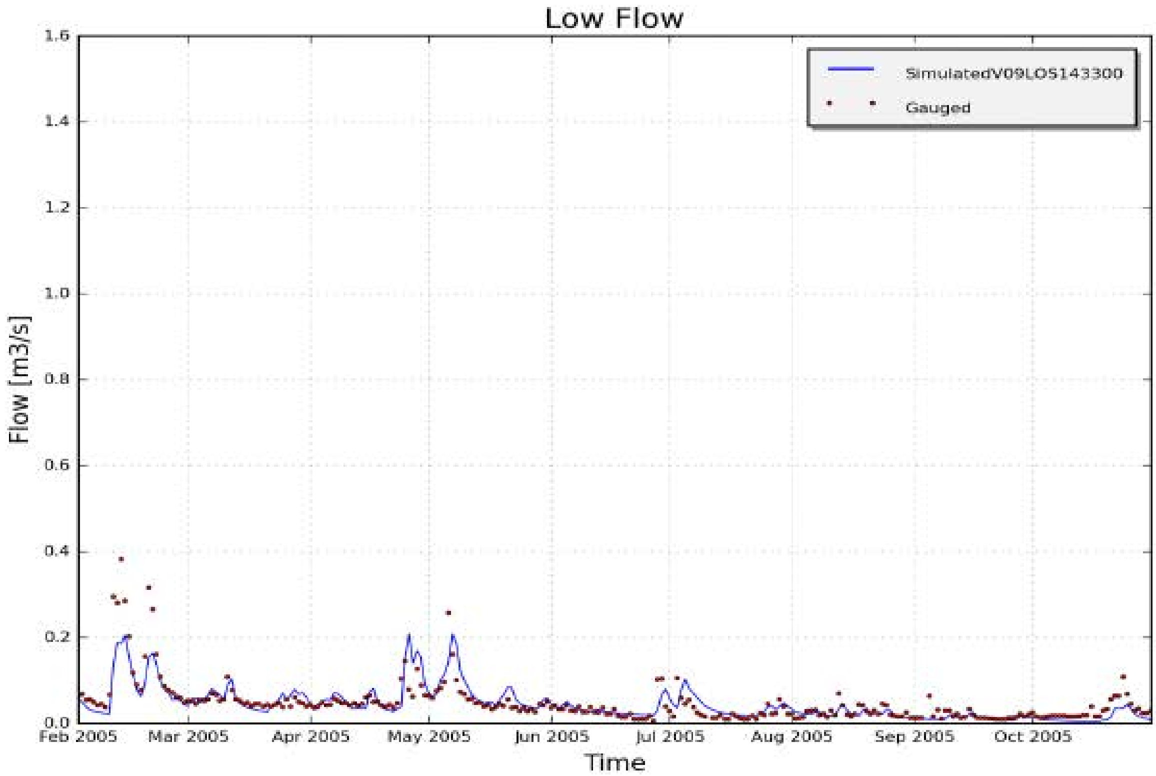


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09LOS143300, station 14310102 - Grote Losting; Wezemaal

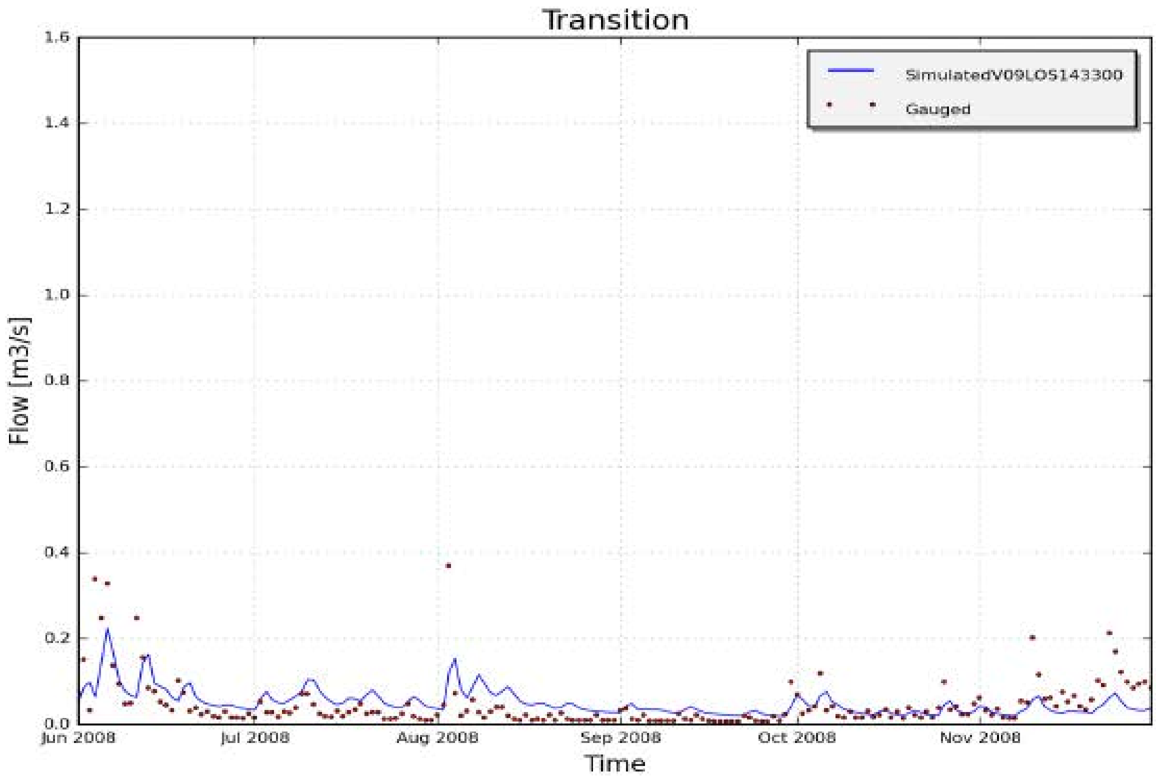


Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09LOS143300, station 14310102 - Grote Losting; Wezemaal

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V09MAN161040" (DEMERBEKKEN)

1.1 Input data

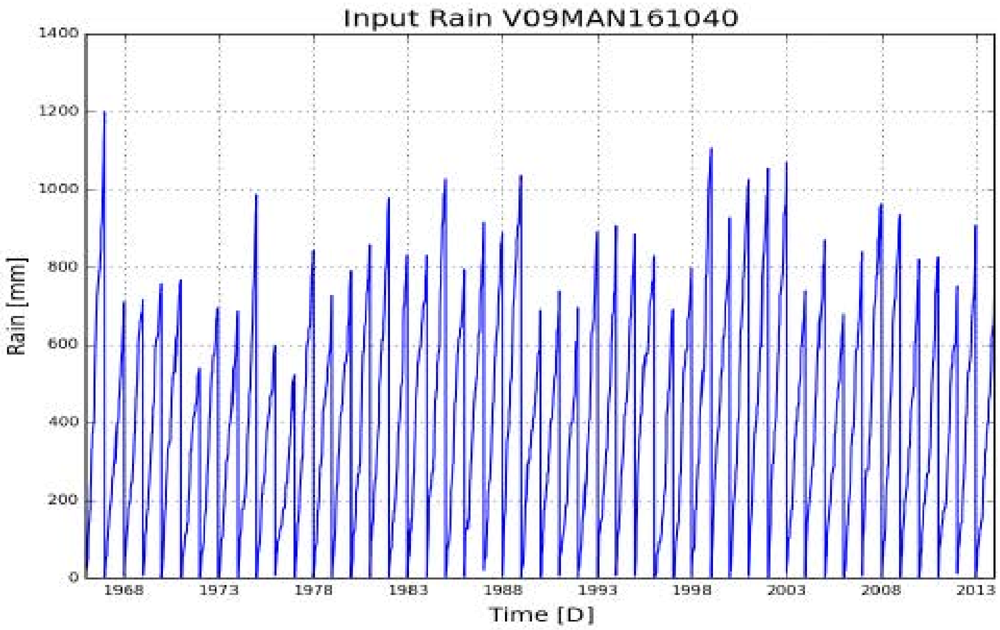


Figure 1: Cumulative precipitation on catchment V09MAN161040 (Demerbekken)

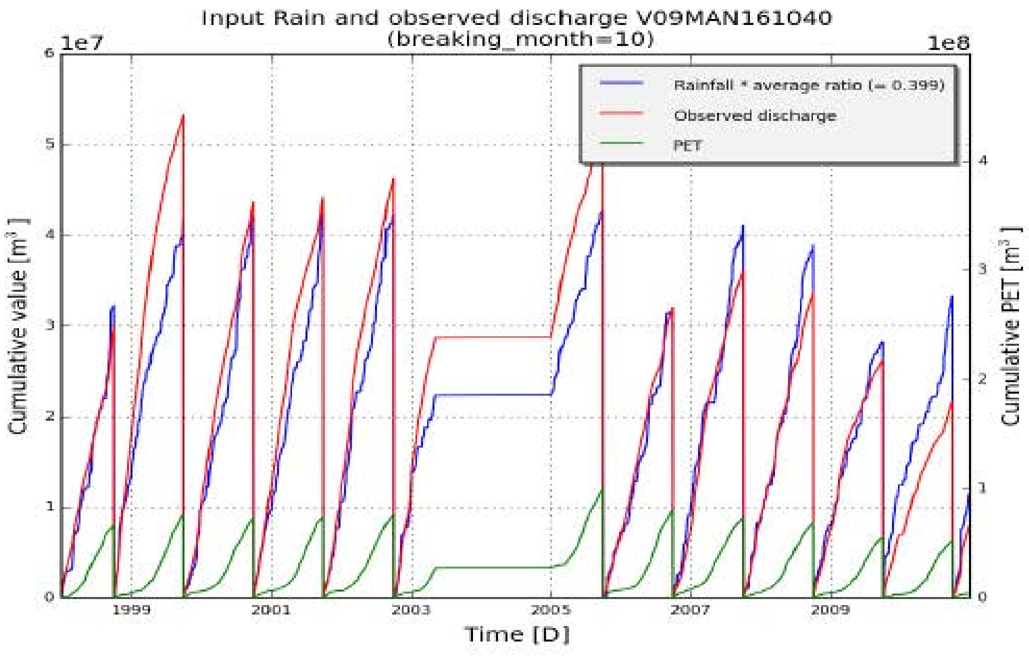


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V09MAN161040 (Demerbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V09MAN161040
subcatchment_area [m2]	103081000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 418.73), ('SMevap', 156.65), ('c1', 1.89), ('c2', 0.71), ('c3', 1.0), ('cOF1', -4.23), ('cOF2', 4.03), ('cIF1', -3.29), ('cIF2', 0.83), ('CQOF', 13.16), ('CKIF', 87.0), ('CKBF', 1050.4)]

Table 1: Goodness of fit for calibration period (1998 - 2010)

	Full year	Summer	Winter
RelErr	-0.1 %	-2.0 %	1.8 %
NS	0.666	0.646	0.635
NS_log	0.616	0.592	0.558
NS_rel	0.594	0.663	0.499
KGE	0.832	0.733	0.806

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	Summer	Winter
RelErr	0.7 %	18.7 %	-4.6 %
NS	0.669	0.572	0.663
NS_log	0.569	0.434	0.579
NS_rel	0.525	0.336	0.645
KGE	0.832	0.699	0.818

1.3 Observed and simulated timeseries for optimum parameters

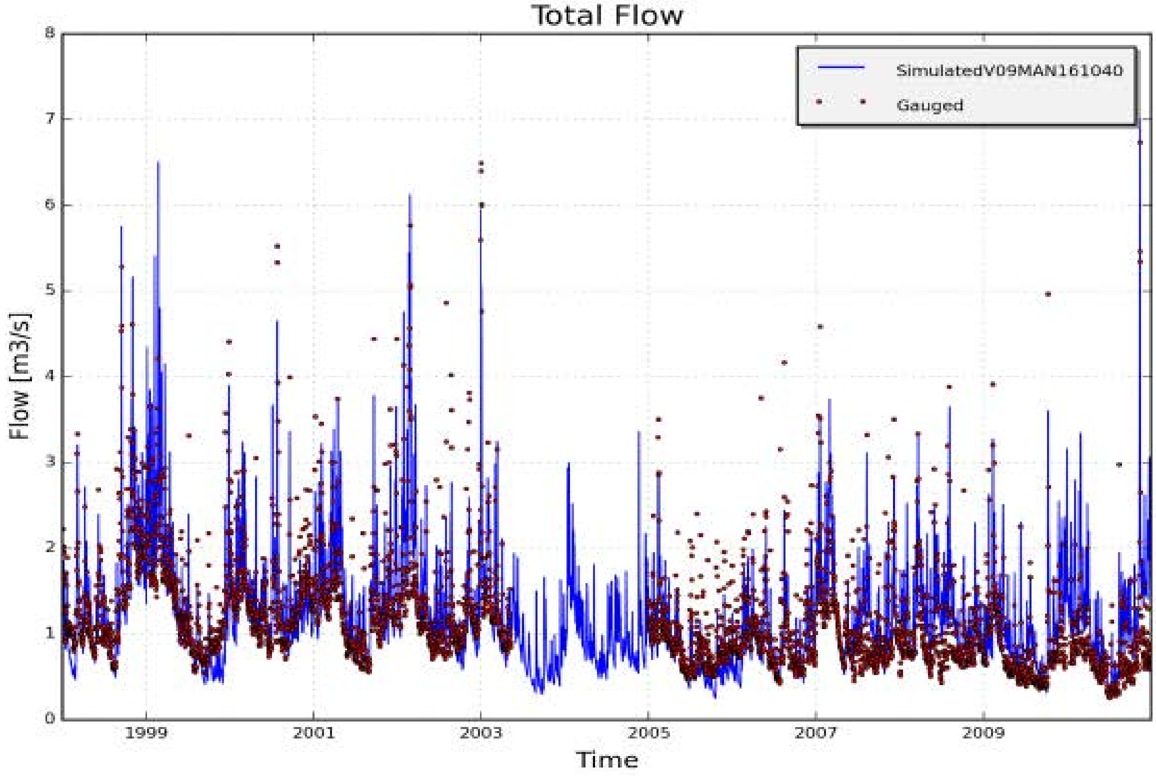


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09MAN161040, station 16110102 - Mangelbeek; Lummen(calibration period)

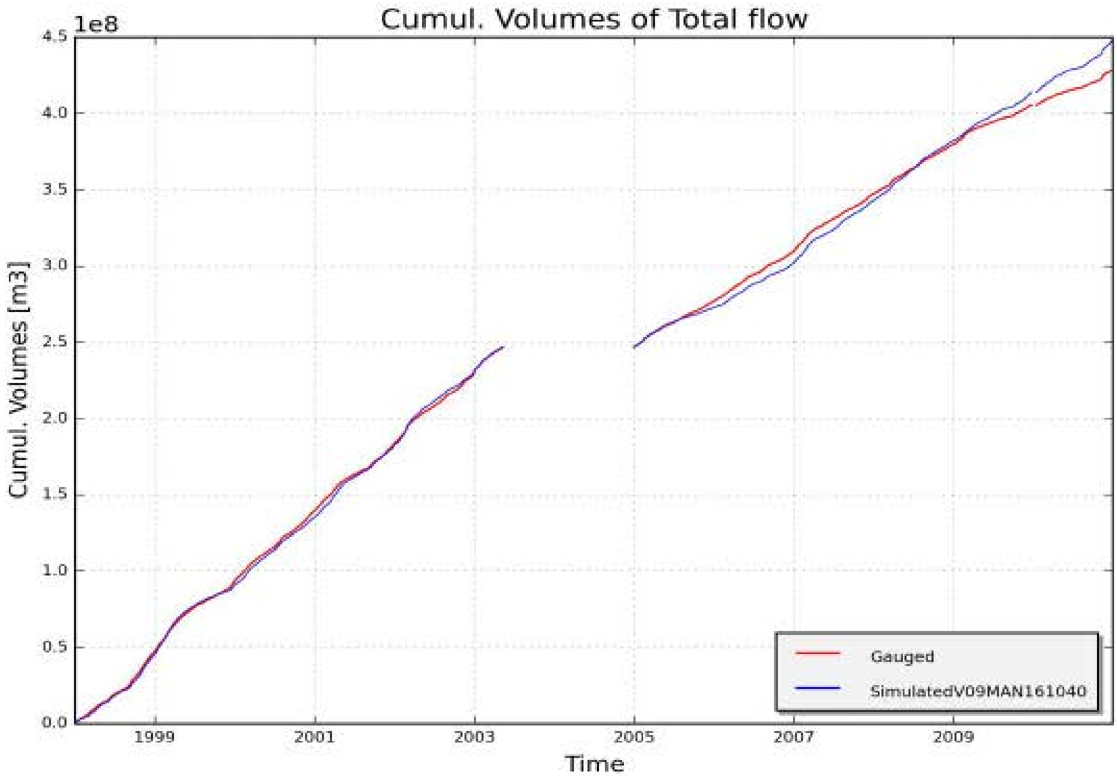


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09MAN161040, station 16110102 - Mangelbeek; Lummen (calibration period)

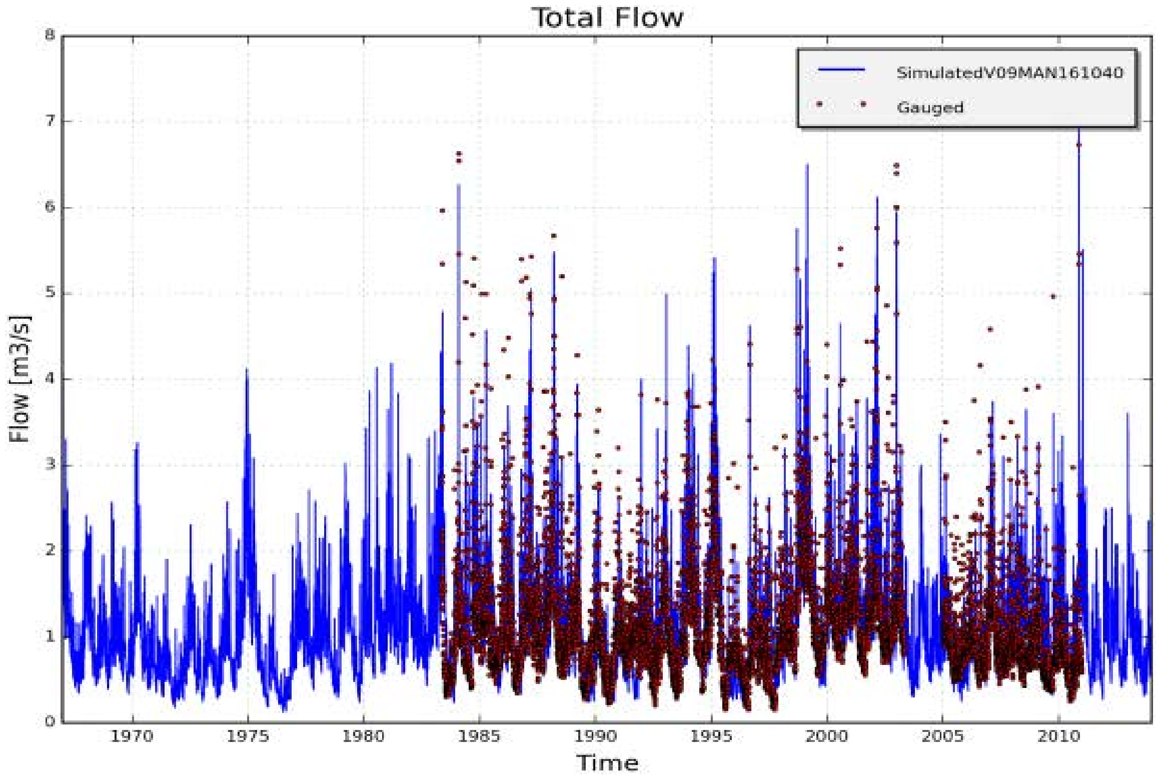


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09MAN161040, station 16110102 - Mangelbeek; Lummen (validation period)

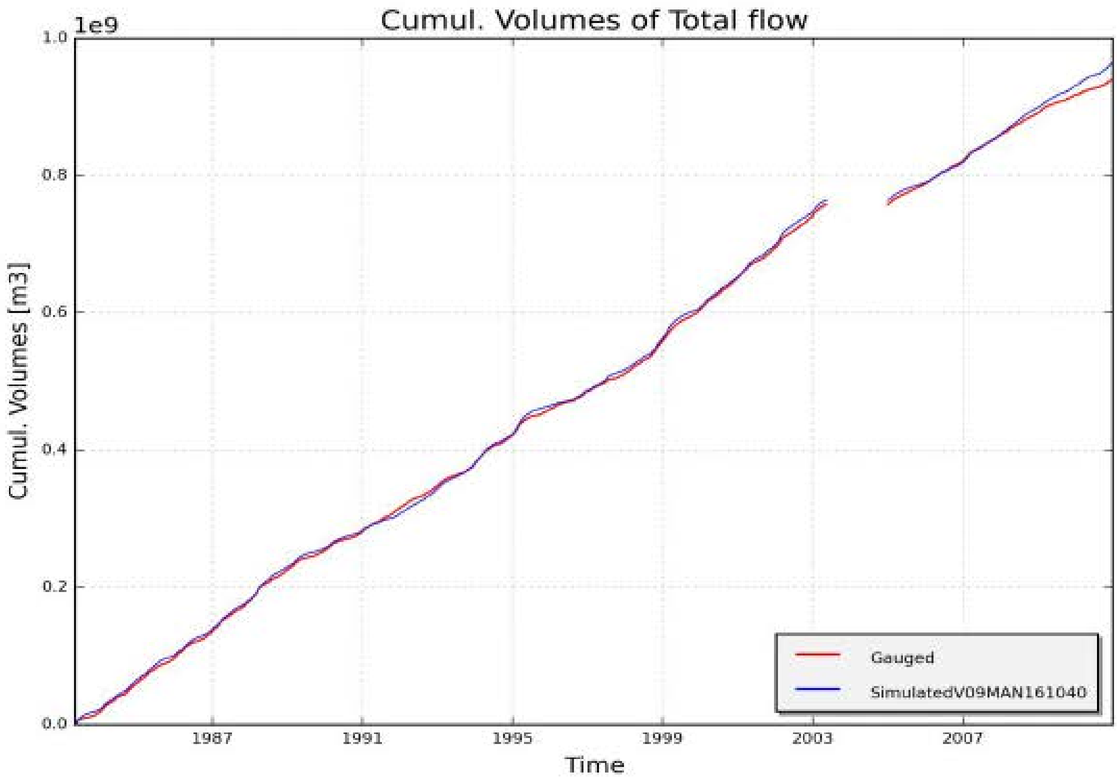


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09MAN161040, station 16110102 - Mangelbeek; Lummen (validation period)

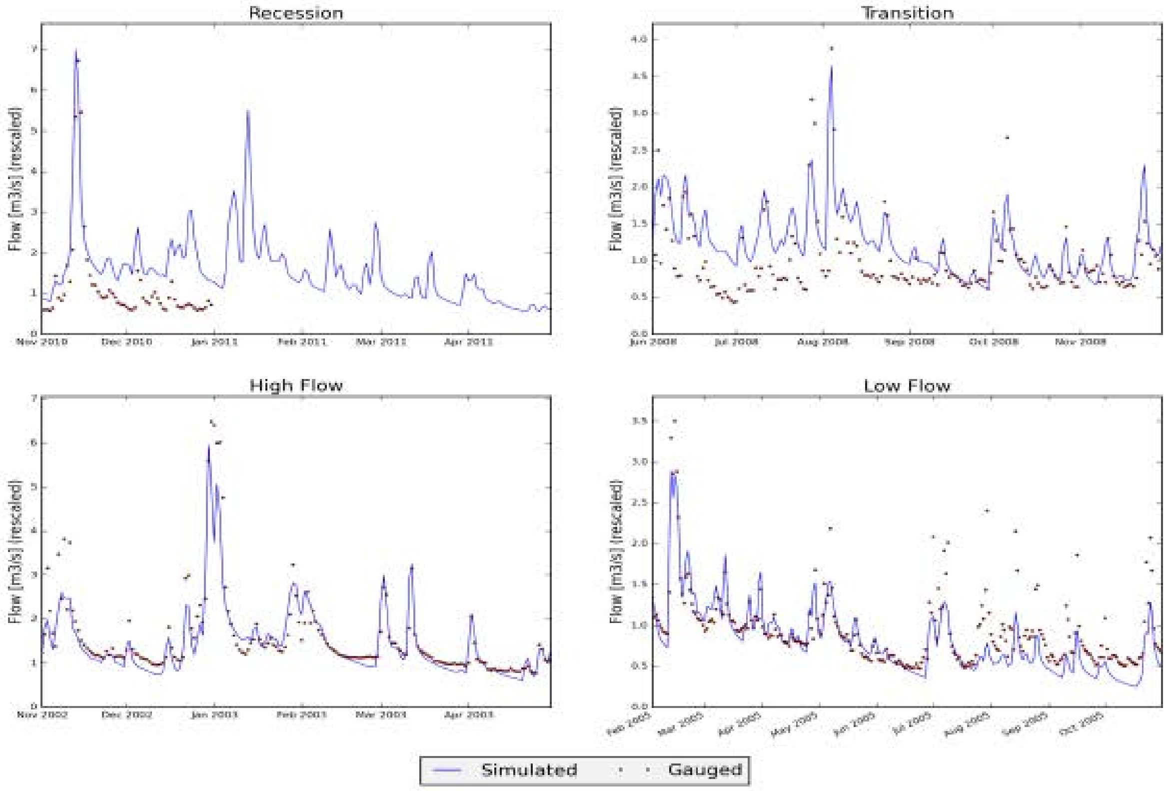


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09MAN161040, station 16110102 - Mangelbeek; Lummen

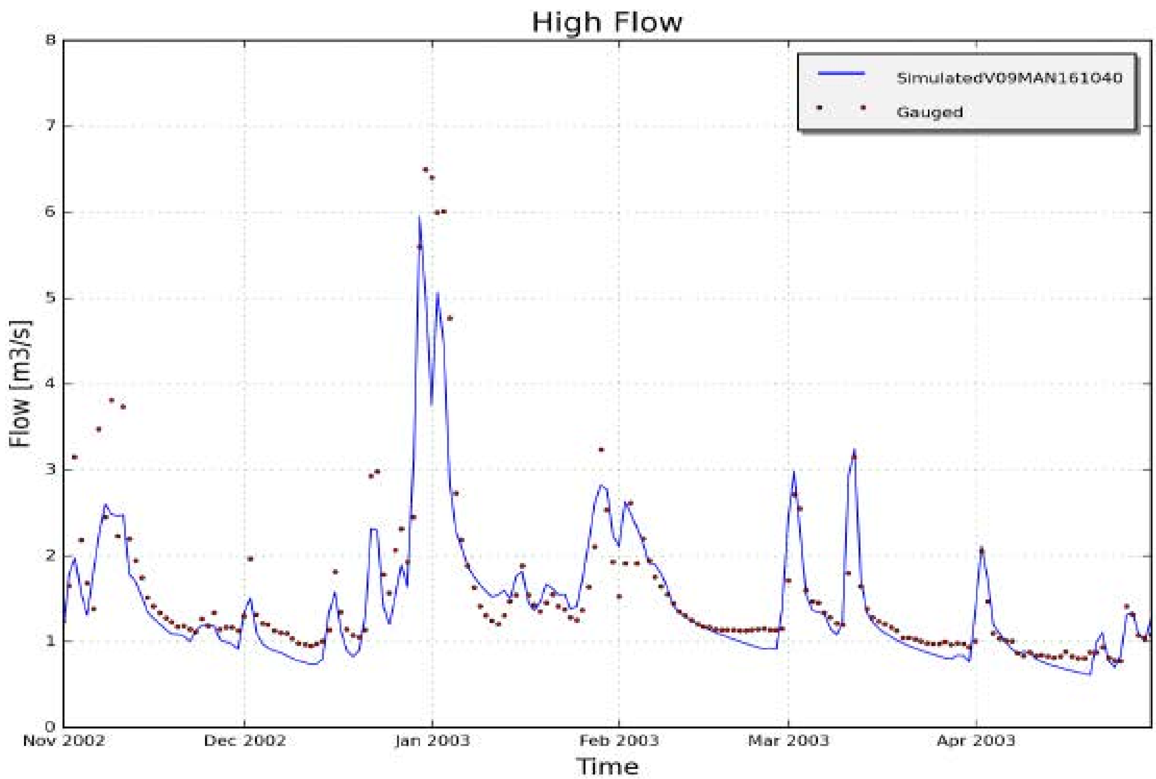


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09MAN161040, station 16110102 - Mangelbeek; Lummen

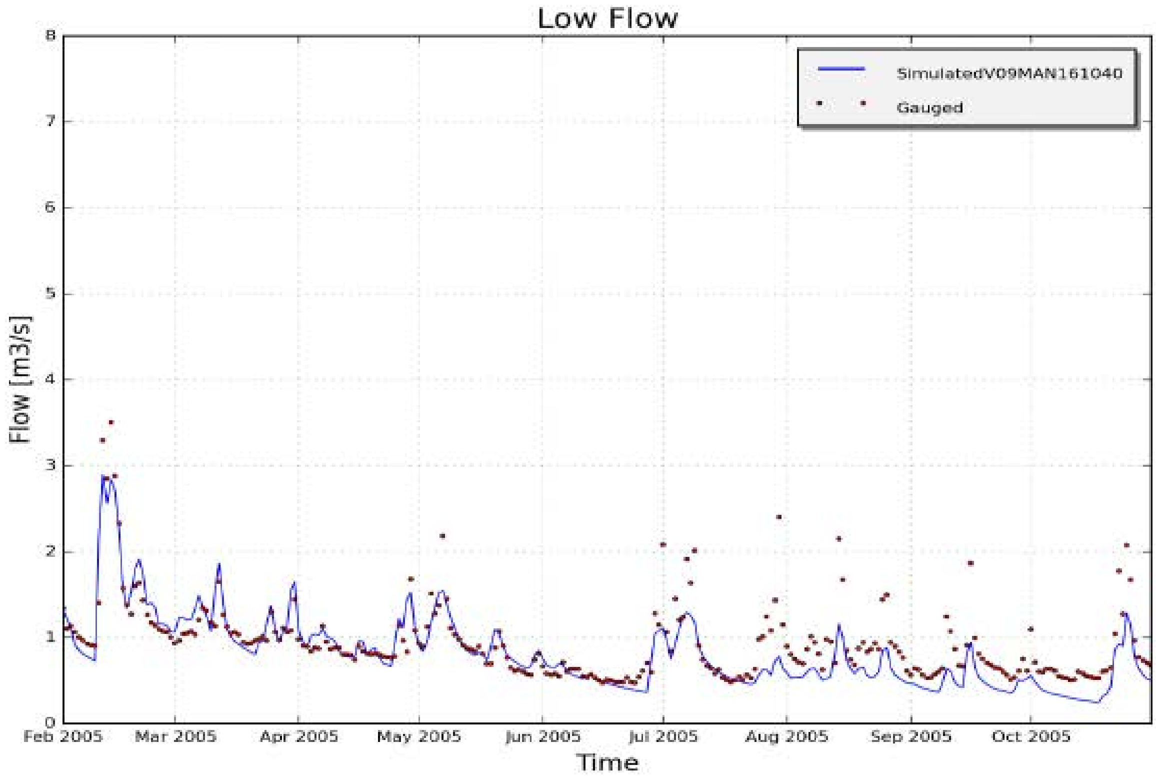


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09MAN161040, station 16110102 - Mangelbeek; Lummen

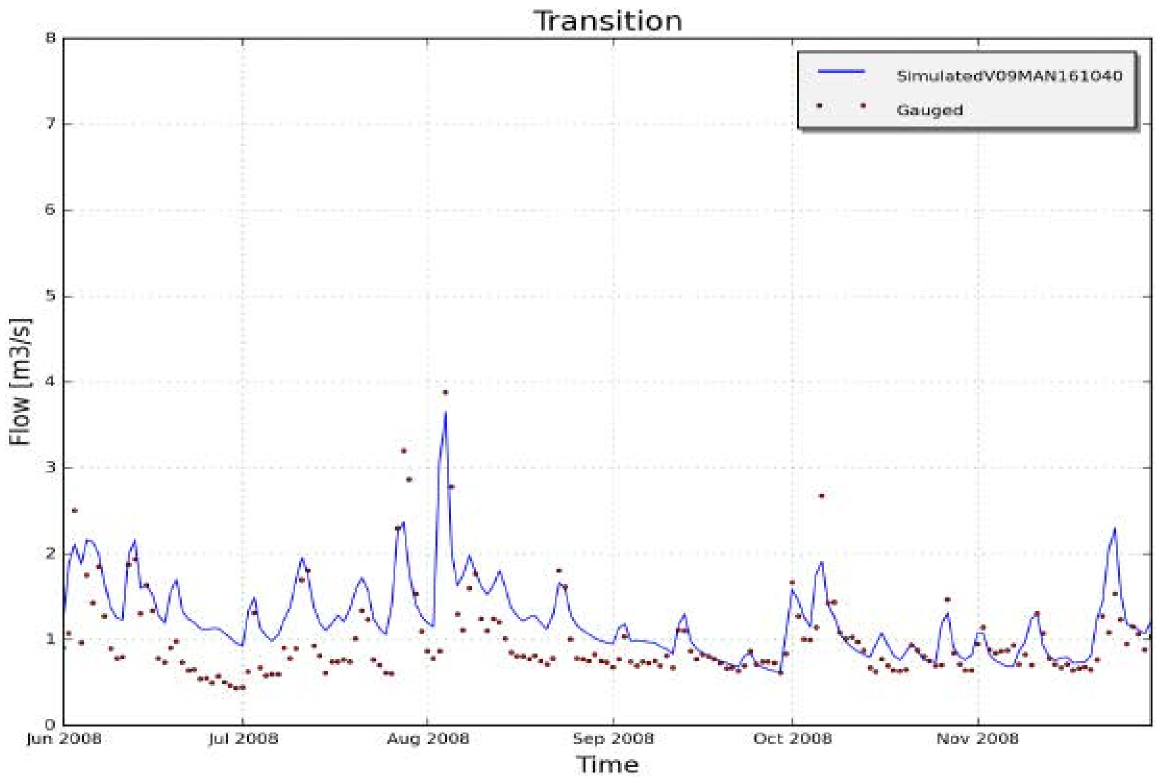


Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09MAN161040, station 16110102 - Mangelbeek; Lummen

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V09MOT144270" (DEMERBEKKEN)

1.1 Input data

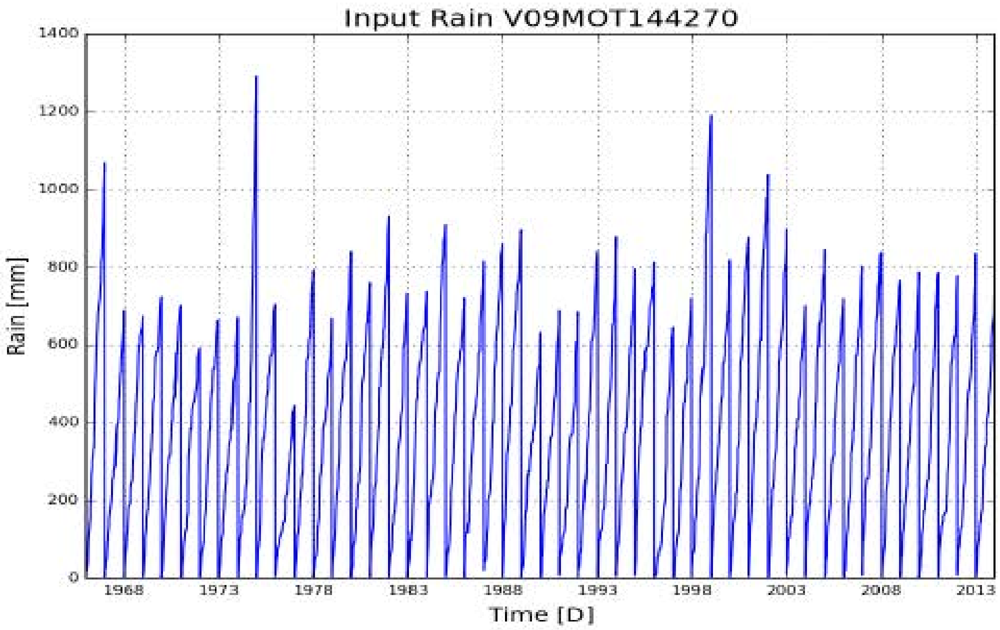


Figure 1: Cumulative precipitation on catchment V09MOT144270 (Demerbekken)

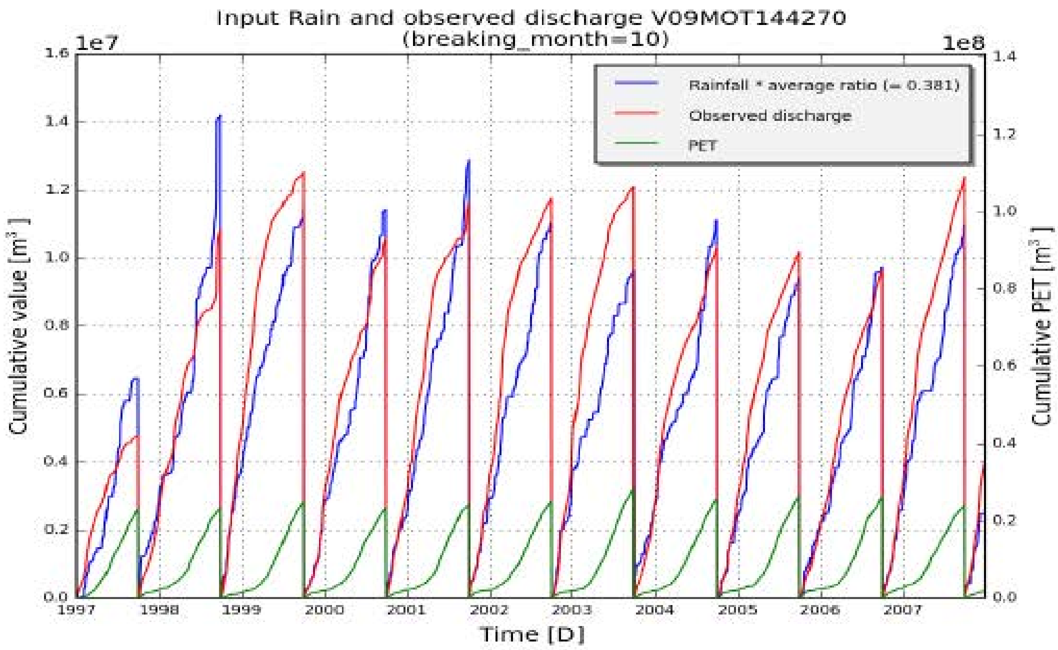


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V09MOT144270 (Demerbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V09MOT144270
subcatchment_area [m2]	33590217
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 473.16), ('SMevap', 168.34), ('c1', 1.95), ('c2', 0.78), ('c3', 1.0), ('cOF1', -5.02), ('cOF2', 4.77), ('cIF1', -3.91), ('cIF2', 5.03), ('CQOF', 12.48), ('CKIF', 65.5), ('CKBF', 1198.0)]

Table 1: Goodness of fit for calibration period (1997 - 2007)

	Full year	**Summer**	**Winter**
RelErr	2.5 %	50.5 %	-11.2 %
NS	0.645	0.67	0.628
NS_log	0.507	0.194	0.446
NS_rel	-1.055	-1.681	0.769
KGE	0.808	0.65	0.752

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-13.0 %	1.5 %	-14.0 %
NS	0.525	0.573	0.43
NS_log	0.208	0.038	-0.166
NS_rel	-0.382	-1.759	0.6
KGE	0.725	0.759	0.692

1.3 Observed and simulated timeseries for optimum parameters

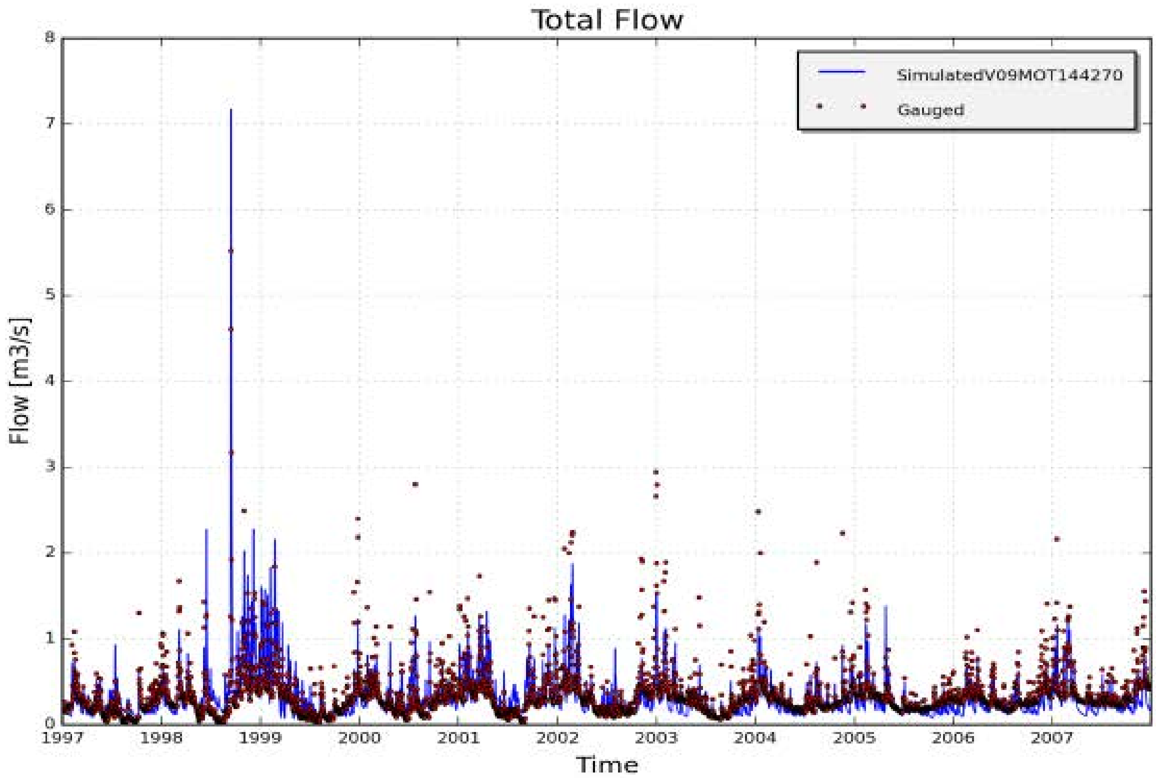


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09MOT144270, station 14410102 - Motte; Rillaar(calibration period)

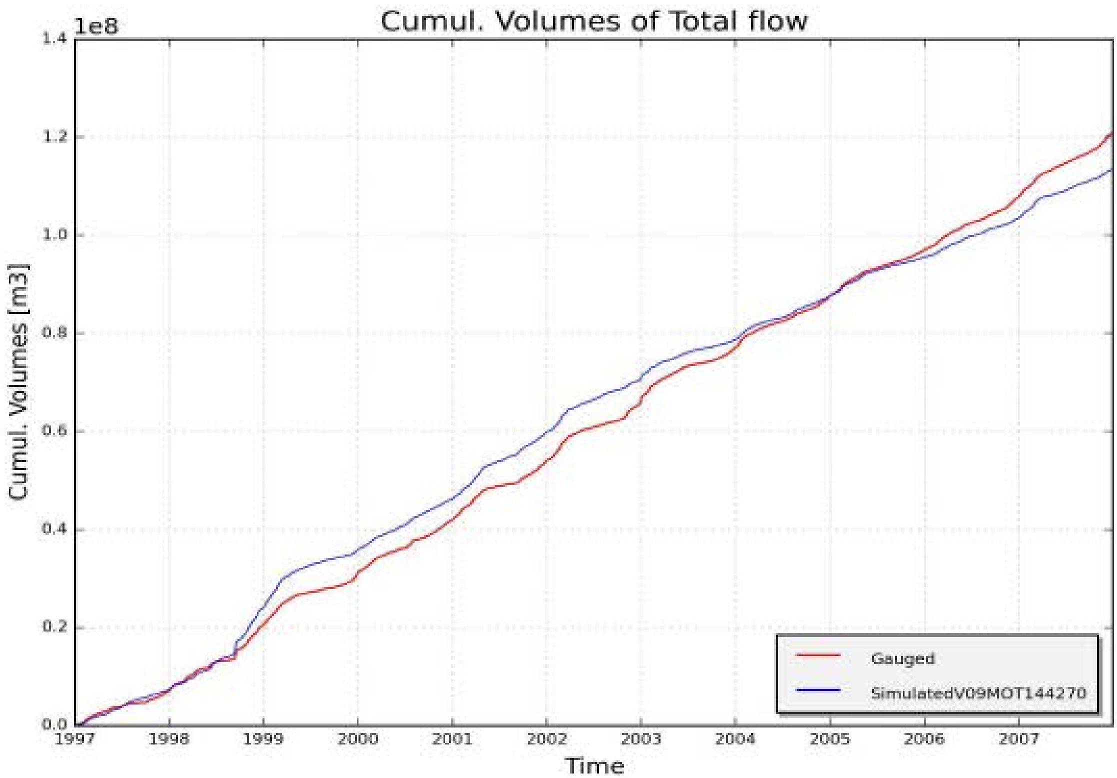


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09MOT144270, station 14410102 - Motte; Rillaar (calibration period)

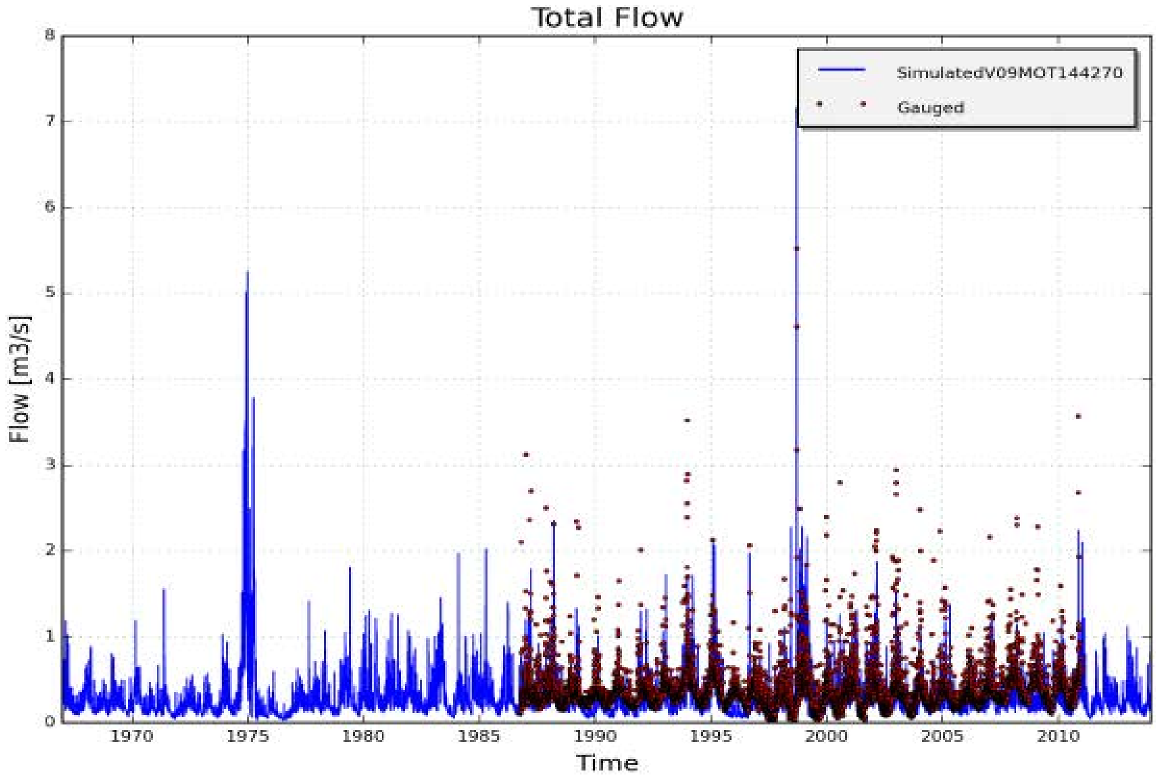


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09MOT144270, station 14410102 - Motte; Rillaar (validation period)

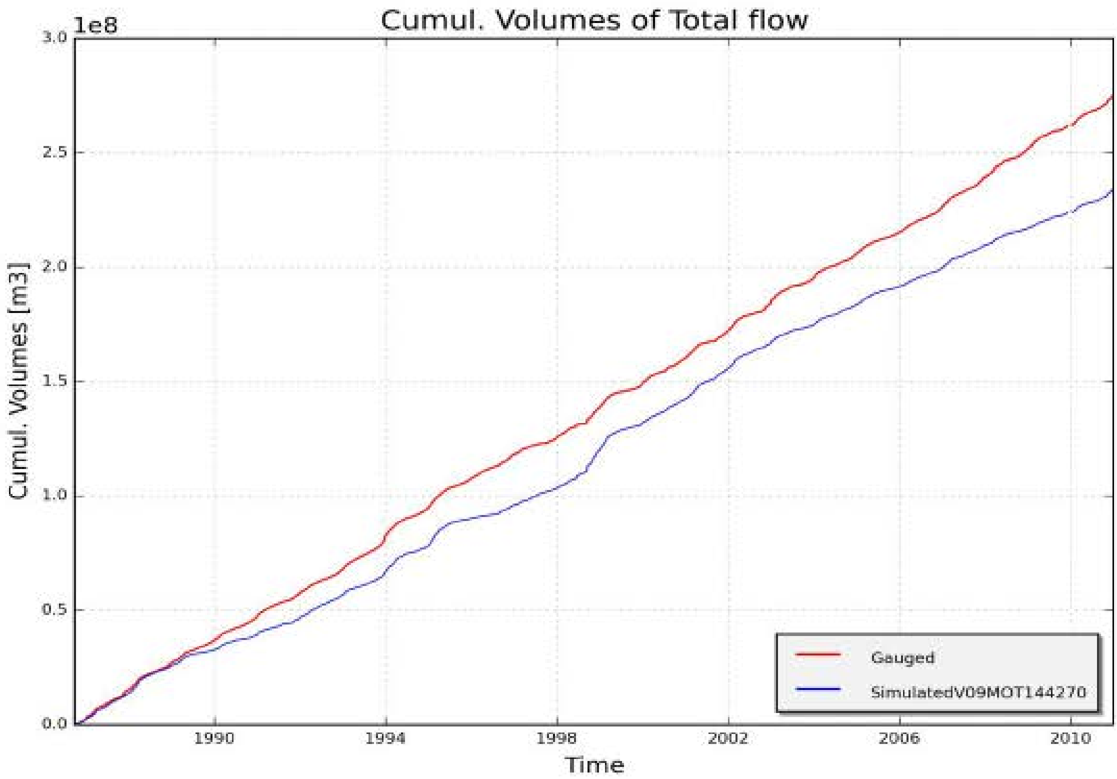


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09MOT144270, station 14410102 - Motte; Rillaar (validation period)

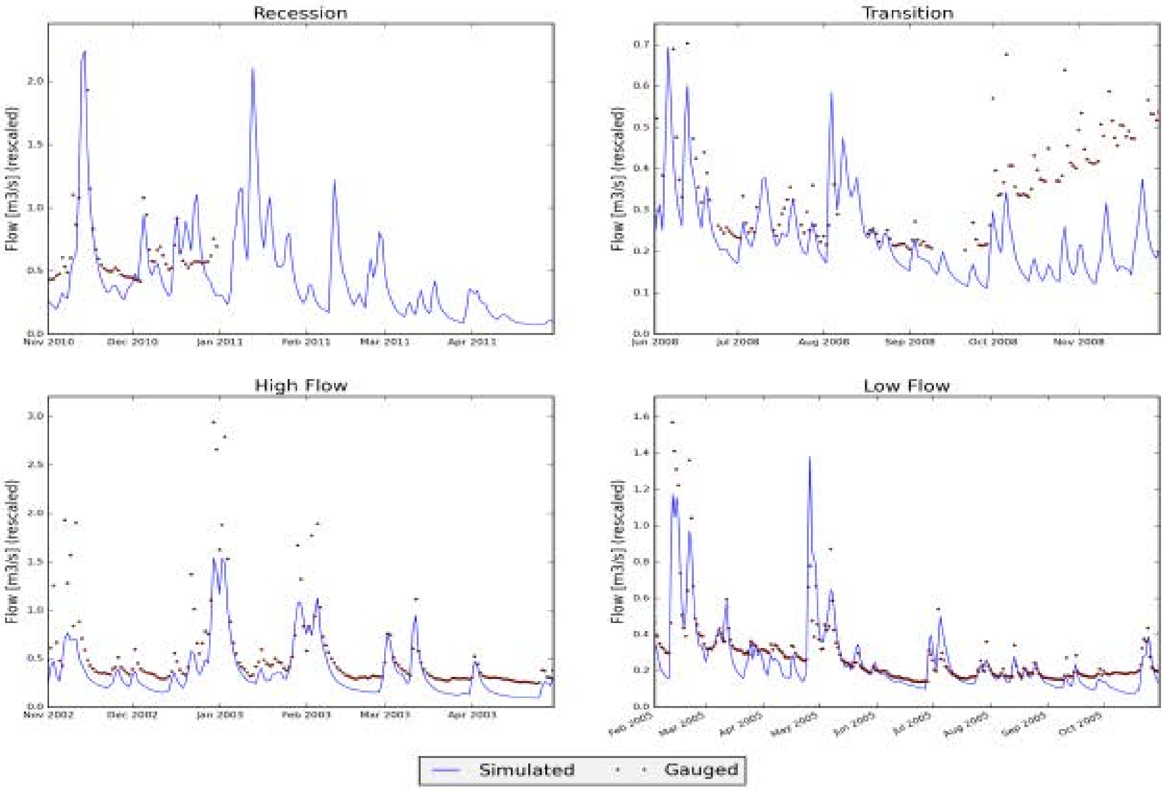


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09MOT144270, station 14410102 - Motte; Rillaar

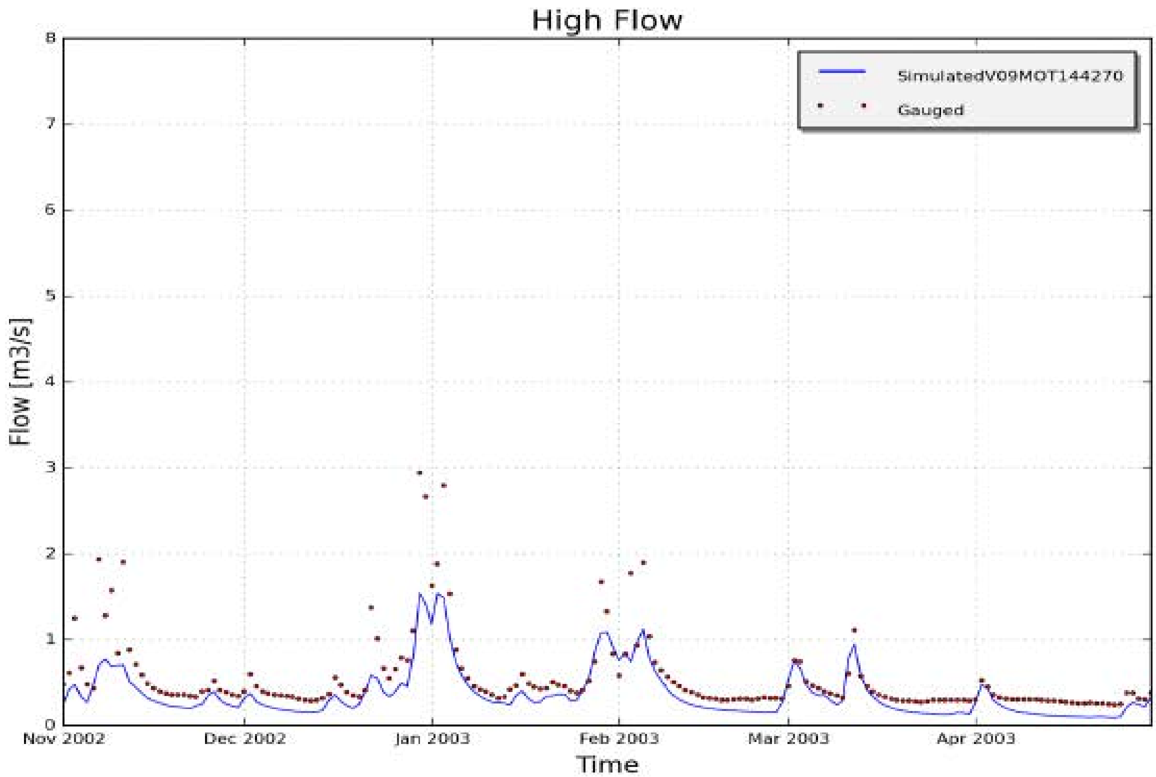


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09MOT144270, station 14410102 - Motte; Rillaar

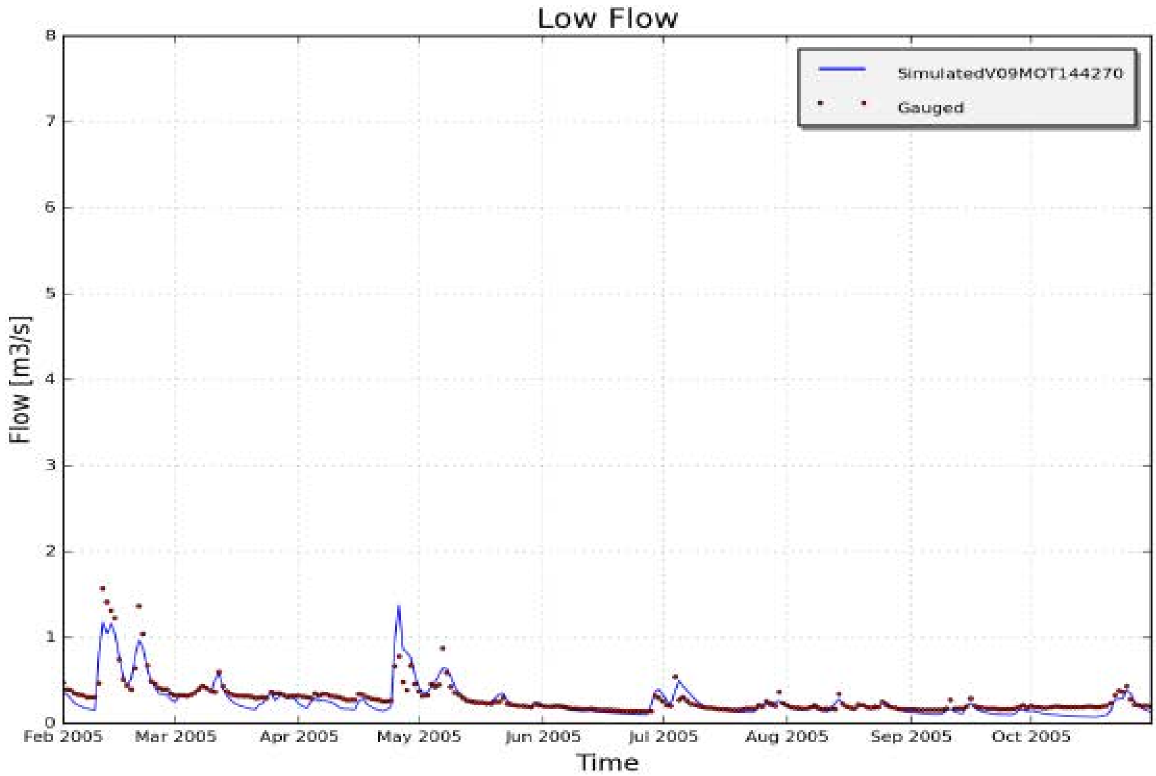


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09MOT144270, station 14410102 - Motte; Rillaar

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V09VEL145100" (DEMERBEKKEN)

1.1 Input data

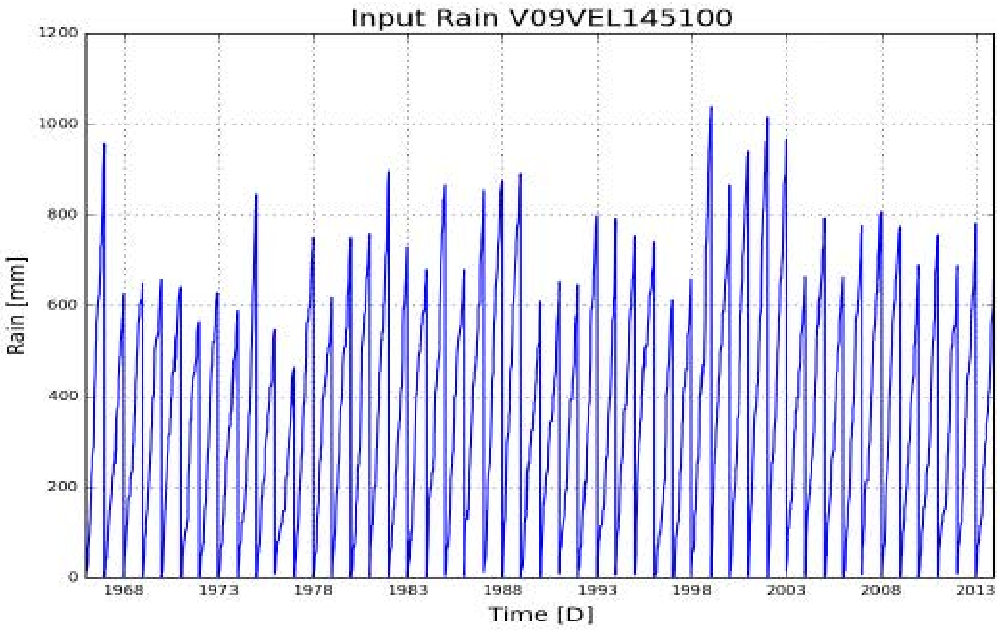


Figure 1: Cumulative precipitation on catchment V09VEL145100 (Demerbekken)

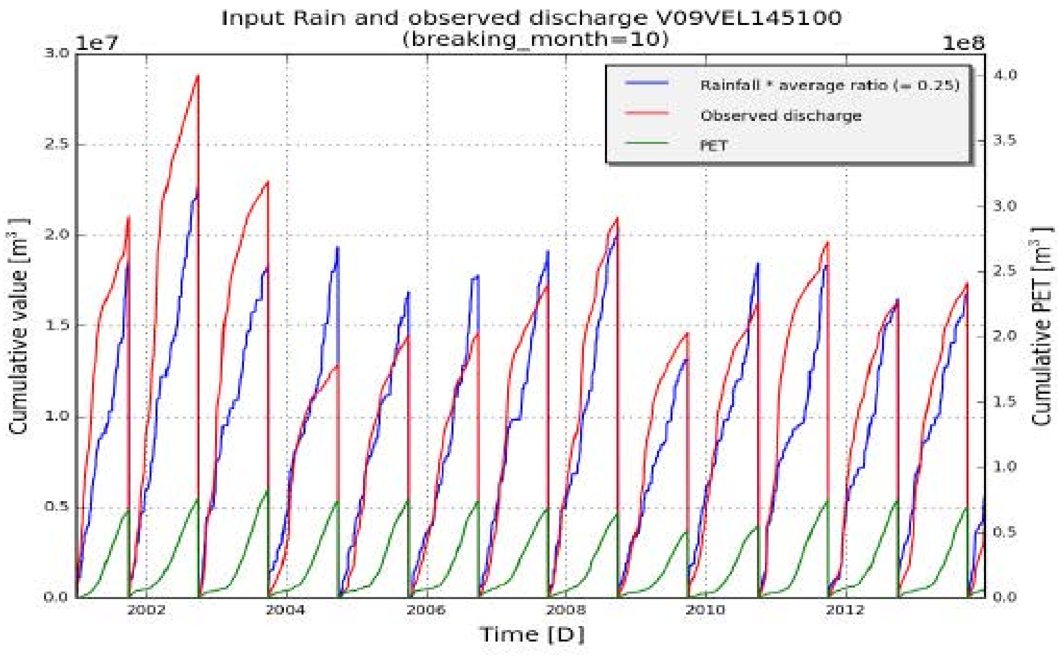


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V09VEL145100 (Demerbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V09VEL145100
subcatchment_area [m2]	96801128
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 415.16), ('SMevap', 213.38), ('c1', 2.13), ('c2', 0.63), ('c3', 1.0), ('cOF1', -6.51), ('cOF2', 5.11), ('cIF1', -4.16), ('cIF2', 3.8), ('CQOF', 9.95), ('CKIF', 81.75), ('CKBF', 1498.36)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	0.6 %	32.2 %	-12.3 %
NS	0.724	0.36	0.664
NS_log	0.658	0.132	0.593
NS_rel	0.7	0.079	0.777
KGE	0.773	0.549	0.711

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.0 %	45.5 %	-19.3 %
NS	0.671	0.524	0.628
NS_log	0.594	0.195	0.475
NS_rel	-1.605	-2.593	0.765
KGE	0.772	0.407	0.75

1.3 Observed and simulated timeseries for optimum parameters

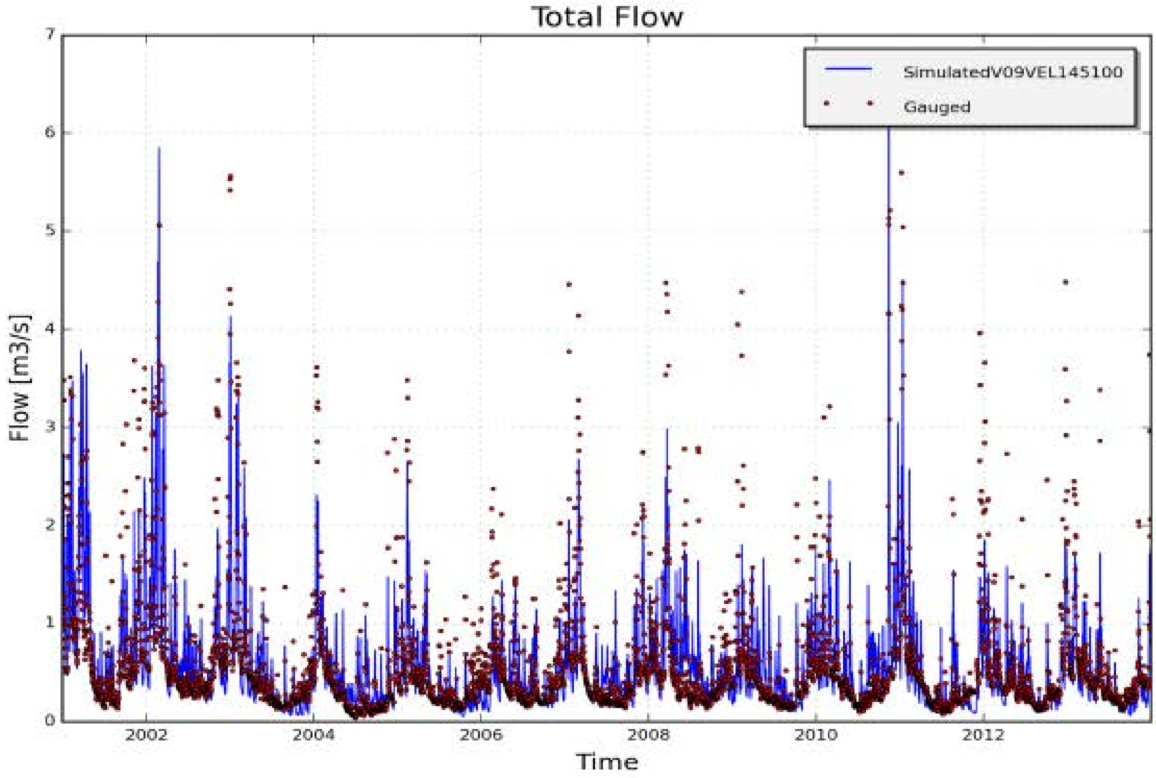


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09VEL145100, station 14510102 - Velp; Ransberg(calibration period)

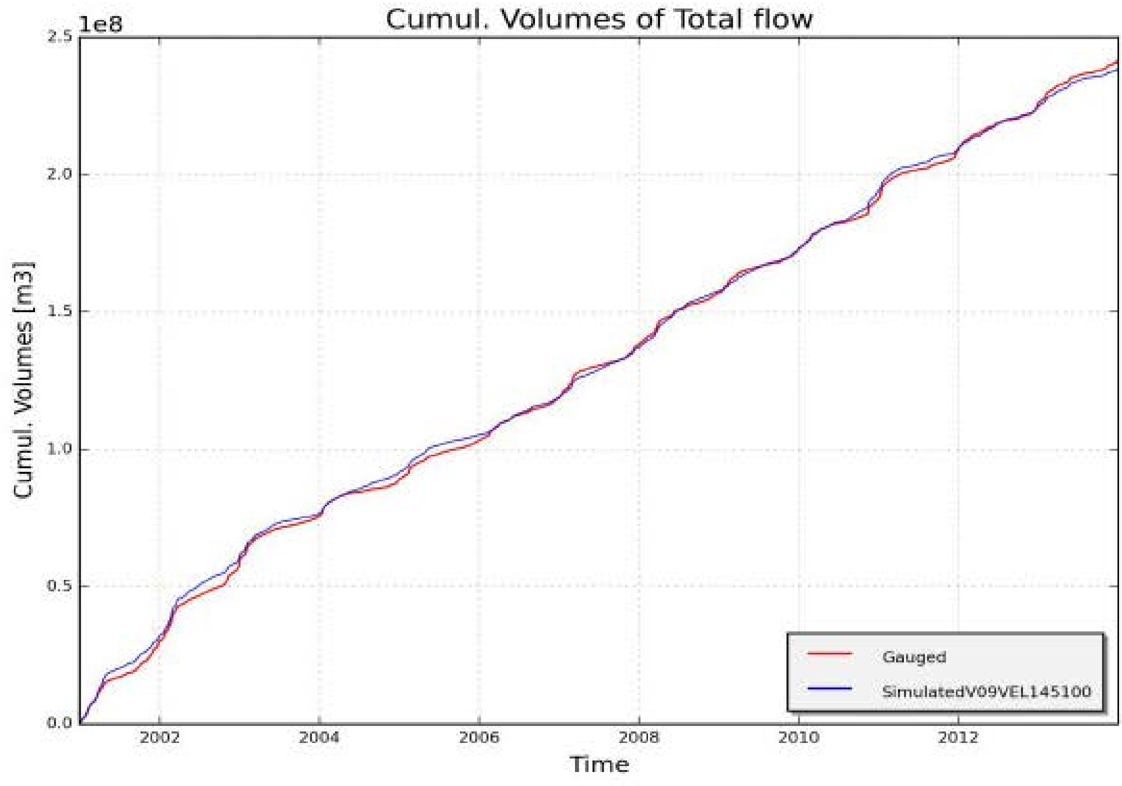


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09VEL145100, station 14510102 - Velp; Ransberg (calibration period)

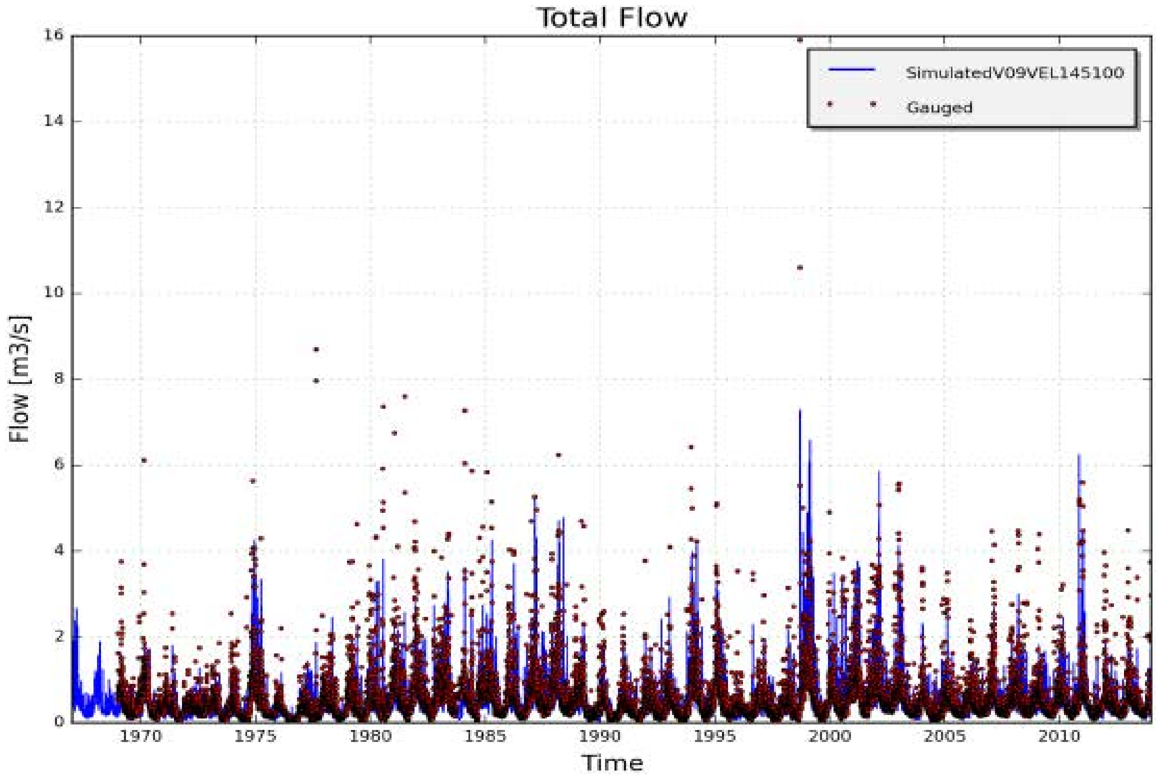


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09VEL145100, station 14510102 - Velp; Ransberg (validation period)

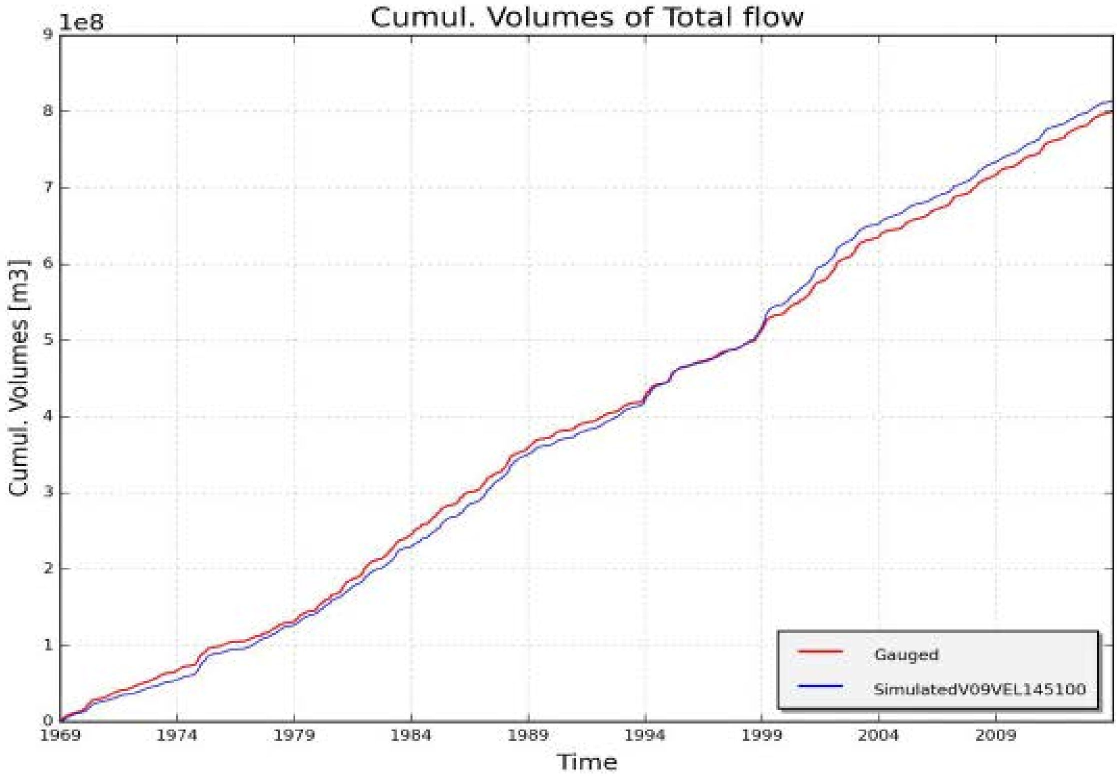


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09VEL145100, station 14510102 - Velp; Ransberg (validation period)

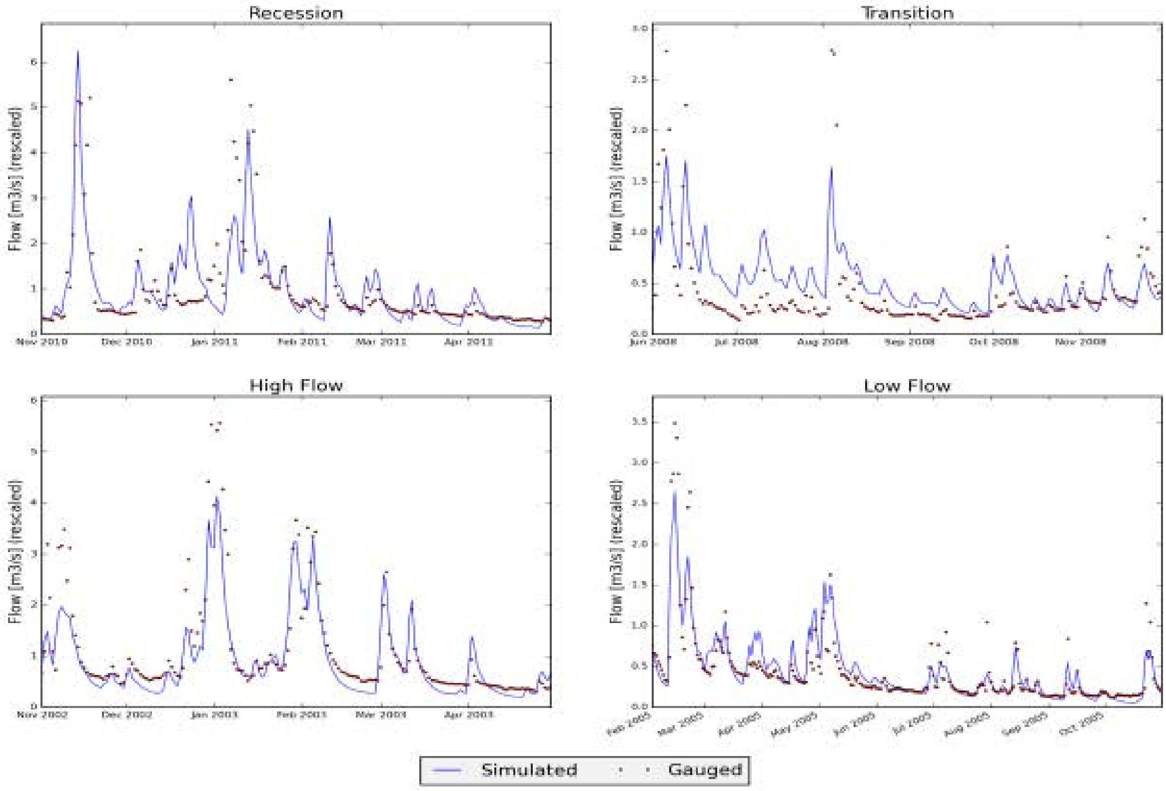


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09VEL145100, station 14510102 - Velp; Ransberg

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V09WIN141310" (DEMERBEKKEN)

1.1 Input data

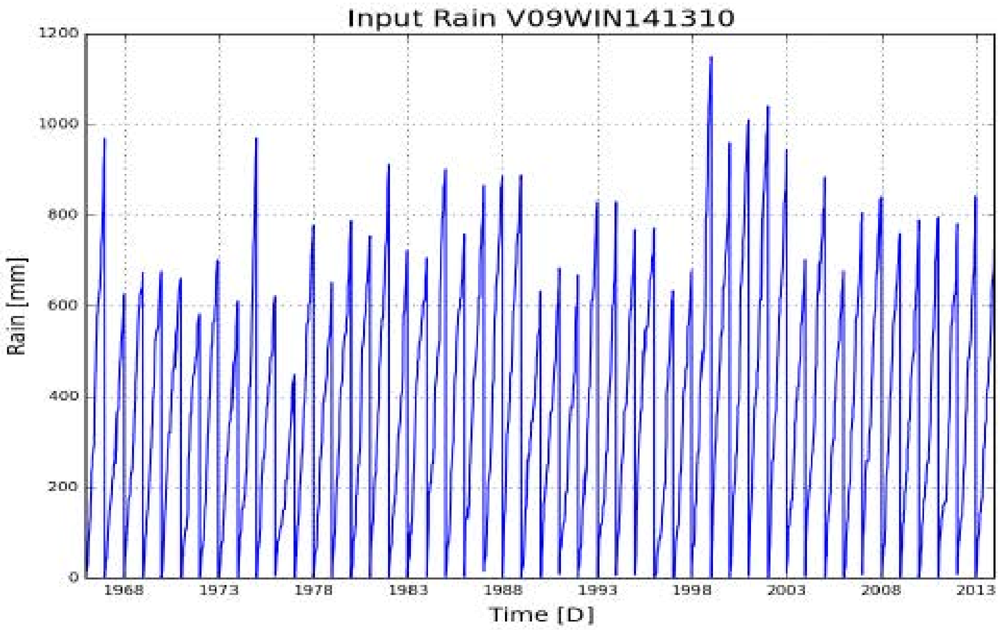


Figure 1: Cumulative precipitation on catchment V09WIN141310 (Demerbekken)

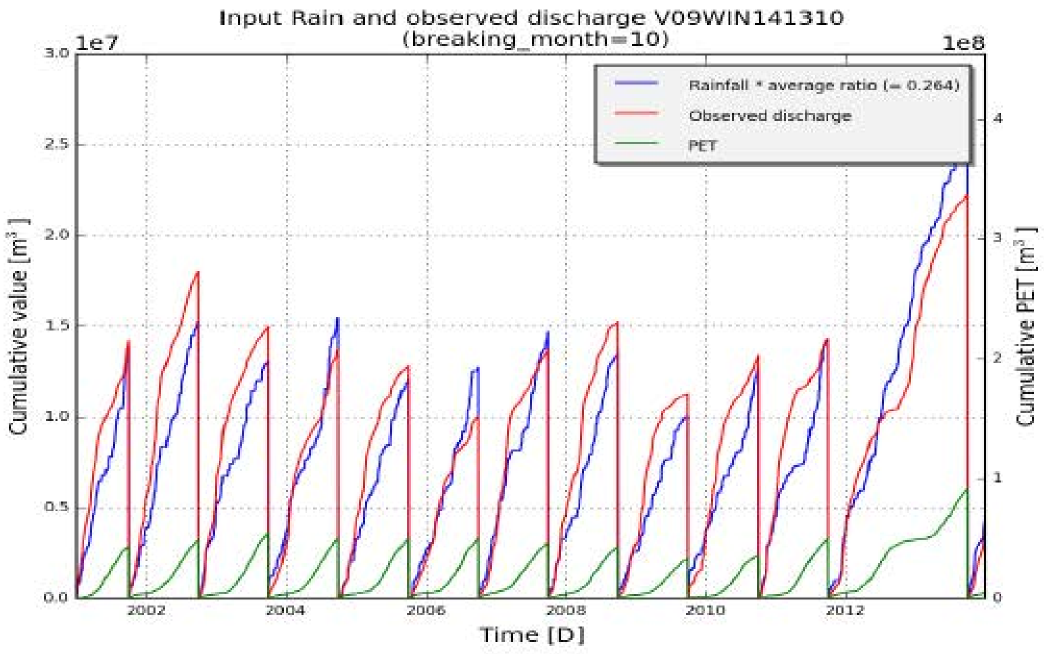


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V09WIN141310 (Demerbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V09WIN141310
subcatchment_area [m2]	64739169
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 471.29), ('SMevap', 165.37), ('c1', 1.99), ('c2', 0.57), ('c3', 1.0), ('cOF1', -4.06), ('cOF2', 3.56), ('cIF1', -4.06), ('cIF2', 2.9), ('CQOF', 10.54), ('CKIF', 81.96), ('CKBF', 722.89)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	1.7 %	15.2 %	-7.2 %
NS	0.677	0.531	0.689
NS_log	0.58	0.247	0.598
NS_rel	-13.532	-28.071	0.757
KGE	0.802	0.623	0.806

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	3.9 %	13.7 %	-2.8 %
NS	0.579	0.593	0.55
NS_log	0.585	0.416	0.498
NS_rel	-7.196	-9.36	0.69
KGE	0.787	0.701	0.746

1.3 Observed and simulated timeseries for optimum parameters

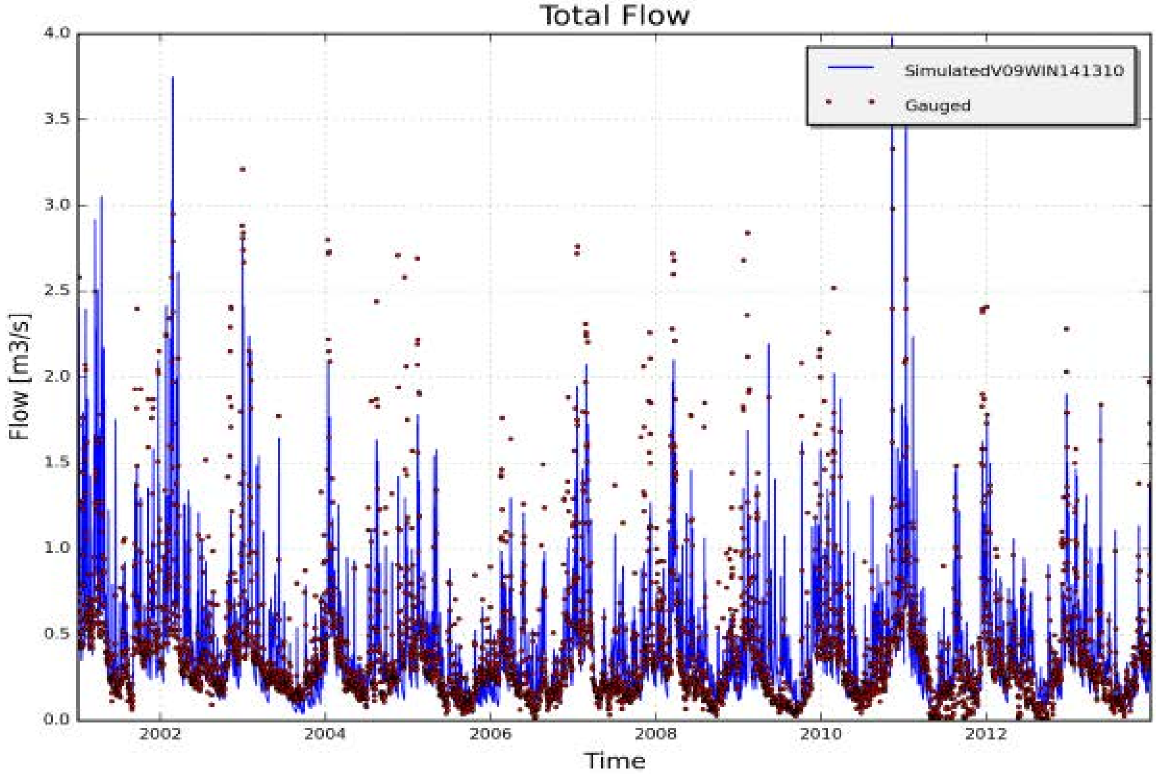


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09WIN141310, station 141 - Rotselaar ; Winge(calibration period)

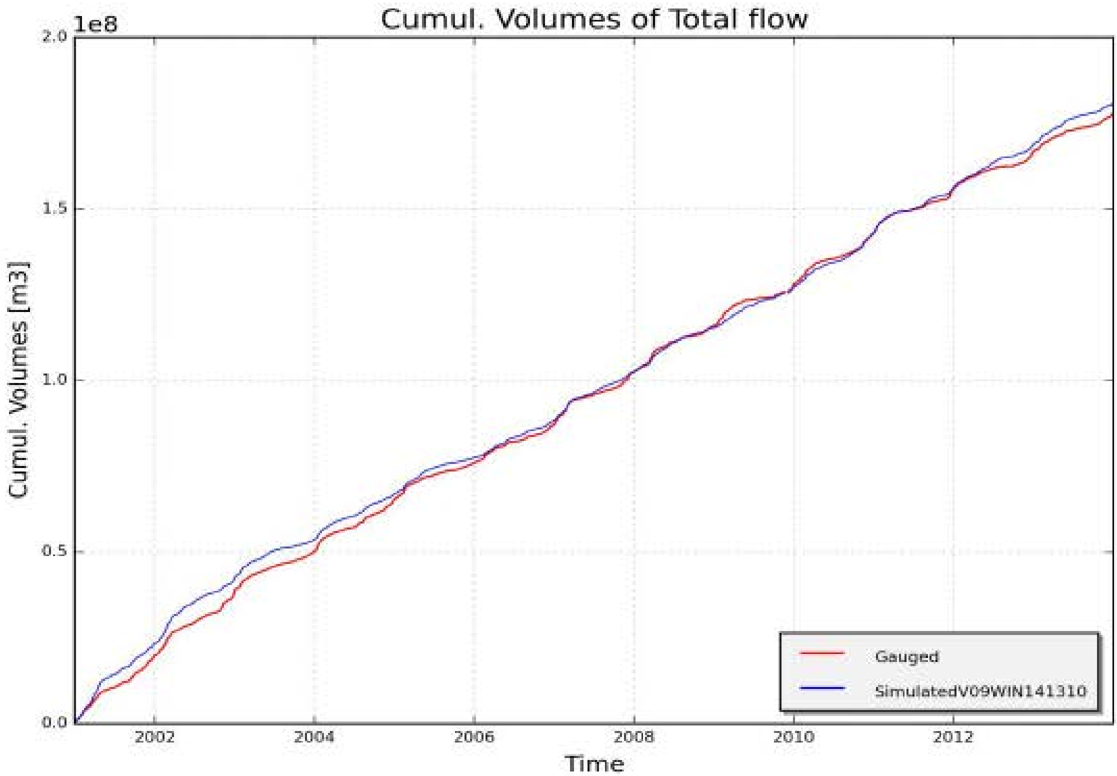


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09WIN141310, station 141 - Rotselaar ; Winge (calibration period)

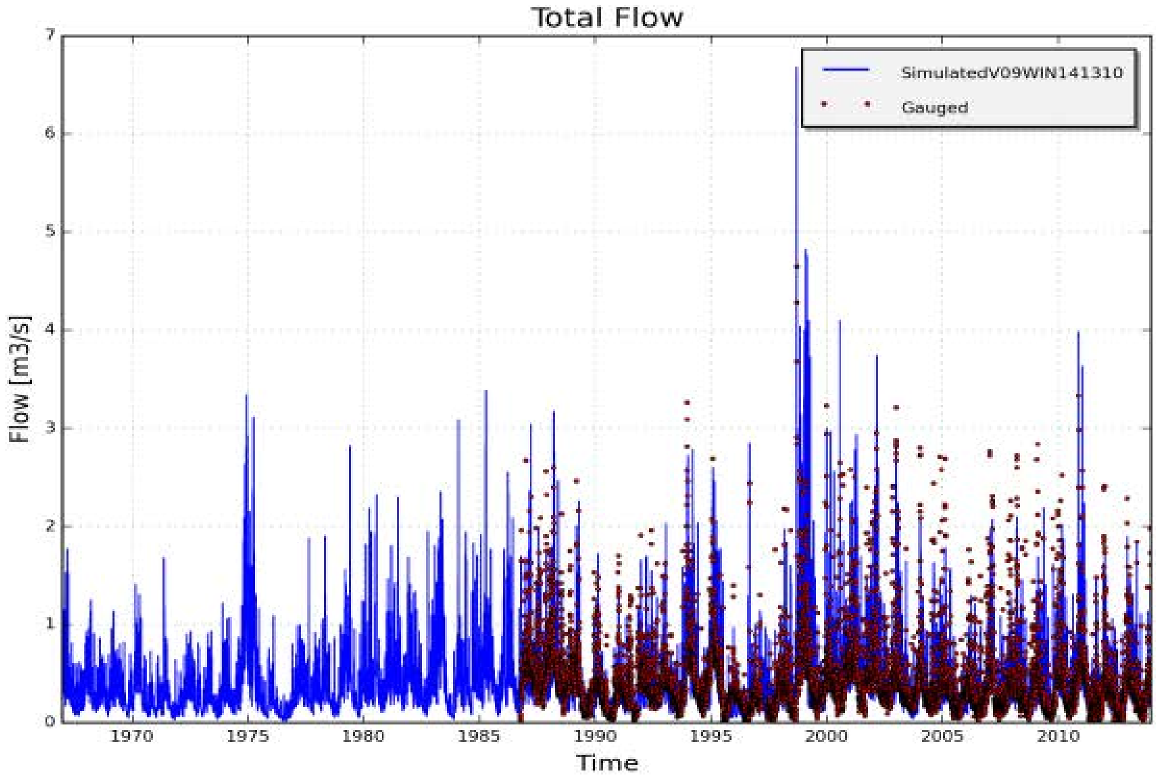


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09WIN141310, station 141 - Rotselaar ; Winge (validation period)

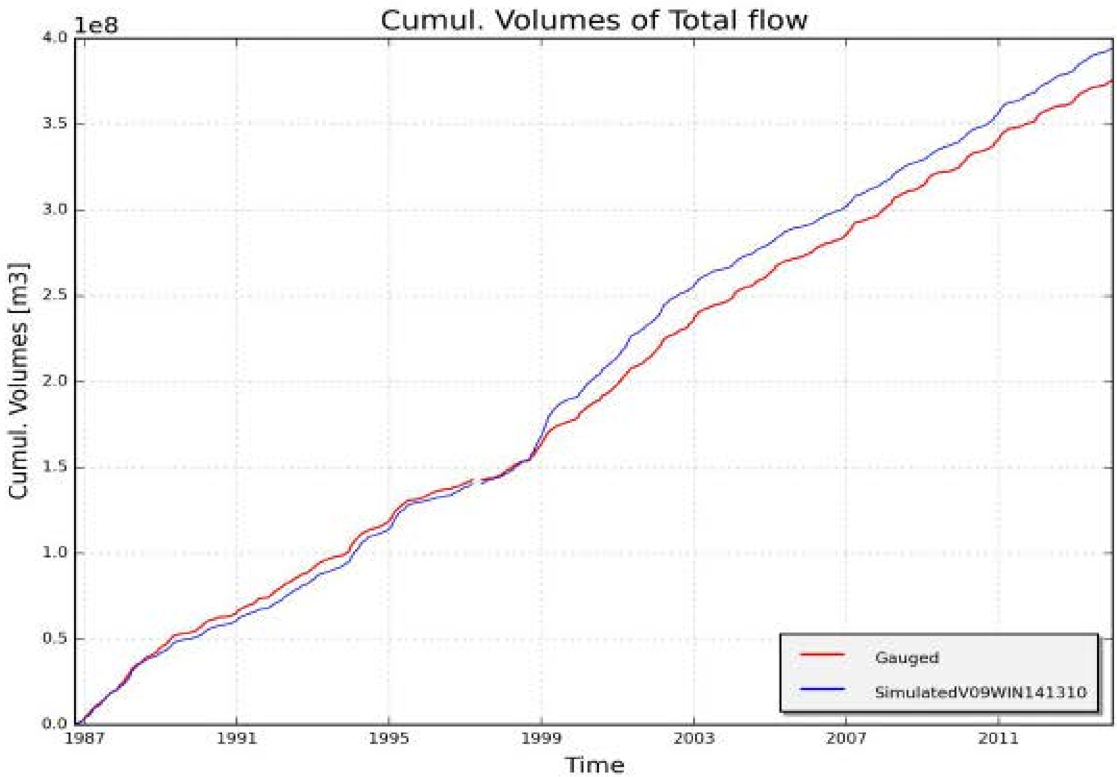


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09WIN141310, station 141 - Rotselaar ; Winge (validation period)

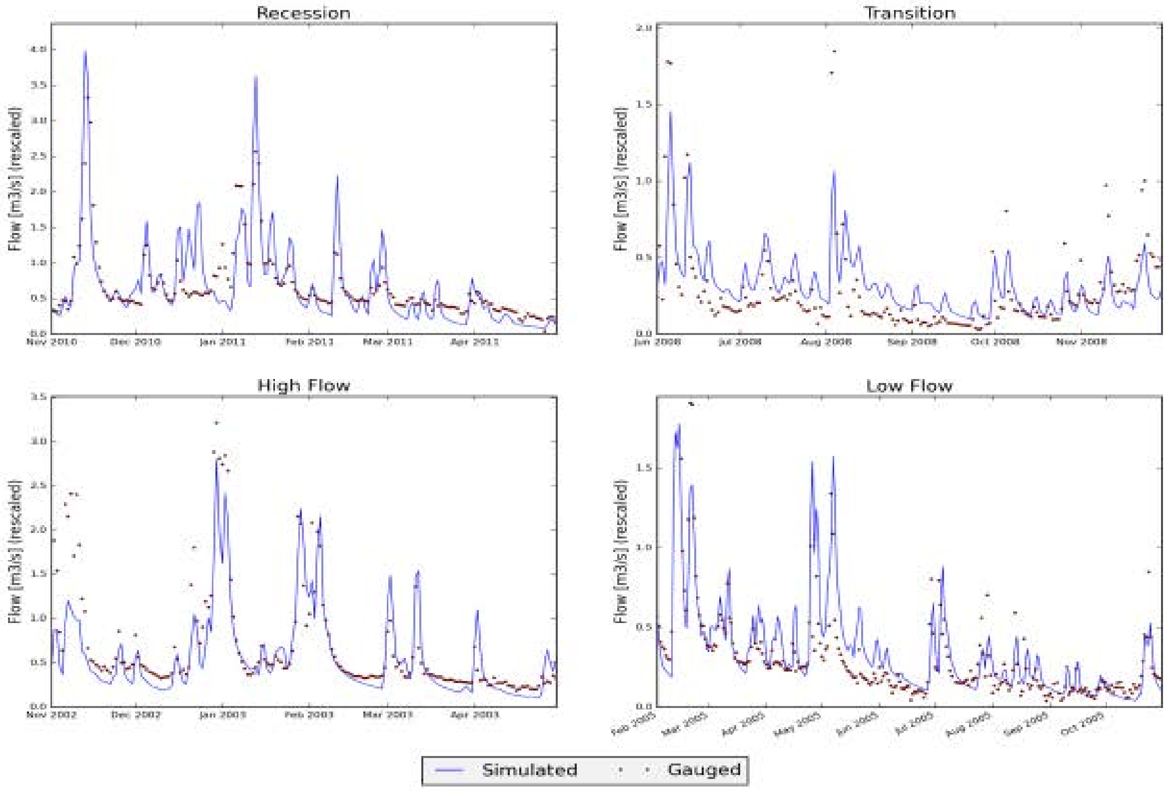


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09WIN141310, station 141 - Rotselaar ; Winge

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V09ZWA148120" (DEMERBEKKEN)

1.1 Input data

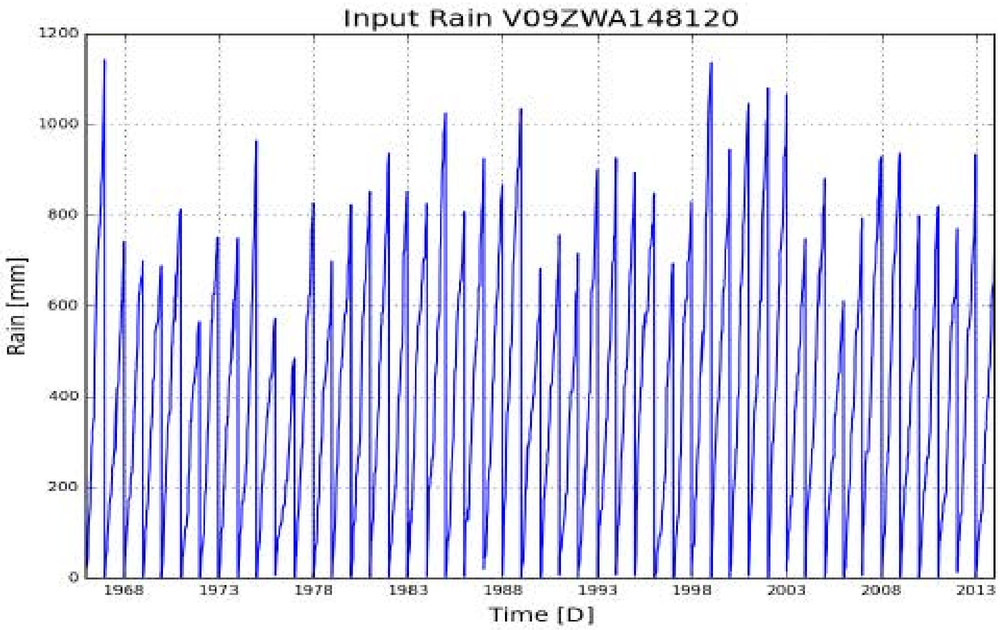


Figure 1: Cumulative precipitation on catchment V09ZWA148120 (Demerbekken)

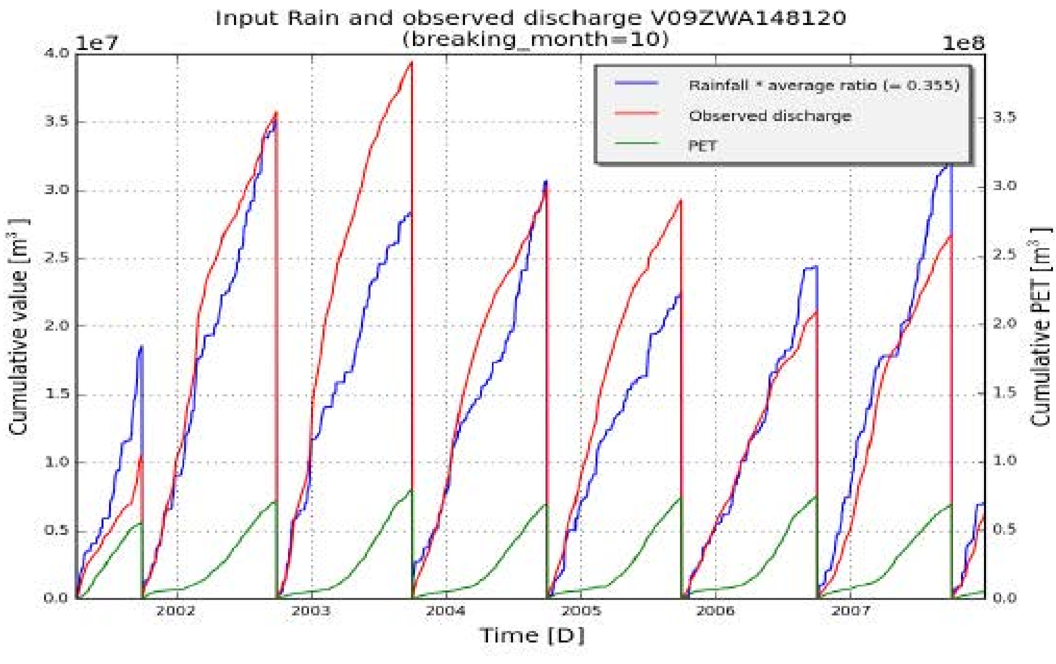


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V09ZWA148120 (Demerbekken)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V09ZWA148120
subcatchment_area [m2]	96514800
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 451.62), ('SMevap', 158.48), ('c1', 1.82), ('c2', 0.48), ('c3', 1.0), ('cOF1', -5.29), ('cOF2', 5.0), ('cIF1', -3.58), ('cIF2', 2.85), ('CQOF', 15.02), ('CKIF', 49.62), ('CKBF', 724.81)]

Table 1: Goodness of fit for calibration period (2001 - 2007)

	Full year	**Summer**	**Winter**
RelErr	3.4 %	29.1 %	-7.9 %
NS	0.637	0.229	0.702
NS_log	0.481	0.024	0.693
NS_rel	0.145	-1.59	0.788
KGE	0.802	0.57	0.838

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-9.7 %	9.2 %	-16.2 %
NS	0.545	0.257	0.65
NS_log	0.336	0.232	0.344
NS_rel	-3.291	-8.101	0.344
KGE	0.734	0.485	0.809

1.3 Observed and simulated timeseries for optimum parameters

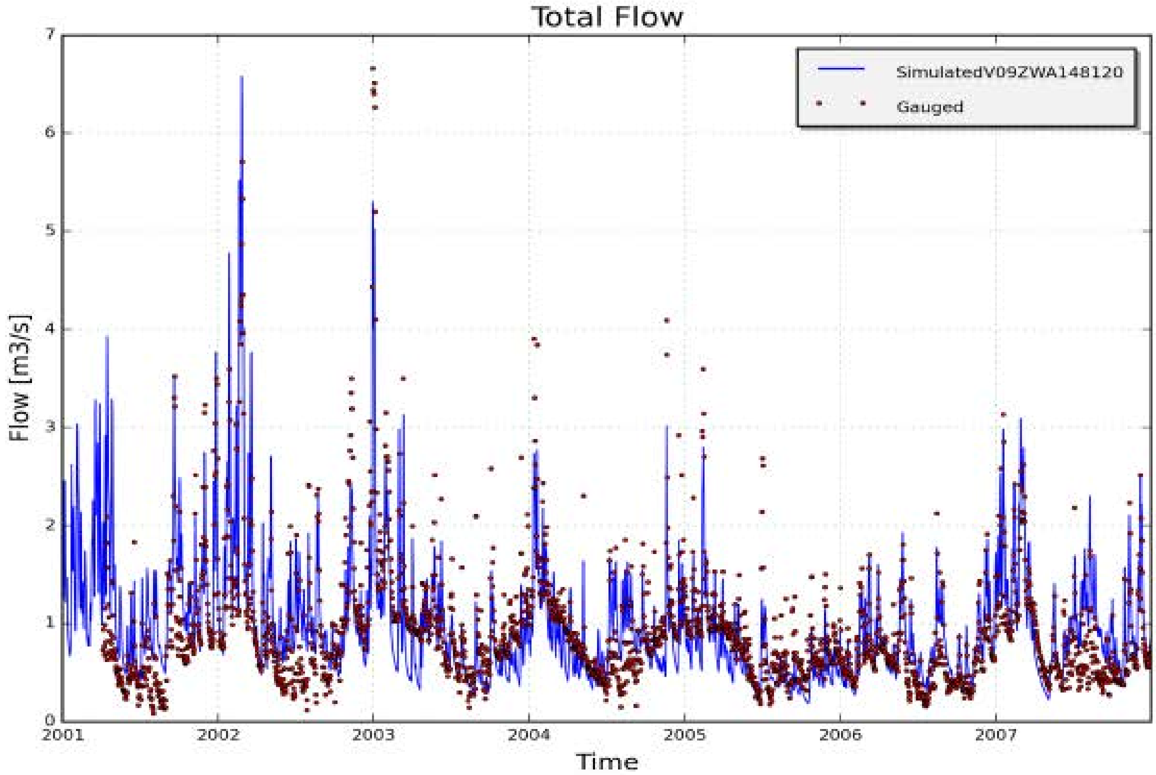


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09ZWA148120, station 14810102 - Zwarte Beek; Lummen(calibration period)

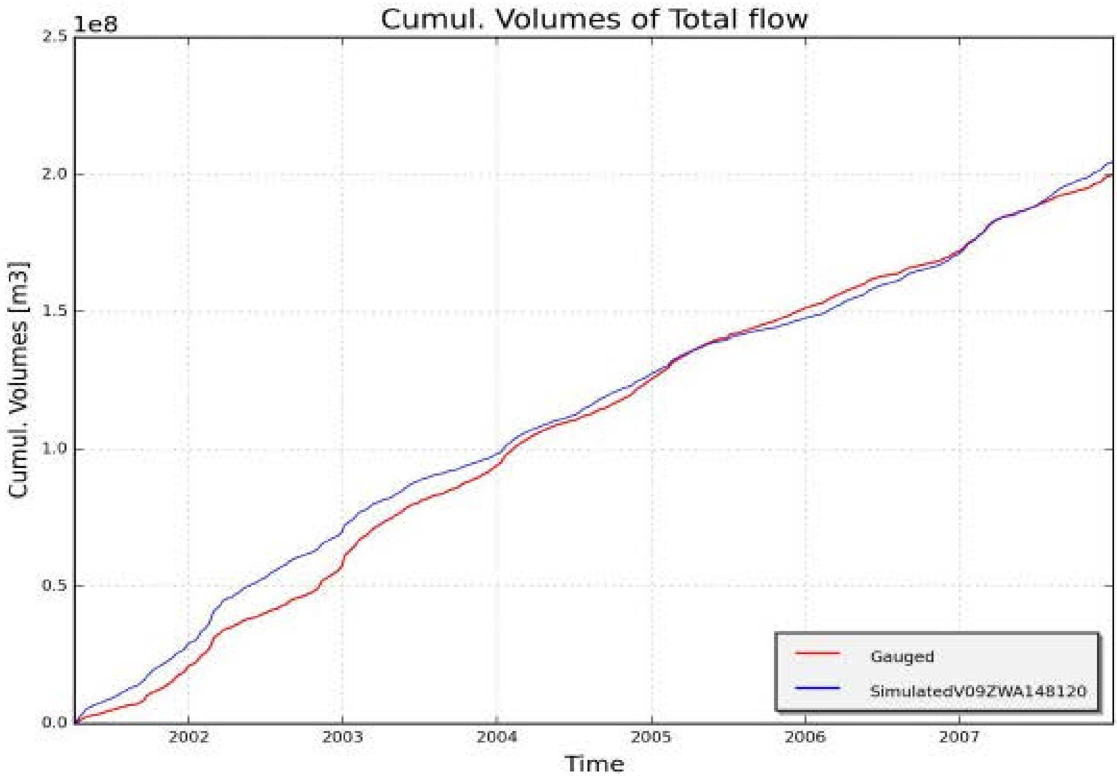


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09ZWA148120, station 14810102 - Zwarte Beek; Lummen (calibration period)

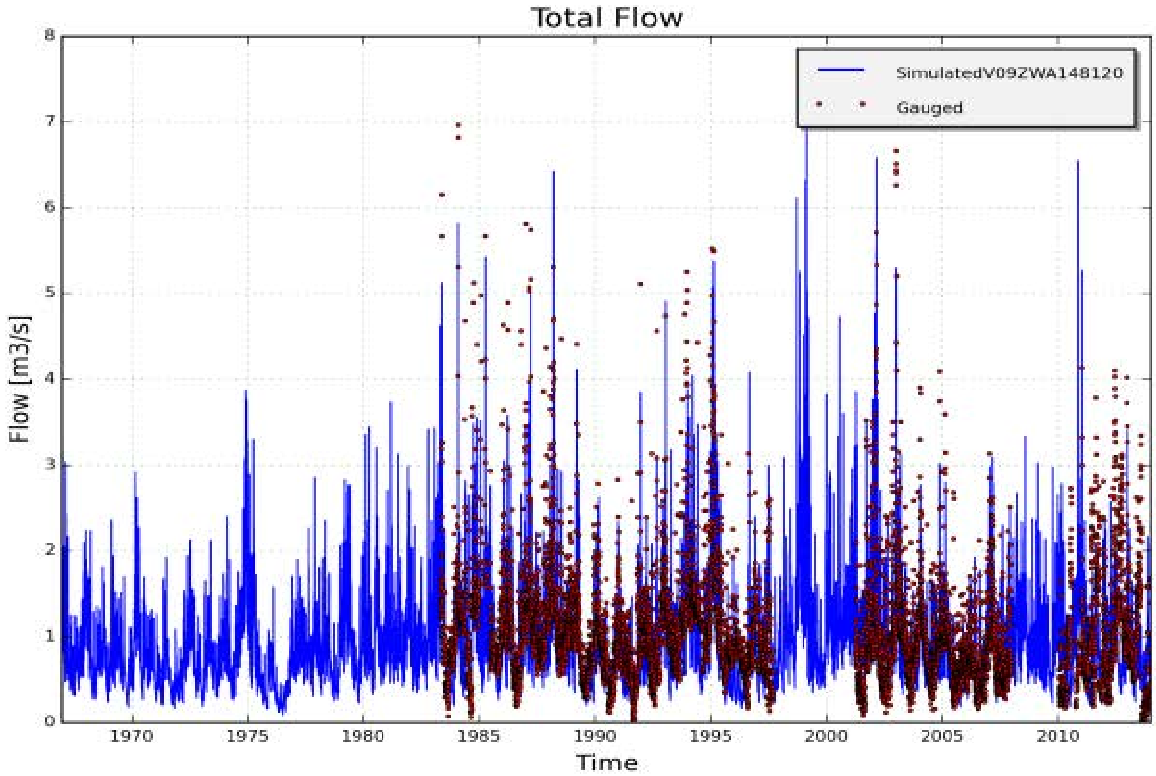


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V09ZWA148120, station 14810102 - Zwarte Beek; Lummen (validation period)

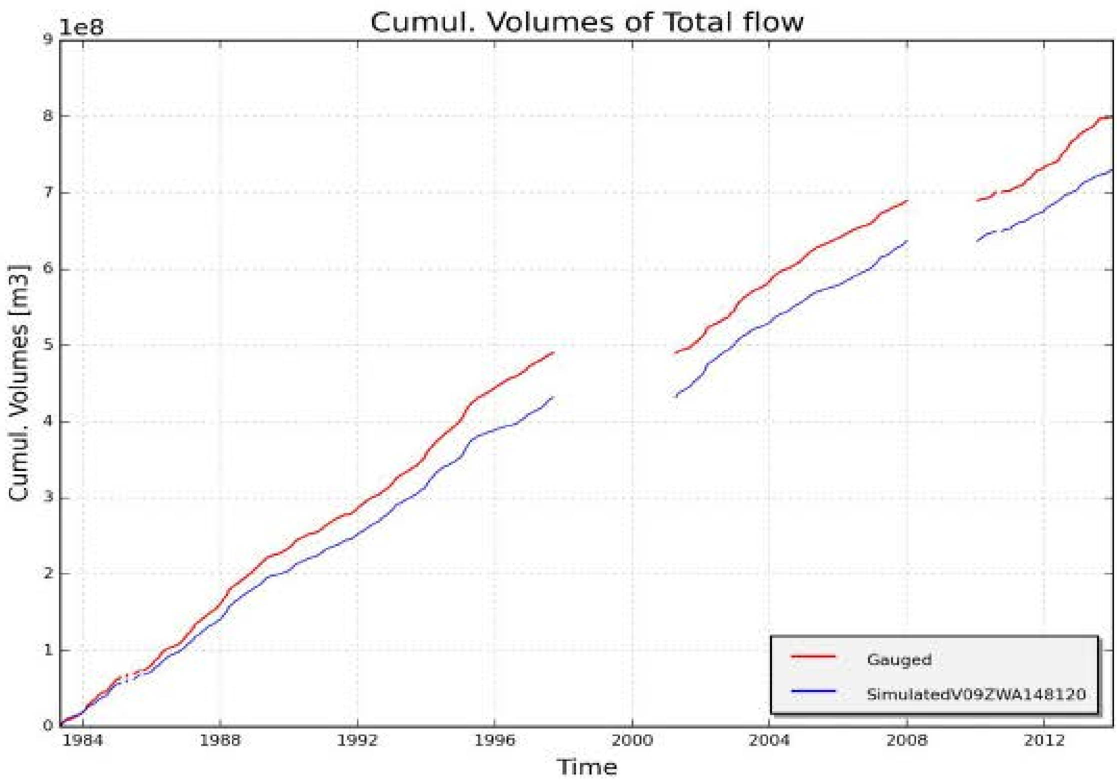


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V09ZWA148120, station 14810102 - Zwarte Beek; Lummen (validation period)

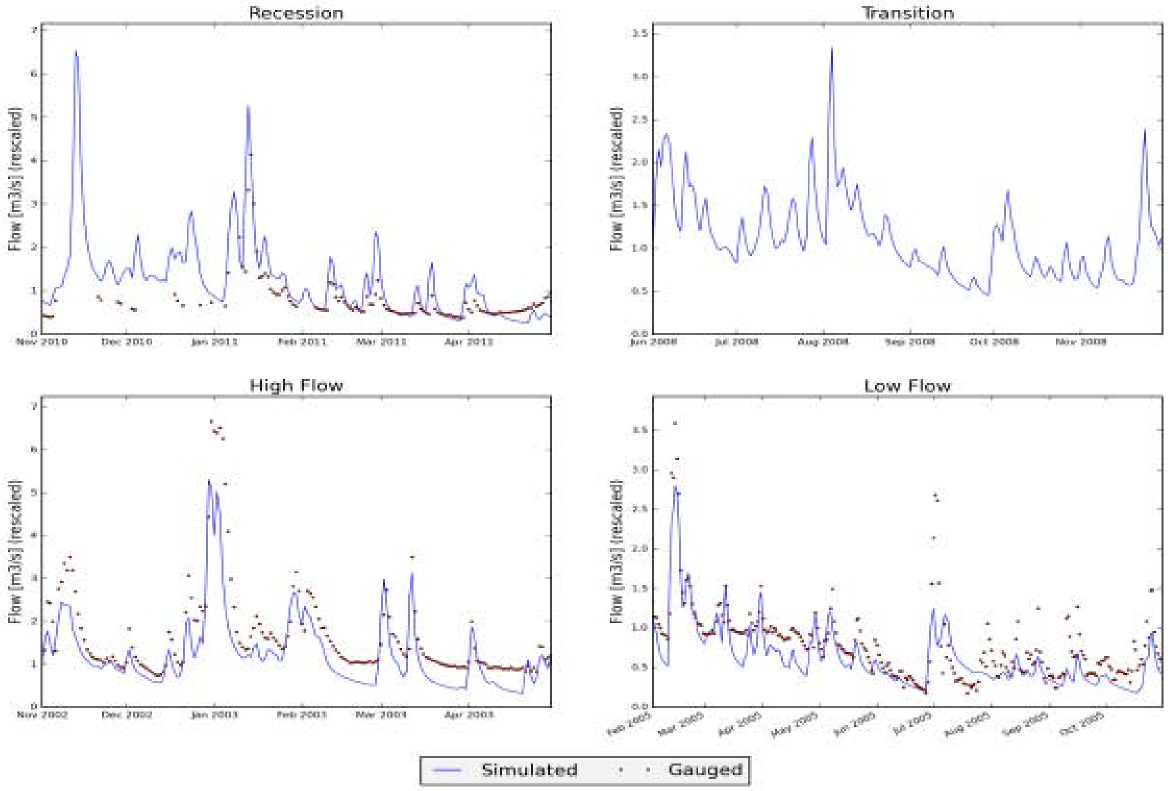


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09ZWA148120, station 14810102 - Zwarte Beek; Lummen

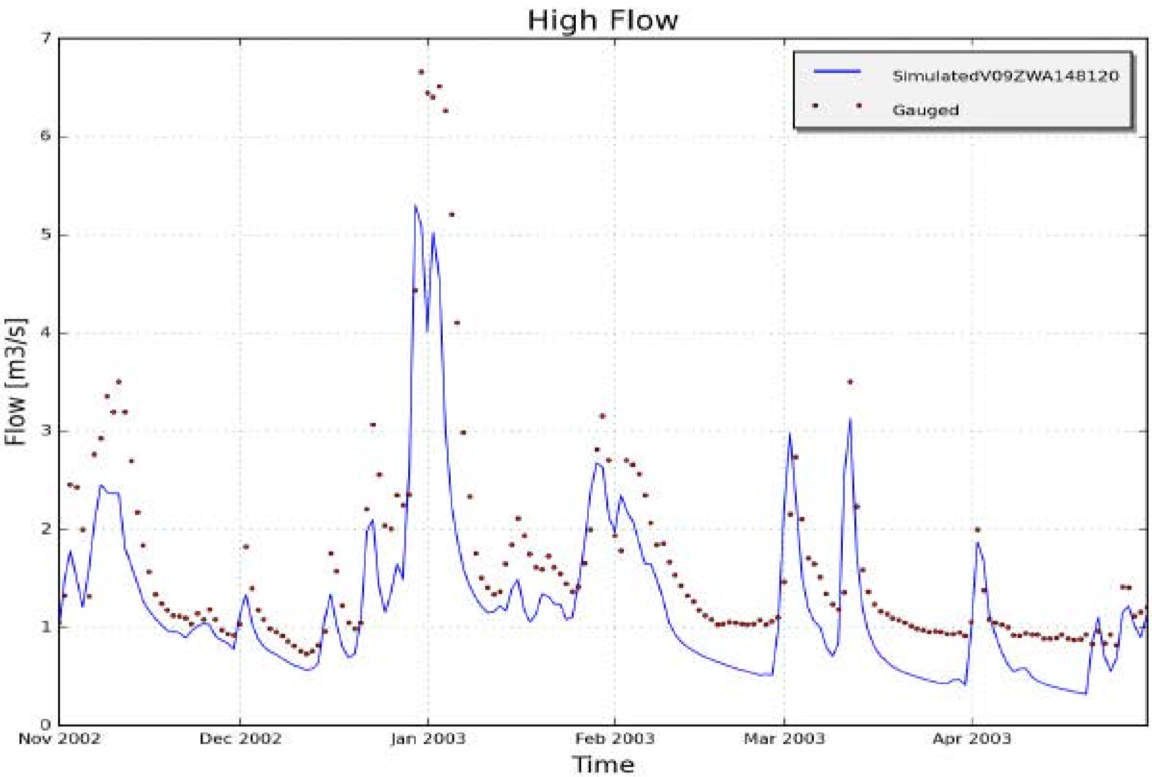


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09ZWA148120, station 14810102 - Zwarte Beek; Lummen

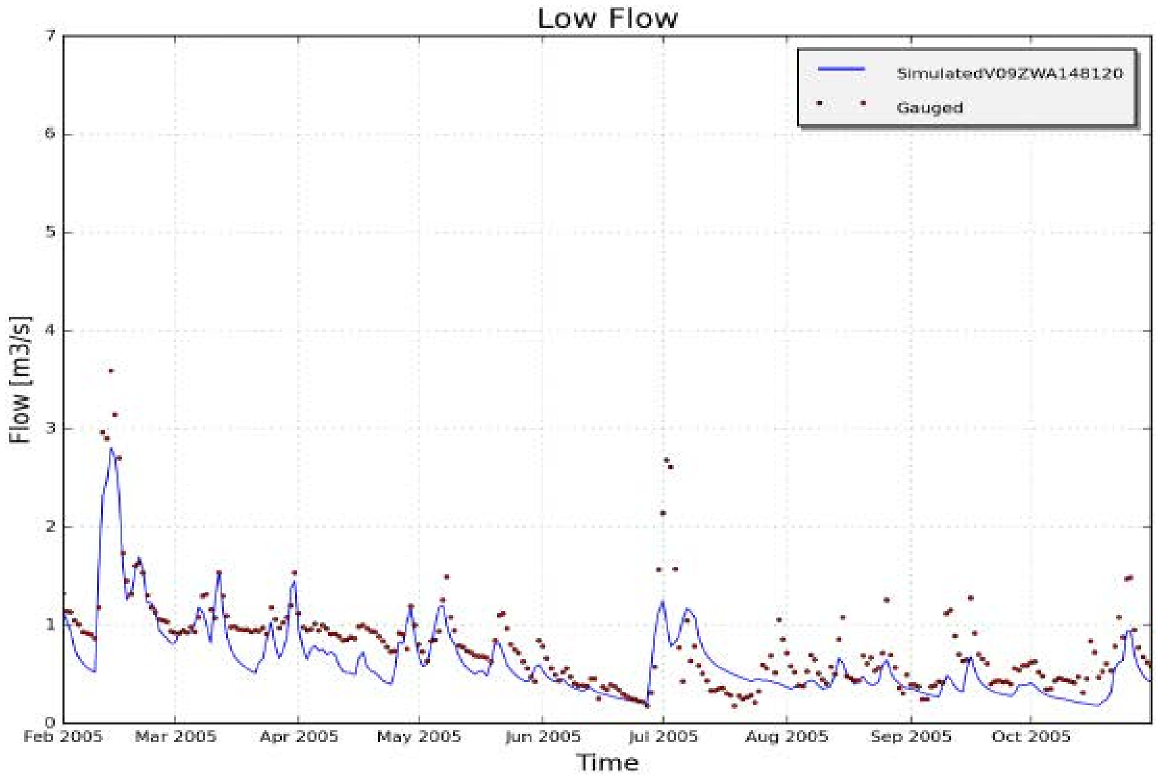


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V09ZWA148120, station 14810102 - Zwarte Beek; Lummen

Appendix 12 Nete

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V10GLA086020" (NETE)

1.1 Input data

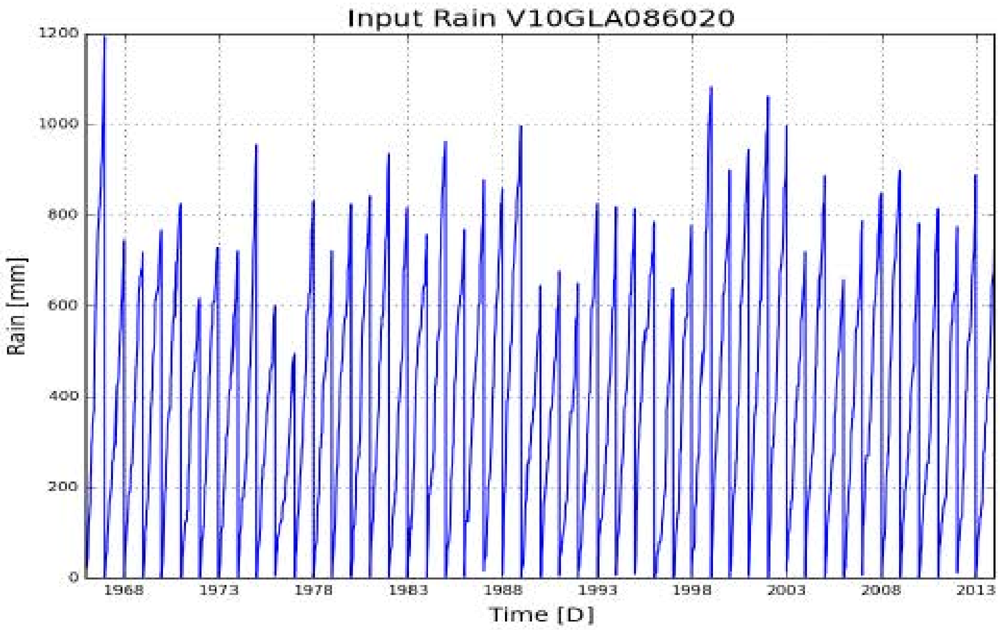


Figure 1: Cumulative precipitation on catchment V10GLA086020 (Nete)

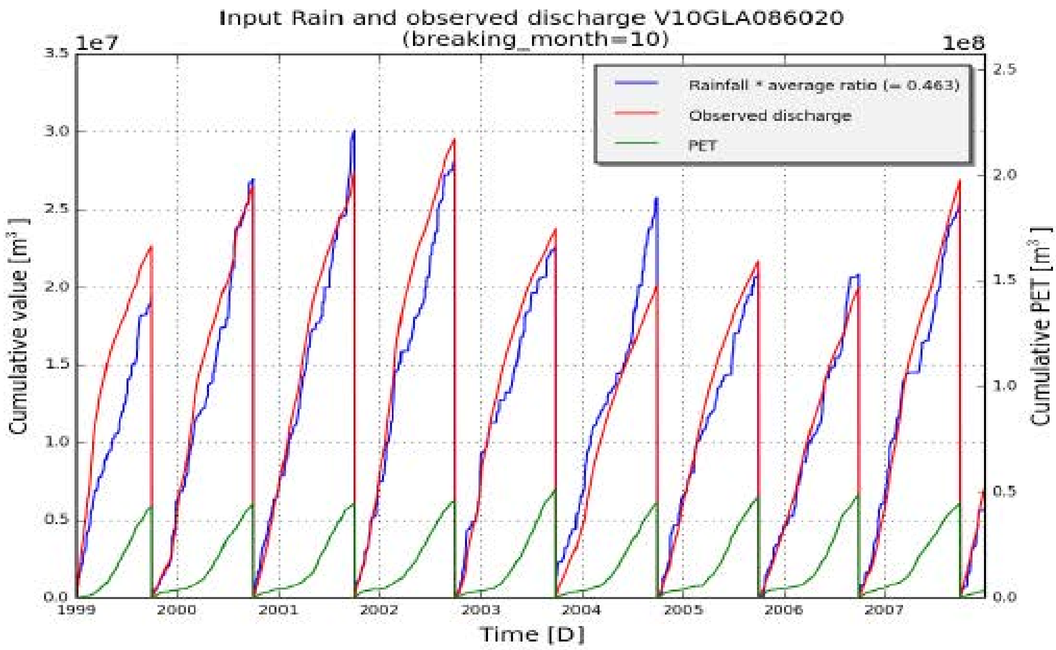


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V10GLA086020 (Nete)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V10GLA086020
subcatchment_area [m2]	62621236
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 417.77), ('SMevap', 253.39), ('c1', 1.66), ('c2', 0.23), ('c3', 1.0), ('cOF1', -7.85), ('cOF2', 4.5), ('cIF1', -4.46), ('cIF2', 4.5), ('CQOF', 14.38), ('CKIF', 83.55), ('CKBF', 1503.0)]

Table 1: Goodness of fit for calibration period (1999 - 2007)

	Full year	**Summer**	**Winter**
RelErr	-0.5 %	23.4 %	-10.7 %
NS	0.706	0.339	0.706
NS_log	0.615	0.092	0.702
NS_rel	0.707	0.38	0.833
KGE	0.776	0.512	0.832

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-15.0 %	-2.3 %	-21.4 %
NS	0.536	0.174	0.55
NS_log	0.321	-0.02	0.394
NS_rel	-12.065	-38.281	0.24
KGE	0.631	0.359	0.703

1.3 Observed and simulated timeseries for optimum parameters

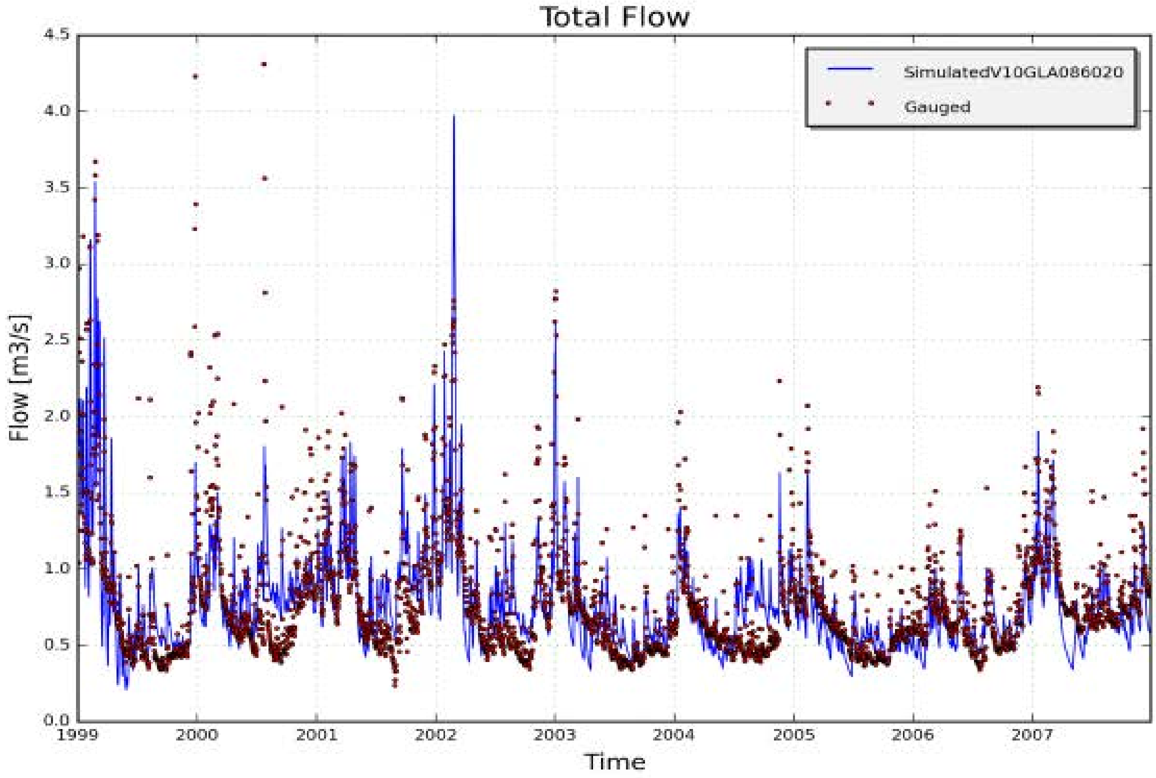


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V10GLA086020, station 8610102 - Grote Laak, Vorst(calibration period)

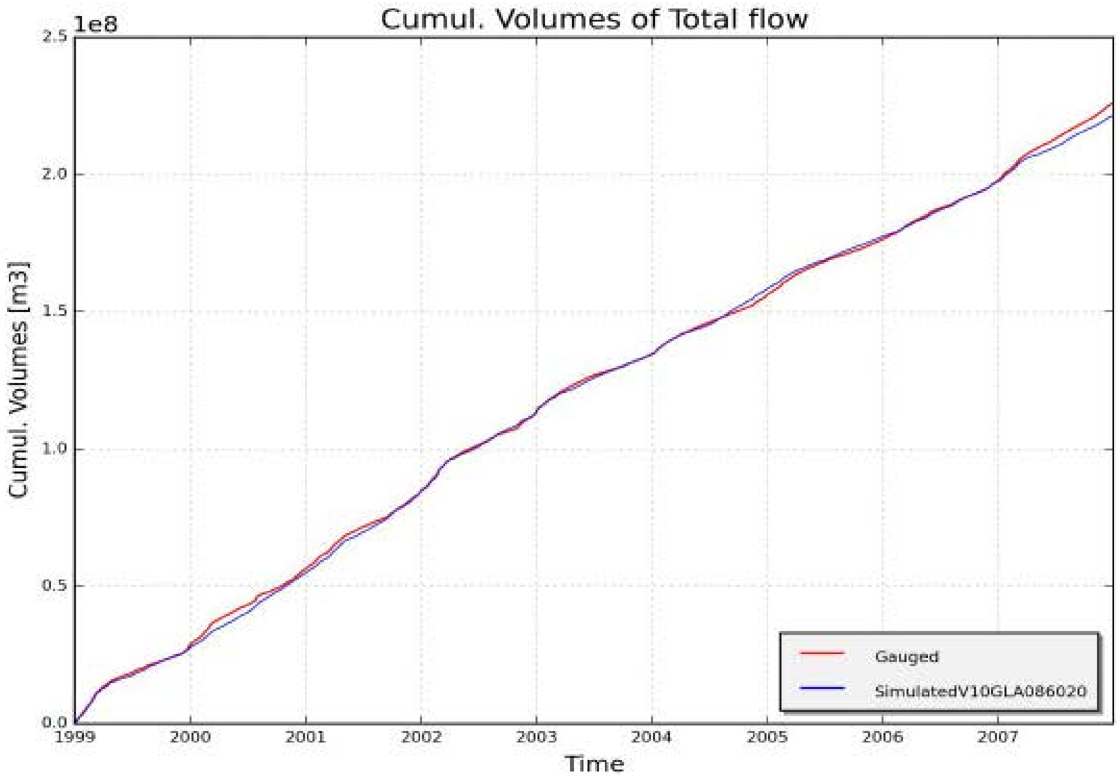


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V10GLA086020, station 8610102 - Grote Laak, Vorst (calibration period)

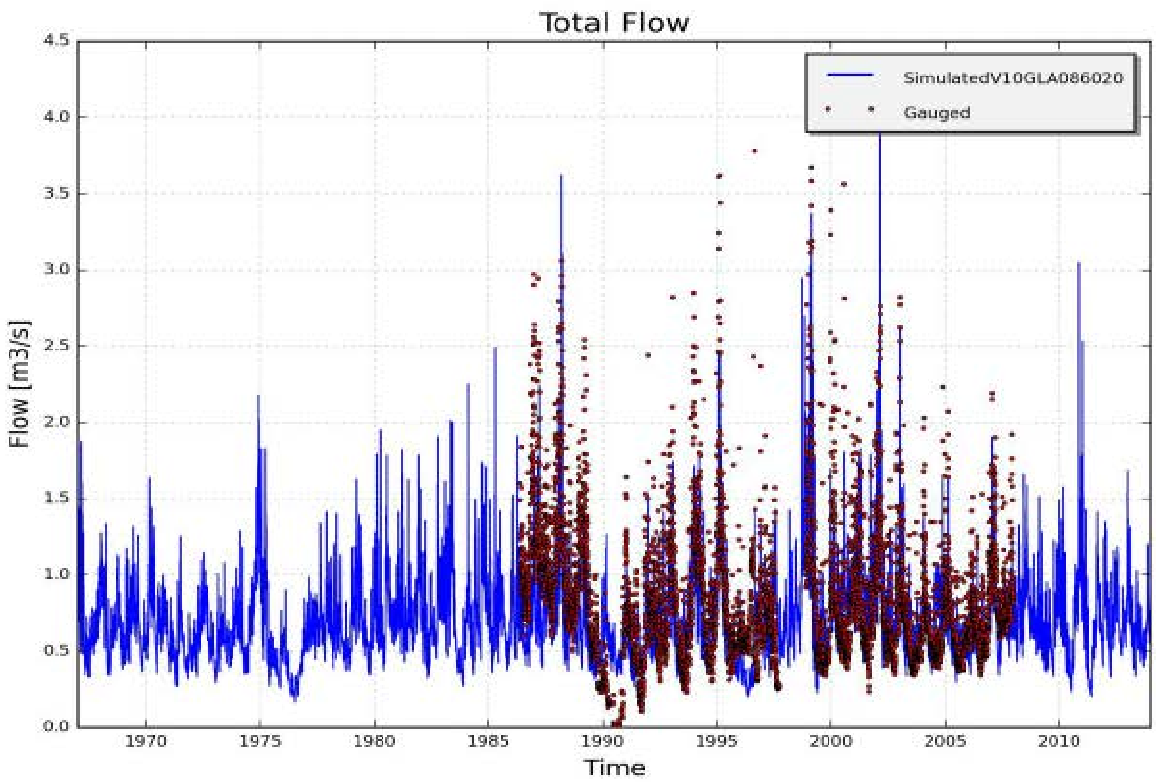


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V10GLA086020, station 8610102 - Grote Laak, Vorst (validation period)

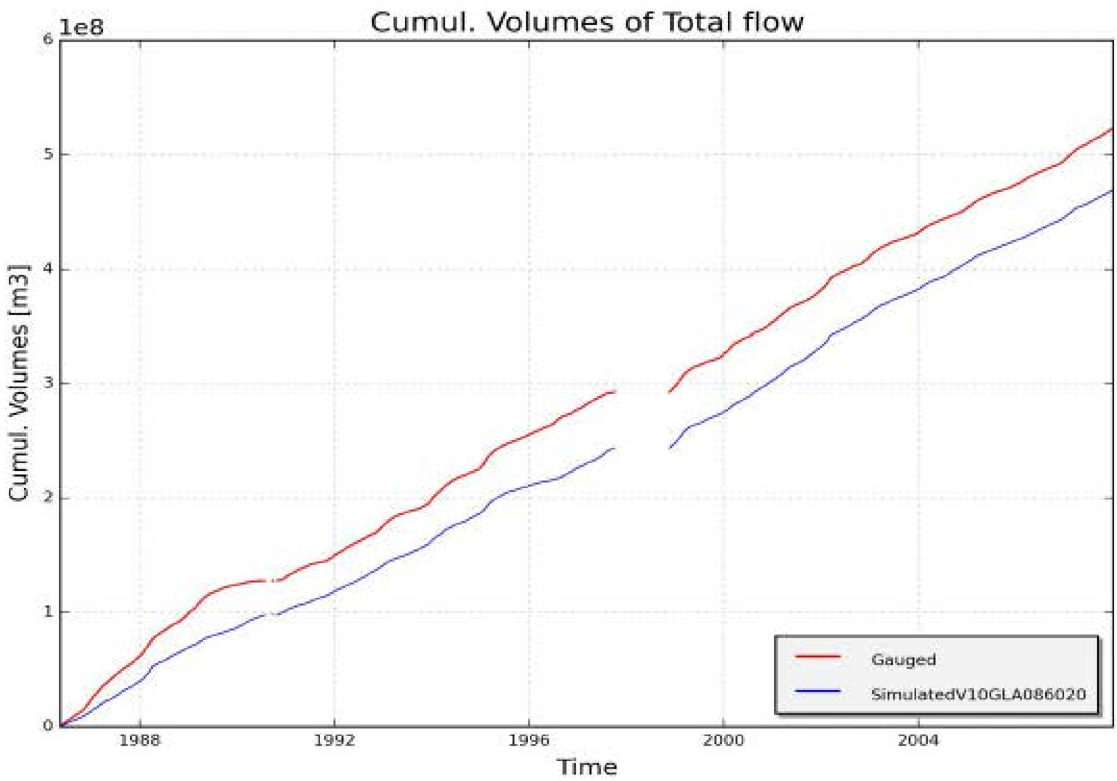


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V10GLA086020, station 8610102 - Grote Laak, Vorst (validation period)

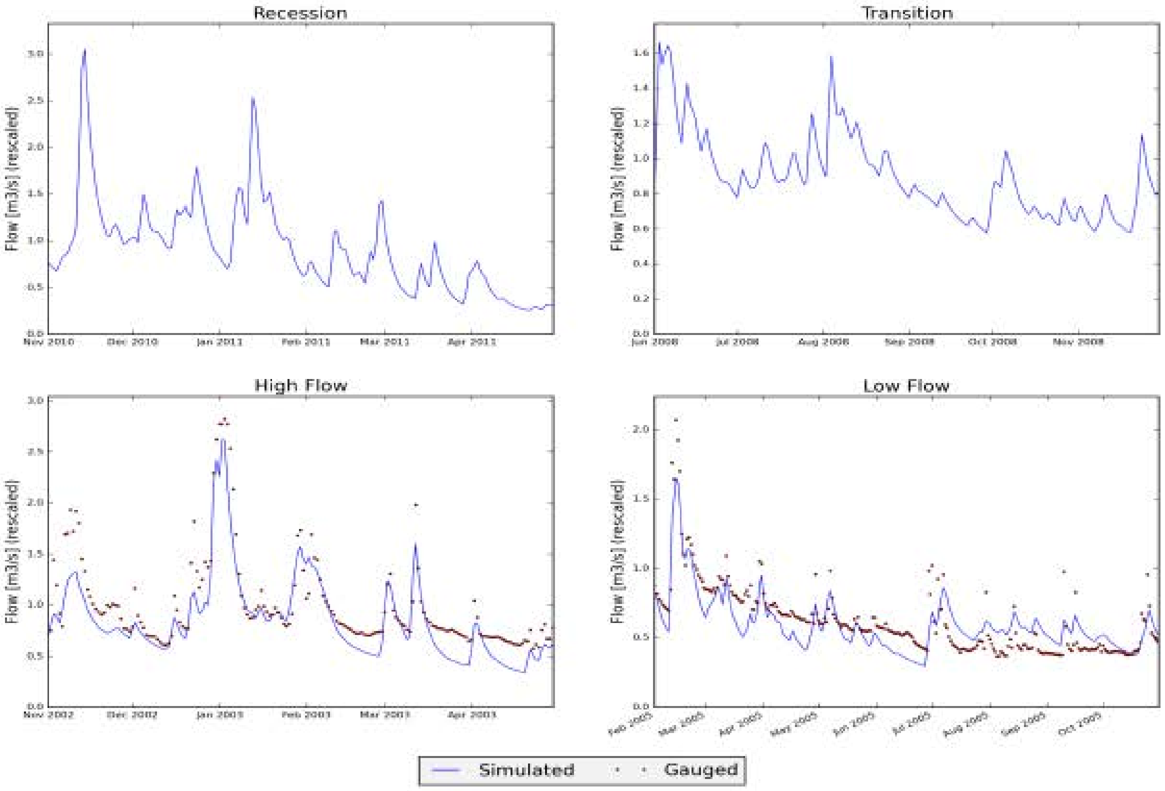


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V10GLA086020, station 8610102 - Grote Laak, Vorst

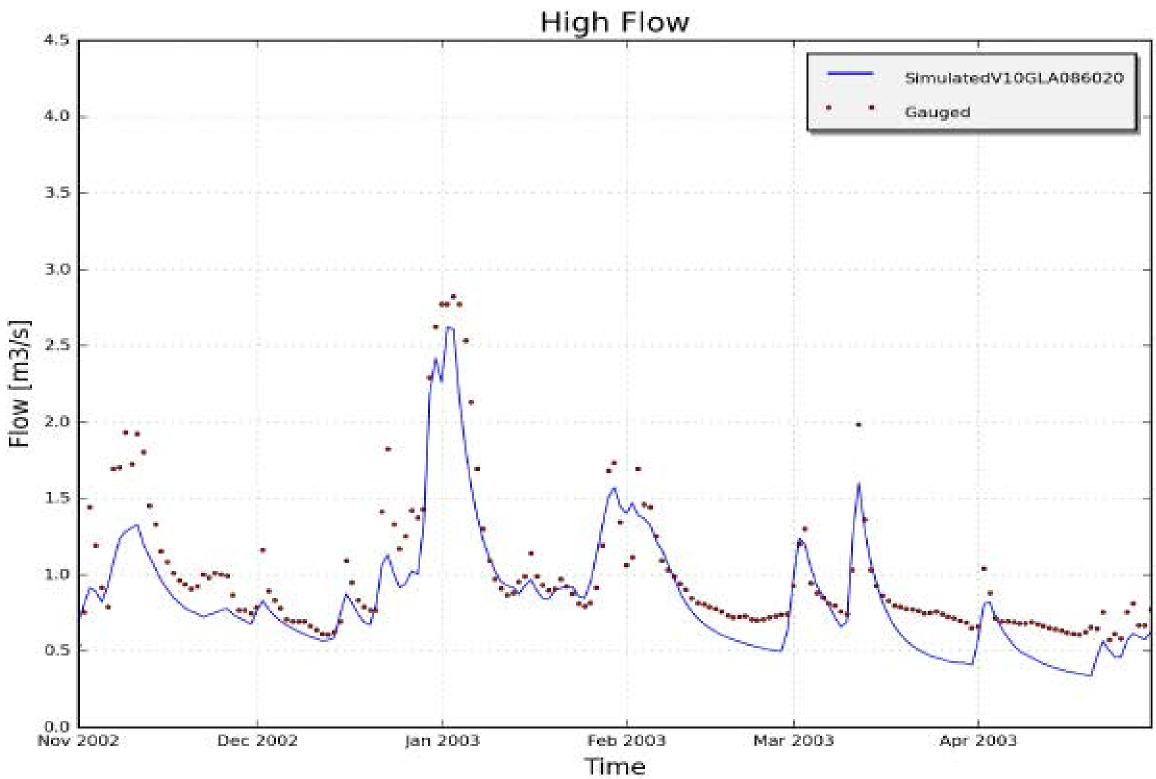


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V10GLA086020, station 8610102 - Grote Laak, Vorst

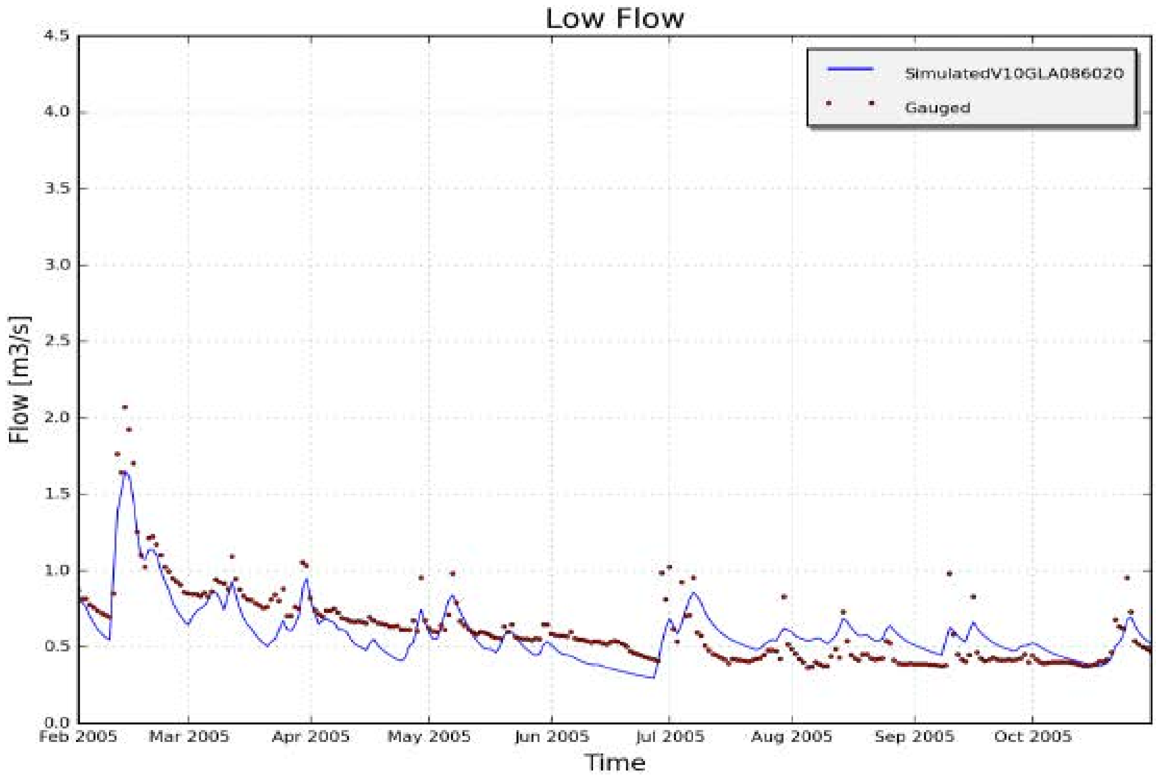


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V10GLA086020, station 8610102 - Grote Laak, Vorst

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V10GNE076999" (NETE)

1.1 Input data

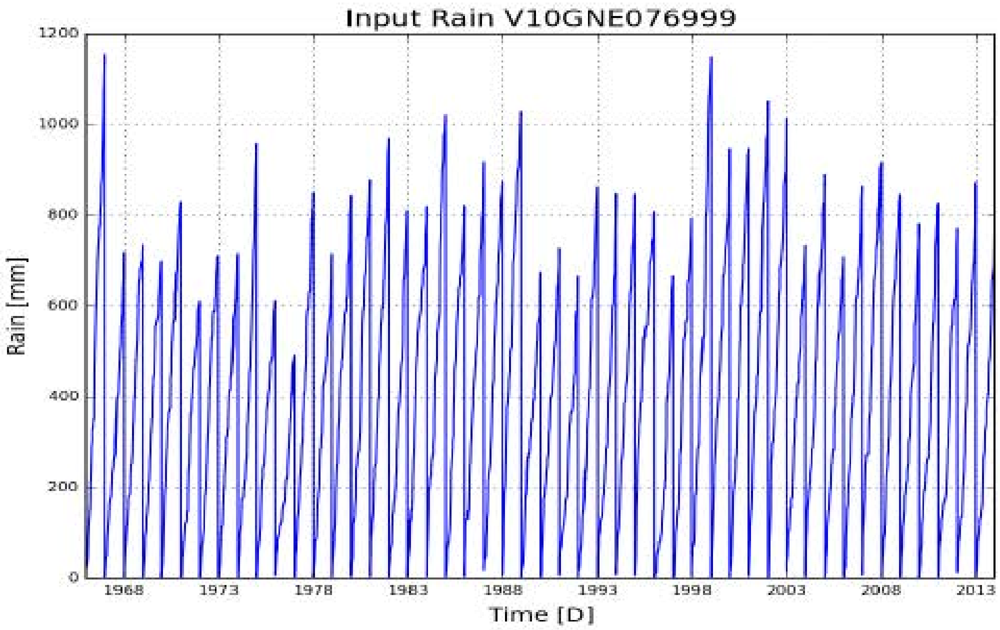


Figure 1: Cumulative precipitation on catchment V10GNE076999 (Nete)

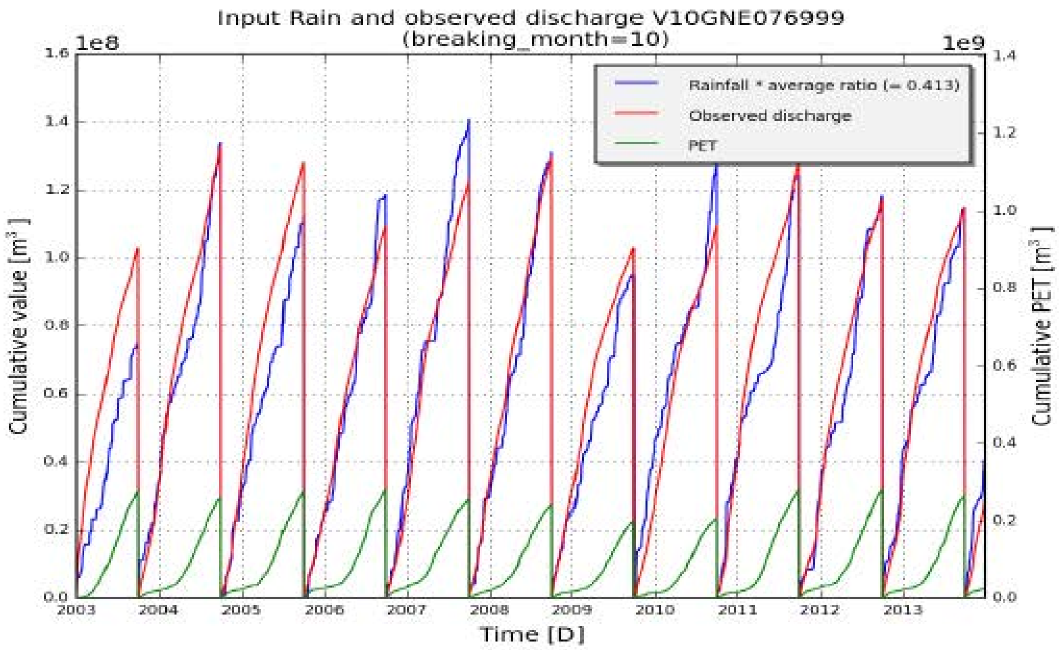


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V10GNE076999 (Nete)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V10GNE076999
subcatchment_area [m2]	359885327
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 436.31), ('SMevap', 233.73), ('c1', 1.83), ('c2', 0.54), ('c3', 1.0), ('cOF1', -5.95), ('cOF2', 2.38), ('cIF1', -3.75), ('cIF2', 3.0), ('CQOF', 13.88), ('CKIF', 66.58), ('CKBF', 1623.0)]

Table 1: Goodness of fit for calibration period (2003 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-1.2 %	14.3 %	-11.5 %
NS	0.714	0.262	0.66
NS_log	0.679	0.304	0.614
NS_rel	0.734	0.127	0.793
KGE	0.758	0.715	0.707

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-4.5 %	17.0 %	-17.5 %
NS	0.684	0.393	0.622
NS_log	0.595	0.133	0.584
NS_rel	0.602	-0.012	0.771
KGE	0.717	0.654	0.706

1.3 Observed and simulated timeseries for optimum parameters

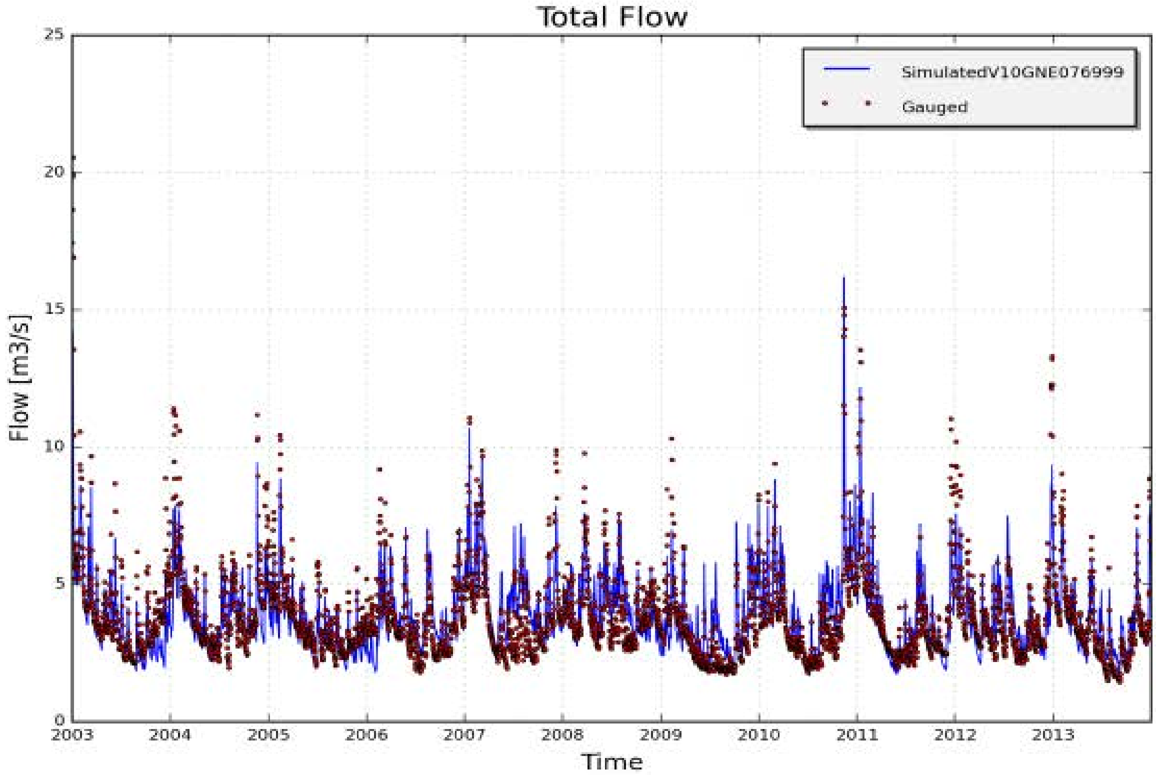


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V10GNE076999, station 7610102 Grote Nete/Geel Zammel(calibration period)

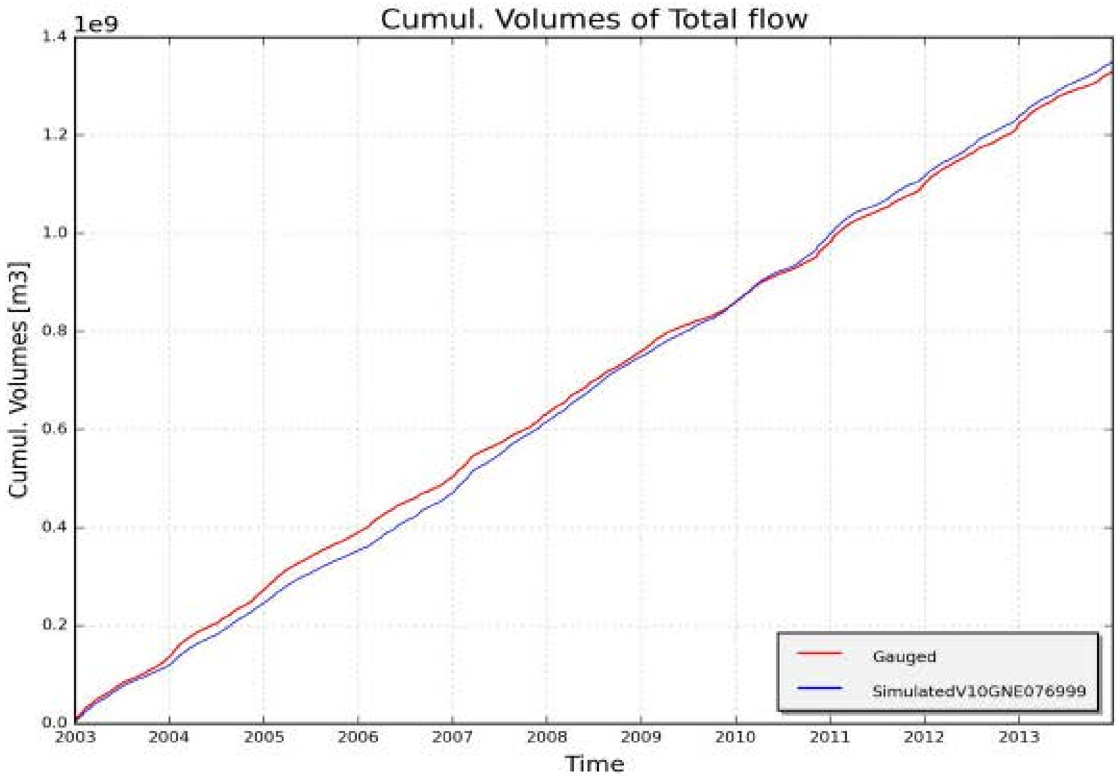


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V10GNE076999, station 7610102 Grote Nete/Geel Zammel (calibration period)

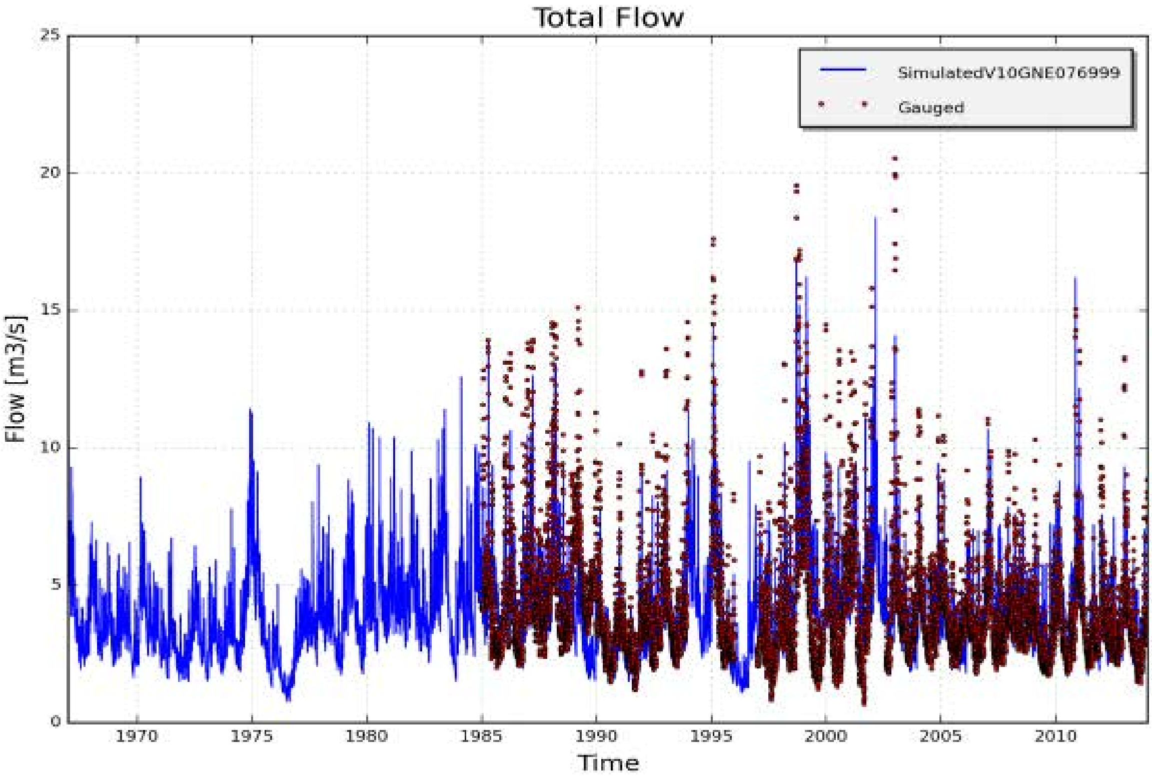


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V10GNE076999, station 7610102 Grote Nete/Geel Zammel (validation period)

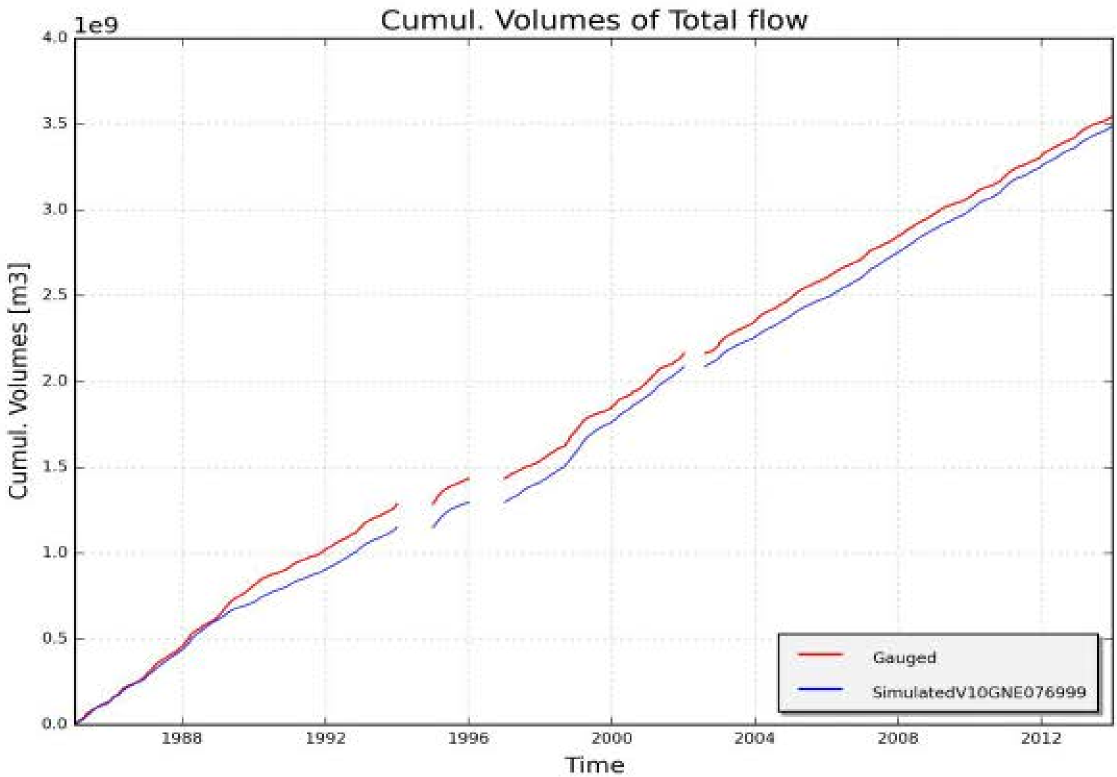


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V10GNE076999, station 7610102 Grote Nete/Geel Zammel (validation period)

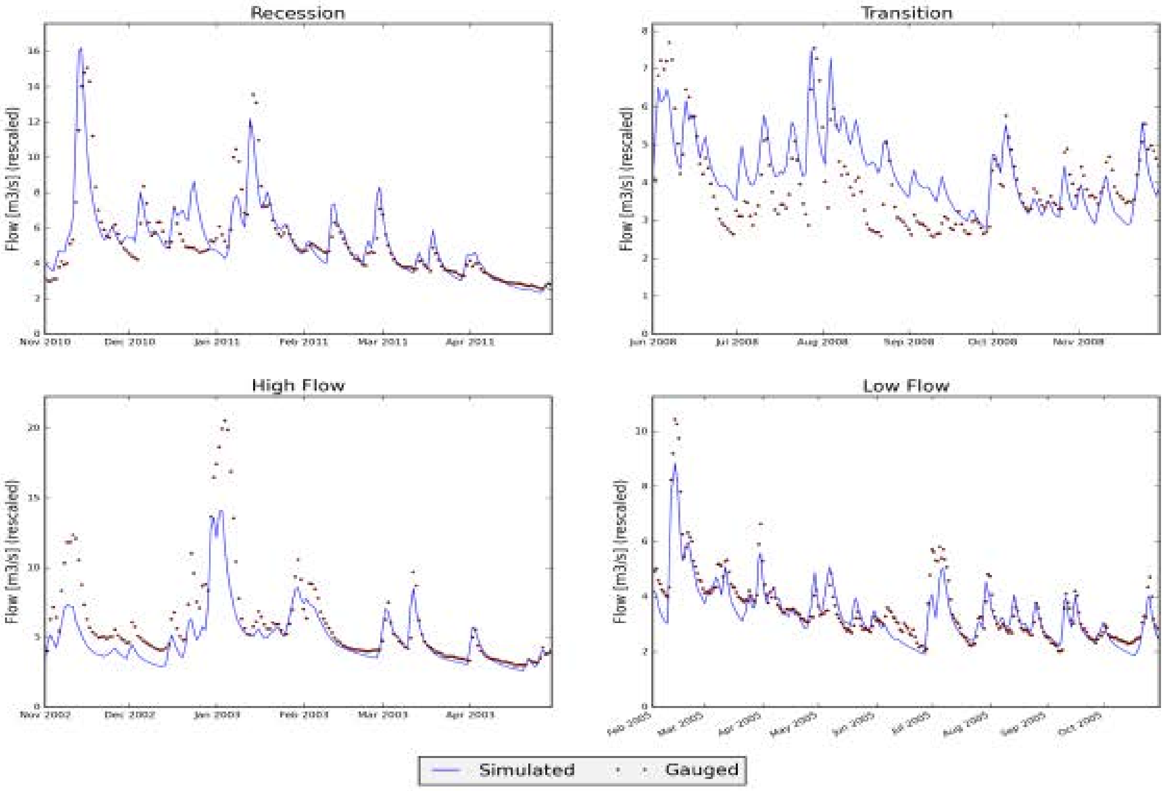


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V10GNE076999, station 7610102 Grote Nete/Geel Zammel

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V10KNE052000" (NETE)

1.1 Input data

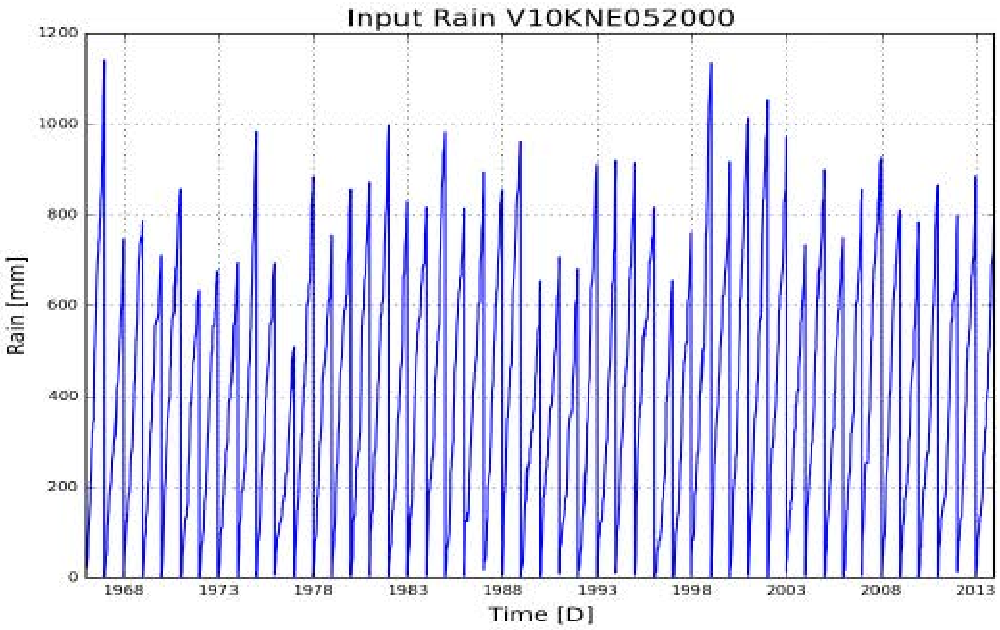


Figure 1: Cumulative precipitation on catchment V10KNE052000 (Nete)

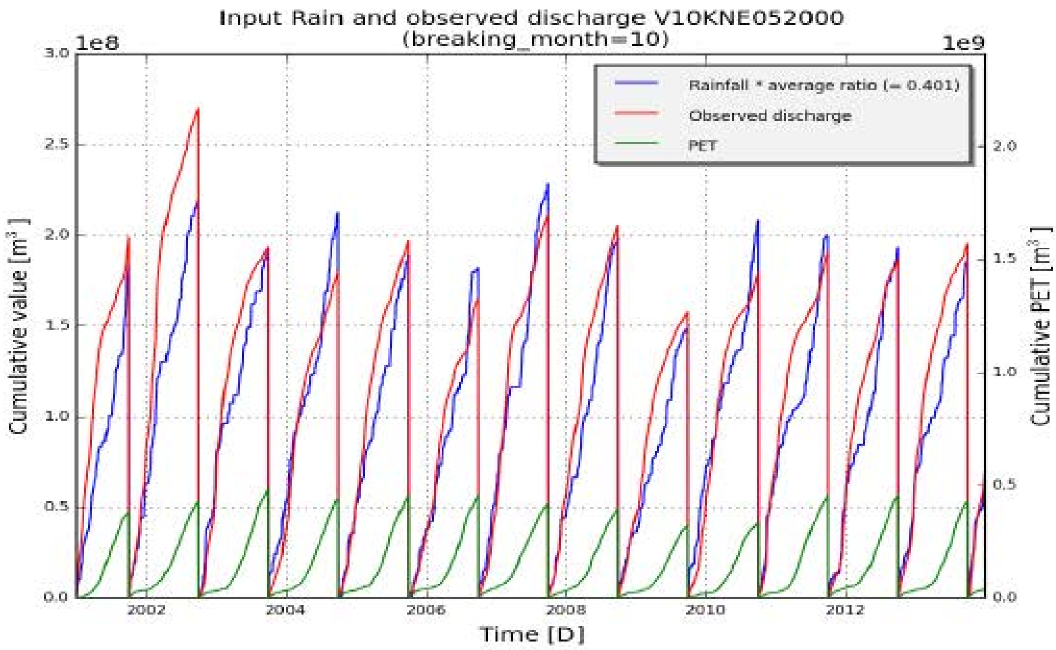


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V10KNE052000 (Nete)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V10KNE052000
subcatchment_area [m2]	584669408
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 474.65), ('SMevap', 202.35), ('c1', 2.1), ('c2', 1.09), ('c3', 1.0), ('cOF1', -6.0), ('cOF2', 0.78), ('cIF1', -3.09), ('cIF2', 3.0), ('CQOF', 14.08), ('CKIF', 56.3), ('CKBF', 1103.01)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	0.0 %	21.5 %	-12.2 %
NS	0.756	0.53	0.693
NS_log	0.72	0.519	0.632
NS_rel	0.739	0.293	0.788
KGE	0.746	0.706	0.68

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-1.4 %	18.4 %	-12.0 %
NS	0.772	0.659	0.73
NS_log	0.698	0.5	0.689
NS_rel	0.734	0.523	0.816
KGE	0.785	0.734	0.737

1.3 Observed and simulated timeseries for optimum parameters

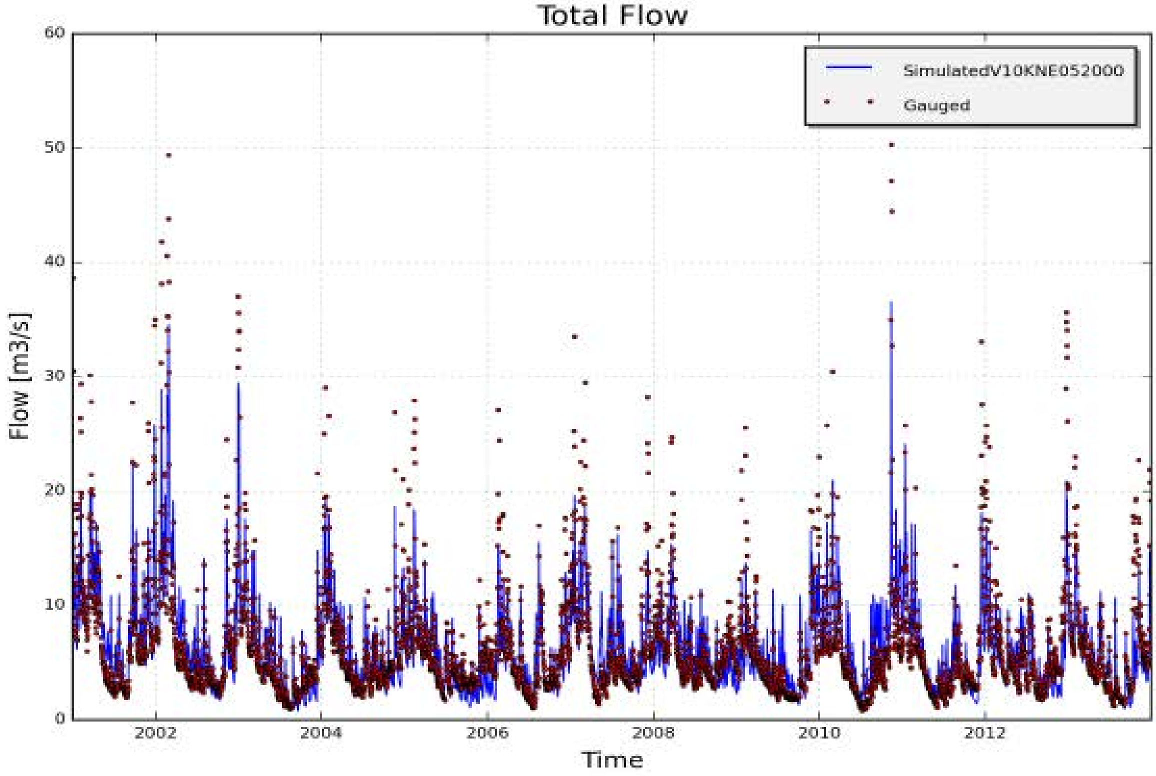


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V10KNE052000, station 5210102 - Kleine Nete; Grobbendonk(calibration period)

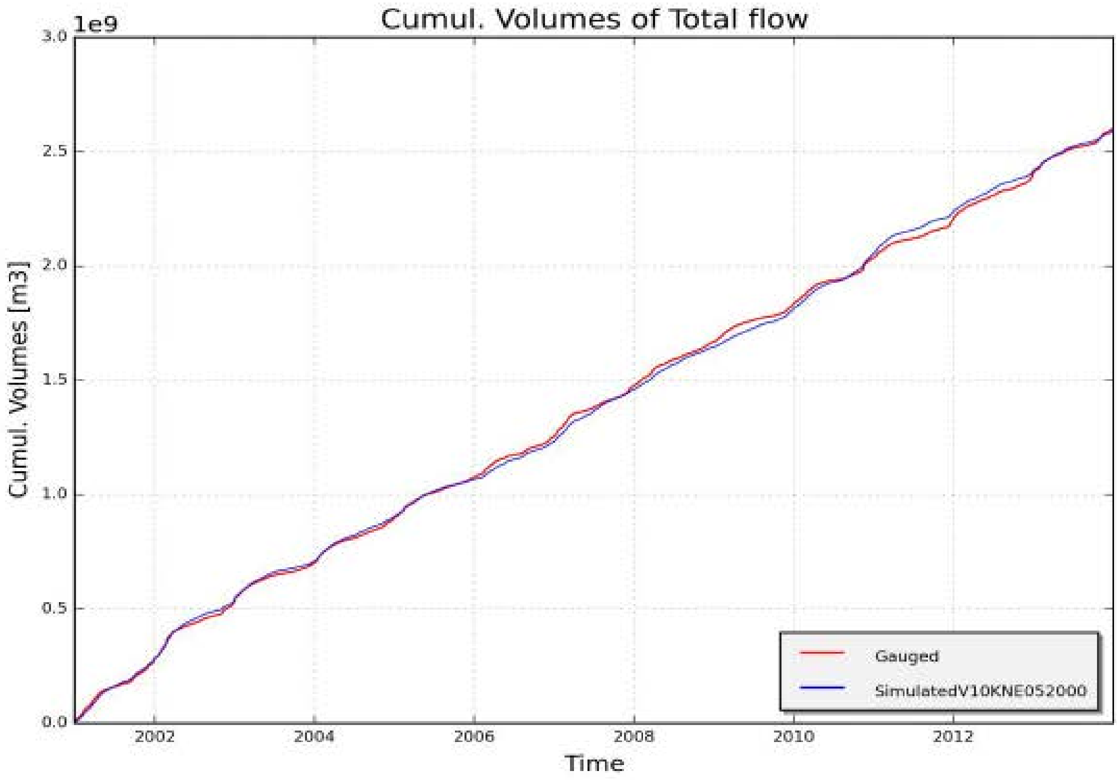


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V10KNE052000, station 5210102 - Kleine Nete; Grobbendonk (calibration period)

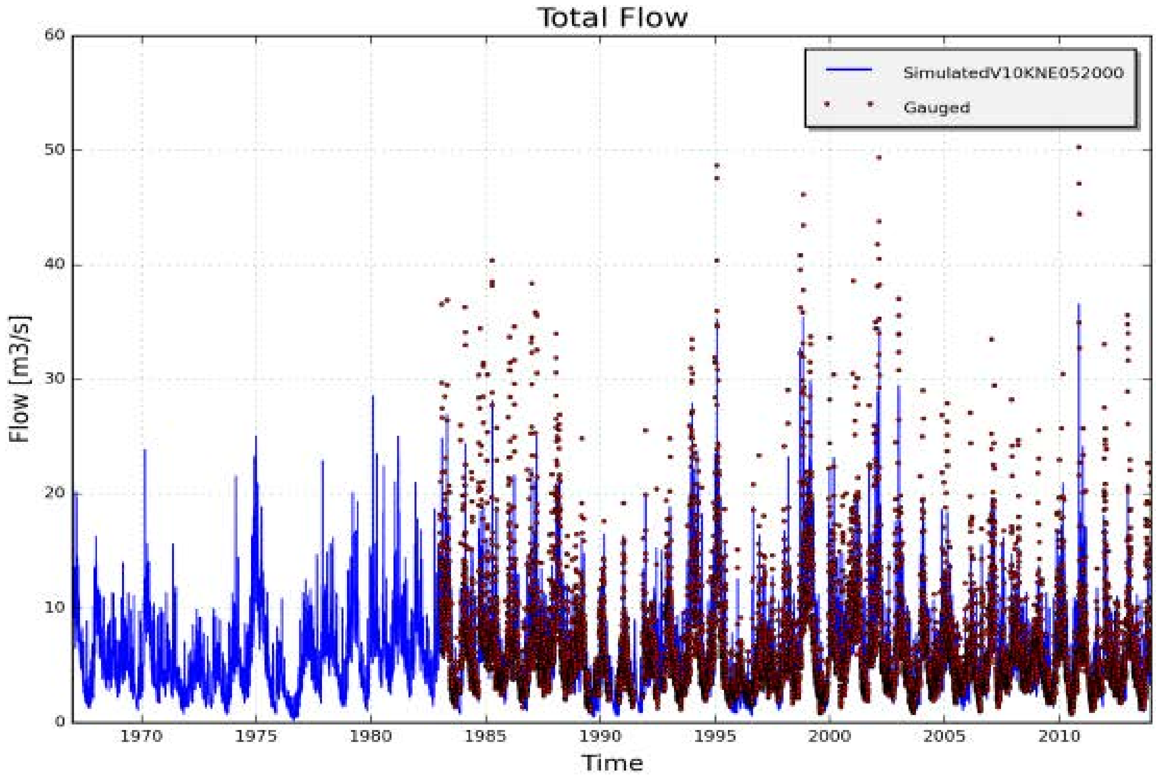


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V10KNE052000, station 5210102 - Kleine Nete; Grobbendonk (validation period)

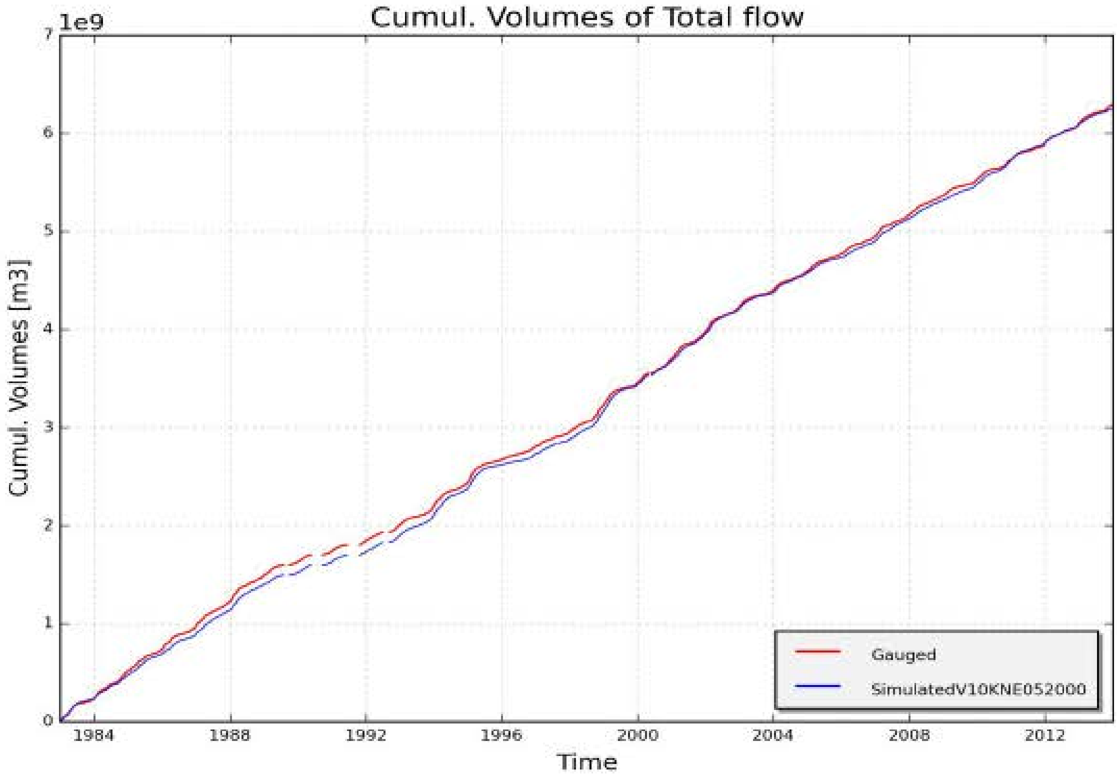


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V10KNE052000, station 5210102 - Kleine Nete; Grobbendonk (validation period)

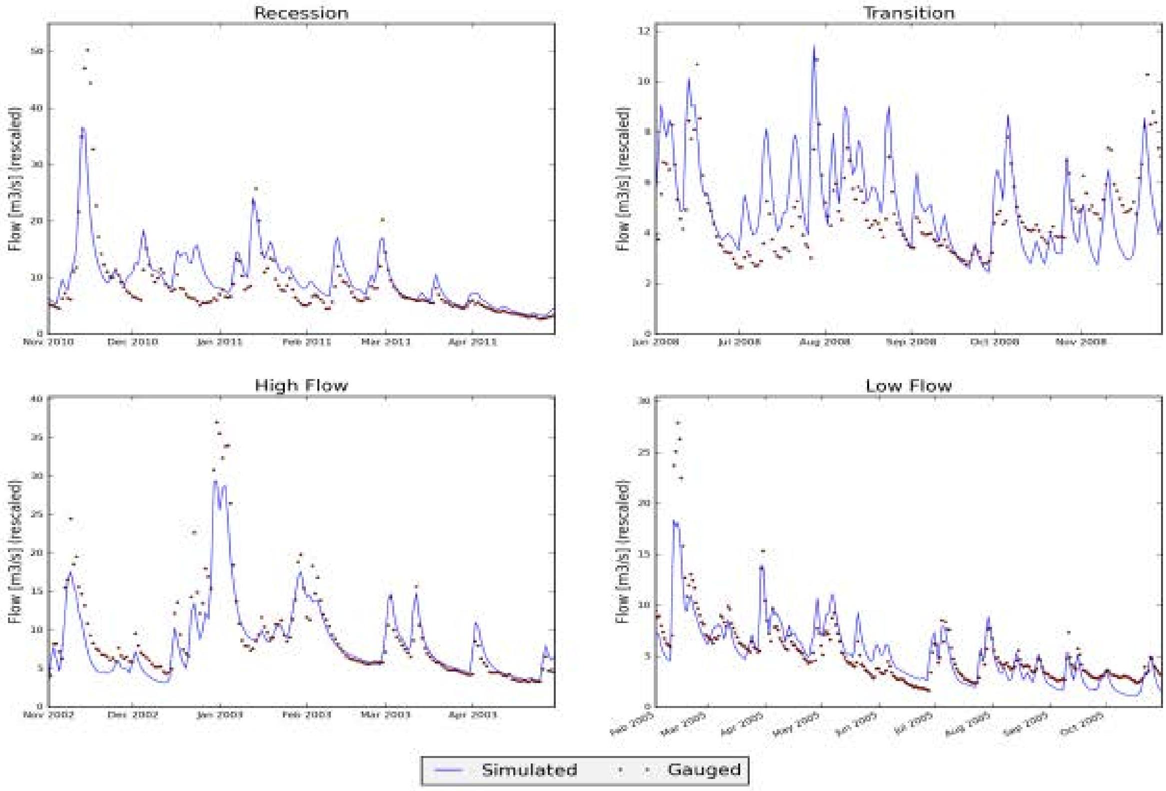


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V10KNE052000, station 5210102 - Kleine Nete; Grobbendonk

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V10MOP062140" (NETE)

1.1 Input data

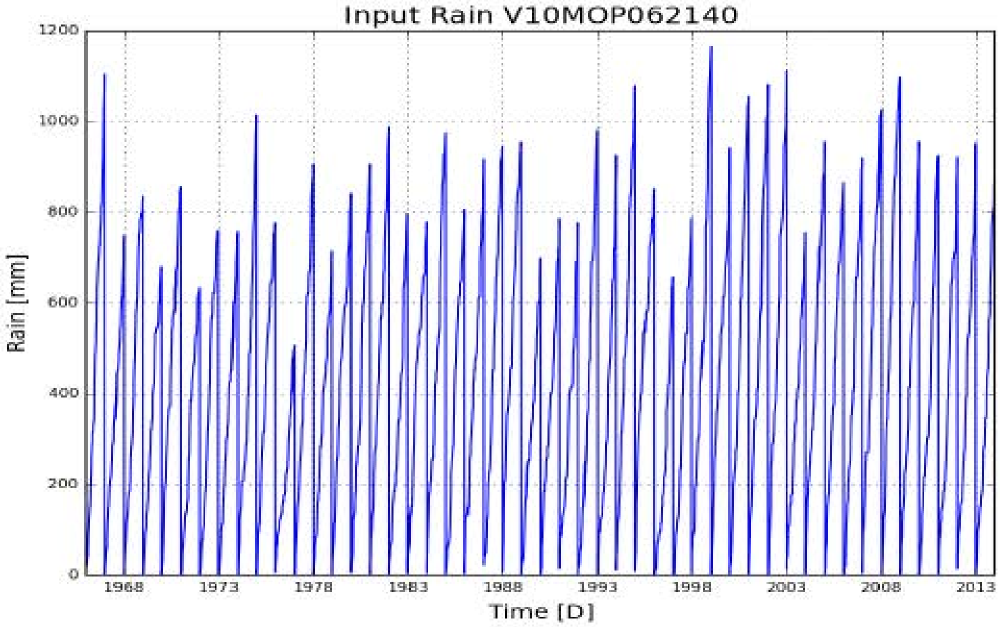


Figure 1: Cumulative precipitation on catchment V10MOP062140 (Nete)

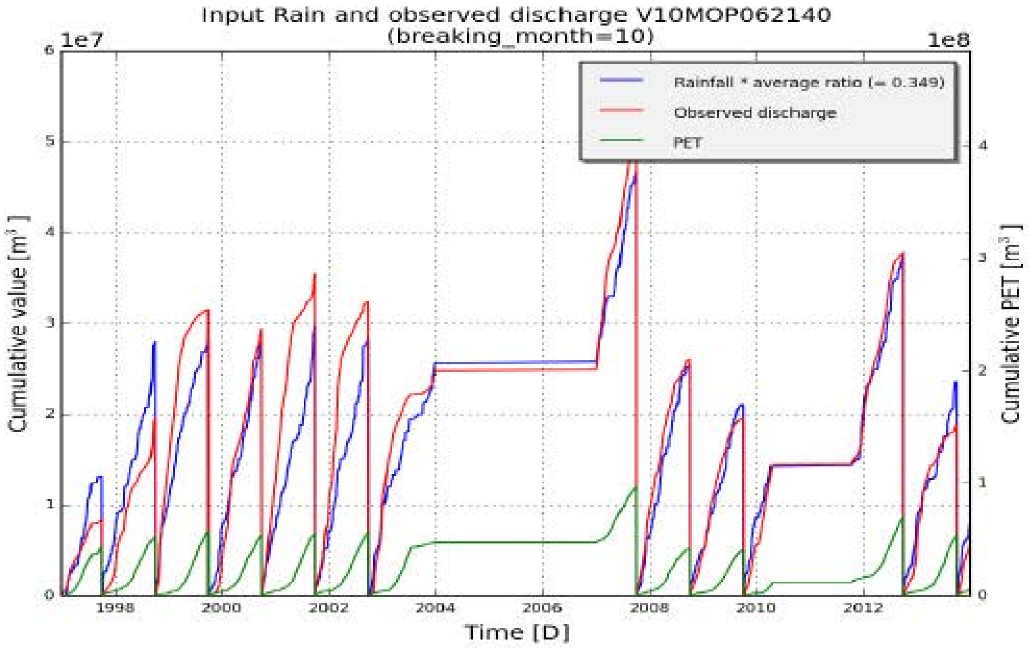


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V10MOP062140 (Nete)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V10MOP062140
subcatchment_area [m2]	77319091
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 426.36), ('SMevap', 210.63), ('c1', 2.18), ('c2', 0.69), ('c3', 1.0), ('cOF1', -5.98), ('cOF2', 0.1), ('cIF1', -4.16), ('cIF2', 3.0), ('CQOF', 10.65), ('CKIF', 62.24), ('CKBF', 667.2)]

Table 1: Goodness of fit for calibration period (1997 - 2013)

	Full year	**Summer**	**Winter**
RelErr	1.4 %	-5.3 %	-5.2 %
NS	0.614	0.461	0.606
NS_log	0.659	0.475	0.744
NS_rel	-0.082	-0.517	0.781
KGE	0.688	0.448	0.644

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	15.7 %	32.0 %	6.5 %
NS	0.647	0.43	0.683
NS_log	0.645	0.462	0.769
NS_rel	-0.804	-1.94	0.756
KGE	0.732	0.491	0.706

1.3 Observed and simulated timeseries for optimum parameters

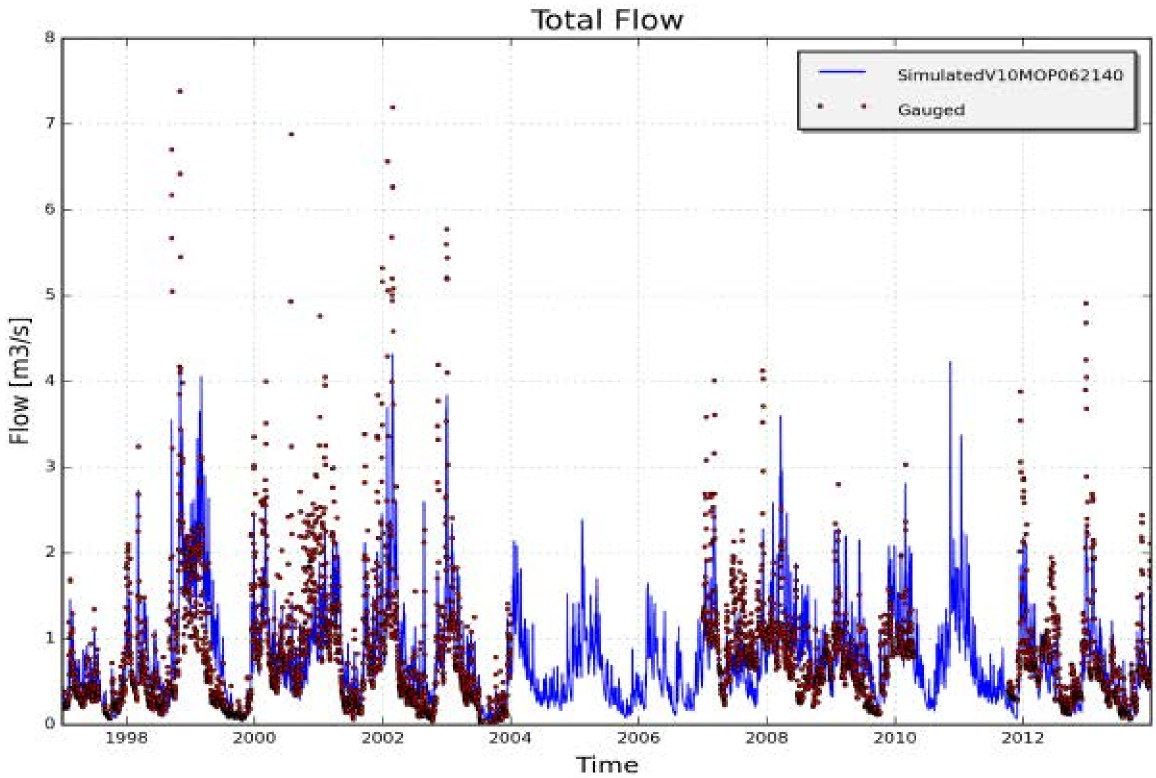


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V10MOP062140, station 6210102 - Molenbeek, Pulle(calibration period)

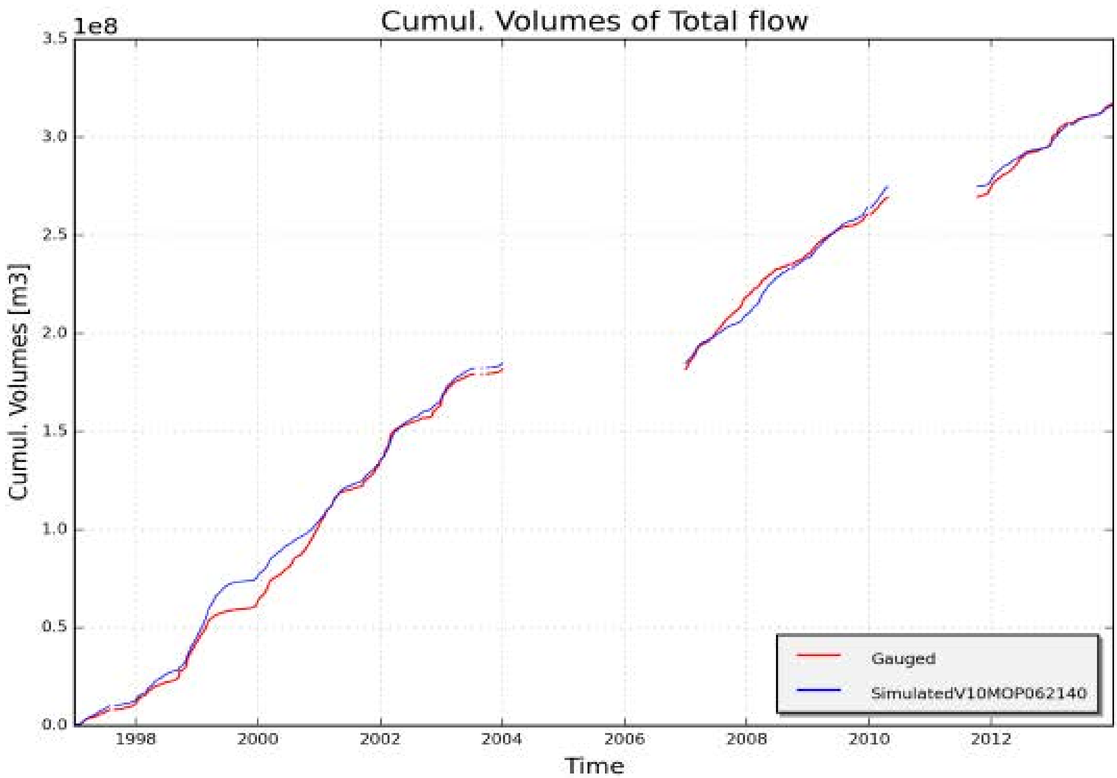


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V10MOP062140, station 6210102 - Molenbeek, Pulle (calibration period)

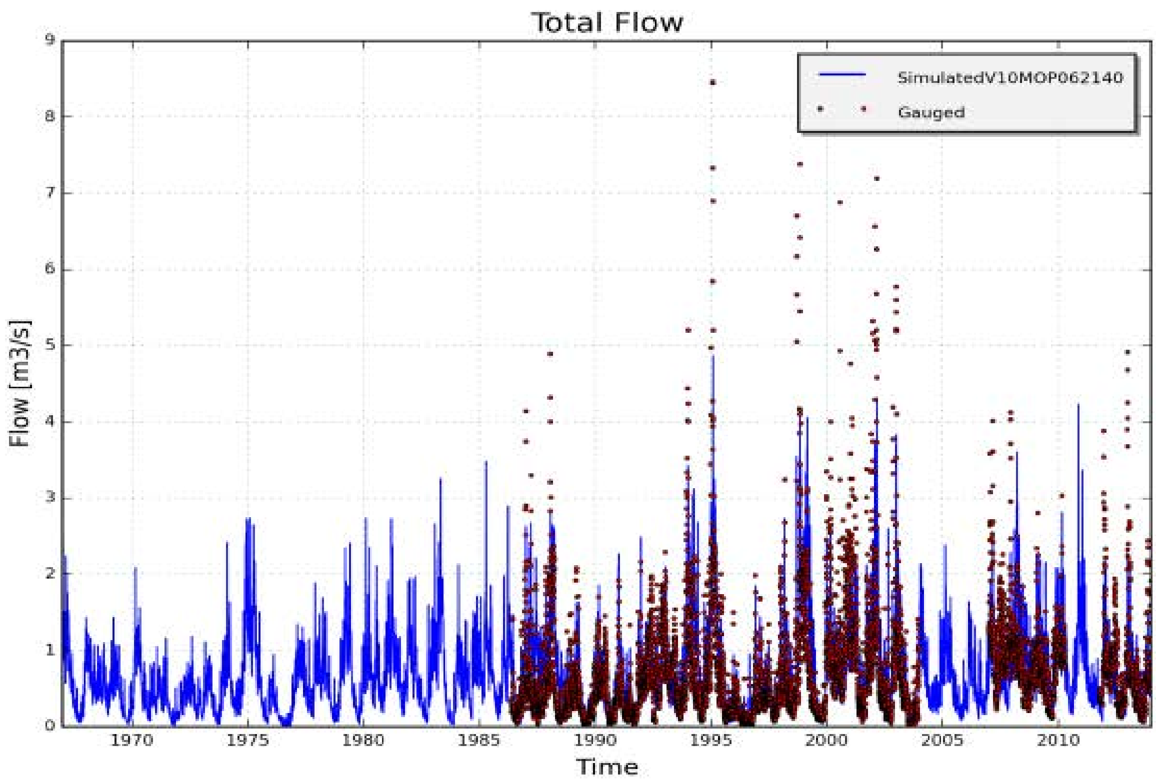


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V10MOP062140, station 6210102 - Molenbeek, Pulle (validation period)

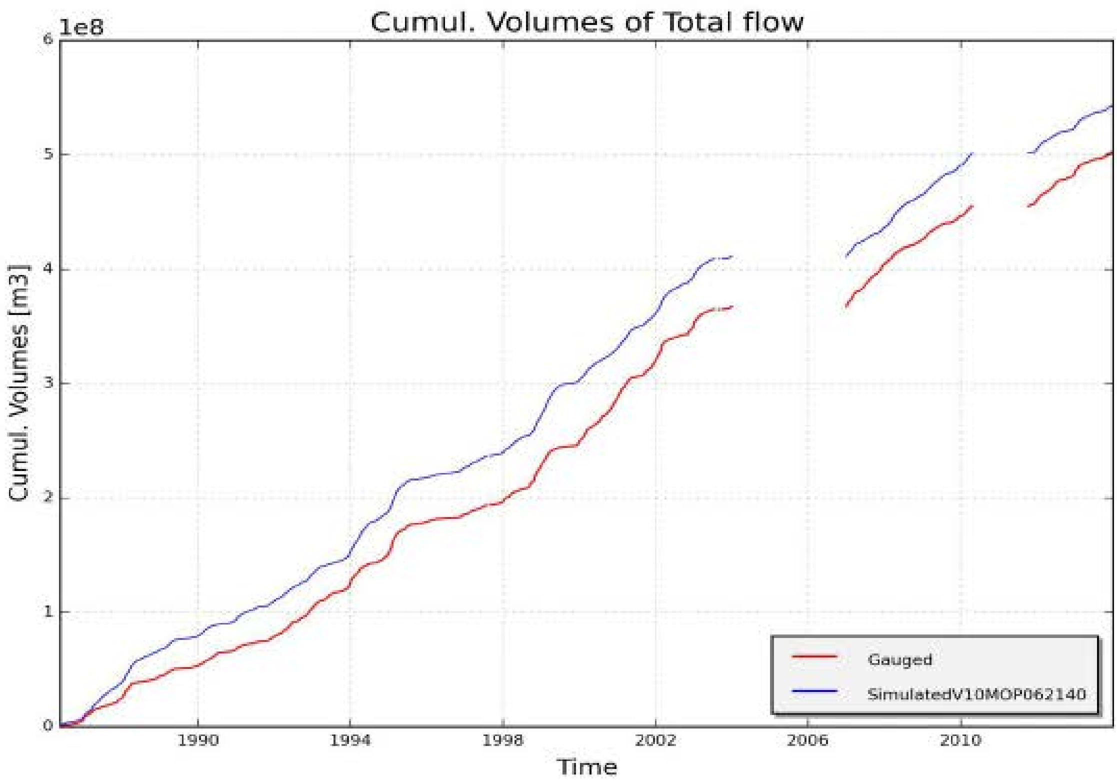


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V10MOP062140, station 6210102 - Molenbeek, Pulle (validation period)

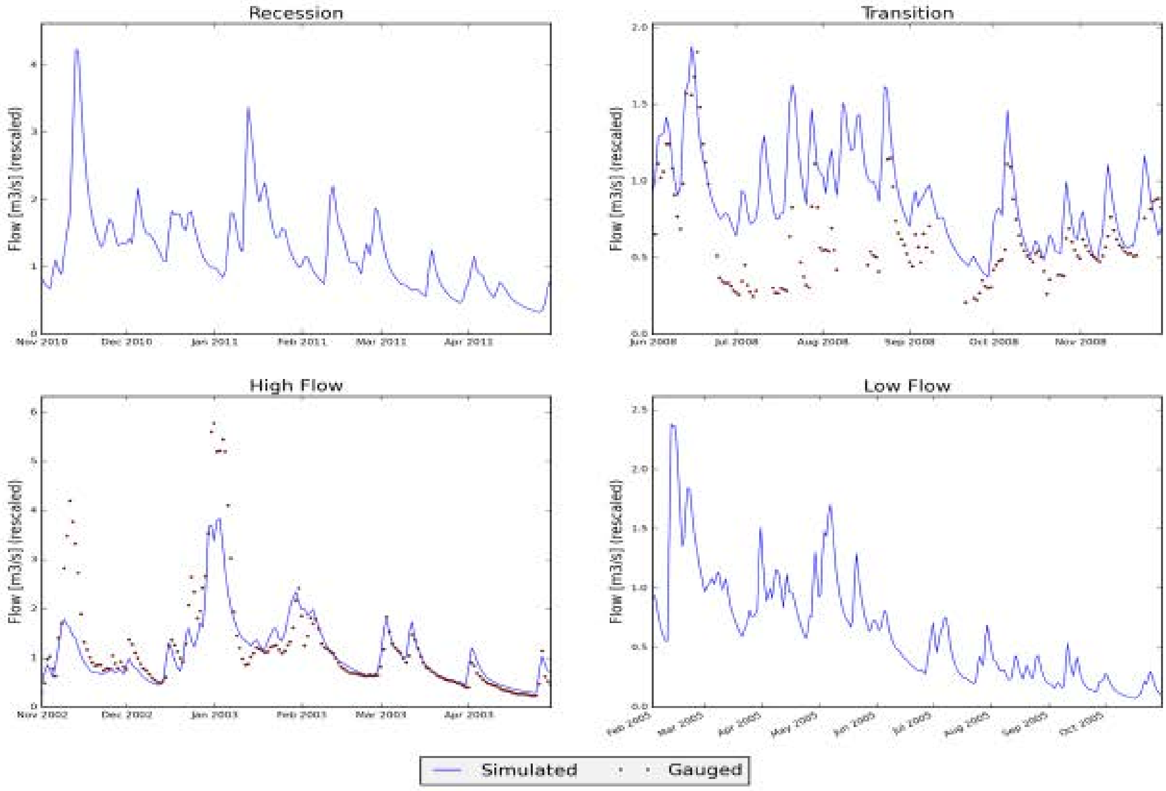


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V10MOP062140, station 6210102 - Molenbeek, Pulle

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "V10WIM082050" (NETE)

1.1 Input data

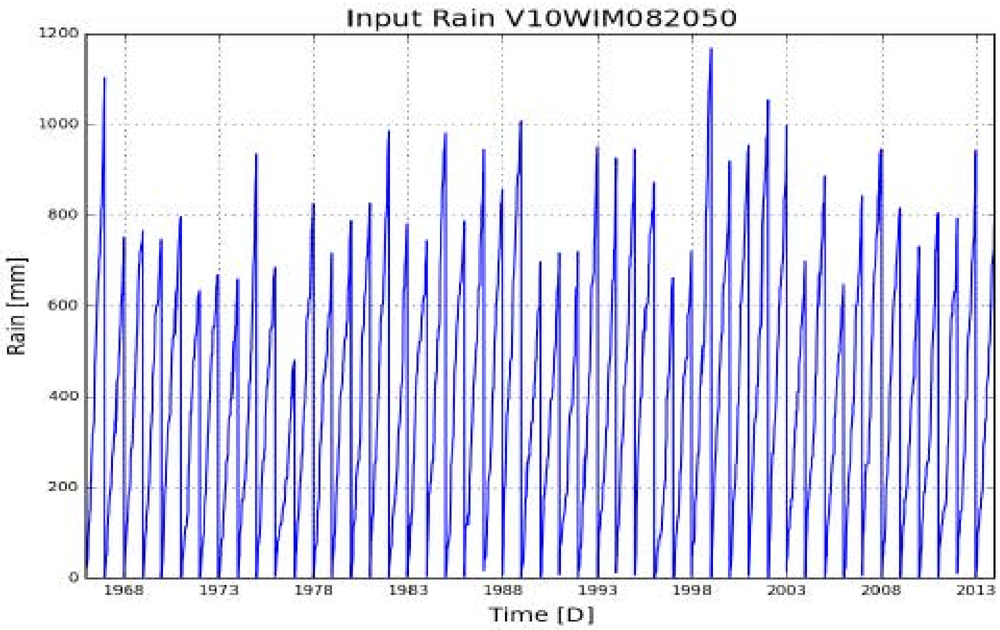


Figure 1: Cumulative precipitation on catchment V10WIM082050 (Nete)

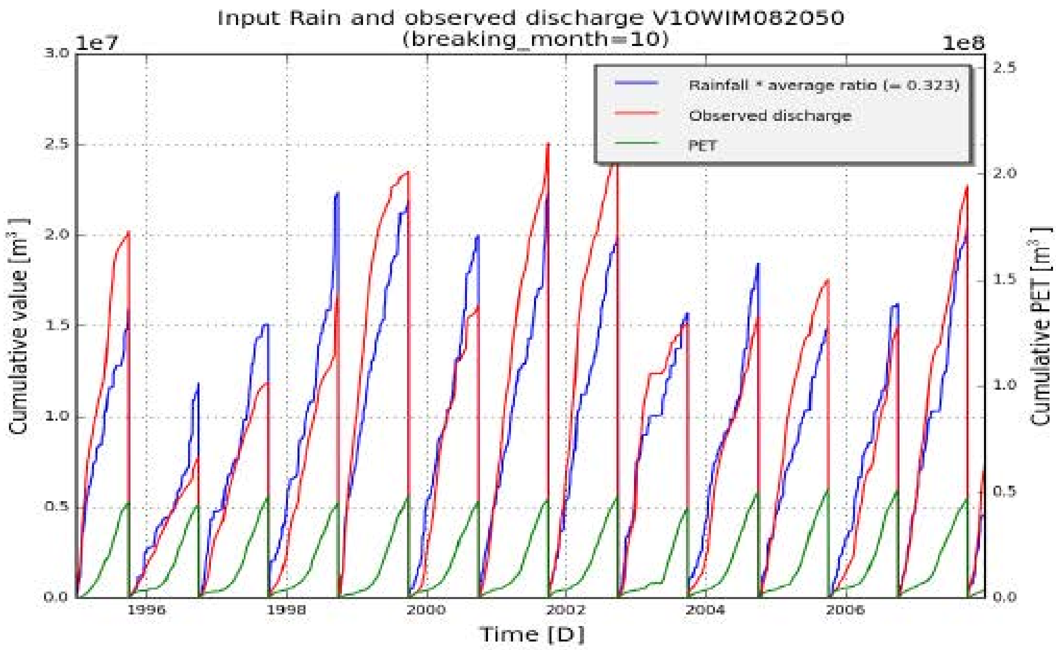


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment V10WIM082050 (Nete)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	V10WIM082050
subcatchment_area [m2]	65701200
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 446.85), ('SMevap', 145.61), ('c1', 1.97), ('c2', 0.55), ('c3', 1.0), ('cOF1', -4.92), ('cOF2', 3.42), ('cIF1', -3.63), ('cIF2', 3.0), ('CQOF', 11.0), ('CKIF', 88.59), ('CKBF', 872.12)]

Table 1: Goodness of fit for calibration period (1995 - 2007)

	Full year	**Summer**	**Winter**
RelErr	0.4 %	-1.4 %	-0.2 %
NS	0.624	0.556	0.682
NS_log	0.599	0.373	0.709
NS_rel	-14.396	-28.095	0.739
KGE	0.754	0.508	0.821

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	13.6 %	1.4 %	19.5 %
NS	0.567	0.523	0.642
NS_log	0.529	0.341	0.637
NS_rel	-9.313	-19.981	0.351
KGE	0.753	0.508	0.821

1.3 Observed and simulated timeseries for optimum parameters

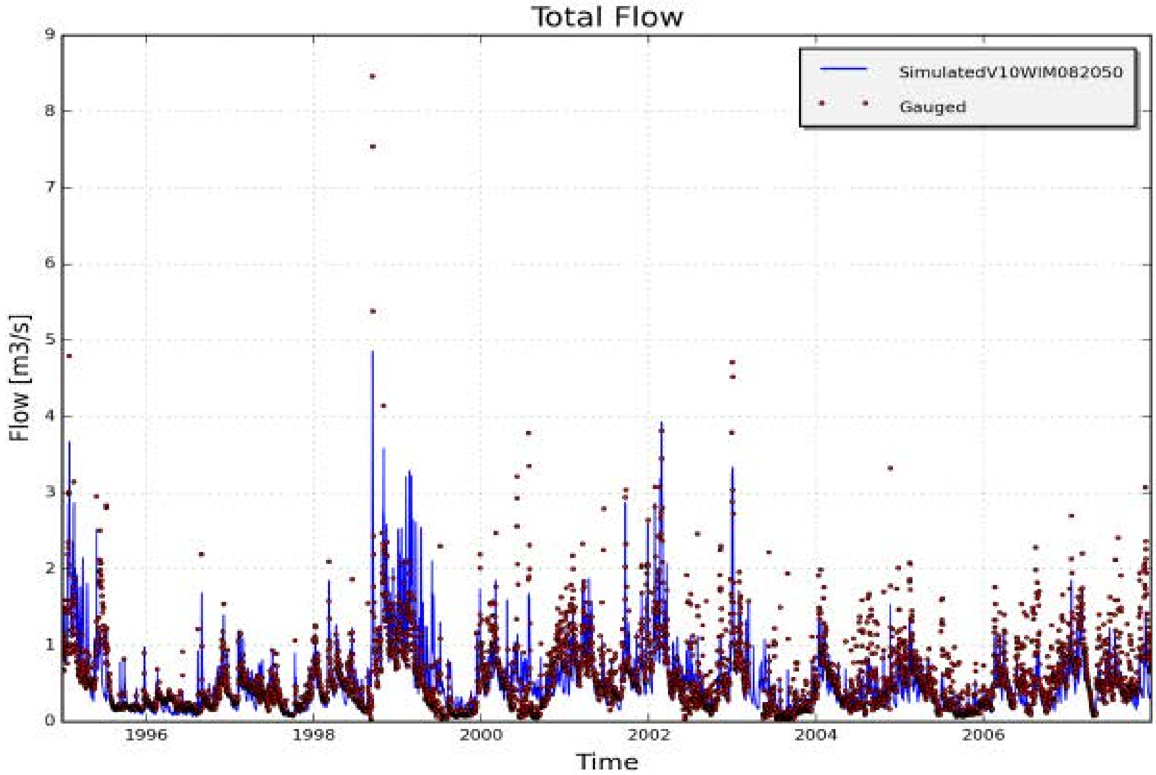


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V10WIM082050, station 8210102 - Wiekevorst(calibration period)

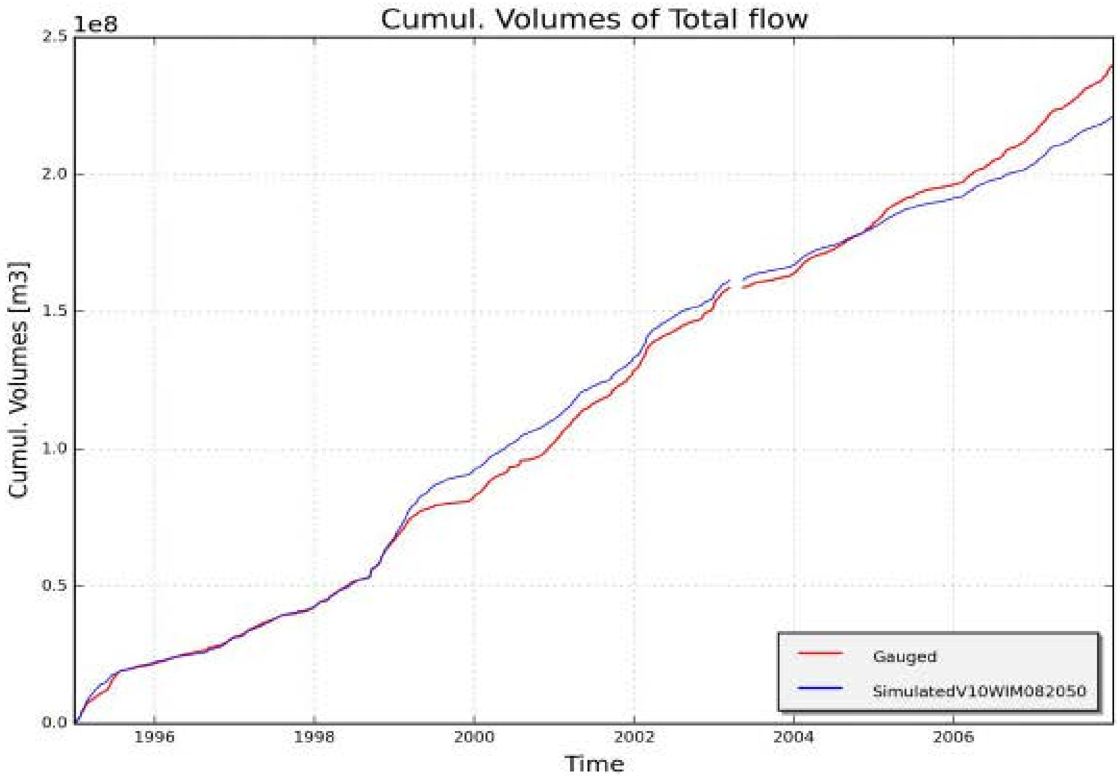


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V10WIM082050, station 8210102 - Wiekevorst (calibration period)

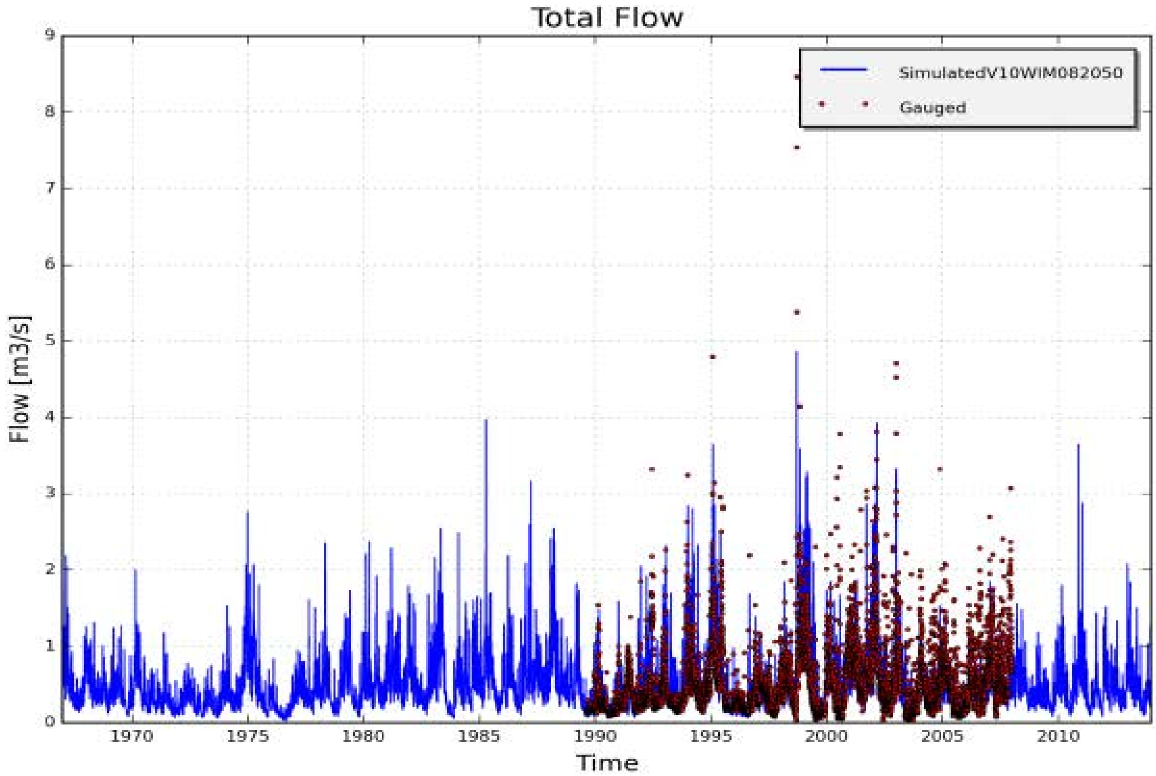


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment V10WIM082050, station 8210102 - Wiekevorst (validation period)

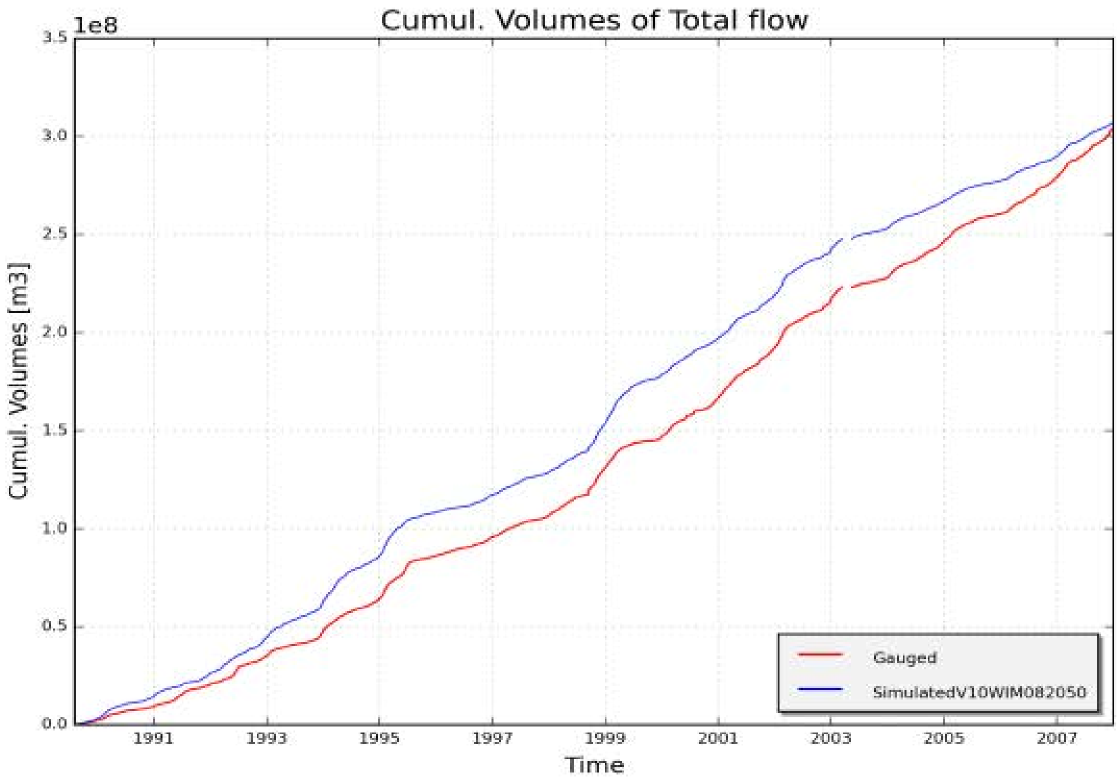


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment V10WIM082050, station 8210102 - Wiekevorst (validation period)

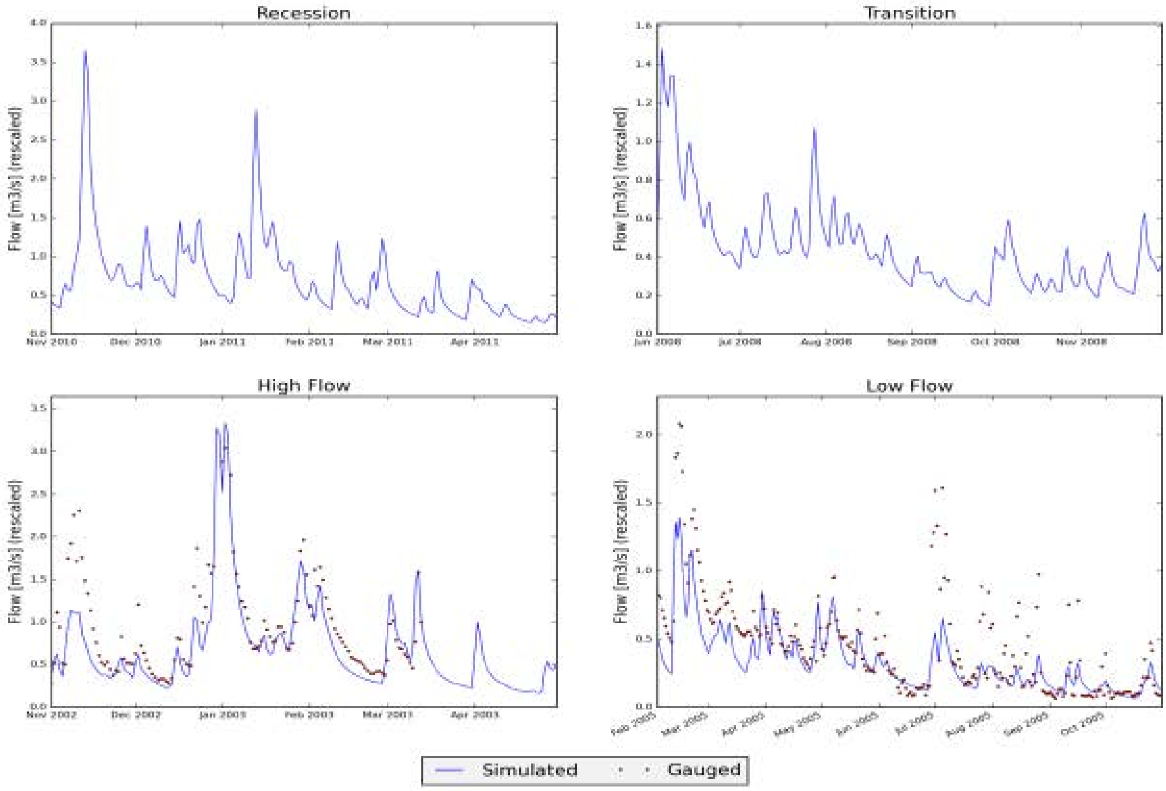


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V10WIM082050, station 8210102 - Wiekevorst

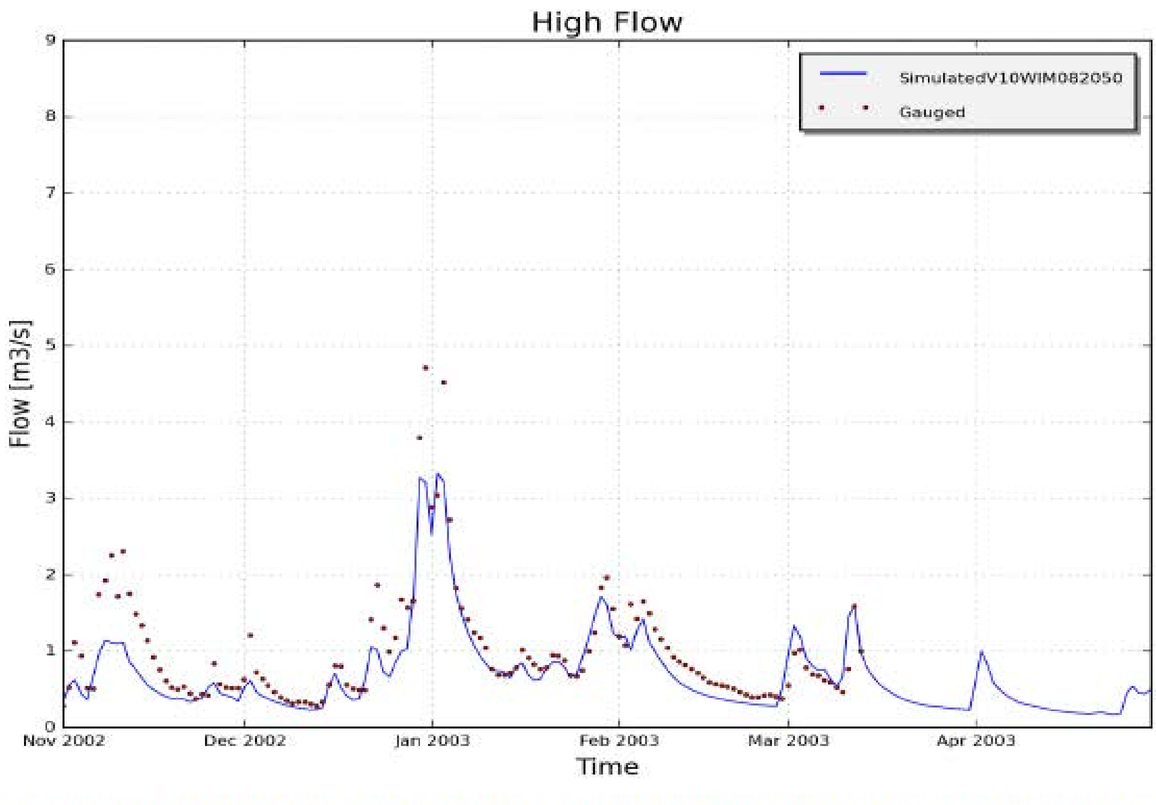


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V10WIM082050, station 8210102 - Wiekevorst

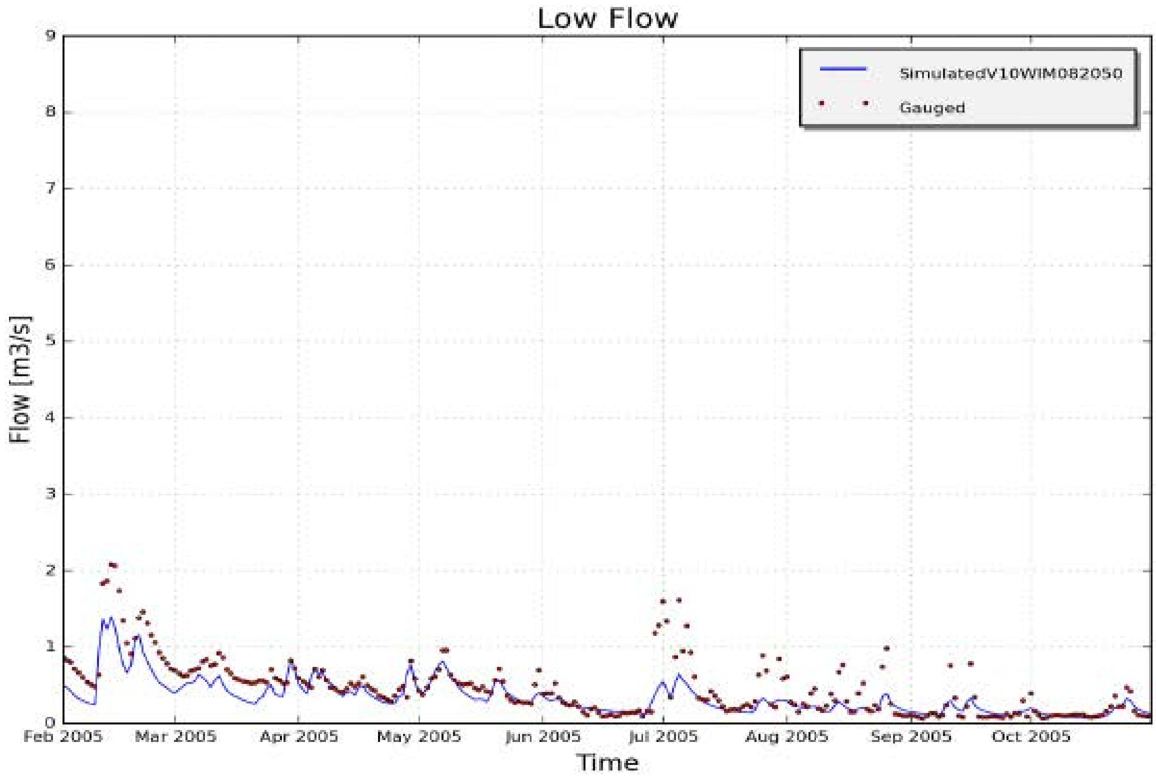


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment V10WIM082050, station 8210102 - Wiekevorst

Appendix 13 Meuse

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "F11MAA8702" (MEUSE)

1.1 Input data

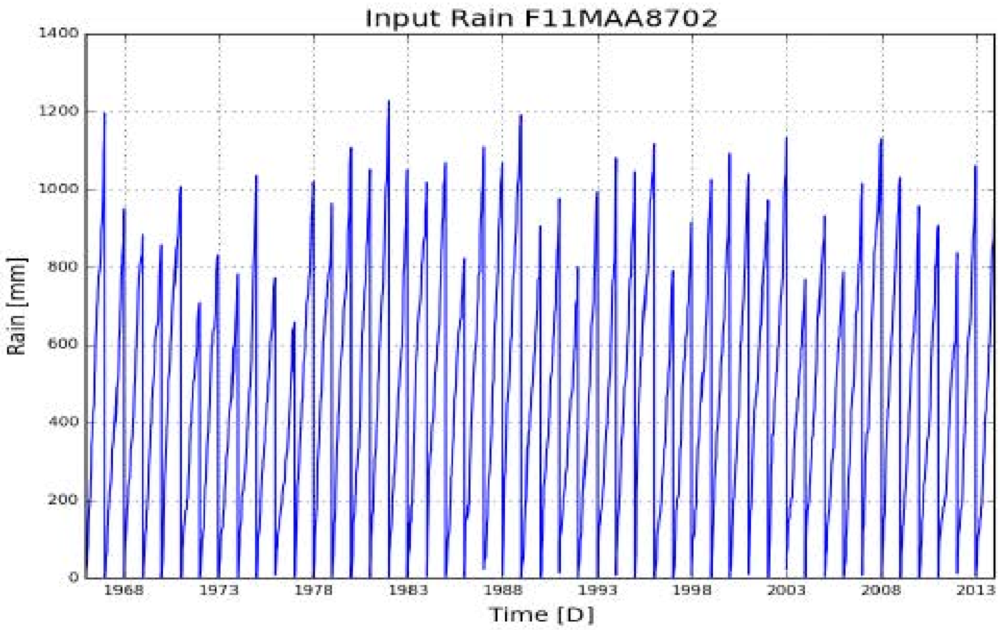


Figure 1: Cumulative precipitation on catchment F11MAA8702 (Meuse)

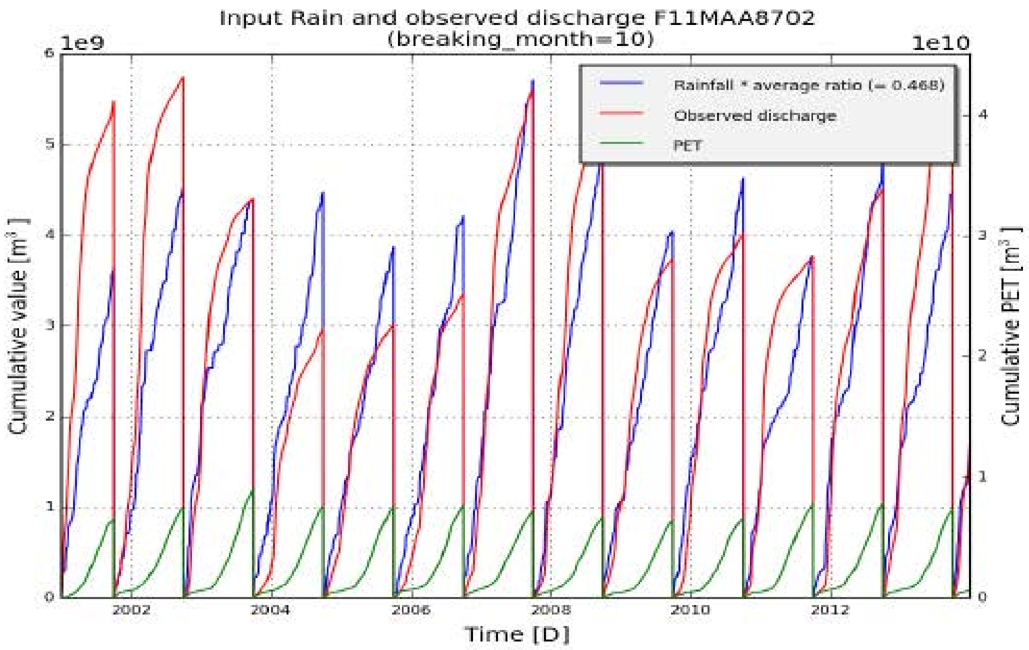


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment F11MAA8702 (Meuse)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	F11MAA8702
subcatchment_area [m2]	10120000000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 380.85), ('SMevap', 221.53), ('c1', 4.0), ('c2', 1.85), ('c3', 1.0), ('cOF1', -6.0), ('cOF2', 0.04), ('cIF1', -4.04), ('cIF2', 3.0), ('CQOF', 11.61), ('CKIF', 86.48), ('CKBF', 1512.08)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-5.9 %	31.4 %	-18.5 %
NS	0.695	0.266	0.486
NS_log	0.761	0.135	0.619
NS_rel	0.736	0.212	0.662
KGE	0.609	0.565	0.418

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-2.5 %	32.2 %	-15.2 %
NS	0.705	0.287	0.529
NS_log	0.775	0.183	0.637
NS_rel	0.754	0.229	0.613
KGE	0.608	0.59	0.431

1.3 Observed and simulated timeseries for optimum parameters

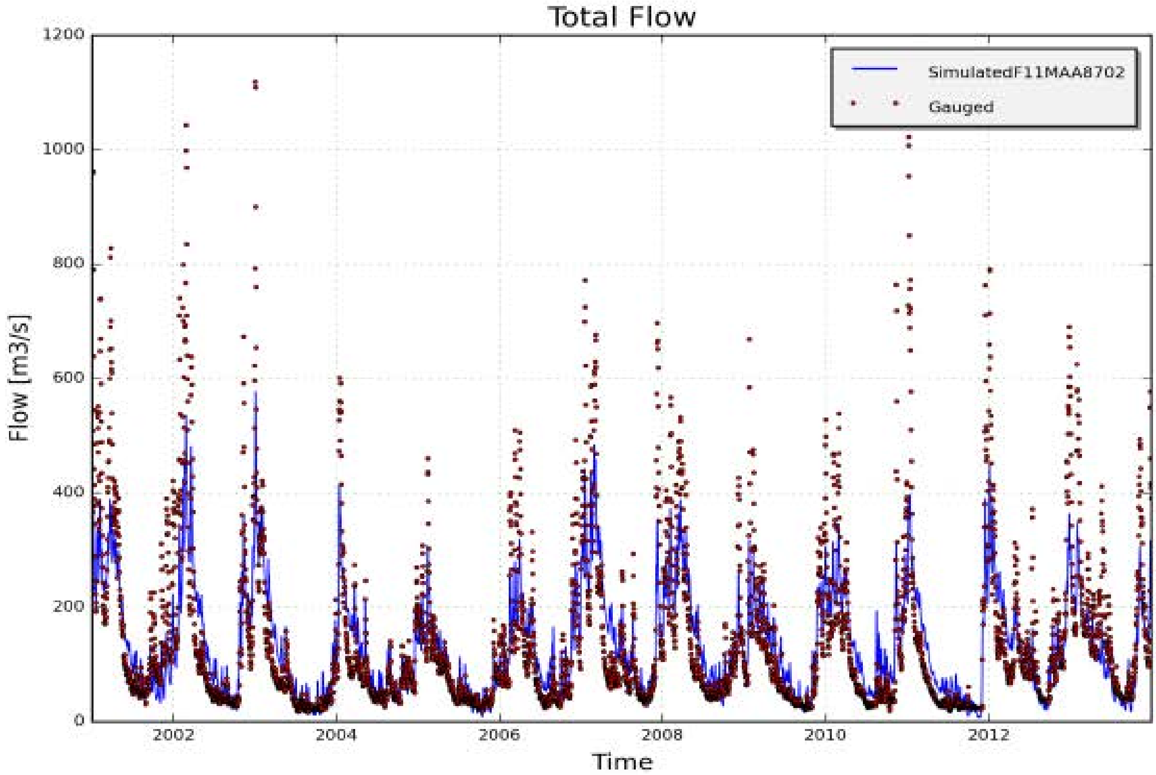


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment F11MAA8702, station Meuse, Chooz(calibration period)

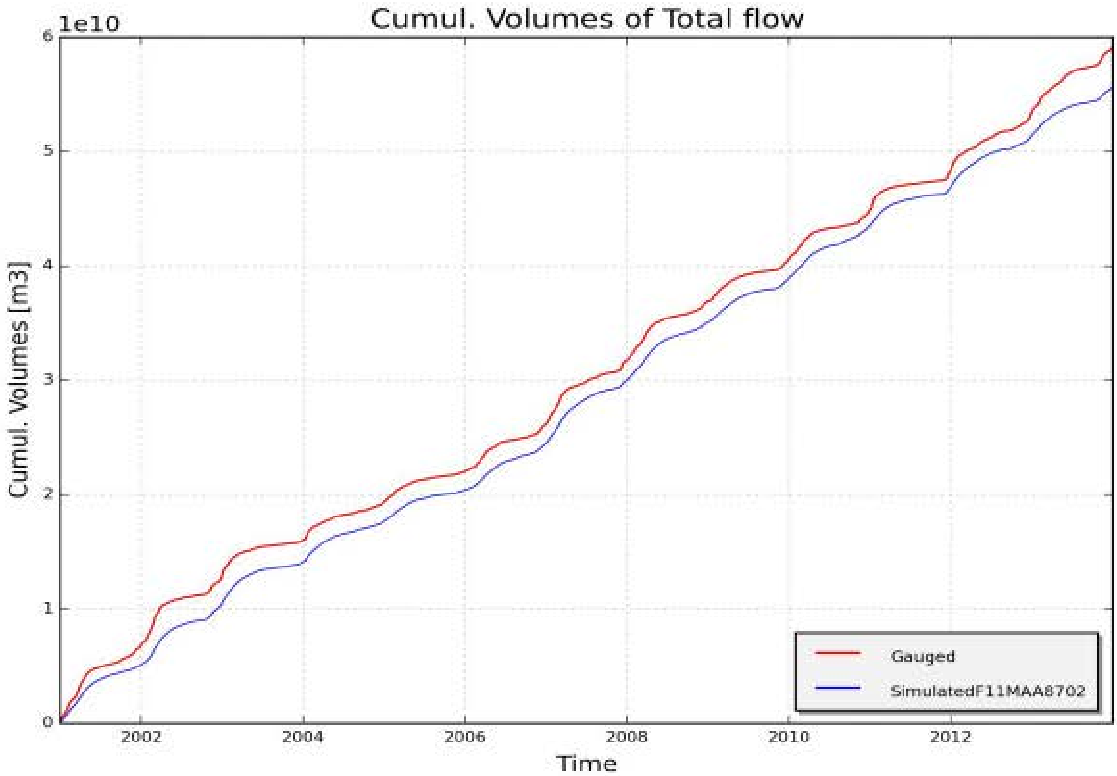


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment F11MAA8702, station Meuse, Chooz (calibration period)

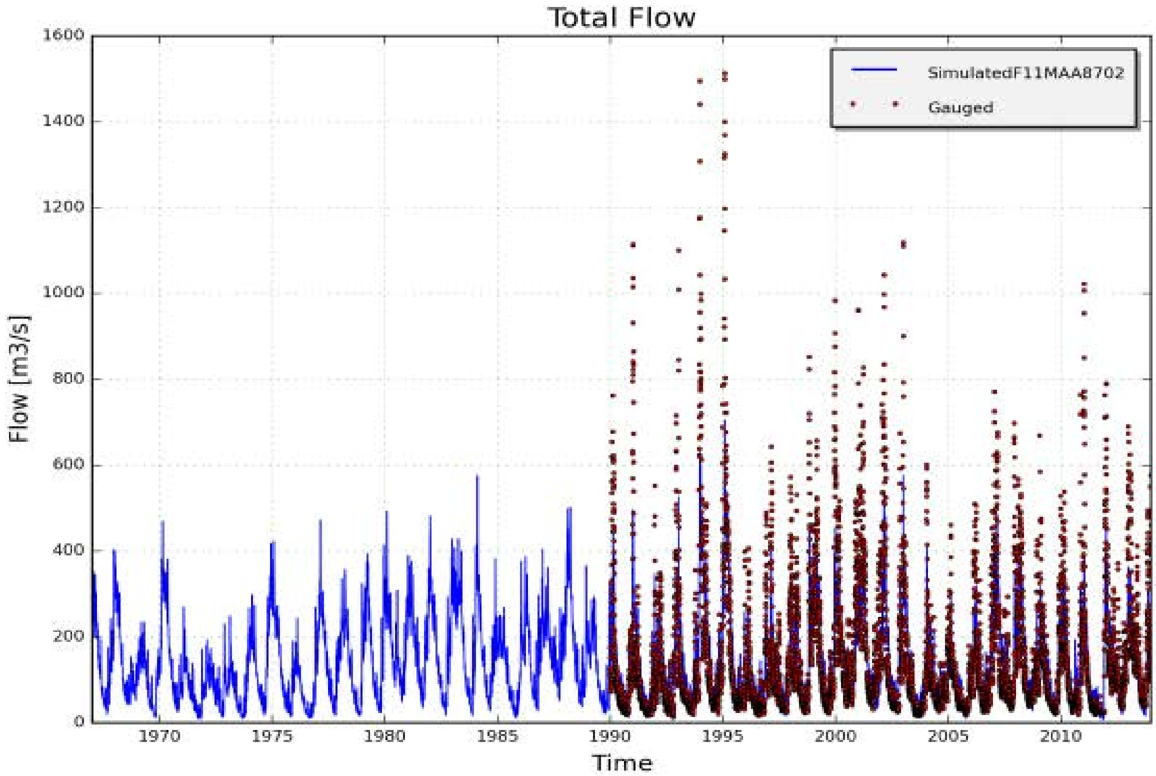


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment F11MAA8702, station Meuse, Chooz (validation period)

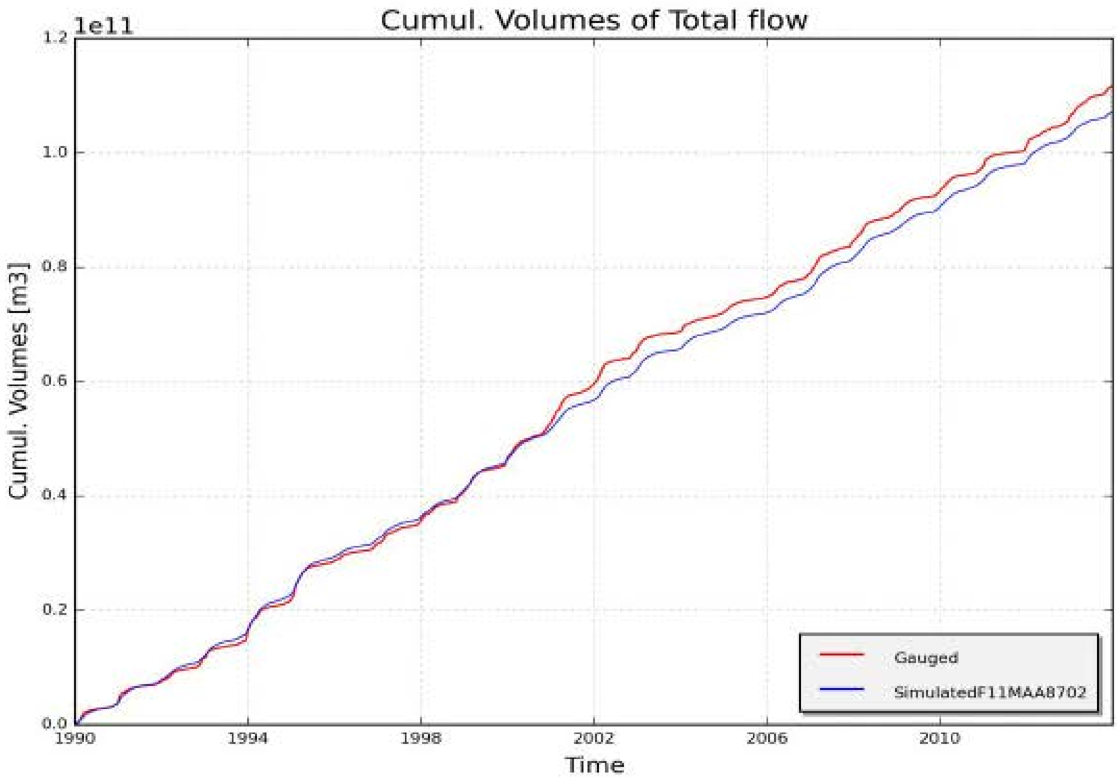


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment F11MAA8702, station Meuse, Chooz (validation period)

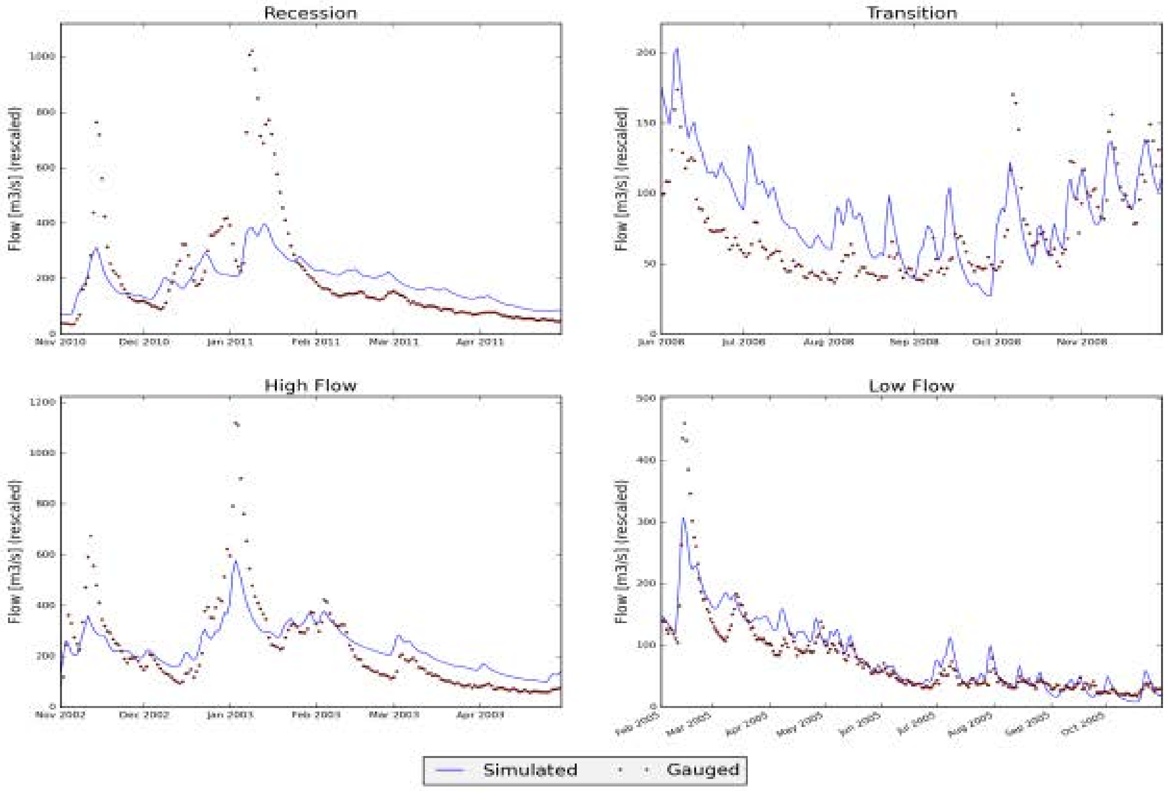


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment F11MAA8702, station Meuse, Chooz

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W11BER551010" (MEUSE)

1.1 Input data

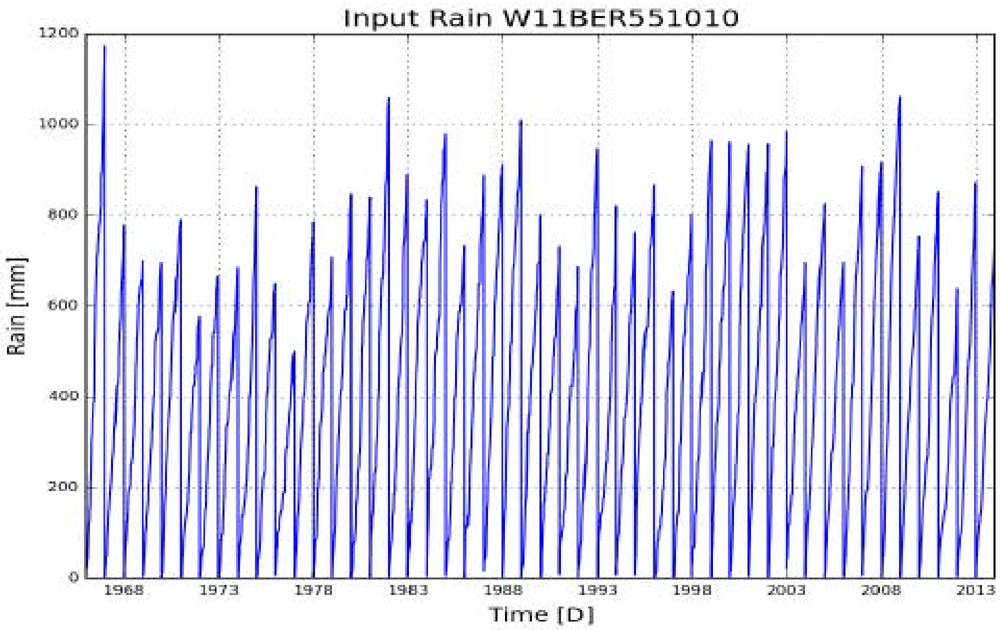


Figure 1: Cumulative precipitation on catchment W11BER551010 (Meuse)

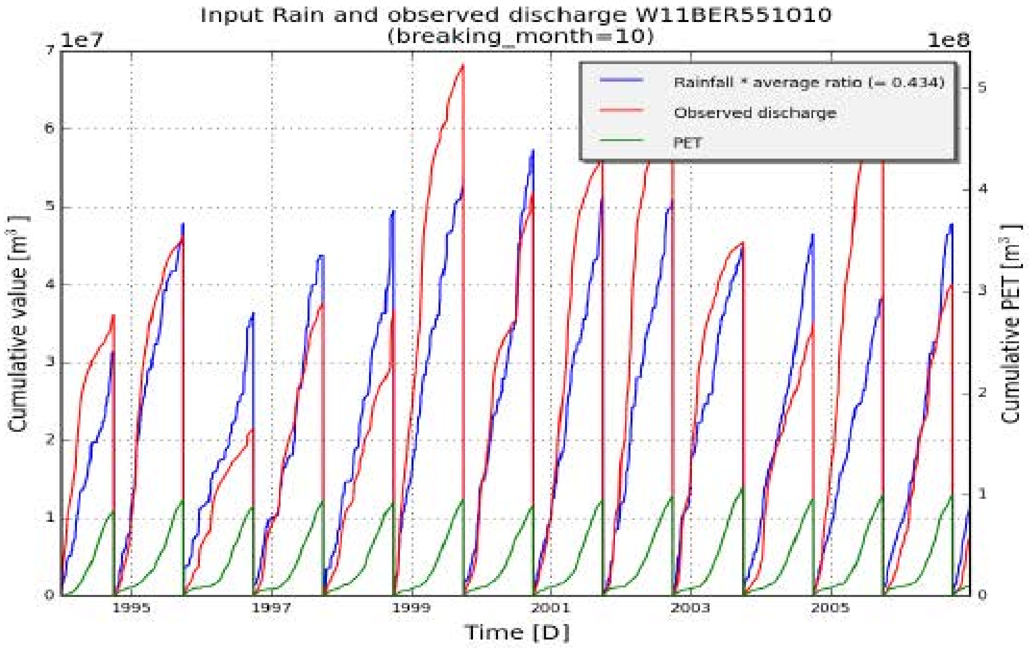


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W11BER551010 (Meuse)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W11BER551010
subcatchment_area [m2]	128000000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 321.2), ('SMevap', 242.15), ('c1', 2.4), ('c2', 1.01), ('c3', 1.0), ('cOF1', -6.04), ('cOF2', 6.78), ('cIF1', -4.67), ('cIF2', 2.59), ('CQOF', 13.96), ('CKIF', 62.96), ('CKBF', 1223.53)]

Table 1: Goodness of fit for calibration period (1994 - 2006)

	Full year	**Summer**	**Winter**
RelErr	0.3 %	0.5 %	-1.4 %
NS	0.623	0.592	0.581
NS_log	0.645	0.486	0.599
NS_rel	0.606	0.722	0.48
KGE	0.742	0.707	0.755

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	5.5 %	17.9 %	-1.2 %
NS	0.511	0.357	0.494
NS_log	0.304	-0.183	0.388
NS_rel	-15.067	-20.865	-4.804
KGE	0.673	0.595	0.67

1.3 Observed and simulated timeseries for optimum parameters

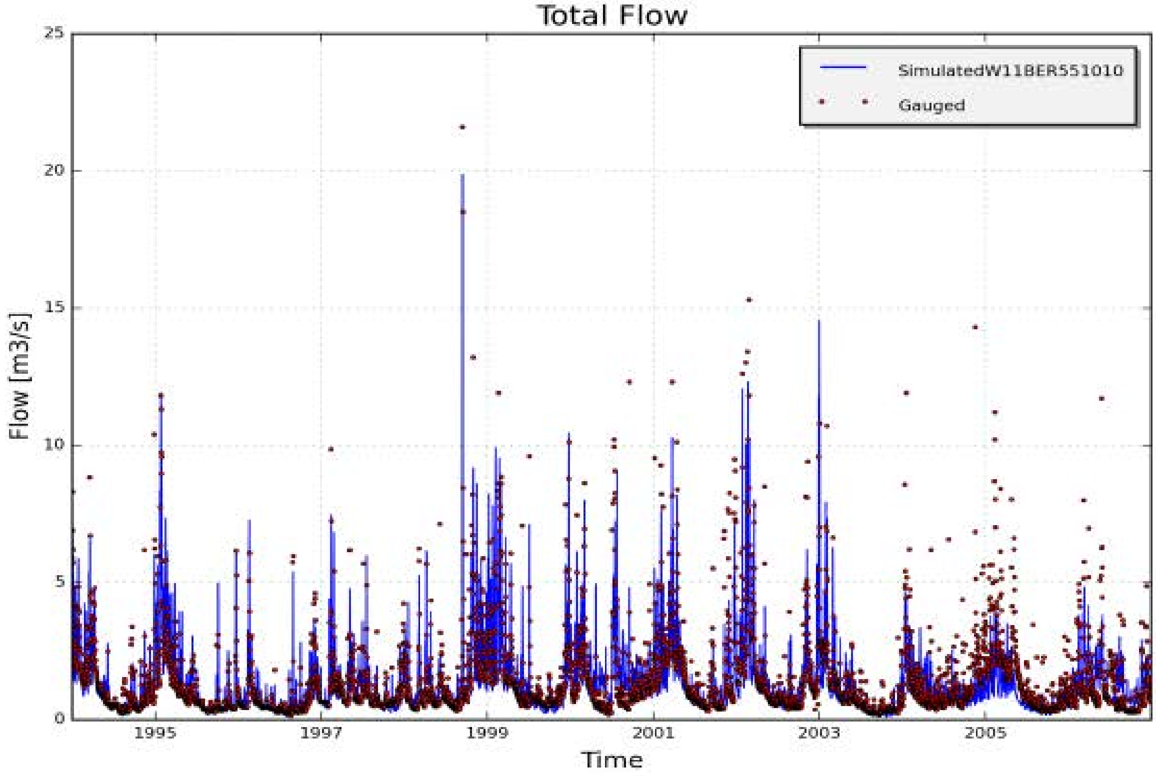


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11BER551010, station unkown(calibration period)

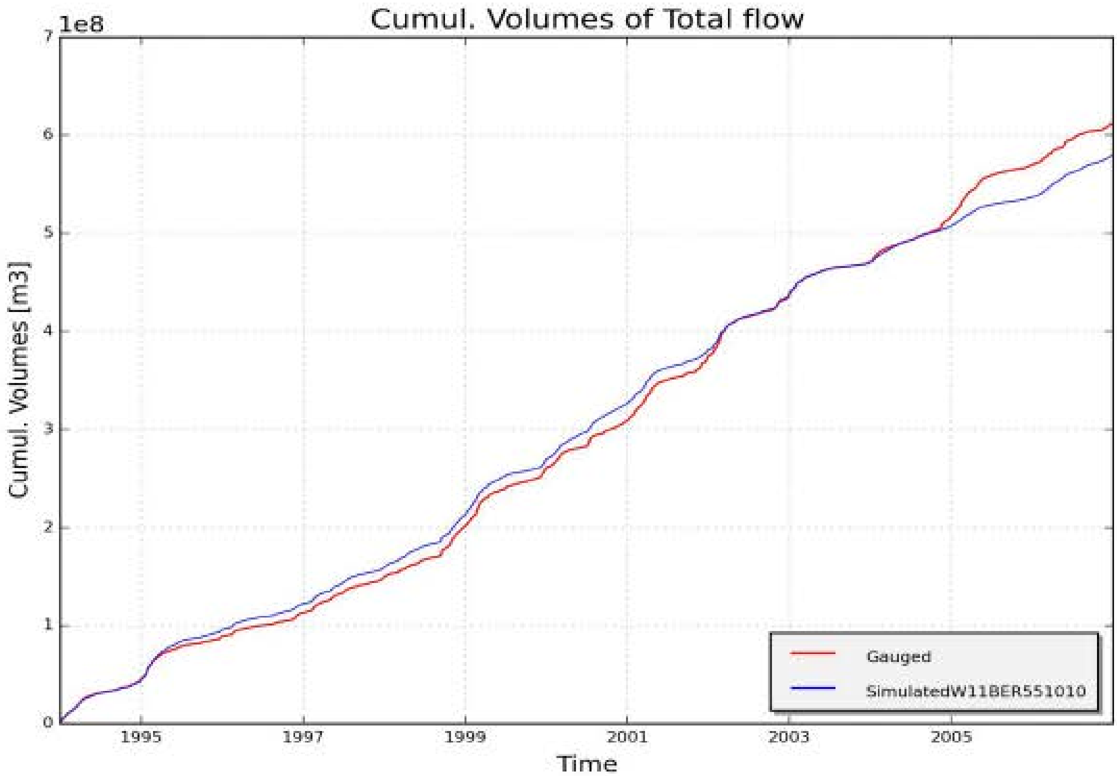


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11BER551010, station unkown (calibration period)

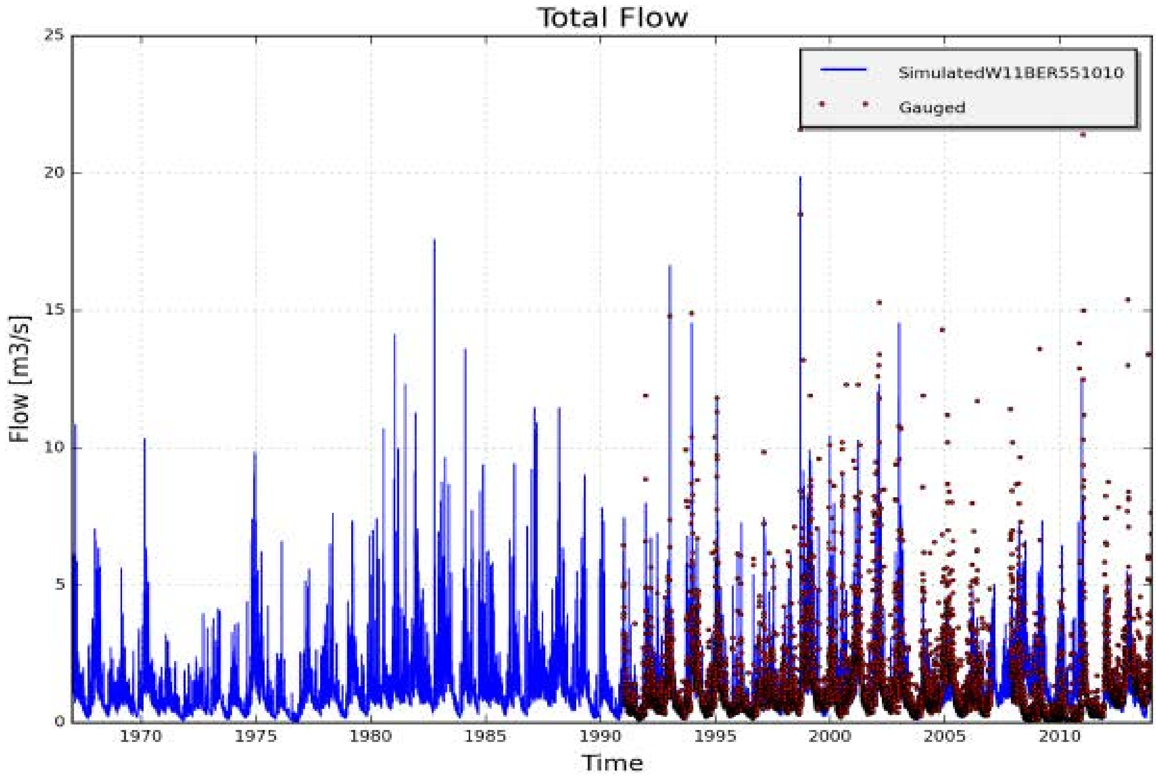


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11BER551010, station unkown (validation period)

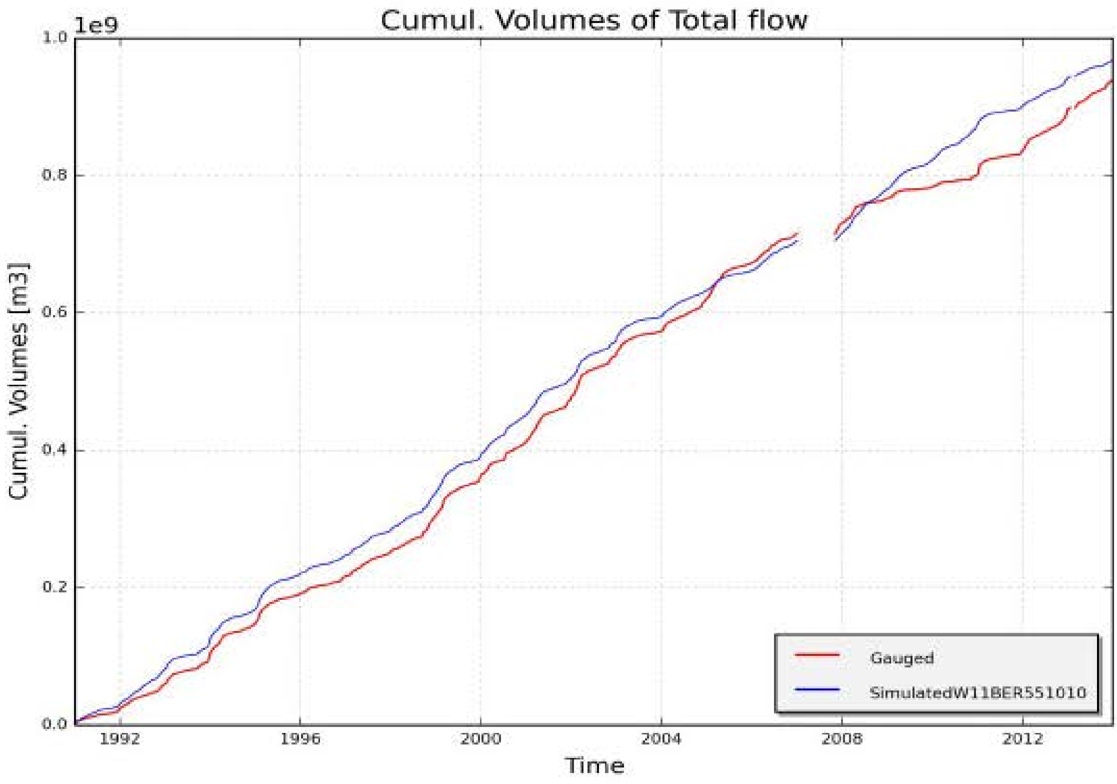


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11BER551010, station unkown (validation period)

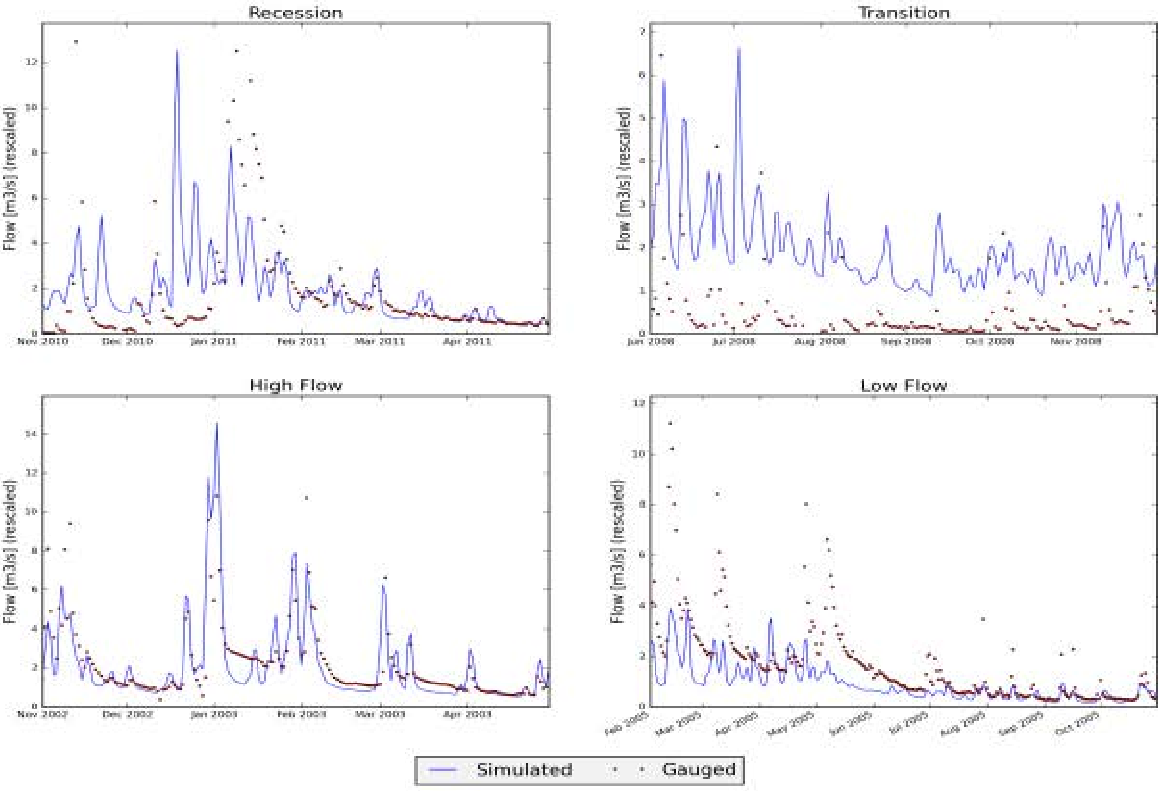


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11BER551010, station unkown

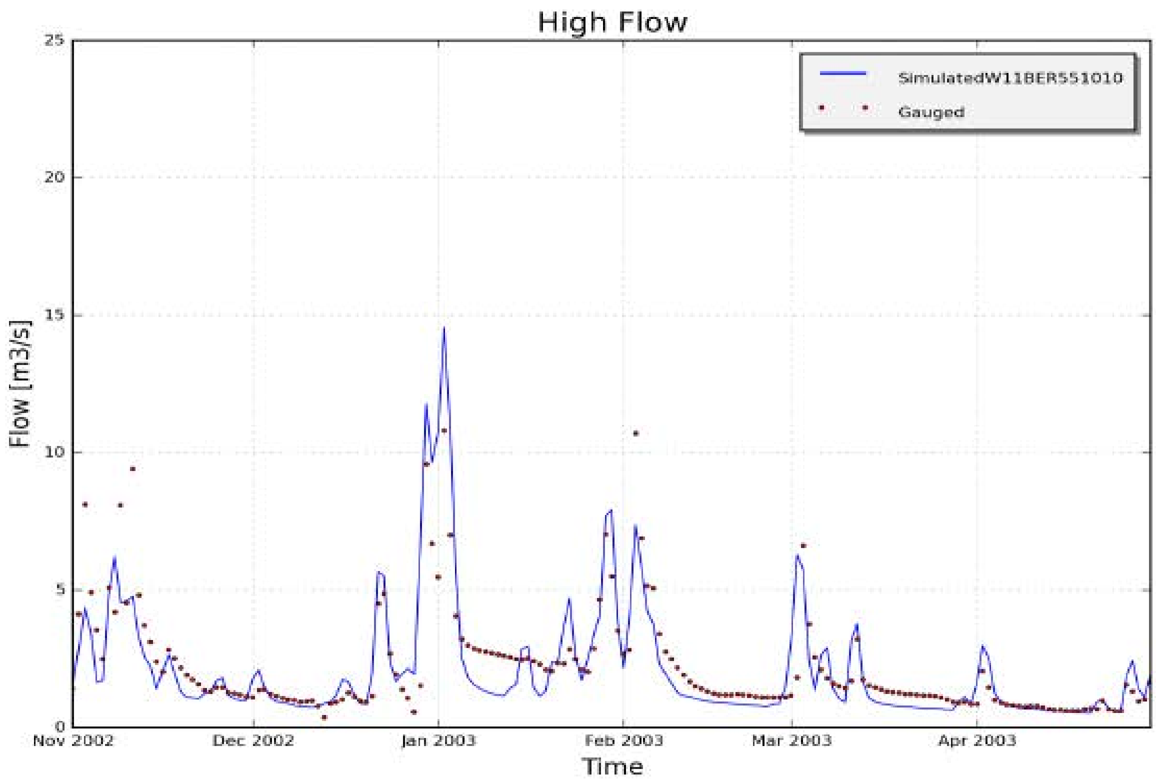


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11BER551010, station unkown

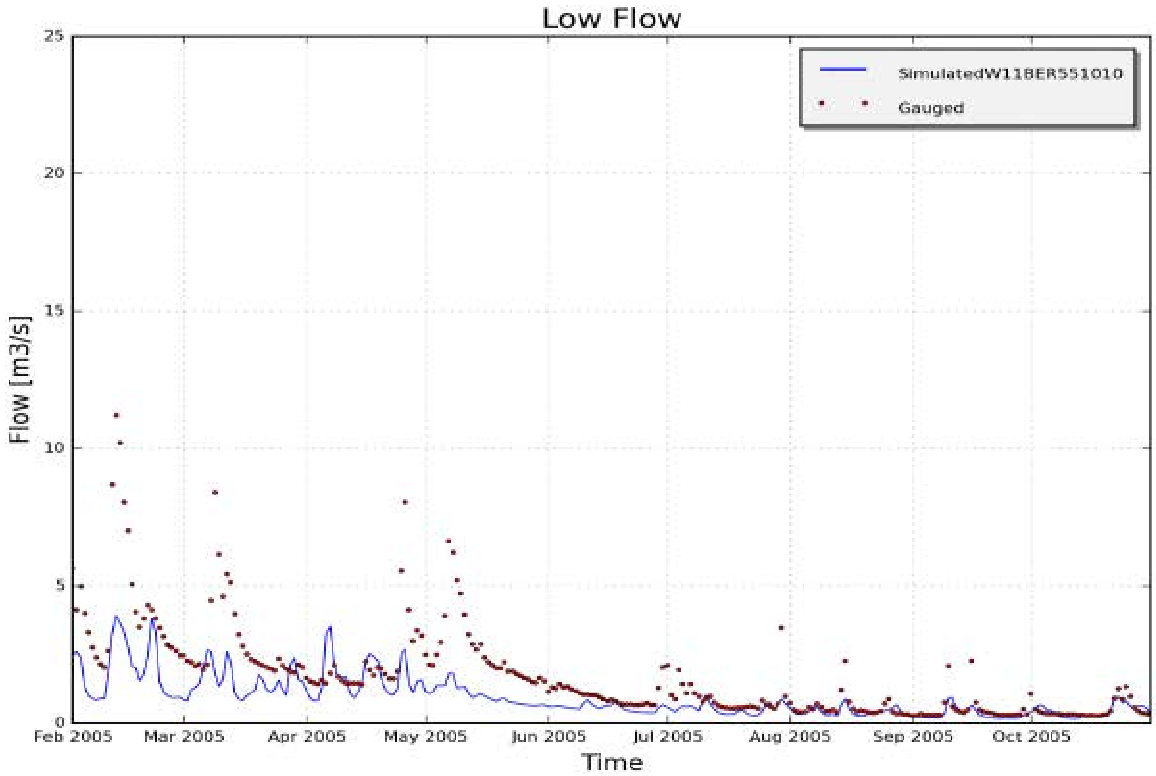


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11BER551010, station unkown

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W11HOY5990" (MEUSE)

1.1 Input data

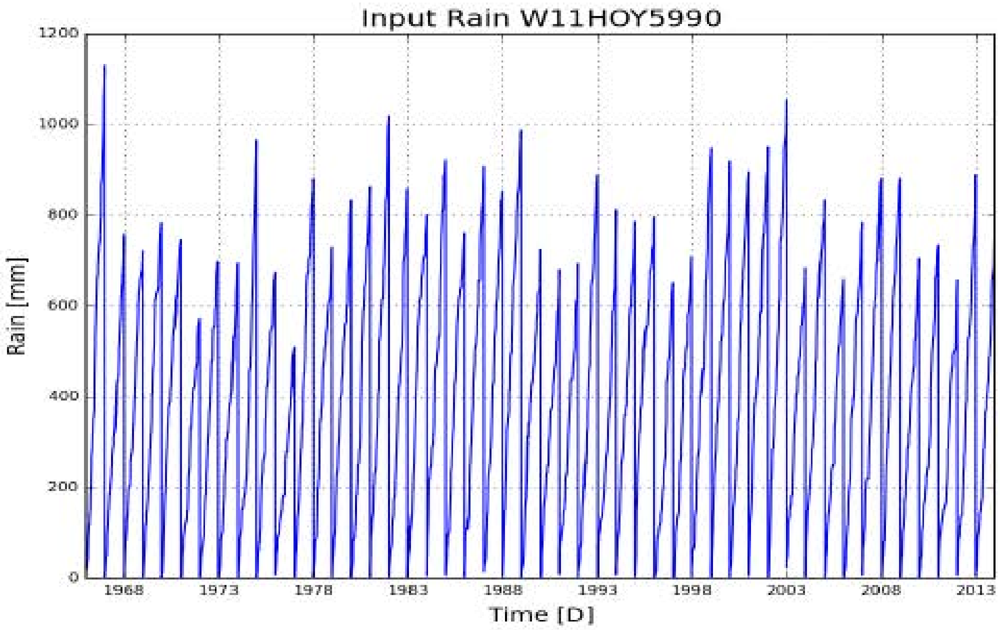


Figure 1: Cumulative precipitation on catchment W11HOY5990 (Meuse)

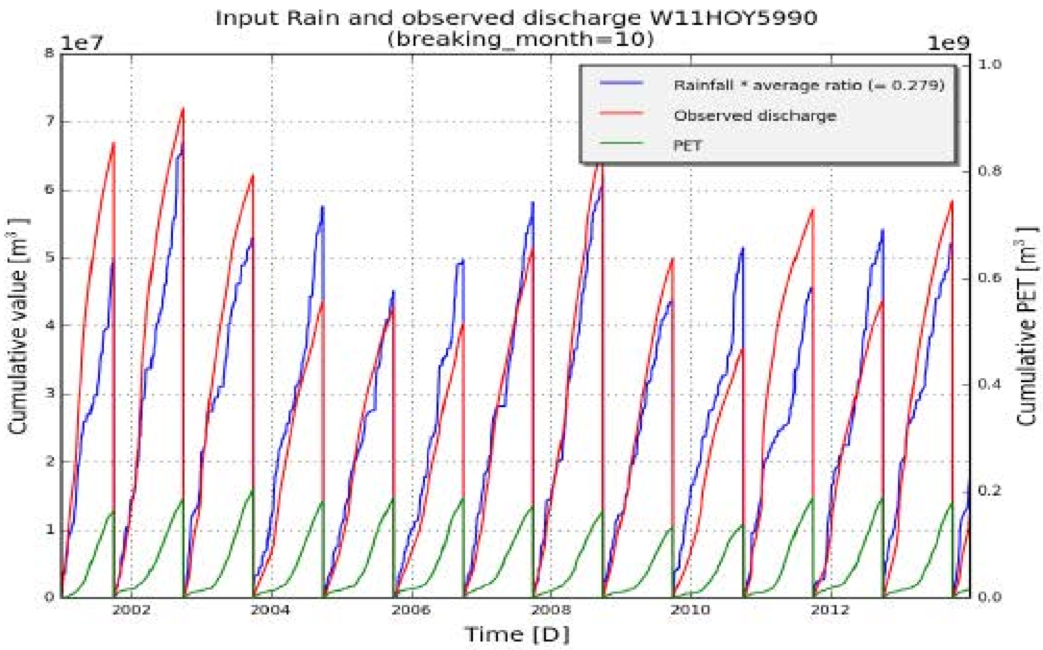


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W11HOY5990 (Meuse)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W11HOY5990
subcatchment_area [m2]	242000000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 601.37), ('SMevap', 144.46), ('c1', 1.96), ('c2', 0.79), ('c3', 1.0), ('cOF1', -5.44), ('cOF2', 5.0), ('cIF1', -4.94), ('cIF2', 3.0), ('CQOF', 13.64), ('CKIF', 77.39), ('CKBF', 1193.9)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	0.4 %	9.2 %	-10.0 %
NS	0.455	0.096	0.3
NS_log	0.687	0.128	0.716
NS_rel	0.876	0.48	0.932
KGE	0.482	0.493	0.261

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-0.8 %	8.5 %	-11.7 %
NS	0.45	0.09	0.296
NS_log	0.683	0.118	0.707
NS_rel	0.875	0.478	0.93
KGE	0.47	0.486	0.254

1.3 Observed and simulated timeseries for optimum parameters

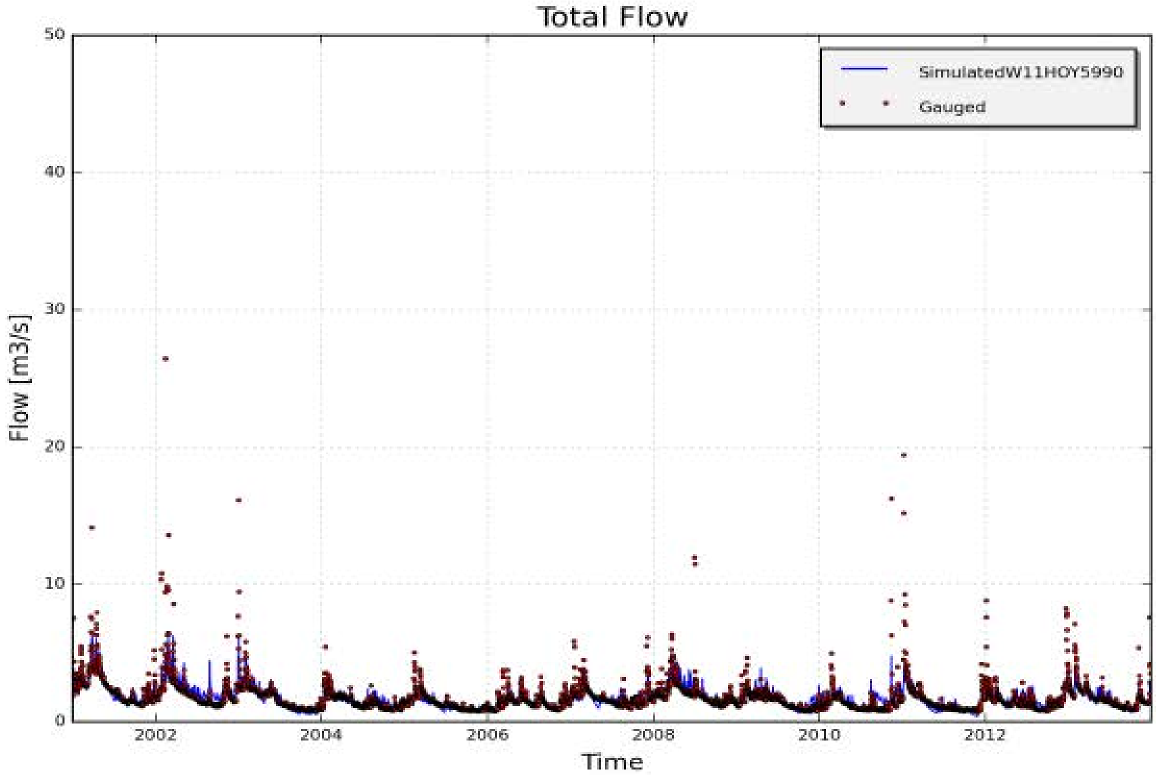


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11HOY5990, station Hoyoux, Marchin(calibration period)

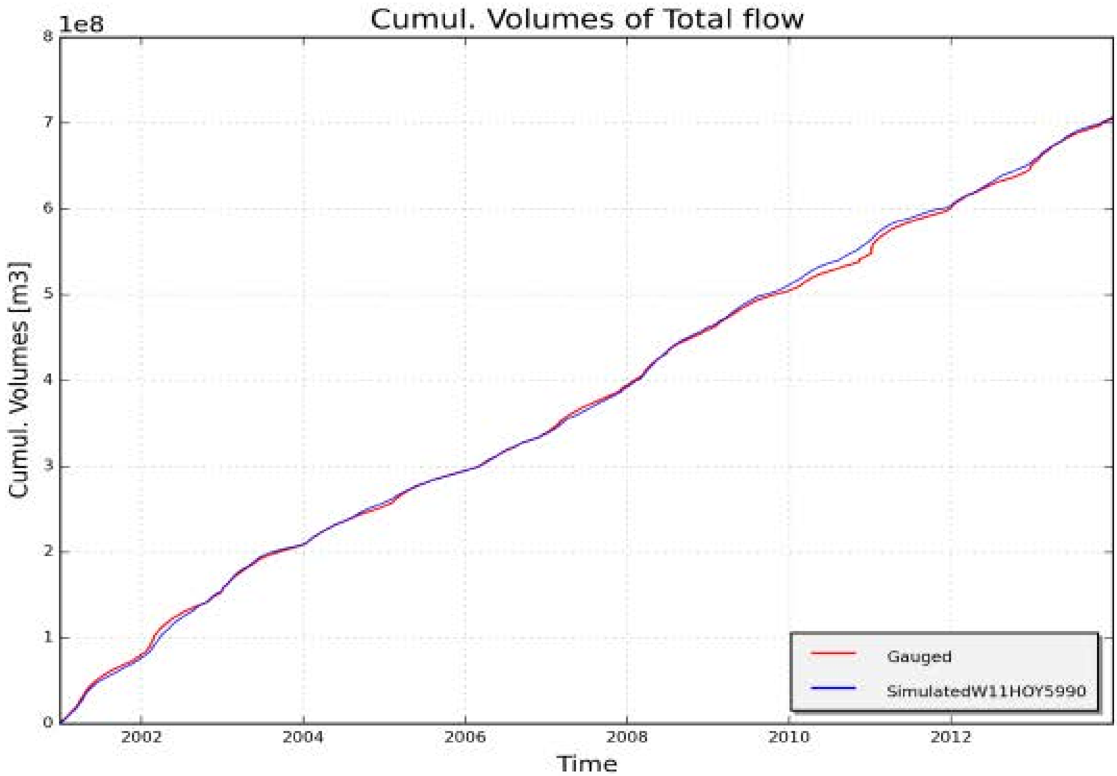


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11HOY5990, station Hoyoux, Marchin (calibration period)

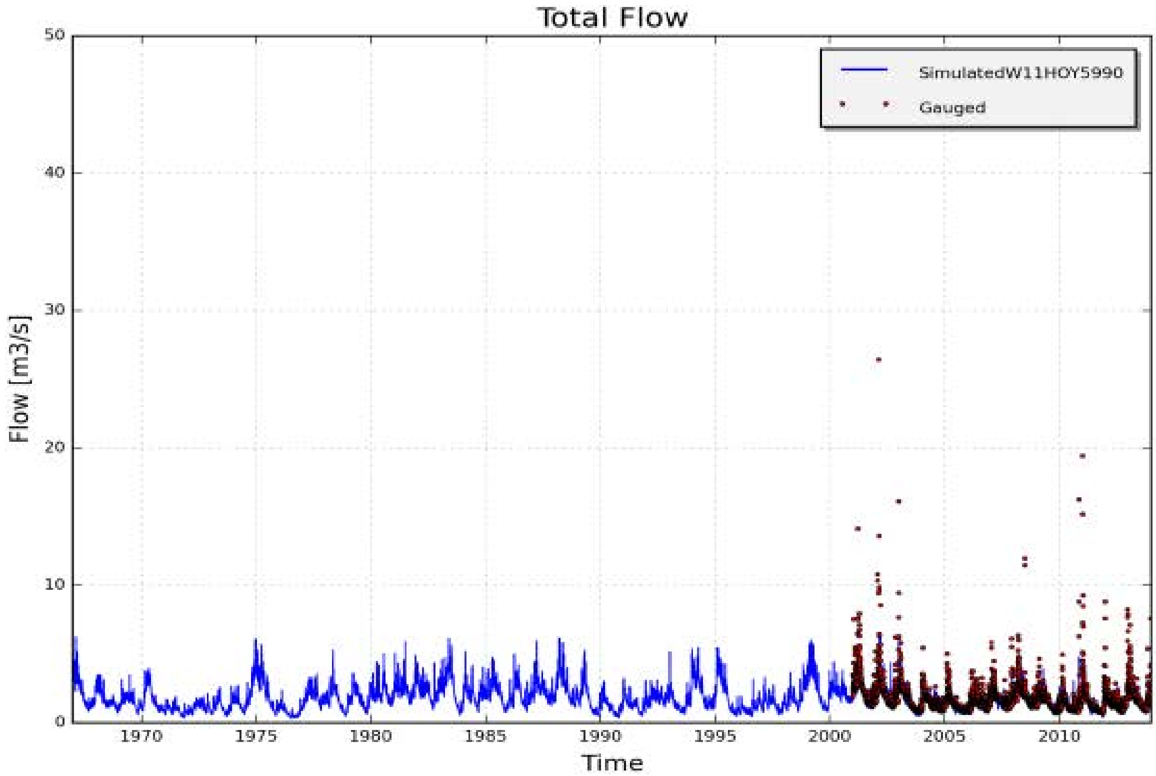


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11HOY5990, station Hoyoux, Marchin (validation period)

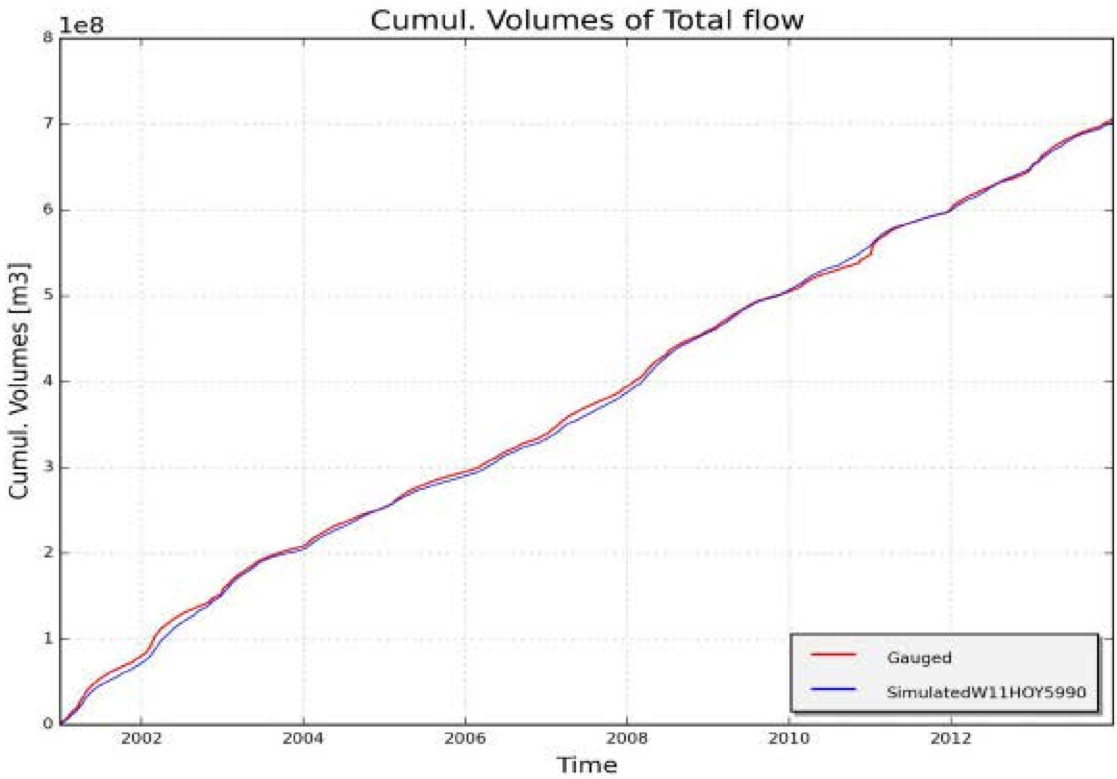


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11HOY5990, station Hoyoux, Marchin (validation period)

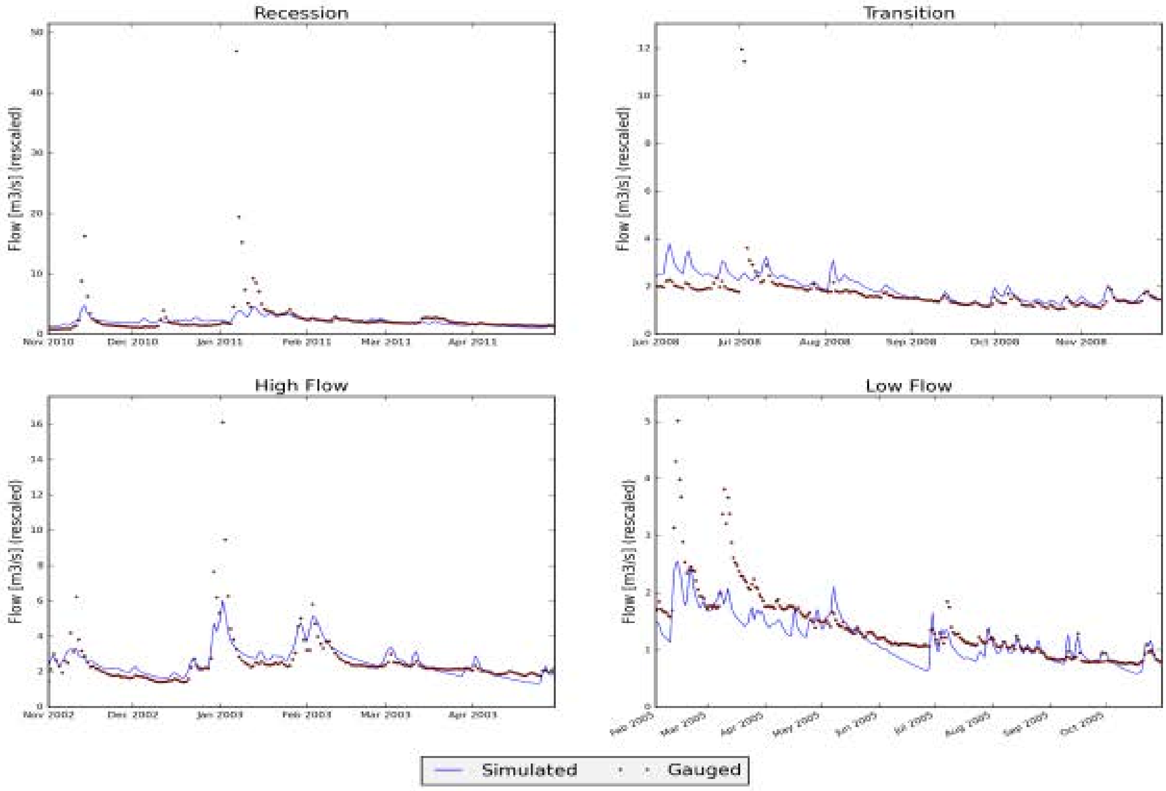


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11HOY5990, station Hoyoux, Marchin

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W11JEK553010" (MEUSE)

1.1 Input data

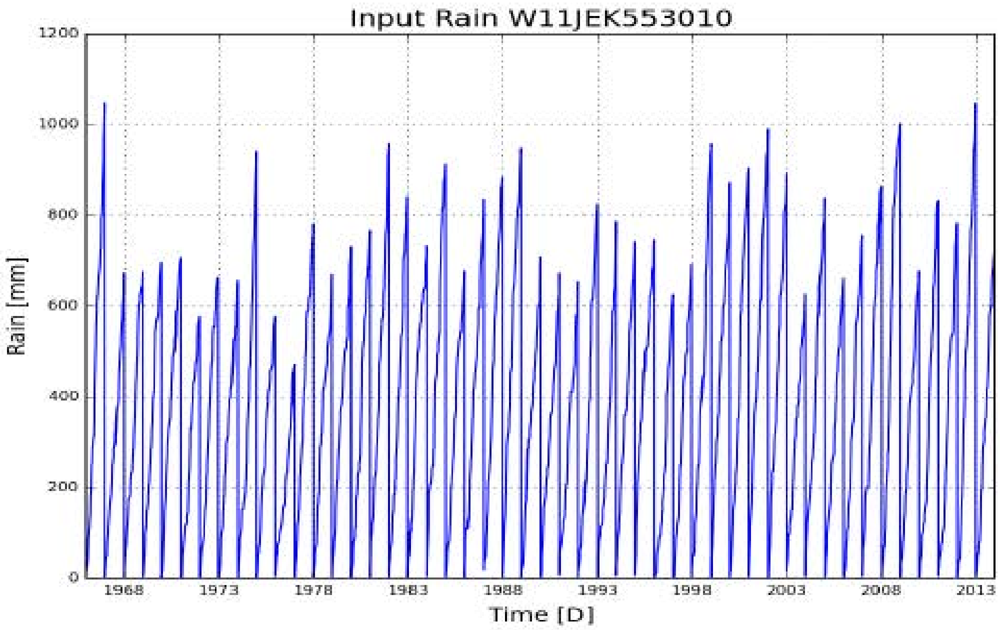


Figure 1: Cumulative precipitation on catchment W11JEK553010 (Meuse)

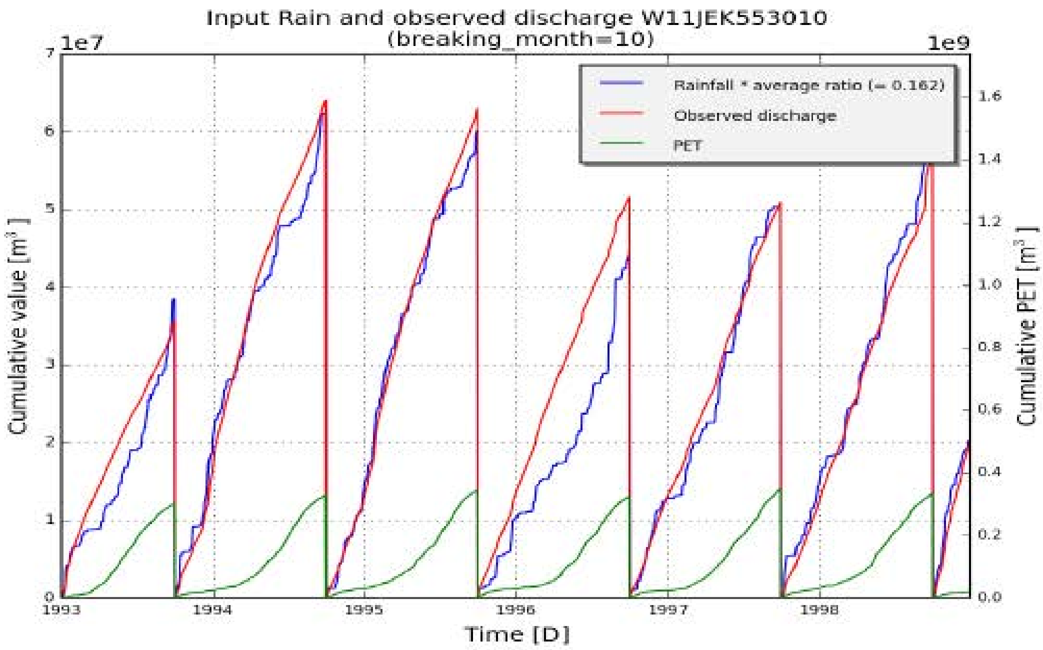


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W11JEK553010 (Meuse)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W11JEK553010
subcatchment_area [m2]	465499442
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 522.03), ('SMevap', 159.03), ('c1', 1.88), ('c2', 0.1), ('c3', 1.0), ('cOF1', -4.02), ('cOF2', 0.56), ('cIF1', -6.0), ('cIF2', 0.42), ('CQOF', 14.39), ('CKIF', 60.28), ('CKBF', 1101.53)]

Table 1: Goodness of fit for calibration period (1993 - 1998)

	Full year	**Summer**	**Winter**
RelErr	0.9 %	6.4 %	-5.3 %
NS	0.509	0.508	0.588
NS_log	0.254	0.305	0.364
NS_rel	0.692	0.835	0.736
KGE	0.646	0.52	0.723

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-10.1 %	2.3 %	-21.3 %
NS	0.185	0.223	0.188
NS_log	-0.064	-0.001	-0.058
NS_rel	0.253	0.252	0.521
KGE	0.476	0.54	0.457

1.3 Observed and simulated timeseries for optimum parameters

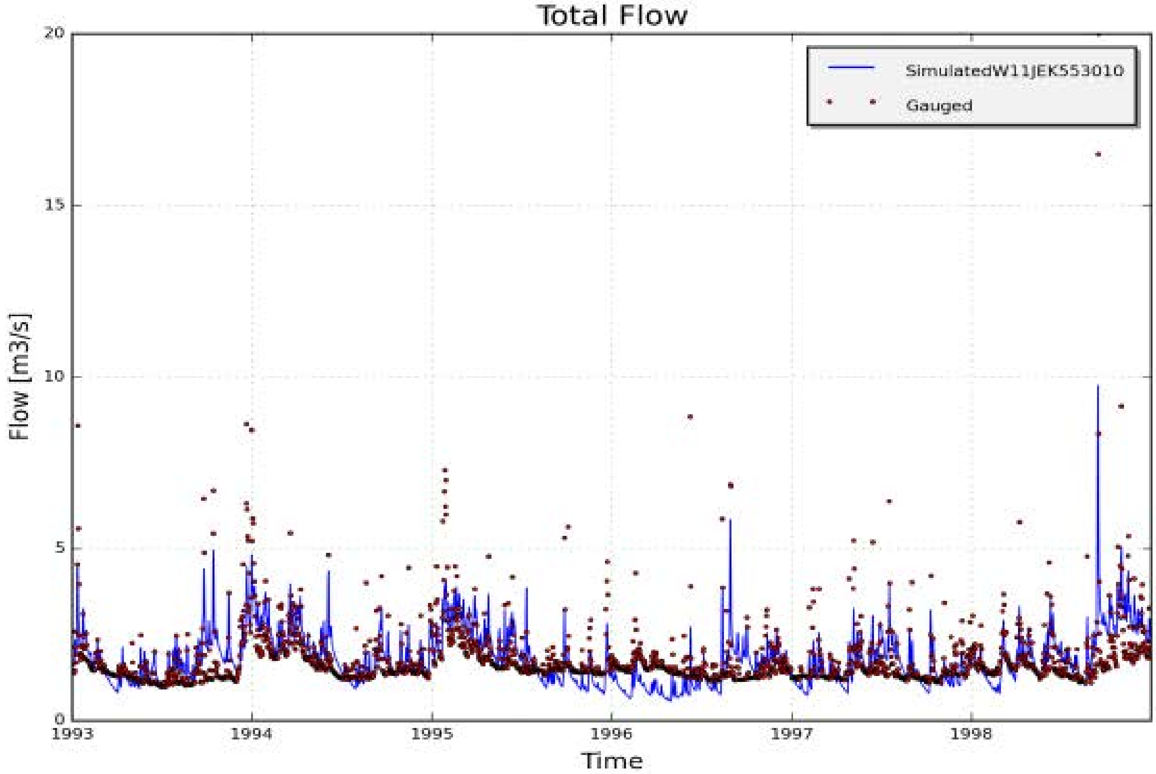


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11JEK553010, station unkown(calibration period)

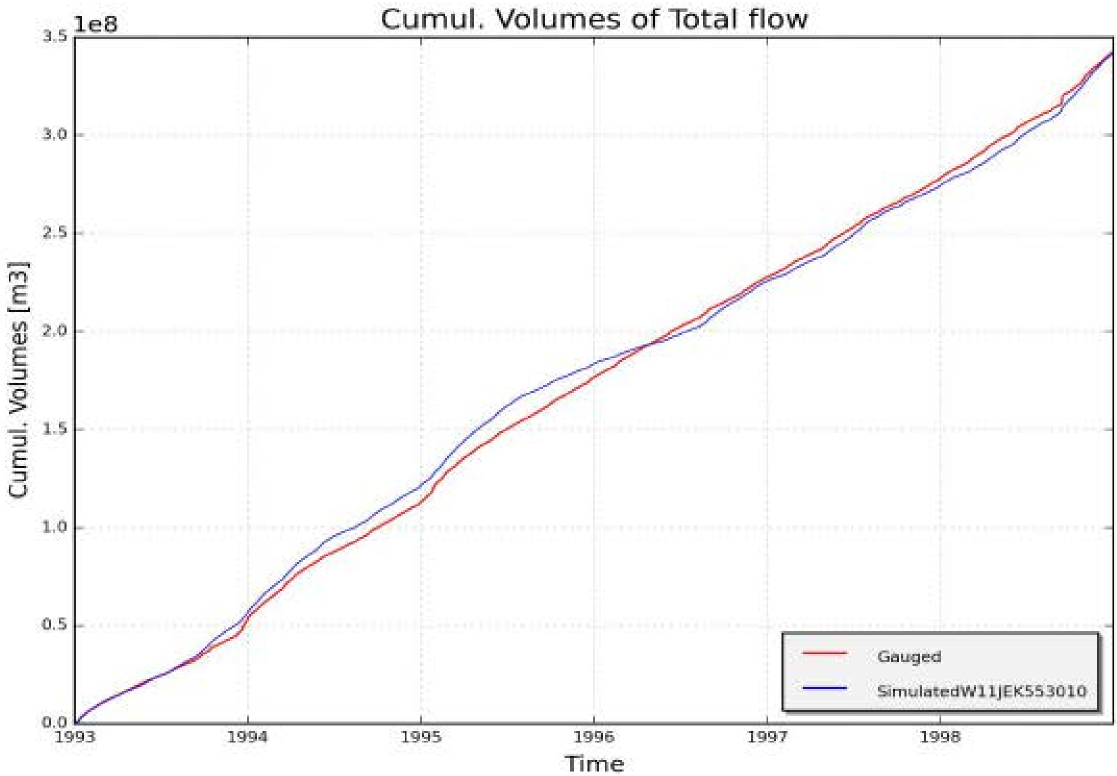


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11JEK553010, station unkown (calibration period)

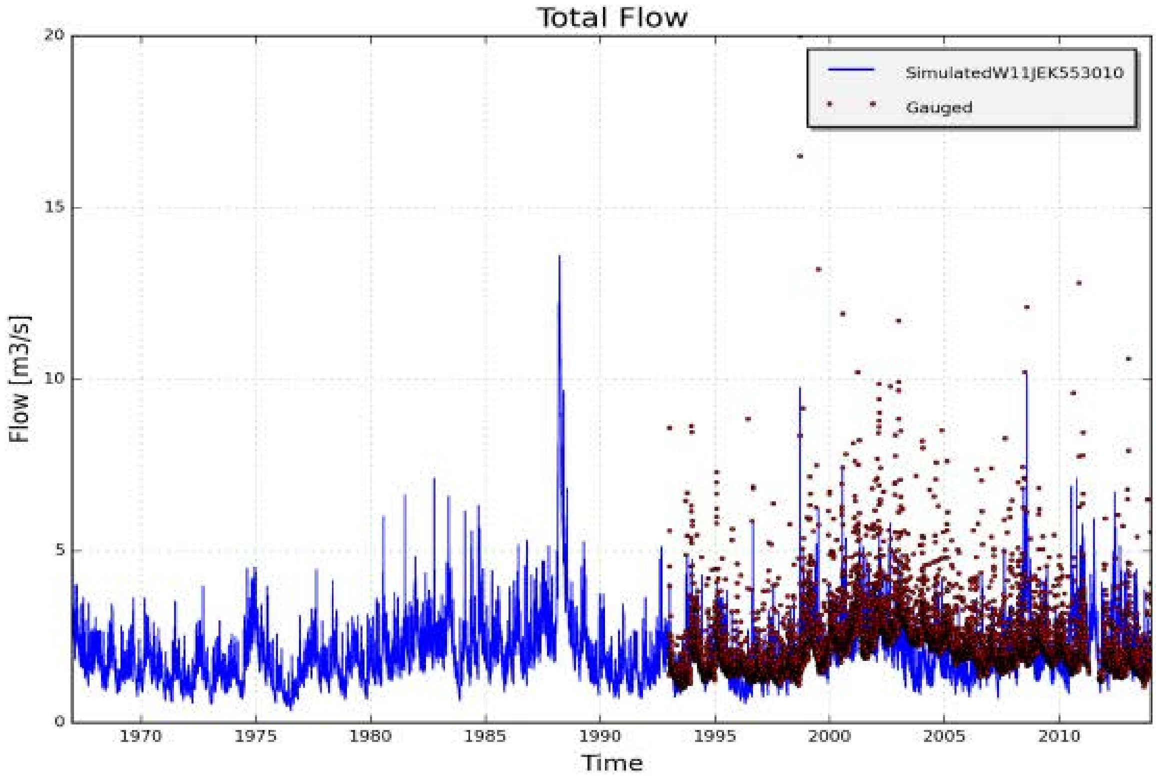


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11JEK553010, station unkown (validation period)

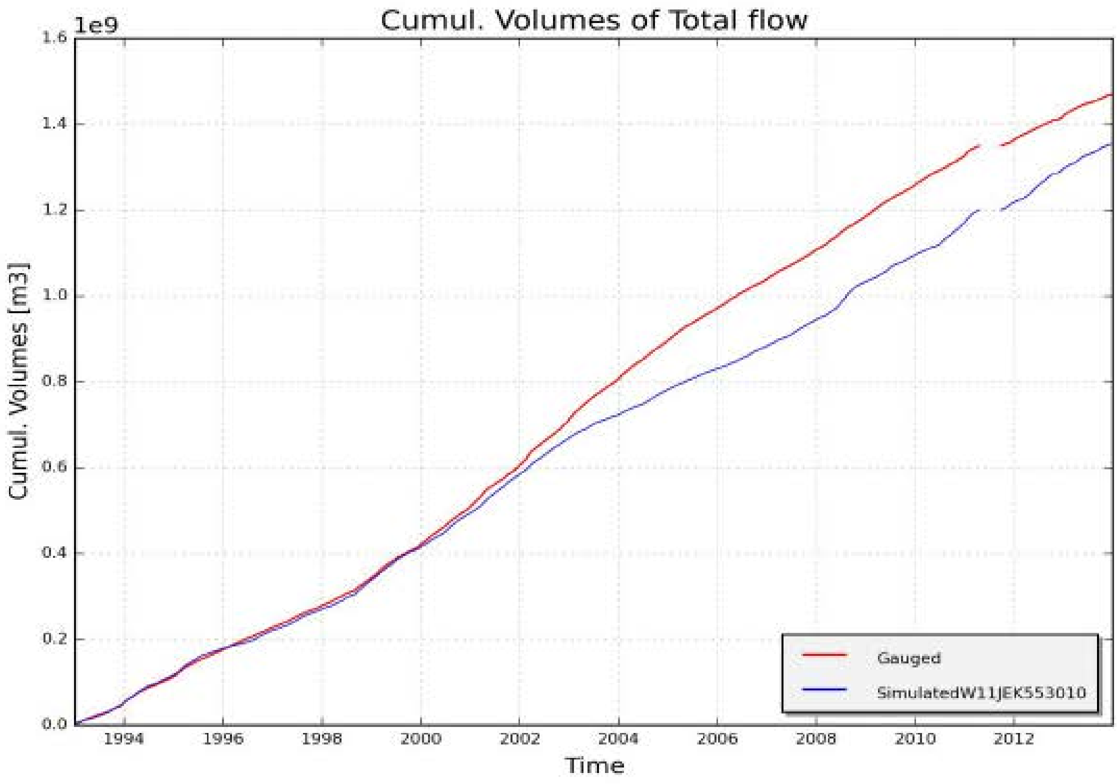


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11JEK553010, station unkown (validation period)

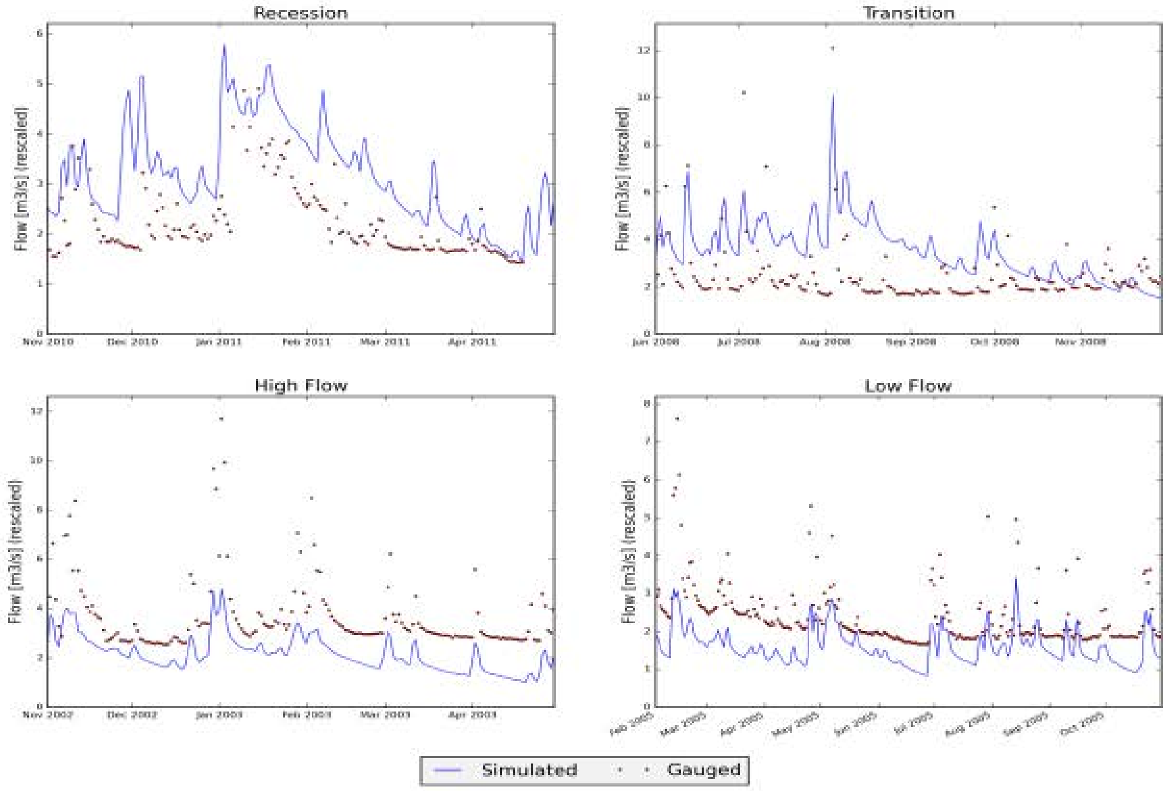


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11JEK553010, station unkown

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W11MAAPROF" (MEUSE)

1.1 Input data

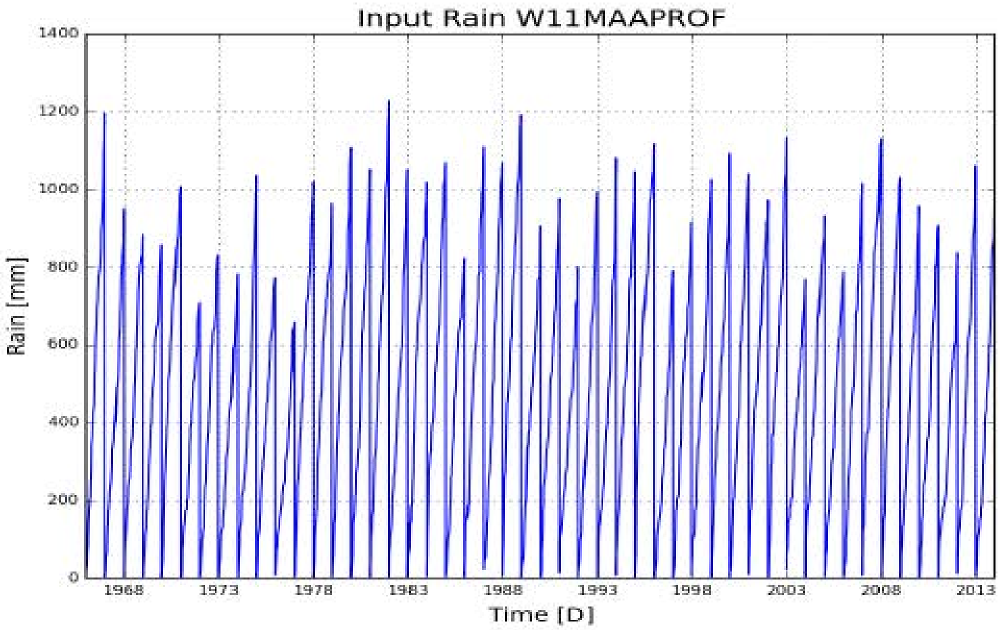


Figure 1: Cumulative precipitation on catchment W11MAAPROF (Meuse)

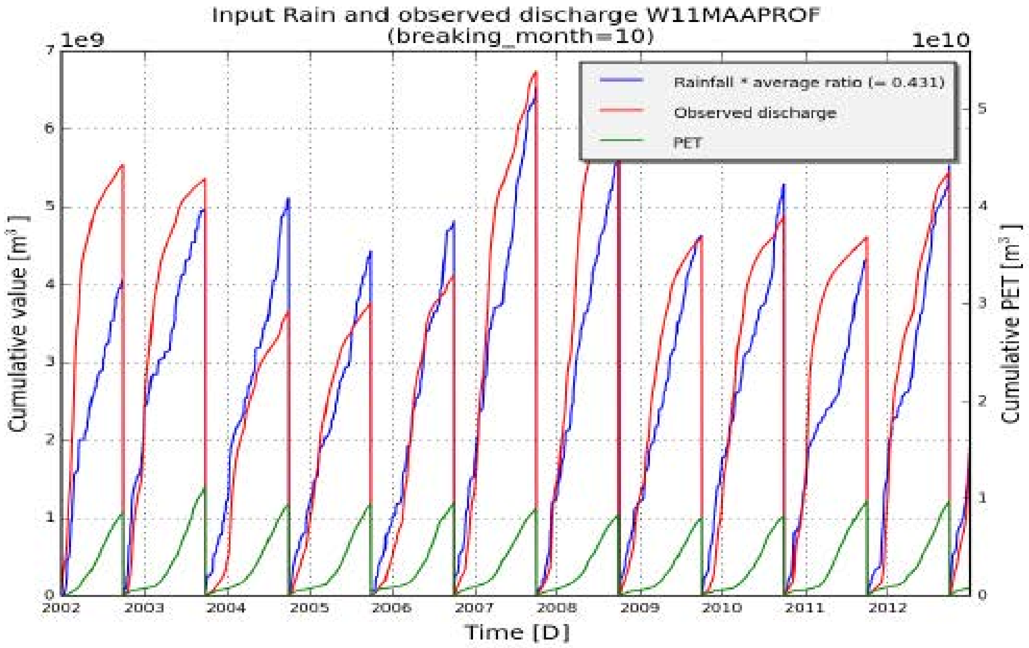


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W11MAAPROF (Meuse)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W11MAAPROF
subcatchment_area [m2]	12585000000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 447.9), ('SMevap', 192.09), ('c1', 3.05), ('c2', 2.13), ('c3', 1.0), ('cOF1', -6.0), ('cOF2', 0.0), ('cIF1', -3.72), ('cIF2', 3.0), ('CQOF', 14.27), ('CKIF', 69.7), ('CKBF', 1148.39)]

Table 1: Goodness of fit for calibration period (2002 - 2012)

	Full year	**Summer**	**Winter**
RelErr	-0.6 %	9.9 %	-12.0 %
NS	0.72	0.513	0.536
NS_log	0.776	0.39	0.622
NS_rel	0.807	0.649	0.628
KGE	0.677	0.672	0.458

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-6.8 %	6.5 %	-14.9 %
NS	0.707	0.496	0.512
NS_log	0.77	0.382	0.619
NS_rel	0.807	0.631	0.626
KGE	0.656	0.665	0.439

1.3 Observed and simulated timeseries for optimum parameters

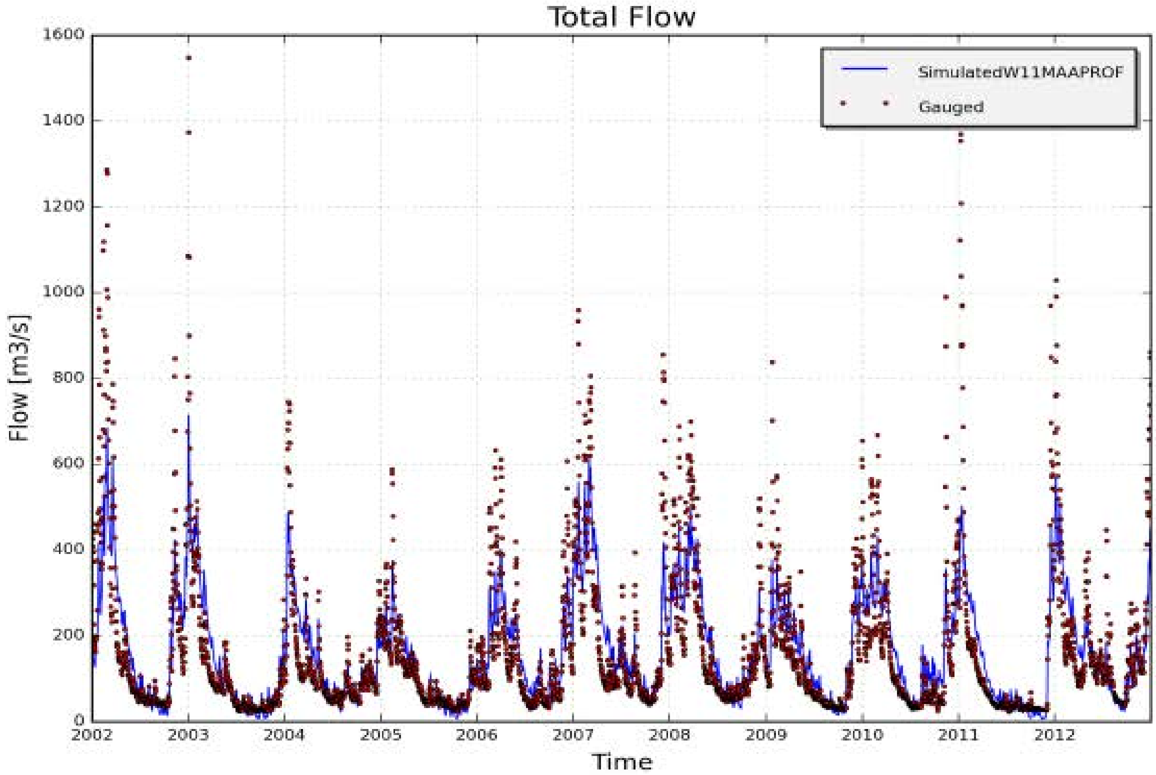


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11MAAPROF, station Meuse, Profondeville(calibration period)

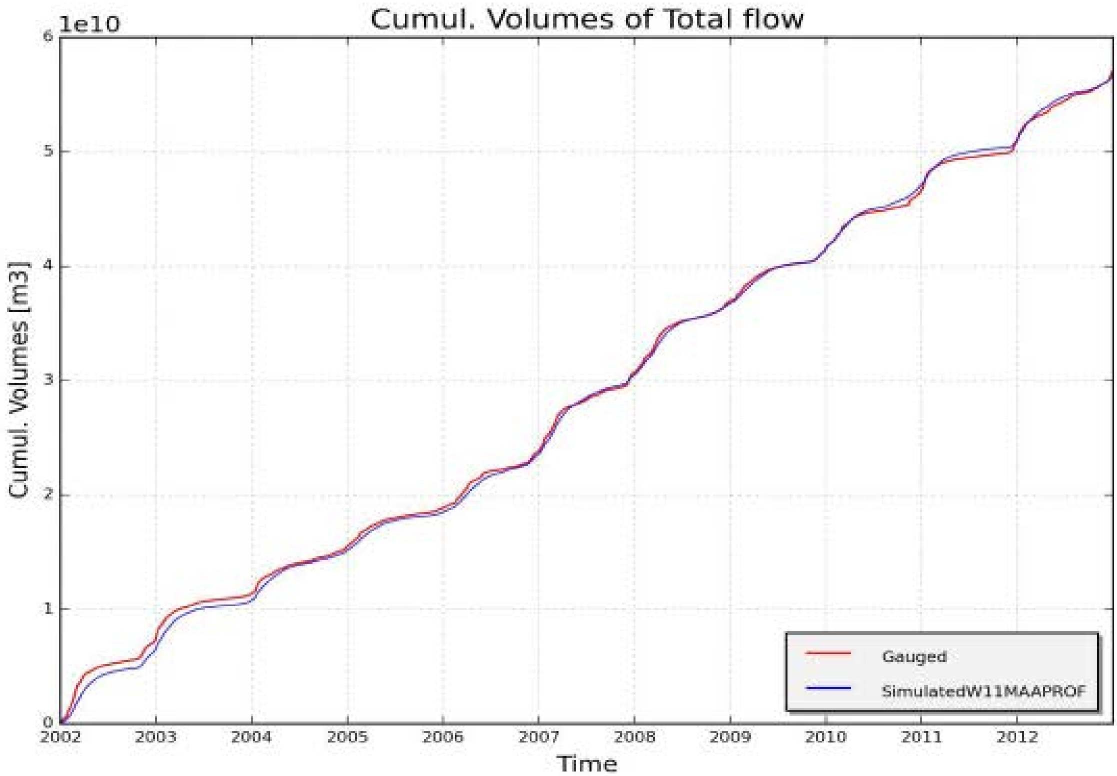


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11MAAPROF, station Meuse, Profondeville (calibration period)

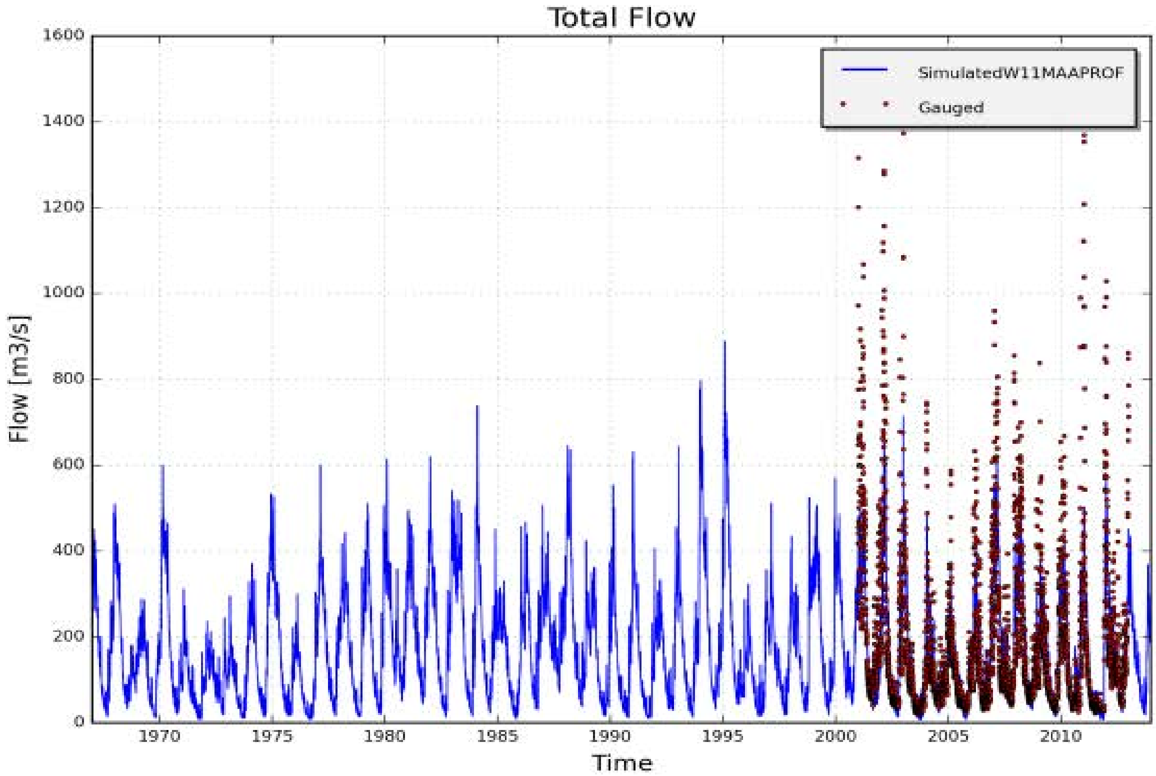


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11MAAPROF, station Meuse, Profondeville (validation period)

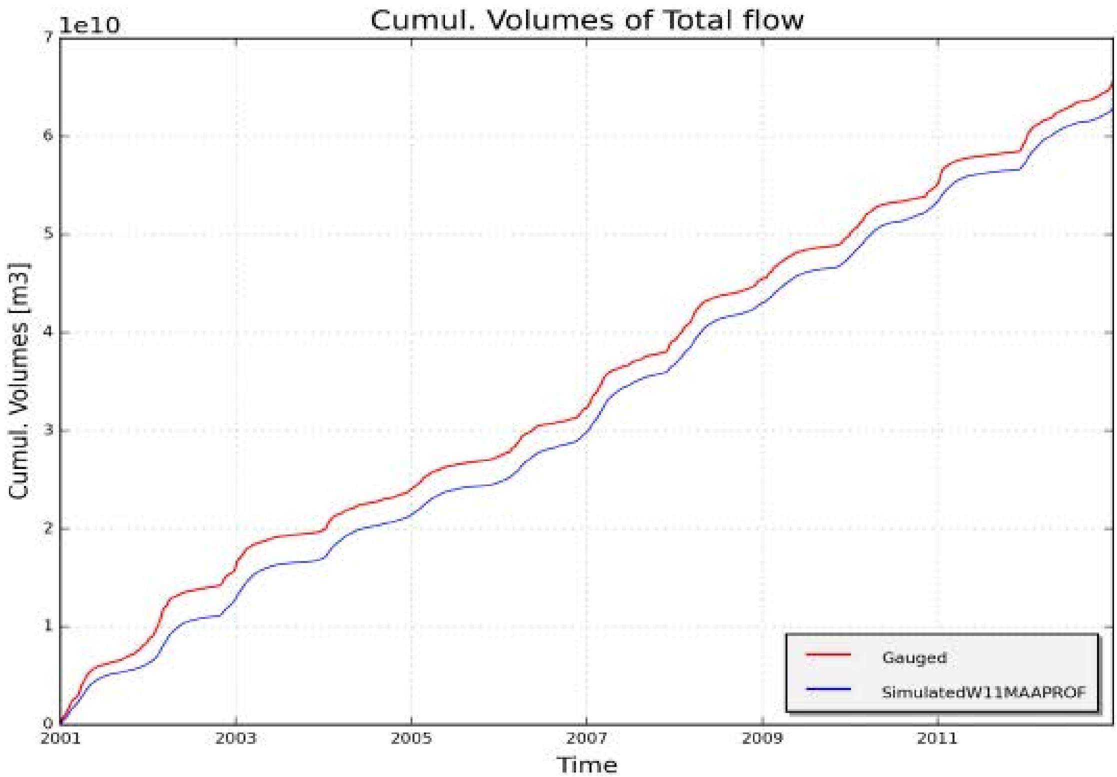


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11MAAPROF, station Meuse, Profondeville (validation period)

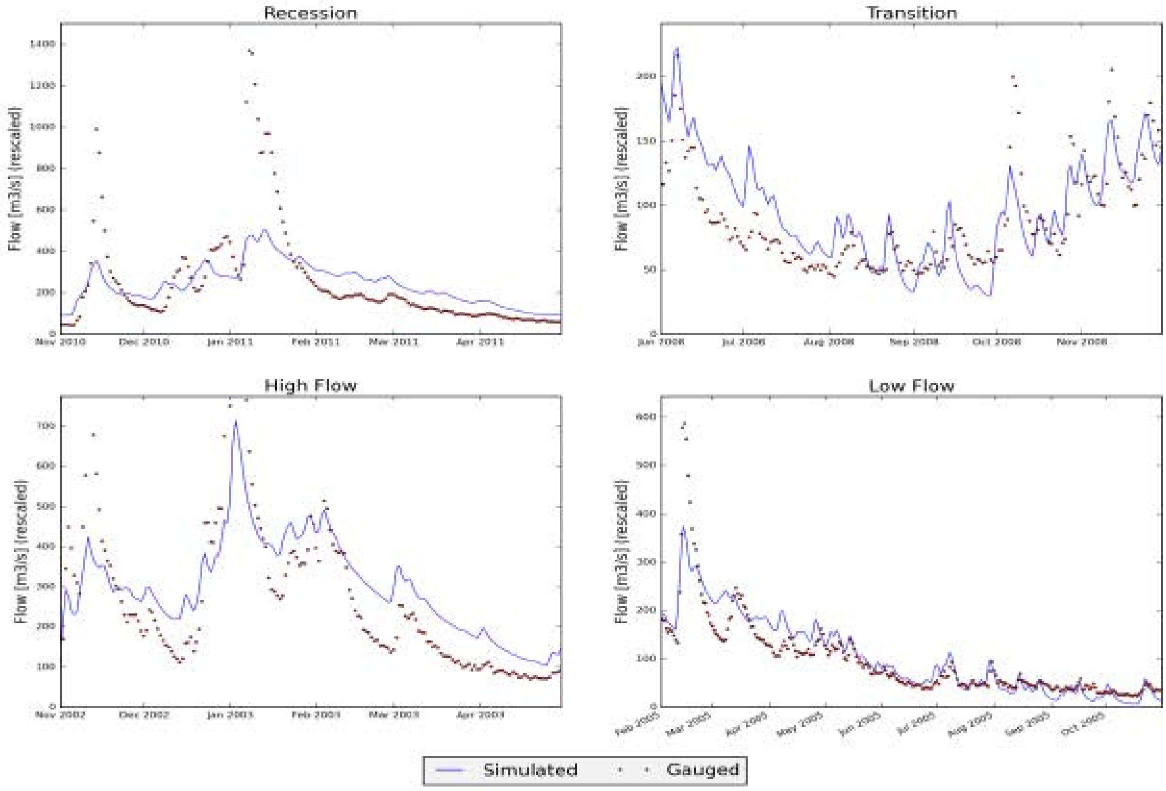


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11MAAPROF, station Meuse, Profondeville

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W11MEH5820" (MEUSE)

1.1 Input data

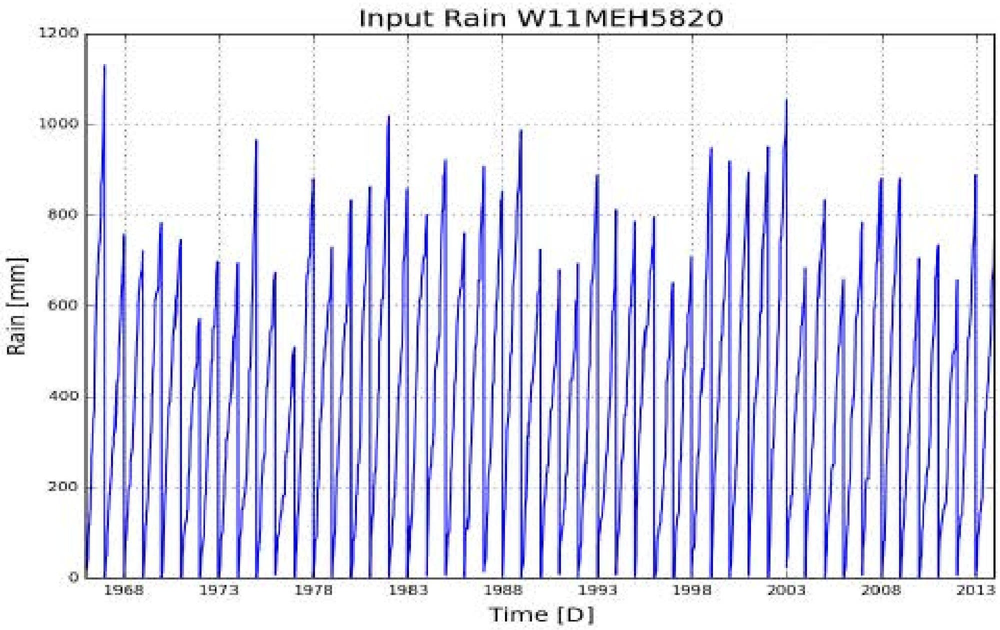


Figure 1: Cumulative precipitation on catchment W11MEH5820 (Meuse)

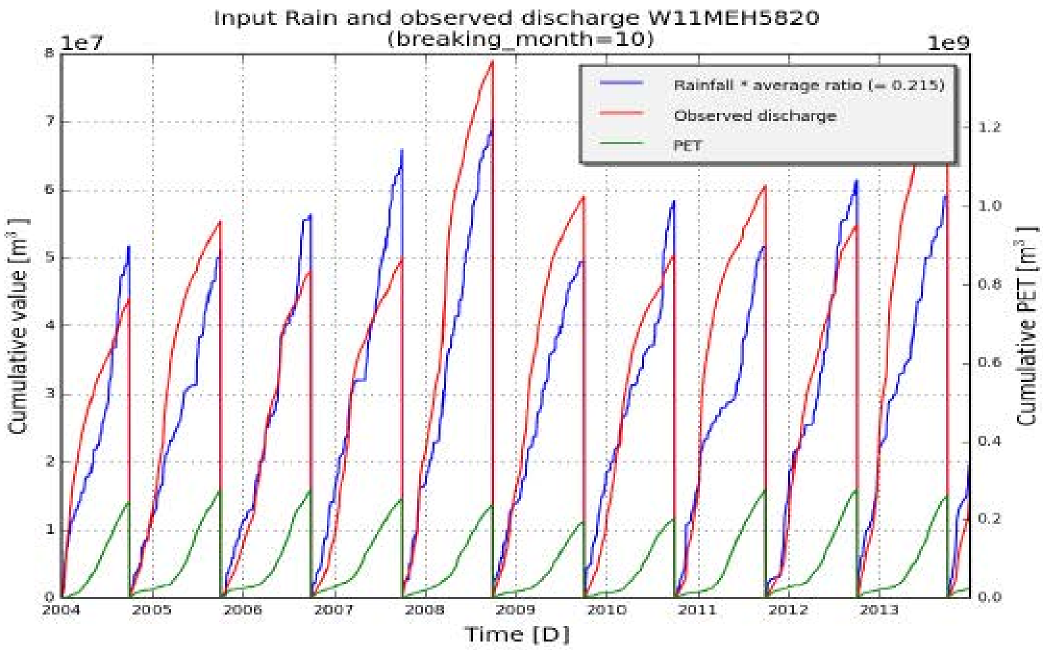


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W11MEH5820 (Meuse)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W11MEH5820
subcatchment_area [m2]	355800000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 396.67), ('SMevap', 169.92), ('c1', 20.35), ('c2', 0.45), ('c3', 1.0), ('cOF1', -5.25), ('cOF2', 3.13), ('cIF1', -4.25), ('cIF2', 2.92), ('CQOF', 12.37), ('CKIF', 82.5), ('CKBF', 1074.66)]

Table 1: Goodness of fit for calibration period (2004 - 2013)

	Full year	**Summer**	**Winter**
RelErr	235.3 %	519.3 %	129.8 %
NS	-8.445	-90.786	-2.842
NS_log	-3.5	-18.701	-1.928
NS_rel	-17.417	-78.682	-4.919
KGE	-1.598	-6.196	-0.315

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	164.6 %	363.5 %	90.0 %
NS	-3.892	-16.981	-1.031
NS_log	-2.331	-10.293	-1.072
NS_rel	-11.112	-18.76	-2.956
KGE	-1.015	-3.454	-0.033

1.3 Observed and simulated timeseries for optimum parameters

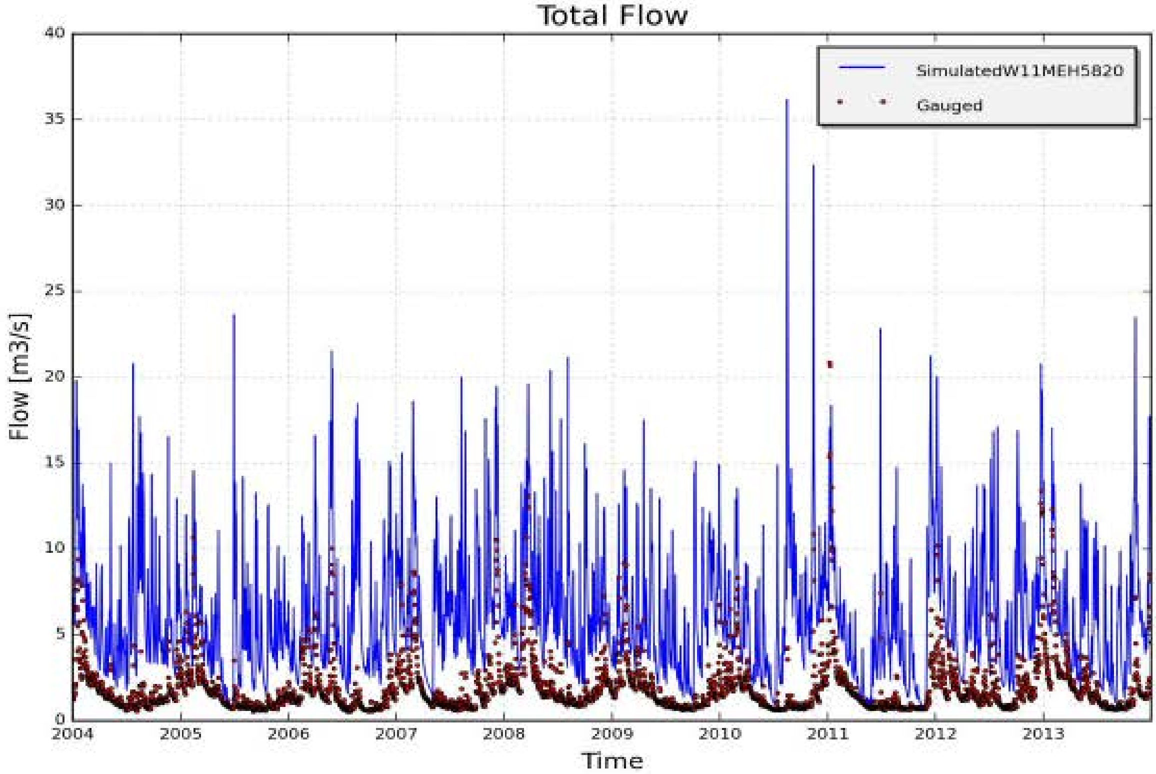


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11MEH5820, station Mehaigne, Wanze(calibration period)

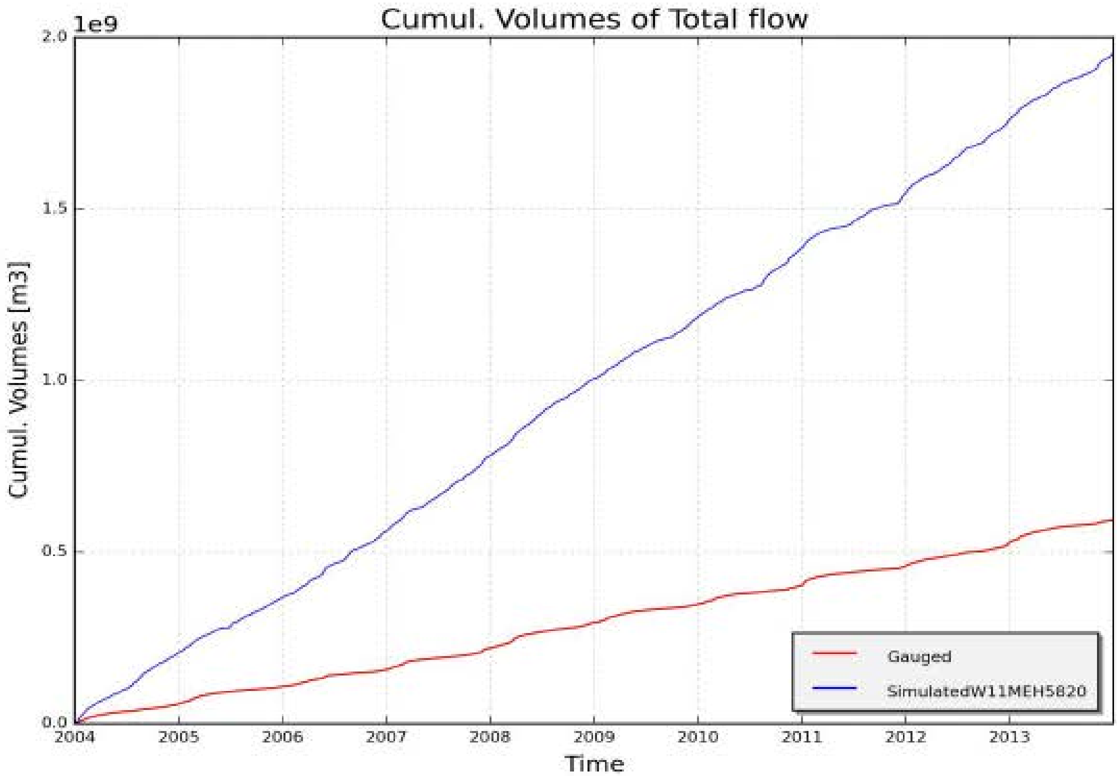


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11MEH5820, station Mehaigne, Wanze (calibration period)

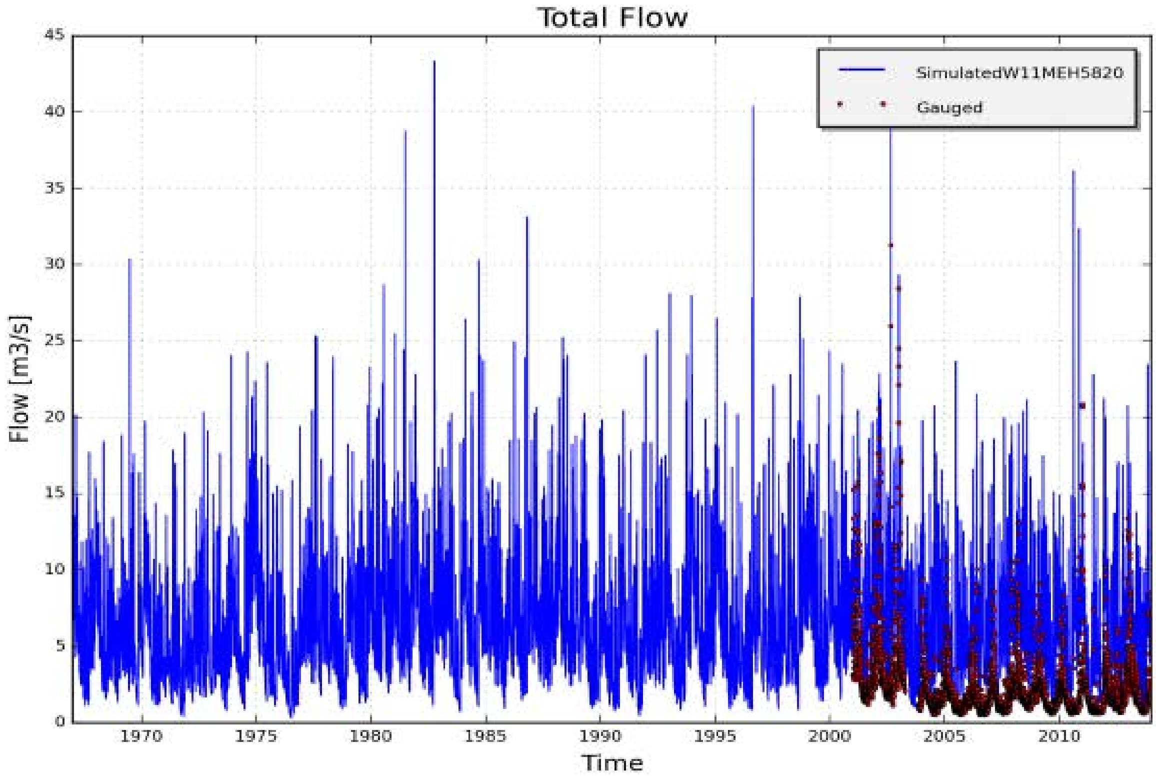


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11MEH5820, station Mehaigne, Wanze (validation period)

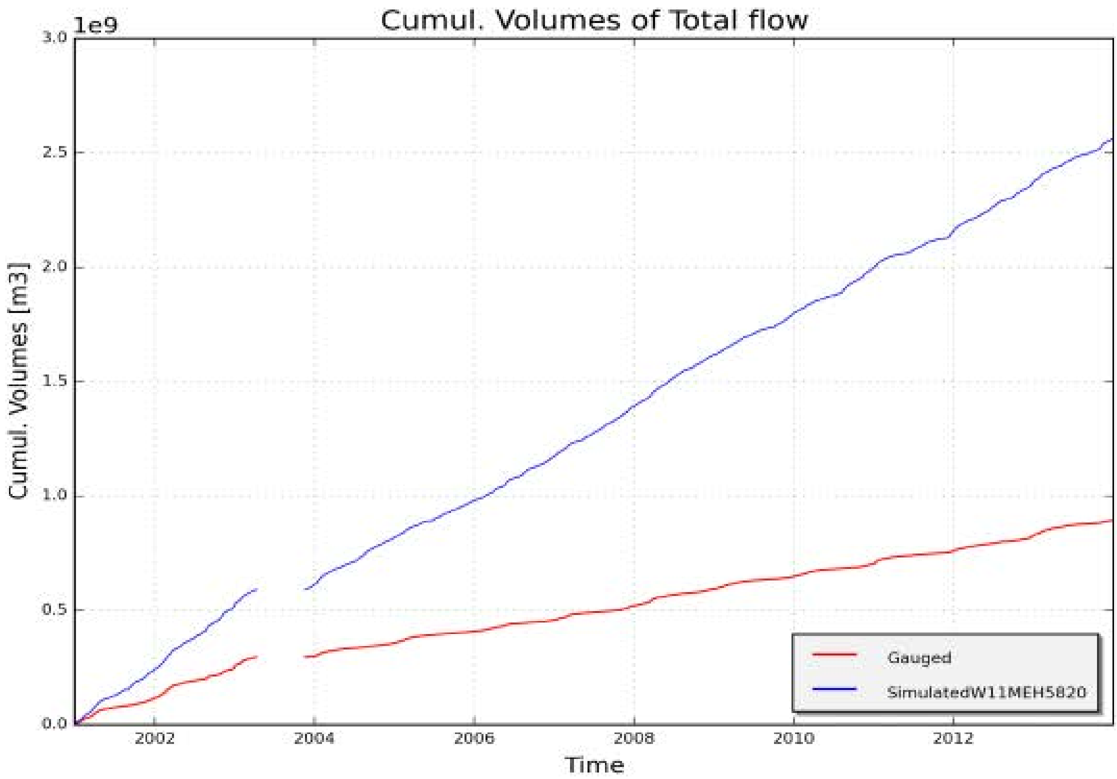


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11MEH5820, station Mehaigne, Wanze (validation period)

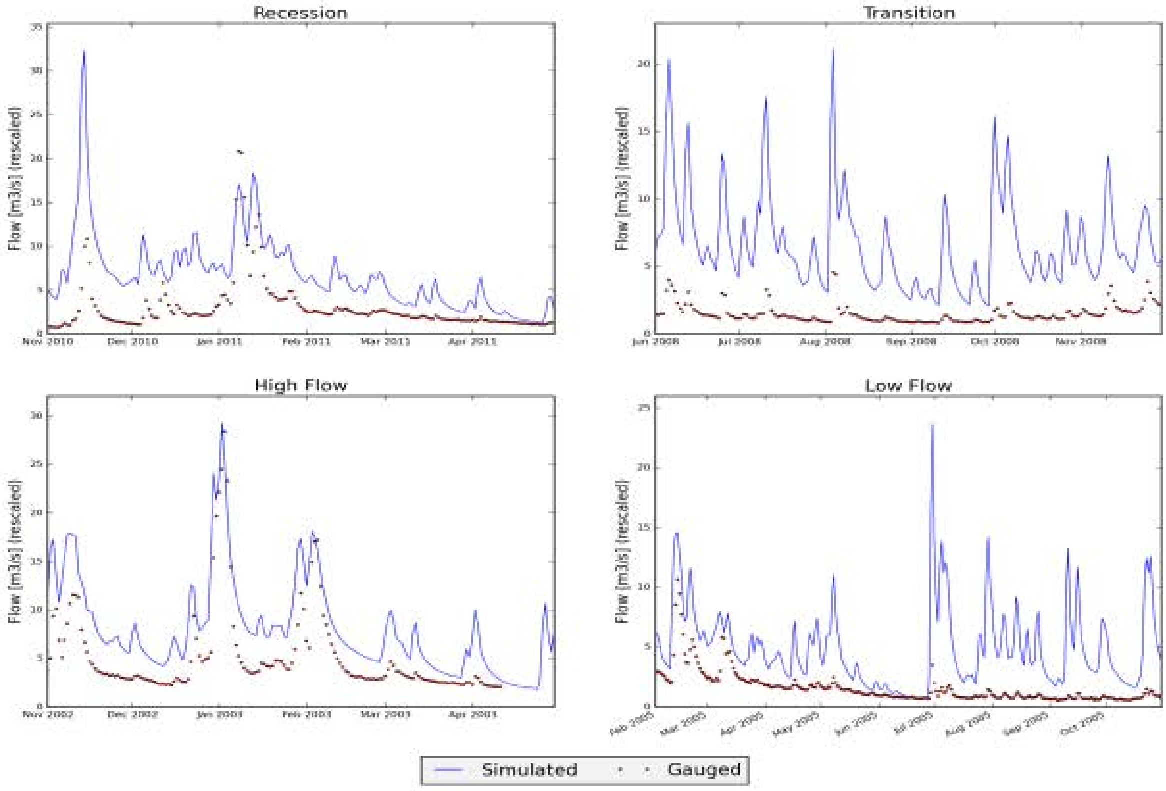


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11MEH5820, station Mehaigne, Wanze

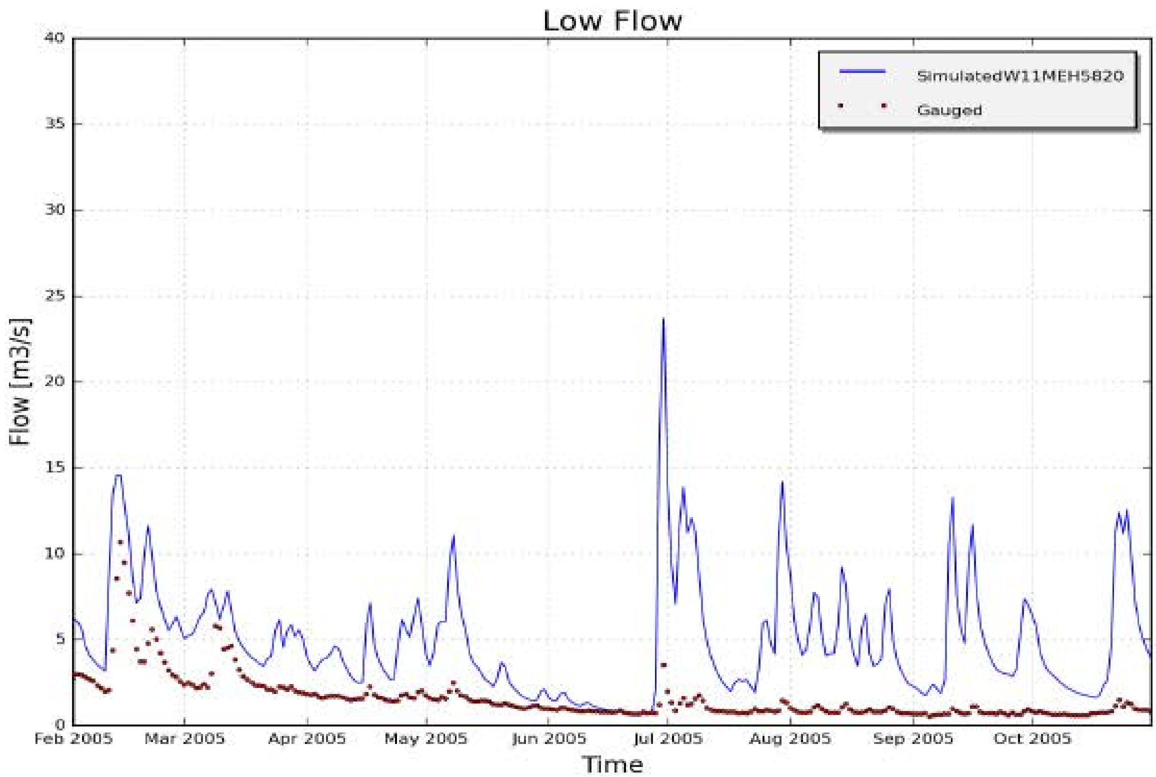


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11MEH5820, station Mehaigne, Wanze

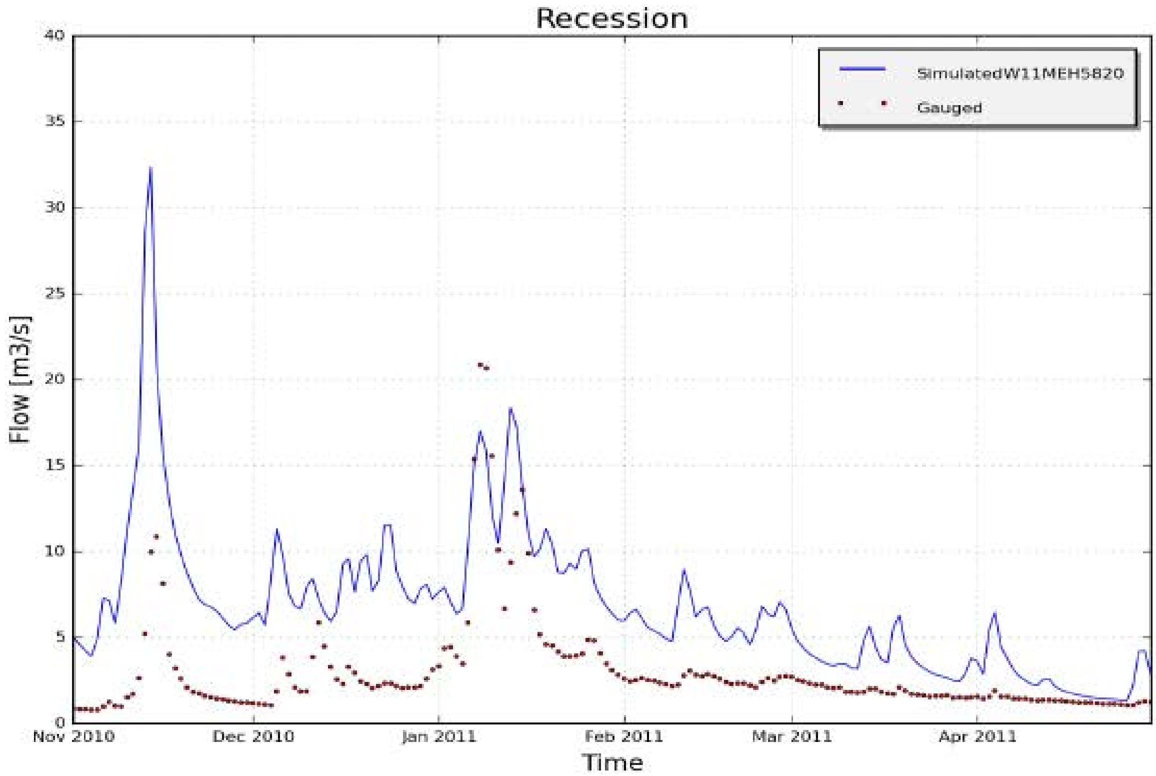


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11MEH5820, station Mehaigne, Wanze

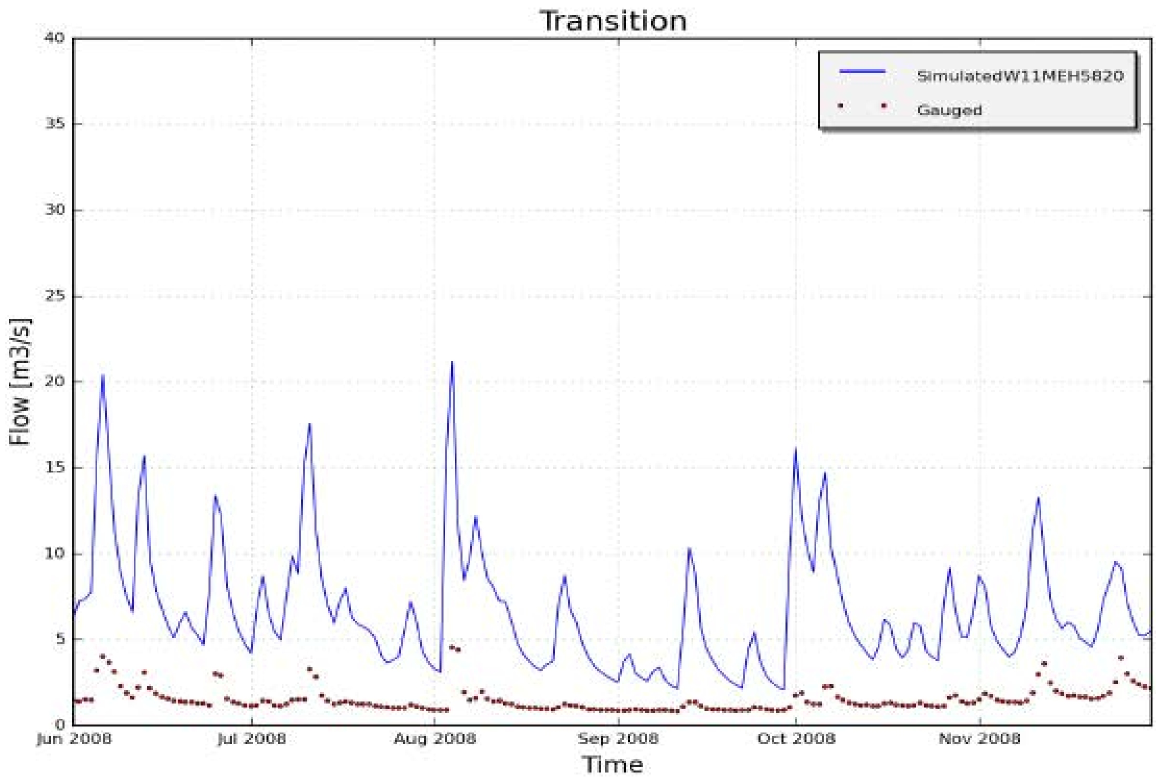


Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11MEH5820, station Mehaigne, Wanze

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W11OUR5805" (MEUSE)

1.1 Input data

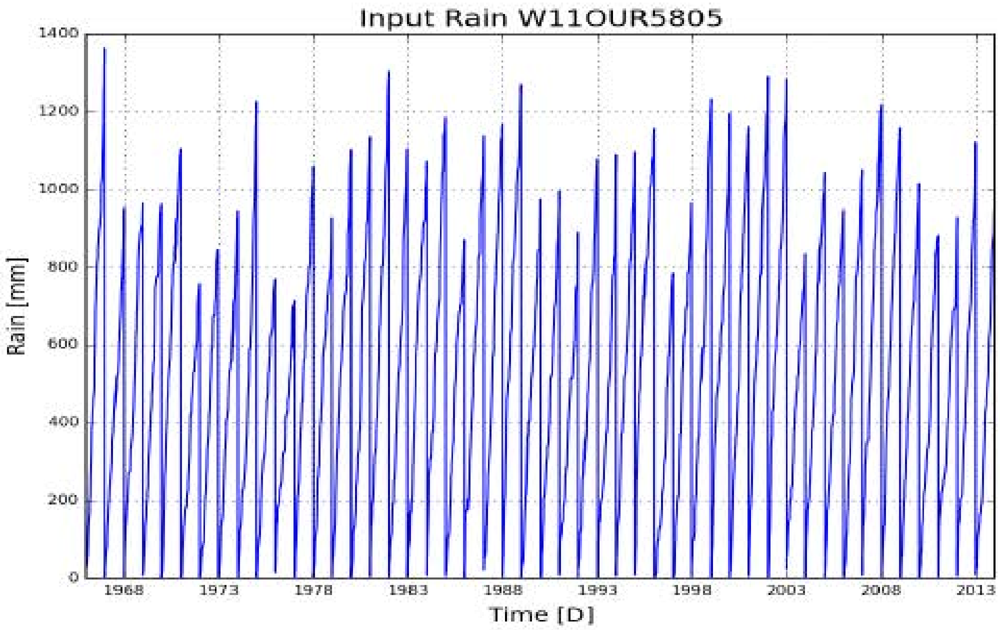


Figure 1: Cumulative precipitation on catchment W11OUR5805 (Meuse)

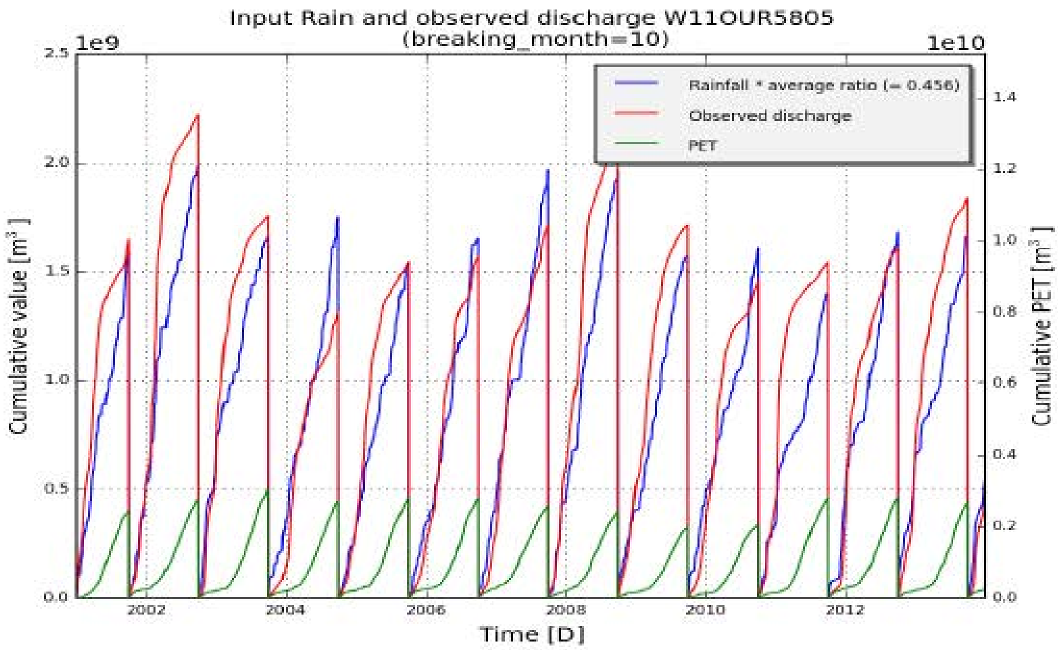


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W11OUR5805 (Meuse)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W11OUR5805
subcatchment_area [m2]	3607000000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 472.91), ('SMevap', 134.84), ('c1', 2.25), ('c2', 1.65), ('c3', 1.0), ('cOF1', -5.88), ('cOF2', 4.4), ('cIF1', -3.13), ('cIF2', 3.0), ('CQOF', 11.82), ('CKIF', 70.32), ('CKBF', 752.44)]

Table 1: Goodness of fit for calibration period (2001 - 2013)

	Full year	**Summer**	**Winter**
RelErr	0.6 %	13.5 %	-10.0 %
NS	0.706	0.635	0.553
NS_log	0.803	0.542	0.668
NS_rel	0.839	0.711	0.776
KGE	0.638	0.716	0.461

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	1.9 %	7.5 %	-2.8 %
NS	0.706	0.623	0.588
NS_log	0.79	0.566	0.69
NS_rel	0.821	0.87	0.72
KGE	0.658	0.59	0.506

1.3 Observed and simulated timeseries for optimum parameters

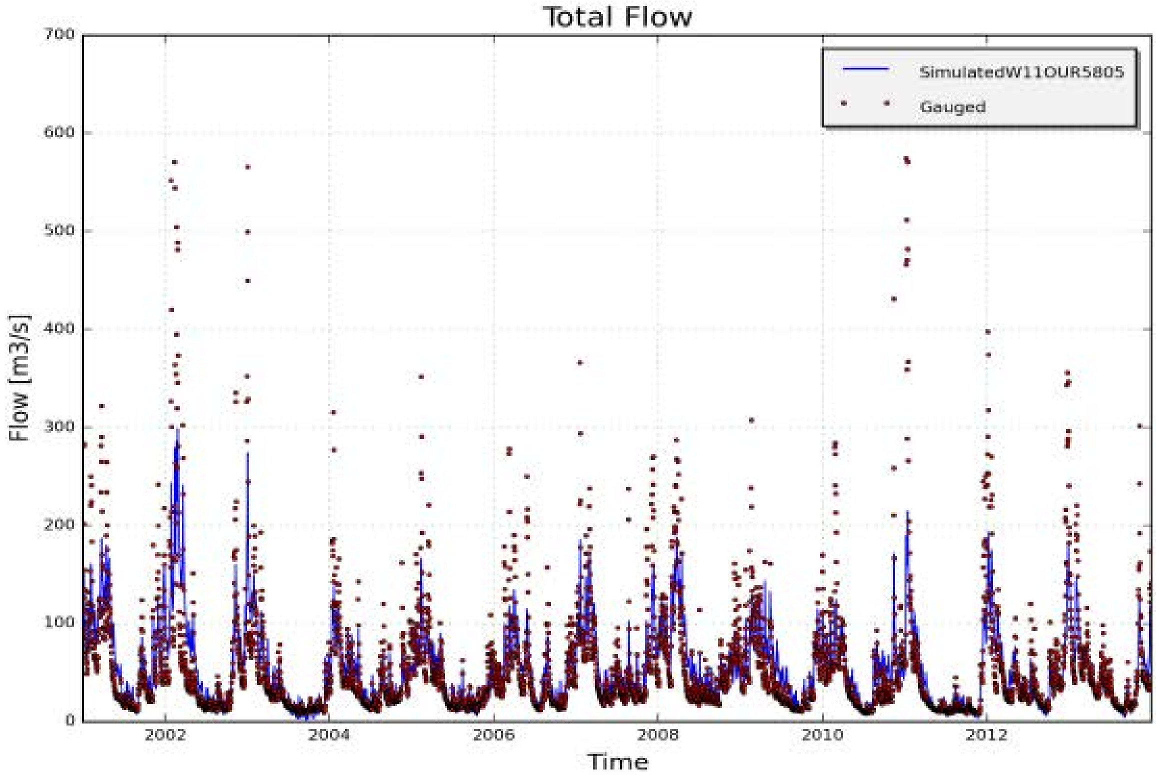


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11OUR5805, station Ourthe, Angleur 2 bis(calibration period)

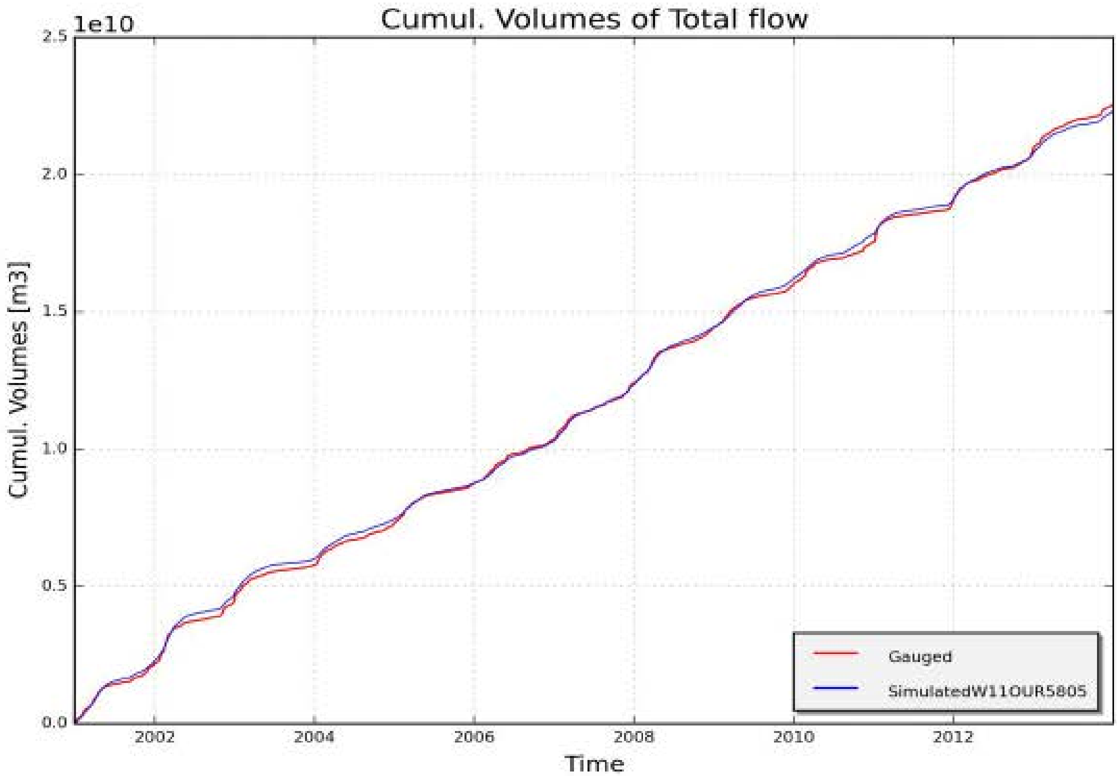


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11OUR5805, station Ourthe, Angleur 2 bis (calibration period)

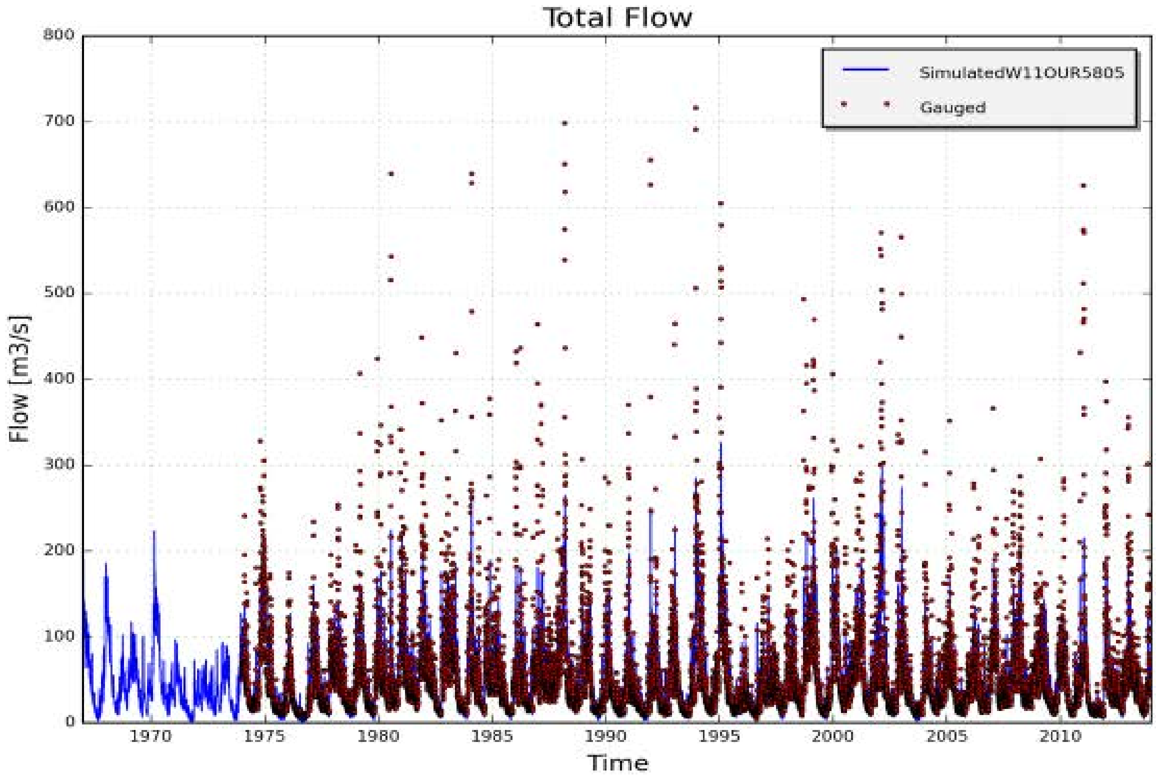


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11OUR5805, station Ourthe, Angleur 2 bis (validation period)

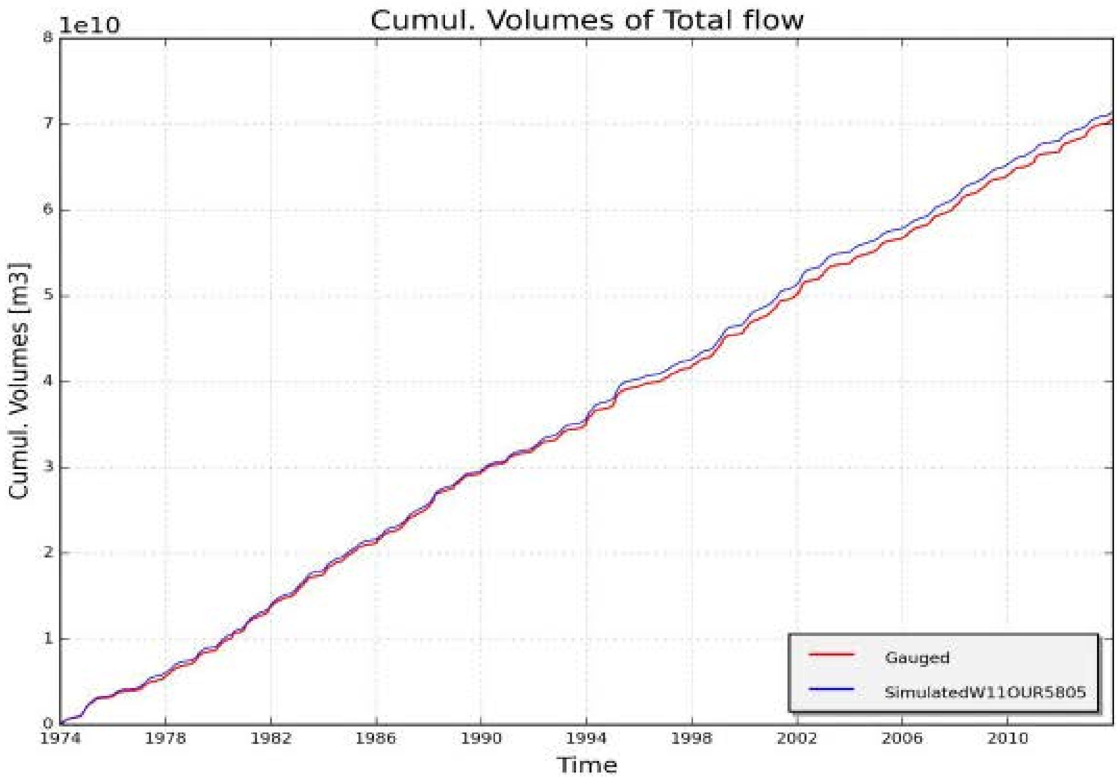


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11OUR5805, station Ourthe, Angleur 2 bis (validation period)

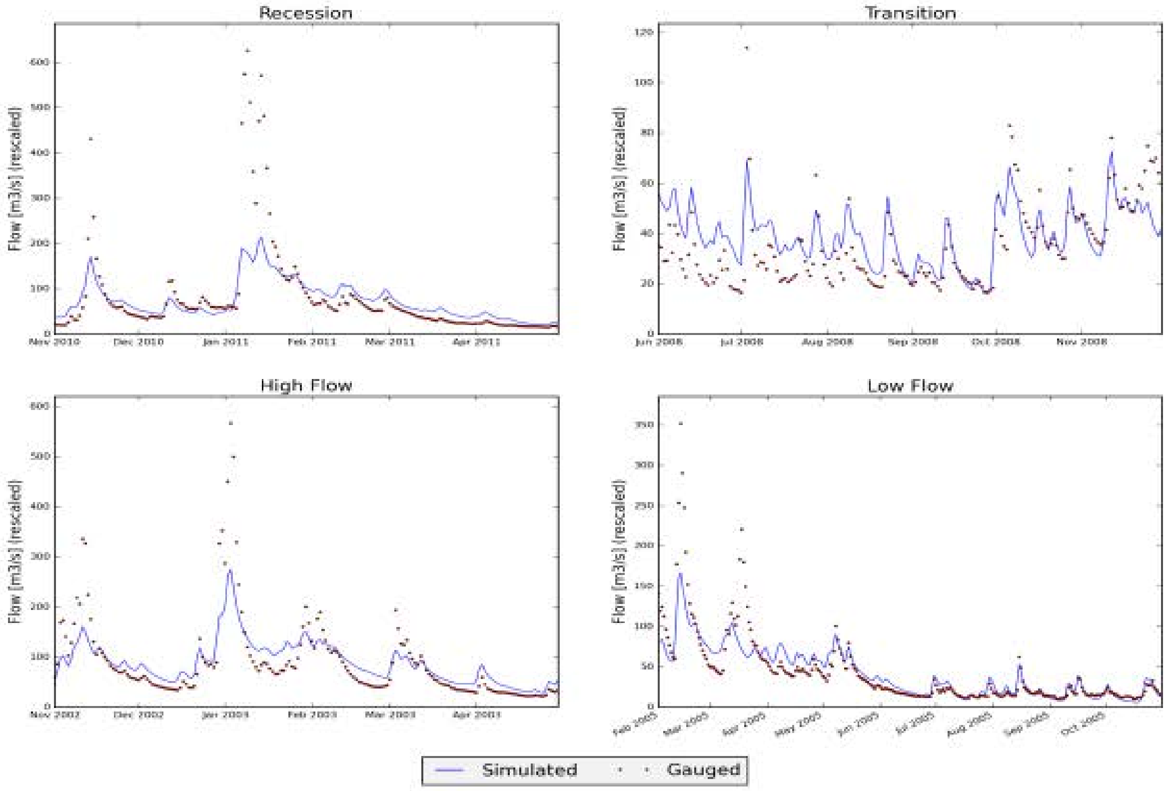


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11OUR5805, station Ourthe, Angleur 2 bis

1 CALIBRATION AND VALIDATION OF VHM PARAMETERS FOR CATCHMENT "W11SAM7319" (MEUSE)

1.1 Input data

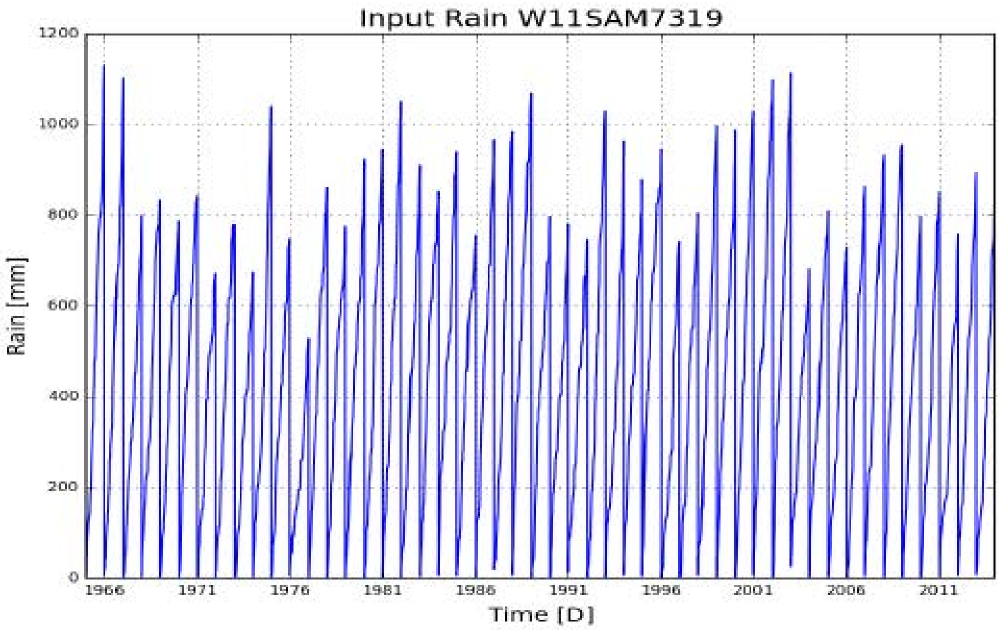


Figure 1: Cumulative precipitation on catchment W11SAM7319 (Meuse)

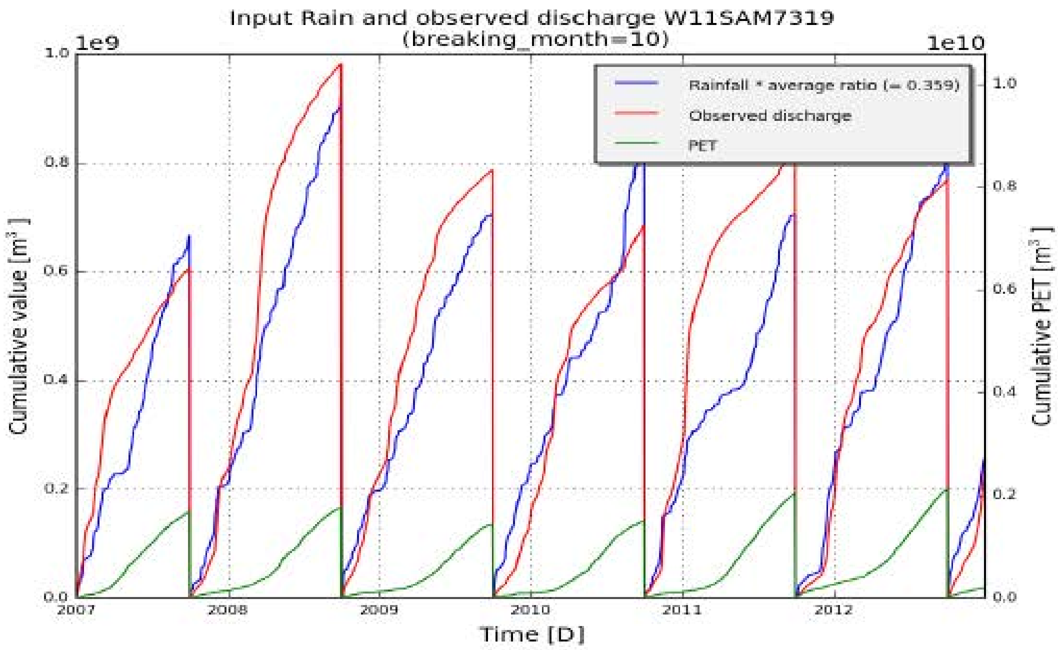


Figure 2: Annual cumulated discharge (red) and scaled precipitation (blue) according to runoff ratio (total Q/total P) and cumulative potential evapotranspiration (green) on catchment W11SAM7319 (Meuse)

1.2 Model summary

model_structure	VHMclassic.Lumped
subcatchment_name	W11SAM7319
subcatchment_area [m2]	2636000000
Validation start_date	01-01-1967
Validation end_date	31-12-2013
frequency	daily

Optimal parameter set:[('SMmax', 421.95), ('SMevap', 253.87), ('c1', 2.65), ('c2', 0.99), ('c3', 1.0), ('cOF1', -6.0), ('cOF2', 0.29), ('cIF1', -3.39), ('cIF2', 3.0), ('CQOF', 12.92), ('CKIF', 87.59), ('CKBF', 1836.69)]

Table 1: Goodness of fit for calibration period (2007 - 2012)

	Full year	**Summer**	**Winter**
RelErr	-0.5 %	44.3 %	-21.0 %
NS	0.728	-0.019	0.635
NS_log	0.636	-0.245	0.663
NS_rel	0.704	-0.321	0.847
KGE	0.665	0.457	0.526

Table 2 :Goodness of fit for validation period (1967 - 2013)

	Full year	**Summer**	**Winter**
RelErr	-1.8 %	41.4 %	-22.0 %
NS	0.713	0.055	0.594
NS_log	0.607	-0.272	0.585
NS_rel	0.718	-0.239	0.821
KGE	0.65	0.501	0.503

1.3 Observed and simulated timeseries for optimum parameters

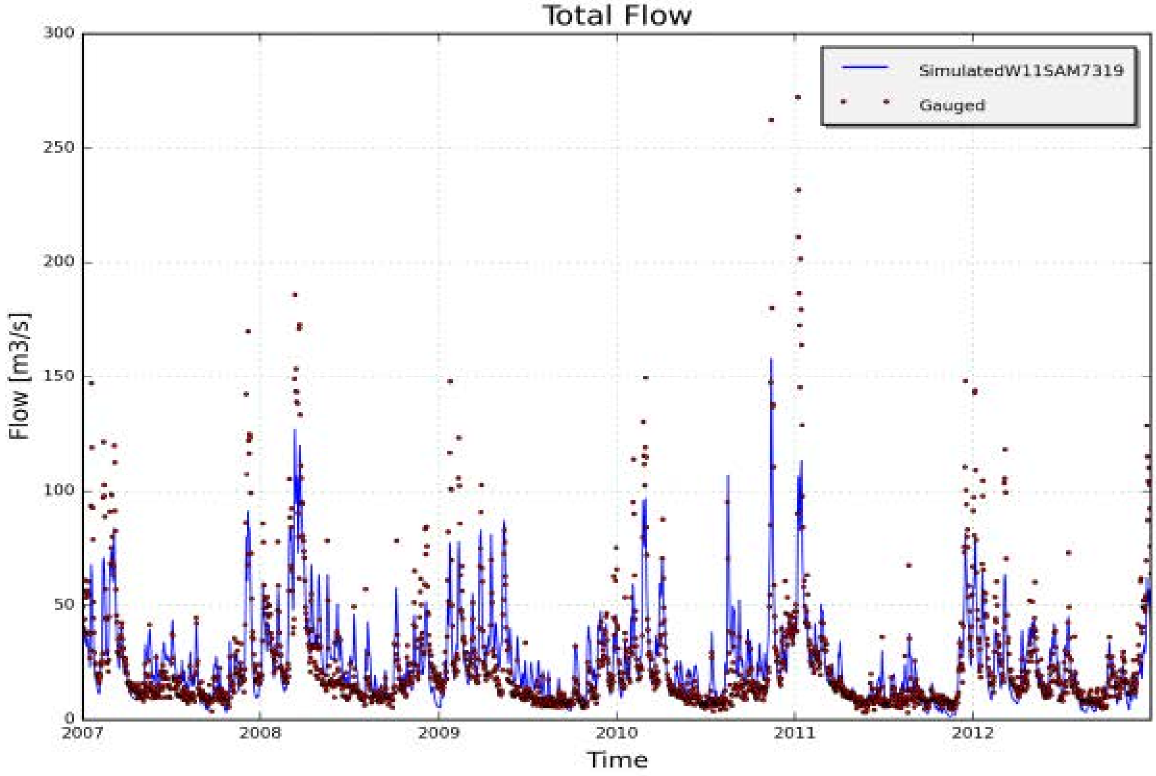


Figure 3: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11SAM7319, station Samber, Salzinne(calibration period)

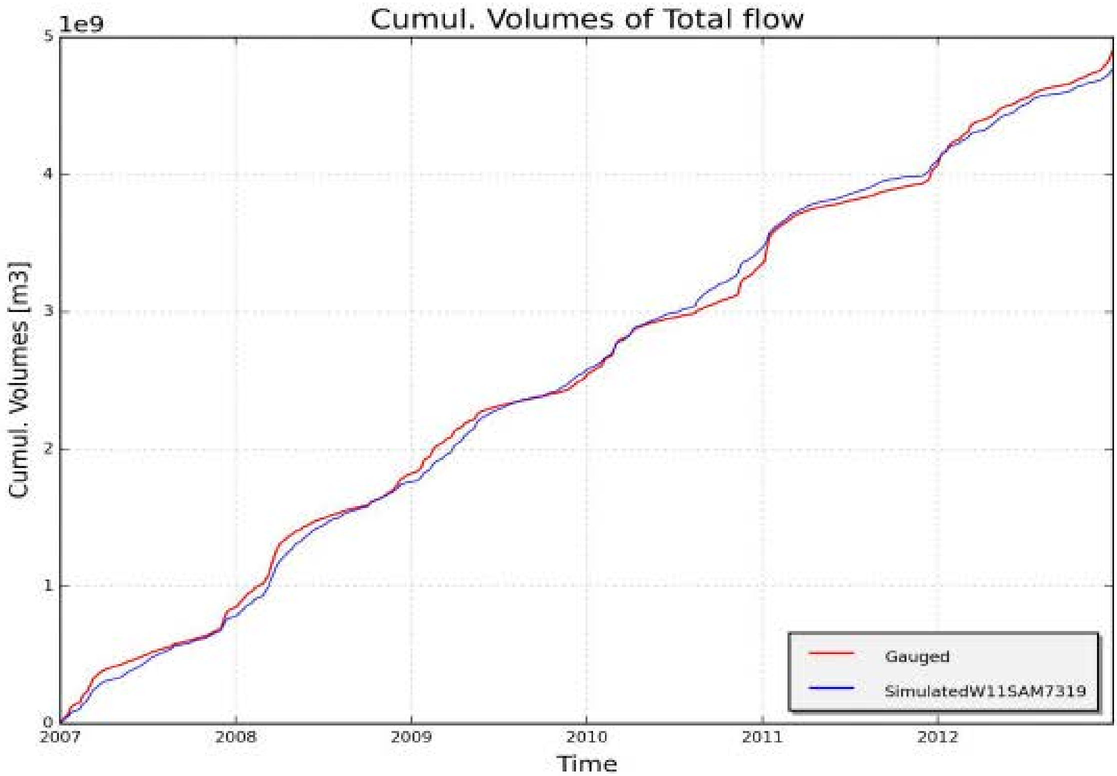


Figure 4: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11SAM7319, station Samber, Salzinne (calibration period)

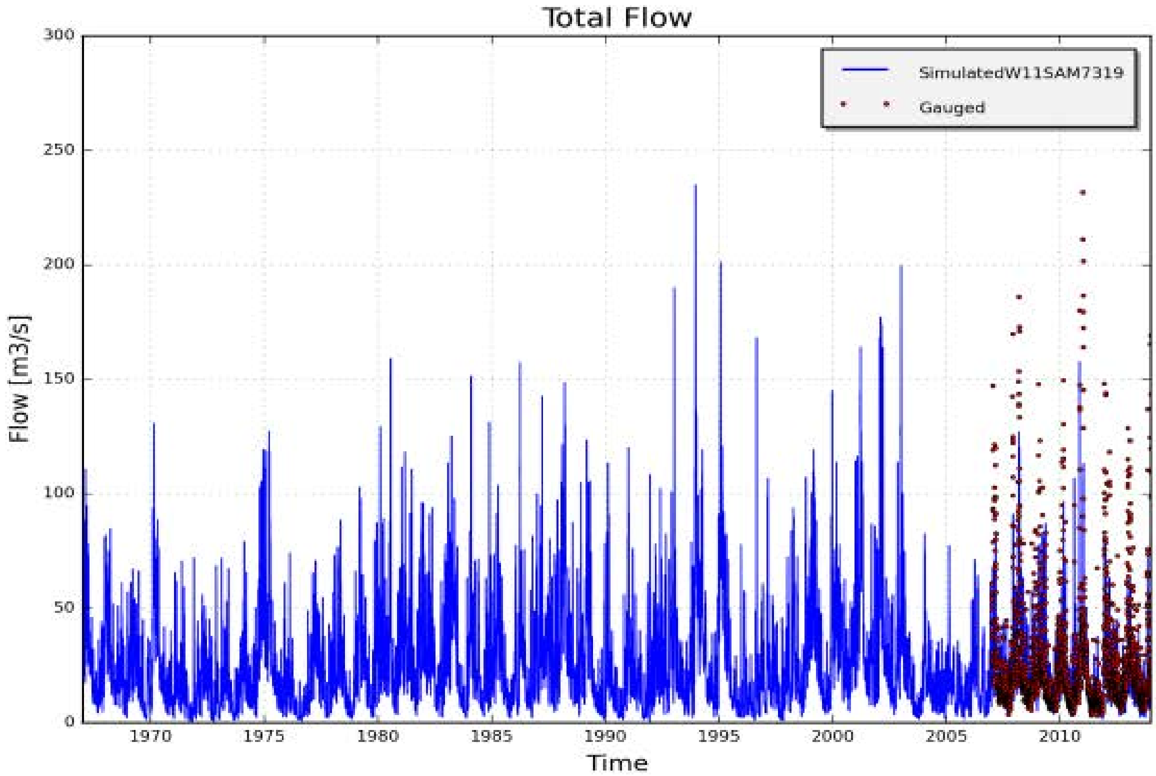


Figure 5: Measured (red) and simulated (blue) daily discharge [m3/s] on catchment W11SAM7319, station Samber, Salzinne (validation period)

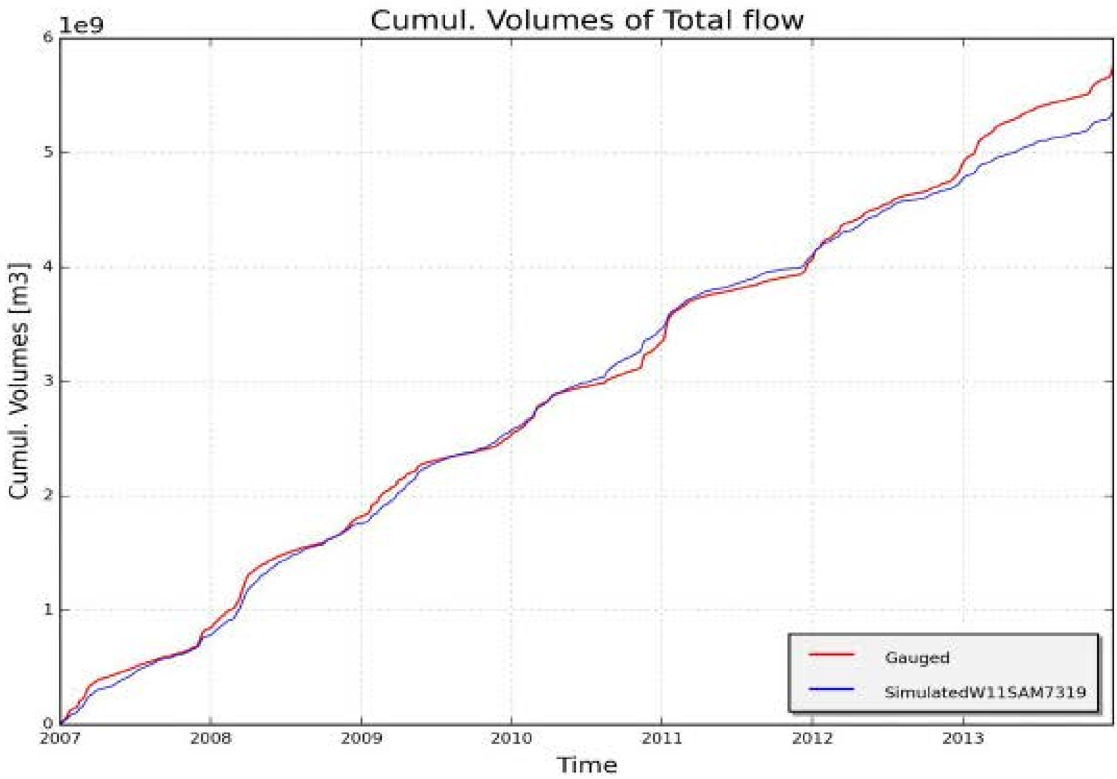


Figure 6: Measured (red) and simulated (blue) cumulative discharge [m3] on catchment W11SAM7319, station Samber, Salzinne (validation period)

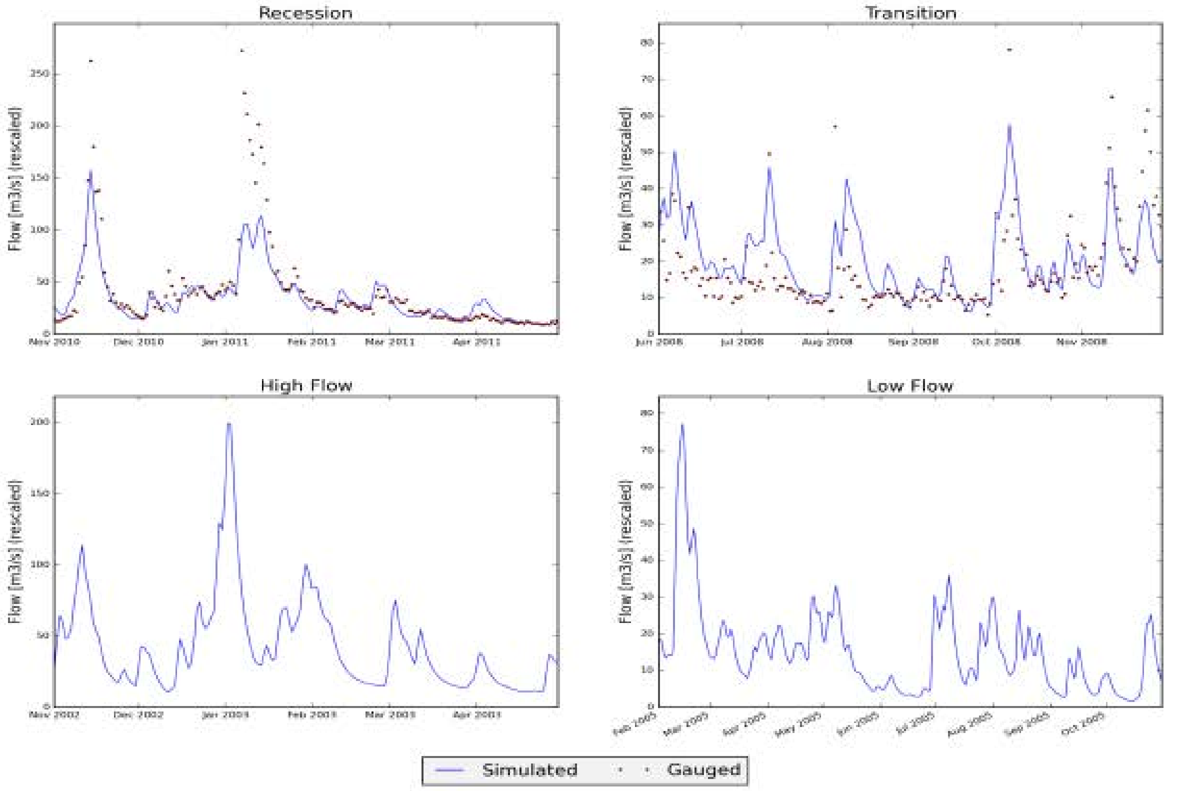


Figure 7: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11SAM7319, station Samber, Salzinne

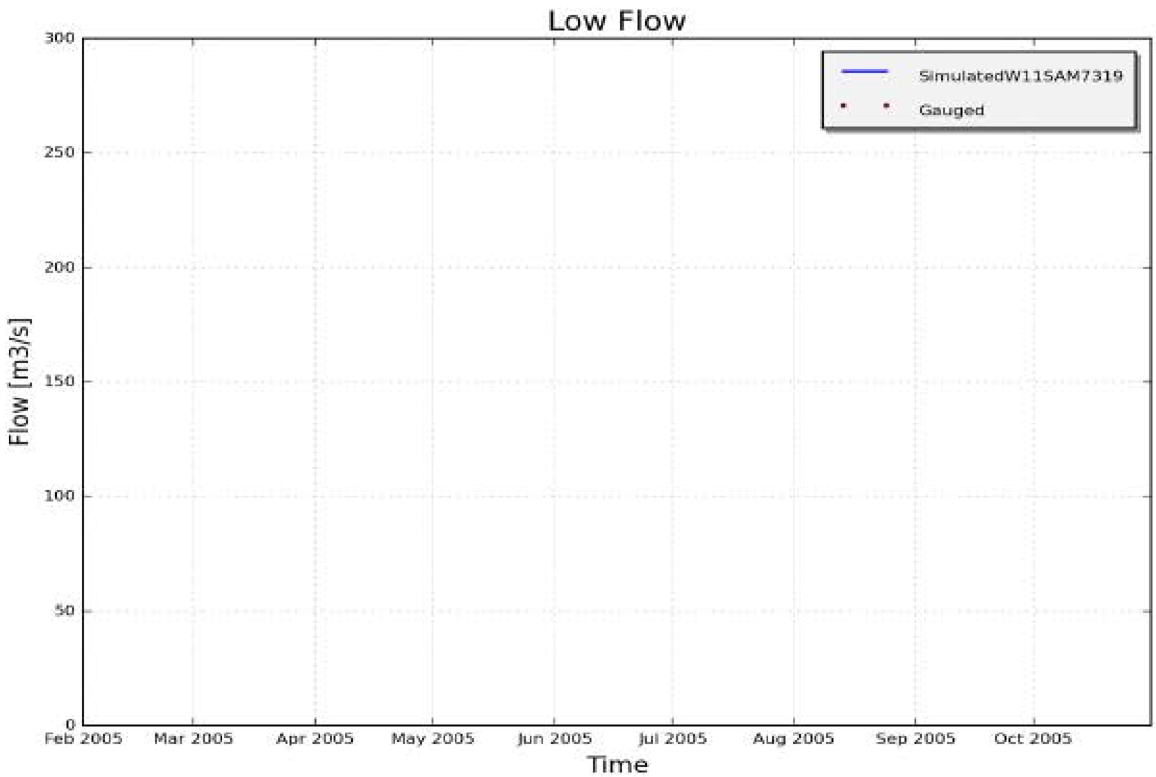


Figure 8: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11SAM7319, station Samber, Salzinne

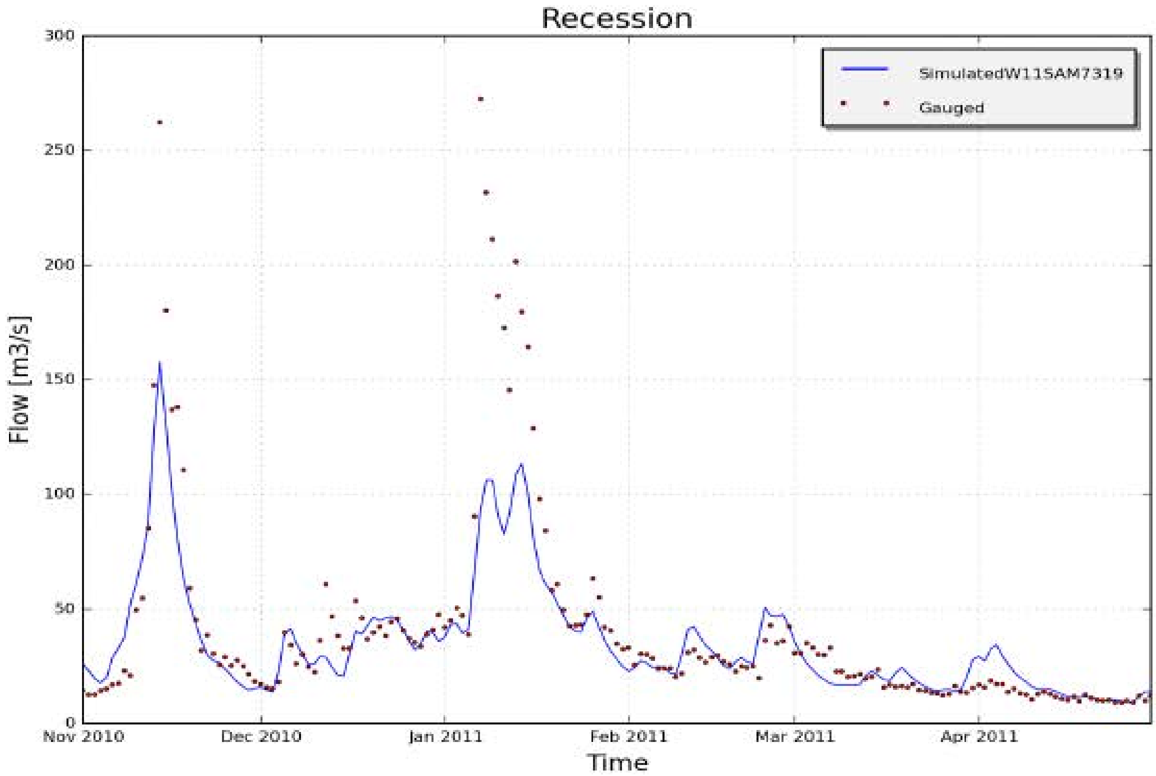


Figure 9: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11SAM7319, station Samber, Salzinne

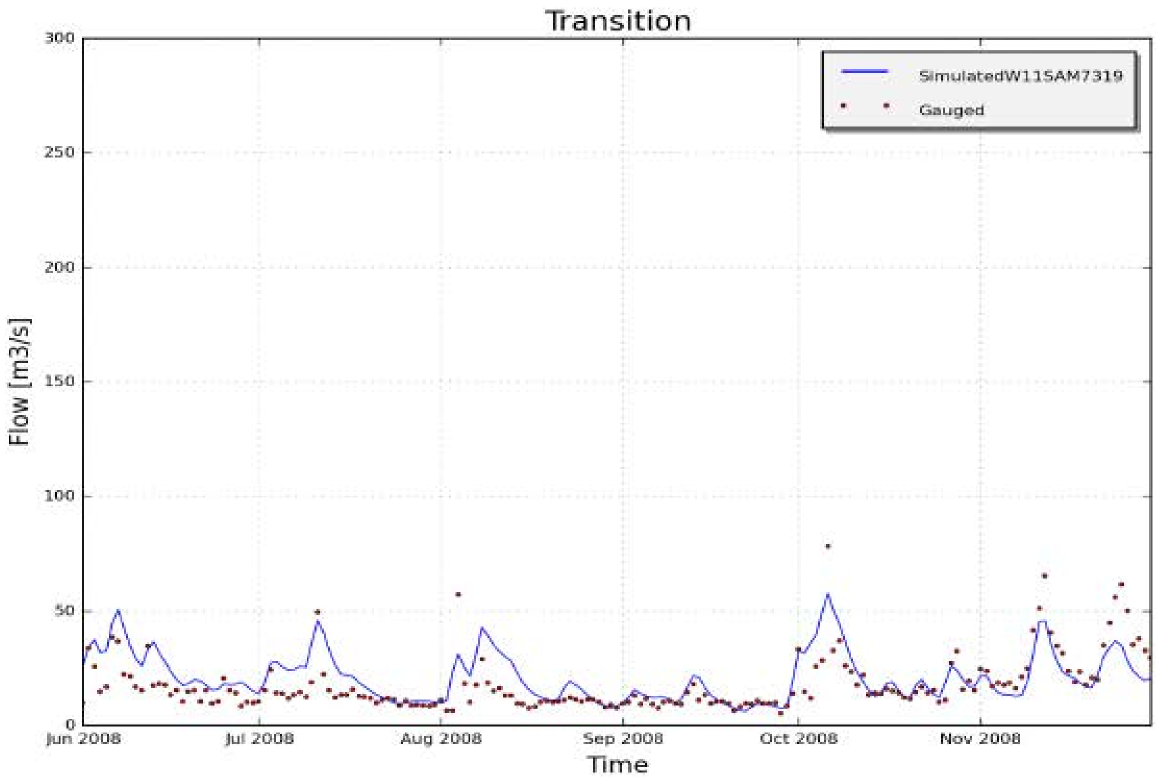


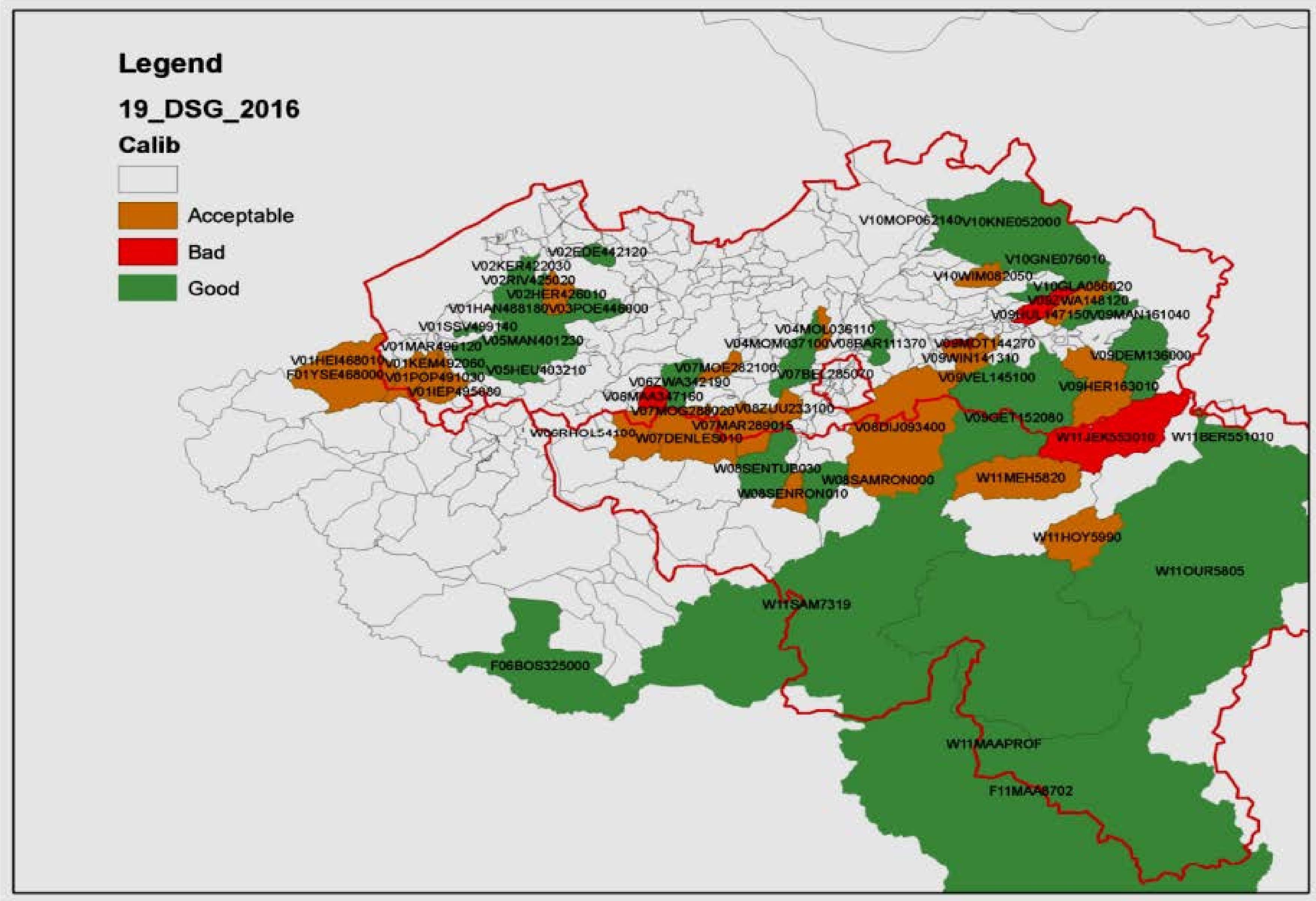
Figure 10: Measured (red) and simulated (blue) daily discharge [m3/s] during specific low and high flow events on catchment W11SAM7319, station Samber, Salzinne

Appendix 14 Geographical overview calibration

Based on the statistics for each of the NAM models, a reclassification is performed. The table below shows how NSE, LogNSE and RelErr are combined to get a unique value for each subcatchment. This evaluation results in the map which is included hereafter.

	When value	Reclassify value
NSE		
	>0,6	3
	0,3-0,6	2
	<0,3	1
LogNSE		
	>0,6	3
	0,3-0,6	2
	<0,3	1
RelErr		
	<15	3
	50-30	2
	>50	1

Combinations				Combination statistics	Reclassification	Judgement
3	3	3		27	3	Good
3	3	2		18	2	Acceptable
2	2	3		12	2	
3	3	1		9	2	
2	2	2		8	2	
1	2	3		6	1	Bad
2	2	1		4	1	
1	1	3		3	1	
1	1	2		2	1	
1	1	1		1	1	

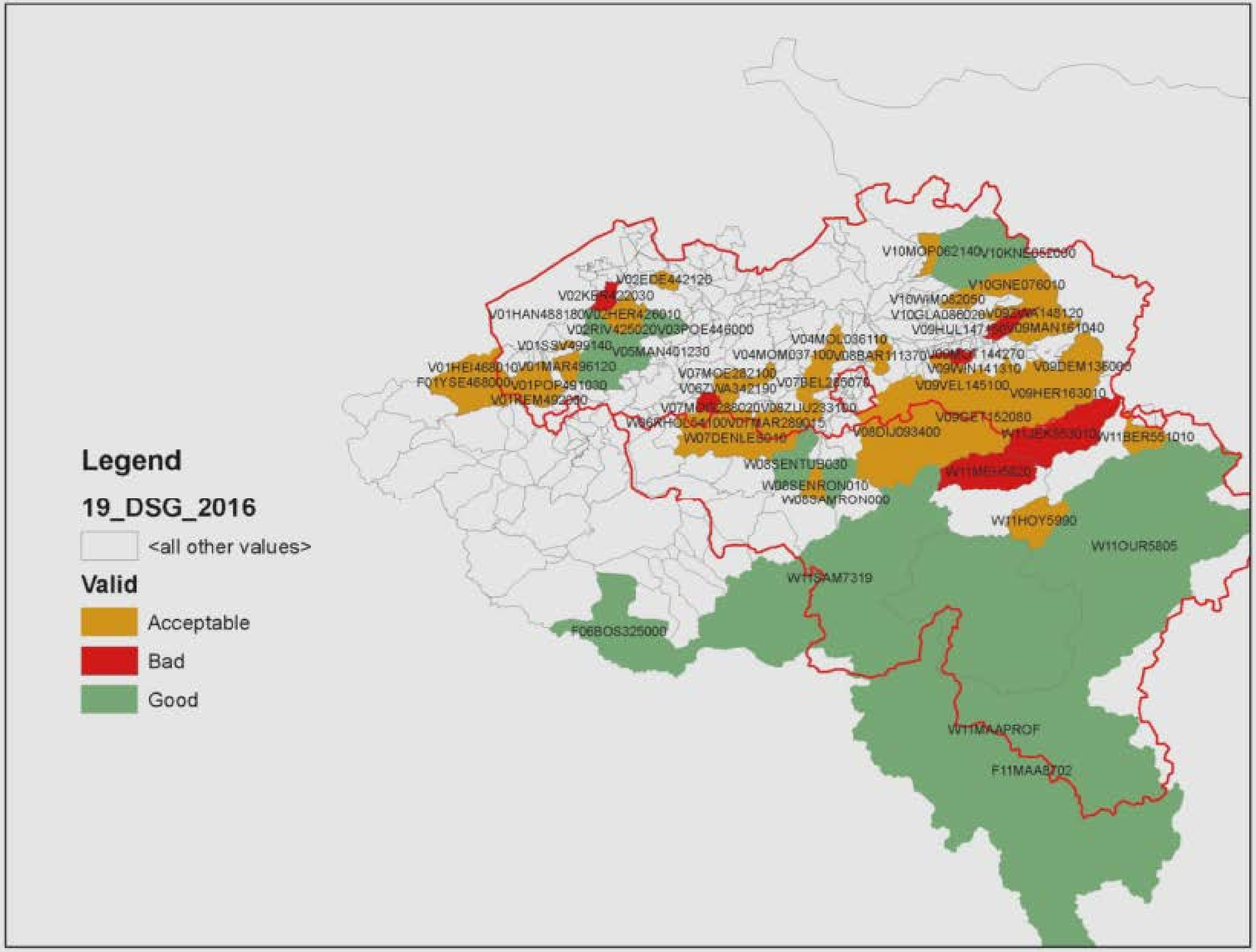

Legend
19_DSG_2016
Calib
Acceptable
Bad
Good
V02EDE442120
V02KER422030
V02RIV425020
V02HER426010
V01HAN488180
V03POE446000
V01SSV499140
V05MAN401230
V01MAR496120
V01HEI468010
V01KEM492060
F01YSE468000
V01POP491030
V05HEU403210
V01IEP495000
V07MOE282100
V06ZWA342190
V08MAA347160
V08ZUU233100
V07MAR289015
W07DENLES010
W08SENTUB030
W08SAMRON000
W08SENRON010
V04MOL036110
V04MOM037100
V08BAR111370
V07BEL285070
V08DIJ093400
V10MOP062140
V10KNE052000
V10GNE076010
V10WIM082050
V10GLA086020
V09MAN161040
V09WIN141310
V09VEL145100
V09DEM136000
V09HER163010
V09GET152080
W11BER551010
W11MEH5820
W11HOY5990
W11OUR5805
W11SAM7319
F06BOS325000
W11MAAPROF
F11MAA8702

Appendix 15 Geographical overview validation

Based on the statistics for each of the NAM models, a reclassification is performed. The table below shows how NSE, LogNSE and RelErr are combined to get a unique value for each subcatchment. This evaluation results in the map which is included hereafter.

	When value	Reclassify value
NSE		
	>0,6	3
	0,3-0,6	2
	<0,3	1
LogNSE		
	>0,6	3
	0,3-0,6	2
	<0,3	1
RelErr		
	<15	3
	50-30	2
	>50	1

Combinations				Combination statistics	Reclassification	Judgement
3	3	3		27	3	Good
3	3	2		18	2	Acceptable
2	2	3		12	2	
3	3	1		9	2	
2	2	2		8	2	
1	2	3		6	1	Bad
2	2	1		4	1	
1	1	3		3	1	
1	1	2		2	1	
1	1	1		1	1	


Legend
19_DSG_2016
<all other values>
Valid
Acceptable
Bad
Good
V10GNE076010
V09VEL145100
V09HER163010
V08DIJ093400
W11OUR5805
W11SAM7319
F06BOS325000
W11MAAPROF
W11HOY5990

DEPARTMENT **MOBILITY & PUBLIC WORKS**
Flanders hydraulics Research

Berchemlei 115, 2140 Antwerp
T +32 (0)3 224 60 35
F +32 (0)3 224 60 36
waterbouwkundiglabo@vlaanderen.be
www.flandershydraulicsresearch.be