EVALUATING THE PERFORMANCE OF SHETRAN SIMULATING A COMPLEX MEDIUM SIZE CATCHMENT

Brito, Josue[1] Vázquez, Raúl F.[1,2] Hampel, Henrietta[2]
Birkinshaw, Stephen J.[3]

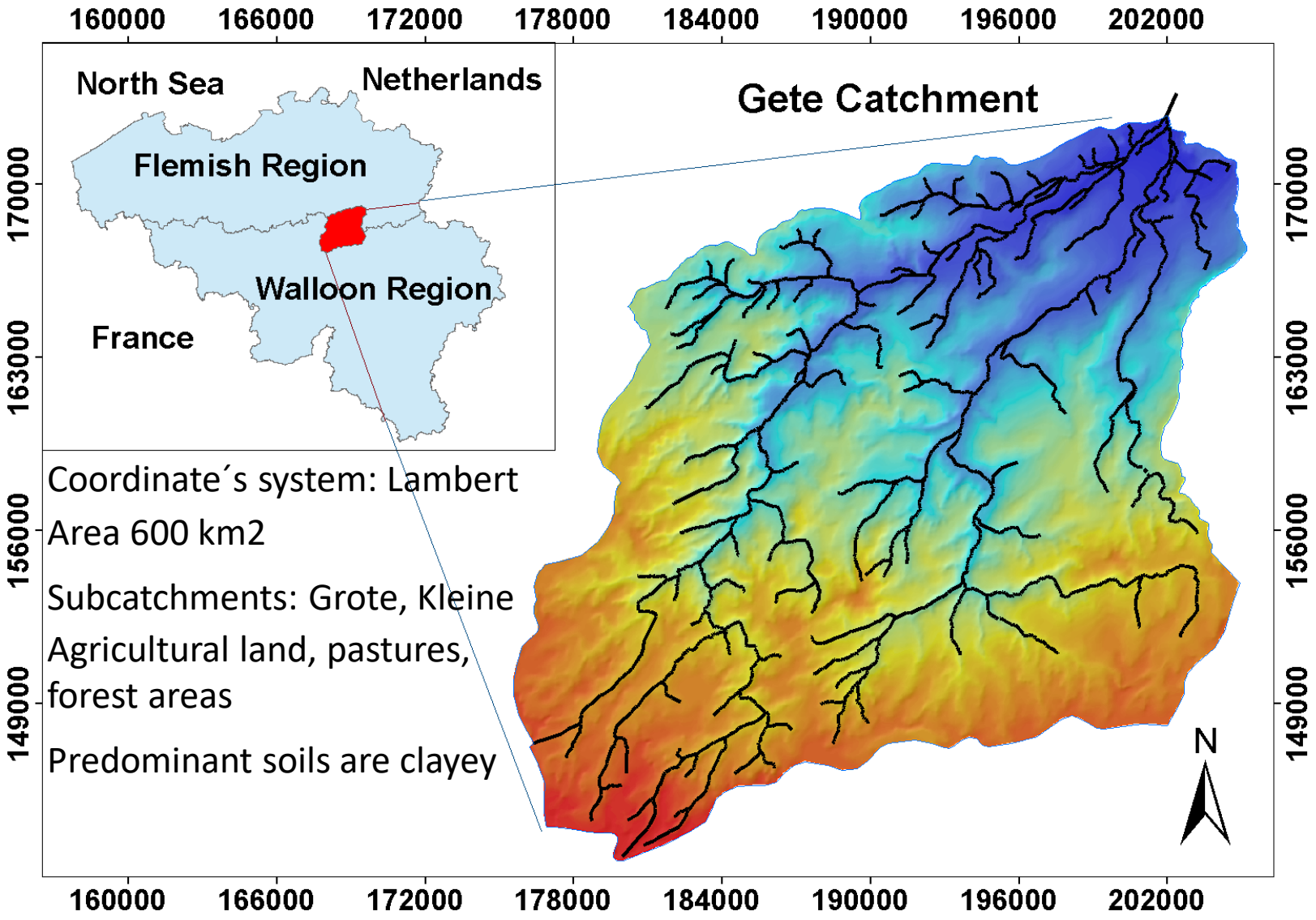
[1] University of Cuenca, Faculty of Engineering, Av. 12 de Abril y Av. Loja, Cuenca, Ecuador. E-mail: josuebritos@msn.com
[2] Aquatic Ecology Laboratory (LEA), University of Cuenca, Department of Water Resources and Environmental Sciences, Av. 12 de Abril y Av. Loja, Cuenca, Ecuador. Email:raulfvazquezz@yahoo.co.uk
[3] School of Civil Engineering and Geosciences, Newcastle University, Claremont Road, Newcastle upon Tyne NE1 7RU, United Kingdom.

Co-funded by the Erasmus+ Programme of the European Union

INTRODUCTION

- Physically based distributed codes (PhBDC) may be reliable tools for water resources management.
- Their application still remains limited, because commercial licenses of some of these codes are rather expensive, even under academic status.
- There is a need for testing the performance of already existing and non-expensive PhBDC simulating complex systems.
- The main objective of the current research is evaluating the performance of a physically based distributed code named SHETRAN.

STUDY AREA



Coordinate´s system: Lambert

Area 600 km2

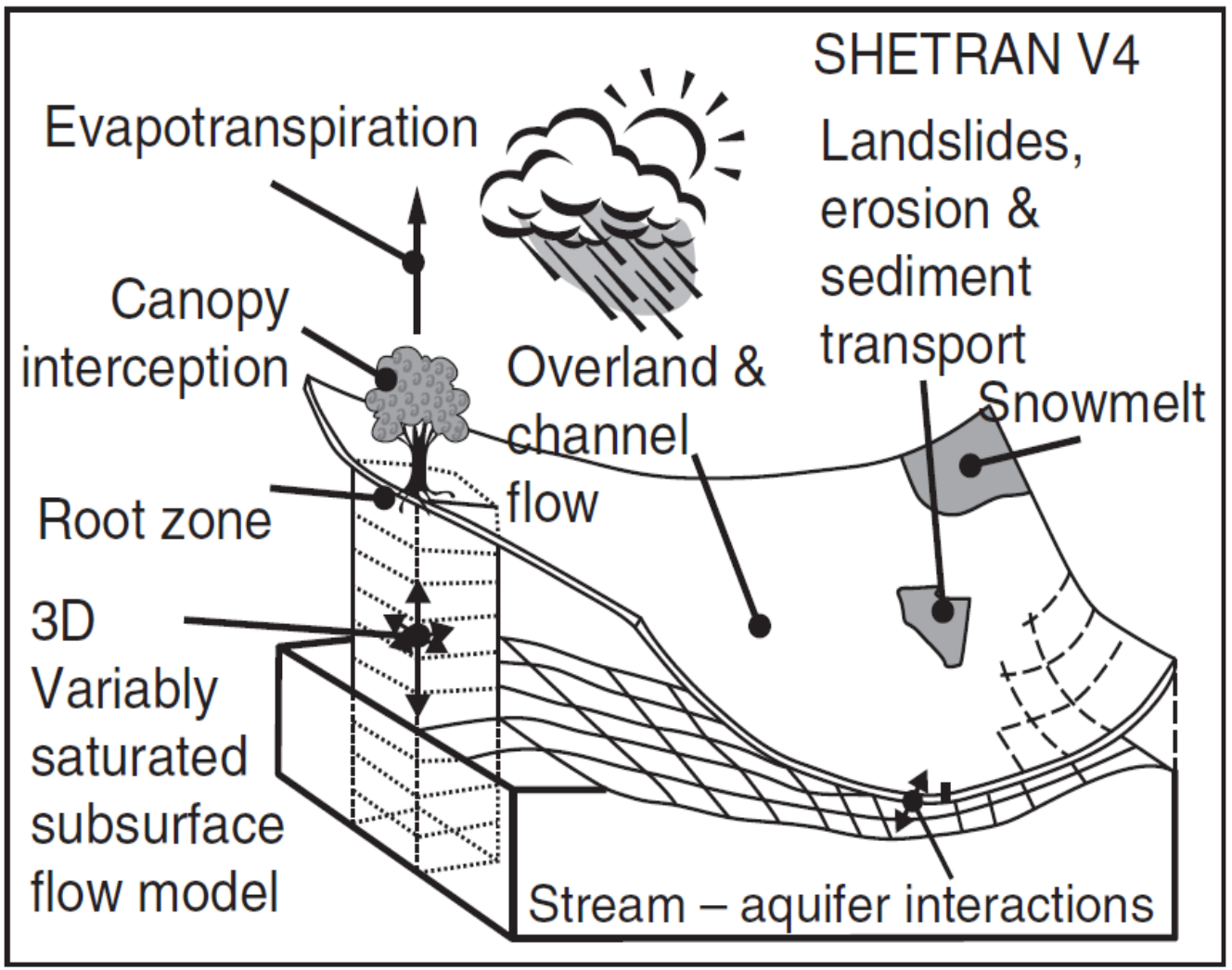
Subcatchments: Grote, Kleine

Agricultural land, pastures, forest areas

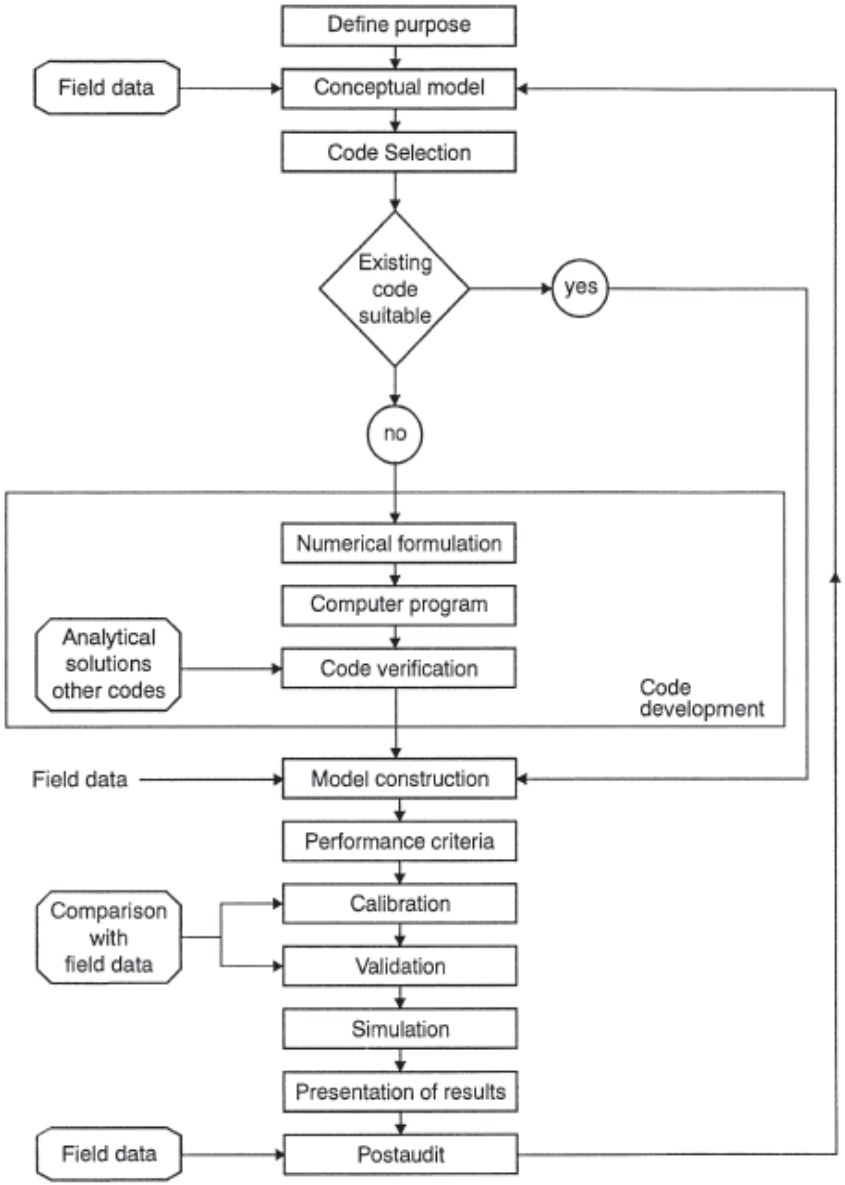
Predominant soils are clayey

MATERIALS

The SHETRAN code



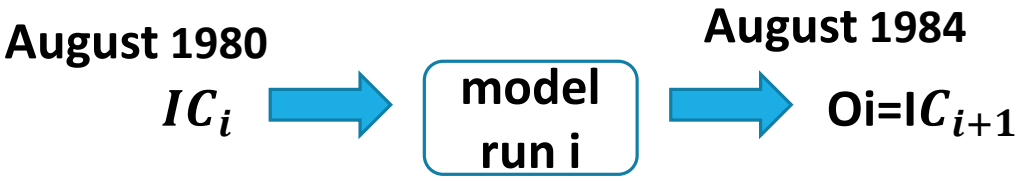
METHODS



Qualitative analysis: Visual technique.

Quantitative: Statistics based on residuals

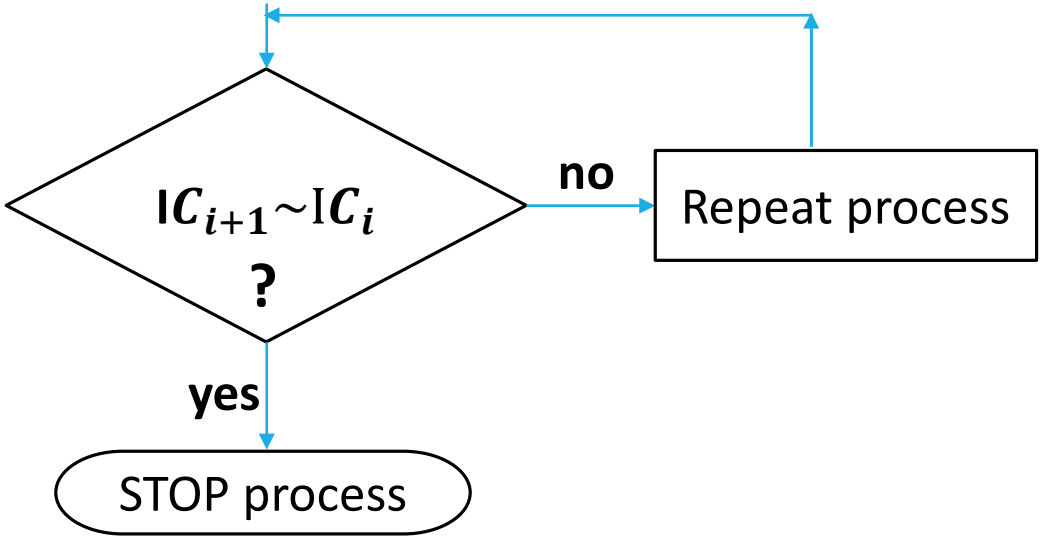
DEFINING INITIAL CONDITIONS



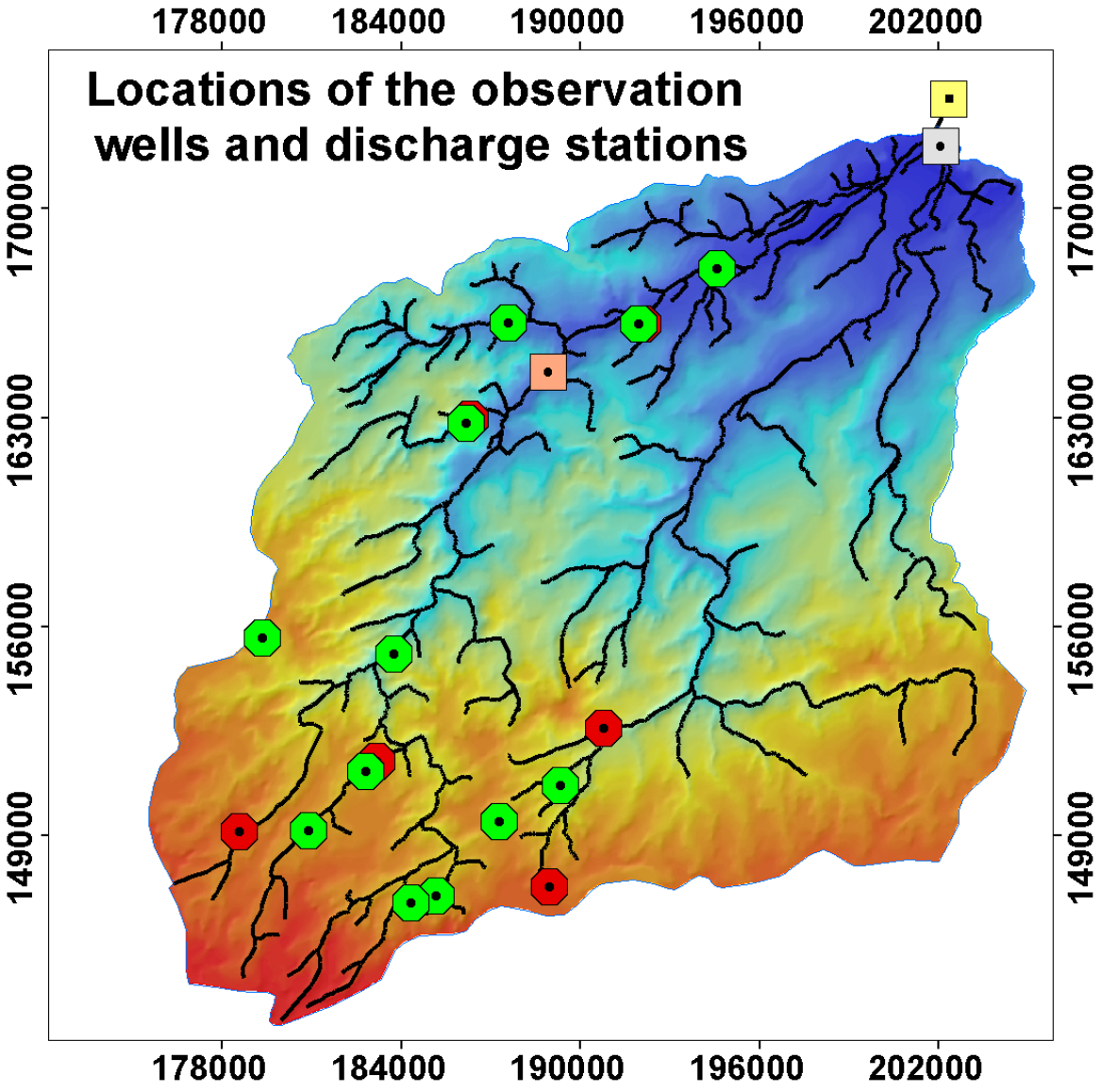
- **Initial Step (i=0)**

Run the process with IC_0

IC_0= Estimated initial conditions for both models



MODEL CALIBRATION AND VALIDATION



Legend

- Kleine Station
- Grote Station
- Gete Station
- Wells_Calibration
- Wells_Validation
- River Network

Gete station was used for the calibration period.

Manual calibration by trial and error

2 internal stations and 6 observation wells for validation.

12 Observation wells

Period: January 1985- December 1986

EVALUATION OF MODEL PERFORMANCE

- It includes the graphic comparison of the simulated and observed discharge.
- Below are the statistical measures of performance:

Coefficient of Eficiciency (EF_2)

$$\boldsymbol{EF_2} = 1 - \left[\frac{\sum_{i=1}^{n}\left(Y_i^{Obs} - Y_i^{Sim}\right)^2}{\sum_{i=1}^{n}\left(Y_i^{Obs} - Y_i^{mean}\right)^2}\right] \qquad -\infty < EF_2 < 1.0$$

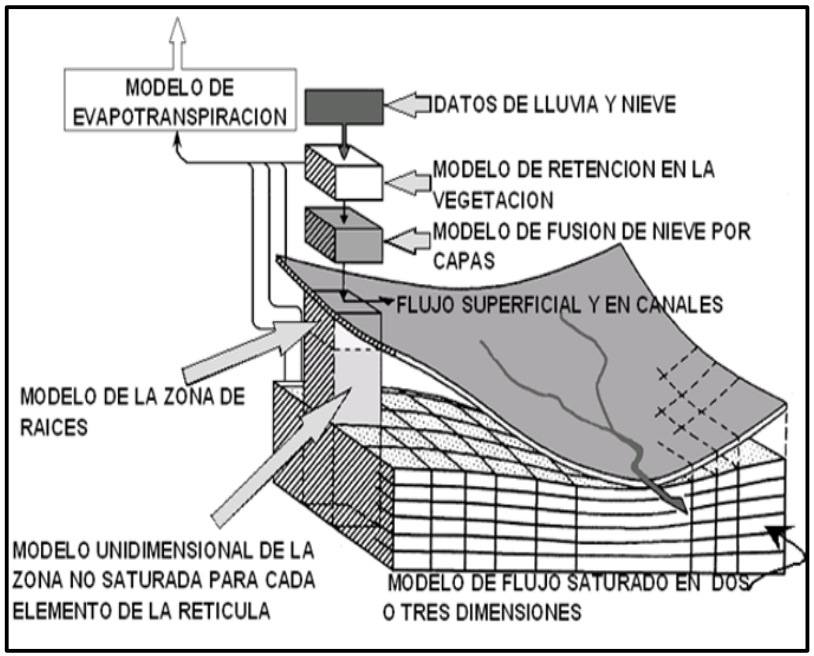
Relative Root Mean Square Error (RRMSE)

$$\textbf{RRMSE} = \sqrt{\frac{\sum_{i=1}^{n}\left(Y_i^{Sim} - Y_i^{Obs}\right)^2}{n}} \cdot \frac{1}{Y^{mean}} \qquad 0.0 \leq RRMSE$$

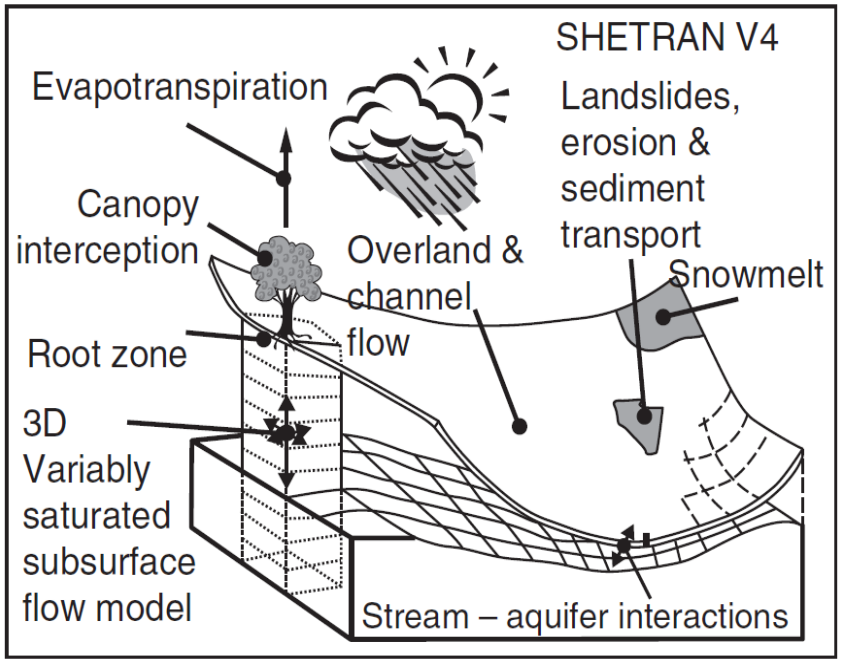
EVALUATION OF MODEL PERFORMANCE

- Model performance evaluation was also based on the consideration of predictions from previously contrasted and widely used models such as MIKE SHE.
- This is not uncommon (Dehotin et al., 2011).

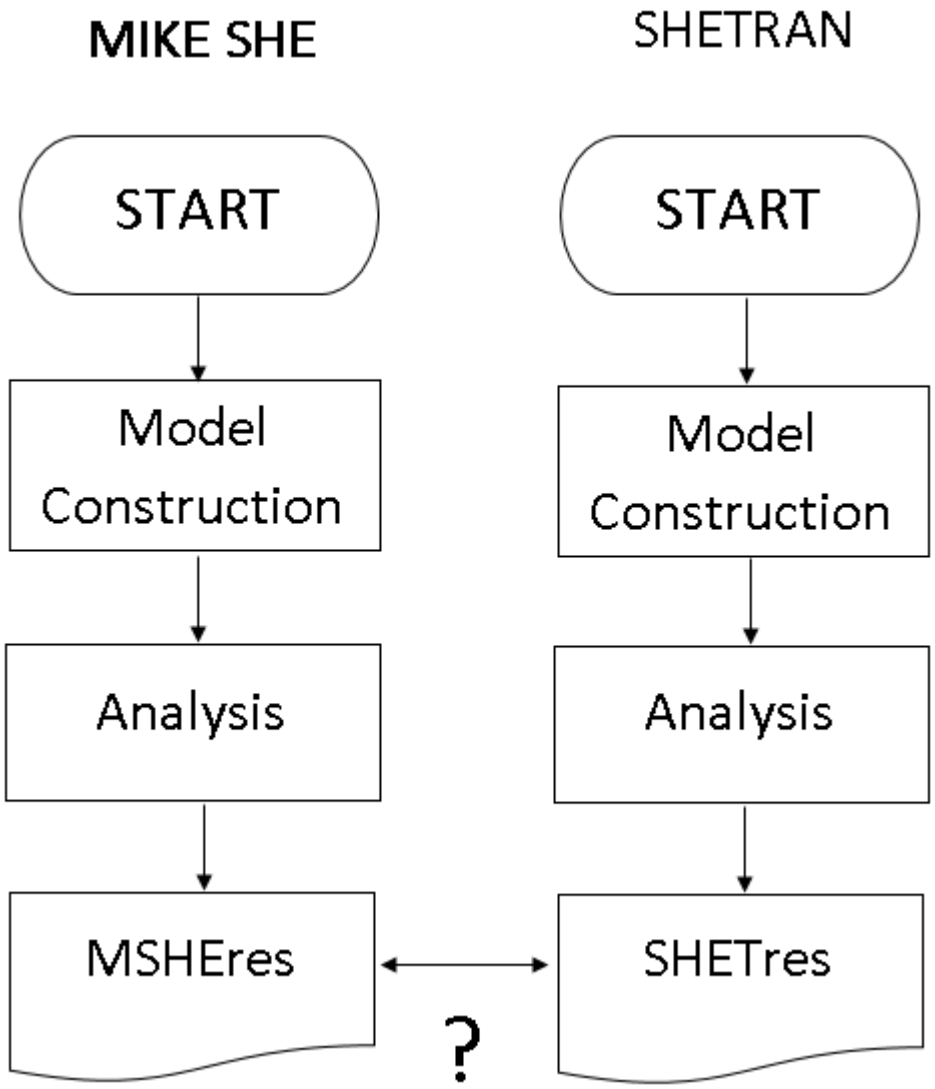
MIKE SHE



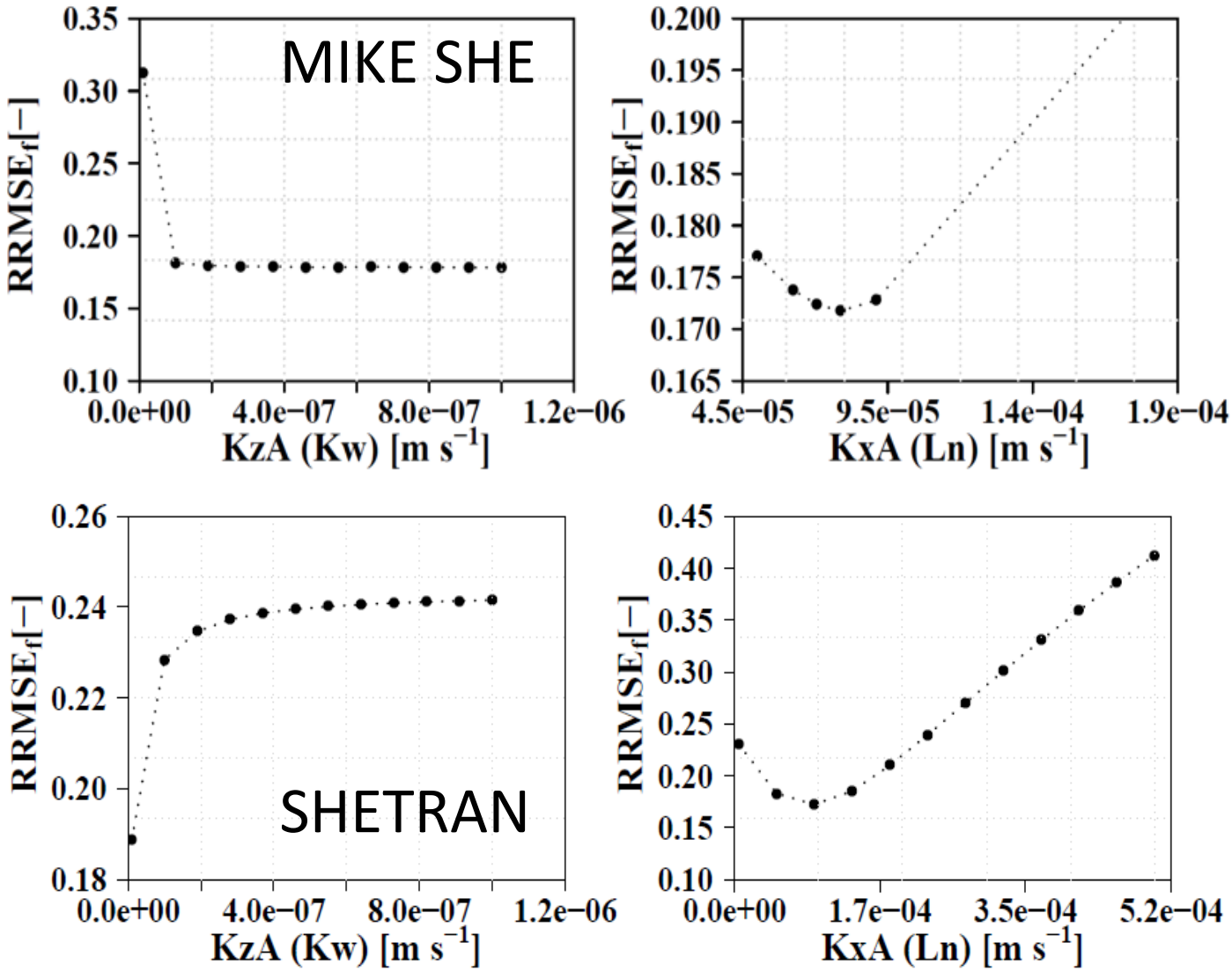
SHETRAN



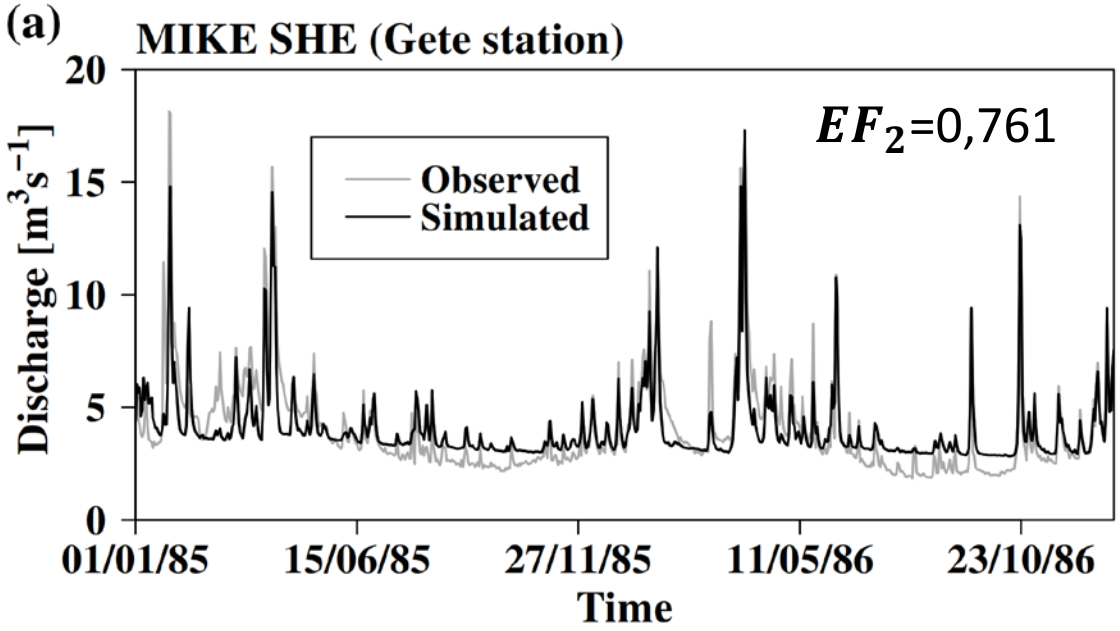
EVALUATION OF MODEL PERFORMANCE

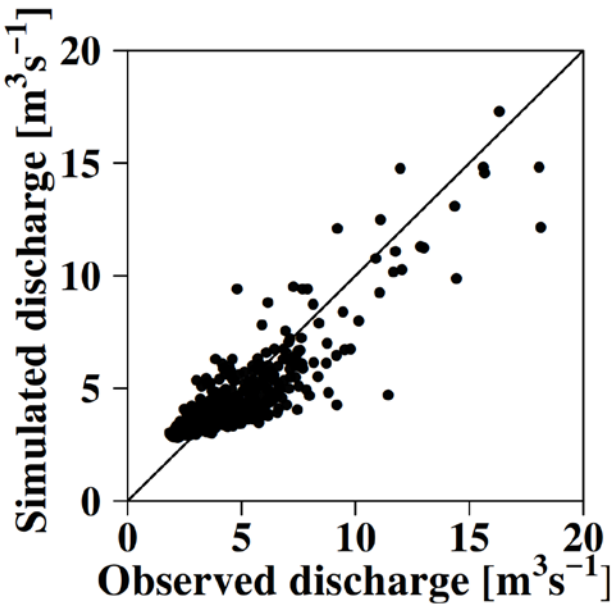


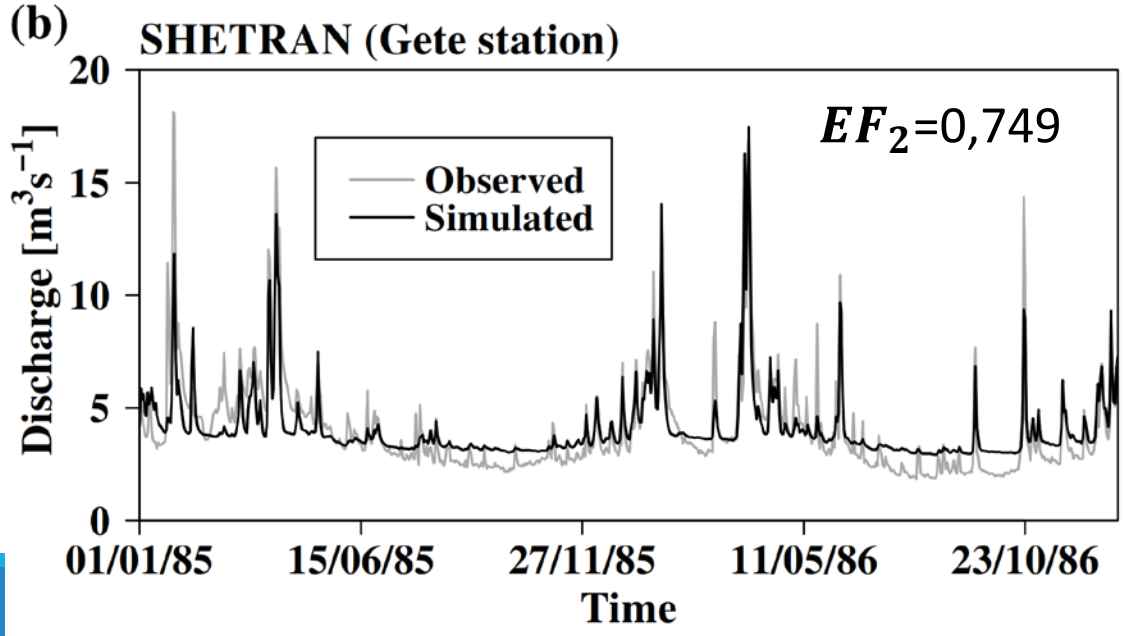
RESULTS: MODEL CALIBRATION

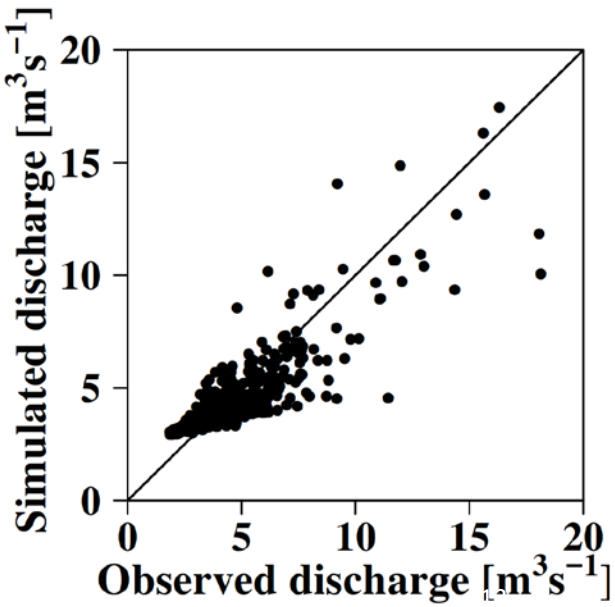


RESULTS: MODEL CALIBRATION

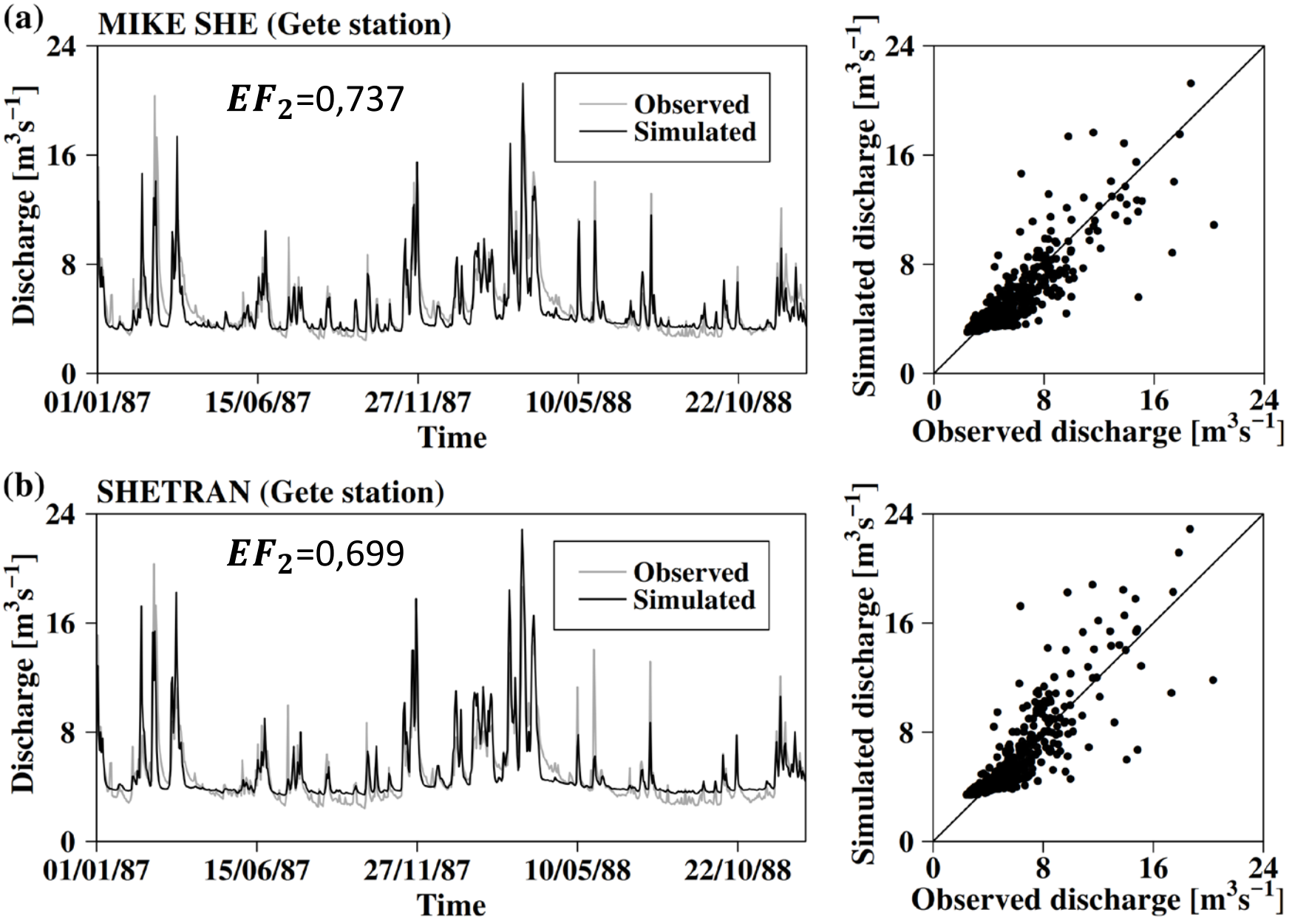




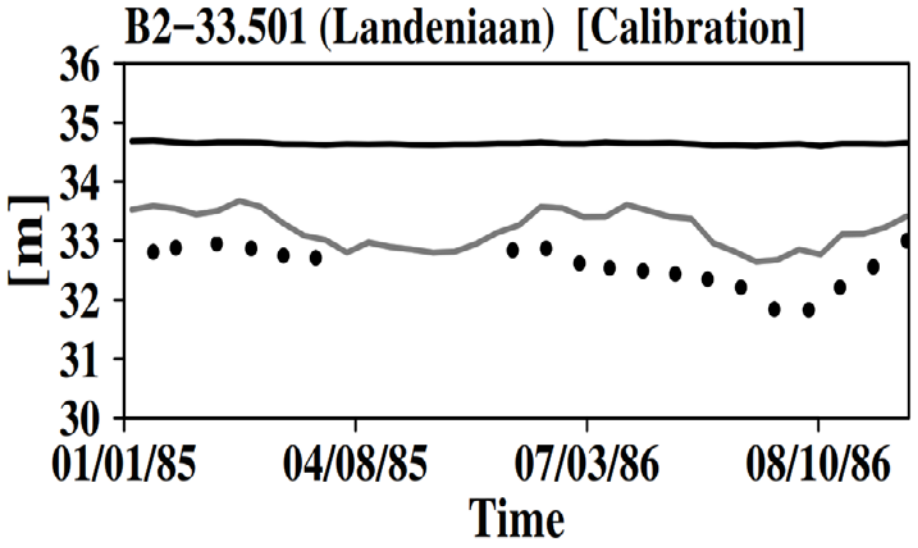


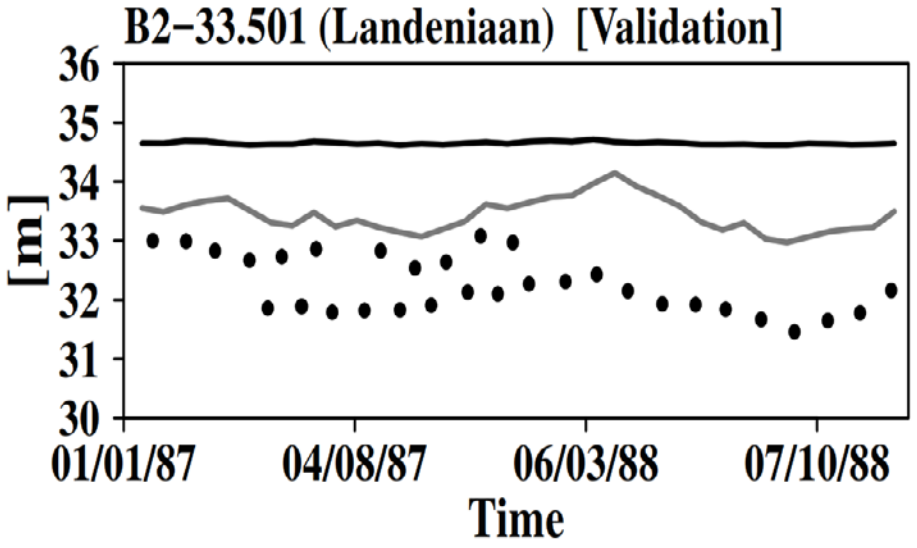


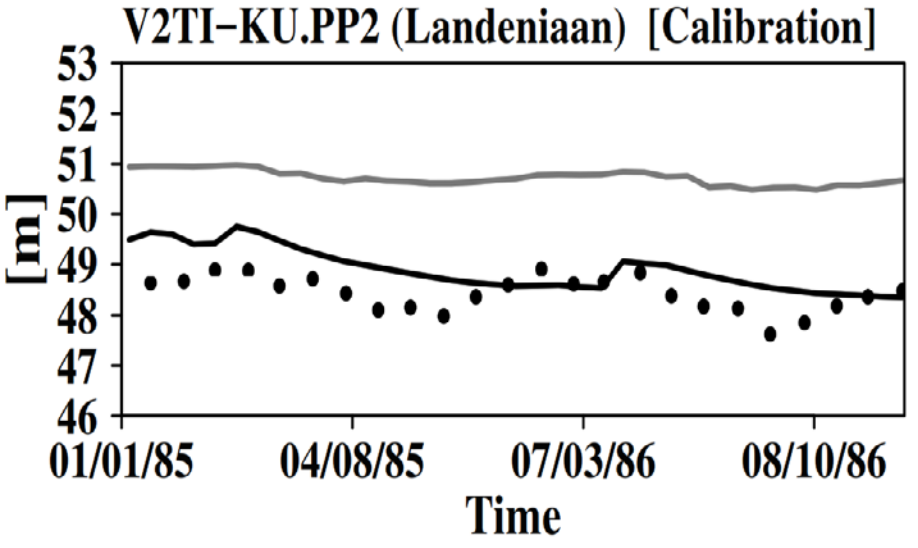
RESULTS: MODEL VALIDATION

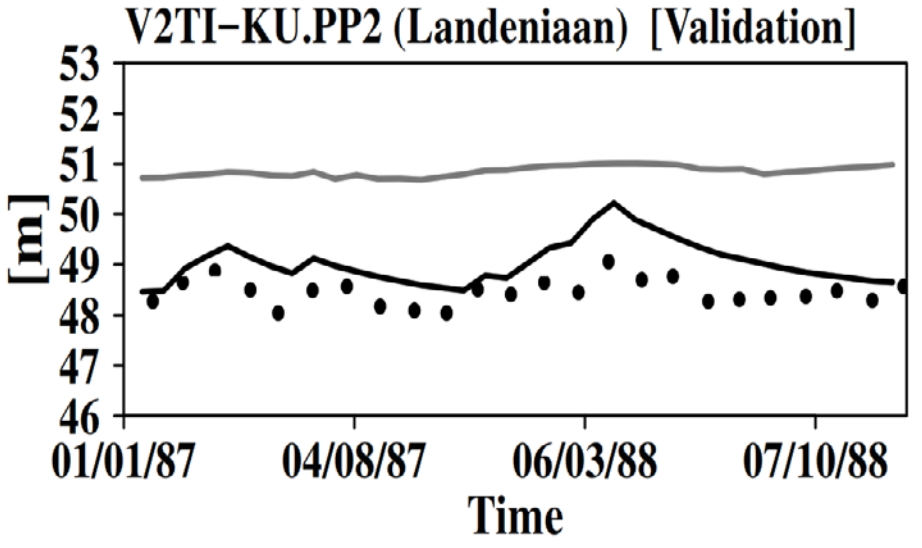


RESULTS: PIEZOMETRIC PREDICTIONS

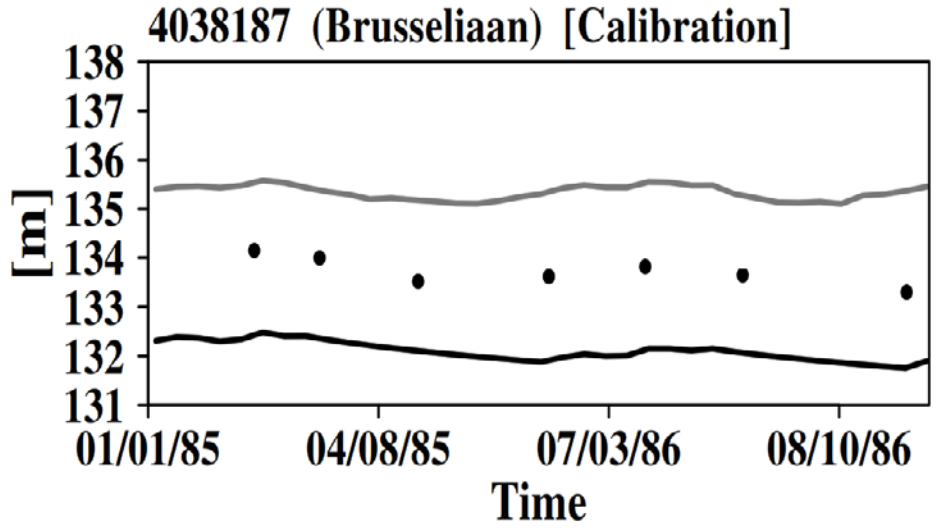


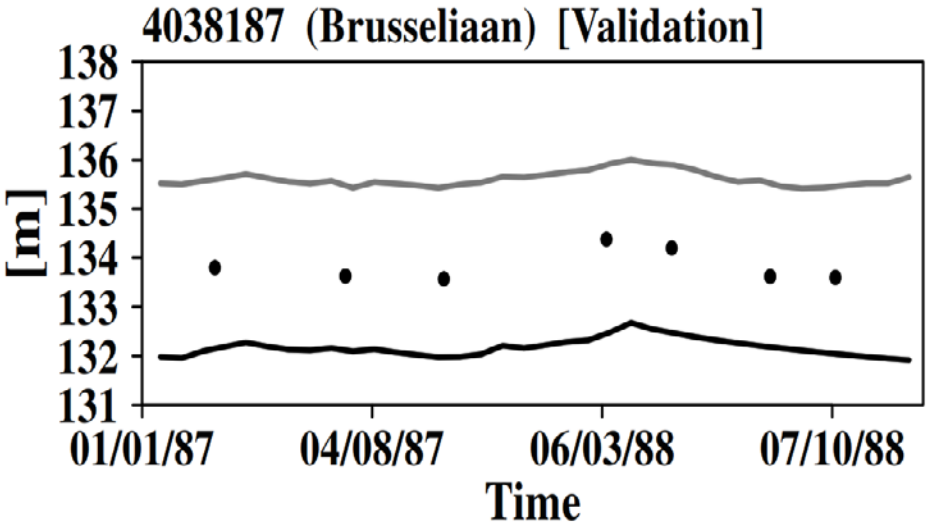


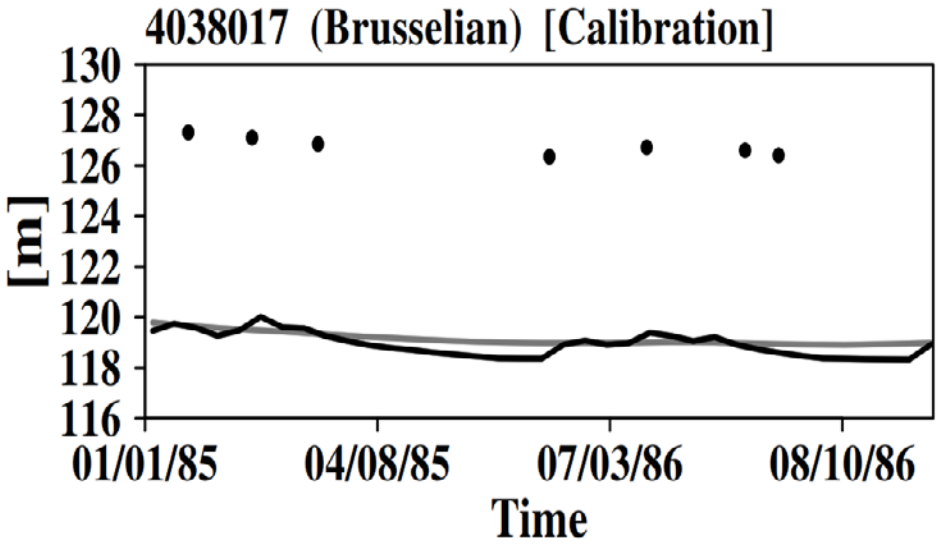


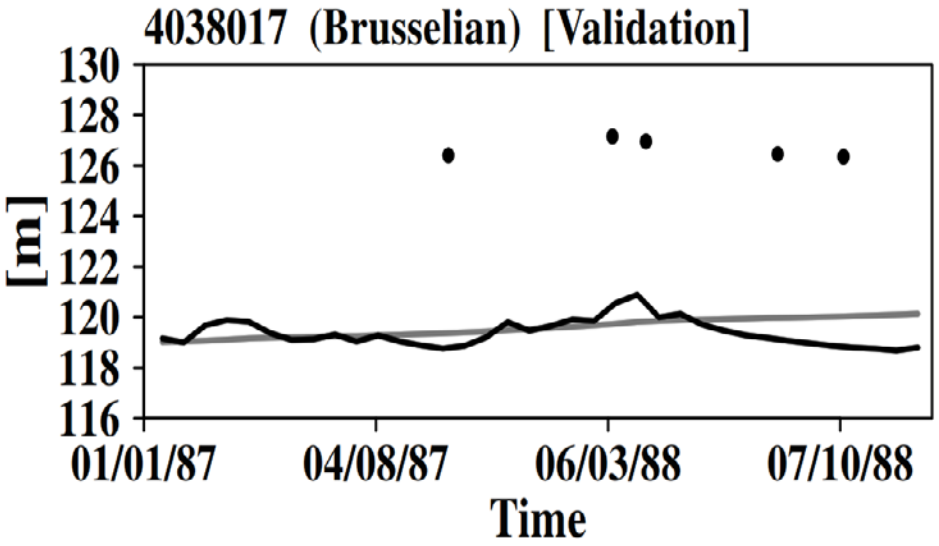


RESULTS: PIEZOMETRIC PREDICTIONS









CONCLUSIONS

- The model of the Gete catchment was calibrated and validated at the outlet.
- Results suggested that the model is capable of simulating the overall discharge with relative accuracy, but distributed piezometric results show large variance.
- Predictions for the internal discharge stations (validation) were of inferior quality.
- Similar variance was observed for piezometric predictions in the validation period.

CONCLUSIONS

- Nevertheless, it is believed that the calibrated model is a reasonable simulator of both, overall discharge and piezometric levels.
- SHETRAN predictions were quite similar to the ones produced by MIKE SHE (commercial license), which encourages future use of the free license code for physically based distributed modelling of complex systems.