Geophysical Research Abstracts
Vol. 20, EGU2018-16514, 2018
EGU General Assembly 2018

Hydrological modelling of decadal predictions to improve forecasting systems for operation of reservoirs

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Under the frame of the Horizon 2020 project BINGO (Bringing INnovation to onGOing water management), climate change impacts on the water cycle in the Wupper River Basin for the next decade are being currently investigated and compared to other possible influences. Extreme climate-related events on the Wupper catchment area including winter floods, flash floods, and also dry periods. The incidence of these events has escalated in the last decades in conjunction with the shifting of the precipitation regime. Therefore an adapted risk management is needed to be better prepared for extreme hydrological situations. One of BINGO's approaches corresponds to the assessment of future climate, land, and water use scenarios based on the identification and comparison of past weather extremes and anomalies. To get a better knowledge for future operation of the water system, a set of hydrological models in NASIM and SWAT have been set up, calibrated, and validated using ground data for a reservoir catchment area.
NASIM and SWAT are physically, catchment-based, hydrological models based on the water balance equation. While NASIM offers high level of detail for modelling of complex urban areas and the possibility of entering precipitation time series at fine temporal resolution (e.g. minutely data), SWAT enables to study long-term impacts offering a huge variety of input and output variables including different soil properties, vegetation and land management practices. Alongside runoff, sediment and nutrient transport can be also simulated. For most calculations, SWAT operates on a daily time step. Every model is representing one of the adressed problems in water management: NASIM high detailed floods and the SWAT influences on the long and mid term water balance.
Observed and simulated discharge by NASIM and SWAT for the drainage area upstream of Neumühle hydrometric station (close to Große Dhünn reservoir's inlet) are compared. Comparison of simulated water balance for several hydrological years between the two models is also carried out. Model performance is assessed with different statistical metrics (relative volume error, coefficient of determination, and Nash-Sutcliffe Efficiency).
The objective is to determine catchment response on different meteorological events and to study parameter sensitivity of stationary inputs such as soil parameters, vegetation, or land and water use to improve the existing forecast model for hydrological extremes.