EGU2020-11018
https://doi.org/10.5194/egusphere-egu2020-11018
EGU General Assembly 2020

Assessing the performance of radar-based and satellite precipitation products in hydrological modelling with SWAT in Vils Basin, Germany

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Hydrological modelling is an important tool to improve our understanding of hydrological processes of river basins and to predict impacts of climate change and environmental change on water resources. Precipitation is a key component of the hydrological cycle, and the most important driver/input data for hydrological models. Accurate precipitation measurements at desirable temporal and spatial resolution are essential for achieving reasonable performance of hydrological modelling. Compared to the conventional measurements from point-based rain gauge stations, remote sensing of precipitation with satellite sensors and ground-based radar can expand observational coverage and provide regional precipitation at varying temporal and spatial resolutions. Radars can provide sampling at very high resolution but also tend to contain significant errors in precipitation estimates. The Deutscher Wetterdienst (DWD; German Weather Service) developed the RADOLAN (RADar-OnLine-ANeichung) method (a real-time, gauge-adjustment and correction procedure) to generate precipitation estimates (termed as RADOLAN product) from the German Doppler radar network. More recently (2017), the DWD published a reanalysis of radar data to generate RADKLIM (RADarKLIMatologie) precipitation product using upgraded correction algorithms and additional offline gauge adjustment.

This study presents the first assessment of the performance of two high spatial resolution (1 km) radar-based precipitation products (RADOLAN and RADKLIM) in streamflow simulation using the hydrological model SWAT (Soil and Water Assessment Tool) in Germany. We also evaluate the performance of conventional point-based rain gauge data and a satellite precipitation product in driving SWAT for streamflow simulation. The selected satellite product is CHIRPS (Climate Hazards Group InfraRed Precipitation with Station data) because of its well reported good performance and the relative higher spatial resolution (0.05°). The Vils Basin located in Bavaria, Germany is chosen as the study area. Performance of investigated precipitation product is assessed by comparing simulated streamflow using calibrated SWAT model against measured streamflow at basin outlet at both daily and monthly time scales. The model calibration is performed using the

SWAT-CUP program with measured streamflow. Different calibration procedures are also investigated to analyze the influence on model performance. This study presents and discusses the accuracy and uncertainty of using ground-based radar and satellite precipitation products in driving SWAT model for daily and monthly streamflow simulation. Our findings are expected to provide beneficial feedback to product developers for further improvements, and to inform local end-users about the quality of investigated precipitation products.