# High-resolution fully-coupled atmospheric – hydrological modeling: a cross-compartment regional water and energy cycle evaluation (EGU2020-17855)

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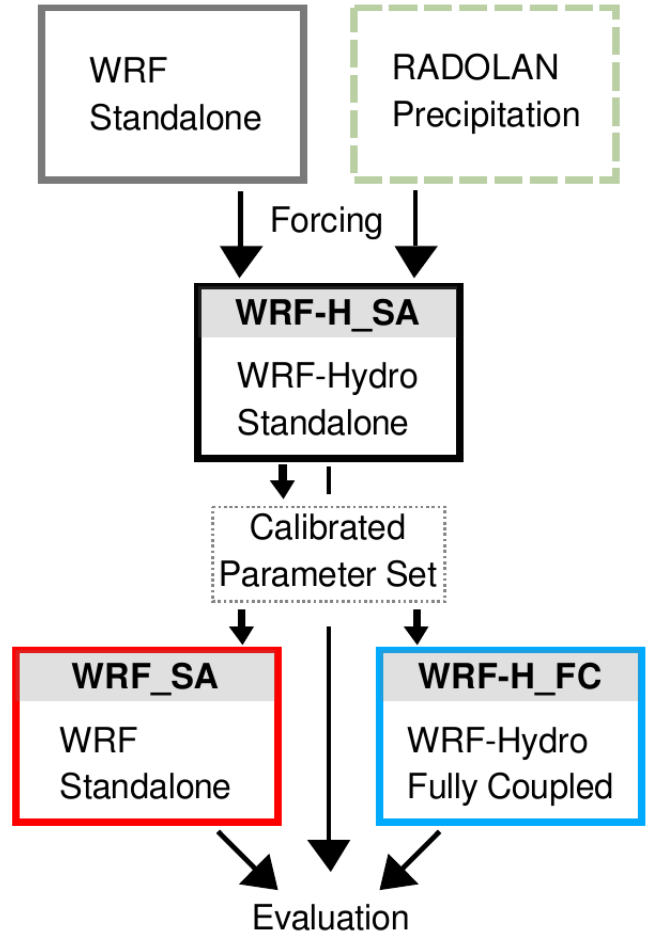
# Study Concept

This study examines the ability of the hydrologically enhanced version of the Weather Research and Forecasting Model (WRF-Hydro) to reproduce the regional water cycle by means of a two-way coupled approach and assesses the impact of hydrological coupling with respect to a traditional regional atmospheric model setting. It includes the observation-based calibration of the hydrological model component (offline WRF-Hydro) and a comparison of the classic WRF (WRF_SA), and the fully coupled WRF-Hydro (WRF_H_FC) models both with identically calibrated parameter settings for their land surface model component (Noah-MP).

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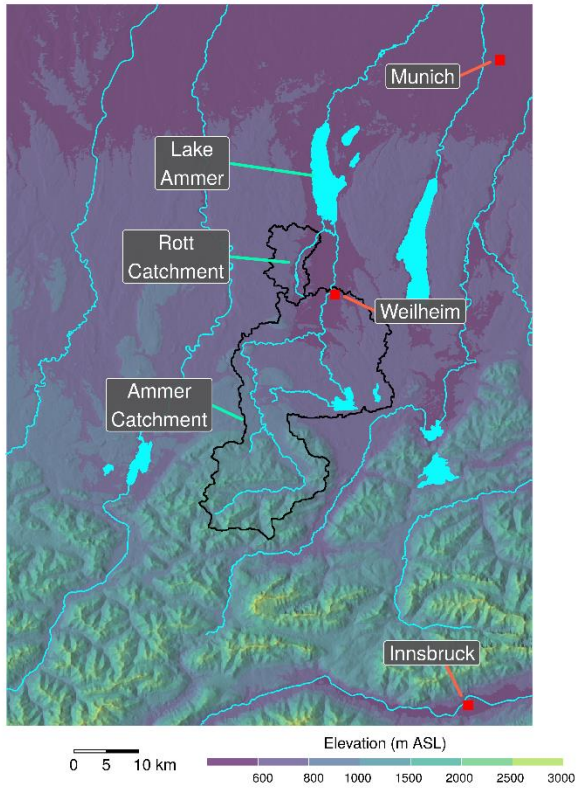
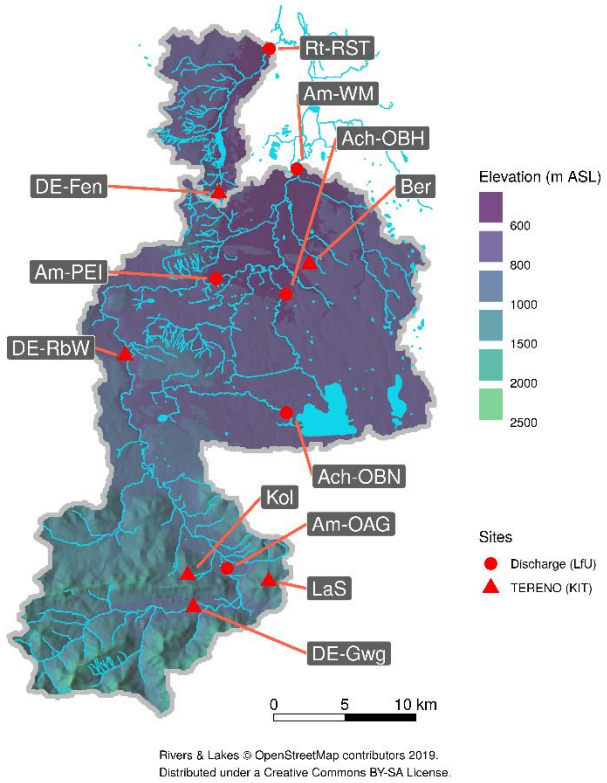
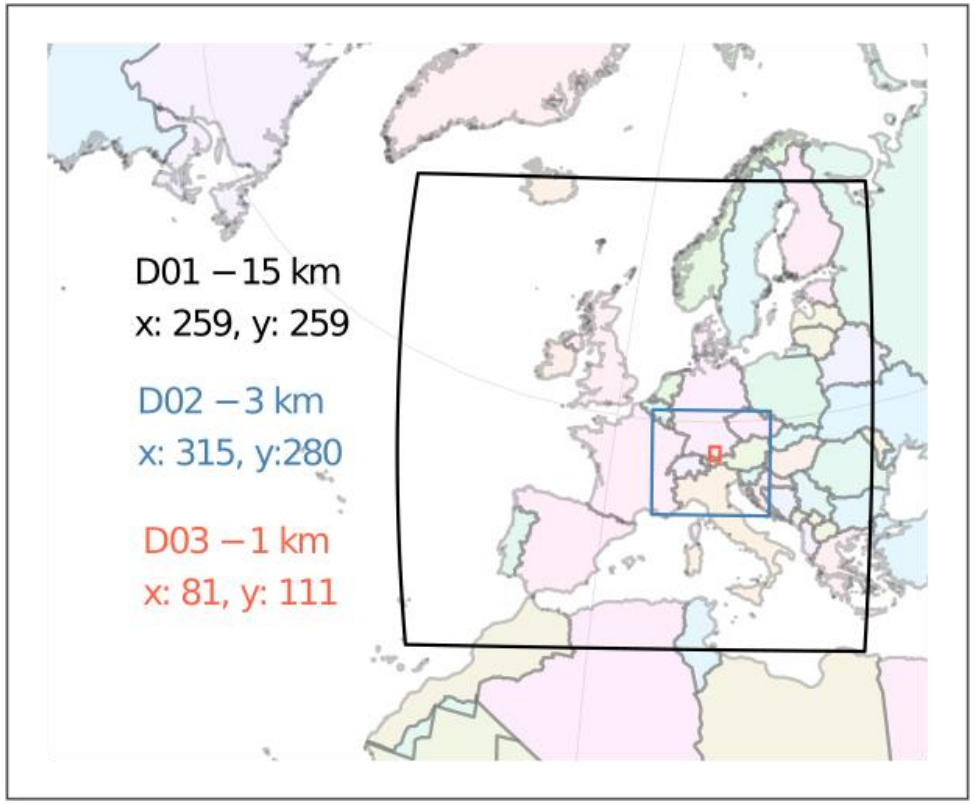
# Study region and model




The simulations are evaluated based on extensive observations at the Pre-Alpine Terrestrial Environmental Observatory (TERENO Pre-Alpine) for the Ammer (600 $km^2$) and Rott (55 $km^2$) river catchments in southern Germany, covering a five month period (Jun–Oct 2016).

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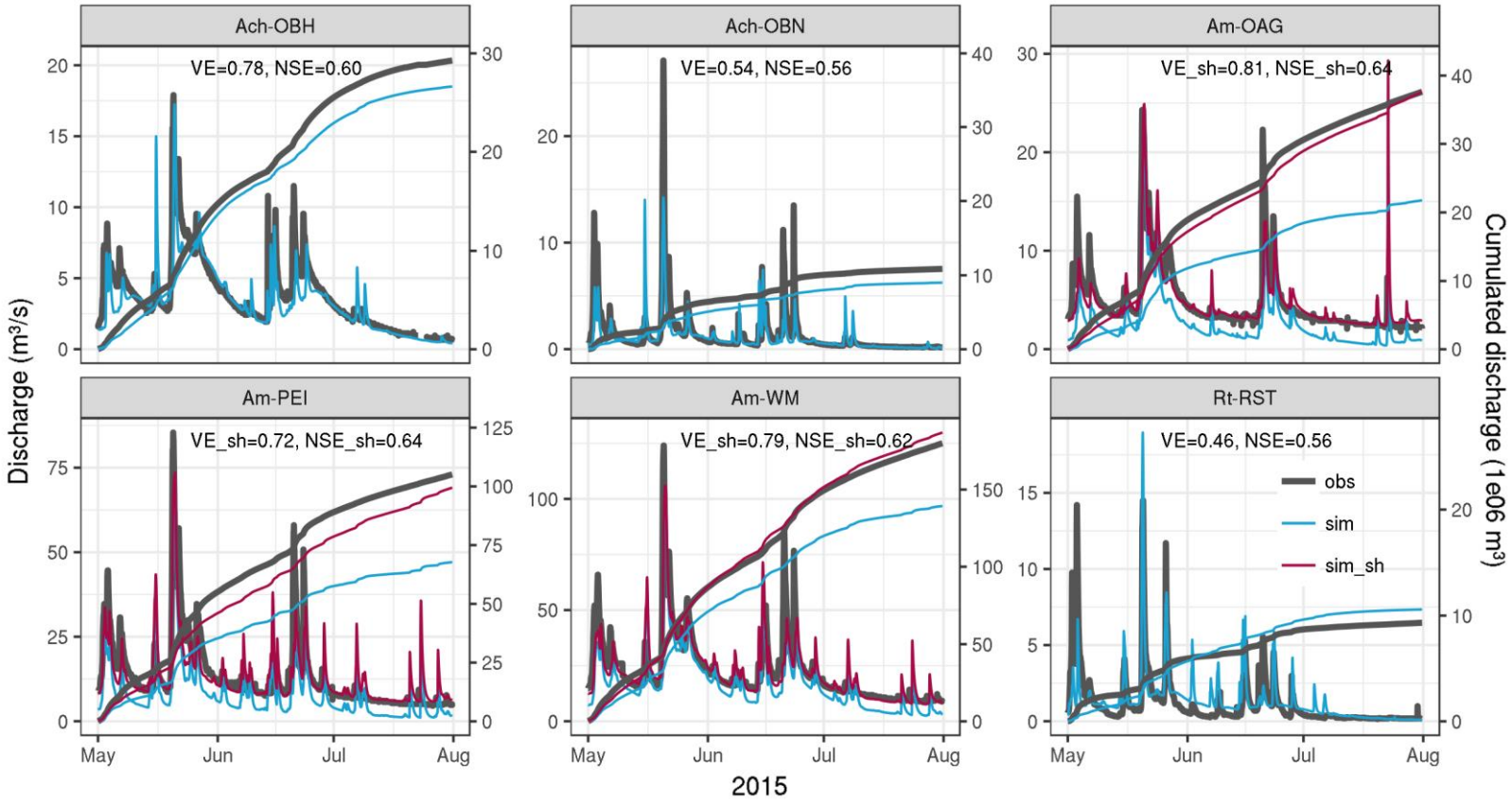
# WRF-Hydro Standalone Model Calibration




The sensitivity of 7 land surface parameters is tested using the *Latin-Hypercube One-factor-At-a-Time* (LH-OAT) method and 6 sensitive parameters are subsequently optimized for 6 different subcatchments, using the Model-Independent *Parameter Estimation and Uncertainty Analysis software* (PEST). The calibration of the offline WRF-Hydro gives Nash-Sutcliffe efficiencies between 0.56 and 0.64 and volumetric efficiencies between 0.46 and 0.81 for the six subcatchments.

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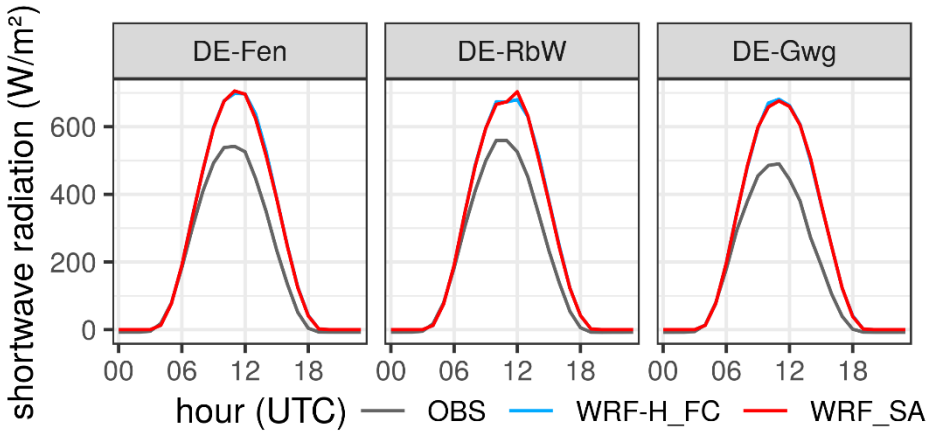
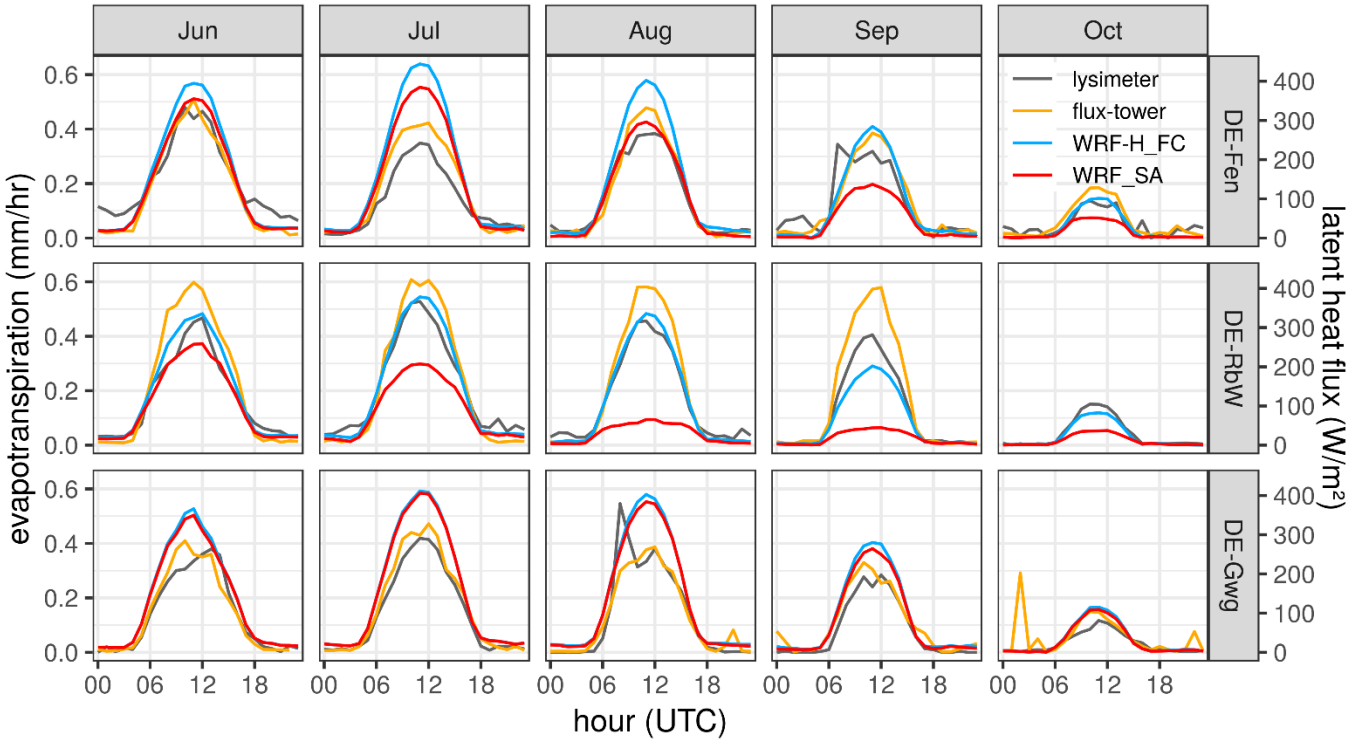
# WRF (WRF_SA) vs. Fully Coupled WRF-Hydro (WRF_H_FC)




The comparison of classic WRF and fully coupled WRF-Hydro, both using the calibrated parameters from the offline model, shows nominal alterations for radiation and precipitation but considerable changes for moisture- and heat fluxes.

By comparison with TERENO-Pre-Alpine observations, the fully coupled model slightly outperforms the classic WRF with respect to evapotranspiration, sensible and ground heat flux, near surface mixing ratio, temperature, and boundary layer profiles of air temperature.

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