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Water balance model versus land surface scheme to model Rhine river discharges

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Comparisons of various land surface models that have been developed in the past few decades indicate a wide variability in simulated land surface-atmosphere fluxes across different schemes. A correct simulation of these fluxes is strongly related to the partitioning of precipitation into evapotranspiration, surface runoff, moisture storage and recharge. Also in the simulation of these water balance terms, there is disagreement between the land surface schemes. Simulation of surface runoff is relatively easy to evaluate when it is converted to streamflow. By comparing streamflow simulated by a land surface scheme with streamflow simulated by a distributed water balance model, an assessment can be obtained of how well the land surface scheme models the water balances and with that the land-atmosphere fluxes.

In this study, a widely applied land surface scheme, VIC, is coupled with a river routing algorithm and applied to the Rhine river basin. Results are compared to simulations from a simple, semi-distributed water balance model, Rhineflow (a model used in many hydrological studeis in the basin). Both models are forced with a downscaled version of ERA-15 data, at a spatial resolution of 0.088 degrees. Forcing data is available between 1993 and 2003. After validating both models using the first part of the dataset, a five year period is simulated. Both time series of simulated streamflow are compared with observations at Lobith, the basin outlet, and some other gauging stations at the outlets of major tributaries.

An important difference between the models is the calculation of evapotranspiration: VIC solves the full energy balance, whereas Rhineflow uses a simple temperature based parameterization. By comparing the models, we investigate how this difference

in complexity influences the accuracy of the water balance estimates. We do this by analyzing differences in simulated streamflow time series between the models, and confronting them with observations.