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Influence of the spatial discretization on the performance of a regional water balance model

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Water balance models are used frequently to assess water resources at different spatial and temporal scales. When applying such models appropriate spatial and temporal discretizations have to be selected. While the selection of the temporal discretization is often based on considerations regarding the (assumed) dominating physical processes, the spatial discretization is often chosen rather arbitrarily. In this study we use a monthly water balance model, which uses regional parameters - based on spatial data sets such as land-use, soil type, and a digital elevation model - and apply it for the whole of Austria (84000 km^2). As initial spatial discretization a 1x1 km raster is used. The influence of the spatial discretization on the simulations is tested with aggregated resolutions of raster cells and elevation bands. Overall 29 different resolutions are used. The aggregations are performed separately for precipitation, air temperature, model parameters, and all three components at once. The model performance is evaluated with observed runoff of a 30-year period in 140 catchments. In general, the model performance decreases with increasing spatial aggregation, but only air temperature - which controls the threshold-like accumulation and melting of snow - shows a pronounced sensitivity. Deficits in the spatial distribution of air temperature can be overcome by a local re-calibration of model parameters. It is concluded that elevation bands are more efficient than raster cells if only total catchment runoff is of concern. However, with a 1x1 km raster spatial properties are correctly retained by the model. Therefore, a distributed rather than a semi-distributed spatial discretization is better suited for a water balance model using regional parameters.