Geophysical Research Abstracts
Vol. 12, EGU2010-14068-1, 2010
EGU General Assembly 2010

Parameter estimates in dynamic models for PUB - influence of input data quality and scale

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The Swedish Meteorological and Hydrological Institute (SMHI) produces hydrological predictions in ungauged basins of both water quantity and quality at different scales, using different input databases. This presentation will demonstrate two such model set-ups and the difference in estimated parameter values of the Hydrological Predictions for the Environment (HYPE) model. The model results are compared, and validation in independent sites is assumed to show the implications for PUB.

The HYPE model is calibrated stepwise for a whole domain when applied, using a hydrological response units concept with interactive check between hydrology and hydrochemistry for soil/groundwater and rivers/lakes, respectively. Relatively few monitoring sites are used to receive reasonable results for the whole domain. The national S-HYPE model system (450 000 km2) produces predictions in 17 313 subbasins, where observations of water discharge are available in 300 and nutrient concentrations in 600 outlets. About 10% of these were used for model calibration and the rest for independent model validation, considered to represent the ungauged conditions. When applying the model for the whole Baltic Sea basin (1 700 000 km2), predictions are made in 5 100 subbasins. Observations are then available for water discharge in 160 unregulated river reaches and for nutrients in 761 subbasin outlets. About half of the water stations were used for calibration and 10% of the nutrient observations. Model performance is calculated using different evaluation criteria for independent sites.

The differences in model performance between the national (S-HYPE) and the Baltic Sea basin (Balt-HYPE) scale applications can be attributed to either differences in model inputs or differences in calibration. In the Swedish application, more detailed input data on physiography, emissions and meteorology have been used for the higher resolution, while generally available databases and generic methods have been used when modelling the entire Baltic basin.

For instance, S-HYPE uses land cover on 250 m, statistics from18 agricultural regions, and forcing data from a 4 km grid based on optimal interpolation between meteorological stations. The Balt-HYPE uses land cover on 1 km, statistics from only 8 agricultural regions, forcing data from a 11 km grid based on European renalysis. Catchment delineation was made by hand in S-HYPE, while an automatic routine is used in Balt-HYPE, based on the topographical database Hydro1k (1x1 km) and manual checking with some correction. Point sources are based on empirical records in S-HYPE while a model concept using e.g. population statistics were applied in Balt-HYPE

The presentation shows the similarities and differences in the input databases and the resulting impact on model coefficients when working on different scales. For instance, the differences in meteorological forcing data had to be accounted for in the model calibration, which can be seen in the resulting evapotranspiration and snow melt parameters. At the larger scale (Balt-HYPE) the gains in model performance were rather made by correcting the regional and global databases by hand than by parameter tuning. Finally, the presentation will demonstrate the impact from model set-up on PUB results. Eventual differences in conclusions for decision-makers will also be highlighted, when using one model set-up or the other.