Geophysical Research Abstracts
Vol. 14, EGU2012-11775, 2012
EGU General Assembly 2012

Assimilation of lake surface temperature and ice cover data in a semi-distributed hydrological model – implications for water balance and water quality predictions in Sweden

D. Gustafsson (1,2), G. Lindström (1), and C. Pers (1)

(1) Swedish Meteorological and Hydrological Institute, Research and Development, Hydrology, Norrköping, Sweden (david.gustafsson@smhi.se), (2) KTH Royal Institute of Technology, Land and Water Resources Engineering, Stockholm, Sweden

Lake and river ice is an important factor for hydrological, chemical, and biological processes in northern watersheds through the impact on heat and water balance, discharge, water temperature, and light condition. The aim of this study was to include representation of lake ice processes in the hydrological model HYPE (Hydrological Predictions for the Environment), and to study the impact of lake ice on the simulation of hydrological and water quality processes when assimilating Earth observation data of surface water temperature and ice cover.
The HYPE model is a semi-distributed hydrological and water quality model that has been applied to the whole of Sweden with high spatial resolution. In this study, a thermodynamic lake ice model driven by air temperature and precipitation input data was added to the model. The model has one ice layer, and includes representation of snow on ice and slush layer formation/freezing. The ability to simulate the ice dynamic correctly is sensitive to the estimated start of the ice formation, the so-called freeze up date. The freeze up date is determined based on a moving average air temperature filter, with a filter parameter related to the mean lake depth. The model was calibrated using a data set of about 40 lakes with in-situ ice depth observations and another 600 lakes with observed freeze-up and break-up dates located all over Sweden. After calibration, the root-mean square error for the freeze up date was about 16 days using a common parameter set for all observed lakes.
The aim of the data assimilation study was to investigate to what extent the ice simulation could be improved by assimilating the lake surface temperature and/or the in-situ observations of freeze-up day, and to what extent this will impact on the hydrological and water quality simulation. The earth observations of lake surface temperatures and the in-situ lake ice observations are assimilated into the model using the Ensemble Kalman filter data assimilation method. The lake surface temperature data will be used to update the simulated freeze-up dates, and to improve the simulated water temperatures also for the water quality processes. A comparison between results obtained by assimilation of earth observation data and assimilation of the in-situ observed freeze-up dates and ice depths will be discussed.