Modelling Runoff from Pan-Arctic River Basins

The aim of the present work is to investigate whether a physically-based land surface model (LSM) SWAP (Soil Water – Atmosphere – Plants) is able to simulate runoff from pan-Arctic river basins, which are characterized by clearly expressed cold season with low temperatures and deep snow cover, seasonally frozen soil or permafrost. Three river basins, located on the north of the European part of Russia, were chosen for investigation: the Mezen River basin (78 000 km$^2$), the Pechora River basin (312 000 km$^2$) and the Severnaya Dvina River basin (348 000 km$^2$). A priori estimated land surface parameters were taken from global data sets, while atmospheric forcing data were both from global data sets and from meteorological stations located within the basins. To reduce uncertainties in land surface parameters and forcing data, the most important a priori estimated parameters and adjustment factors for precipitation and incoming radiation were optimized against streamflow data for the 5-year period. Model validation was performed for 10-33 year periods. Comparison of measured daily streamflow with corresponding hydrographs simulated by SWAP has shown a good agreement for all versions of forcing data: daily Nash-Sutcliffe coefficient of efficiency ranged from 0.75 to 0.90 and the absolute bias did not exceed 10%. Conclusions: (1) LSM SWAP can be used for simulation streamflow from pan-Arctic river basins; (2) global parameter data sets can be used for streamflow simulations in high latitudes after calibration, (3) global meteorological data sets can provide good results after calibrating adjustment factors for precipitation and incoming radiation.