Geophysical Research Abstracts
Vol. 16, EGU2014-4177-1, 2014
EGU General Assembly 2014

Comparison of various remote sensing snow products in a distributed hydrological model

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With the development of remote sensing, more and more data series with spatially distributed snow cover become available. These data can be obtained for free, from many sources varying in spatial and temporal resolution, the length of the time series and the method of acquisition (VIS-NIR or microwave sensors). A popular use of remotely sensed snow distribution data is in hydrological modelling. However, a suitability test of different remote sensing snow products for hydrological models was so far not conducted. In this work, some of the most common remote sensing snow products (MOD10A1, IMS , GLOBSNOW and AMSR-E_DySno) are used as input data in the WetSpa distributed hydrological model. Each of the snow products has different properties and is based on different algorithms, which makes the analysis interesting and multidimensional. The area of research is the Biebrza River catchment - located in north-eastern Poland, comprising approximately 7000 km^2. Biebrza is a natural river with a snow melt regime, making it very suitable for this kind of analysis.

In total 6 modelling scenarios were conducted (4 with remote sensing data, 1 standard approach – temperature threshold for snow accumulation and melting, 1 based on snow data from meteorological stations). Each model was calibrated against discharge with the Shuffled Complex Evolution (SCE) algorithm. The calibration was repeated three times for each model to make sure that the global optimum was found. The calibration and validation periods were both 3 years long. The next stage was a comparison with the GLUE uncertainty analysis for each of the models, on a shorter, one-year period.

The best model in terms of Nash-Sutcliffe efficiency and r^2 was using the MOD10A1 data; however, the models using GLOBSNOW SWE and the standard approach received similar scores. In terms of the model bias the best results were obtained for the IMS and MOD10A1 data. Nevertheless, the lowest root mean square error was found for the models using the standard approach and the MOD10A1 data. The GLUE analysis shows that models using remote sensing data have lower uncertainty than those using the standard approach, as the remotely sensed driven models need less global parameters.