Pre-operational runs of atmospheric model COSMO-Ru with initial snow data from 1D multilayer snow model SnoWE

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The investigation is devoted to the development of new runoff forecast methods in modern climate conditions on the example of floods on the Sukhona river near Velikiy Ustyug. The main purpose of the research is creation of a new scheme of assimilation and application of observations (in situ) and model data (COSMO-Ru [1] and SnoWE [3]) for a hydrological model ECOMAG (the model of runoff formation - author Motovilov Yu.G., Institute of Water Problem of RAS [2]). For analysis of flood characteristics, the most promising method is synthesizing models of the hydrometeorological cycle.

The initial and boundary data for the mesoscale COSMO-Ru system are taken from the global ICON model [5]. The comparisons of ICON snow water equivalent (SWE) values with the results of the hydrological model and in situ measurements demonstrated some serious inaccuracies for the territory of the Russian Federation with a permanent snow cover (Fig.1).

Initial meteorological data for the hydrological model ECOMAG were obtained from in-situ observations and (or) the mesoscale atmospheric circulation model COSMO-Ru. Thus, we had to launch the hydrological model on the COSMO-Ru grids. The information about snow and snow cover characteristics was obtained from the SnoWE with different spatial steps.

The SnoWE program complex is based on the 1-d multilayer model of snow evaluation for synoptic meteorological stations based on synoptic measurements. The 1-d multilayer model calculates daily values of SWE and changes in snow density (SD). In the SnoWE program complex, two different schemes of modelling SWE and SD values are implemented.

The focus of this research is coupling the hydrological (ECOMAG) and meteorological (COSMO-Ru) models and linking ECOMAG and the snow model. The second purpose is the comparison of snow cover from ECOMAG and SnoWE for the research territory.

The research was done for two time periods from 01.09.2017 to 01.06.2018 and from 01.09.2018 to the present based on the COSMO-Ru system with different spatial resolutions (COSMO-Ru13 – 13 km: all territory of Russia and neighboring areas; COSMO-Ru7 – 7 km: European part of Russia and the nearest areas, COSMO-Ru2 – 2.2 km: Central Russian regions) in quasi-operational mode. The results demonstrated that the fields of snow cover from SnoWE (with ICON data as the first guess fields) contain less errors and are a positive alternative to ICON data.

This approach can be effective for analyzing possible extreme hydrometeorological events and allows to solve diverse problems associated with the flooding of the territory, both in the short-term forecast mode and for various scenario simulations. At the same time, the combination of different models (hydrological, atmospheric and snow cover) are expected to lead to a loss of accuracy when moving from one level to another and requires the improvement of modeling techniques.

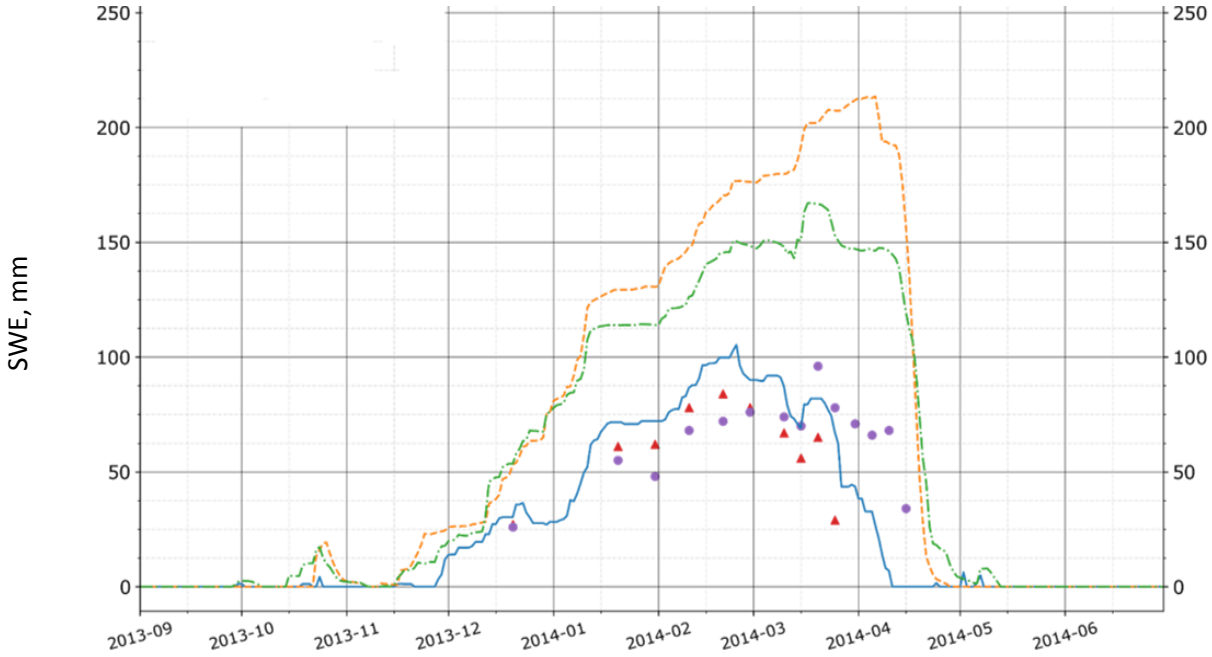

Fig. 1. Comparison of SWE for the meteorological station Syktyvkar: ICON data – yellow line, SnoWE data – blue line, ECOMAG data – green line, snow field survey –red triangles, snow forest survey – violet points

References:

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5. *Official webpage of DWD with information about ICON* https://www.dwd.de/EN/research/weatherforecasting/num_modelling/01_num_weather_prediction_modells/icon_description.html