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Real-time application of meteorological ensembles for Danube flood forecasting

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Flood forecasting schemes may have the most diverse structure depending on catchment size, response or concentration time and the availability of real time input data. The centre of weight of the hydrological forecasting system is often shifted from hydrological tools to the meteorological observation and forecasting systems. At lowland river sections simple flood routing techniques prevail where accuracy of discharge estimation might depend mostly on the accuracy of upstream discharge estimation. In large river basin systems both elements are present. Attempts are made enabling the use of ensemble of short and medium term meteorological forecast results for real-time flood forecasting by coupling meteorological and hydrological modelling tools.
The system is designed in three parts covering the upper and central Danube. The large number of nodes (41) makes the system in fact semi distributed in basin scale. All of the nodes are prepared for forecast purposes. Real time mode runs are carried out in 6 hourly time steps. The available meteorological analysis and forecasting tools are linked to the flood forecasting system. Meteorological forecasts include 6 days and 12 days out of the ECMWF 10-14-day ahead EPS and VarEPS. The hydrological side of the system includes the data ingestion part producing semi distributed catchment wise input from gridded fields and rainfall-runoff, flood routing modules.
Operational application of the of the ensemble system has been studied by the comparison of real time deterministic forecast and the experimental real time ensemble forecast results since the summer of 2008 on the river Danube. The period of June-October 2008 included mostly low water period interrupted by smaller floods.
The real time ensemble hydrological forecasting experiment proved that the use of meteorological ensembles to produce sets of hydrological predictions increased the capability to issue forecasts with describing current uncertainties. As the result of the demonstration experiment was that the NHFS (VITUKI National Hydrological Forecasting Service of Hungary) system can be used for such a purpose like real-time usage. The relative large number of model runs could be performed within reasonable time. Suggestions are given to adjust appropriate decision support rules to utilise the array of flood forecasts for flood management and warning purposes. The proper estimation of the contribution to forecast error by different modules of the system may help to better understand expected current uncertainty of the forecast.
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Keywords: real time flood forecast, hydrological ensembles, meteorological ensembles, River Danube, quantitative precipitation forecast, gridded fields, semi-distributed.