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Dealing with multiple weather forecast inputs for medium-range ensemble flood forecasting on European scale

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Following the disastrous floods in the Elbe and Danube river basins in August 2002, the European Commission launched an activity to support the development of a European Flood Alert System (EFAS) to increase preparedness for flood events. EFAS is in development and testing phase since 2003 at the EC Joint Research Centre in close collaboration with the hydrological services in the Member States. The system is designed to provide early flood warnings between 3-10 days in advance to the local hydrological services. These warnings are based on a number of medium-range weather forecasts, including the full suite of Ensemble Prediction Products with 51 members from the European Centre for Medium-Range Weather Forecasting (ECMWF). EFAS is based on the rainfall-runoff model LISFLOOD which can be characterized as a hybrid between a physical and a conceptual hydrological model. The advantage of this approach is that calibration of the model parameters is simplified as compared to full conceptual models, which is essential when simulating hydrological processes for large catchments and on European scale. At present EFAS is set-up on a 5km grid for the whole of Europe and on a 1km grid for the pilot catchments Elbe and Danube.

EFAS forecasts consist of 4 steps. In the first step the initial conditions at the onset of the hydrological simulations are determined and the uncertainty in the initial conditions assessed. In Step 2, the best-guess initial conditions are taken for the calculation of the forecasted discharges based on the different weather forecasts. Each weather forecast is processed individually by EFAS in a deterministic way, so that at the end of the second step n discharge forecasts exist – in the present configuration, n=53 hydrographs are produced twice a day. Step 3 represents the decision support module,

where the simulated discharges are compared against critical thresholds and the results are summarized in a way that hotspot areas can be easily visualized qualitatively and quantitatively in a spatial-temporal framework. Persistent forecasting of threshold exceedance is one major part of the decision process concerning whether or not EFAS information on the probability of flooding should be sent to national hydrological services. It is a non-trivial task, since EFAS is based on several independent weather forecasts. Finally, the 4^{th} step in EFAS forecasting consists in the preparation of information reports that are sent to the collaborating hydrological services. The layout and contents of these reports have been elaborated under consideration of Member States authority feedback.

EFAS results during 2005, a year of several severe floods in the Danube and other river basins, show that EFAS approach yields positive results and can potentially increase preparedness for flood events in the future. The investigation of methods to reduce uncertainty in flood forecasting in case of conflicting forecasts and the communication of ensemble products to hydrological experts are some of the currently research activities under EFAS.