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Supporting inland waterway transport on German waterways by operational forecasting services – water-levels, discharges, river ice

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Inland waterway transport (IWT) is an important commercial sector significantly vulnerable to hydrological impacts. River ice and floods limit the availability of the waterway network and may cause considerable damages to waterway infrastructure. Low flows significantly affect IWT's operation efficiency usually several months a year due to the close correlation of (low) water levels / water depths and (high) transport costs. Therefore "navigation-related" hydrological forecasts focussing on the specific requirements of water-bound transport (relevant forecast locations, target parameters, skill characteristics etc.) play a major role in order to mitigate IWT's vulnerability to hydro-meteorological impacts. In light of continuing transport growth within the European Union, hydrological forecasts for the waterways are essential to stimulate the use of the free capacity IWT still offers more consequently.

An overview of the current operational and pre-operational forecasting systems for the German waterways predicting water levels, discharges and river ice thickness on various time-scales will be presented. While short-term (deterministic) forecasts have a long tradition in navigation-related forecasting, (probabilistic) forecasting services offering extended lead-times are not yet well-established and are still subject to current research and development activities (e.g. within the EU-projects EUPORIAS and IMPREX). The focus is on improving technical aspects as well as on exploring adequate ways of disseminating and communicating probabilistic forecast information.

For the German stretch of the River Rhine, one of the most frequented inland waterways worldwide, the existing deterministic forecast scheme has been extended by ensemble forecasts combined with statistical post-processing modules applying EMOS (Ensemble Model Output Statistics) and ECC (Ensemble Copula Coupling) in order to generate water level predictions up to 10 days and to estimate its predictive uncertainty properly. Additionally for the key locations at the international waterways Rhine, Elbe and Danube three competing forecast approaches are currently tested in a pre-operational set-up in order to generate monthly to seasonal (up to 3 months) forecasts: (1) the well-known Ensemble Streamflow Prediction approach (ensemble based on historical meteorology), (2) coupling hydrological models with post-processed outputs from ECMWF's general circulation model (System 4), and (3) a purely statistical approach based on the stable relationship (teleconnection) of global or regional oceanic, climate and hydrological data with river flows. The current results, still pre-operational, reveal the existence of a valuable predictability of water levels and streamflow also at monthly up to seasonal time-scales along the larger rivers used as waterways in Germany.
Last but not least insight into the technical set-up of the aforementioned forecasting systems operated at the Federal Institute of Hydrology, which are based on a Delft-FEWS application, will be given focussing on the step-wise extension of the former system by integrating new components in order to meet the growing needs of the customers and to improve and extend the forecast portfolio for waterway users.