Geophysical Research Abstracts,
Vol. 11, EGU2009-13204, 2009
EGU General Assembly 2009

Operational hydrological forecasting in Bavaria. Part I: Forecast uncertainty

U. Ehret (1), A. Vogelbacher (2), K. Moritz (2), S. Laurent (2), I. Meyer (2), and I. Haag (3)

(1) TU München, Insitute for Water and Environment, Department for Hydrology and River Basin Management, Aricsstrasse 21, 80333 München, u.ehret@bv.tum.de, (2) Bayerisches Landesamt für Umwelt, Lazarettstrasse 67, 80636 München, (3) Hydron Ingenieurgesellschaft für Umwelt und Wasserwirtschaft mbH, Haid-und-Neu-Strasse 7, 76131 Karlsruhe

In Bavaria, operational flood forecasting has been established since the disastrous flood of 1999. Nowadays, forecasts based on rainfall information from about 700 raingauges and 600 rivergauges are calculated and issued for nearly 100 rivergauges. With the added experience of the 2002 and 2005 floods, awareness grew that the standard deterministic forecast, neglecting the uncertainty associated with each forecast is misleading, creating a false feeling of unambiguousness. As a consequence, a system to identify, quantify and communicate the sources and magnitude of forecast uncertainty has been developed, which will be presented in part I of this study. In this system, the use of ensemble meteorological forecasts plays a key role which will be presented in part II.

Developing the system, several constraints stemming from the range of hydrological regimes and operational requirements had to be met:
Firstly, operational time constraints obviate the variation of all components of the modeling chain as would be done in a full Monte Carlo simulation. Therefore, an approach was chosen where only the most relevant sources of uncertainty were dynamically considered while the others were jointly accounted for by static error distributions from offline analysis.
Secondly, the dominant sources of uncertainty vary over the wide range of forecasted catchments: In alpine headwater catchments, typically of a few hundred square kilometers in size, rainfall forecast uncertainty is the key factor for forecast uncertainty, with a magnitude dynamically changing with the prevailing predictability of the atmosphere. In lowland catchments encompassing several thousands of square kilometers, forecast uncertainty in the desired range (usually up to two days) is mainly dependent on upstream gauge observation quality, routing and unpredictable human impact such as
reservoir operation.

The determination of forecast uncertainty comprised the following steps:
a) From comparison of gauge observations and several years of archived forecasts, overall empirical error distributions termed 'overall error' were for each gauge derived for a range of relevant forecast lead times.
b) The error distributions vary strongly with the hydrometeorological situation, therefore a subdivision into the hydrological cases 'low flow, 'rising flood', 'flood', flood recession' was introduced.
c) For the sake of numerical compression, theoretical distributions were fitted to the empirical distributions using the method of moments. Here, the normal distribution was generally best suited.
d) Further data compression was achieved by representing the distribution parameters as a function (second-order polynome) of lead time.

In general, the 'overall error' obtained from the above procedure is most useful in regions where large human impact occurs and where the influence of the meteorological forecast is limited. In upstream regions however, forecast uncertainty is strongly dependent on the current predictability of the atmosphere, which is contained in the spread of an ensemble forecast. Including this dynamically in the hydrological forecast uncertainty estimation requires prior elimination of the contribution of the weather forecast to the 'overall error'. This was achieved by calculating long series of hydrometeorological forecast tests, where rainfall observations were used instead of forecasts. The resulting error distribution is termed 'model error' and can be applied on hydrological ensemble

forecasts, where ensemble rainfall forecasts are used as forcing.

The concept will be illustrated by examples (good and bad ones) covering a wide range of catchment sizes, hydrometeorological regimes and quality of hydrological model calibration.
The methodology to combine the static and dynamic shares of uncertainty will be presented in part II of this study.