Geophysical Research Abstracts,
Vol. 11, EGU2009-8442, 2009
EGU General Assembly 2009

Error correction of a hydrological forecasting system by the use of State–Space models in the Wavelet domain

K. Bogner, J. Thielen, M. Kalas, and A. de Roo
JRC, IES, Ispra, Italy (konrad.bogner@jrc.it)

Streamflow predictions most often show multiscale errors with unknown source and statistical structure that degrade forecast quality and limit the operational usefulness of the forecasts. According to the fact that the errors between observed and simulated series, occurs across many different time-scales and across different levels of resolution, the river flow discharge is decomposed by the use of wavelet transformations first. For example the range of scales for the error, that occurs at the spring time will be caused by long lasting snowmelt processes, and is by far larger then the error, that appears during the summer period and is caused by an overlapping of stratiform precipitation and convective rain fields of short duration. The wavelet decomposition is an excellent way to provide the detailed model error at different levels in order to estimate the (unobserved) state variables more precisely. At next a simple State–Space model has been fitted for each resolution level in the wavelet domain, where the various matrices defining the dynamics of the model are time-invariant. After updating the system by the use of the Kalman filter the data are transformed back into the time domain in order to get error corrected discharge forecast series.

Prediction of wavelet coefficients at the end of a series can result in artifacts because of the boundary problem, which is of great relevance in operational forecast. Especially the application of the usual boundary treatment rules by extending the series by reflection will give wrong results.

To alleviate this boundary problem, a redundant representation using dilations and translations of the auto-correlation functions of compactly supported wavelets (the auto-correlation shell) will be used instead of the wavelets per se. The recursive definition of the auto-correlation functions of compactly
supported wavelets leads to fast recursive algorithms to generate the multiresolution representations.

LISFLOOD, a distributed, raster-based, combined rainfall-runoff and hydrodynamic model embedded in a dynamic GIS environment, is used at the JRC as a hydrological forecasting system. Within the EU Project PREVIEW (PREVention, Information and Early Warning) ensembles of discharge series have been generated for the Danube catchment taking various weather forecast products as input to the LISFLOOD model. Different error correction methods have been applied to the Danube basin upstream Bratislava. The combination of state-space models and wavelet transformations in order to update errors between the simulated (forecasted) and the observed discharge indicate better predictability then classical ARMAX and modern kernel-based machine learning error correction methods.