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Hydrologic predictions on ungauged catchments using deterministic distributed modelling system

Pavel Tachecí (1) and Martina Kimlová (2)

(1) DHI a.s., Prague, Czech Republic (p.tacheci@dhi.cz), (2) Czech Hydrometeorological Institute, Prague, Czech Republic (kimlova@chmi.cz)

There is a need for warning system giving prediction of flash-flood risk conditions with sufficient advance even in source areas and in small tributaries catchments. New approach is based on combination of numerical weather prediction (NWP) model, radar or rain gauge data with distributed hydrologic mathematical model of particular area. Set of newly developed tools, customized for particular use in the Czech Hydrometeorological Institute (CHMI) environment enhance import of data and presentation of results. This forecast system focuses on hydrological modelling of running water balance in spatially distributed manner. Its computation is repeated day-to-day.

Six models of particular basins (800 – 4000 km2), representing different conditions across the Czech Republic territory were calibrated and validated successfully. The Sázava river basin model (4.000 km2) is used for regular testing operation in CHMI Forecast centre since October 2007. Basic size of grid cells used in models is 300x300 m, basic time step of forecast is 1 day, but can be refined according to the input data. Water balance is computed using simplified 2-layer method for unsaturated zone, 2D approximation of Boussinesq equation for saturated zone, diffusion equation for overland flow and 1D kinematic equation for river flow (MIKE 11 model).

The whole process of input data processing, model simulation and result generation may be run automatically or in step-by step mode via simple graphical user interface. Three types of input data are supported:

•time series (temperature and precipitation) measured at observation stations and stored in CHMI database

•radar data products (precipitation intensity field)

•results of ALADIN weather forecast model (temperature and precipitation field).

For forecast purposes, reference evapotranspiration is approximated according relationship to air temperature for every computational grid cell. The user may choose area (catchment) to be processed and period of simulation. Back-calculation of initial conditions using regular observation network data is applied to minimize errors of water balance. Scaled values of simulated deficit of water content in unsaturated zone, aggregated over user-defined areas, were chosen as flash-flood danger indicator. User – defined templates for presentation of results are available.

The advantage of this approach sustains in a fact, that it uses three different types of input data. Further on, it may give results for user-defined areas, which are not necessarily connected to on-line flow gauging station profiles. This means, that it is capable to give flash-flood danger maps also for upper catchments and small tributaries, which are not included in the network of main warning profiles.