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# Flood modelling in complex hydrologic systems with sparsely resolved data

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The European Directive on Assessment and Management of Flood Risks places significant emphasis on establishing tools suitable for simulating the relevant hydrologic processes in areas of high flood risk. Because flood modelling requires relatively detailed spatial and temporal resolutions, the model selection is controlled by the available distributed hydrologic information. The value of data (mainly stage/discharge records) is indisputable, since the quality of calibration and, consequently, the model predictive capacity, depends on the availability of reliable observations at multiple sites. On the other hand, data scarcity is a global problem in hydrologic engineering that is getting increasingly severe as the monitoring infrastructure is shrinking and degraded. It is therefore crucial to build reliable models that are parsimonious.

In this vein, we have adapted the HYDROGEIOS model (Efstratiadis et al., 2008), initially developed as a conjunctive surface-groundwater simulation and water management tool at the monthly time scale, to run in daily time steps. In typical flood simulation packages inputs are time series of precipitation, which are resolved in hourly or finer increment, and detailed hydro-morphologic properties of the stream network. In contrast, the enhanced version of HYDROGEIOS only uses daily rainfall depths and a limited number of parameters that are estimated or calibrated on the basis of once-a-day discharge data. The character of HYDROGEIOS as a conjunctive model enables to represent simultaneously the interactions among the surface and sub-surface processes and the human interventions, and to route the runoff across the stream network. Lacking finely resolved precipitation data and for the purpose of flood routing, we have applied a disaggregation technique to analyse the simulated daily hydrographs in finer time steps. Flood routing is implemented via either a kinematic-wave or a Muskingum diffusive-wave scheme, introducing only one or two parameters per stream reach, respectively.

The new version of HYDROGEIOS is being tested on the Boeotikos Kephisos River Basin for flood forecasting in real-time, using as input precipitation forecasts from numerical weather prediction simulations (European project FLASH). The basin is heavily modified, with strong physical heterogeneities, involving multiple peculiarities such as significant karst springs, which rapidly contribute to the streamflow, thus reflecting a strong interaction between surface and ground water processes, and a drainage canal and network in the lower basin with extremely small slopes.

Reference

Efstratiadis, A., I. Nalbantis, A. Koukouvinos, E. Rozos, and D. Koutsoyiannis, HYDROGEIOS: a semi-distributed GIS-based hydrological model for modified river basins, Hydrol. Earth Syst. Sci., 12, 989-1006, 2008.