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Modelling floods in the Ammer catchment: limitations and challenges with a coupled meteo-hydrological model approach

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Abstract. Numerous applications of hydrological models have shown their capability to simulate hydrological processes with a reasonable degree of certainty. For flood modelling, the quality of precipitation data — the key input parameter — is very important but often remains questionable. This paper presents a critical review of experience in the EU-funded RAPHAEL project. Different meteorological data sources were evaluated to assess their applicability for flood modelling and forecasting in the Bavarian pre-alpine catchment of the Ammer river (709 km^2), for which the hydrological aspects of runoff production are described as well as the complex nature of floods. Apart from conventional rain gauge data, forecasts from several Numerical Weather Prediction Models (NWP) as well as rain radar data are examined, scaled and applied within the framework of a GIS-structured and physically based hydrological model. Multi-scenario results are compared and analysed. The synergetic approach leads to promising results under certain meteorological conditions but emphasises various drawbacks. At present, NWPs are the only source of rainfall forecasts (up to 96 hours) with large spatial coverage and high temporal resolution. On the other hand, the coarse spatial resolution of NWP grids cannot yet address, adequately, the heterogeneous structures of orographic rainfields in complex convective situations; hence, a major downscaling problem for mountain catchment applications is introduced. As shown for two selected Ammer flood events, a high variability in prediction accuracy has still to be accepted at present. Sensitivity analysis of both meteo-data input and hydrological model performance in terms of process description are discussed and positive conclusions have been drawn for future applications of an advanced meteo-hydro model synergy.

Keywords: RAPHAEL, modelling, forecasting, model coupling, PROMET-D, TOPMODEL

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