Flood modelling in arid areas: potential and limitations

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Arid areas cover a large part of the world, but the lack of dense data networks and their hydro-meteorological characteristics prevent a good application of hydrological models. Catchment scale studies in these environments require distributed data at high resolution, which are often not available. Our study aims at understanding in what case a model can provide consistent simulations, and which processes are important to be captured for reliable hydrological simulations. A unique database composed of stream gauge measurements and about 23 years of radar rainfall estimates at 5 minutes and 1 km2 resolution is available for the Eastern Mediterranean. A hydrological model specific for arid areas, KINEROS2, is applied to six basins, with climate ranging from semi-arid to hyperarid. As observed in similar studies, the optimal parameterization is inconsistent between floods, strongly limiting the predictive capacity of the models. By analysing the consistency of model parameterization among multiple floods and basins, we identified the conditions in which hydrological models can provide consistent results. Despite high inter-basin variability, the correct assessment of rainfall volume and local rainfall intensities proves to be the most important issue. Model performance deteriorates in conditions where rainfall amount cannot be accurately estimated, such as localized rainfall or lack of active rain gauges. In the second part of the study, we focus on one basin and test different setups combining model structures and inputs. For each setup we compare specific properties of the simulated hydrograph with the ones observed in desert areas over multiple floods. Despite the uncertainties, the analysis of targeted indexes can give more precise indications on model setup compared to a general hydrograph evaluation. We show that in order to capture flood peaks, it is important to represent rainfall intensities with high spatial and temporal resolution.