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Flood risk assessment at the regional scale: Computational challenges and the monster of uncertainty

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We present a methodological framework for flood risk assessment at the regional scale, developed within the implementation of the EU Directive 2007/60 in Greece. This comprises three phases: (a) statistical analysis of extreme rainfall data, resulting to spatially-distributed parameters of intensity-duration-frequency (IDF) relationships and their confidence intervals, (b) hydrological simulations, using event-based semi-distributed rainfall-runoff approaches, and (c) hydraulic simulations, employing the propagation of flood hydrographs across the river network and the mapping of inundated areas. The flood risk assessment procedure is employed over the River Basin District of Thessaly, Greece, which requires schematization and modelling of hundreds of sub-catchments, each one examined for several risk scenarios. This is a challenging task, involving multiple computational issues to handle, such as the organization, control and processing of huge amount of hydrometeorological and geographical data, the configuration of model inputs and outputs, and the co-operation of several software tools. In this context, we have developed supporting applications allowing massive data processing and effective model coupling, thus drastically reducing the need for manual interventions and, consequently, the time of the study. Within flood risk computations we also account for three major sources of uncertainty, in an attempt to provide upper and lower confidence bounds of flood maps, i.e. (a) statistical uncertainty of IDF curves, (b) structural uncertainty of hydrological models, due to varying anteceded soil moisture conditions, and (c) parameter uncertainty of hydraulic models, with emphasis to roughness coefficients. Our investigations indicate that the combined effect of the above uncertainties (which are certainly not the unique ones) result to extremely large bounds of potential inundation, thus rising many questions about the interpretation and usefulness of current flood risk assessment practices.