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Probabilistic Flood Mapping and Visualization Issues: Application to the River Ubaye, Barcelonnette (France)

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Potential loss of life and damage to infrastructure is an ever present risk along several rivers globally. Recent floodings in Thailand (2011), Pakistan (2010) and Australia (2010) testify the level of damage experienced. Increasing population levels and migration patterns result in space shortages, and floodplain encroachment. This has increased the vulnerability and exposure of the population. The problem is compounded by the uncertainty in the derived flood risk mitigation parameters and design guidelines, due to unknown behavior of hydrological extremes (Klemes, 1989). Current flood risk management practices acknowledge the inability of hydrological extremes (and resulting floods) to be fully contained by structural flood defense measures (Loat and Petrascheck, 1997). Consequently, decision makers are faced with a challenge in the safeguarding of civil society. Flood mapping provides prior knowledge and aids land-use planning strategies.

The EU flood directive (2007) clearly outlines procedures to be followed in the mapping of floodplains, by the production of hazard maps corresponding to specified probabilities of occurrence. The main challenge is the reliability of natural randomness and epistemic uncertainty of the hydraulic flood modeling process (Refsgaard et al., 2007). Several studies over the resent past have investigated methods to estimate (and possibly reduce) the uncertainty (e.g. Montanari, 2007). However, it is acknowledged that the degree of randomness and the incomplete knowledge of natural system behavior contribute to a certitude level in the derived outputs (Di Baldassarre et al., 2010). Several authors pinpointed the need for "honest" portrayal of this uncertainty in modeling output. Nevertheless, the fear of introducing confusion has hampered this endeavour (Pappenberger and Beven, 2006).

This study focuses on a flood inundation modeling and a probabilistic mapping carried out along the R. Ubaye (Barcelonnette Basin, South French Alps) using a historical disastrous flood event (experienced in 1957; Weber, 1994) as a reference. The input hydrograph uncertainty and the parametric uncertainty were taken into account. Probabilistic maps were produced using a Monte-Carlo based approach taking into account (i) rating curve uncertainty (Di Baldassarre and Montanari, 2009) and (ii) roughness coefficient uncertainty (Pappenberger et al, 2005). The 2D raster based model, LISFLOOD-FP (Bates et al, 2010) was used to carry out the simulations.

The derived uncertainty maps show the variation of the simulated flood extent contrary to the common binary wet-dry maps. Consequently, this in turn forms a basis for further qualitative analysis to foster adoption criteria.