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Multi-scale hydrometeorological observation and modelling strategy for flash-flood understanding

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Flash floods are a major natural hazard, especially in the Mediterranean region, but their predictability remains low due to high non-linearity in the hydrological response related to
threshold effects and structured-heterogeneity at all scales. In this paper, we propose a coupled observation and modelling strategy aiming at improving the understanding of processes triggering flash floods. This strategy is illustrated for the Mediterranean area using two French catchments (Gard and Ardèche) larger than 2000 km^2. The experimental approach is based on the monitoring of nested spatial scales: 1/ the hillslope scale, where processes influencing the runoff generation and its concentration can be tackled; 2/ the small to medium catchment scale (1-100 km^2) where the impact of the network structure and of the spatial variability of rainfall, landscape and initial soil moisture can be quantified; 3/ the larger scale (100-1000 km^2) where the river routing and flooding processes become important. These observations are part of the HyMeX (Hydrological Cycle in the Mediterranean Experiment) Enhanced Observation Period (EOP) and lasts four years (2012-2015). In terms of hydrological modelling the objective is to set up models at the regional scale, while addressing small and generally ungauged catchments, which is the scale of interest for flooding risk assessment. Top-down and bottom-up approaches are combined and the models are used as "hypothesis testing" tools by coupling model development with data analyses, in order to incrementally evaluate the validity of model hypotheses. The paper focuses on the presentation of the experimental strategy and the instrumentation, with first results obtained during the first years of the experiment. The perspectives in terms of modelling are also presented.