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Ensemble generation strategies for the short-range forecast of flash floods: the 12-13 September 2019 event in Eastern Spain

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The Mediterranean region is frequently affected by heavy precipitation and flash flooding during the extended warm season. A precise meteorological forecast of socially relevant aspects of these phenomena such as location, timing and intensity is crucial to prevent personal and material losses. However, forecasting these aspects becomes extremely challenging due to small-scale processes involved in the triggering, development and subsequent evolution of convective systems.

On 12 and 13 September 2019 widespread flash flooding caused devastating effects across Murcia and Valencia, eastern Spain. Seven fatalities were reported, hundreds of homes were flooded and economic losses were estimated at 200 M€. The performance of various ensemble generation strategies for short-range convection-permitting ensemble prediction systems (EPS) are evaluated for this episode. Different sources of error are coped by the implemented ensemble generation approaches. Uncertainty in the initial and lateral boundary conditions uncertainty is sampled in two ways: (i) the dynamical downscaling of the ECMWF global EPS and, (ii) a new tailored breeding technique that accounts for perturbations across the multiple scales of interest for short-range forecasting. Additionally, errors in mesoscale model formulation are encompassed by combining different parameterization schemes and stochastic physics.

This study contributes to the identification of the most relevant sources of uncertainty hampering an accurate spatial and temporal forecasting of heavy precipitation resulting in flash flooding over the Spanish Mediterranean region. These cutting-edge EPS can contribute to implement more reliable and effective hydrometeorological prediction chains with lead times up to 24 h, providing a valuable support to civil protection and emergency management authorities.