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WRF model performance under flash-flood associated rainfall

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Understanding the natural processes that precede the occurrence of flash floods is crucial to improve the future flood projections in a changing climate. Using numerical weather prediction tools allows to determine one of the triggering conditions for these particularly dangerous events, difficult to forecast due to their short lead-time. However, simulating the spatial and temporal evolution of the rainfall that leads to a rapid rise in river levels requires determining the best model configuration without compromising the computational efficiency.

The current research involves the results of the first part of a cascade modeling approach, where the Weather Research and Forecasting (WRF) model is used to simulate the heavy rainfall in the east of the UK in June 2012 when stationary thunderstorms caused 2-hour accumulated values to match those expected in the whole month of June over the city of Newcastle. The optimum model set-up was obtained after extensive testing regarding physics parameterizations, spin-up times, datasets used as initial conditions and model resolution and nesting, hence determining its sensitivity to reproduce localised events of short duration. The outputs were qualitatively and quantitatively assessed using information from the national weather radar network as well as interpolated rainfall values from gauges, respectively. Statistical and skill score values show that the model is able to produce reliable accumulated precipitation values while explicitly solving the atmospheric equations in high resolution domains as long as several hydrometeors are considered with a spin-up time that allows the model to assimilate the initial conditions without going too far back in time from the event of interest.

The results from the WRF model will serve as input to run a semi-distributed hydrological model to determine the rainfall-runoff relationship within an uncertainty assessment framework that will allow evaluating the implications of assumptions at the top of the modeling process in the final outputs of the cascade.