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Ensemble simulations with perturbed physical parametrisations: Pre-HyMeX case studies

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During the last 15 or 20 years, ensemble prediction systems have made substantial progress and have become an indispensable tool in forecasting the probability of certain weather events. Recent improvements in computer-modelling have also allowed convection and other physically complex processes to be well represented within atmospheric models. This however has also led to more questions, such as the representation of uncertainties in the initial field, the definition of boundary conditions, along with other areas of incertitude in the model. The relative importance of each field remains to be investigated more vigorously in order to allow for further improvements in forecasting, especially for heavy rainfall episodes, which can have large social and economic consequences.

This study focuses on model uncertainties related to cloud physics and turbulence parametrisations, which have been so far less studied than other areas such as boundary or initial state uncertainties. The sensitivity of the precipitation forecasts to the details of the parametrisation are assessed by (a) varying the tunable parameters of micro-physical and turbulence schemes of the model within their range of allowed values and (b) by introducing random perturbations on the factors which govern hydro-meteor and/or turbulent kinetic energy evolution. An ensemble of simulations was performed in order to find the optimum setting of the model in relation to the forecasting of precipitation events. Two different sets of initial and boundary conditions were used during the ensembles, one from the French forecasting model AROME and the other from the ECMWF analyses. This methodology was applied in particular to the cases of the 1st to the 5th of November 2011 and the 6th - 7th of September 2010 which prefigure the heavy precipitation events expected to occur during the HyMeX field campaign of Autumn 2012. The simulations were performed with the French research model MESO-NH.

The results show that the second set of perturbations (b) induce a wider spread of results, and that higher skilled forecasts show a lower sensitivity to the micro-physical scheme than less skilled forecasts. It is also found that the spread in the sensitivity is related to the boundary conditions that are chosen. The resulting spread of effects on forecasting skill illustrates that physical parametrisations should be taken into account when using convective scale ensemble prediction systems to forecast certain weather events.