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Mixing length controls on high resolution simulations of convective storms

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Convective storms are a crucially important forecasting problem in the UK, not least because of the flooding they can cause. In the last few years many operational weather centres have begun to run at “convection permitting” resolutions, with the UK Met Office currently running a 1.5 km forecast model. While there is evidence that precipitation forecasts at this resolution are more accurate than lower resolution forecasts, it is clear that there are still significant shortcomings in the nature of the simulated convective cells at this resolution. Cells in the model tend to be too large and too intense, and tend not to organise into mesoscale complexes as observed, illustrating our lack of understanding of the nature of small-scale mixing and microphysical processes.

The DYMECS (Dynamical and Microphysical Evolution of Convective Storms) project has obtained a large database of convective storm lifecycles by tracking storms with the Chilbolton Advanced Meteorological Radar. Individual storms were tracked on 40 days using a combination of scanning techniques to extract the dynamical and microphysical properties of the storm (such as storm size, vertical velocity, maximum surface rain-rate and hail intensity). In this study we perform simulations of some of the DYMECS cases with the Met Office Unified Model (UM) at horizontal grid lengths ranging from 1.5 km to 200 m, which allows us to apply a statistical approach to evaluate the properties and evolution of the simulated storms over a range of conditions. Here we present results comparing the storm morphology in the model and reality which show that the simulated storms become smaller as resolution increases and that the resolution that fits the observations best changes with the size of the observed cells. We investigate the sensitivity of storm morphology in the model to the mixing length used in the subgrid Smagorinsky mixing scheme. As the subgrid mixing length is decreased, the number of small storms with high area-averaged rain rates increases.