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The DYMECS project: The Dynamical and Microphysical Evolution of Convective Storms

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A new frontier in weather forecasting is emerging by operational forecast models now being run at convection-permitting resolutions at many national weather services. However, this is not a panacea; significant systematic errors remain in the character of convective clouds and rainfall distributions. The DYMECS project (Dynamical and Microphysical Evolution of Convective Storms) is taking a fundamentally new approach to evaluate and improve such models: rather than relying on a limited number of cases, which may not be representative, we have gathered a large database of 3D storm structures on 40 convective days using an automated storm-tracking and scan-scheduling algorithm for the high resolution Chilbolton radar in southern England. These structures have been related to storm life-cycles derived by tracking features in the rainfall from the UK radar network, and compared statistically to simulated reflectivity fields from multiple versions of the Met Office model, varying horizontal grid length between 1.5 km and 100 m, and changing the sub-grid mixing and microphysics schemes. We also evaluated the scale and intensity of convective updrafts using a new radar technique. We find that the horizontal size of simulated convective clouds and the updrafts within them decreases with decreasing grid lengths down to 200 m, below which no further decrease is found. Comparison with observations reveals that at these resolutions, updrafts are about the right size (around 2 km across), but the clouds are typically too narrow and rain too intense (in both cases by around a factor of two), while progressing through their lifecycle too slowly. The scale error may be remedied by artificially increasing mixing length, but the microphysics scheme has little effect on either scale or intensity.