Thorwald Stein (Reading University)

Title: The 3D morphology of convective storms: A priority target for next-generation model evaluation

Abstract:

Weather radar data are widely used for quantitative precipitation estimation and for nowcasting hazardous weather, including in Australia. Here, we explore their potential use for model evaluation of the 3D representation of convective storms. This has been made possible by development of forward operators, which estimate radar measurements from model cloud variables. When scanning at multiple elevations, weather radar data can provide substantial information of convective cloud vertical extent and development. We compare the average 3D storm morphology as estimated using a research-grade radar in southern England against that derived from the UK Met Office radar composite and find that the latter is appropriate for evaluating km-scale and higher-resolution simulations with the Met Office Unified Model (MetUM). We exploit this potential by evaluating convective cloud development simulated using the MetUM for South Africa and in India, evaluated against their respective weather radar networks. Across all regions, we find that the MetUM produces too intense rainfall from relatively shallow storms, but other biases such as in the timing of convective initiation vary between regions and across seasons. This work demonstrates how model biases may vary with the large-scale environment and that a collaborative approach is essential to model evaluation and development. Looking ahead, the continuing advance of computing power enables global weather and climate simulations at km-scale grid (convection-permitting) grid lengths, with models requiring a single (possibly scale-aware) configuration to reliably simulate convection across a range of environments. Ongoing investment in weather radar networks across the world, and the routine availability of weather radar data, makes the 3D morphology of convective storms a feasible priority target for next-generation model evaluation.