Geophysical Research Abstracts
Vol. 18, EGU2016-8757, 2016
EGU General Assembly 2016

Quantifying the effects of resolution on convective organisation in cloud-system resolving simulations of West Africa.

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Convection transports moisture, momentum, heat and aerosols through the troposphere, and so the variability of convection is a major driver of global weather and climate. Convection in the tropics is organised across a wide range of spatiotemporal scales, from the few kilometres and hours associated with individual cloud systems, through the mesoscale of squall lines and cloud clusters, to the synoptic scale of tropical cyclones. Global and limited area models often fail to represent many of these scales of organisation, and the interaction between the scales remains poorly understood.

In this work we devise a new metric to quantify the degree of convective organisation. We apply this metric to data from simulations of the West African Monsoon region from the CASCADE project, where simulations were performed using the Met Office Unified Model at 12 km horizontal grid length with parameterised convection, and at 12, 4 and 1.5 km horizontal grid lengths with permitted convection. This allows us to perform quantitative analysis of convective organisation across model configurations that experience the same large-scale state and differ only in horizontal grid length and representation of deep convection.

We show that our analysis technique can be usefully applied to high-resolution, cloud-system resolving, large-domain simulations of tropical convection. We use our technique to quantify the effects of horizontal grid length and of convective parameterisation on the degree of organisation in the simulated convection, and investigate the spatiotemporal variability of the convective organisation in the different model configurations. We then determine relationships between the degree of convective organisation and precipitation. Further, we compare our results against equivalent parameters derived from satellite data to identify how well each of the model configurations performs against observations. Through the use of this new metric, this work provides a quantitative comparison of convective organisation in otherwise-equivalent model configurations. The metric may have potential for future parameterisations of convective organisation.