Improved dynamics of deep–convective storms influences forcing of tropical circulation

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Mesoscale Convective Systems (MCSs) dominate tropical rainfall and, due to interactions with radiation and strong diabatic heating from stratiform rainfall, play significant roles in global circulations. Major international groups have recently called for an unprecedented coordination of global convection–permitting (CP) modelling to remove long–standing model biases and improve our understanding of the full climate system. It is essential that such models accurately represent MCSs, and in particular storm interactions with their environment. Here we investigate West African MCSs in CP configurations of the MetUM. We show that improvements in model physics have enabled the resolution of an anticipated sensitivity of entrainment rates in MCS core updrafts to environmental wind shear, and that this leads to realistic storm rainfall responses. We show that the control of environmental shear extends to mean storm rainfall and anvil heights, influencing the upscale impacts of MCSs. Results from a sensitivity experiment with a modified microphysics scheme further indicate that although cold pools affect MCS organisation, they play little role in determining the response of entrainment dilution and rainfall rates to storm environments. Our results support recent findings from idealised modelling studies investigating dynamical influences on MCSs, and moreover demonstrate key tests for focused process–based assessment of the fidelity of global CP models.