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Impacts of the new UM convection scheme (CoMorph) over the Indo-Pacific and Australian regions

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Abstract:

There are major long-standing model biases in the tropical Indian and Pacific Oceans in both the ACCESS coupled and atmosphere models that act to limit our prediction skill over Australia on a range of timescales.

Simulations with a climate version of the UK Met Office (UKMO) unified model (UM) indicate large negative precipitation biases over the Maritime Continent (MC) region (Neale and Slingo, 2003). Errors persist even in higher-resolution simulations of the same model, indicating deficiencies in the representation of the physical system. It is further argued that deficient rainfall over the MC could be a driver for other systematic errors, such as the excess precipitation over the western Indian Ocean (IO), the easterly wind bias over the eastern IO and the hyperactive Indian Ocean Dipole. The MC dry bias has been persistent in recent global atmosphere (GA) versions of the UM, including the latest versions GA7 and GA8 (Walters et al., 2017, Willett et al., 2020). Biases in rainfall over the MC region have also been reported to adversely affect simulation of the eastward propagation of the Madden–Julian Oscillation (MJO) across the region (e.g. Neale and Slingo, 2003).

The existing convection scheme lacks much of the structural flexibility needed to address systematic biases generated by the convection scheme and, given the growth in capability of regional modelling at kilometre scales, a scheme that can be scale-adaptive is required. To address this, a new mass flux convection scheme has recently been developed at the UKMO called CoMorph (Convection Morph). This scheme has removed ad-hoc structure assumptions which have hampered progress in the past and allows representation of new physical processes which were previously neglected. Initial results from the UKMO suggest that the CoMorph scheme has a positive impact in the Australian and Indo-Pacific regions.

In this work, we have evaluated the performance of CoMorph in the latest global model (GA8 and GC4). We found that compared to the standard configuration, there are significant improvements in rainfall bias, diurnal cycle of MC rainfall, tropical cyclone forecasts and the MJO when CoMorph is included.

References:

Neale RB, Slingo JM. 2003. The maritime continent and its role in the global climate: A GCM study. J. Climate 16: 834–848.

Walters D, and co-authors, 2017: The Met Office Unified Model Global Atmosphere 6.0/6.1 and JULES Global Land 6.0/6.1 configurations, Geosci. Model Dev. 10: 1487–1520, https://doi.org/10.5194/gmd-10-1487-2017.

Willett M. R., T. Graham, M. Brooks and D. Copsey, 2020: GC4 and GA8GL9 Acceptance Report, Met Office Technical report.