1. Evaluation of MJO in UM

We use UK Met office Unified Model (UM) version 7.1 with pre-Hadgem3 configuration, in which convection scheme is based on mass flux scheme with CAPE closure. The cross power spectrum of precipitation and U850 wind (Fig. 1) indicates that UM7.1 has no strong evidence of an intra seasonal spectral peak at MJO wave number and frequency.

Further investigation of the spatial distribution of rainfall variance (Fig. 2) reveals some additional deficiencies that may contribute to the lack of a MJO in the UM7.1 simulation: the peak rainfall variance in UM7.1 is about 30 degree west compared to observations in the tropical Indian Ocean, which is thought to be the incipient region for the MJO.

Fig. 3: Cross power spectrum of precipitation and U850 for Sens. Expt. 1 (a) and and Expt. 2 comparing to control experiment.

Fig. 4 shows that there is more variability of precipitation in the central Indian Ocean for both Expt. 1 and Expt. 2.

Fig. 4: Averaged precipitation variance for Expt. 1 (upper panel) and Expt. 2 (lower panel).

Fig. 5: Daily mean moisture anomaly composited by the occurrence of daily mean precipitation rate anomaly greater than 9.6 mm / day for (a) Observation, CAM and SP-CAM; (b) UM Expts. In Fig. 7a, the latent heat flux for the higher saturation fraction (> 0.85 for Expt. 1 and > 0.9 for Expt. 2) are increased in the sensitivity experiments comparing to the control experiment. Latent heat fluxes in three experiments all have a decreasing tendency at higher saturation fraction.

In Fig. 7 (b) in the Sens. Expt. 1 and 2, the latent heat fluxes increase gradually before -10 day, and quickly reduced to zero after 7 day. In the control Expt., there is less increase prior and a second peak of latent heat flux anomaly at +20 day.

Discussion: Shallow convection helps to build up a pre-condition for deep convection and also helps to stabilize atmosphere after the intense rainfall events. Without Momentum transport, the rainfall events for the moderate saturation fraction reduces. Both sensitivity experiments increases precipitation at the higher saturation fraction and increases the rainfall variability at the central Indian Ocean.