

# Impacts of systematic model biases on intraseasonal variability of the Asian summer monsoon and the intraseasonal-interannual relationship

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**Background and method:** Intraseasonal monsoon variation is of utmost importance to the agrarian societies of Southeast Asia, especially if associated active-break cycles are extreme in their intensity or duration.

- This study presents initial findings into the role of systematic model biases in intraseasonal monsoon variation and its connection with interannual variability.
- Systematic biases are reduced using a seasonal cycle of heat-flux adjustments applied to the equatorial Indo-Pacific ocean surface (Inness *et al.* 2003; Turner *et al.* 2005).
- Two 100-year integrations of the UK Met Office Unified Model HadCM3 are compared under control climate conditions. One of the integrations uses the model in its standard configuration; the other (HadCM3FA) has the flux adjustments applied.
- Comparisons are made of spatio-temporal behaviour in intraseasonal bands and EOF principle components stratified by interannual ENSO forcing.

**Temporal characteristics:** The temporal behaviour of the filtered anomalies is assessed by regressing zonally or meridionally averaged U850 anomalies against a reference timeseries, after Goswami & Xavier (2005).

- The 10-20 day band often associated with westward propagating modes at Indian latitudes is reasonably simulated in both versions of the model (Fig. 2, top).
- The 30-60 day mode associated with northward propagation and the active-break cycle is poorly represented (Fig. 2, bottom).

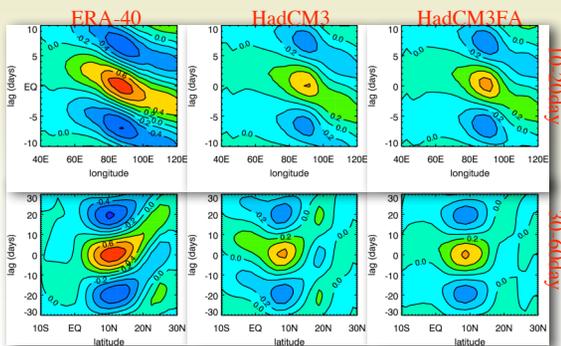


Fig. 2: Lag regression of U850 anomalies against reference (U850 over 85-90°E, 5-10°N). 10-20 day band over 5-15°N; 30-60 day band over 70-90°E. After Goswami & Xavier (2005)

**Spatial characteristics:** Daily zonal wind anomalies to the climatological annual cycle at 850hPa are Lanczos bandpass-filtered into 10-20 and 30-60 day bands, representing peak spectral power at intraseasonal timescales in observations.

- In HadCM3FA, where systematic biases have been removed, the variance explained by the 30-60 day band (more often associated with the active-break phenomena) more faithfully matches ERA-40 reanalysis (Uppala *et al.* 2005).
- There is little change to the spatial pattern of the 10-20 day band, however.

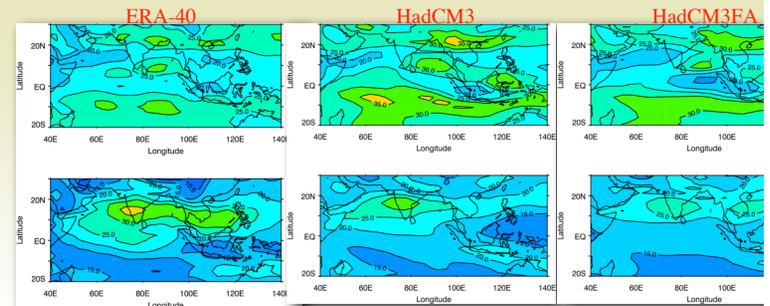


Fig. 1: Percentage variance explained in 10-20 day and 30-60 day bands of daily U850

**EOF analysis and interannual forcing:** EOF analysis is performed on unfiltered daily anomalies in each model version (Fig. 3).

- The most common mode of variation, similar in both model versions, is systematically perturbed by remote ENSO forcing (JJAS Niño-3 index exceeding 1σ from the mean).
- The influence of ENSO is more remarkable where systematic biases are removed (HadCM3FA).

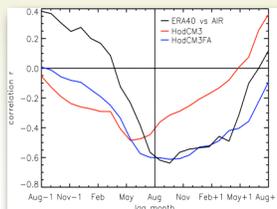


Fig. 4: Niño-3 SST vs. JJAS Indian rainfall lag correlation.

The strengthened relationship between intraseasonal monsoon behaviour and remote forcing may be related to the stronger monsoon-ENSO teleconnection in HadCM3FA (Fig. 4, from Turner *et al.* 2005).

- However, EOF-1 is similar at intraseasonal and interannual timescales, suggesting a residual of the forcing in the daily anomaly timeseries.

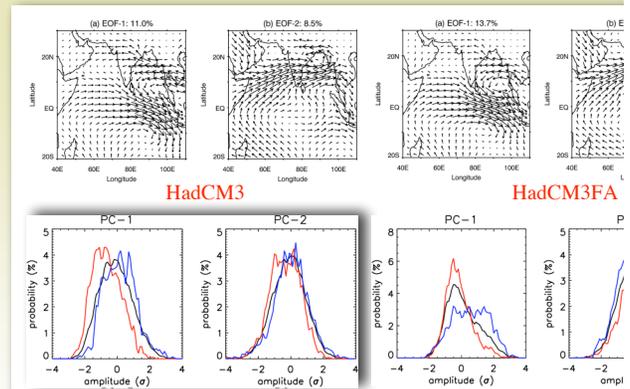


Fig. 3: Intraseasonal EOFs of 850hPa wind (top) and pdfs of t timeseries (bottom) stratified by El Niño (red) or La Niña (blue).

**Implication:** The stronger teleconnection present when systematic model biases are removed may also strengthen the relationship between interannual and intraseasonal behaviour of the monsoon, at the expense of internal variability.

**Future plans:** Daily anomalies will be re-calculated by also removing the seasonal mean anomalous component (Krishnamurthy & Slingo 2005) to determine if the residual large scale forcing is still present.

**References:** Goswami & Xavier (2005) *J. Geophys. Res.* **110**; Inness *et al.* (2003) *J. Clim.* **16**: 365-382; Krishnamurthy & Shukla (2000) *J. Clim.* **13**: 4366-4377; Turner *et al.* (2005) *Q. J. R. Meteorol. Soc.* **131**: 781-804; Uppala *et al.* (2005) *Q. J. R. Meteorol. Soc.* **131**: 2961-3012.