The Maritime Continent Prediction Barrier: Traversing *vs.* Collapsing observed MJO events

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Abstract

In previous work we have shown that the most important factor hampering forecast skill for predictions of the MJO with the CFS is the Maritime Continent Prediction Barrier. In this model, eastward propagating organized convective activity associated with the MJO loses its coherence and finally collapses as it enters the Maritime Continent. This behavior was subsequently found in most of the operational forecast models.

Observations show that, at times, the Maritime Continent can also act as a barrier to the MJO. Understanding the reasons for the intermittent action of the Maritime Continent as a barrier would allow to incorporate the related physical parameterizations into forecast models. This would increase the forecast skill for the MJO. The first step towards this understanding is to classify observed MJO events that traversed the Maritime Continent or collapsed over it.

In this paper we consider upper level (200hPa) zonal flow from the Reanalysis-2 data set and daily OLR observations. We classify observed MJO events as traversing or collapsing and describe some fundamental differences between them.

A simplified MJO metric

1. We consider daily mean zonal wind at 200hPa averaged between 20S-20N.
2. We remove the mean annual cycle and zonal mean.
3. We filter the signal using a 120 days running mean, compute the EOFs and subtract the three first components from the daily values i.e., extracting the ENSO signal.
4. The two first EOFs of the filtered signal correspond to the MJO. Projection of these EOFs to observed data provide a two-dimensional phase space plot on the status of the MJO. Sum of the squares of these two first projections indicates the 'energy' of the MJO mode.
5. During the 2002 – 2006 period (a period with no significant ENSO) this simplified MJO index is very similar to the Wheeler Hendon RMM index.

MJO events in the 1981 – 2007 period

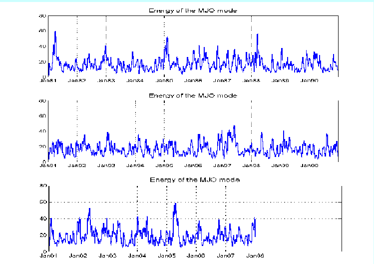

Figure 1 The sum of the squares of the two first principle components.

Representation of a strong MJO event: March 1981

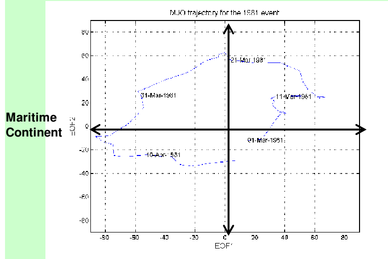

Figure 2 The March 1981 strong MJO event in EOF space. The Maritime Continent is found at around (-1,0)

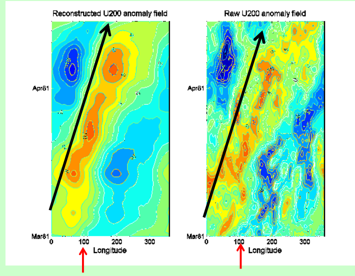

Figure 3 The March-April 1981 strong MJO in geometrical space (a) as reconstructed by projecting to the two first EOFs and (b) raw anomalies

Classification of observed MJO events in Traversing and Collapsing

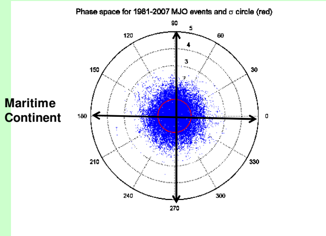

Figure 4 The 1981 – 2007 period as seen by the simplified standardized MJO index. The red circle indicates one standard deviation.

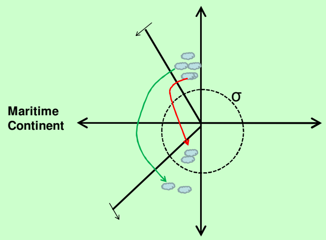

Figure 5 Classification algorithm. We consider all events with an amplitude exceeding one standard deviation occurring in the Indian Ocean. Events that are crossing the Maritime Continent maintaining an amplitude higher than one standard deviation are characterized as Traversing. Collapsing are events of which amplitude drops bellow one standard deviation.

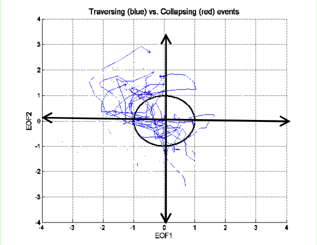

Figure 6 Summary of Traversing (blue trajectories) vs. Collapsing (red trajectories) for the 1981-2007 period

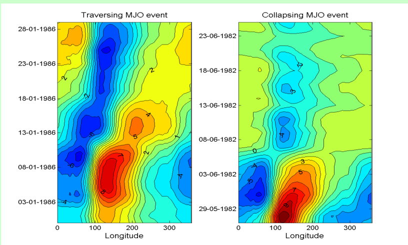

Figure 7 Reconstruction of the MJO mode by projection on the two first EOFs. Examples of Traversing (left panel) vs. Collapsing (right panel) MJO events

Singular Value Decomposition of Traversing versus Collapsing MJO events

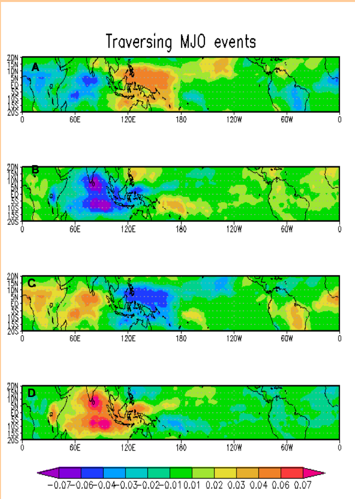

Figure 8 SVD analysis between Traversing MJO events as seen from the U200 zonal index and OLR anomalies.

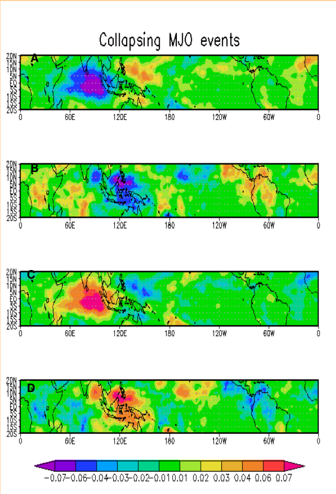

Figure 9 As in Figure 8 for Collapsing events.

Conclusions

• Forecasts of the MJO with coupled models are hampered by the Maritime Continent Prediction Barrier. In the model world organized convection associated with the MJO collapses as it crosses the Maritime Continent.

• However, we show that observed MJO can also collapse over the Maritime Continent.

• Traversing and Collapsing MJO events show a different structure in organized convection in the Indian Ocean. It is therefore possible to predict which MJO event will eventually Traverse or Collapse on the Maritime Continent as soon as it develops in the Indian Ocean. This means that there is no physical reason behind the Maritime Continent Prediction Barrier. Therefore, we should expect significant improvement in MJO forecast skill as numerical models improve.