The Maritime Continent as a Prediction Barrier for the MJO

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Points to take back home….

- Forecast of the MJO is at, average, skillful for lead times of up to circa 2 weeks.
- However, forecast skill strongly depends on the phase of the MJO.
- When the actively convective phase of the MJO is in the Indian Ocean, the forecast skill becomes a function of target time rather than lead time. The forecast skill drops sharply as the enhanced convection approaches the Maritime Continent.
- This appears to be a model independent result.
- Understanding the physics behind this Barrier will allow for a significant improvement of MJO prediction.

Points to take back home….

- There is empirical evidence that the ocean is an important player for the evolution of the MJO.
- Currently, ocean models are not assimilating and simulating realistically intraseasonal modes.
- Improving the ocean models in this respect would allow for better MJO forecasts

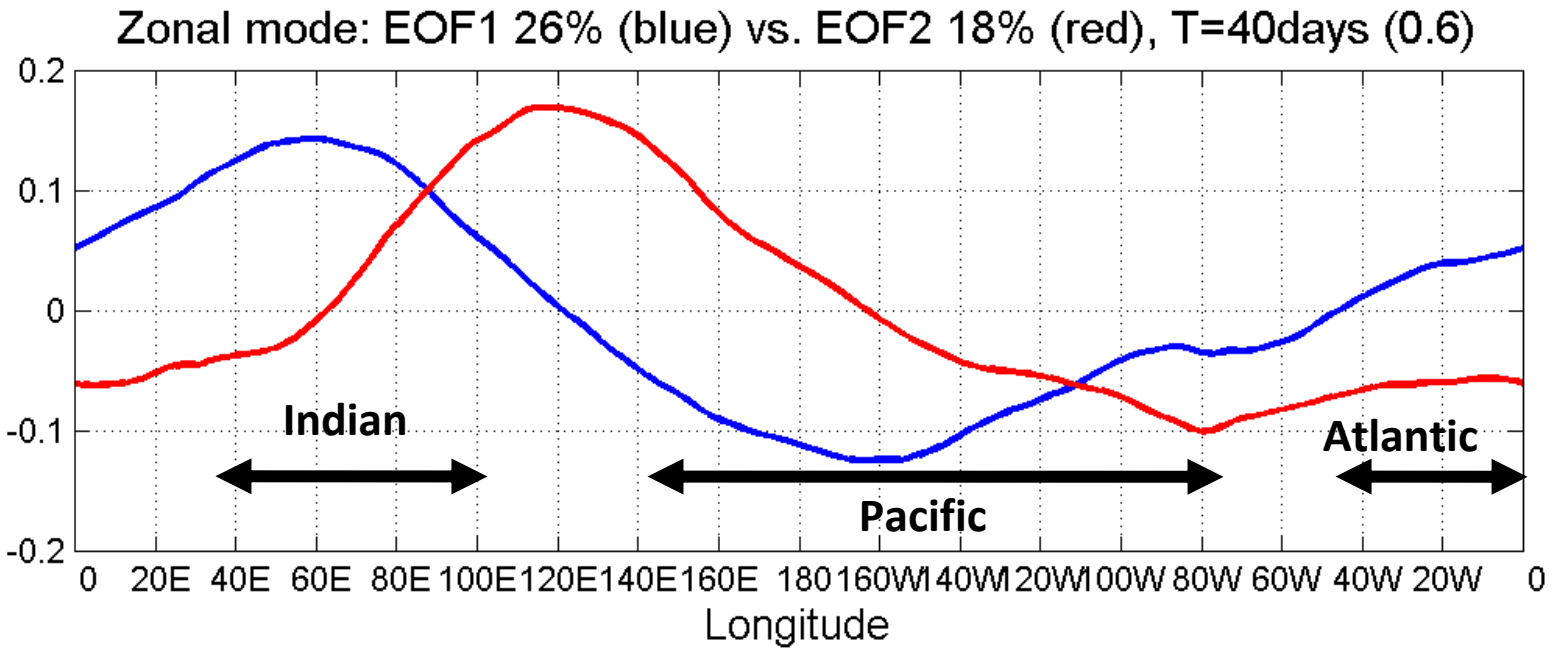
Forecasting the MJO with the CFS:

Defining a metric for the MJO

We use a simplified version of the Wheeler and Hendon Index:

- Verifying fields are from Reanalysis-2
- Use the zonal wind at 200 hPa from 2002 to 2006 averaged between 20°S-20°N
- Compute and remove the mean annual cycle and the zonal mean
- Perform and EOF analysis of the resulting field (no time filtering)

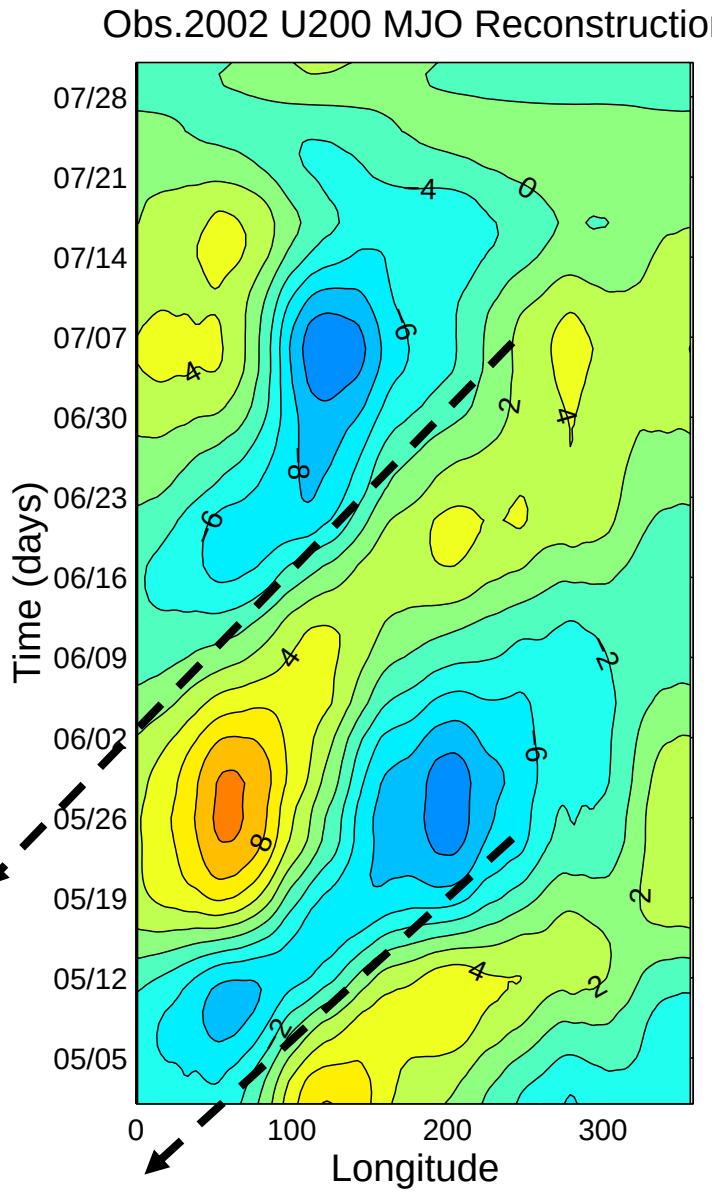
First and second EOFs of the zonal wind at 200 hPa averaged between 20°S – 20°N



EOF1 $\xrightarrow[r=0.6]{\text{10 days}}$ EOF2 $\longrightarrow$ -EOF1 $\longrightarrow$ -EOF2

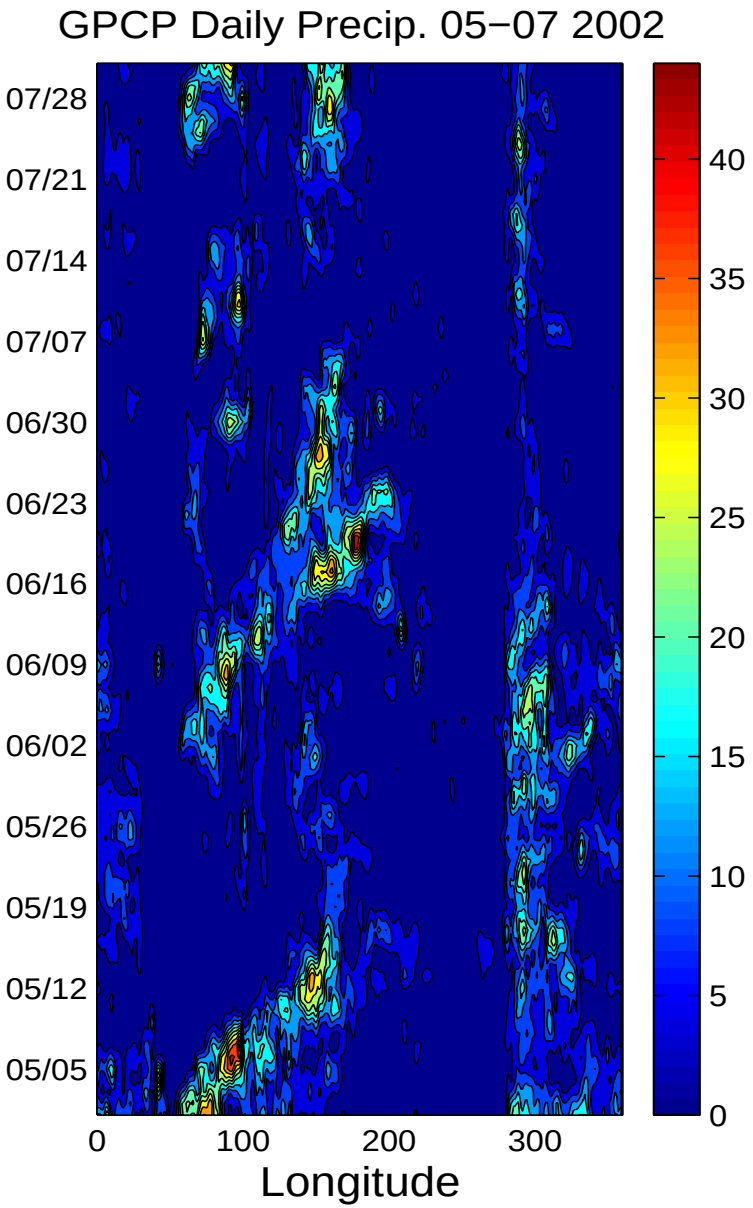
A full oscillation in 40 days

Reconstructed U200 vs. GPCP Precipitation, May – July, 2002



Upper level divergence

20S-20N averaged, filtered U200 anomaly field



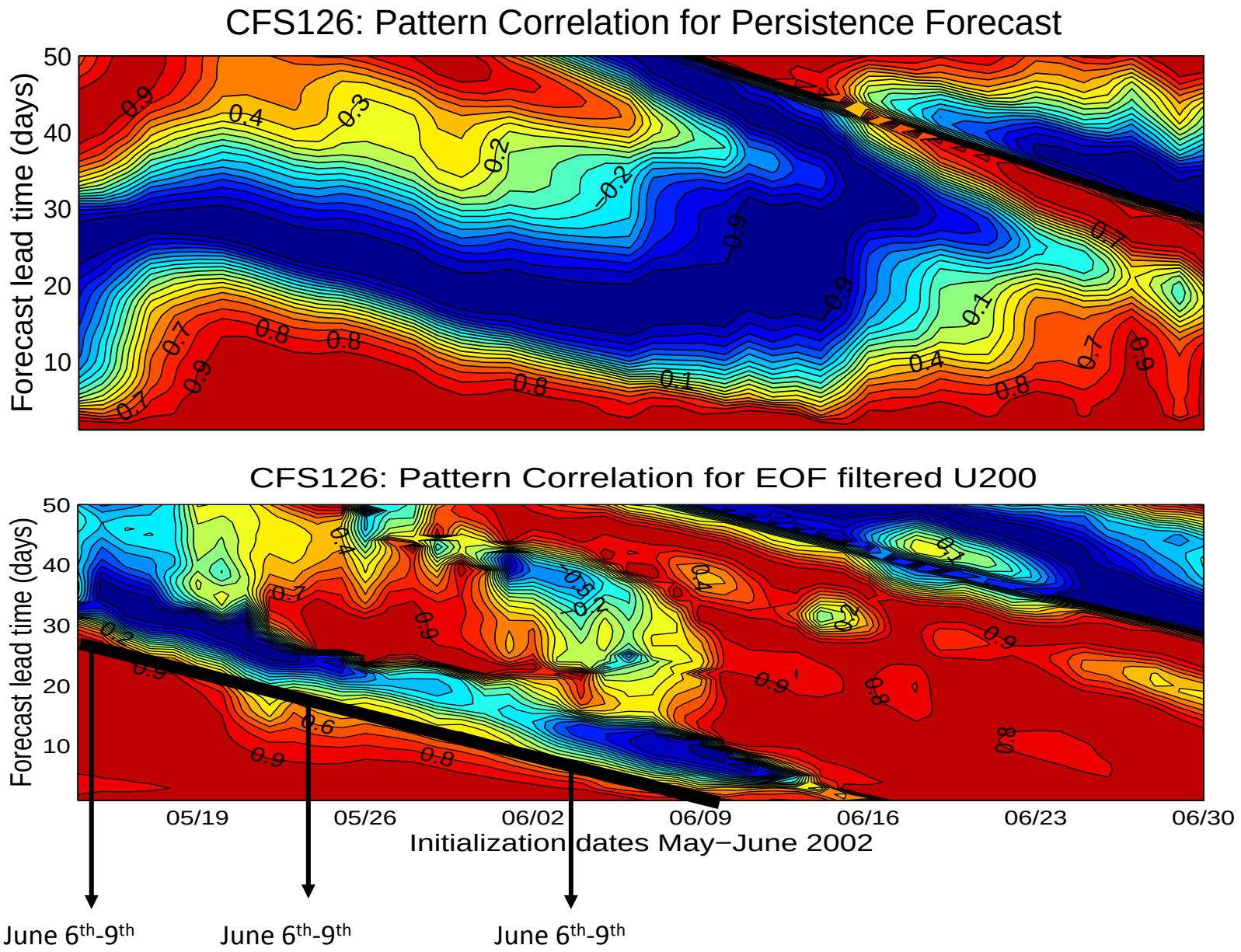
5S-5N averaged, total unfiltered precipitation field

Forecasting the MJO with the CFS:

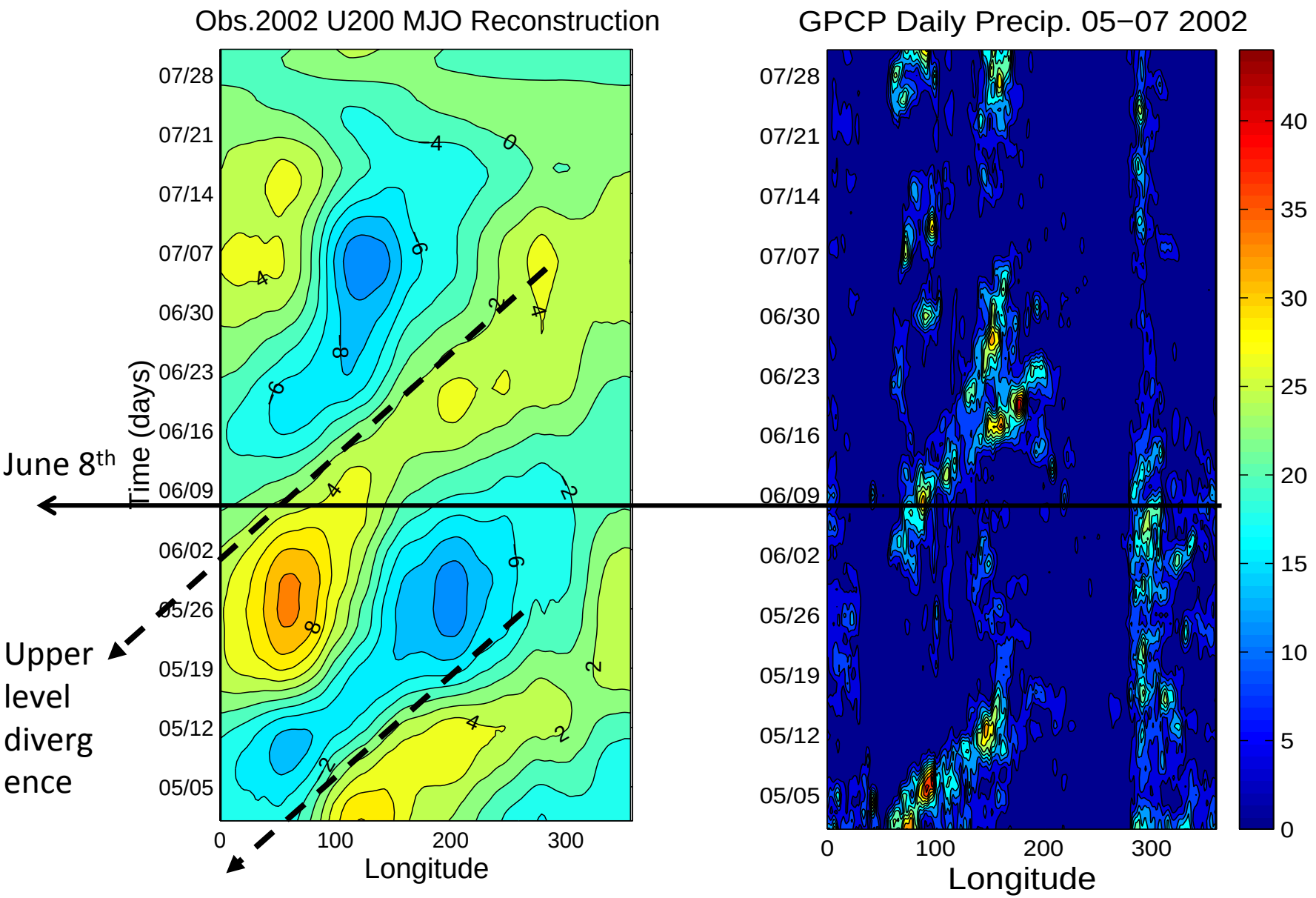
The Maritime Continent Prediction Barrier

Pattern Correlation as a function of initialization day and lead time for some initial experiments with the CFS

Forecast Skill as a function of initialization day and lead time for: May – June 2002



Reconstructed U200 vs. GPCP Precipitation, May – July, 2002



20S-20N averaged, filtered U200 anomaly field

5S-5N averaged, total unfiltered precipitation field

CFS forecasts: Horizontal resolution and atmospheric I.C.:

Experiments conducted under NOAA's Climate Test Bed

Reforecasts:

May 23rd to August 11th from 2002 to 2006, 1 forecast every 5 days

Forecast lead: 60 days

Model resolution:

Atmosphere: T62 = 200Km x 200Km

T126 = 100Km x 100Km

T254 = 50Km x 50Km

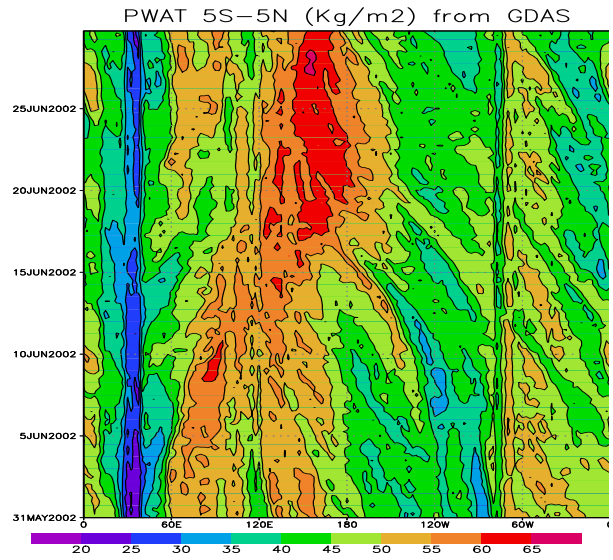
Ocean: the standard CFS resolution

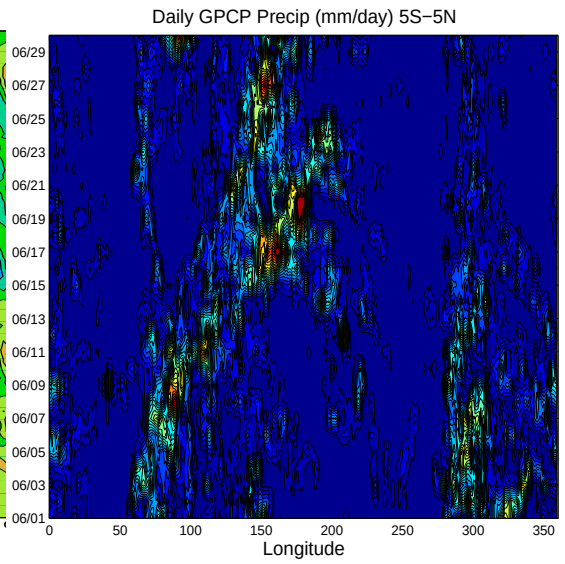
Initial conditions:

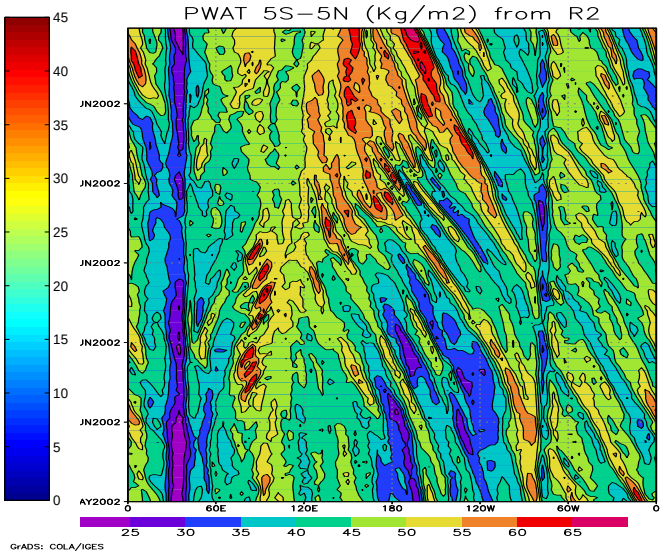
Atmosphere, Land: from **Reanalysis 2 (CDAS2)** and from **GDAS**

Ocean: from GODAS

Operational GDAS versus Reanalysis-2 initial conditions: June 2002





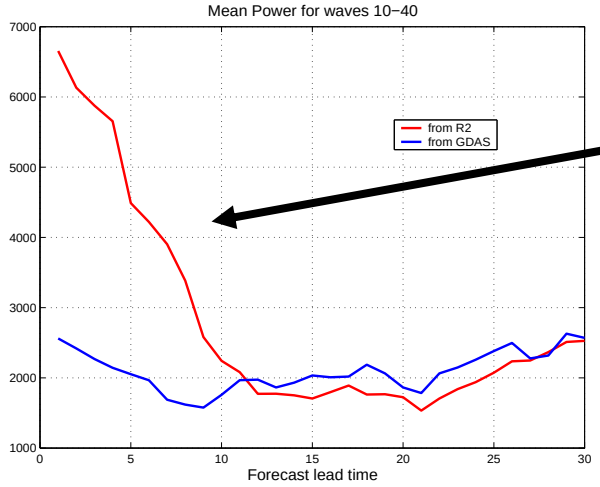


GDAS Precipitable Water

GPCP Precipitation

Reanalysis 2 Precipitable Water

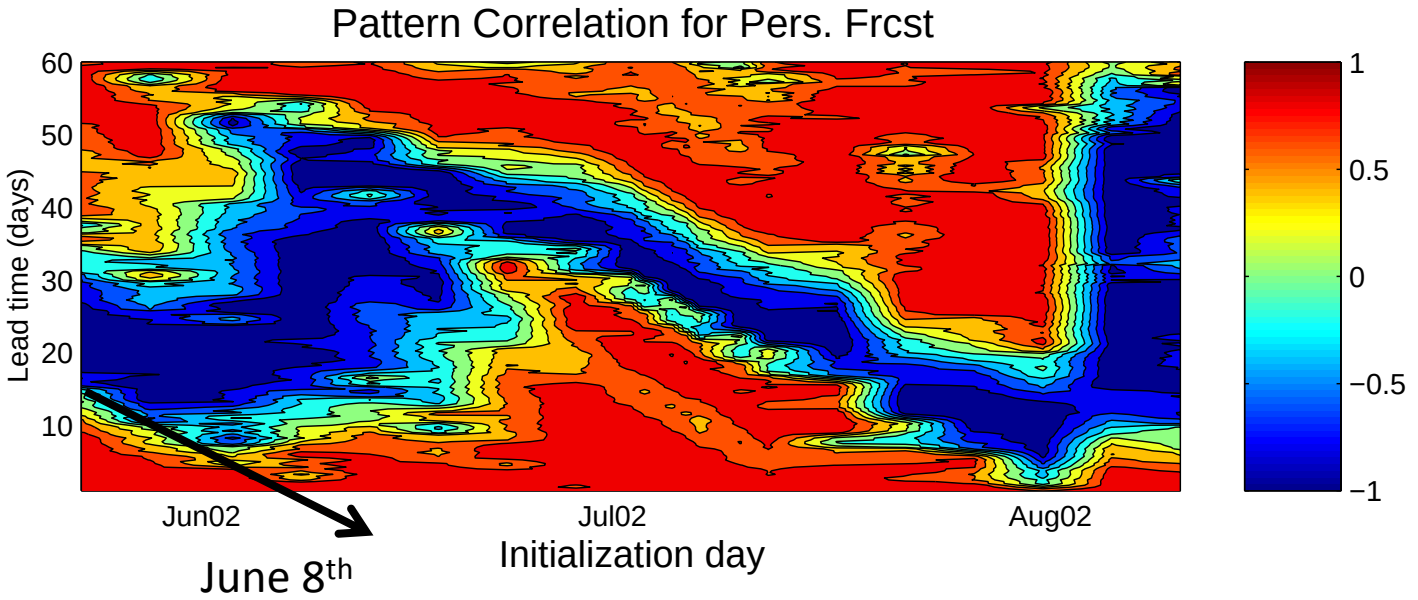
Time evolution of mean energy at wave numbers 10-40 when CFS is initialized by R-2 (red) or by GDAS (blue).



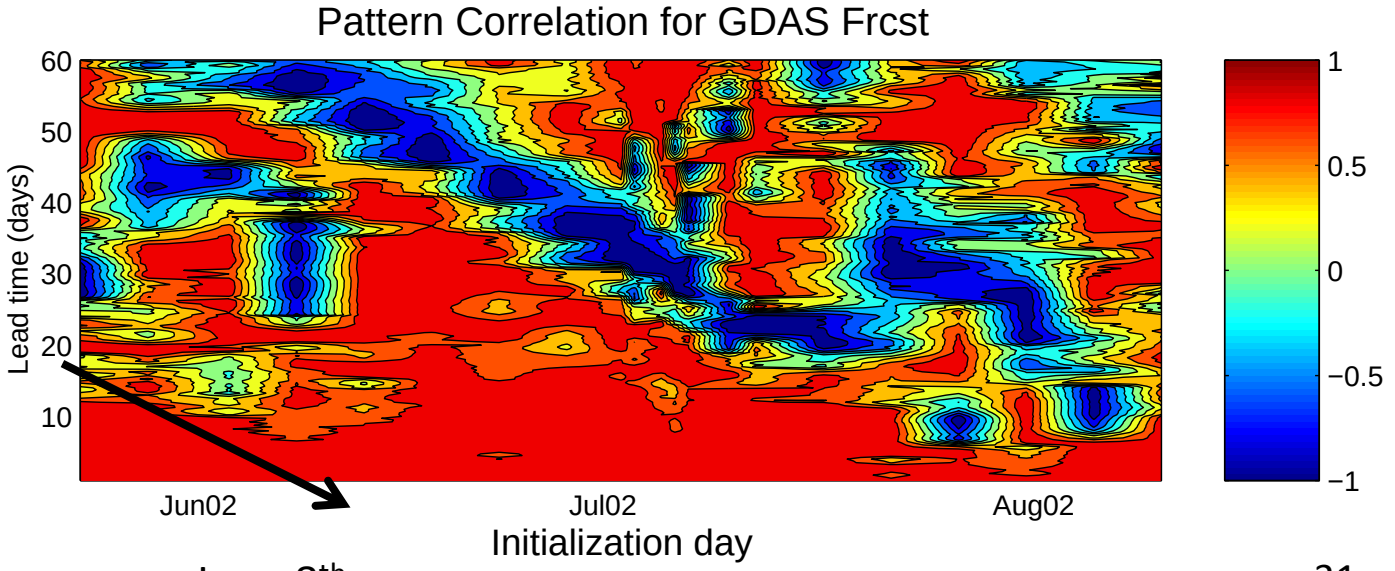
drift

Pattern correlation as a function of initialization day and lead time

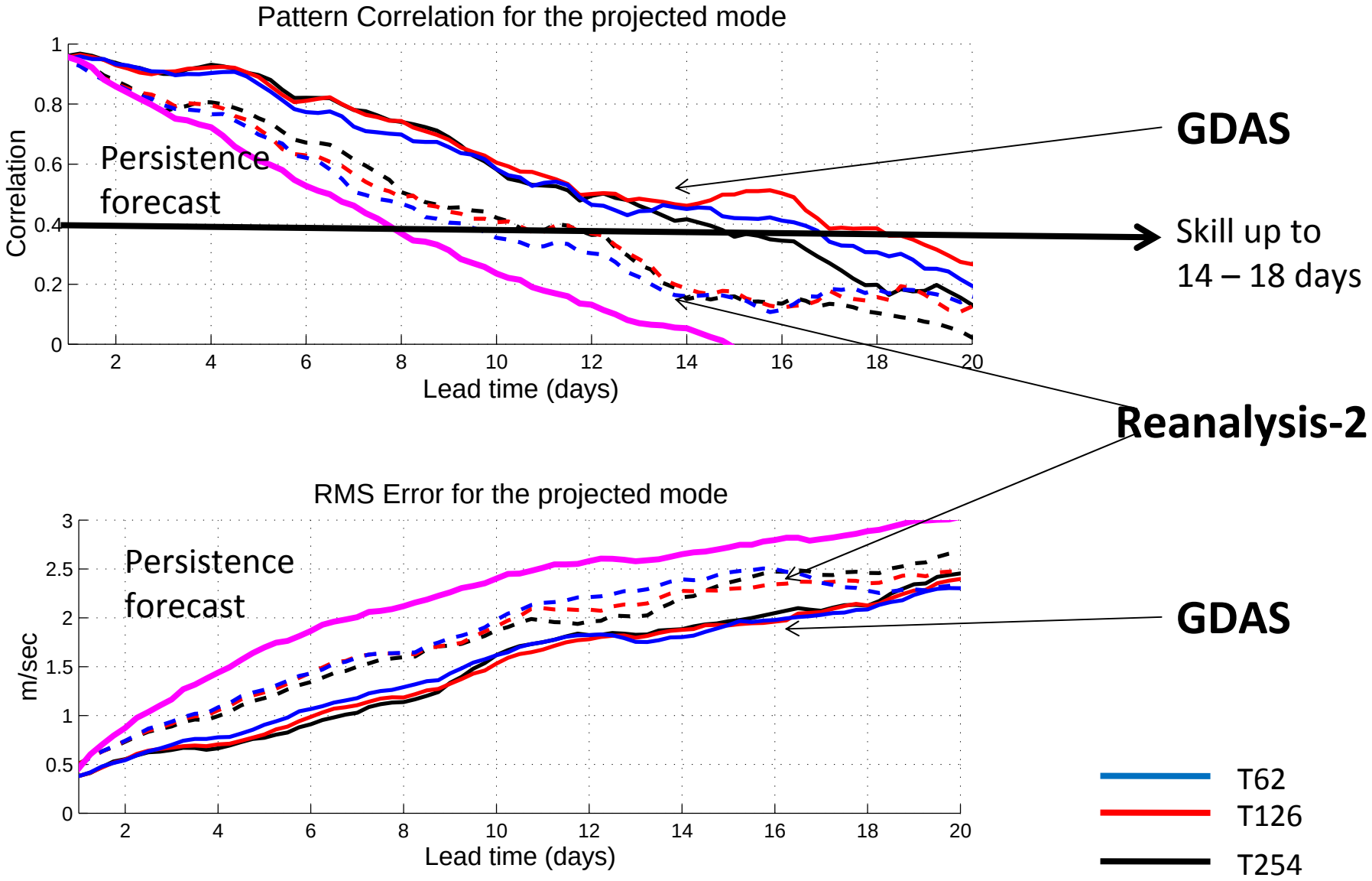
The CFS has better skill than persistence during the propagation of the dry phase of the MJO through the Maritime Continent.



However, during the transition of the wet phase of the MJO through the Maritime Continent the CFS is not better than persistence



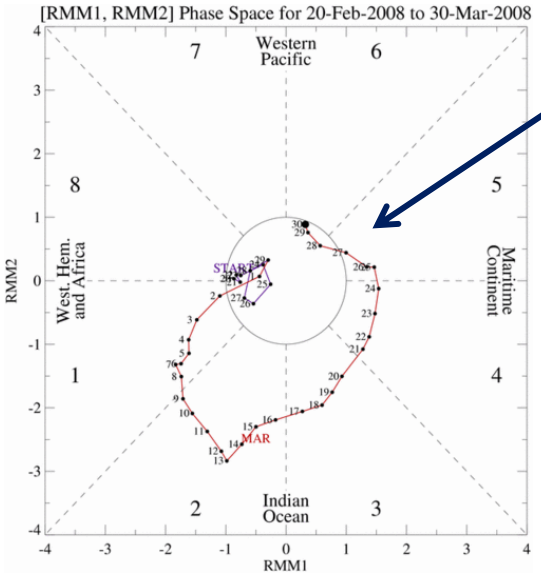
Skill for the MJO mode (verification CDAS2)



The Maritime Continent Barrier in Real Time Forecasts

A real time GEFS forecast example of the barrier

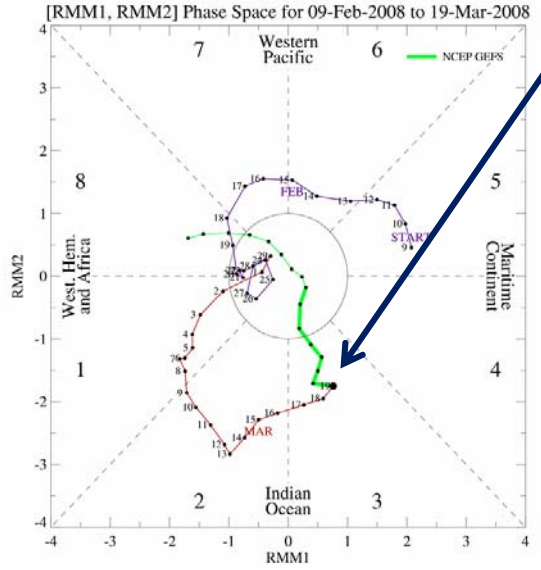
(graphs courtesy Jon Gottschalck CPC)

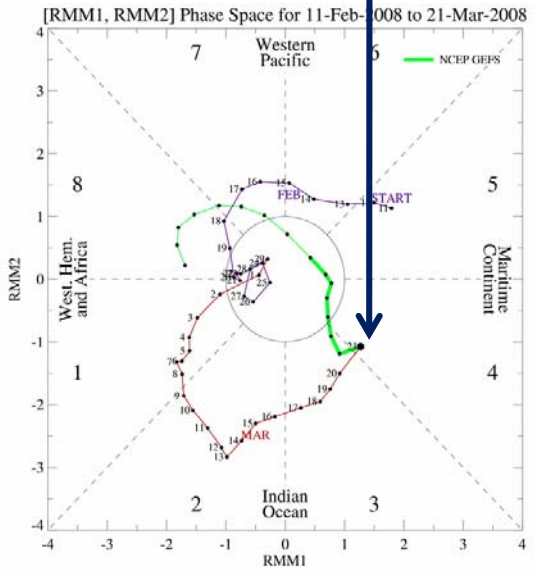


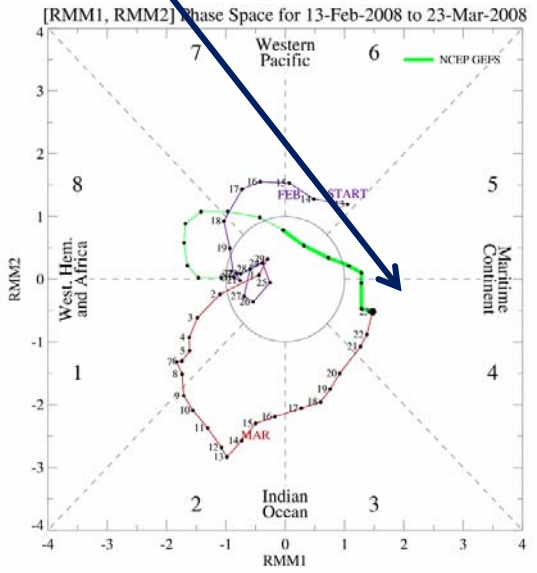
Observed MJO event of March 2008 is crossing the Maritime Continent

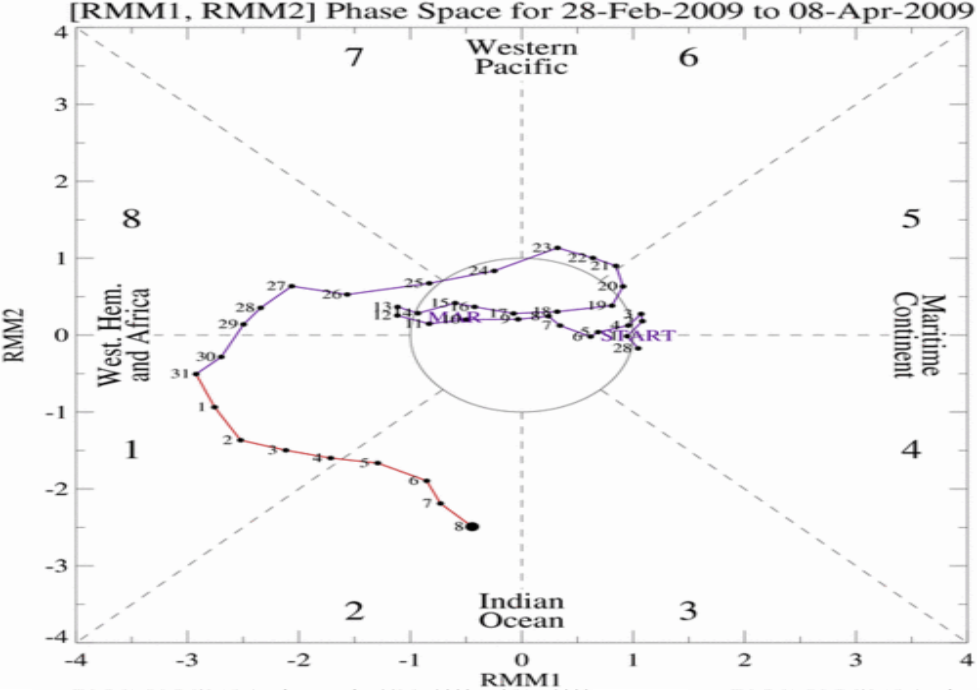
Based on the Wheeler and Hendon (2004) index

Forecast MJO 'collapses' immediately after initialization before crossing the Maritime Continent



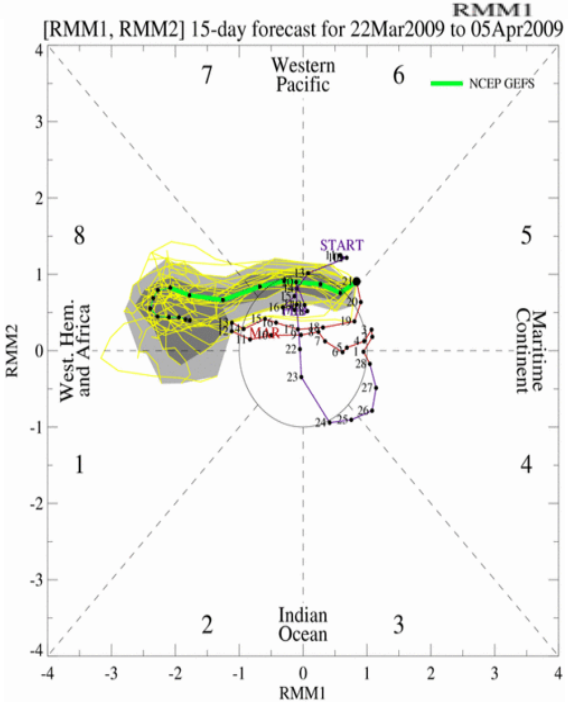


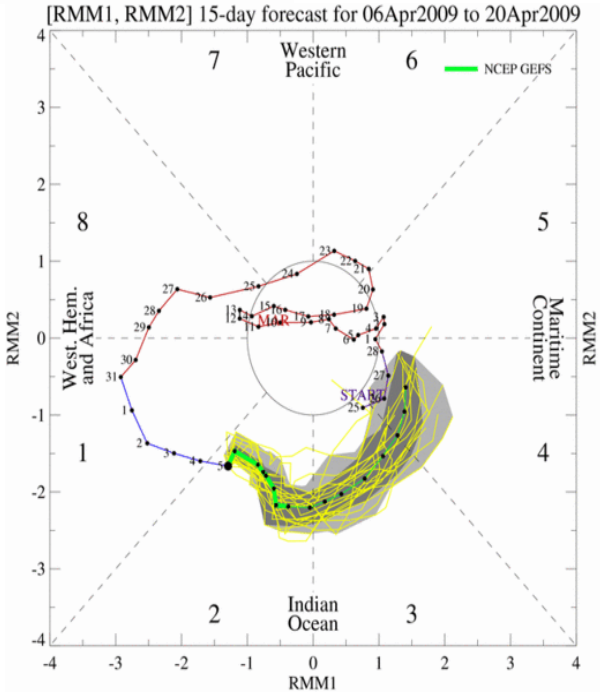


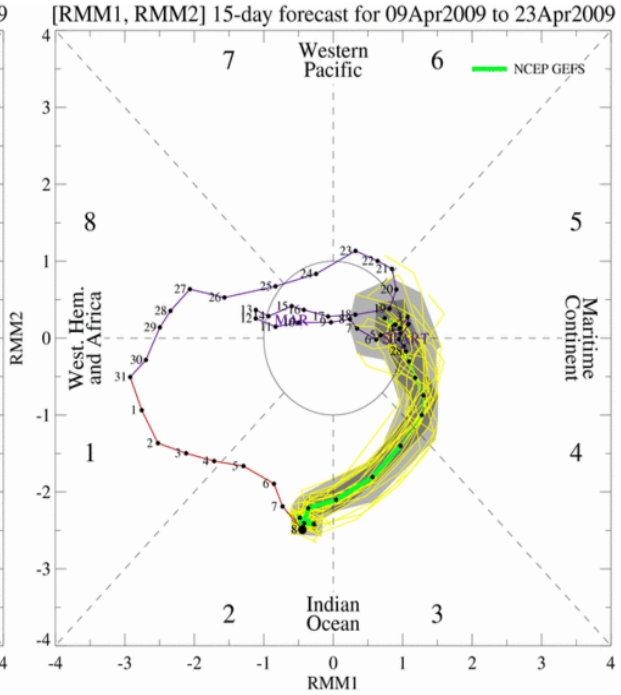


Most current MJO event as viewed through the perspective of the CLIVAR index (Wheeler and Hendon)

Graphics Courtesy CPC







Summary…..

The most important phenomenon hampering forecast skill of the MJO is the Maritime Continent Prediction Barrier.

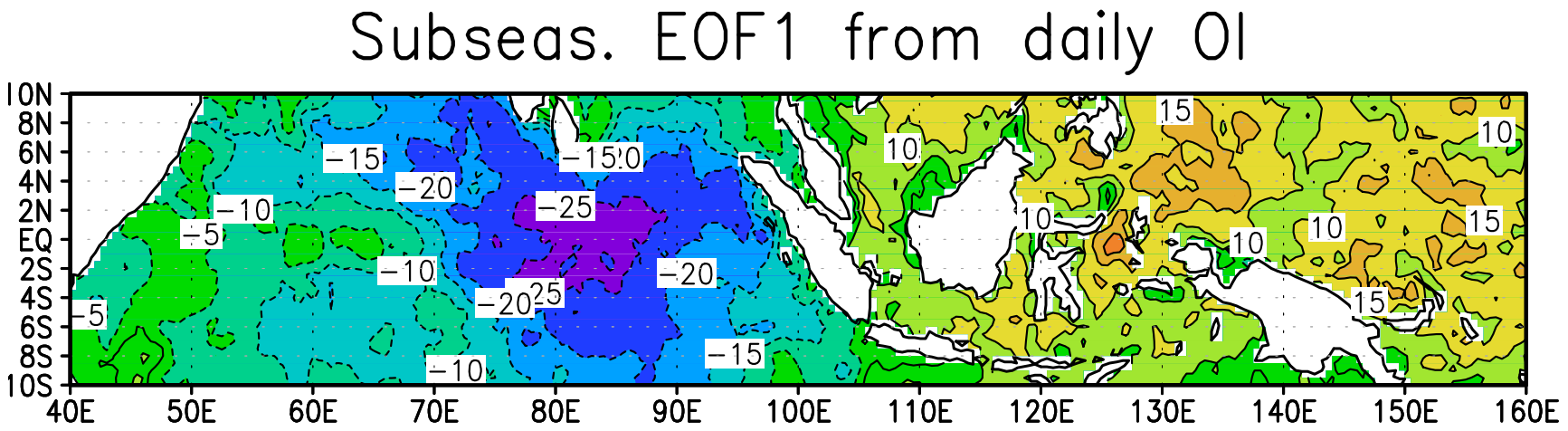
Good sets of atmospheric and oceanic initial conditions are important for improving MJO forecast skill but not for breaking trough the prediction barrier. We need to improve physical parameterizations.

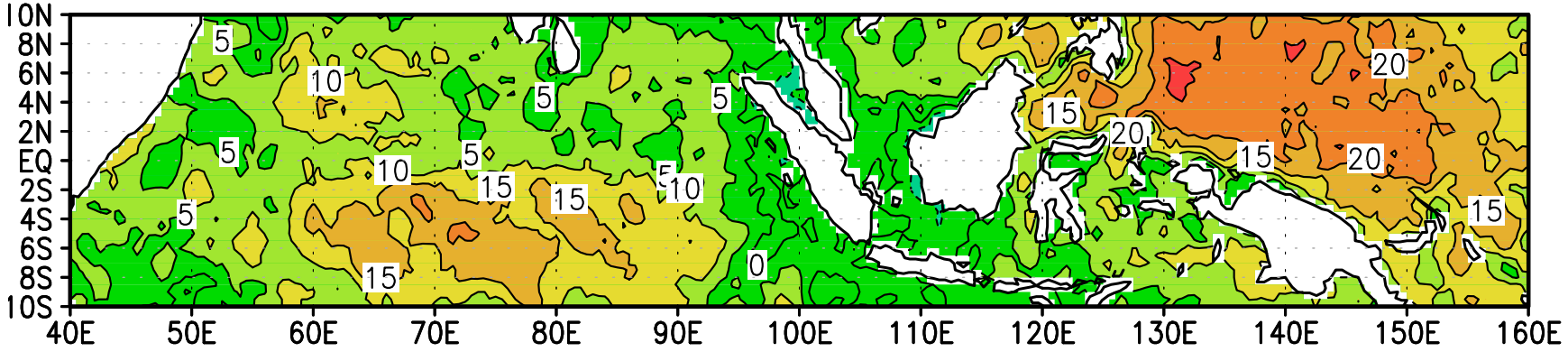
Horizontal resolution is not as essential for MJO forecast but it could be for forecasting the impacts of the MJO to the extra-tropics.

The importance of the Ocean…

First two eigenvectors of the daily observed SST correlation matrix

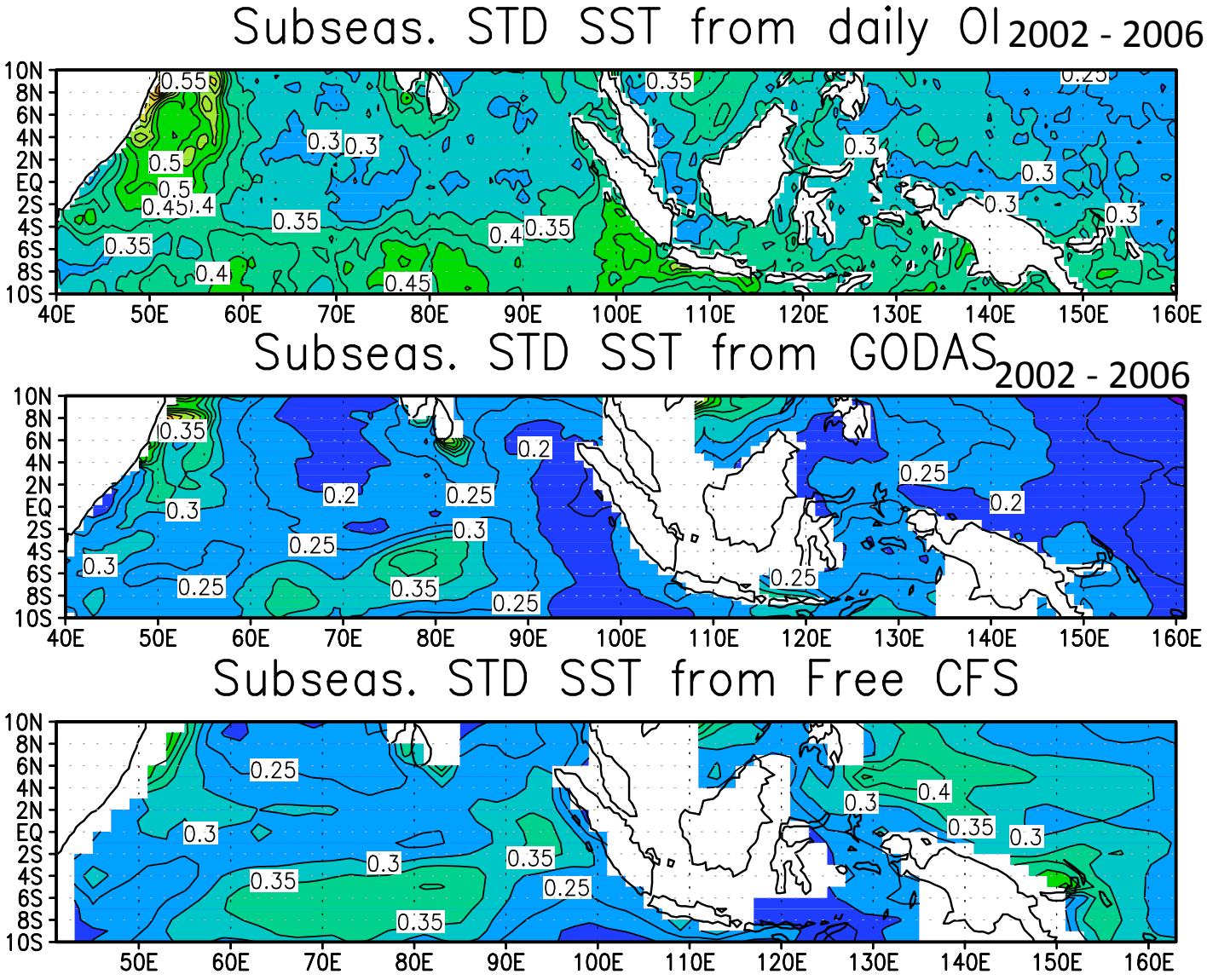
(10% and 7% of total intraseasonal variance)





These two modes project to the simplified MJO index

Standard Deviation of the 20-90 day filtered SST



As expected GODAS generally presents weaker intra-seasonal variability than observations

Intraseasonal variability increases in free runs with the coupled CFS