



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

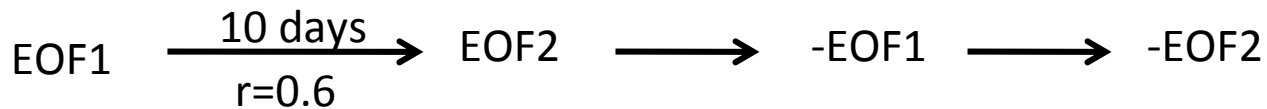
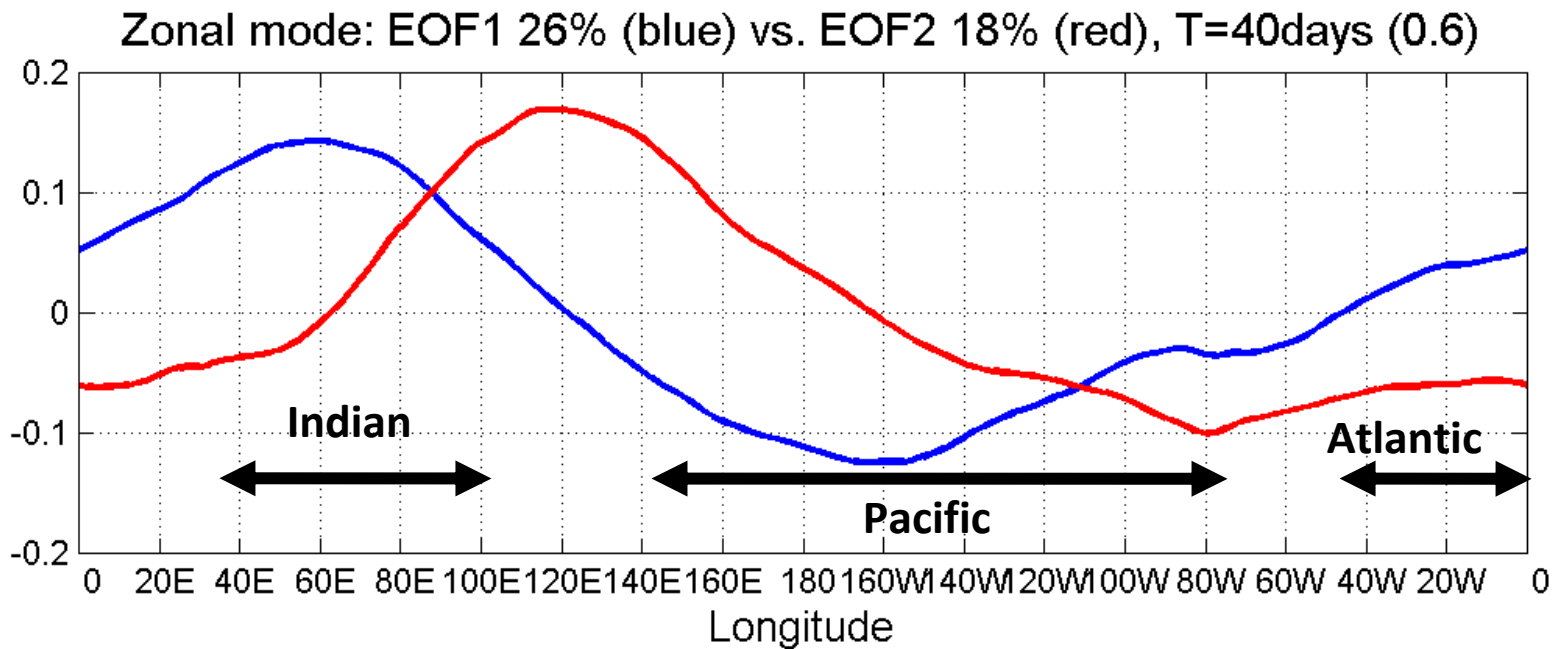
Forecasting the MJO with the CFS:

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)

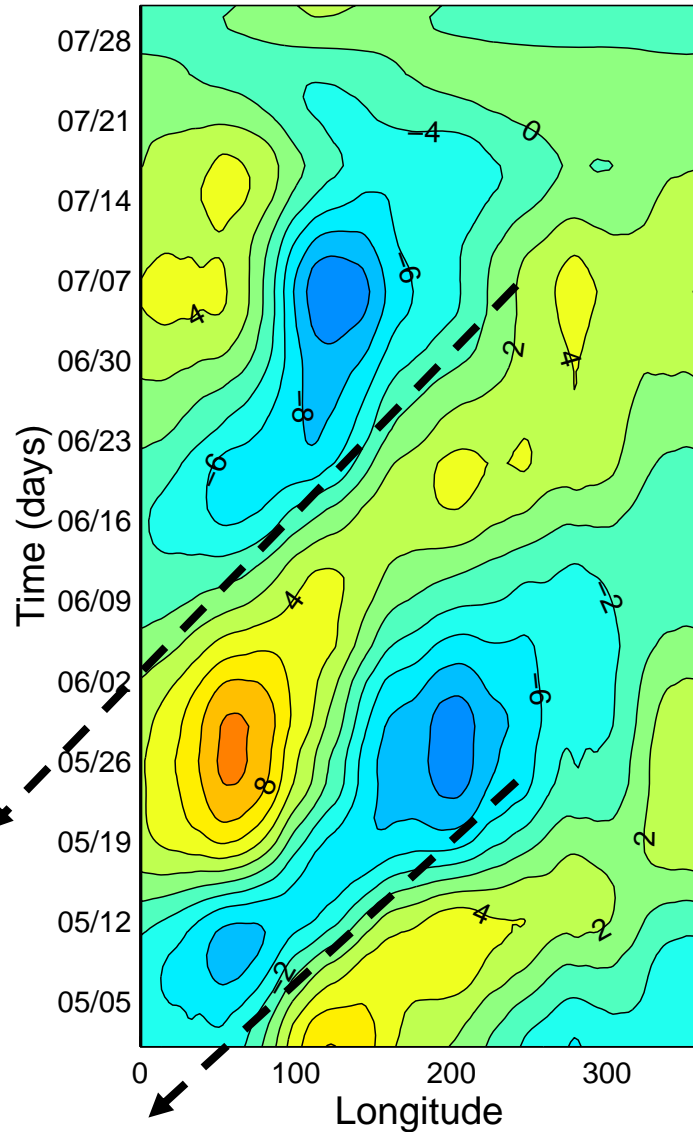
First and second EOFs of the zonal wind at 200 hPa averaged between 20°S – 20°N



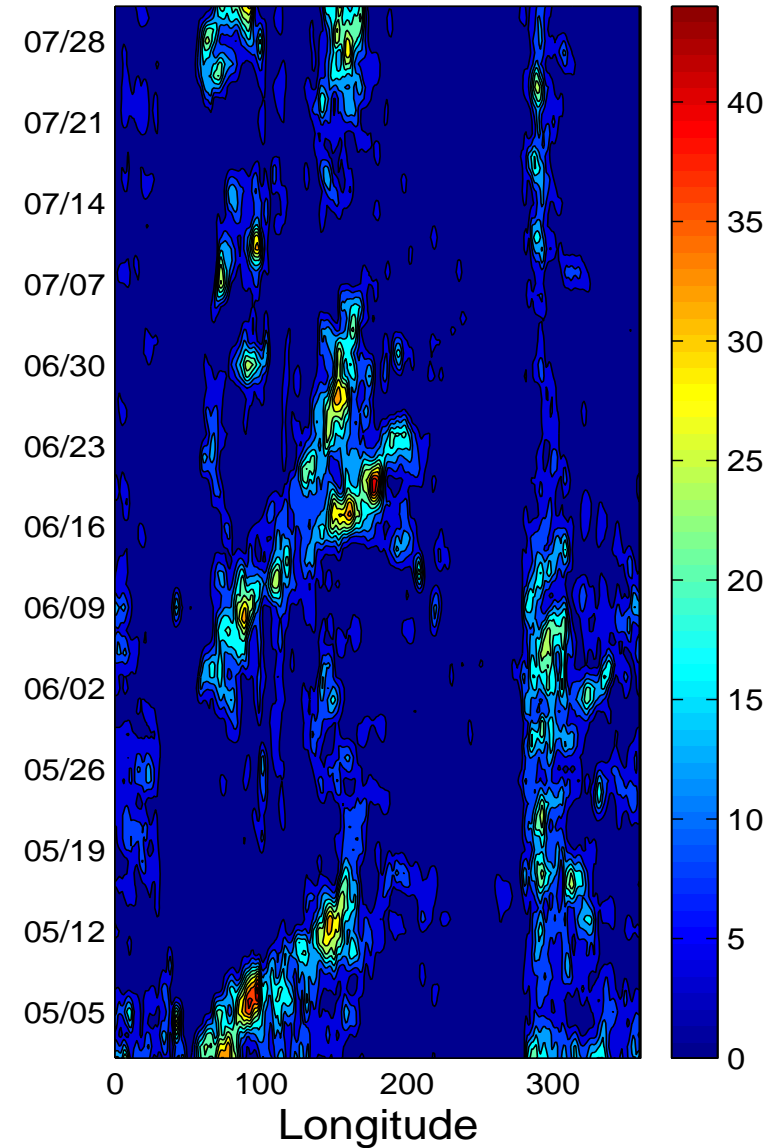
A full oscillation in 40 days


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

Obs.2002 U200 MJO Reconstruction



GPCP Daily Precip. 05-07 2002



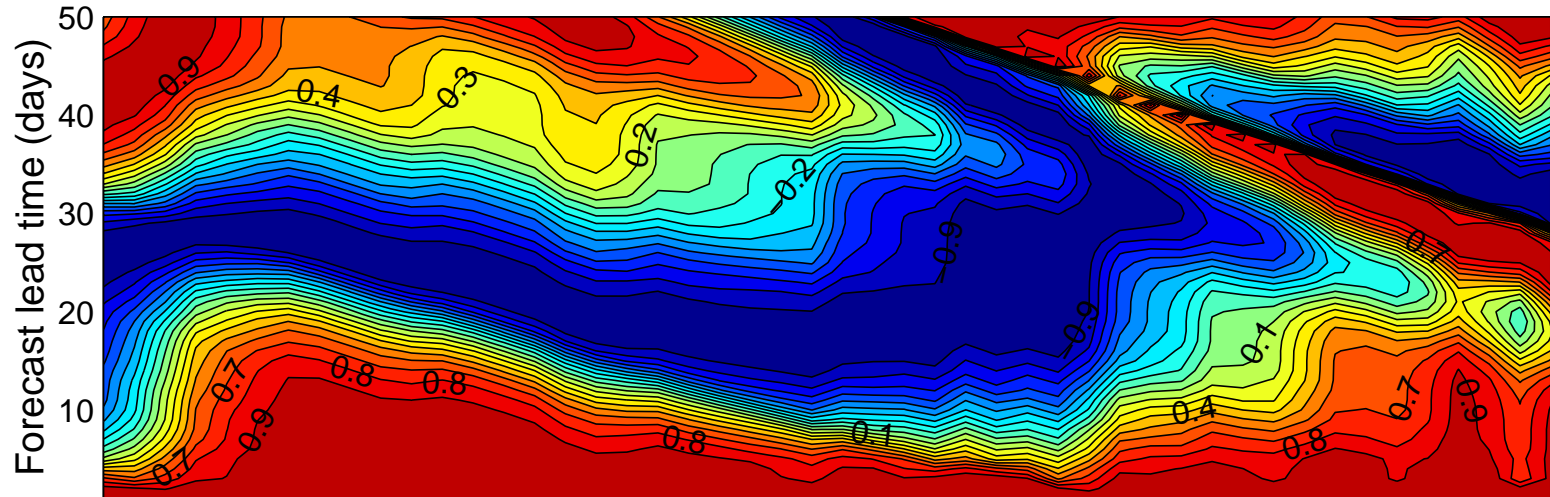
The background of the slide features a large, light blue watermark of the NOAA logo. The logo is circular and contains the text "NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION" at the top and "U.S. DEPARTMENT OF COMMERCE" at the bottom. In the center of the logo is a stylized sun rising over a blue wave, with the word "NOAA" written in large, bold, white letters across the middle.

Forecasting the MJO with the CFS: The Maritime Continent Prediction Barrier

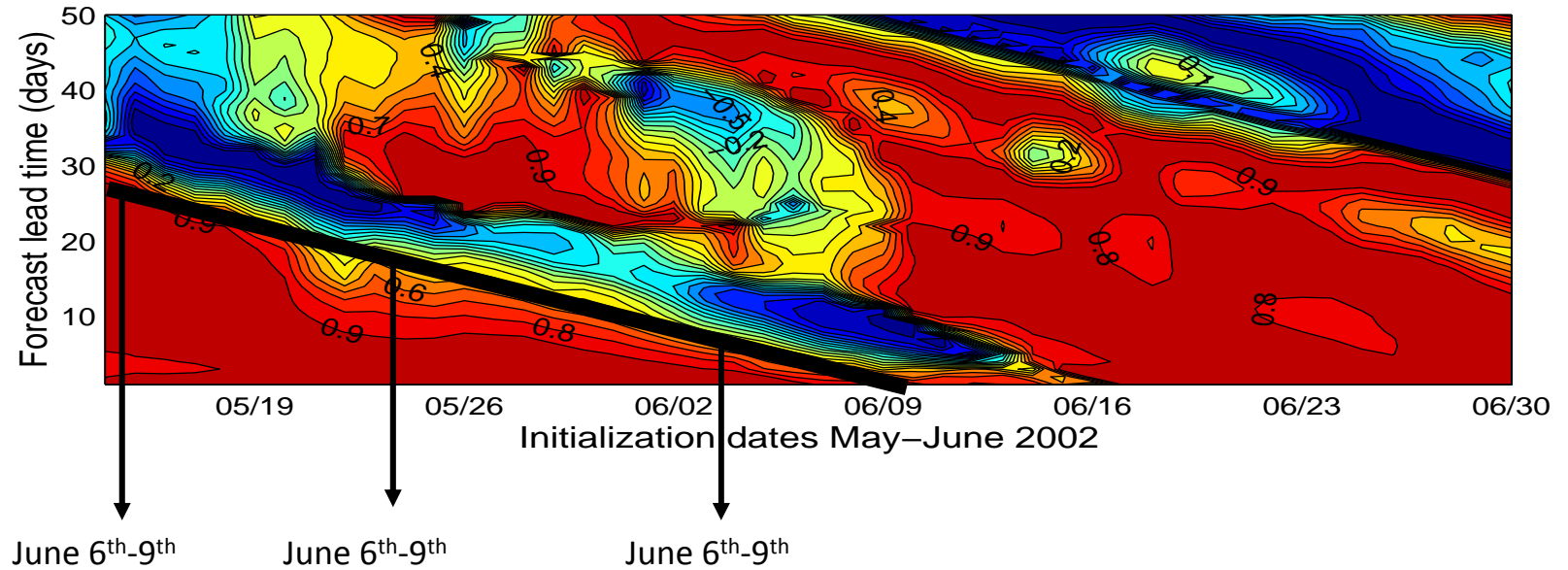
Pattern Correlation as a function of initialization day and lead time
for some initial experiments with the CFS

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

CFS126: Pattern Correlation for Persistence Forecast



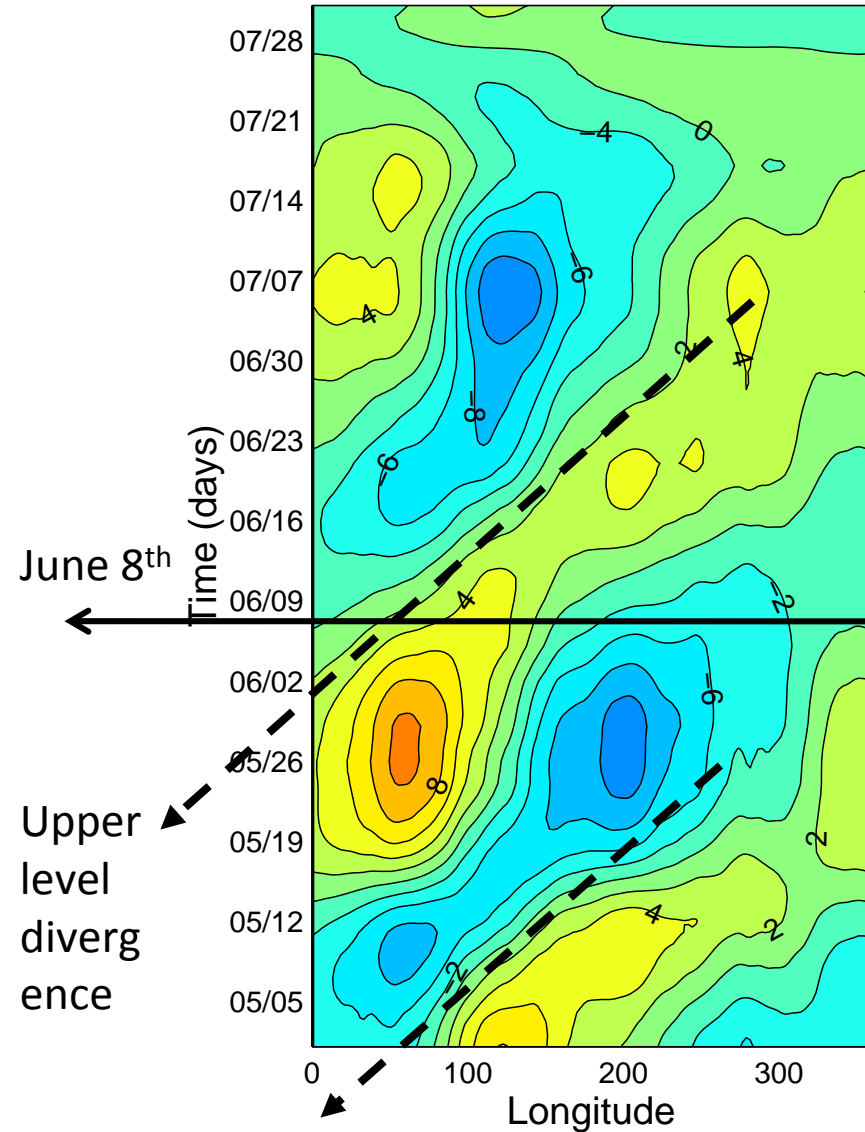
CFS126: Pattern Correlation for EOF filtered U200



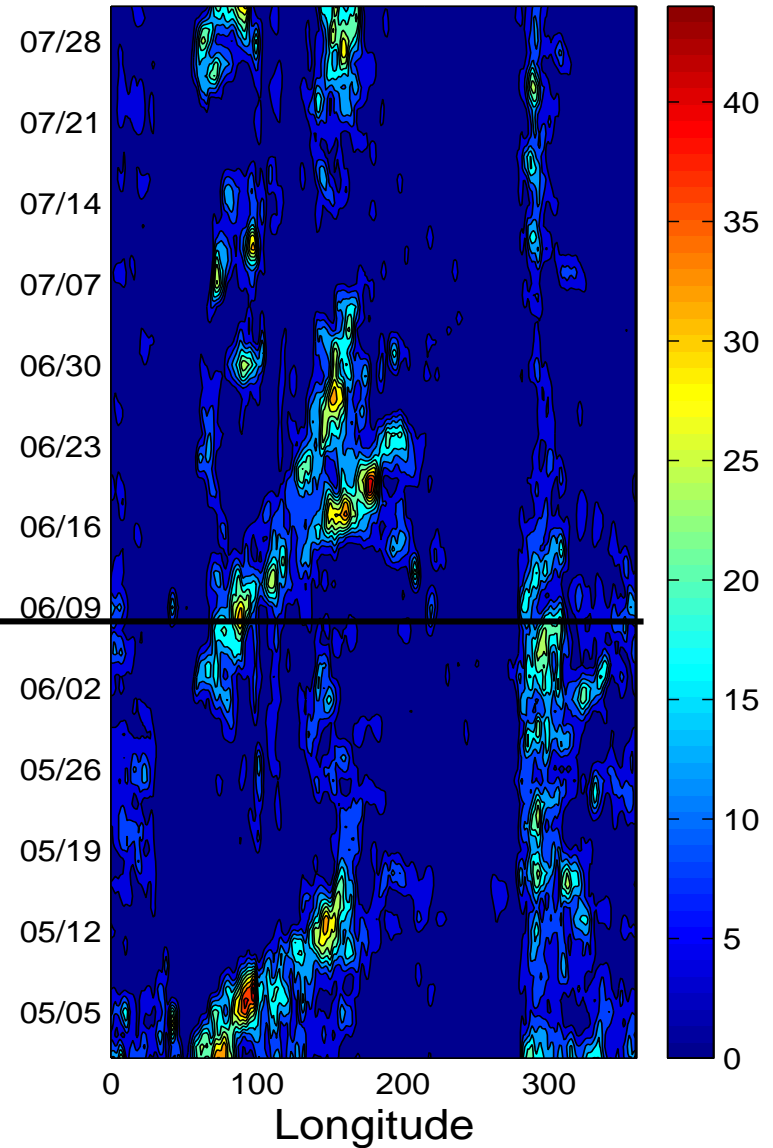
Reconstructed U200 vs. GPCP Precipitation, May – July, 2002

Obs.2002 U200 MJO Reconstruction

GPCP Daily Precip. 05–07 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

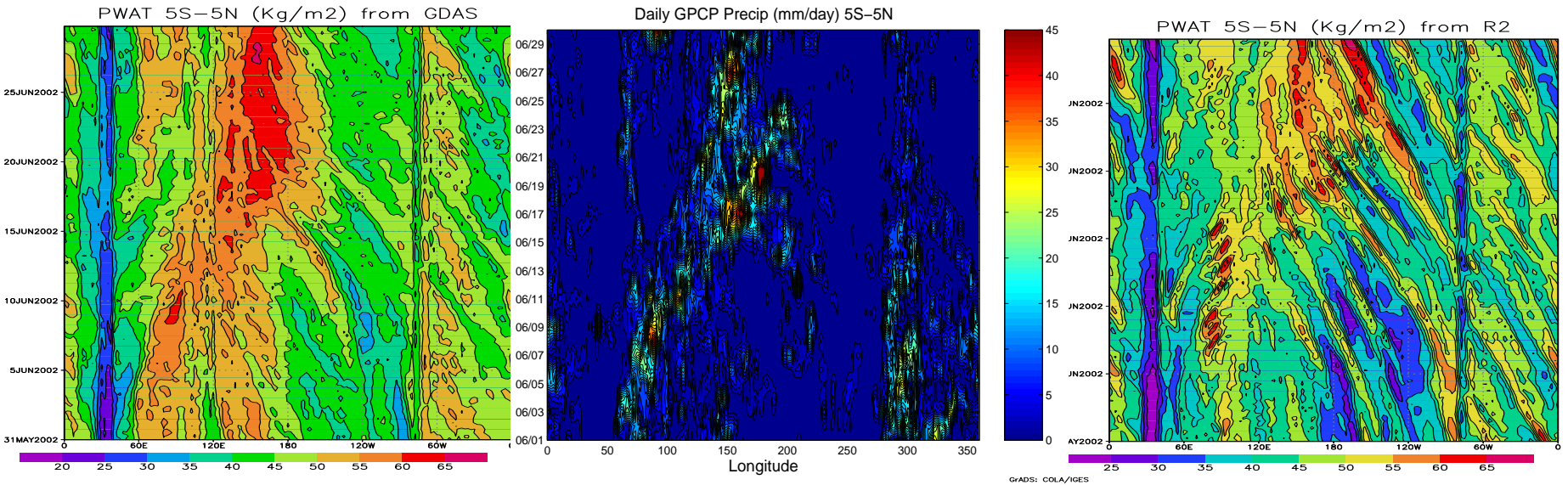
Ocean: the standard CFS resolution

Initial conditions:

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

Ocean: from **GODAS**

Operational GDAS versus Reanalysis-2 initial conditions: June 2002

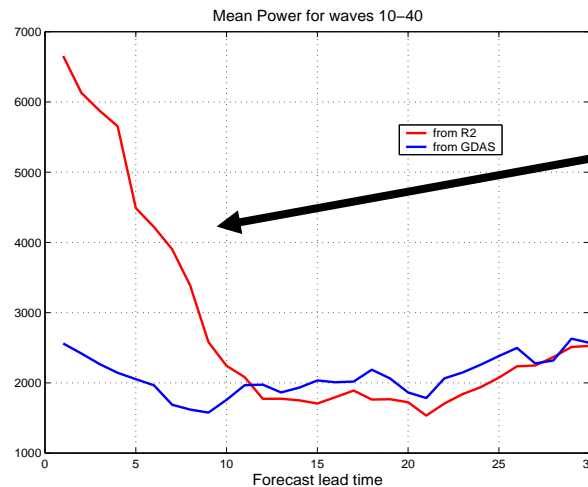


GDAS Precipitable Water

GPCP Precipitation

Reanalysis 2 Precipitable Water

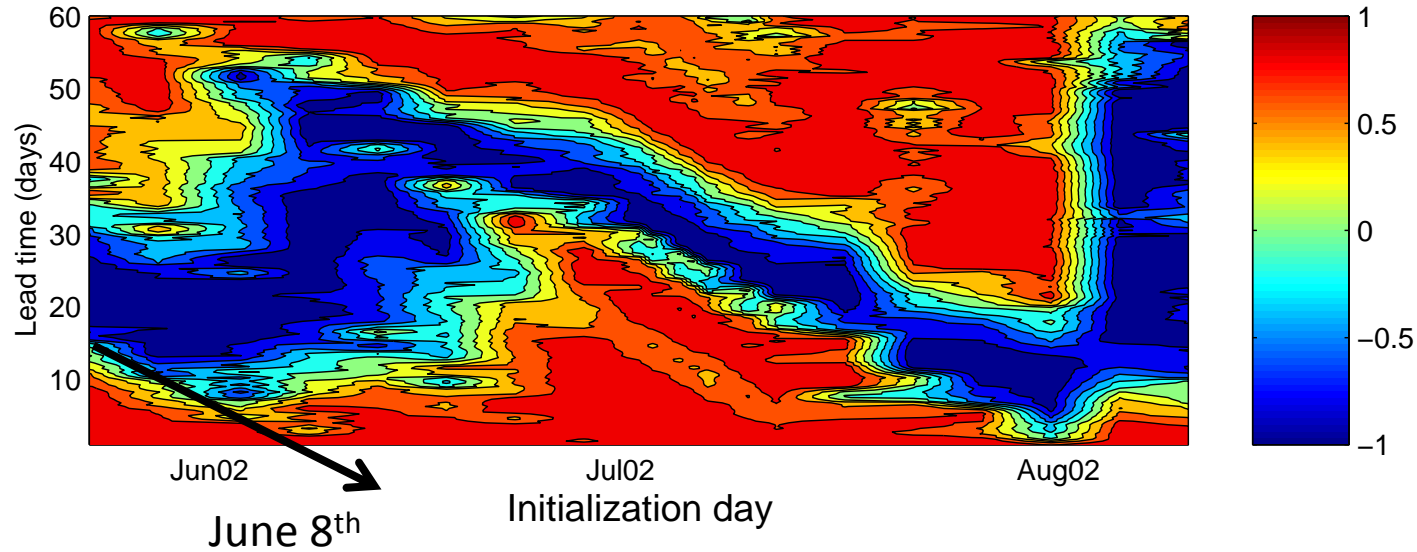
Time evolution of mean energy at wave numbers 10-40 when CFS is initialized by R-2 (red) or by GDAS (blue).



drift

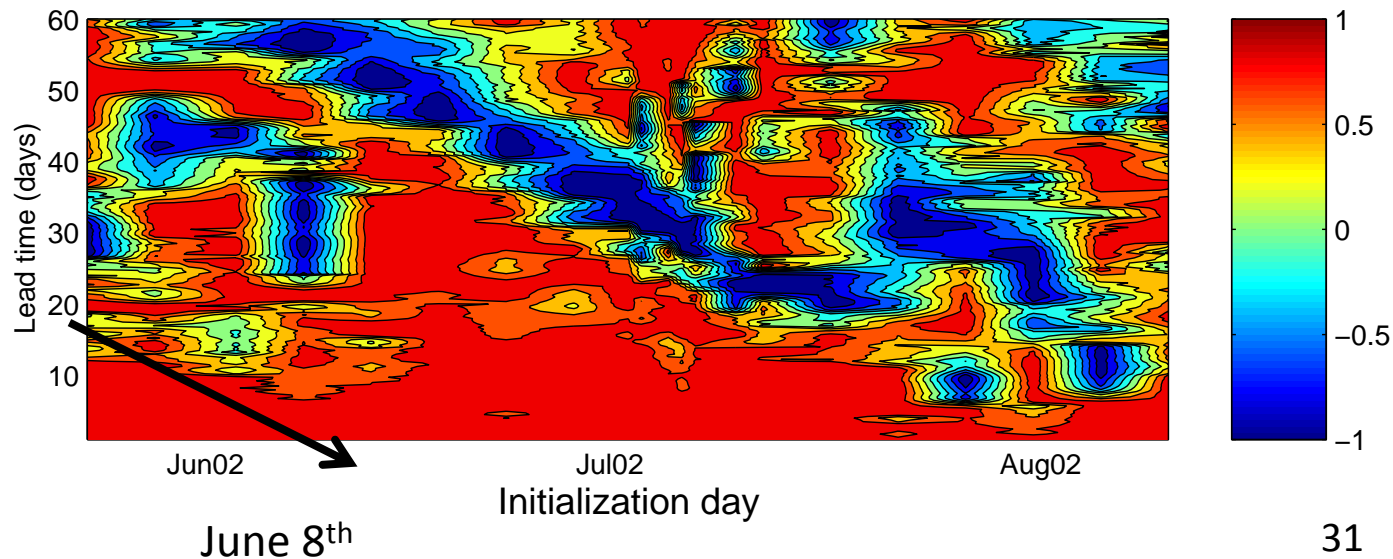
Pattern correlation as a function of initialization day and lead time

Pattern Correlation for Pers. Frcst



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

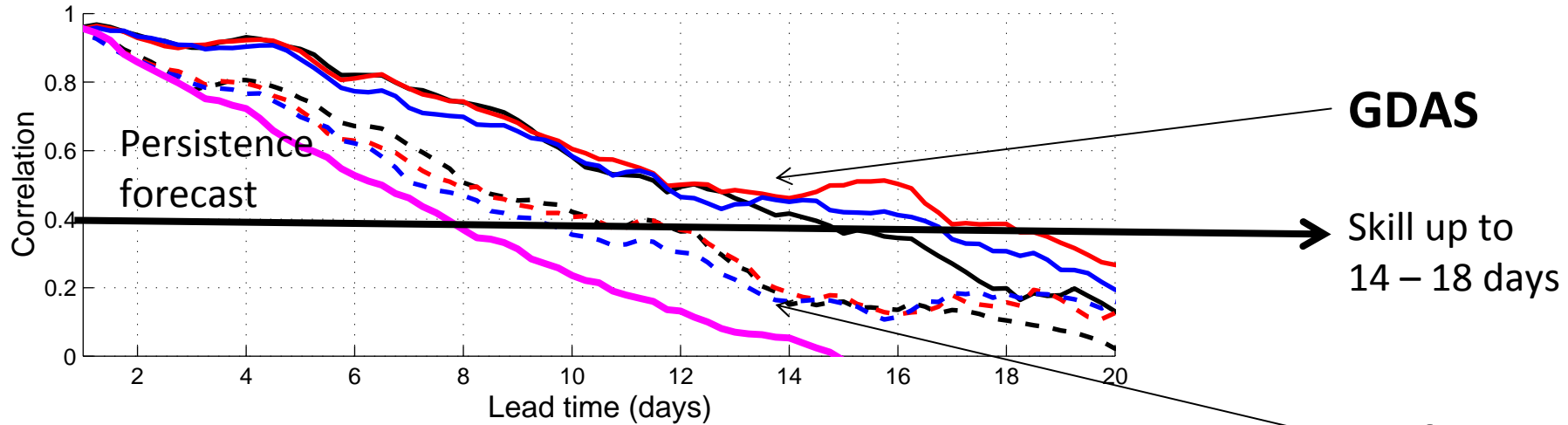
Pattern Correlation for GDAS Frcst



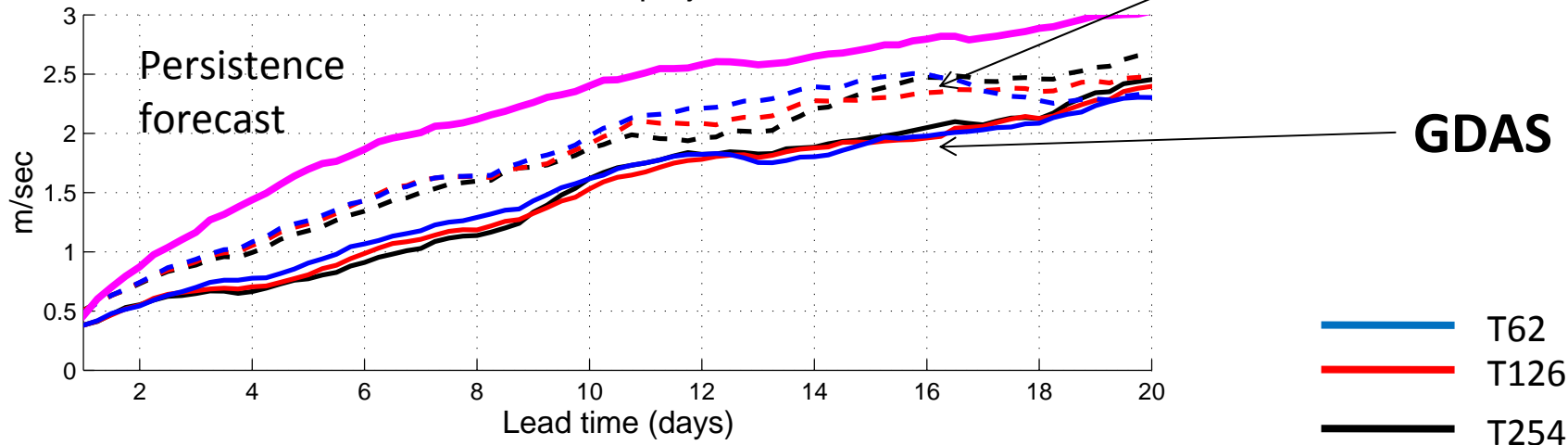
However, during the transition of the wet phase of the MJO through the Maritime Continent the CFS is not better than persistence


Skill for the MJO mode (verification CDAS2)

Pattern Correlation for the projected mode



RMS Error for the projected mode

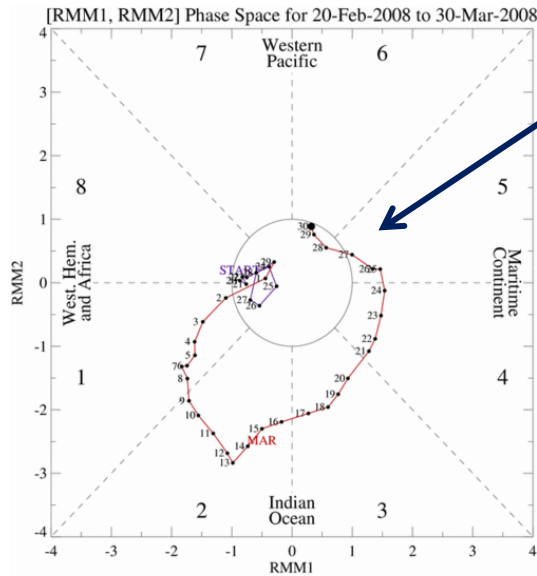


The background of the slide features the official seal of the National Oceanic and Atmospheric Administration (NOAA). The seal is circular and contains the text "NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION" at the top and "U.S. DEPARTMENT OF COMMERCE" at the bottom. In the center of the seal is a stylized white bird, likely a frigatebird, flying over a blue wave. The word "NOAA" is prominently displayed in the center of the seal in a bold, white, sans-serif font.

The Maritime Continent Barrier in Real Time Forecasts

A real time GEF5 forecast example of the barrier

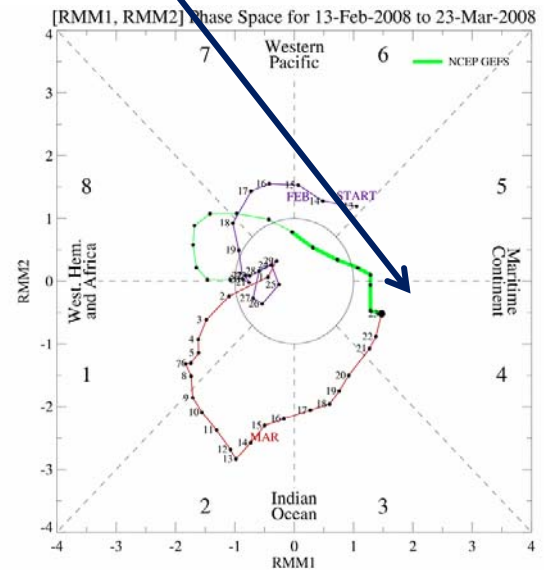
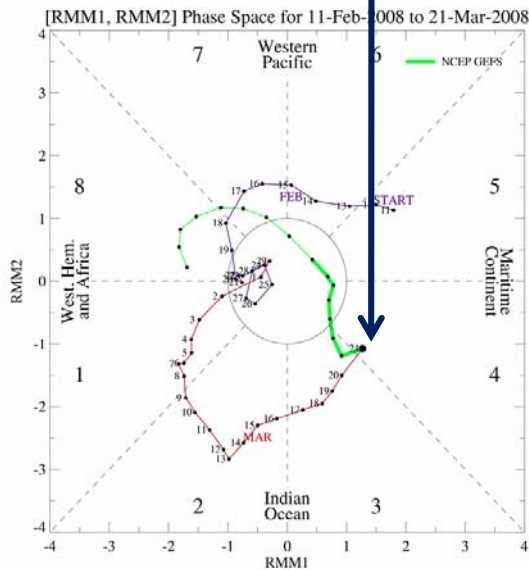
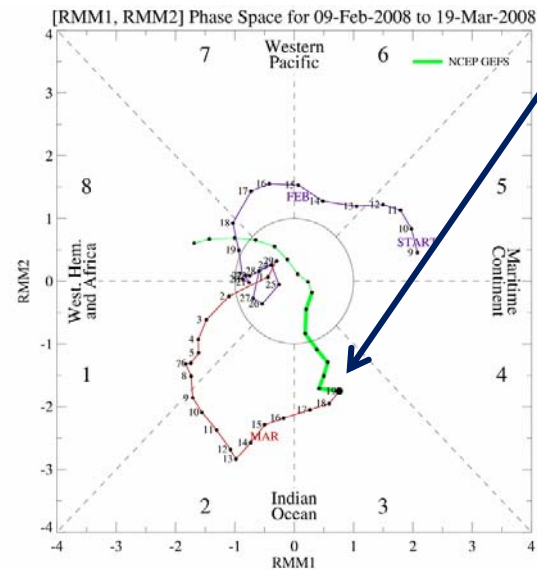
(graphs courtesy Jon Gottschalck CPC)



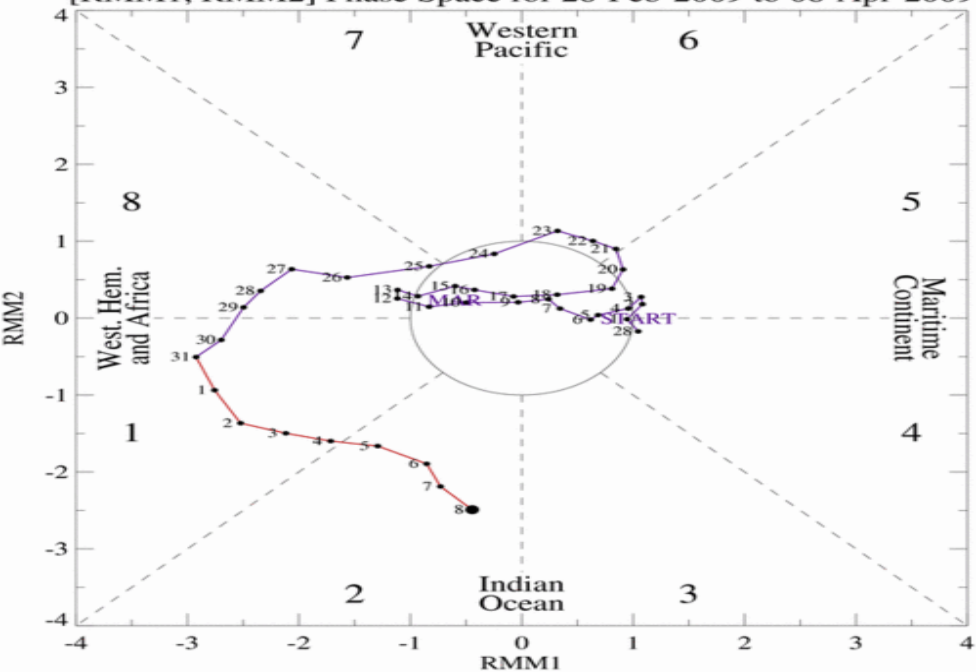
Observed MJO event of March 2008 is crossing the Maritime Continent

Based on the Wheeler and Hendon (2004) index

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



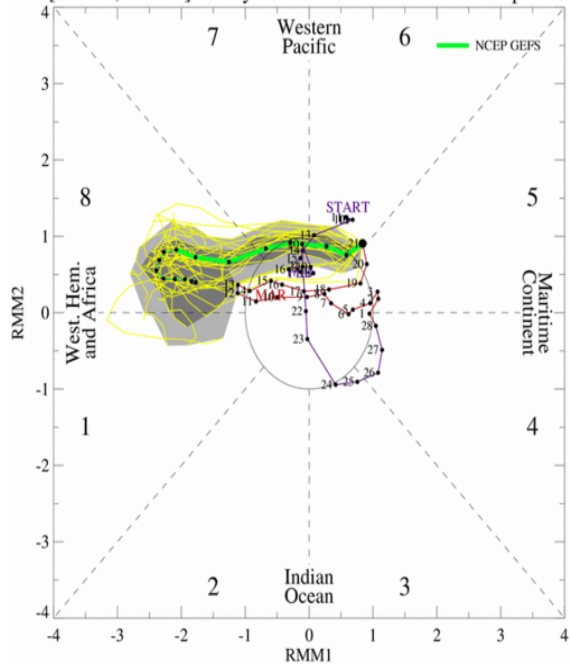
[RMM1, RMM2] Phase Space for 28-Feb-2009 to 08-Apr-2009



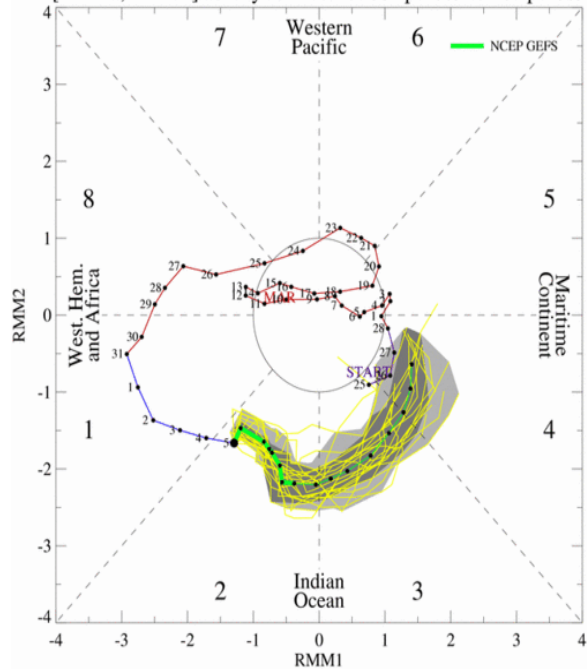
Most current MJO event as viewed through the perspective of the CLIVAR index (Wheeler and Hendon)

Graphics Courtesy CPC

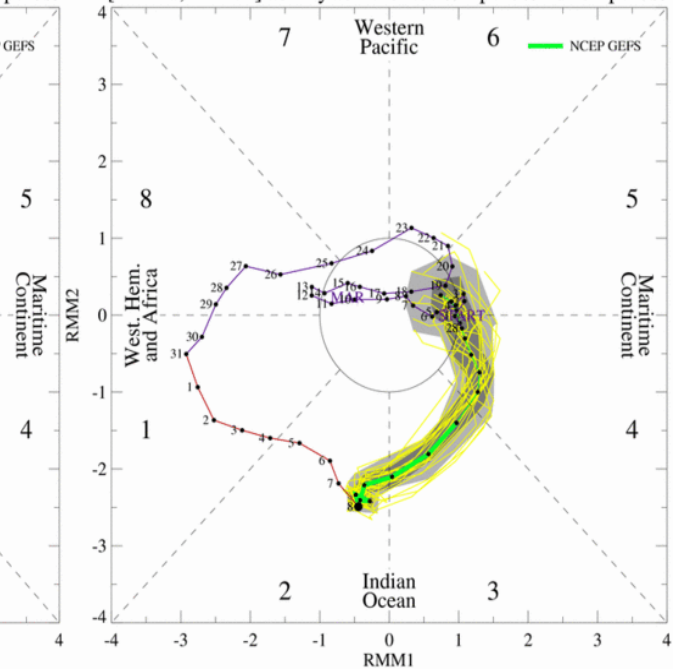
[RMM1, RMM2] 15-day forecast for 22Mar2009 to 05Apr2009



[RMM1, RMM2] 15-day forecast for 06Apr2009 to 20Apr2009



[RMM1, RMM2] 15-day forecast for 09Apr2009 to 23Apr2009



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 through the prediction barrier. We need to improve physical parameterizations.

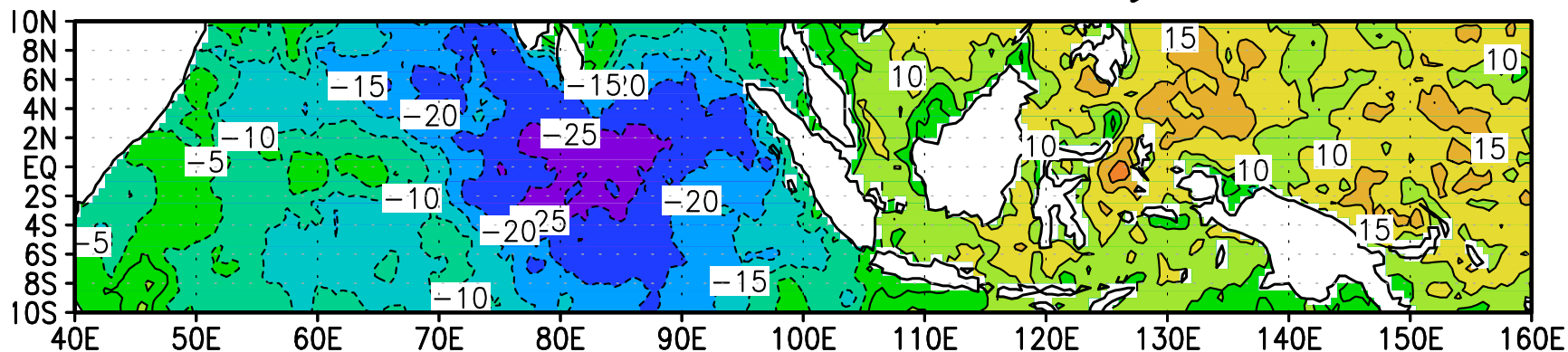
Horizontal resolution is not as essential for MJO forecast but it could be for forecasting the impacts of the MJO to the extra-tropics.

The importance of the Ocean...

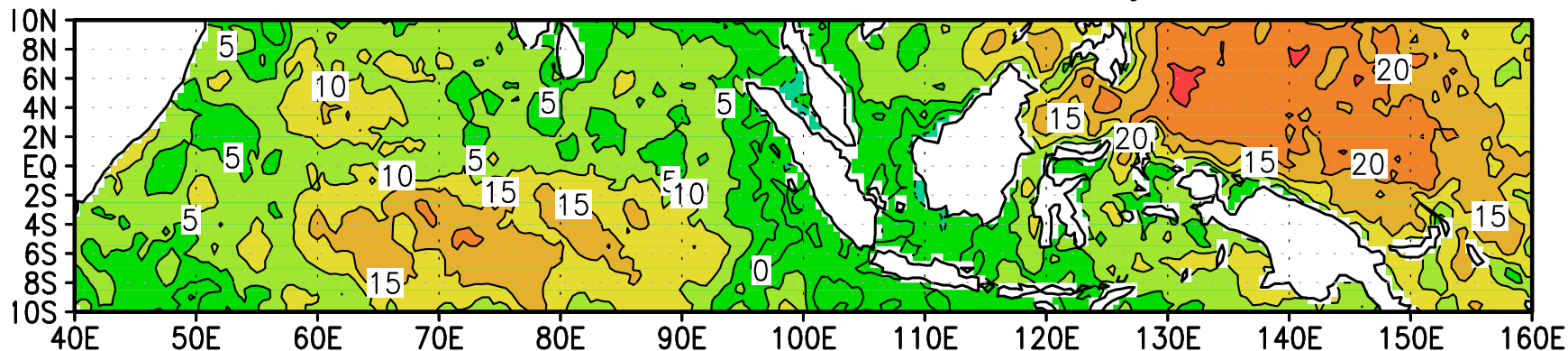
First two eigenvectors of the daily observed SST correlation matrix

(10% and 7% of total intraseasonal variance)

Subseas. EOF1 from daily OI



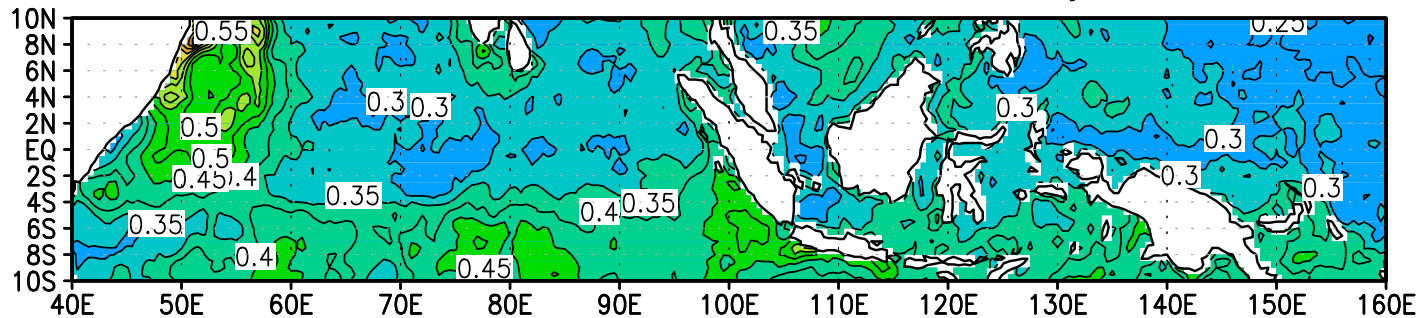
Subseas. EOF2 from daily OI



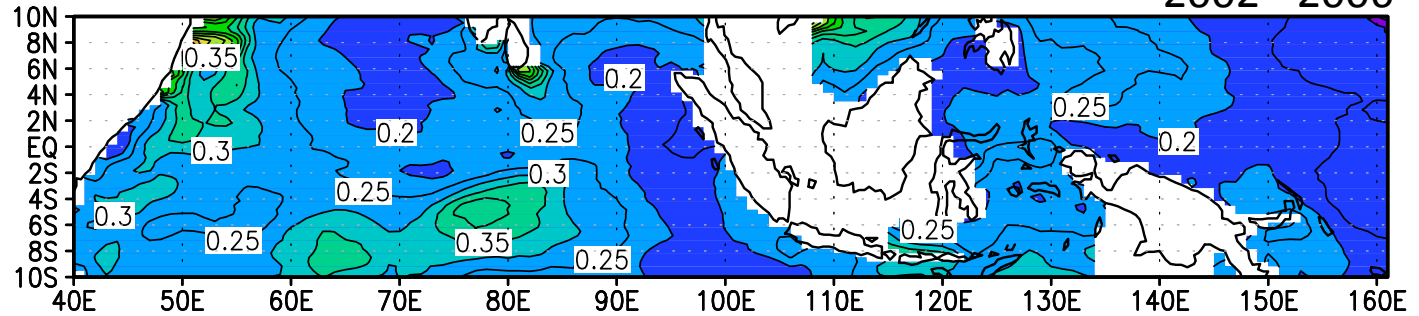
These two modes project to the simplified MJO index

Standard Deviation of the 20-90 day filtered SST

Subseas. STD SST from daily OI 2002 - 2006

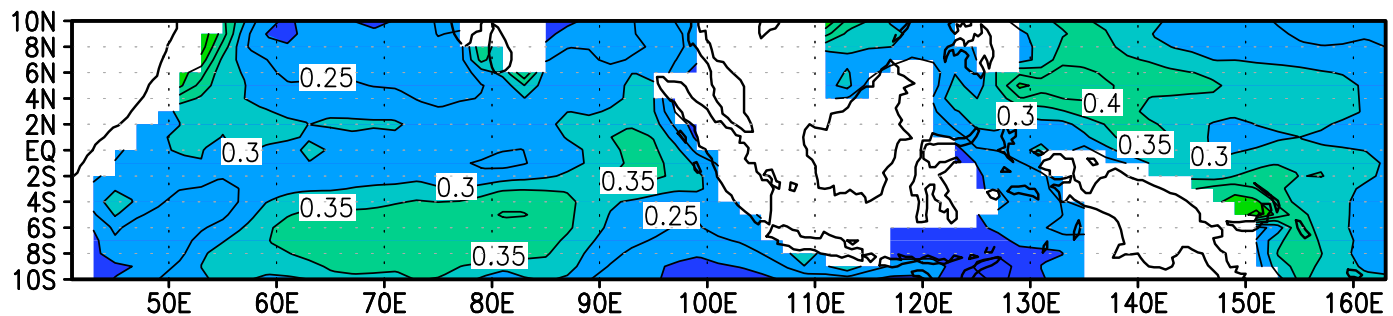


Subseas. STD SST from GODAS_{2002 - 2006}



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

Subseas. STD SST from Free CFS



Intraseasonal
variability
increases in free
runs with the
coupled CFS