The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

1956-18

Targeted Training Activity: Seasonal Predictability in Tropical Regions to be followed by Workshop on Multi-scale Predictions of the Asian and African Summer Monsoon

4 - 15 August 2008

Status and plans for the US CLIVAR MJO WG forecast metric activity at NCEP

GOTTSCHALCK Jonathan

National Centers For Environmental Prediction
Climate Prediction Center (Noaa)
World Weather Building Room 605, 5200 Auth Road
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Status and Plans for the US CLIVAR MJOWG Forecast Metric Activity at NCEP

Jon Gottschalck, Qin Zhang
US CLIVAR MJOWG Forecast Metrics Team
NOAA / Climate Prediction Center

"Workshop on Multi-scale Predictions of the Asian and African Summer Monsoon"
Trieste, Italy
August 11-15, 2008

Outline and Goals

- Background, Motivation
- Status and Examples
- Web page overview
- Current Issues
- Plans
- Applications

1. Describe MJOFM activity, entice further participation

2. Outline the illustration of this information (when completed)

3. Introduce an operational assessment with collaborative opportunities (related to ENSO, MJO / ISO)

Background and Motivation

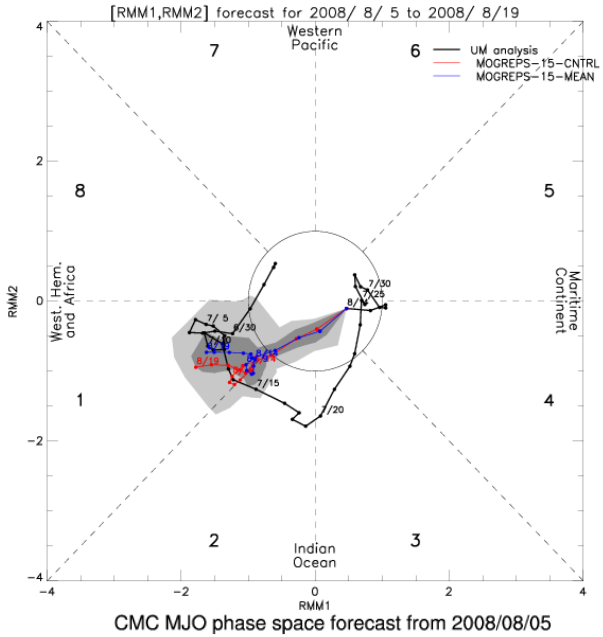
• US CLIVAR MJOWG designated a team focused on MJO realtime operational forecasting issues

• Recently some operational centers have applied WH2004 MJO filtering to model output

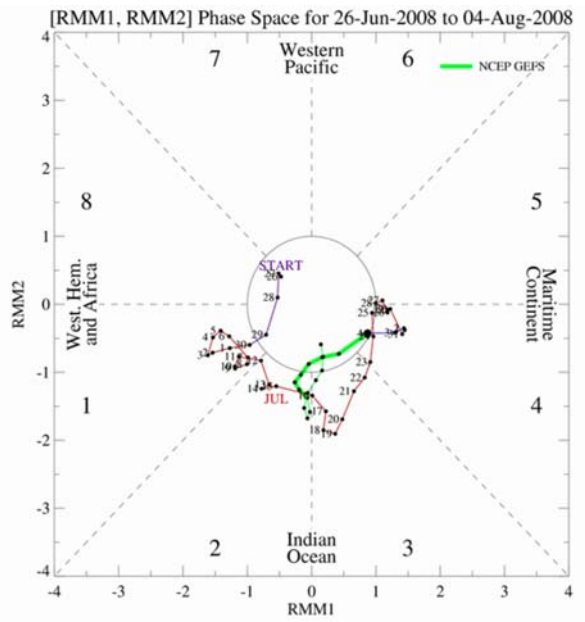
Varying datasets used with center specific methodologies

Background and Motivation

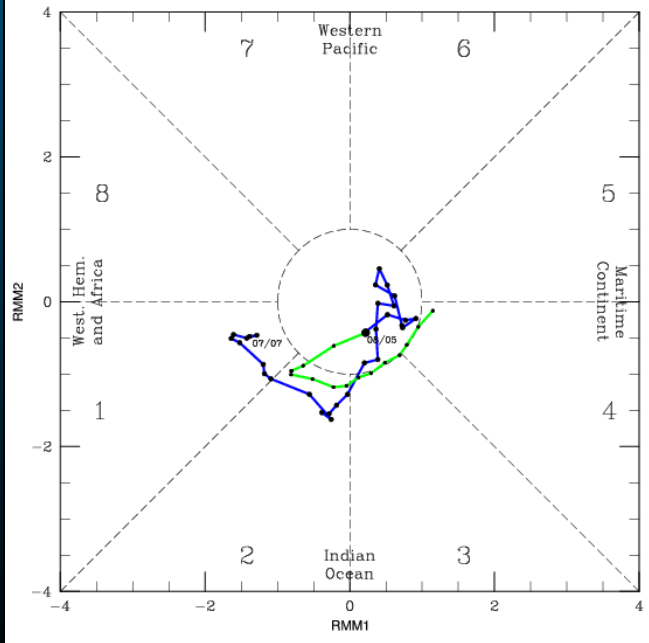
UKMET



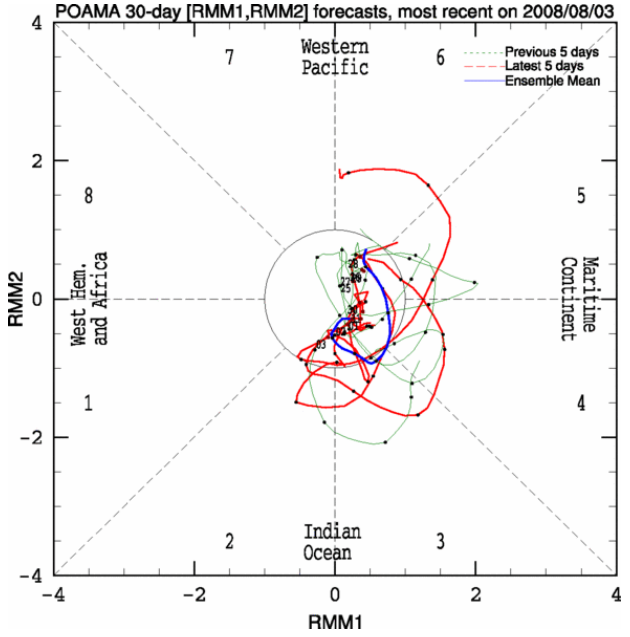
NCEP



CMC



ABOM



Background and Motivation

- US CLIVAR MJOWG outlined a strategy for uniform application and display of WH2004

- Provide framework for better coordination of these evaluations

- Focus additional visibility and expertise to the operational MJO forecasting issue

- Means to quantify MJO forecast skill within and across Centers

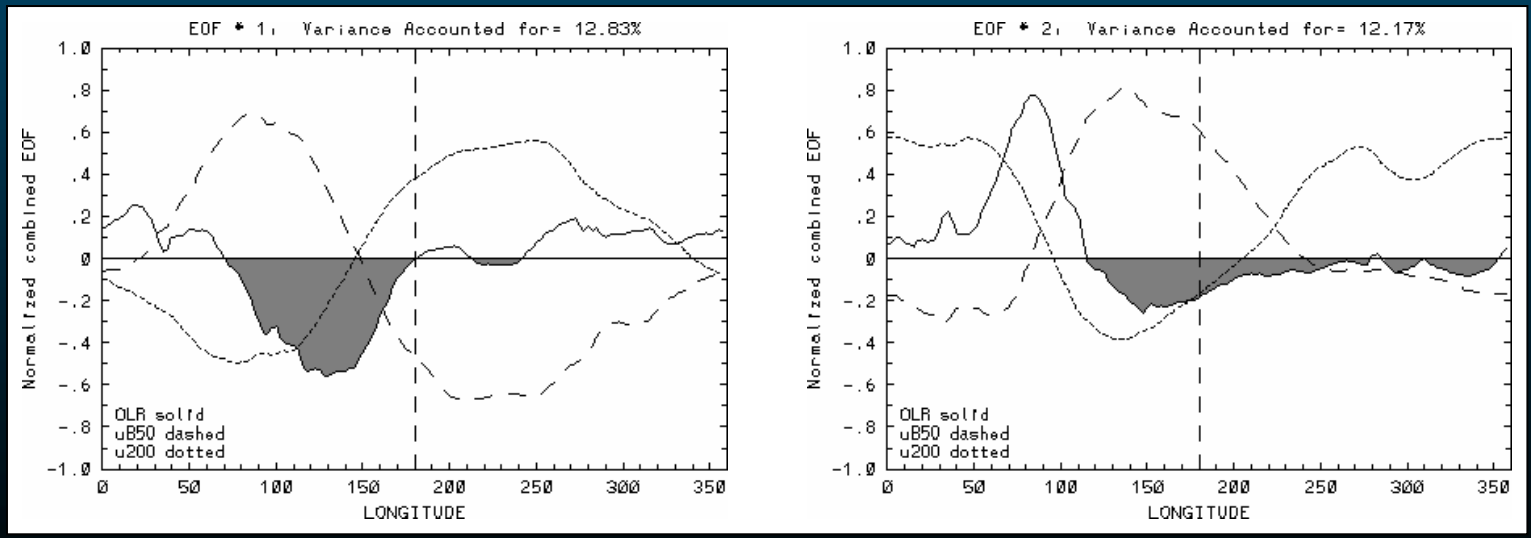
CLIVAR Activity Specifics

- Housed at NCEP – Climate Prediction Center (CPC)

- Data received:
  - ➔ Raw data and not RMM1 and RMM2
  - ➔ Previous days analysis as initial condition
  - ➔ All ensemble forecast members

- Model forecast anomalies based on NCEP Reanalysis (1979-2001)

- Project model anomalies on observed EOFs



CLIVAR Activity Specifics

- NCEP ftp site established and supported 24 hours / 7 days
- CPC receiving data in realtime
- Current participating operational centers:

NCEP: National Centers for Environmental Prediction
ECMWF: European Centre for Medium Range Weather Forecasting
UKMO: United Kingdom Meteorology Office
CMC: Canadian Meteorology Centre
ABOM: Australian Bureau of Meteorology
CPTEC: Brazilian Centre for Time and Climate Studies
JMA: Japan Meteorology Agency

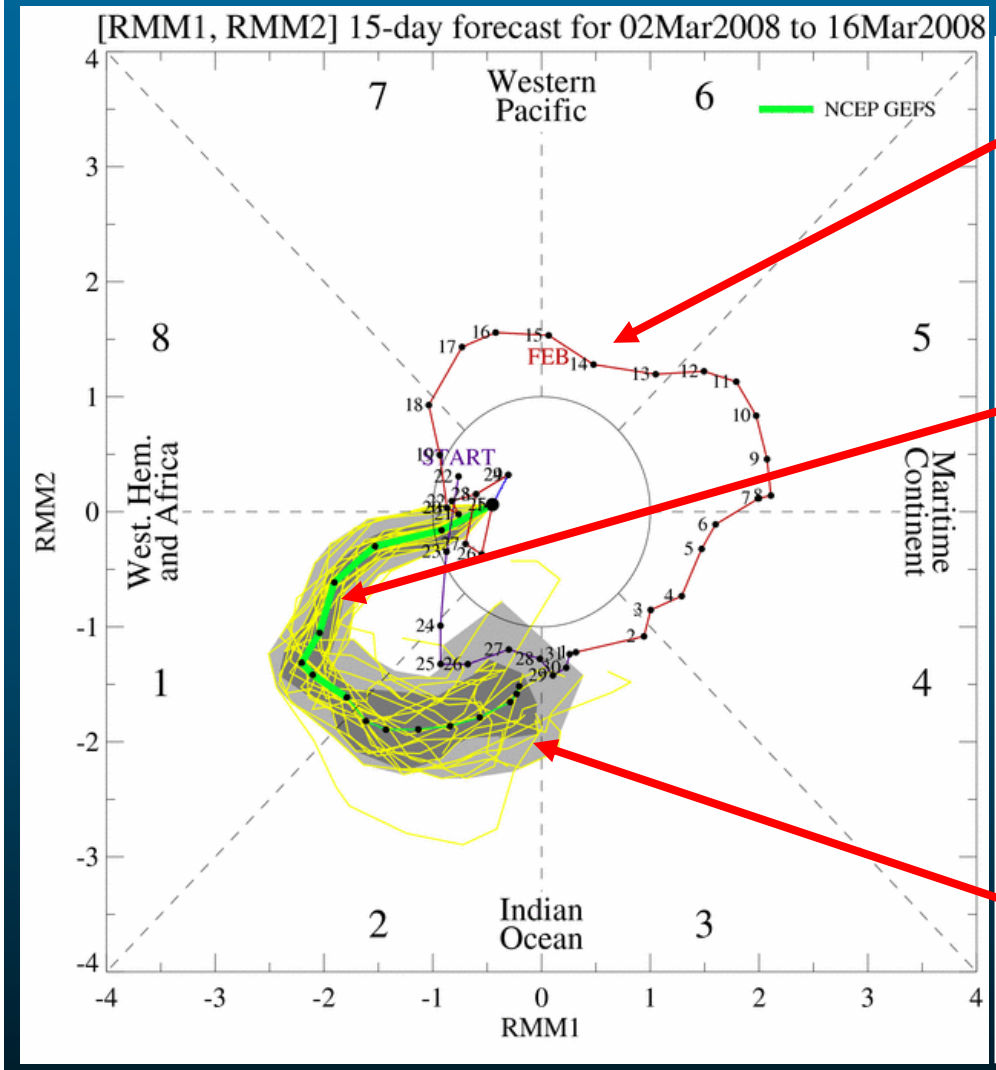
CLIVAR Activity Specifics

Center	Product ID	Ensemble Members	Forecasts Start	Forecast Length (Days)	Realtime Data FTP	Version 1 Plots	Model Climatology Available
NCEP	NCPE	21	11/1/2007	15	-----	Yes	No
NCEP	NCPA	1	1/1/2008	15	-----	Yes	No
NCEP	NCFS	4	1/1/2005	40	-----	Yes	Yes
CMC	CANM	20	6/8/2008	16	Yes	Yes	No
UKMO	UKMA	1	10/10/2007	15	Yes	Yes	No
UKMO	UKME	23	10/10/2007	15	Yes	Yes	No
ABOM	BOMA	1	1/1/2008	10	Yes	Yes	No
ABOM	BOME	32	------	10	No	No	No
ABOM	BOMC	1	1/1/2008	40	Yes	Yes	No
ECMWF	ECMF	51	6/9/2008	15	Yes	Yes	No
ECMWF	ECMM	51	6/9/2008	15	Yes	Yes	Yes
ECMWF	EMON	51 (W)	6/12/2008	32	Yes	Yes	No
ECMWF	EMOM	51 (W)	6/12/2008	32	Yes	Yes	Yes
JMA	JMAN	51	------	9	No	No	No
CPTEC	CPTC		------		Yes	No	No

See web page for key to Product IDs **W: forecast sent only once per week**

http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/clivar_wh.shtml

Examples – Display Format



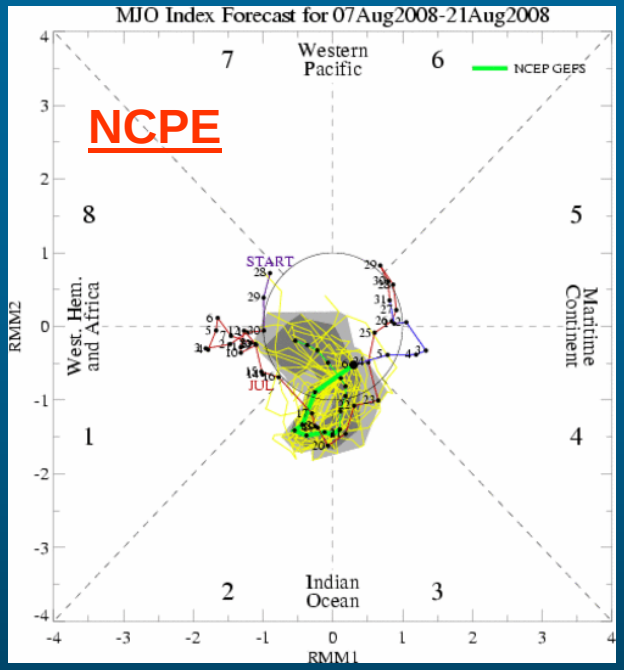
Observational RMM1 / RMM2 values for the past 40 days

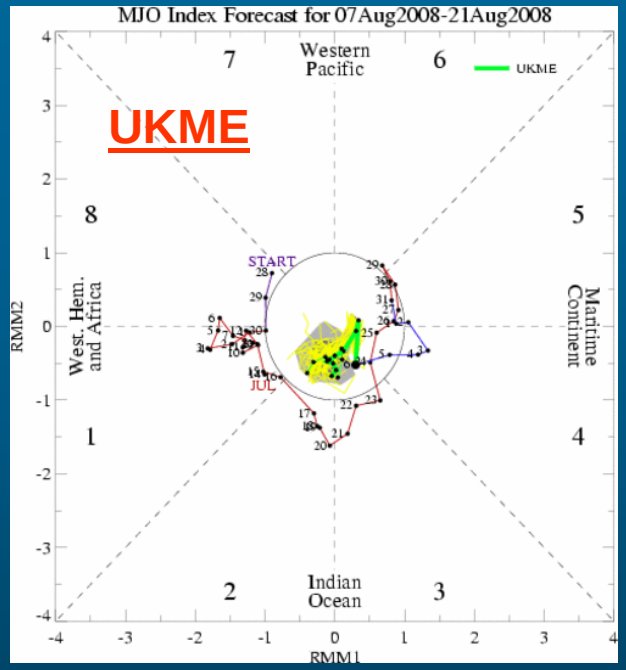
15-day model forecasts
--Green line: Ensemble mean week 1 (thick), week 2 (thin)

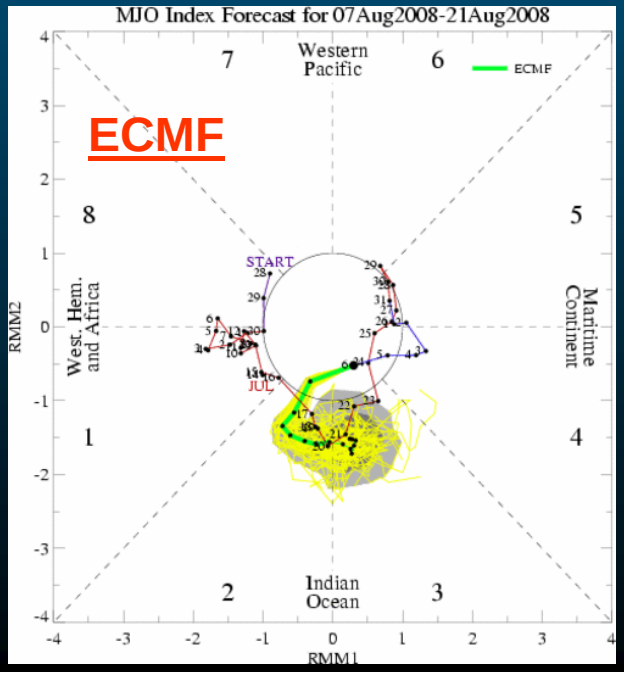
--Ensemble members

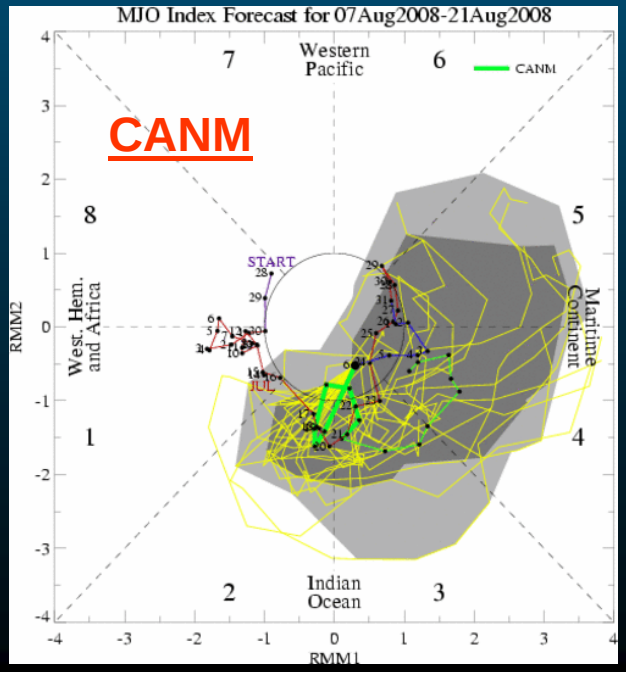
light gray shading: 90% of forecasts
dark gray shading: 50% of forecasts

Examples – Model Comparison

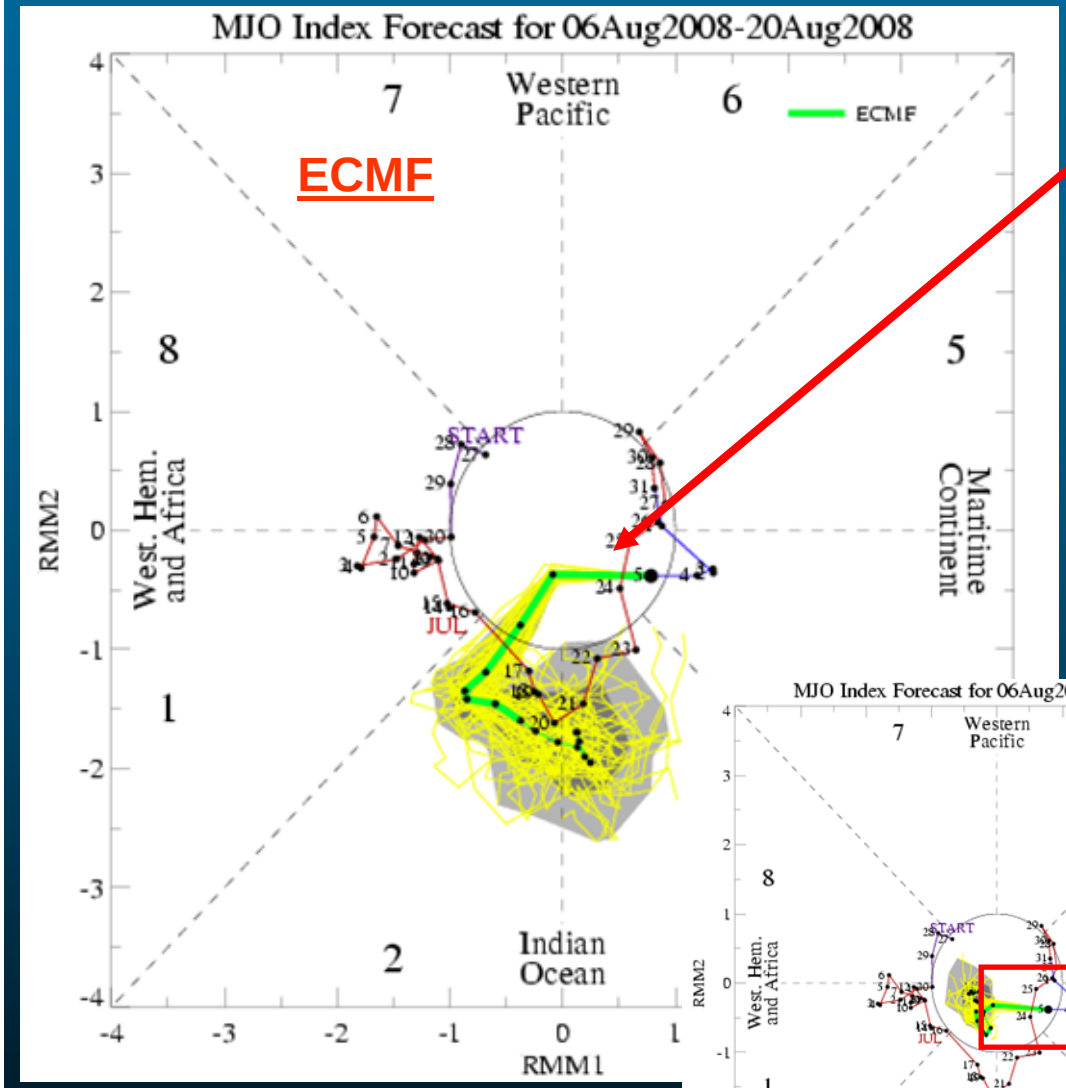








Issues – Model Bias

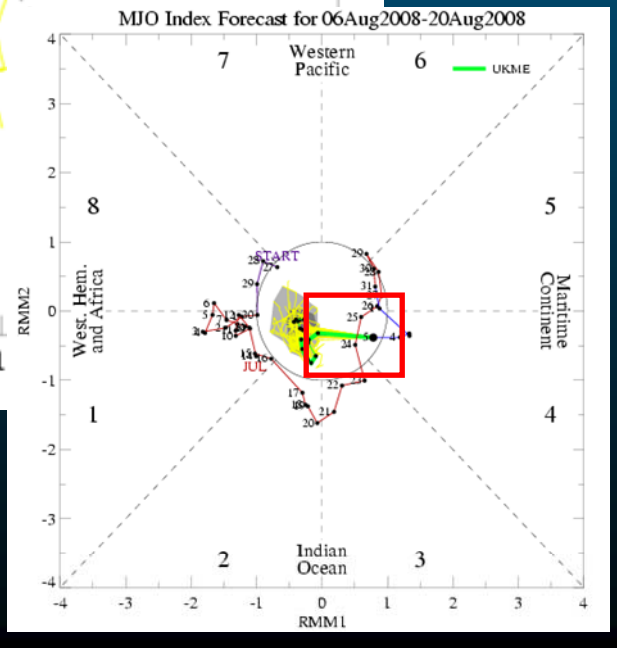


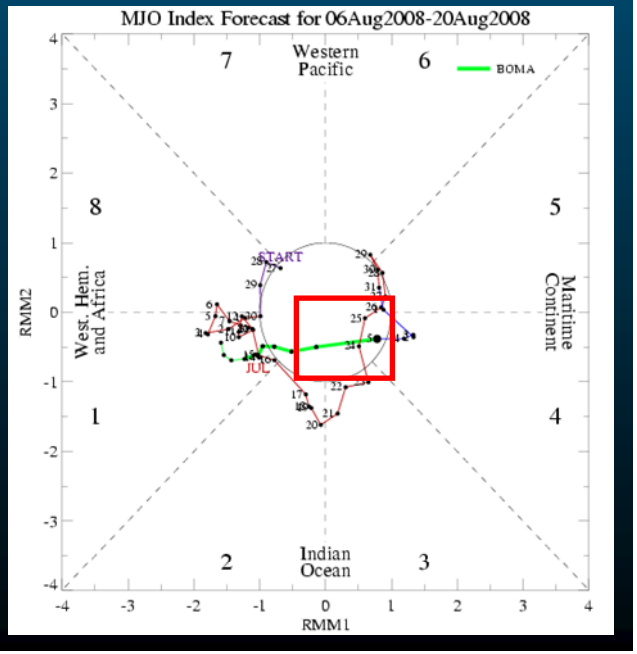
ECMF

Day 1 jump is a combination of:

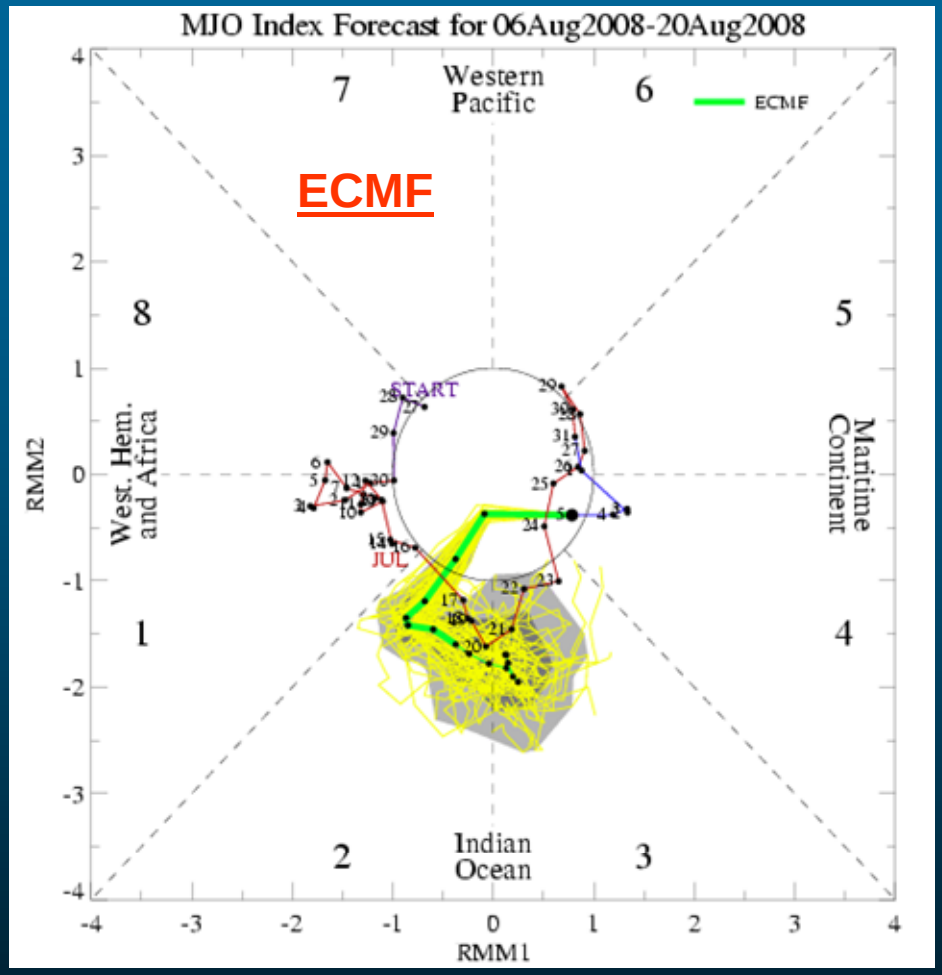
1. Both real amplitude increase (future observations show this)

2. Model bias (using NCEP Reanalysis climatology)



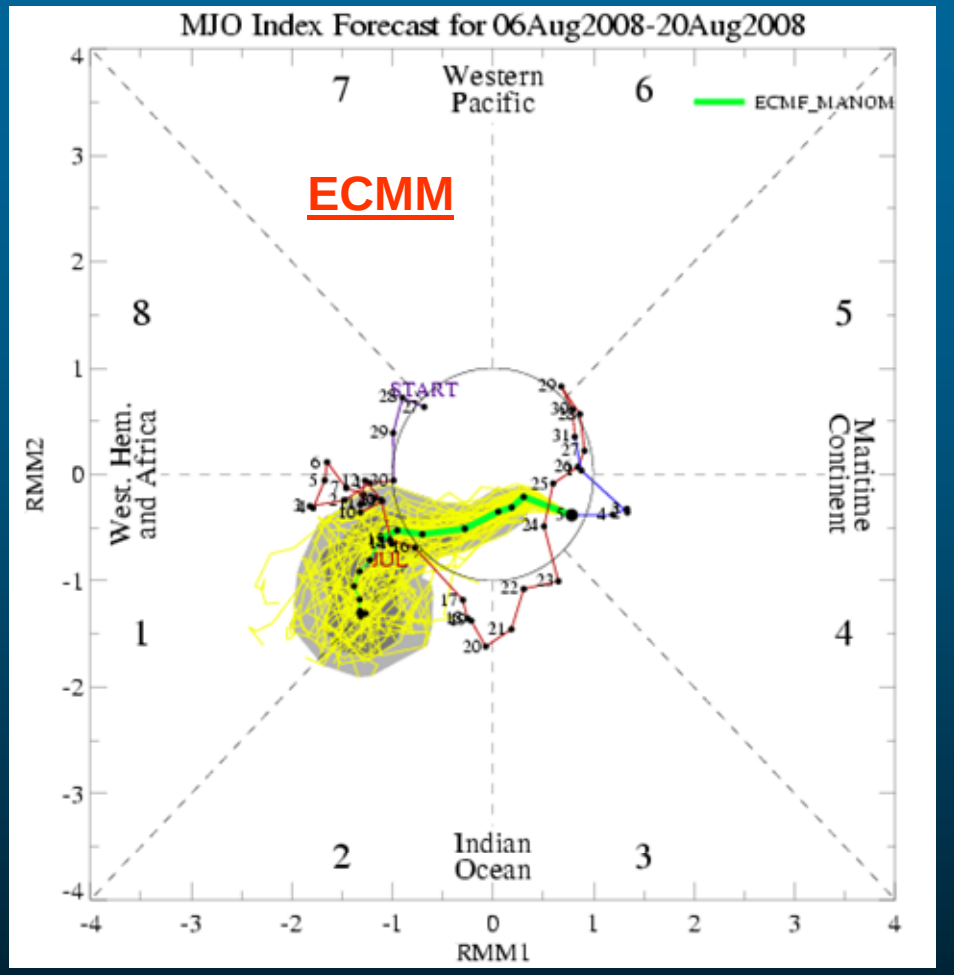


Issues – Lead Dependent Model Climatology?



ECMF

Anomalies based on using NCEP Reanalysis observation climatology

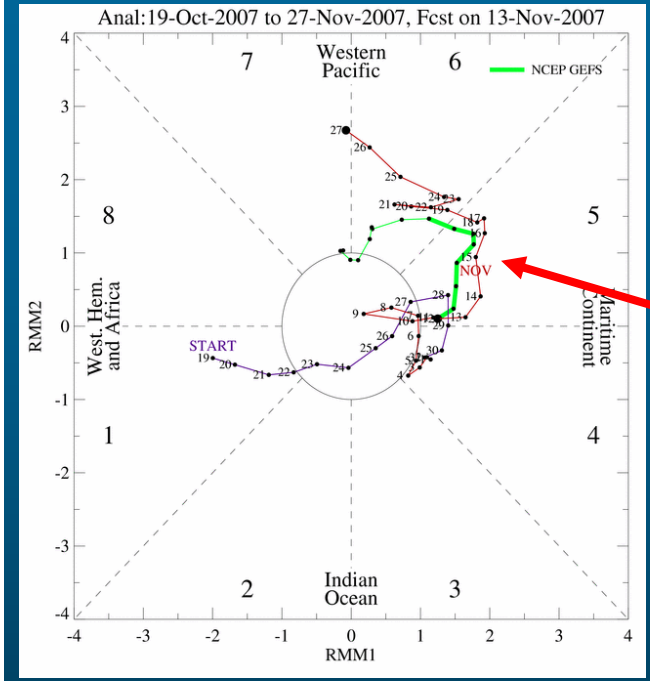


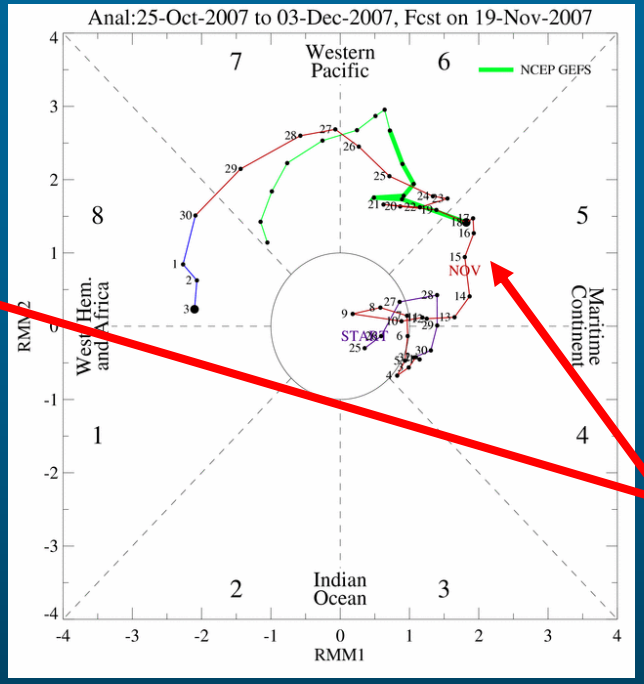
ECMM

Anomalies based on a bias corrected, model climatology

Substantial difference so we need to spend some time to verify and understand

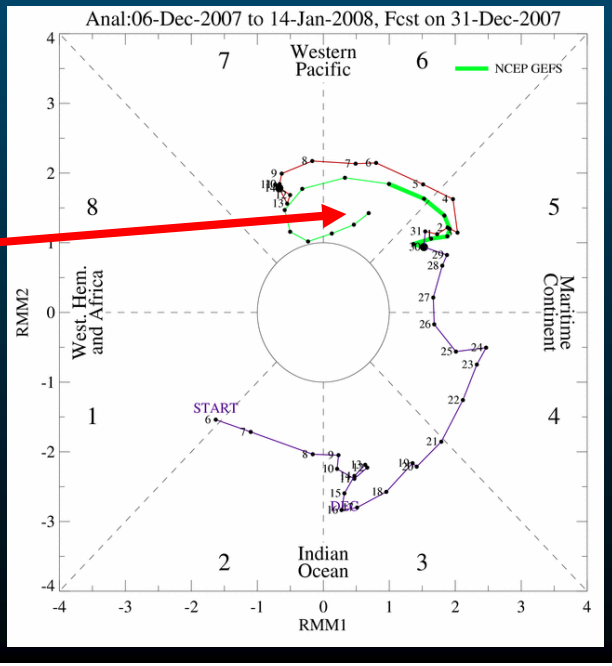
Issues – Initial Operational Lessons Learned



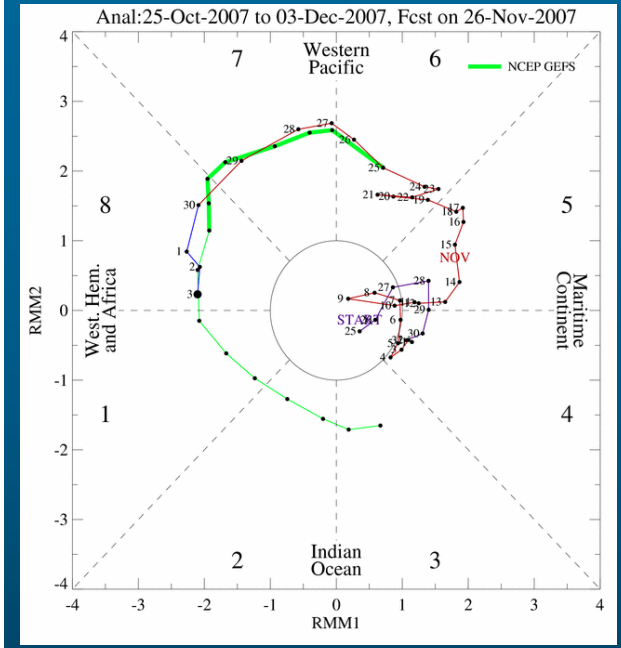


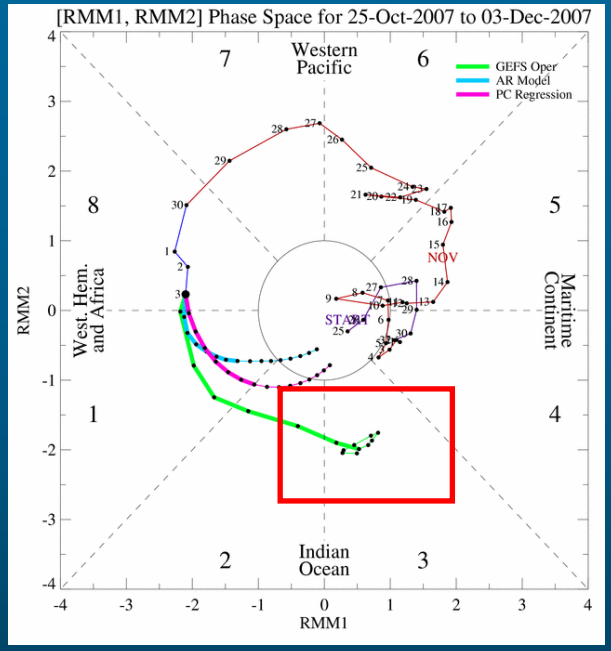
- Generally accurate depiction for strong MJO development
- Eastern Maritime Continent, western Pacific

- Second MJO cycle of 2007-2008 event
- Similar geographical location

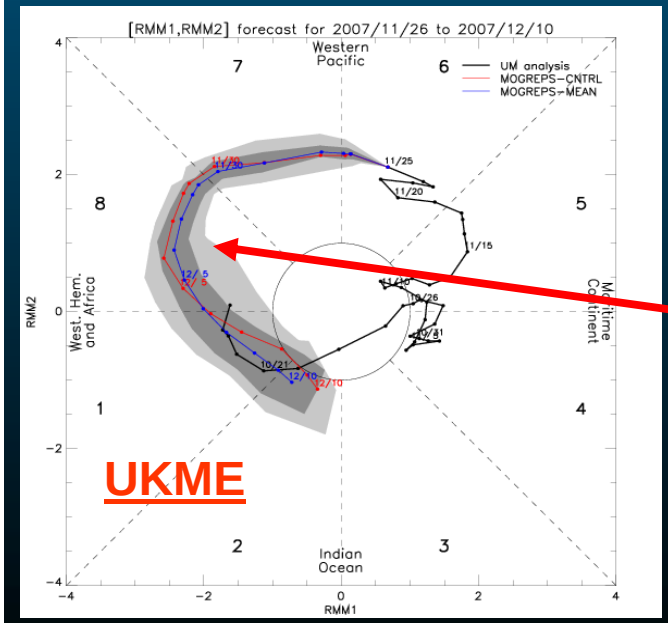


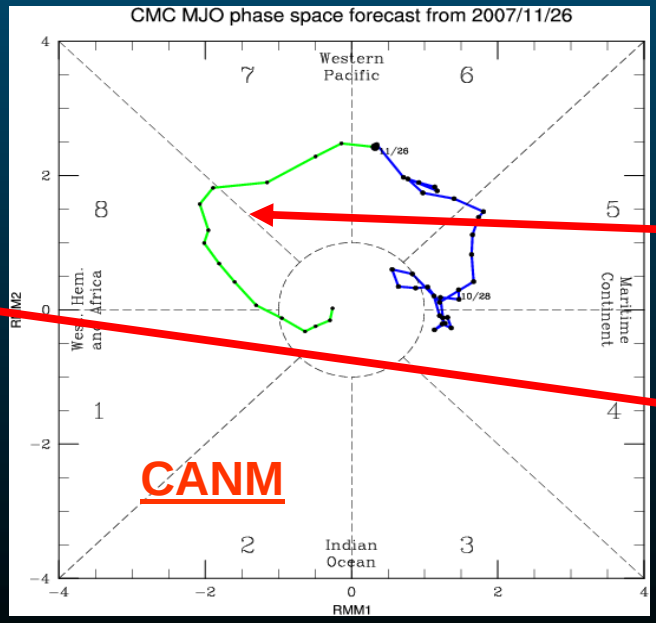
Issues – Initial Operational Lessons Learned





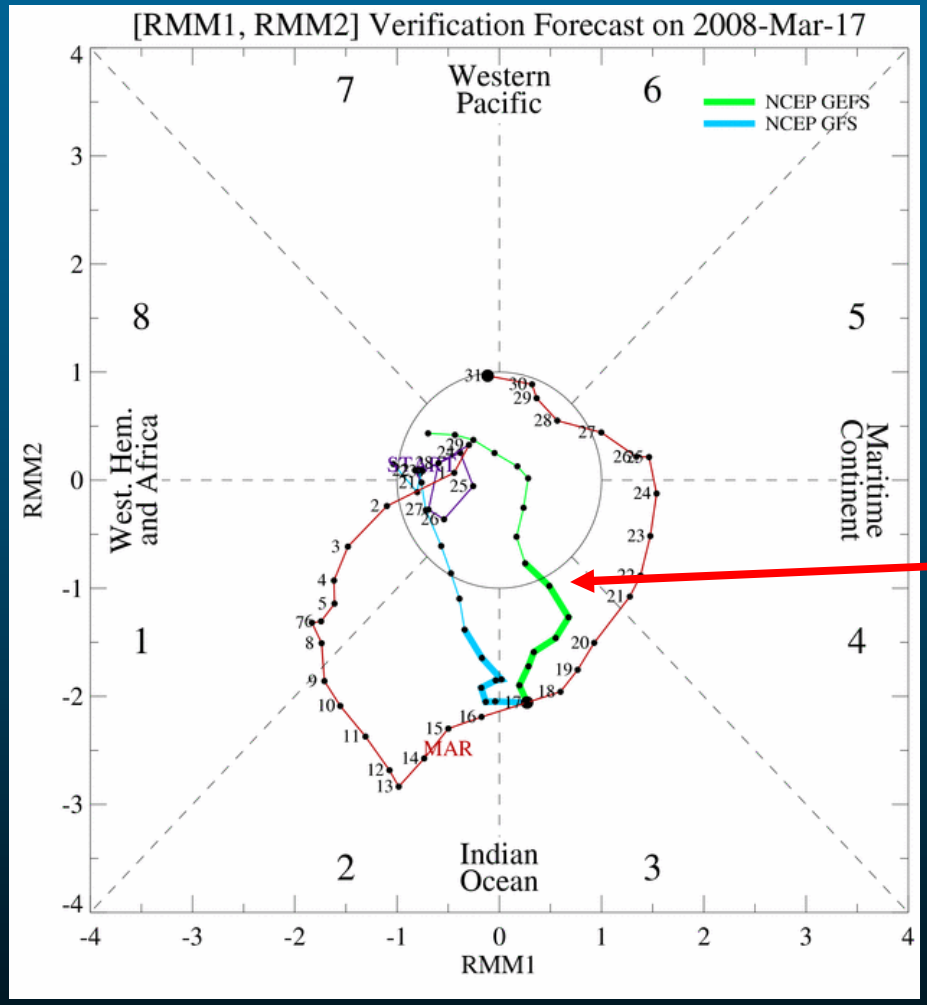
- Accurate forecasts often from Pacific into the Indian Ocean
- Wind signal contributes substantially to the MJO index





- Most models correctly forecast this evolution for the 2007-2008 MJO event

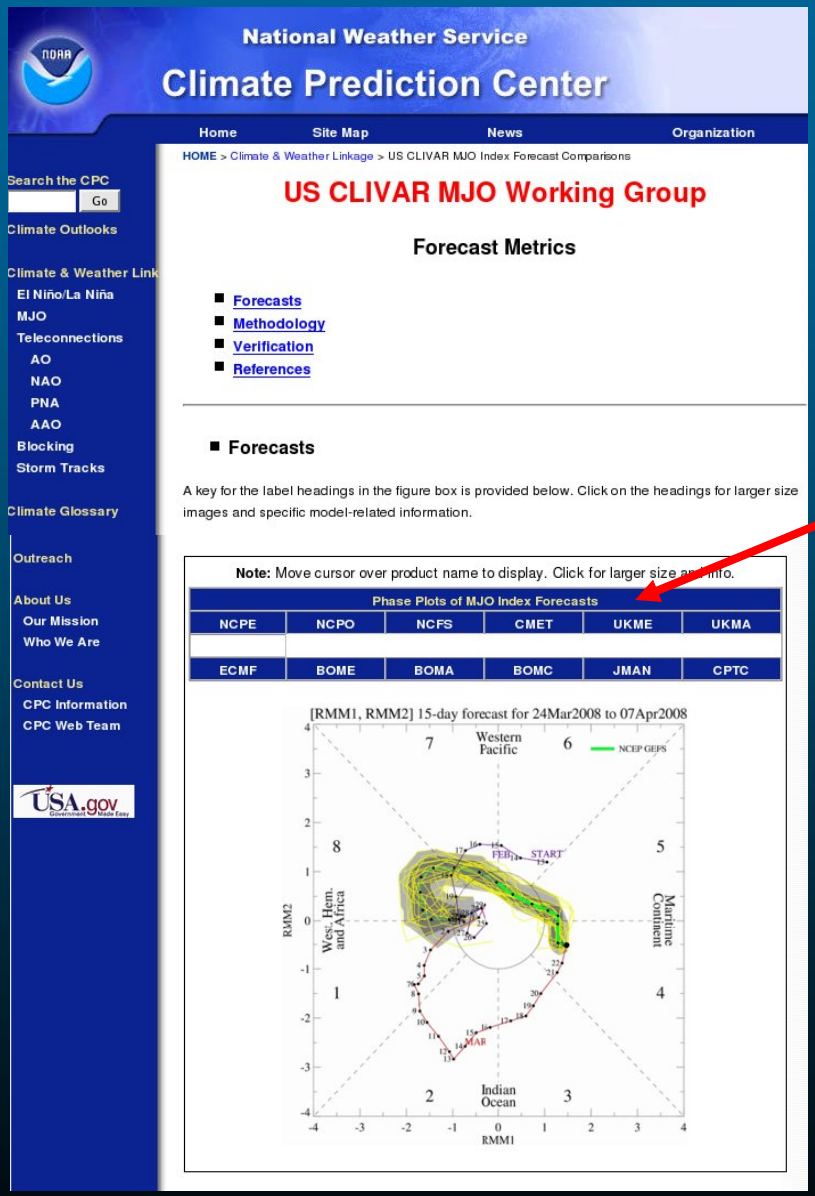
Issues – Initial Operational Lessons Learned



- Problems with MJO propagation, strength, and coherency in transition region
- Indian Ocean/Maritime Continent (model convection issues)

Preliminary Website – Main Page

http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/clivar_wh.shtml



- Scroll-over Heading Labels
- Links to Model Specific Information

Preliminary Website – Forecast Phase Plots

Outreach

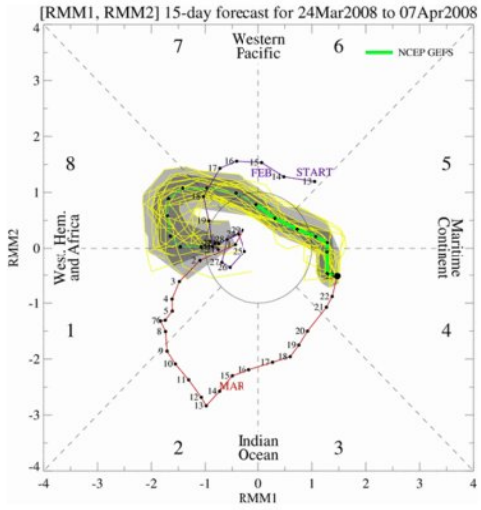
About Us
- Our Mission
- Who We Are

Contact Us
- CPC Information
- CPC Web Team

USA.gov

Note: Move cursor over product name to display. Click for larger size and info.

Phase Plots of MJO Index Forecasts					
NCPE	NCPO	NCFS	CMET	UKME	UKMA
ECMF	BOME	BOMA	BOMC	JMAN	CPTC



Heading Key:

NCPO: National Centers for Environmental Prediction - Operational Global Forecast System
NCPE: National Centers for Environmental Prediction - Ensemble Global Forecast System
NCFS: National Centers for Environmental Prediction - Climate Forecast System

UKMA: United Kingdom Meteorology Office - Operational Control Run
UKME: United Kingdom Meteorology Office - Ensemble System

ECMF: European Centre for Medium Range Weather Forecasting - Ensemble System

BOMA: Australian Bureau of Meteorology - Global Analysis and Prediction Control Run
BOME: Australian Bureau of Meteorology - Global Analysis and Prediction Ensemble System
BOMC: Australian Bureau of Meteorology - POAMA Coupled System

CMET: Canadian Meteorology Centre - Ensemble System

CPTC: Brazil Centre for Time and Climate Studies - Ensemble System

JMAN: Japan Meteorology Agency - Global Spectral Model Ensemble System

[Back to the Top]

Key for Model Heading Labels

Preliminary Website – Methodology

Model Comparison Methodology Specifics

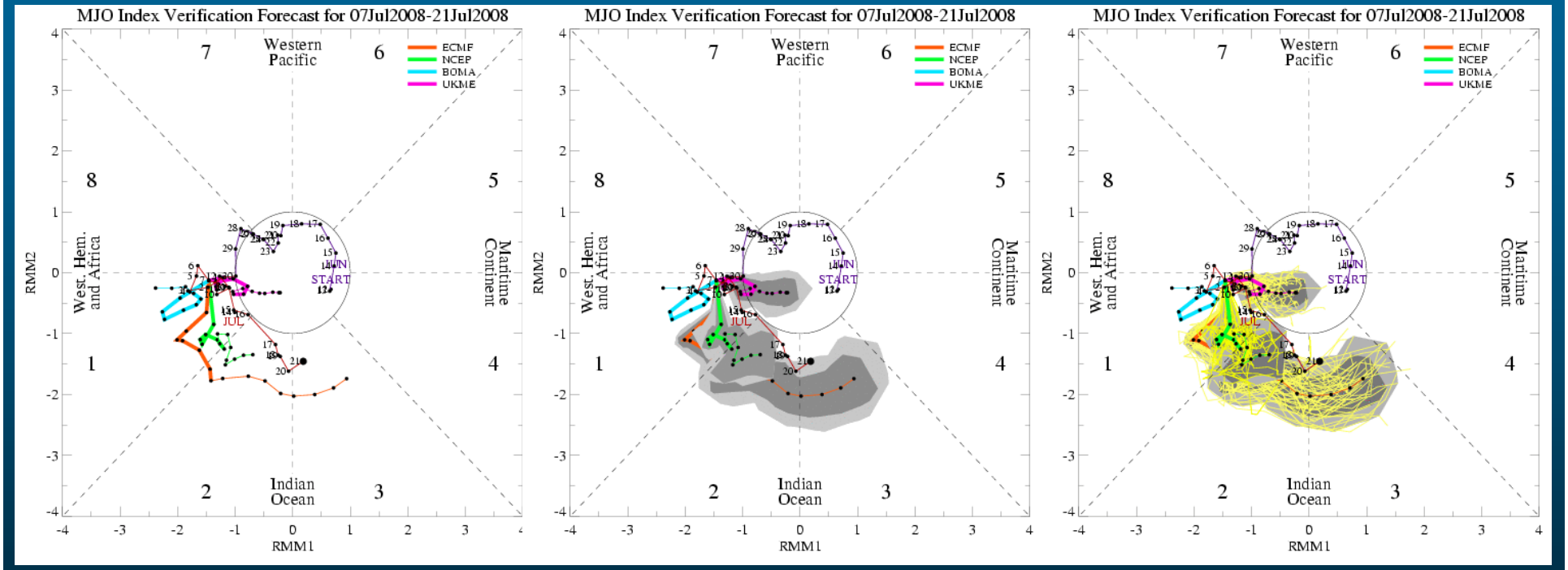
The methodology for the creation of the phase space plots above follows closely to that described in Wheeler and Hendon (2004) (hereafter WH2004). A notable difference between WH2004 and the procedure employed here is that the linear removal of the ENSO signal (related by the BMRC SST1 index) is not performed. After discussion among the MJOWG members, it was decided that this step was not necessary as the subsequent removal of the 120-day mean is sufficient to remove much of the interannual signal.

The table below summarizes the data requested by the MJOWG for the operational centers. For additional details regarding the data and methodology, see the document link below the table. This document includes background information and motivation for this activity along with directions for interested operational centers who wish to participate in this project.

Fields	OLR, u850, and u200 totals (anomaly fields optional) Initial analysis, forecasts of all ensemble members, out to no more than 40 days
Resolution	2.5 in longitude (0, 2.5E. 5.0E, Daily averaged (00-24Z))
Update Frequency	Daily, or less for those systems run at a reduced frequency Additional data during initial transfer (i.e., send analysis data for past 120 days)
Format	ASCII

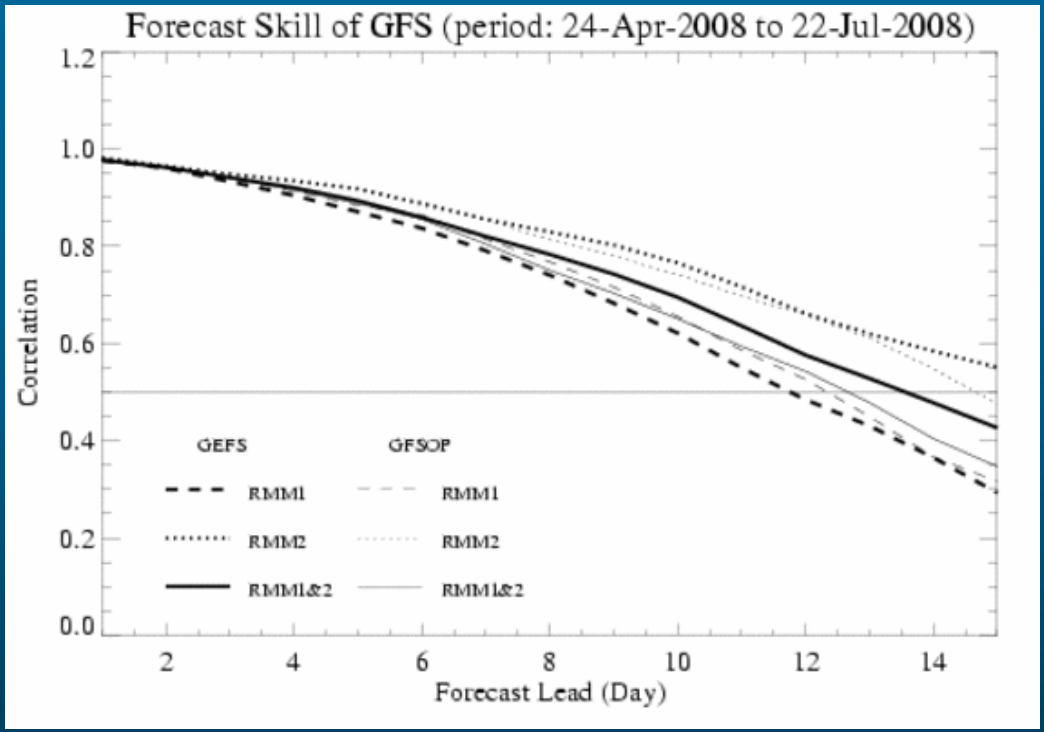
Further Information -- Working Group on Numerical experimentation (WGNE) Letter

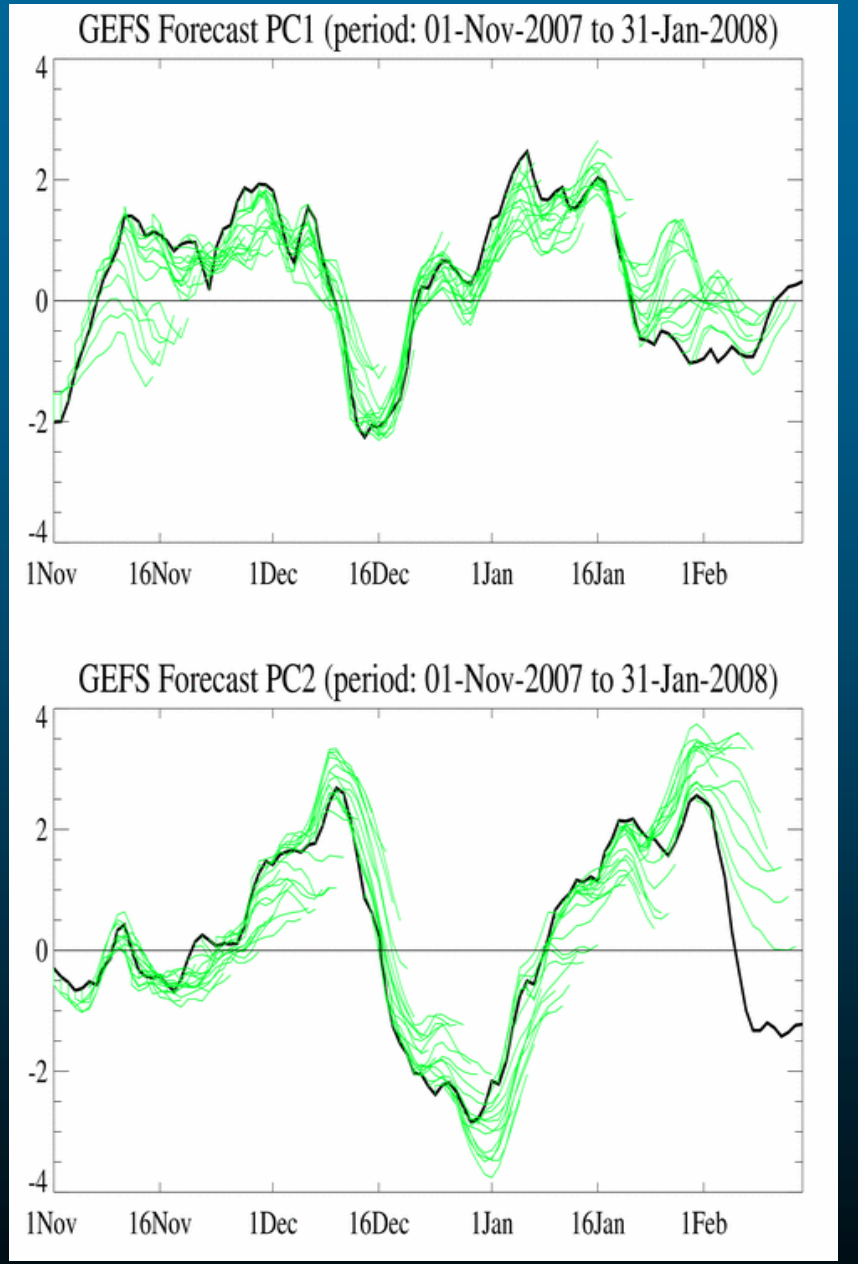
Planned Verification – Phase Plots



- **Assess overall amplitude and propagation daily**

Planned Verification





- **Currently insufficient forecast data length for verification**

Planned Verification – Comments

--Final verification of RMM's will be against a "multi-model analysis" (MMA) and satellite OLR

--Each Centre is welcome to verify forecasts with their Centre analysis

--Comprehensive verification is planned when data record is of sufficient length

- ➔ Stratify by MJO phase, amplitude, etc.
- ➔ Composite structure of each operational model MJO

Multi-Model Ensemble

- Multi-model ensemble (MME) is a high priority

- Two MME methodologies:

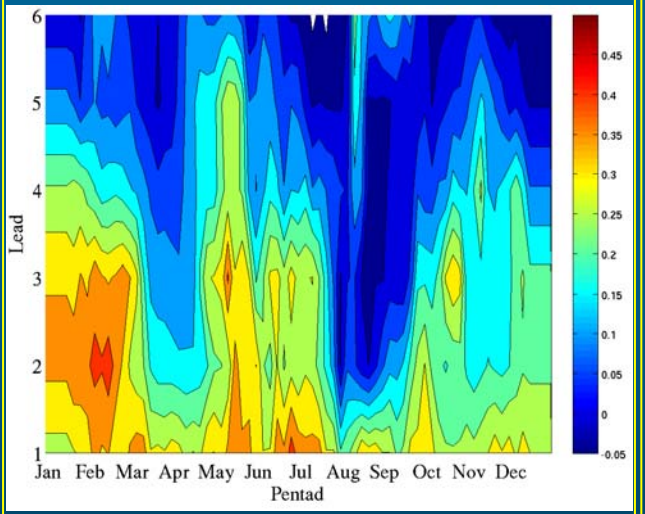
  1. Equal weights for each model at all leads and time of the year
  2. Objectively partition weights based on historical skill

➔ Focuses on utilizing the independent skill from each method
➔ Weights are a function of model, lead and seasonal cycle
➔ Retrospective forecasts needed

- Build upon similar CPC effort that uses this approach for consolidation of statistical and dynamical (CFS) MJO forecast methods

Multi-Model Ensemble

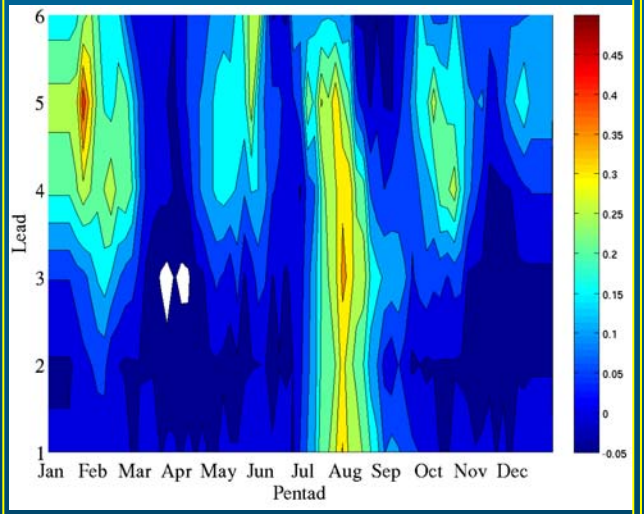
- Weights are a function of forecast method, time of year, and lead



Constructed Analogue

Greatest contribution of all methods

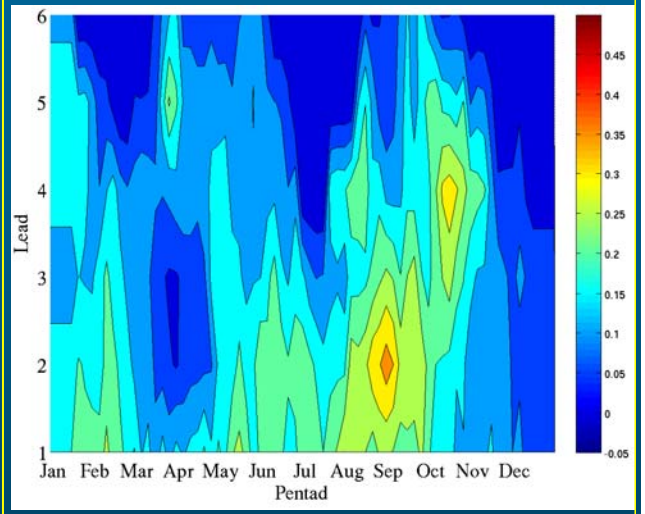
Largest during Jan-Mar, May-Jul



Autoregression Model

Little contribution to the consolidated forecast at early leads

Substantial contribution during summer



Climate Forecast System

CFS contributes to the consolidated forecast during the late summer-early fall only

Multi-Model Ensemble

- Need commitment from operational Centers

  ➔ Understanding the importance of hindcasts for MME

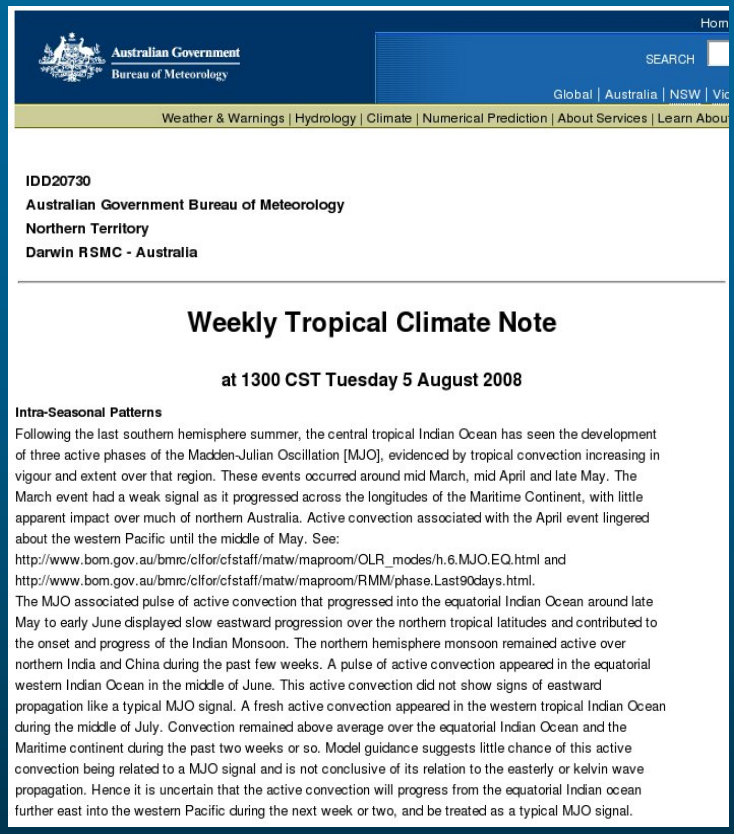
  ➔ US CLIVAR MJOWG will need to make the case for why this would work and help research and operational interests

- Computational and human resources the major roadblock

Applications – ABOM / NCEP MJO updates

Madden-Julian Oscillation:
Recent Evolution, Current Status and Predictions

Update prepared by
Climate Prediction Center / NCEP
December 3, 2007



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IDD20730
Australian Government Bureau of Meteorology
Northern Territory
Darwin RSMC - Australia

Weekly Tropical Climate Note

at 1300 CST Tuesday 5 August 2008

Intra-Seasonal Patterns

Following the last southern hemisphere summer, the central tropical Indian Ocean has seen the development of three active phases of the Madden-Julian Oscillation [MJO], evidenced by tropical convection increasing in vigour and extent over that region. These events occurred around mid March, mid April and late May. The March event had a weak signal as it progressed across the longitudes of the Maritime Continent, with little apparent impact over much of northern Australia. Active convection associated with the April event lingered about the western Pacific until the middle of May. See:
http://www.bom.gov.au/bmrc/clfor/cfstaff/matw/maproom/OLR_modes/h.6.MJO.EQ.html and
http://www.bom.gov.au/bmrc/clfor/cfstaff/matw/maproom/RMM/phase.Last90days.html.
The MJO associated pulse of active convection that progressed into the equatorial Indian Ocean around late May to early June displayed slow eastward progression over the northern tropical latitudes and contributed to the onset and progress of the Indian Monsoon. The northern hemisphere monsoon remained active over northern India and China during the past few weeks. A pulse of active convection appeared in the equatorial western Indian Ocean in the middle of June. This active convection did not show signs of eastward propagation like a typical MJO signal. A fresh active convection appeared in the western tropical Indian Ocean during the middle of July. Convection remained above average over the equatorial Indian Ocean and the Maritime continent during the past two weeks or so. Model guidance suggests little chance of this active convection being related to a MJO signal and is not conclusive of its relation to the easterly or kelvin wave propagation. Hence it is uncertain that the active convection will progress from the equatorial Indian ocean further east into the western Pacific during the next week or two, and be treated as a typical MJO signal.

Purpose:

- ➔ Review of weekly changes in the MJO
- ➔ Anticipated evolution of the MJO during the next 1-2 weeks

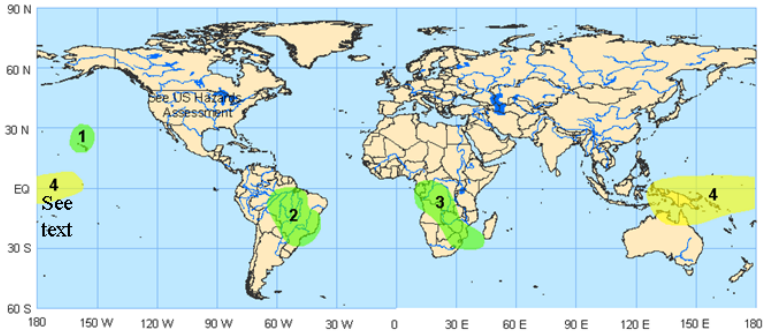
- ➔ WH phase plots from operational centers used as guidance

Applications – NCEP Global Tropics Hazard Assessment

http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/ghaz.shtml

Issued: 12/3

Week 1 Outlook – Valid: December 4 – 10, 2007



1. An increased chance for above-average rainfall for Hawaii and nearby waters mainly to the north. An upper-level cutoff low is expected to become established to the west-northwest of the Hawaiian Islands and result in rather persistent surface low pressure and so the potential for enhanced rainfall in this region during the period. **Confidence: High**

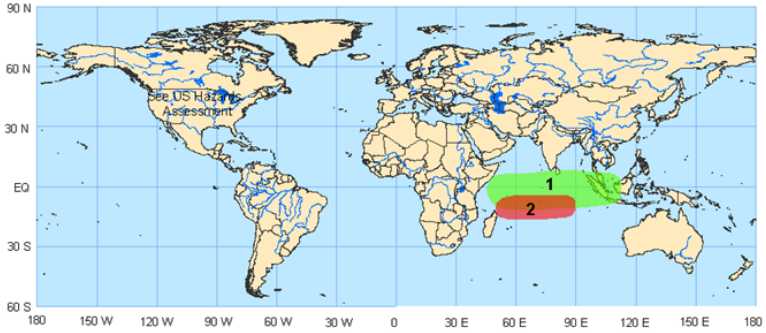
2. An increased chance for above-average rainfall for east-central Brazil. Low-latitude frontal systems and a large-scale environment favorable for convection associated with the MJO is expected to continue to produce beneficial rains across this region during the period. **Confidence: High**

3. An increased chance for above-average rainfall for sections of interior and southern Africa. The enhanced phase of the MJO will produce a favorable environment for convection especially across interior Africa. Southern hemisphere frontal activity will likely increase the flow of moisture southeast towards southern Africa resulting in enhanced rainfall during the period. **Confidence: High**

4. An increased chance for below-average rainfall for the eastern Maritime continent, northern Australia, and the western Pacific Ocean. The suppressed phase of the MJO and cool sea surface temperatures associated with La Nina is expected to result in drier-than-average conditions across this region. **Confidence: High**

Issued: 12/3

Week 2 Outlook – Valid: December 11 – 17, 2007



1. An increased chance for above-average rainfall for the equatorial Indian Ocean and western Maritime continent. The enhanced phase of the MJO is expected to continue shifting eastward during the period and provide a favorable large-scale environment for convection in this region. **Confidence: High**

2. Favorable conditions exist for tropical cyclogenesis across the western Indian Ocean. The enhanced phase of the MJO is expected to result in active convection in this region and result in a greater likelihood for low-level westerly flow, upper-level divergence, and other factors favorable for tropical development. Sea surface temperatures are also warmer than average in this region. **Confidence: High**

Applications – NCEP Global Tropics Hazard Assessment

Outlook:

- Extensive, persistent enhanced / suppressed rainfall
- Regions favorable/unfavorable for tropical cyclogenesis
- Week 1 and 2

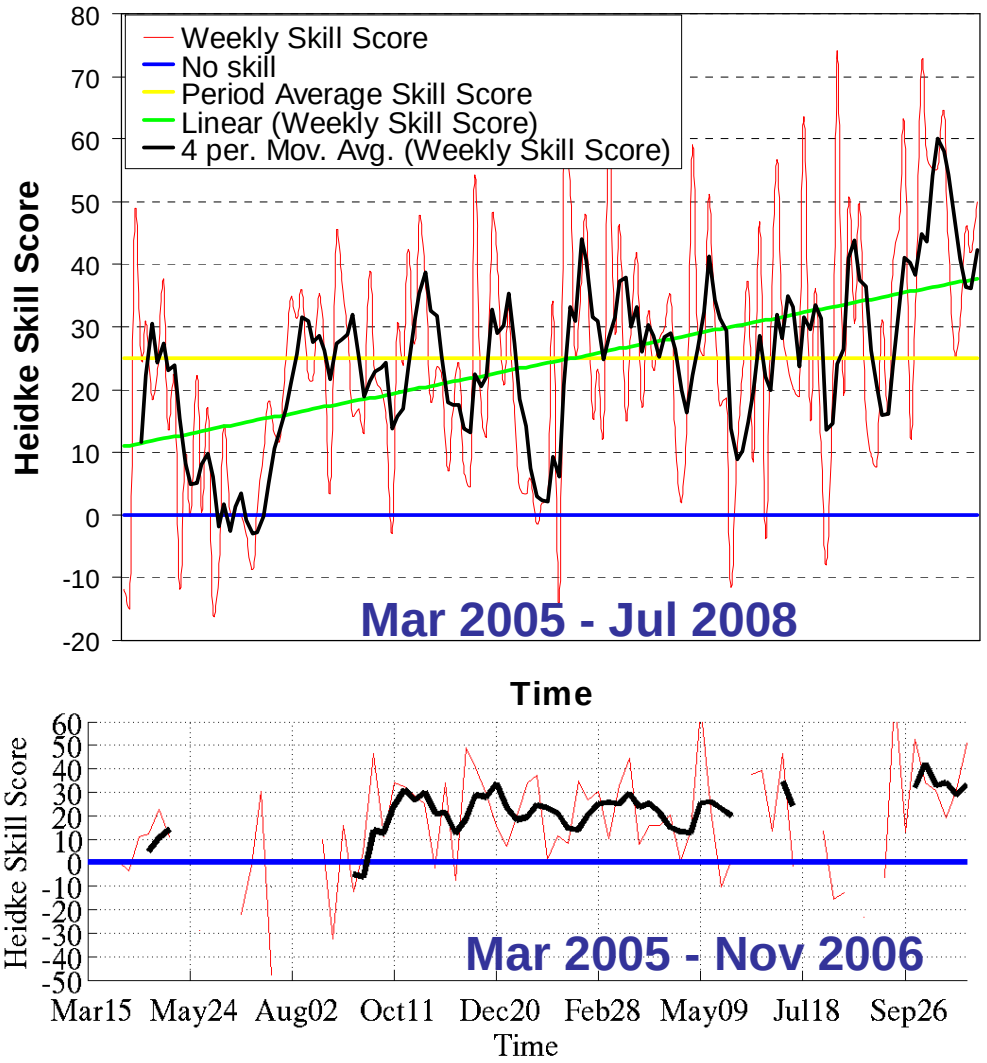
Purpose:

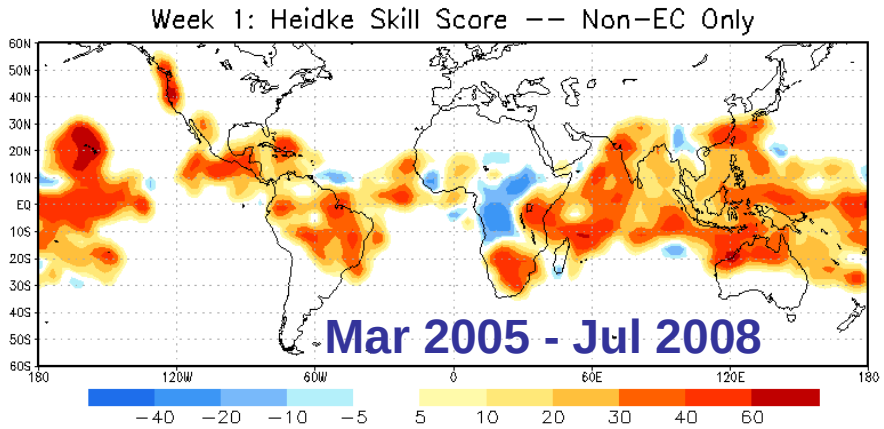
- Advance notice of potential hazards related to climate, weather and hydrological events (US sectors: finance, energy, agriculture, water resources)

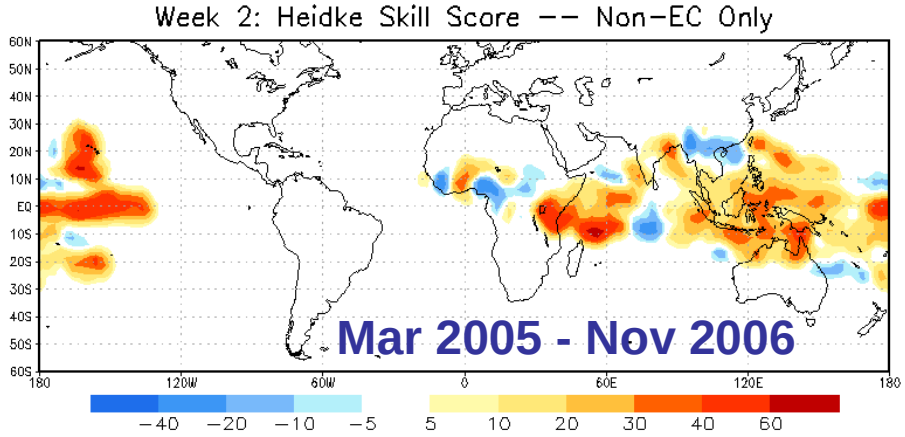
Forecast Physical Basis:

- ENSO, MJO, ISO, other coherent subseasonal tropical variability
- Interactions with the extratropical circulation
- Numerical weather forecast guidance
- Boundary layer forcing (*i.e.* SST, soil moisture, *etc.*)
- Statistical tropical cyclone development tools

Applications – NCEP Global Tropics Hazard Assessment







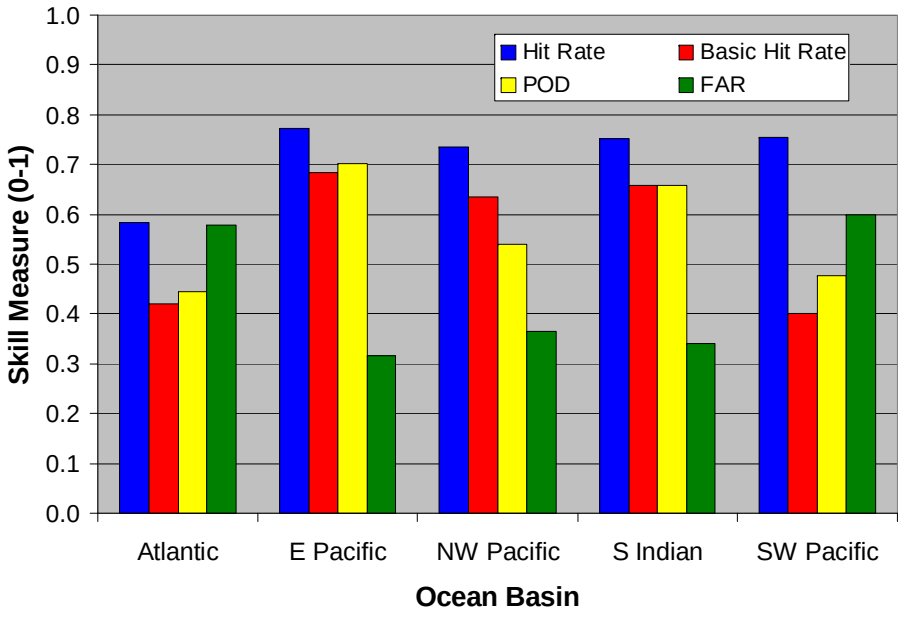
--Positive values indicate the percent improvement over random forecasts

--Zero (blue line) indicates no skill

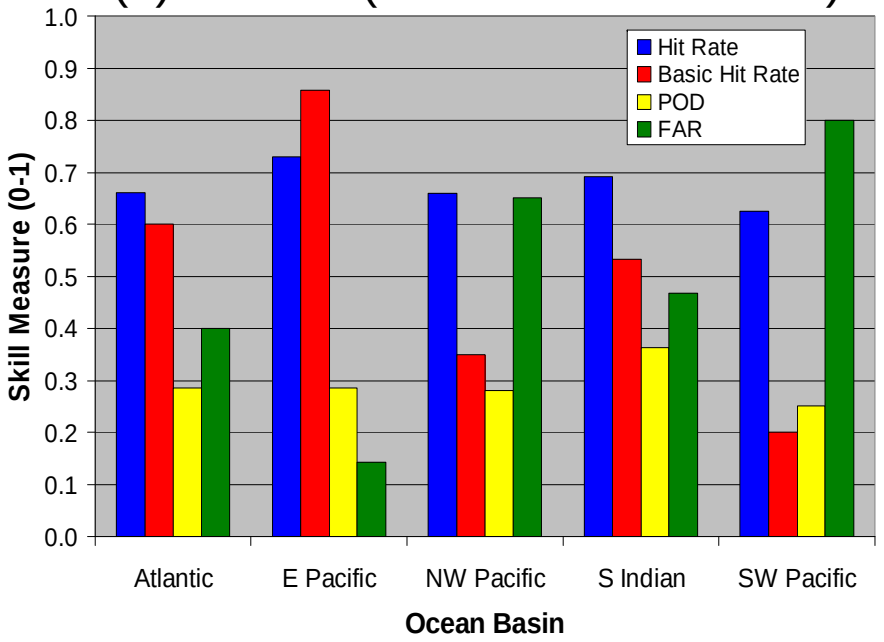
--Negative values indicate the percent degradation over random forecasts

Applications – NCEP Global Tropics Hazard Assessment

(a) Week 1 (Mar 2005 - Jul 2008)



(b) Week 2 (Mar 2005 - Feb 2007)



Forecast \ Observed	yes	no
yes	a	b
no	c	d

- **Hit Rate:** correct "yes" and "no" forecasts, [(a+d)/n]
- **Basic Hit Rate:** correct "yes" forecasts, [a / (a+b)]
- **Probability of Detection (POD):** [a / (a+c)]
- **False Alarm Rate (FAR):** [b / (a+b)]
- The total number of forecasts, n=(a+b+c+d)

Closing Remarks -- Status

- Initial infrastructure, procedure, format established at CPC for forecasting metric activity of the MJOWG
- Participation from 7 operational centers
- Initial application of CLIVAR recipe applied to most model data streams
- Version 1 realtime webpage developed

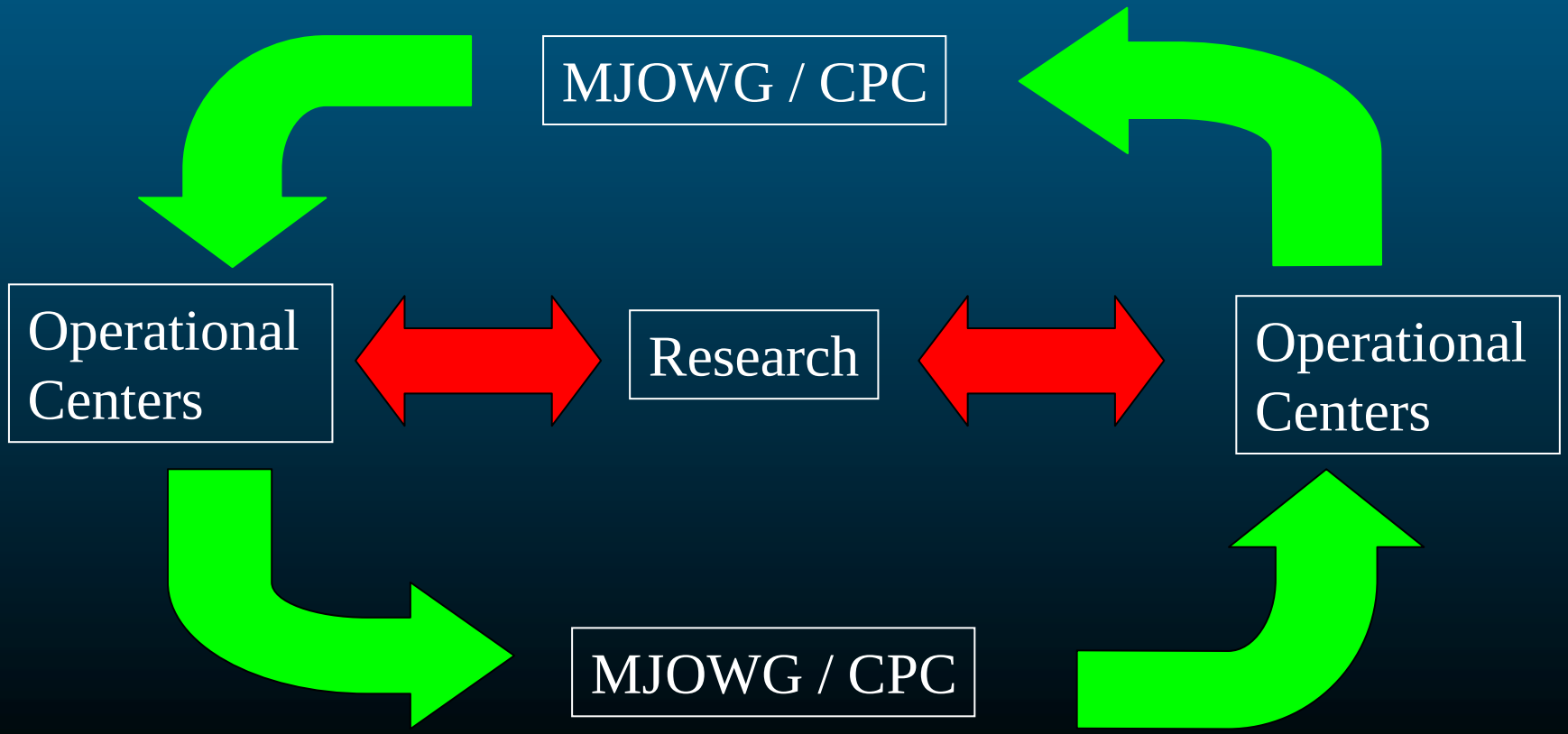
Closing Remarks – Moving Forward

• Substantial issues need to addressed (bias, further inspection of data, reasons for large differences, etc.)

• Feedback from MJOWG/CPC to operational centers

1. Plan to organize and document above issues as a function of PID

2. Document operational forecast experience as a function of PID



Closing Comments – Moving Forward

- Seek participation from additional operational centers

- Website will be vetted through the MJOWG and operational centers before officially publicized to the larger community

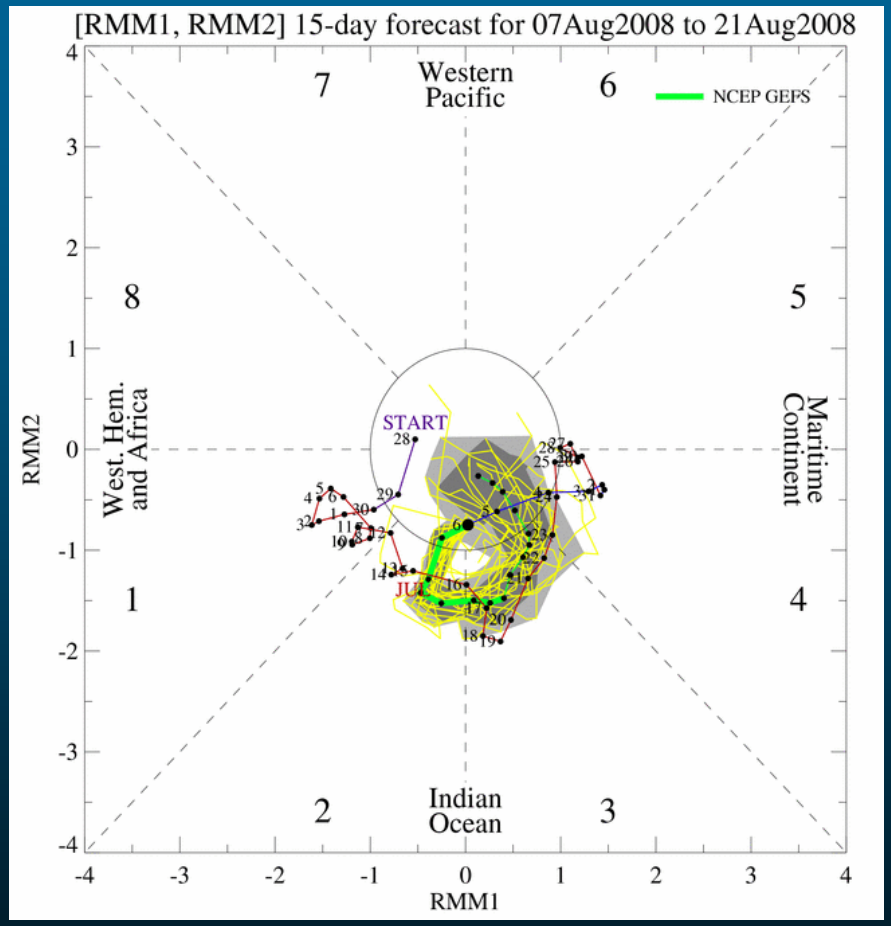
- Please don't forget about the **operational forecasting community** when doing your MJO and monsoon research work

Questions / Comments / Suggestions?

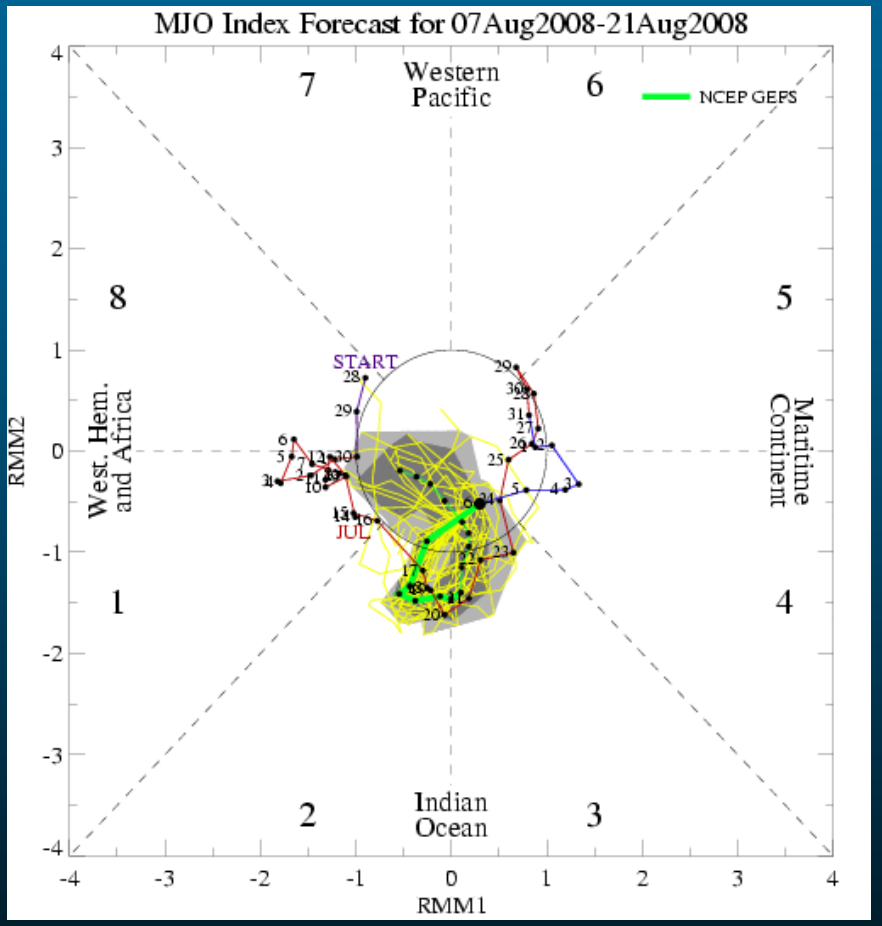
Jon.Gottschalck@noaa.gov

Examples – WH2004 vs CLIVAR

Non-CLIVAR Recipe (Current CPC Realtime)



CLIVAR Recipe

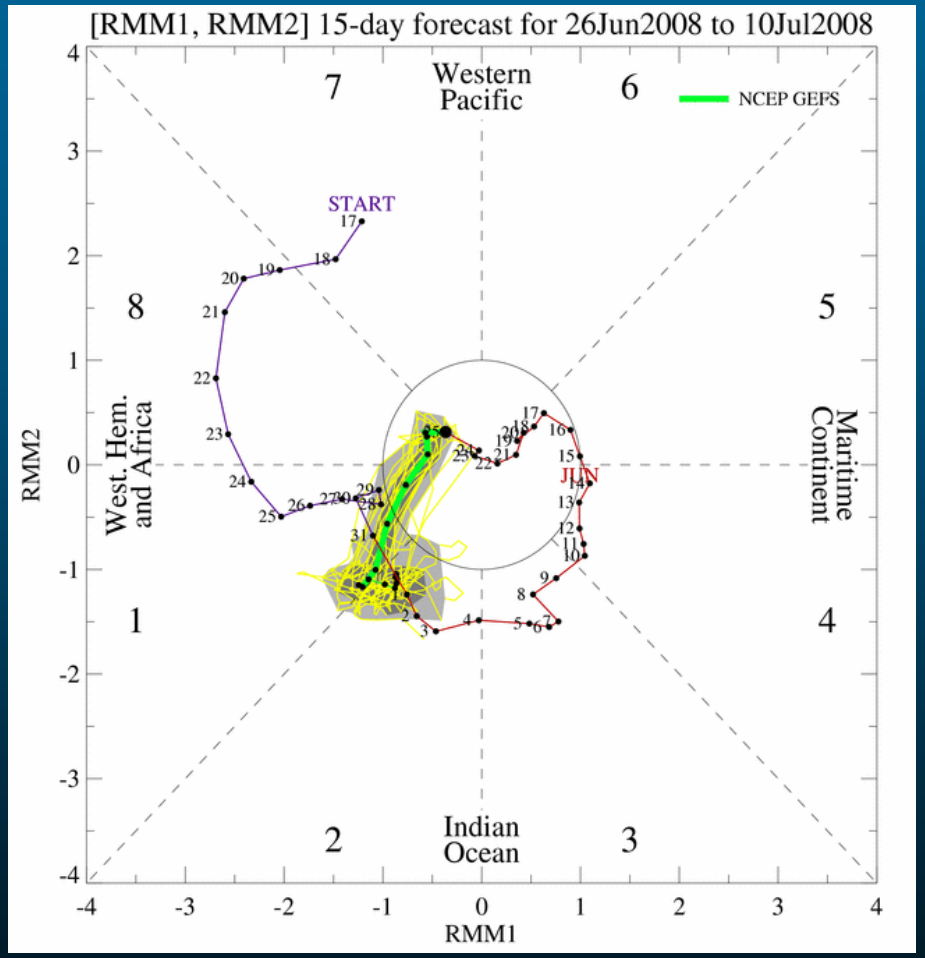


➔ Slight shift to the upper-left in phase space

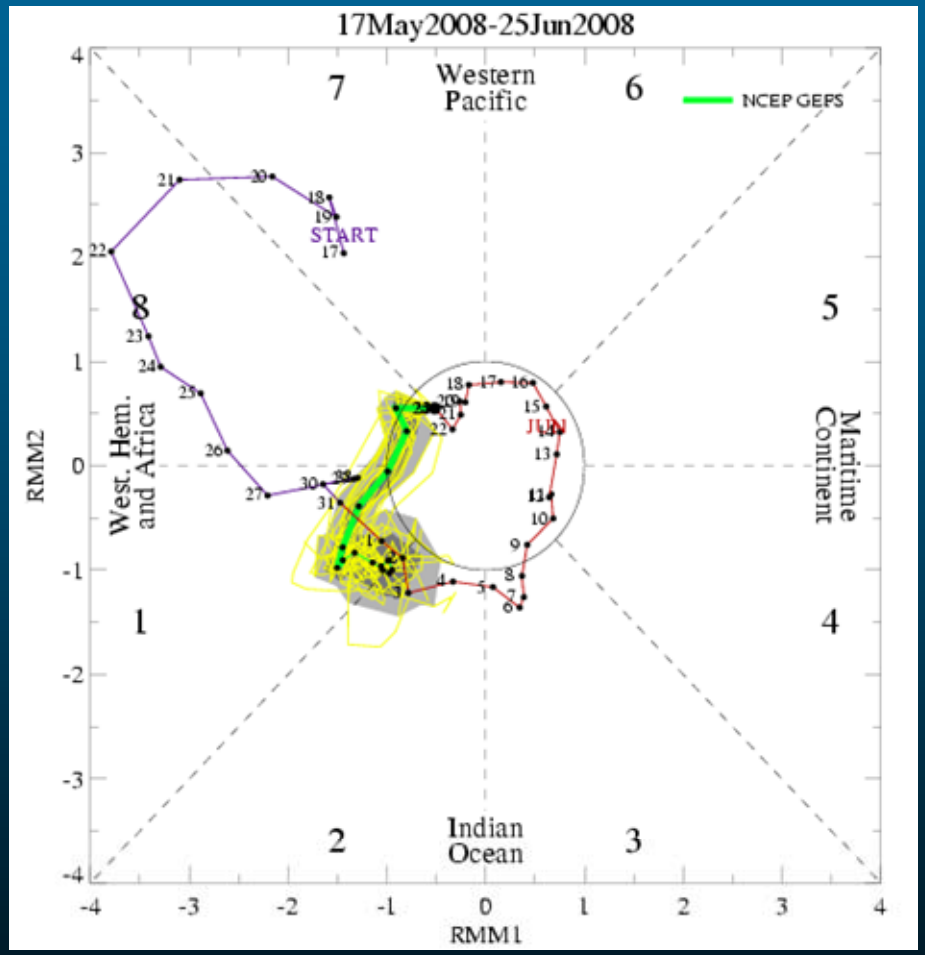
➔ Plots similar to first order

Examples – WH2004 vs CLIVAR

Non-CLIVAR Recipe (Current CPC Realtime)



CLIVAR Recipe



➔ Slight shift to the upper-left in phase space

➔ Plots similar to first order

Planned Verification