WGNE MJO Task Force: Current Activities and Next Steps

Jon Gottschalck
on Behalf of the WGNE MJO Task Force

MJO Task Force: Background

- Renewed in early 2013 for a term of 3 years
- Sponsor: Working Group on Numerical Experimentation (WGNE)
- Follow on from the WCRP-WWRP/THORPEX/YOTC MJOTF and US CLIVAR MJO Working Group
- Website: http://www.wmo.int/pages/prog/arep/wwrp/new/MJO_Task_Force_index.html

Members

Steve Woolnough	University of Reading **(co-chair)**
Eric Maloney	Colorado State University **(co-chair)**
Charlotte DeMott	CMMAP/Colorado State Univ
Jon Gottschalck	National Centers for Environmental Prediction
Daehyun Kim	University of Washington
Nick Klingaman	University of Reading
Tieh-Yong Koh	Nanyang Technological University
June-Yi Lee	Pusan National University
Adrian Matthews	University of East Anglia
Tomoki Miyakawa	AORI/ University of Tokyo
Richard Neale	National Center for Atmospheric Research
Camille Risi	IPSL/Laboratoire de Météorologie Dynamique
Ken Sperber	PCDMI/Lawrence Livermore National Laboratory
Matthew Wheeler	Centre for Australian Weather and Climate Research
Prince Xavier	UK Met Office

Important others and former members

X. Jiang, D. Waliser, J. Petch, F. Vitart, J. Benedict, H. Hendon, D. Raymond, Xiouhua Fu, Chidong Zhang, Augustin Vintzileos, Masaki Satoh, Hai Lin, Mitch Moncrieff, Min-Seop Ahn, Hae-Jeong Kim, Surya Rao, Jerome Vialard

<u>Overall Goal</u>: Facilitate improvements in the representation of the MJO in weather and climate models to increase the predictive skill of the MJO and related weather and climate phenomena.

<u>Organized into 5 Subprojects:</u>

- **Process-oriented diagnostics/metrics for MJO simulation**

  (leads: D. Kim, P. Xavier, E. Maloney, T. Miyakawa, C. Risi, R. Neale)
- **Evaluation of real-time forecasts of tropical intraseasonal variability** *(leads: J.-Y. Lee, M. Wheeler, J. Gottschalck)*
- **Assessment of CMIP5 model capability to simulate realistic intraseasonal variability** *(leads: K. Sperber, D. Kim, M.-S. Ahn)*
- **MJO TF + GASS Multi-Model Diabatic Processes Experiment**

  (leads: D. Waliser, X. Jiang, J. Petch, P. Xavier, S. Woolnough, N. Klingaman)
- **Develop, coordinate, and promote analyses of MJO air-sea interaction** *(leads: C. DeMott, N. Klingaman, S. Woolnough)*

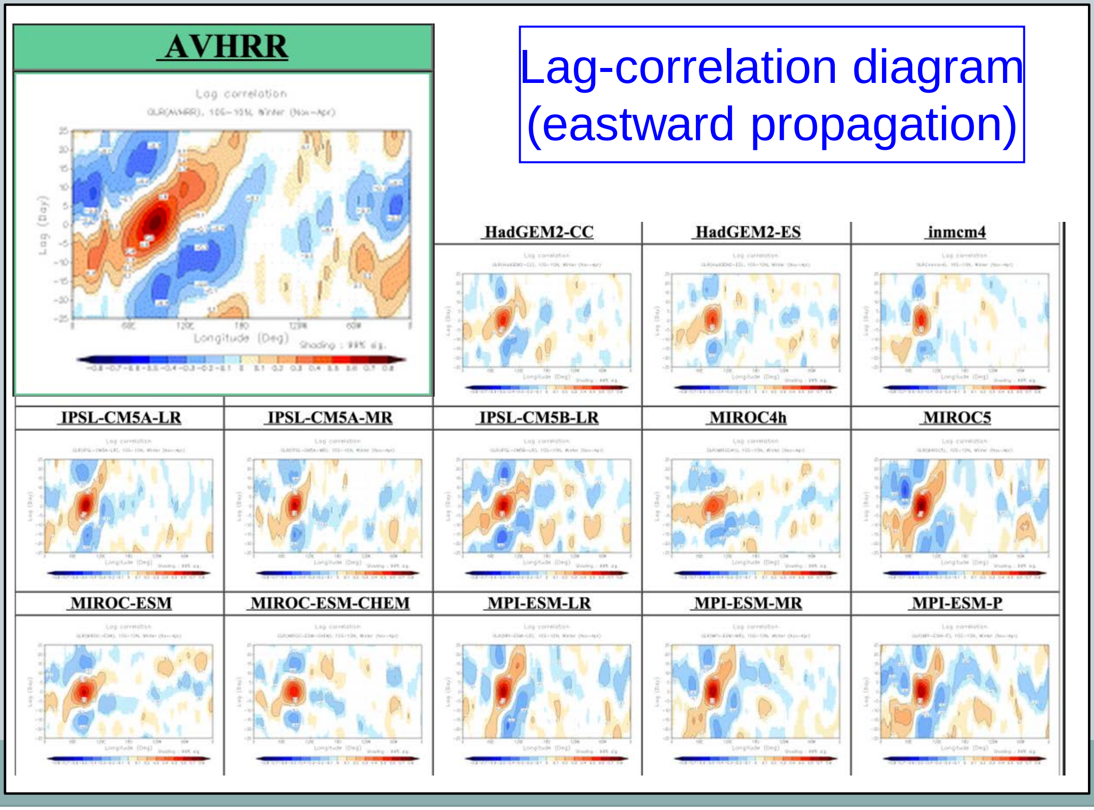
MJO simulation capability - CMIP5 models

- **Goal**: Contribute to the **assessment of CMIP5 model capability** to simulate realistic intraseasonal variability, including the development of simplified MJO metrics to **support the work of the WGCM/WGNE Climate Model Metrics Panel**.
- **Key outcomes**:
  - **Development of simplified MJO metric from projection of model data onto observed OLR EOF pair** and determine the maximum correlation between the projection coefficients, and the lag at which it occurs (Sperber and Kim 2012)
  - **Comprehensive analysis of intraseasonal variability in CMIP5 models**, (Ahn et al. 2015, in prep)

- **http://climate.snu.ac.kr/mjo_diagnostics/index.htm**

MJO simulation capability - CMIP5 models

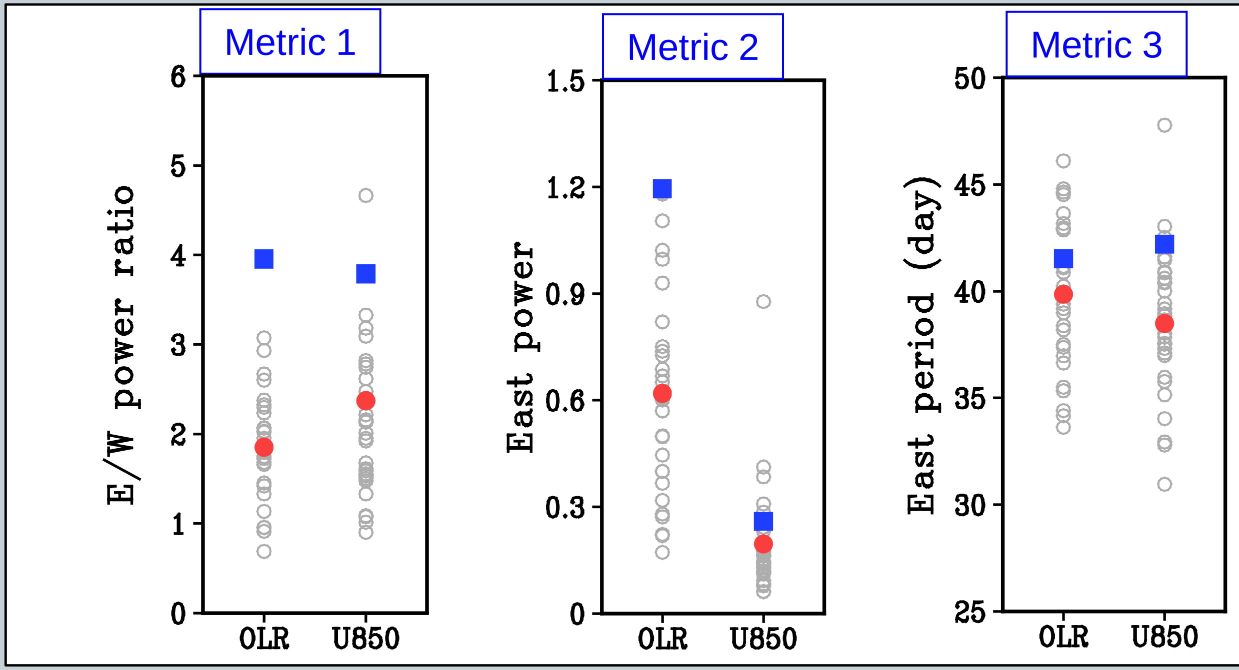
- CLIVAR MJO simulation diagnostics (CLIVAR MJO WG 2009) applied to CMIP5 models by Min-Seop Ahn (Seoul National University)
- Results posted online (**http://climate.snu.ac.kr/mjo_diagnostics/index.htm**)



- Diagnostics that have applied include
  - EOF
  - Lag-correlation (left)
  - Space-time power spectrum
  - Wheeler-Kiladis diagram
  - CEOF analysis
  - Mean state
  - Relationship with process-oriented diag.
- Research paper based on the analysis in preparation

MJO simulation capability - CMIP5 models

MJO metrics based on space-time power spectrum



- **Blue square(■):** OBS(AVHRR,NCEP1)
- **Red circle(●):** Multi-model mean
- **Open circle(○):** CMIP5 models

○ Metric 1: East/west power ratio from space-time power spectrum

○ Metric 2: East power from space-time power spectrum

○ Metric 3: East dominant period from space-time power spectrum

Points

- **Most CMIP5 models underestimate the E/W power and the East power**
- **Most CMIP5 models simulate fast MJO propagation speed compared to observations**

ISV Monitoring and Forecasting

Goal: Promote the ongoing **evaluation of real-time forecasts of tropical intraseasonal variability**, including efforts to develop and implement boreal summer ISV forecast metrics under operational conditions. **Coordinate with WGNE to implement the new metrics within the operational forecast centers**.

Key Outcomes:

- **Definition** of real-time multivariate BSISO indices (Lee et al. 2013)
- **Assessment of predictability and prediction skill** for BSISO indices using Intraseasonal Variability Hindcast Experiment (ISVHE) data (Neena et al. 2014; Lee et al. 2015). The model range of useful forecast skill for BSISO indices is 10-20 days for the two years of 2013-2014.
- **Real-time monitoring and forecast activities** in collaboration with APEC Climate Center (Wheeler et al. 2015)

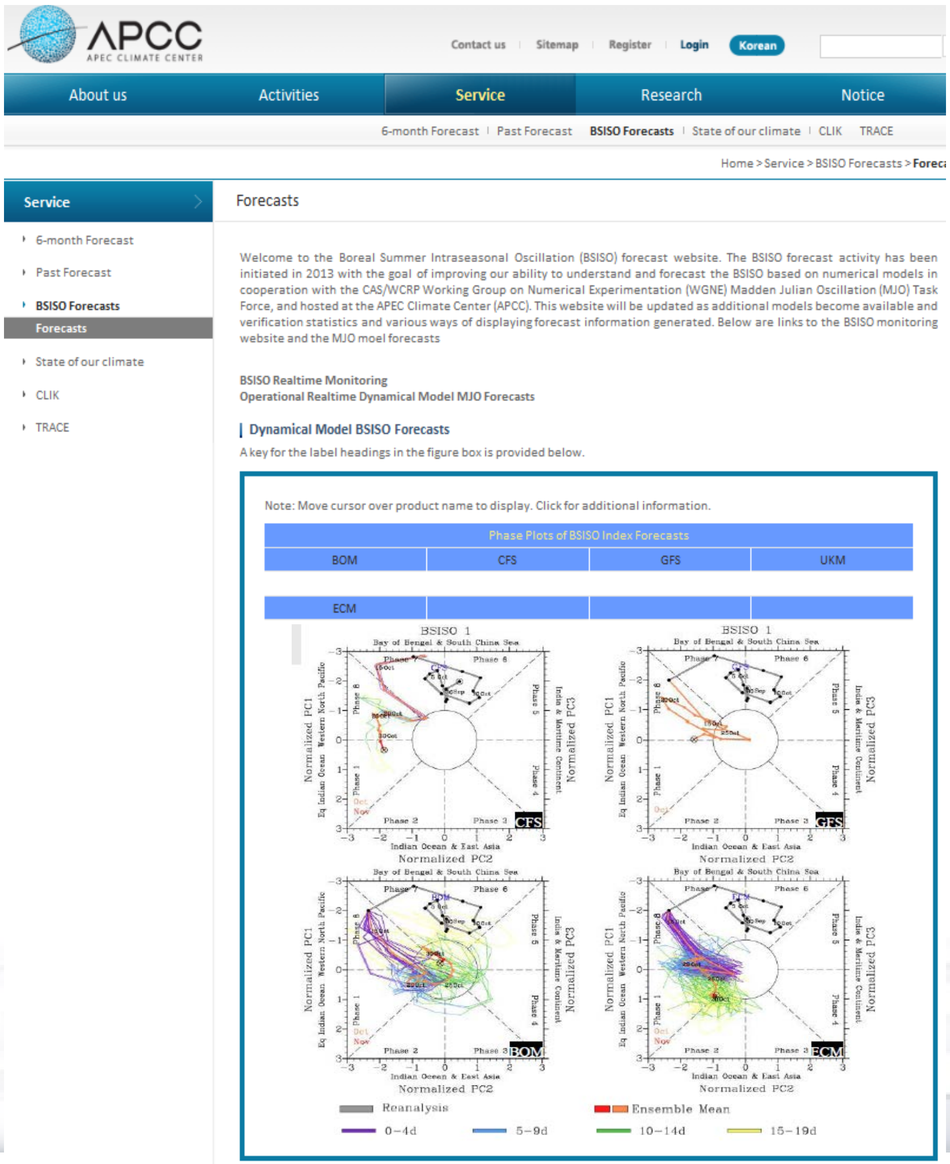
BSISO real-time monitoring and forecast

In cooperation with the WGNE MJO TF, APCC has hosted real-time monitoring and forecast of BSISO indices since 2013 summer.

Participating Institutions

Institute	Model	Ensemble Size	Forecast Period	Update frequency	Resolution
NCEP	Climate Forecast System	4	40 days	Once a day	T126 L64
	Global Forecast System	1	16 days	Once a day	T574, T190 L64
	Global Ensemble Forecast System	*20*	*35 days*	*ASAP*	
Australia	POAMA 2.4 multi-week model	33	40 days	Twice per week	T47 L17
ECMWF	ECMWF Ensemble Prediction System	51	32 days	Twice per week	T639, T319 L62
UK Met Office	MOGREPS-15	24	15 days	Once a day	60km L70
Taiwan CWB	*CWB EPS T119*	*1*	*40 days*	*From 2015*	
CMC	*GEMDM_400x200*	*20*	*15 days*	*ASAP*	

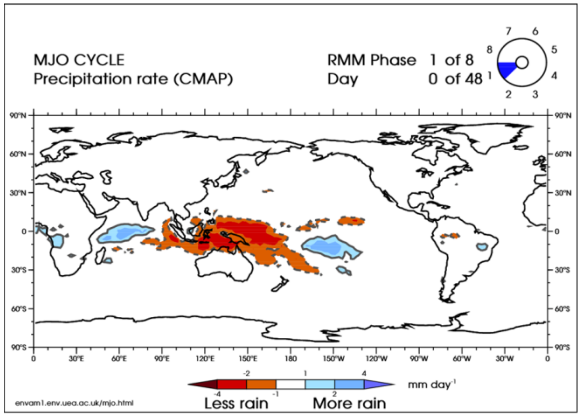
BSISO real-time monitoring and forecast

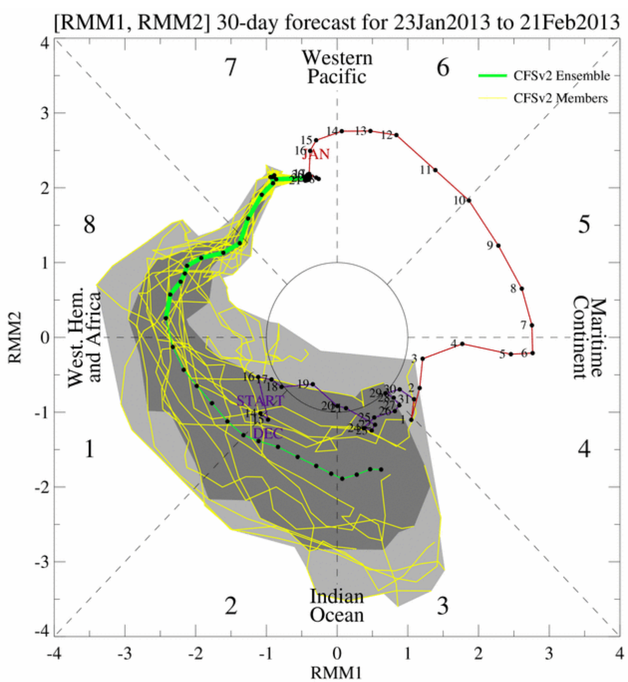


The final product is a ***phase diagram*** displaying BSISO1 and BSISO2 values , including the values for ***the recent 15 days and forecasts for the next 20 days.***

- The BSISO forecast is updated every day with the latest information and is available from May to October at APCC webpage (http://www.apcc21.org).
- BSISO real-time forecast webpage (http://www.apcc21.org/eng/service/bsiso/fore/japcc030601.jsp)

Realtime MJO Index dynamical model forecast activity





- Yellow Lines: 20 Individual Members, Green Line: Ensemble Mean
- RMM1 and RMM2 values for the most recent 40 days and forecasts for the next 30 days
- Light gray shading: 90% of forecasts, dark gray shading: 50% of forecasts

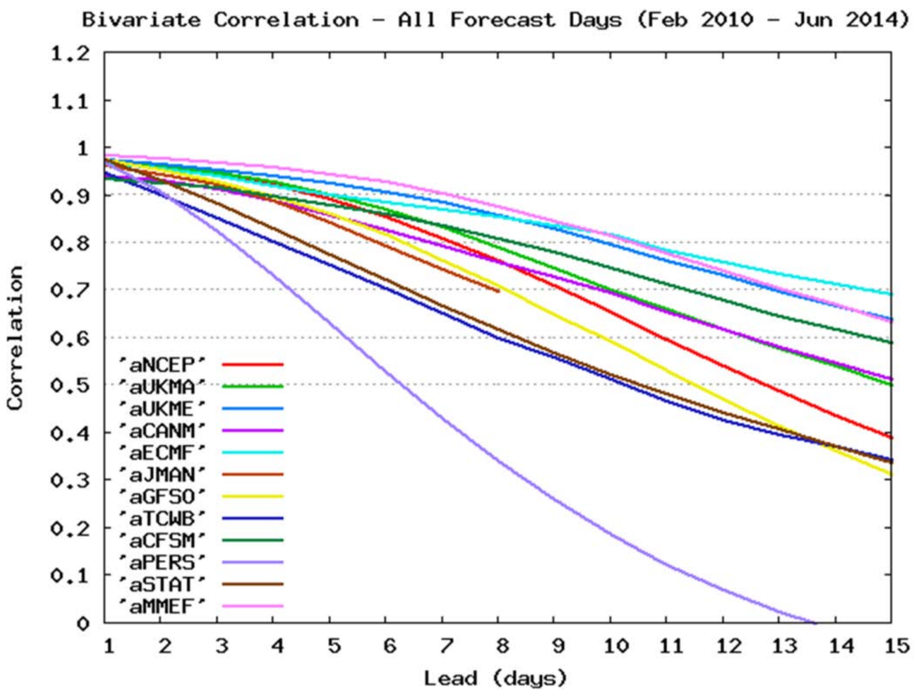
MJO Task Force

U.S. CLIVAR MJO Working Group and MJO Task Force adopted this metric as a uniform diagnostic for MJO identification, skill evaluation and display of MJO forecasts

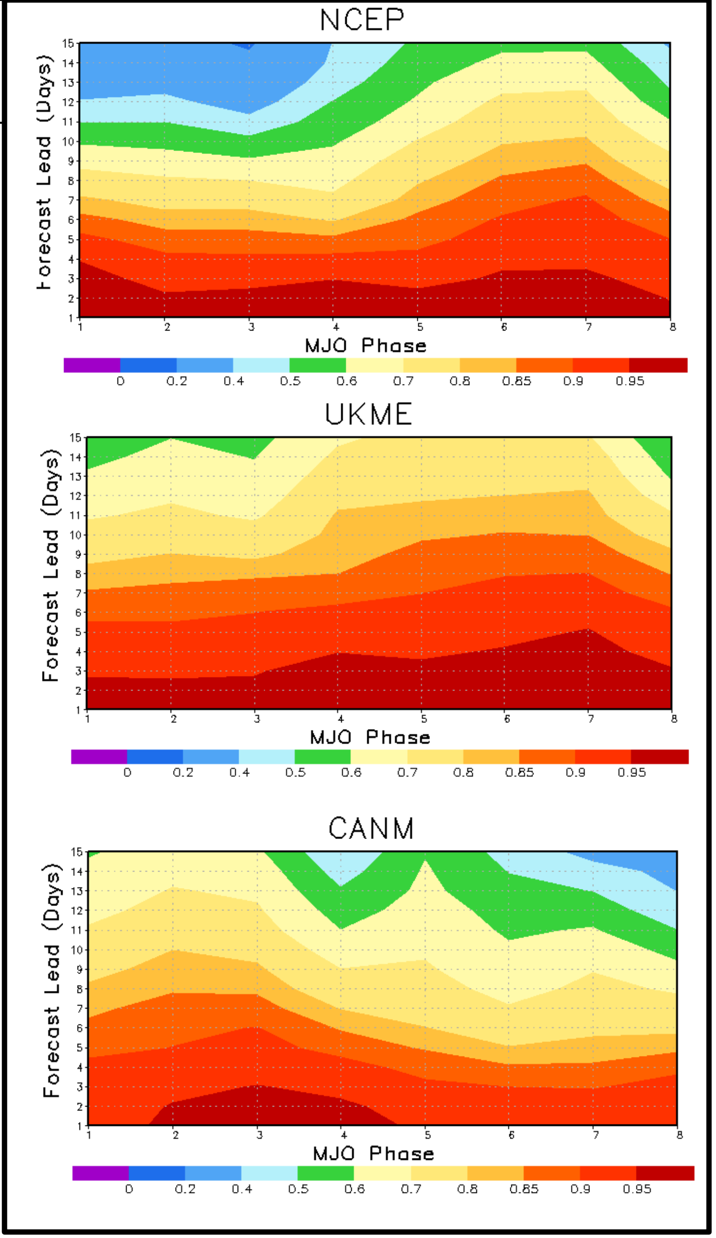
Realtime data contributions to CPC from operational international centers further supported by WGNE

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

Assessment of Forecast Skill



- Bivariate correlation for several models and benchmarks
- Boreal winter forecast skill is better
- Forecast skill linked to initial amplitude
- ECMWF, UK Metoffice performed the best



- Forecast skill as a function of MJO initial phase
- Varying structure as a function of forecast model

Process-oriented MJO Simulation Diagnostics

- Goal: Provide insight into how parameterizations should be improved to enhance an MJO simulation for the correct physical reason
- To achieve the goal, the diagnostics should be relevant to:
  - resolved-scale processes that are important in the MJO dynamics
  - unresolved-scale processes (i.e. parameterizations) in GCMs

MJO

- Moisture-convection coupling
- Cloud-radiation interaction
- Surface flux feedback

resolved-scale processes

- Cumulus convection
- Radiation
- Cloud macrophysics
- Cloud microphysics
- Boundary layer
- Surface flux

parameterized processes

Process-oriented MJO Simulation Diagnostics

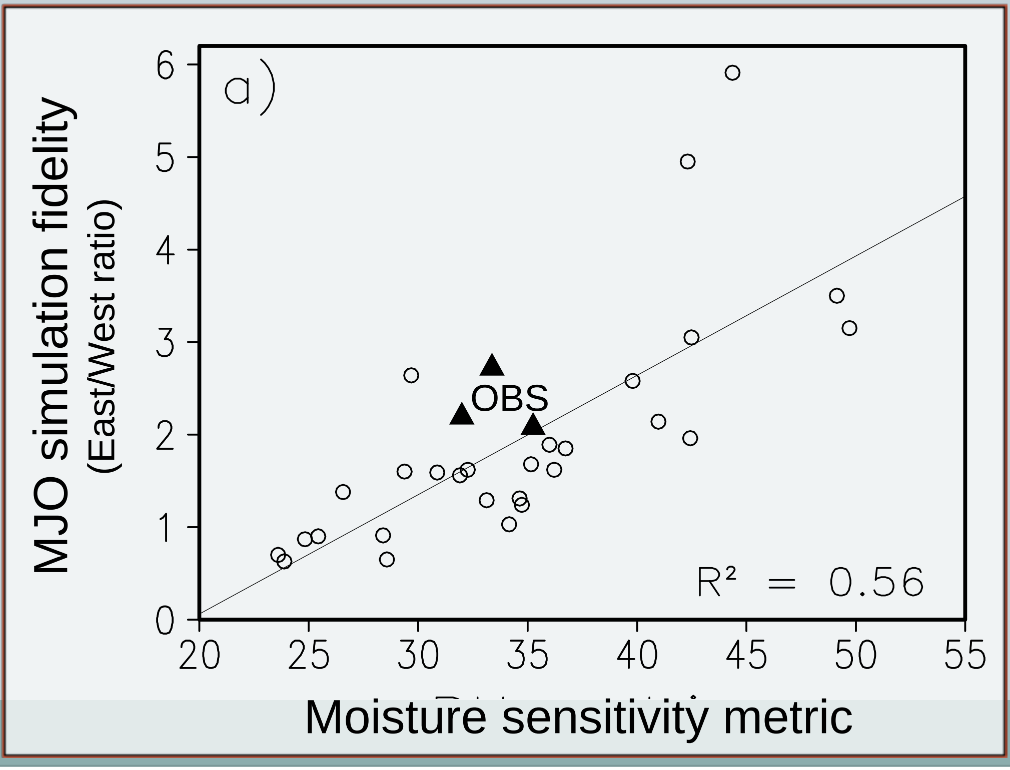
- Key Outcomes

Several promising process-oriented model diagnostics have been developed and documented:

- Convective moisture sensitivity (Kim et al. 2014, JC)
  - Models with better MJOs have greater sensitivity of convection to lower free tropopsheric humidity
- Radiative Feedbacks (Kim et al. 2015)
  - Models with better MJOs feature stronger radiative feedbacks
- Gross Moist Stability (Benedict et al. 2014; Maloney et al. 2014)
  - Models with lower gross moist stability have stronger MJOs
- Others ongoing thrusts: Water Isotopes to evaluate moistening processes (Risi), vertically resolved MSE budgets (Maloney), etc….

Process-oriented MJO simulation diagnostics

- Example Diagnostic: relationship between lower tropospheric relative humidity (RH) and precipitation
- Metric: amount of RH increase required for a transition from suppressed (lower 20% precip events) to active (upper 10%) convective phase



- 28 CMIP3 and CMIP5 models (open circles, Corr.=0.75)
- Relevant resolved and parameterized processes

Moisture-convection coupling

Cumulus convection

Cloud microphysics

(Kim et al. 2014, JC)

MJO TF/GASS Multi-Model Diabatic Processes Experiment

- Goal: **Develop, coordinate, and promote analyses of the multi-scale interactions and processes that are a critical component of the MJO**, both in observations and by exploiting recent advances in high-resolution modeling frameworks, with particular **emphasis on vertical structure and diabatic processes.**

- **Key Outcomes:**
  - Generation of extensive model data archive of climate experiments and 2- and 20-day MJO hindcasts available on the Earth System Grid at https://earthsystemcog.org/projects/gass-yotc-mip/
  - Detailed description and diagnostic analysis of these simulations in four manuscripts (Xiang et al. 2015; Xavier et al. 2015; Klingaman et al. 2015a,b)

- **Key results:**
  - MJO fidelity is related to realism of rainfall-moistening profile relationship
  - MJO fidelity is related to realism of rainfall- lower to middle tropopsheric RH relationship (consistent with the process-oriented diagnostic above)
  - **Lack of importance of diabatic heating structure to MJO fidelity**
  - Little relationship between success of MJO hindcasts and MJO fidelity in long climate simulations

MJOTF/GASS Project Data Archive

Data archive available on the Earth System Grid at https://earthsystemcog.org/projects/gass-yotc-mip/

The archive contains
- Prognostic variables, cloud variables
- Surface and top of the atmosphere fluxes, near surface variables, integrated water paths
- tendencies from individual model parametrization schemes
- and for 2 day experiments some parametrization diagnostics

	Number of Models	Data domain	Data Resolution			Length of data
			Horizontal	Vertical	Temporal	
Climate	27	Global	2.5x2.5°	22 press lev	6hrly	20 years
20 day	14	50N - 50S	2.5x2.5°	22 press lev	3hrly	94 x 20 day
2 day	11	10N - 10S 60E - 180E	Model Grid	Model Grid	Model timestep	44 x 2 day

This data could be analyzed for a wide variety of processes and phenomena

Develop, coordinate, and promote analyses of MJO air-sea interaction

- Goal: **Develop, coordinate, and promote analyses of MJO air-sea interaction**, including development of diagnostics that relate MJO simulation capability to fidelity in simulating key air-sea interaction processes.

- Key Outcomes:
  - Manuscript that provides a comprehensive review of air-sea coupled processes in the MJO, including observational, theoretical, and modeling studies (DeMott et al. 2015)
  - Set of recommendations for further understanding.

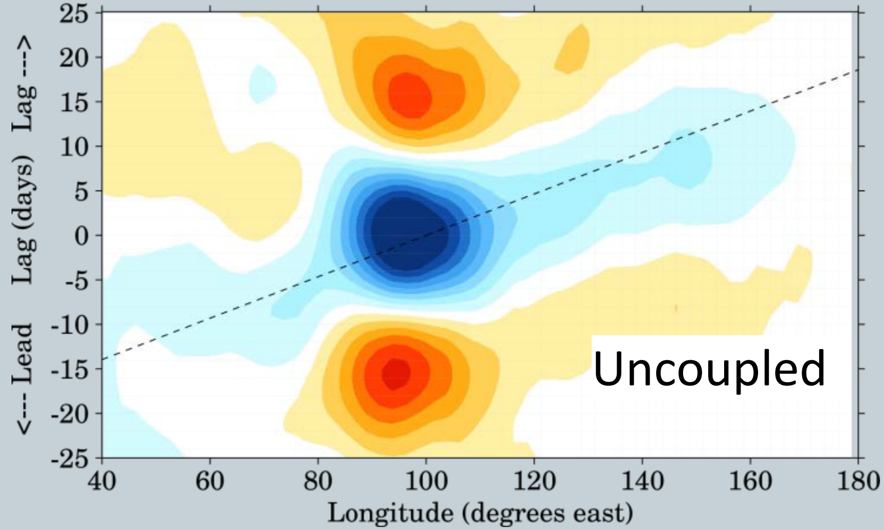
MJO Air-Sea Interactions

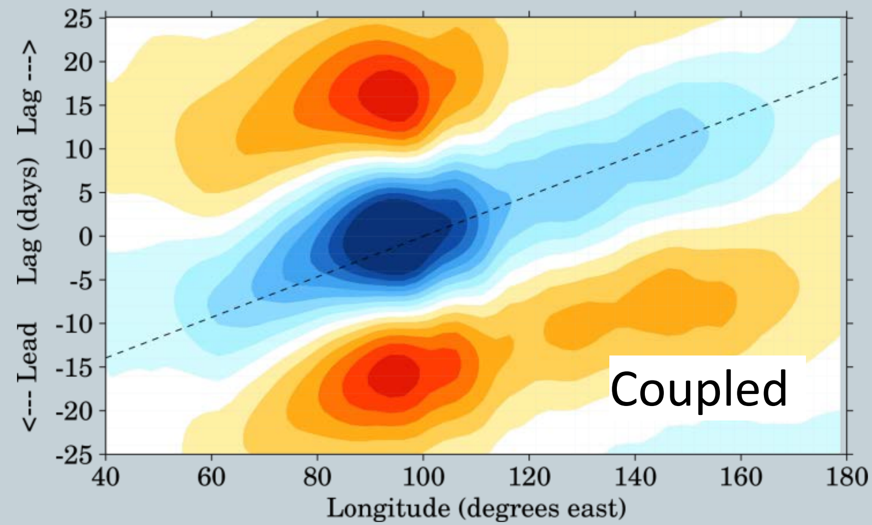
- **Review of atmosphere-ocean coupled processes in the MJO** submitted to *Reviews of Geophysics* (DeMott et al. 2015)

  - **Makes recommendations for a process-oriented diagnostic framework to understand how air-sea coupling improves the MJO in models** (e.g. how SST-modulated surface fluxes impact MJO)

  - **Proposes novel modelling experiments with AGCMs coupled to a high (vertical) resolution thermodynamic ocean** that constrains mean state (e.g. Klingaman and Woolnough 2014)

- **Funding is committed to this effort.** Dr. **Nicholas Klingaman has a five-year** UK Research Fellowship on air-sea interactions in sub-seasonal variability (starts 31 March) and **Dr. Charlotte DeMott has a three-year NSF** grant to study air-sea interaction and Maritime Continent impacts on MJO (started 1 March).





Lead-lag regressions of bandpass-filtered (20-100 day) OLR in the KPP-coupled (MetUM-GOML1) and atmosphere-only (MetUM-GA3) simulations from Klingaman and Woolnough (2014)

MJO Task Force Bibliography Since 2013 Renewal

General papers:

- Wheeler, M. W., E. D. Maloney, and the MJO Task Force, 2013: Madden-Julian Oscillation (MJO) Task Force: a joint effort of the climate and weather communities. *CLIVAR Exchanges*. No. 61 (Vol 18 No.1).
- Zhang, C., Gottschalck, J., E. Maloney, M. Moncrieff, F. Vitart, D. Waliser, B. Wang, and M. Wheeler, 2013: Cracking the MJO Nut. *Geophys. Res. Lett.*, **40**, 1223–1230, doi:10.1002/grl.50244.

Process-oriented diagnostics:

- Benedict, J. J. E. D. Maloney, A. H. Sobel, and D. M. Frierson, 2014: Gross moist stability and MJO simulation skill in three full-physics GCMs. *J. Atmos. Sci.*, **71**, 3327-3349.
- Kim, D, P. Xavier, E. Maloney, M. Wheeler, D. Waliser, K. Sperber, H. Hendon, C. Zhang, R. Neale, Y.-T. Hwang, and H. Liu, 2014: Process-oriented MJO simulation diagnostic: Moisture sensitivity of simulated convection. *J. Climate*, **27**, 5379-5395.
- Kim, D., M.-S. Ahn, I.-S. Kang, and A. D. Del Genio: Role of longwave cloud-radiation feedback in the simulation of the Madden-Julian oscillation. *J. Climate*, In revision.
- Kim, D., and E. D. Maloney, 2015: Review: Simulation of the Madden-Julian oscillation using general circulation models. *The Global Monsoon System*, 3nd Edition, C.-P. Chang et al., Eds., in press.
- Maloney, E. D., X. Jiang, S.-P. Xie, and J. J. Benedict, 2014: Process-oriented diagnosis of east Pacific warm pool intraseasonal variability. J. Climate, 27, 6305-6324.

Air-Sea Interaction:

- DeMott, C., N. Klingaman, and S. Woolnough, 2015: Atmosphere-ocean coupled processes in the Madden-Julian oscillation. *Reviews of Geophysics*, accepted pending revision.

MJO Task Force Bibliography Since 2013 Renewal (cont'd)

Boreal summer ISV:

- Lee, J.-Y., B. Wang, M.C. Wheeler, X. Fu, D.E. Waliser, and I.-S. Kang, 2013: Real-time multivariate indices for the boreal summer intraseasonal oscillation over the Asian summer monsoon region. *Clim. Dyn.*, 40, 493-509
- Neena, J.M., X. Jiang, D. Waliser, J.-Y. Lee, and B. Wang, 2014: Eastern Pacific Intraseasonal Variability: A Predictability Perspective. *J. Climate*, 27 (23), 8869-8883
- Neena, J. M., J. Y. Lee, D. Waliser, B. Wang, and X. Jiang, 2014: Predictability of the Madden–Julian Oscillation in the Intraseasonal Variability Hindcast Experiment (ISVHE). *Journal of Climate*, **27**, 4531-4543.
- Lee, S.-S., B. Wang, D.E. Waliser, J.M. Neena, and J.-Y. Lee, 2015: Predictability and prediction skill of the boreal summer intraseasonal oscillation in the Intraseasonal Variability Hindcast Experiment. *Clim. Dyn* in press
- Wheeler, M. C., H.-J. Kim, J.-Y. Lee, and J. C. Gottschalck: Real-time forecasting of modes of tropical intraseasonal variability: The Madden-Julian and Boreal summer intraseasonal oscillations. Submitted to the *Global monsoon system III* book

GASS/MJOTF Diabatic Heating Project:

- Klingaman, N. P., X. Jiang, P. K. Xavier, J. Petch, D. Waliser, and S. J. Woolnough, 2015: Vertical structure and diabatic processes of the Madden-Julian Oscillation: Synthesis and summary, *J. Geophys. Res.*, submitted.
- Jiang, X., and others, 2015: Vertical structure and diabatic processes of the Madden-Julian Oscillation: Exploring Key Model Physics in Climate Simulations*, J. Geophys. Res. – Atmospheres*, accepted pending revision.
- Xavier, P., and others, 2015: Vertical structure and diabatic processes of the Madden-Julian Oscillation: Biases and uncertainties at short range. *, J. Geophys. Res. – Atmospheres*, accepted pending revision.
- Klingaman, N., and others, 2015: Vertical structure and diabatic processes of the Madden-Julian Oscillation: Linking hindcast fidelity to simulated diabatic heating and moistening. *J. Geophys. Res. – Atmospheres*, accepted pending revision.

New MJOTF-S2S Joint Effort on the Maritime Continent (MC)

- **Goal**: **To improve understanding of MJO propagation through the Maritime Continent region**, where prediction skill is limited by model deficiencies and the complexity of interactions among the atmosphere, ocean, and land-surface.
- **Motivation**:
  - The MJO represents one of the high priority subprojects of the WMO Subseasonal-to-Seasonal (S2S) prediction program .
  - S2S and the MJO Task Force deemed the interaction of the MC with the MJO as a high priority research question that has significant bearing on shortcomings/improving operational MJO predictions
  - Motivating Principles:
    - To better understand processes and improve prediction
    - **Practicalities and Opportunities (i.e. why now?)**
      - **Significant interest across S2S, MJOTF, and AAMP**
      - **Existing modeling resources (S2S, MJOTF-GASS, and ISVHE databases)**
      - **Impending "Years of the Maritime Continent" project. Opportunity to help define objectives of campaign and make scientific progress**

- **Tieh-Yong Koh and Adrian Matthews** have joined TF to assist this effort
- 2016 boreal spring **MJOTF-S2S-YMC Singapore workshop** being developed on issues related to subseasonal variability, simulation and prediction in the MC region

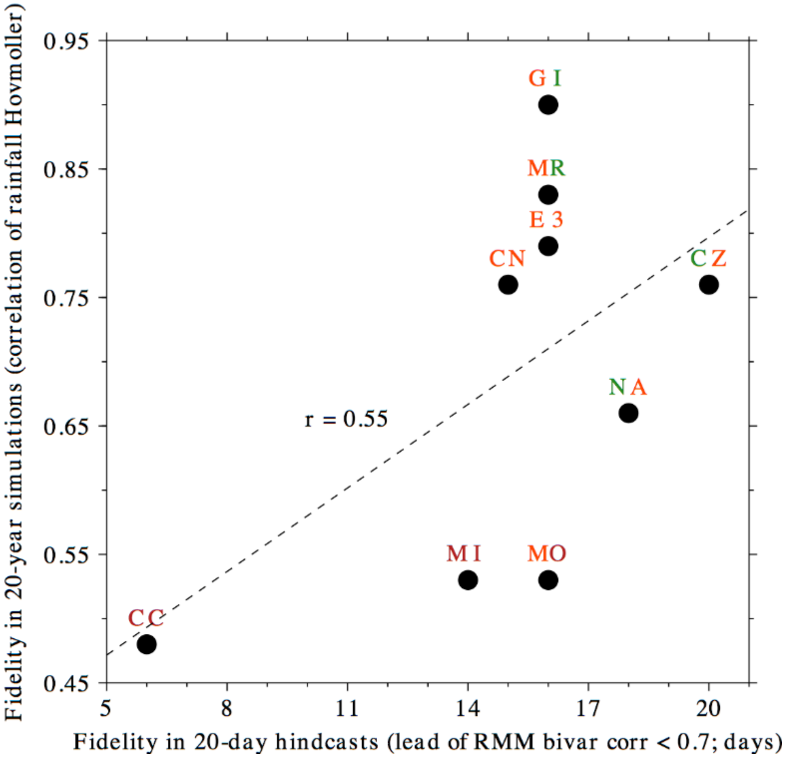
Potential Renewal of MJO Task Force in early 2016

Proposed research subprojects:

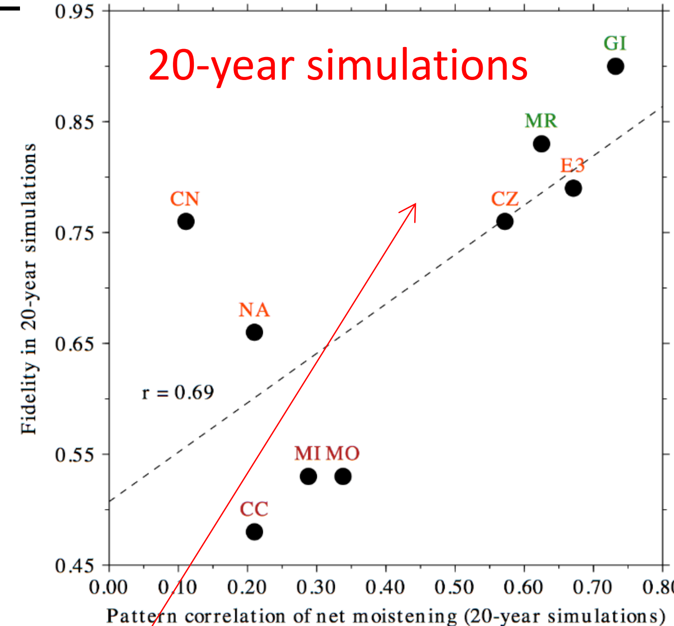
- Intraseasonal prediction (ongoing)
  - In collaboration with S2S, exploiting their database?
- Process-oriented model diagnostics (ongoing)
- Air-sea interaction (recent activity)
- Maritime Continent intraseasonal processes and prediction (recent activity)
  - joint project with S2S
- Tropical-extratropical interactions (new)
  - Recent proposal to S2S from COLA on tropical-extratropical interactions on subseasonal to seasonal timescales

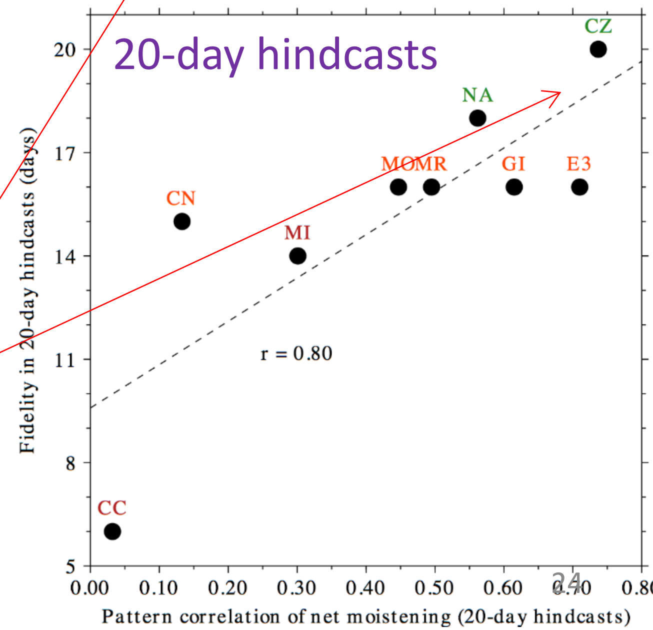
Thank you
Questions and Comments?

MJO TF/GASS Multi-Model Diabatic Processes Experiment



There is little correspondence between MJO fidelity in 20-year simulations and 20-day hindcasts.

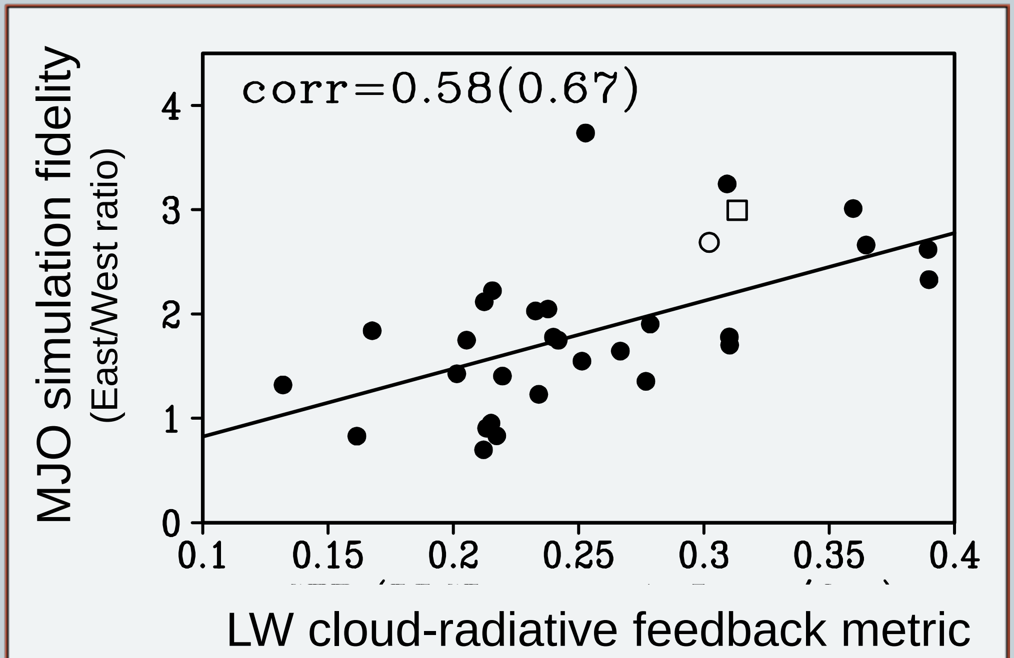




Models that simulate moistening profile well have higher MJO fidelity.

Longwave cloud-radiative feedback

- Diagnostic: relationship between anomalous precipitation and anomalous outgoing longwave radiation (OLR)
- Metric: ratio of OLR anomaly to precipitation anomaly for weak (< 5 mm day^{-1}) precipitation anomaly events



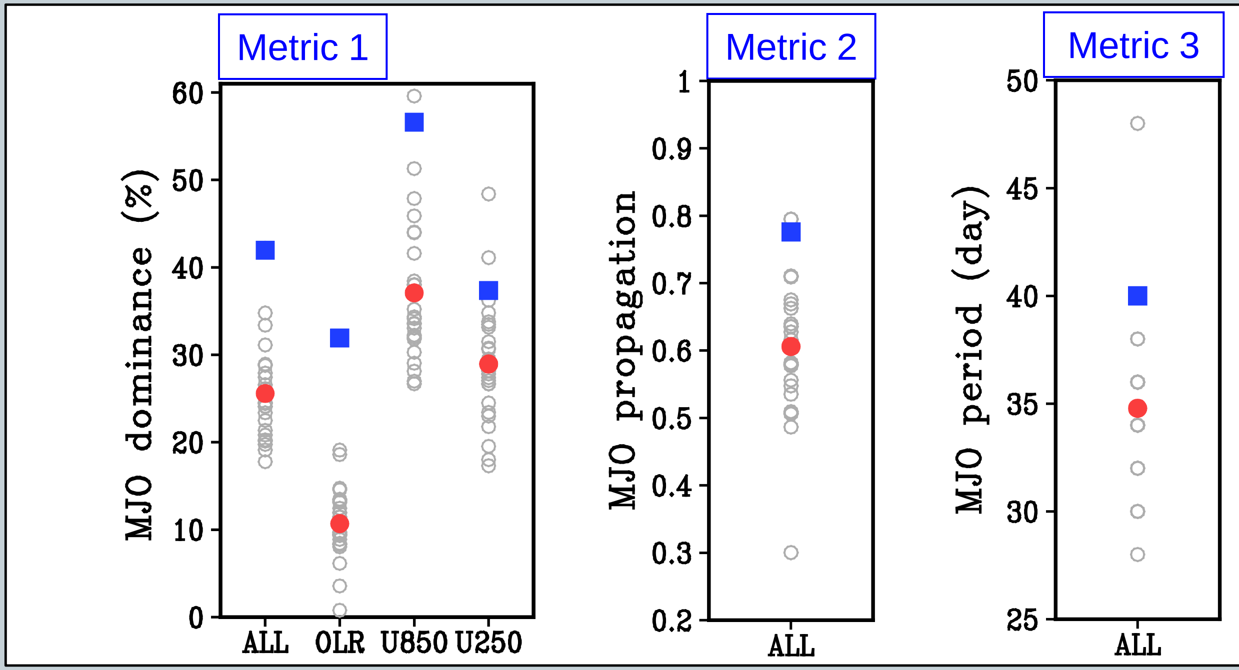
- 29 CMIP5 models (closed circles, Corr.=0.58)
- Relevant resolved and parameterized processes

Cloud-radiation interaction	Cumulus convection
Radiation	Cloud microphysics

(Kim et al. 2015, JC, in revision)

MJO simulation capability - CMIP5 models

- MJO metrics based on combined EOF



- **Blue square( ):** OBS(AVHRR,NCEP1)
- **Red circle( ):** Multi-model mean
- **Open circle( ):** CMIP5 models

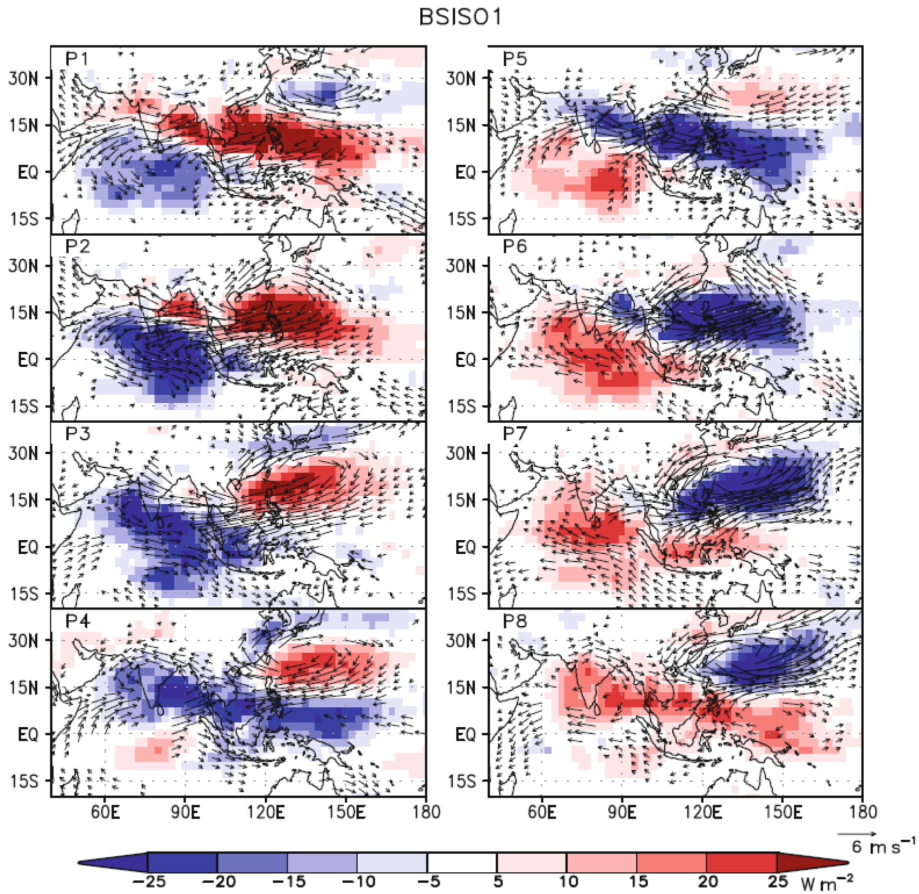
  - Metric 1: % variance explained by MJO mode from CEOF analysis
  - Metric 2: Lag-correlation between PCs of mode: from CEOF analysis
  - Metric 2: Max lag-correlation interval between PCs of mode: from CEOF analysis

Points

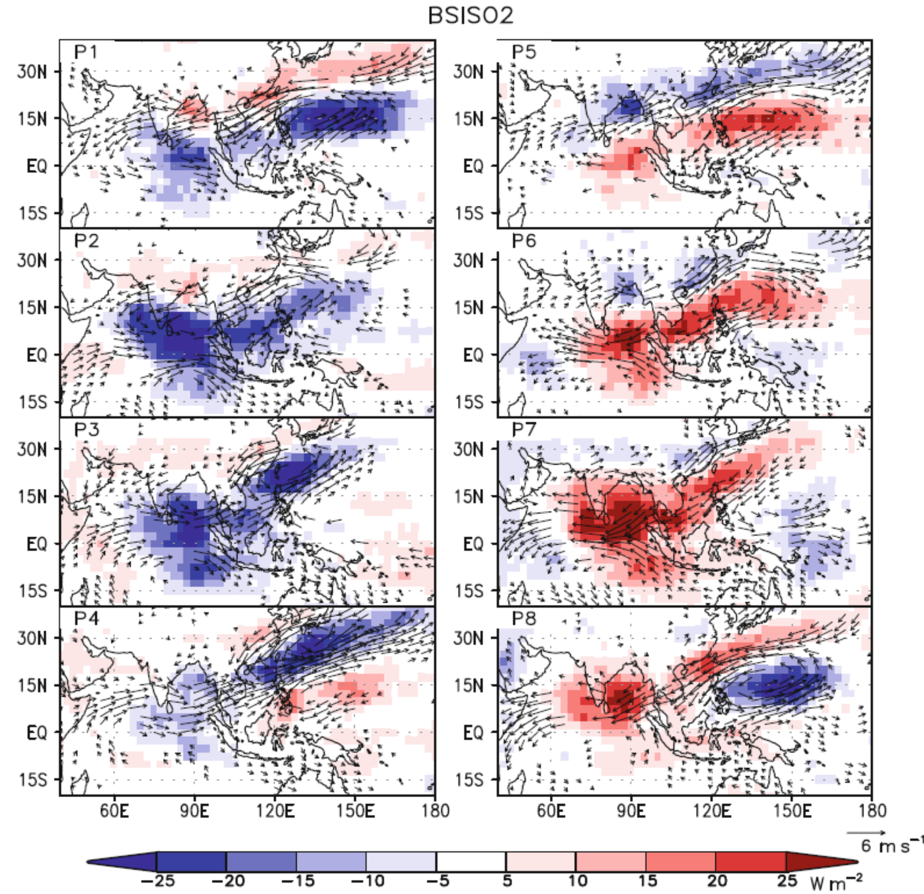
- Most CMIP5 models underestimate the MJO dominance and MJO propagation
- Most CMIP5 models simulate fast MJO propagation speed compared to observation

Definition of real-time multivariate BSISO indices

BSISO1
The canonical northward propagating component



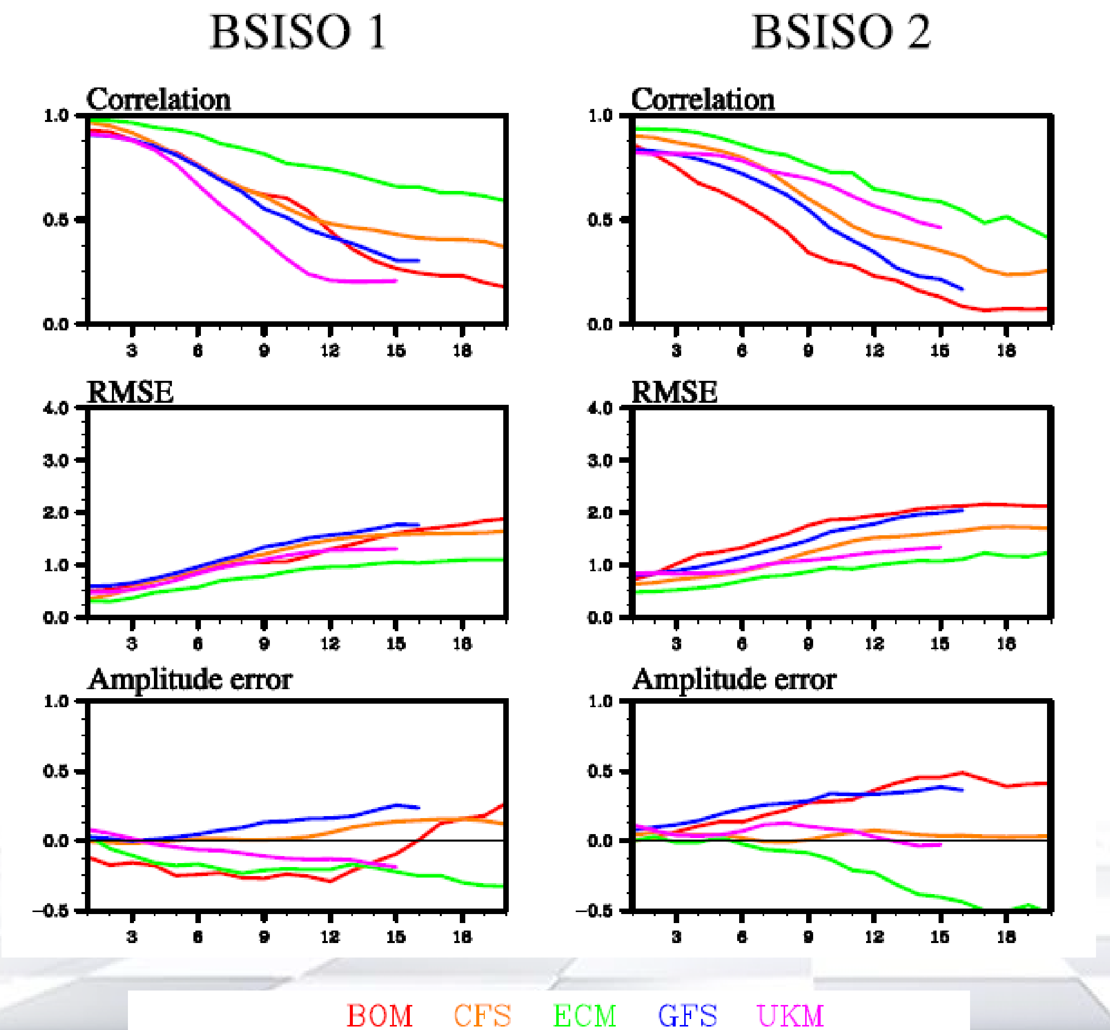
BSISO2
The AMS pre-monsoon and onset component



Shading: Outgoing longwave radiation, Vector: 850-hPa wind

BSISO real-time monitoring and forecast

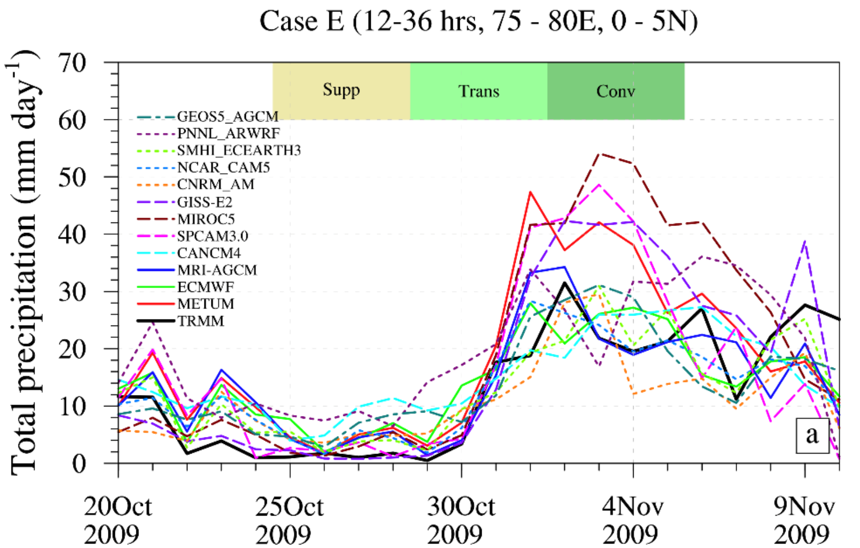
Assessment of real-time forecast skill for the BSISO1 and BSISO2 during May-October for 2013-2014



Models have a useful forecast skill of 0.5 for BSISO1 (BSISO2) up to 10-20 days (10-16 days) for the two years of 2013-2014.

Vertical structure and physical processes of the MJO

- Linking biases in MJO simulation to errors in simulated processes, focusing on diabatic heating and moistening
- Three experiments, taking advantage of links between biases in hindcasts and climate:
  - 20-year AMIP/CMIP style Data: 6-hr, 2.5° , 24 p levels
  - 2-day hindcasts, initialized daily for two YoTC MJO events (winter 2009-10) Data: Timestep, native grids
  - 20-day hindcasts for the same two events, but with more start dates. Data: 3-hr, 2.5° , 24 p levels
- 32 models; 9 for all three experiments. "Cross-timescale" analysis on these 9 as project synthesis.
- Four papers submitted to *JGR*: *Jiang et al.*, *Xavier et al.*, *Klingaman et al. (a)*, *Klingaman et al. (b)* [synthesis]

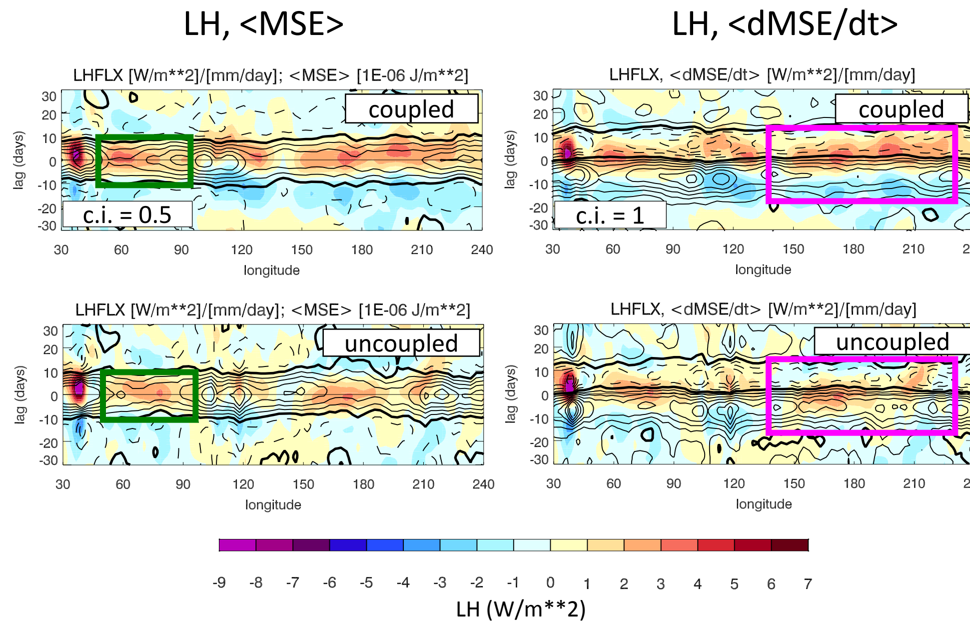


Models struggle to simulate the transition from MJO suppressed to active phases, even at very short range.

Precipitation at 12-36 hour lead time for a region in the Indian Ocean (indicated in title) from 2-day hindcasts. Observations (TRMM) in black.

Review of atmosphere-ocean coupled processes in the MJO

- Submitted to *Reviews of Geophysics*, Nov 2014 (DeMott et al. 2015).
- Covers observational, theoretical, and modeling studies.
  - Summarizes several 2005 reviews; special attention to post-2005 studies.
  - Focuses on atmospheric forcing of ocean, ocean response, and ocean feedback to atmosphere on intraseasonal timescales.
- Makes recommendations for further understanding:
  - Focus on air-sea feedback mechanism (make one sentence with that below).
  - Design modeling experiments to constrain mean state.
  - Analyze SST-modulated surface fluxes in terms of existing MJO theories.

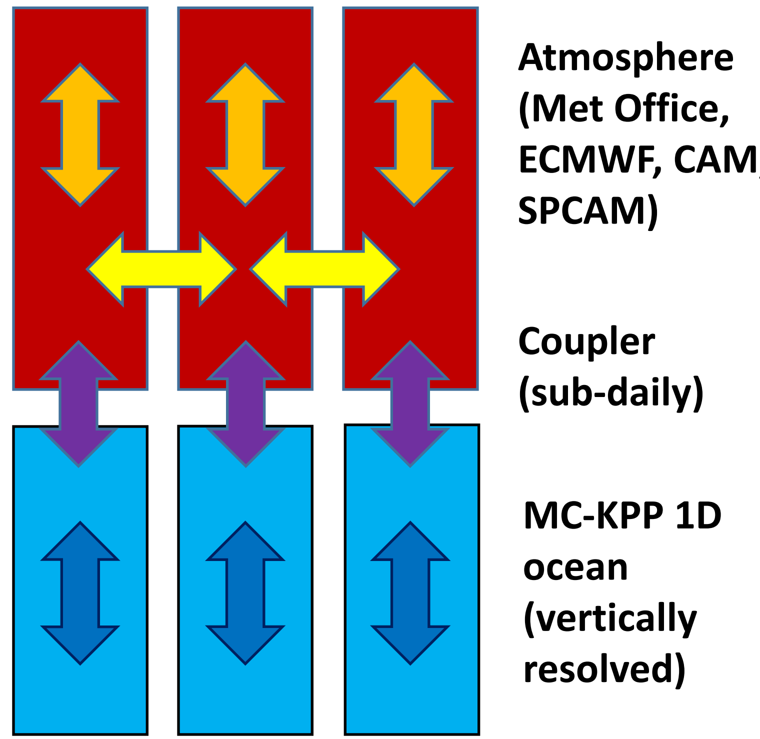


<u>Sample diagnostic</u>: LH (shaded) and vertically integrated MSE (moist static energy; left) and dMSE/dt (right) regressed onto 20-100 day rainfall for each longitude. Top: coupled SPCAM3. Bottom: uncoupled SPCAM3 with coupled model SSTs. LH maintains <MSE> in Indian Ocean. LH reduces (increases) West and Central Pacific <dMSE/dt> in coupled (uncoupled) simulation.

Dr. Charlotte DeMott has a three-year NSF grant to study air-sea interaction and Maritime Continent impacts on the MJO (started 1 March).

Future Plans: Investigating the role of air-sea feedbacks

- How does intra-seasonal SST variability feed back onto atmospheric convection?
- Novel modelling experiments with AGCMs coupled to a high (vertical) resolution thermodynamic ocean.
  - Parallel experiments with different AGCMs, but the same mean ocean state (via ocean temperature and salinity corrections).
  - Effect of full CGCM mean-state errors on MJO activity, examined in a coupled framework.
  - Regional coupling
  - "Switch-on" or "switch-off" experiments (e.g., couple only during certain MJO phases).
  - Prescribe climatological fluxes to atmosphere
- Development and application of process-based diagnostics of air-sea interactions, to inform and be informed by these experiments.



Coupled modelling framework

See *Hirons et al. (2015, GMD)* for info and *Klingaman et al. (2014, QJRMS)* for MJO

Dr. Nicholas Klingaman has a five-year UK Research Fellowship on air-sea interactions in sub-seasonal variability (starts 31 March).

Model Resources for MC Collaboration

- **S2S Database**: This new modeling database will provide a comprehensive set of prospective *state-of-the-art operational forecasts for the MJO*, and in most cases associated hindcast data sets. This makes it well suited for studies of prediction diagnostics and skill, and to a lesser degree for studies of physical processes and multi-scale interactions.
- **MJOTF-GASS Experiment**: With full vertical profiles of all physical tendency terms for climatological simulations with 6 hour output from ~30 models and higher time resolution (time step, 3 hour) output from ~12 models for 2 specific MJO cases during YOTC (boreal winter 2009-10), this is well suited for physical processes and multi-scale interactions studies.
- **ISVHE**: presently the best hindcast data set targeting the MJO and related phenomena, albeit with limited output to study physical processes.

New MJOTF-S2S Joint Effort on the Maritime Continent (MC)

Motivating Questions:

- What is the current skill of operation systems at predicting the passage of precipitating/active phases of the MJO into and across the MC, including aspects such as reliability?
- What processes determine whether individual MJOs propagate through the Maritime Continent?
- How is the simulated propagation of the MJO through the Maritime Continent related to biases in models?
- How does the partitioning of variability from diurnal to seasonal, including equatorial wave characteristics, influence the MJO and MC interaction?
- Does the above partitioning depend on model resolution, and is accordingly affected by the use of explicitly resolved convection versus parameterized convection?
- How does the ocean-atmosphere coupling in the context of the MC influence the MJO and MC interaction?
- How does topography versus land-sea contrast play a role in the MJO and MC interaction?
- How do land-atmosphere interactions (temperature, soil moisture, diurnal cycle) influence the MJO and MC interaction?
- How is forecast skill associated with the MJO over the MC influenced by the above science elements?