

*S2S – MJOTF Joint Research Project White
Paper*

**MJO and Maritime Continent Interactions:
Evaluating State of the Art, Characterizing
Shortcomings,**

**Eric Maloney
Colorado State University**

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

Columbia University

Tieh-Yong Koh

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Ken Sperber

PCDMI/Lawrence Livermore National Laboratory

Duane Waliser

Jet Propulsion Laboratory/Caltech

Matthew Wheeler

Centre for Australian Weather and Climate Research

Prince Xavier

UK Met Office

Important others and former members

X. Jiang, N. Klingaman, 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

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

Organized into 5 Subprojects

- ✧ **Process-oriented diagnostics/metrics for MJO simulation**
(leads: D. Kim, P. Xavier, E. Maloney, T. Miyakawa, C. Risi)
- ✧ **Boreal summer monsoon ISV monitoring and forecast metrics**
(leads: J.-Y. Lee, M. Wheeler)
- ✧ **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, J. Vialard, S. Rao)*

Motivation for S2S-MJO Task Force Collaboration

- 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:
 - Processes and Prediction
 - Practicalities and Opportunities
 - Significant interest across S2S, MJOTF, and AAMP
 - Existing modeling resources
 - Impending YMC project. Opportunity to help define objectives of campaign and make scientific progress

Model Resources

- **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.

Motivating Questions from MJO Task Force- S2S Collaboration

- 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?

Proposed 2016 MJOTF-S2S-YMC Workshop

- Objectives:
 - Issues related to subseasonal variability, simulation and prediction in the MC region
 - Foster future collaboration plans among S2S, MJOTF, and YMC
 - Possible interest from CLIVAR AAMP panel?
- Proposed location, Singapore, March-April 2016 (precise venue not decided)
- Participation from 75-80 researchers

Interests of Specific TF Members (e.g. Tieh Yong Koh)

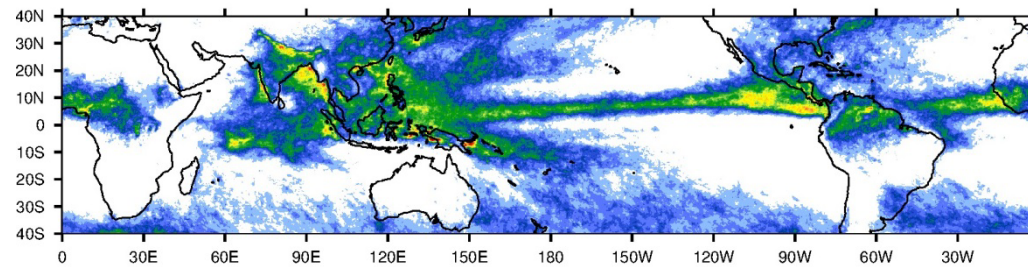
- Objectives:
 - To address shortcomings in model representations of MJO interactions with the MC and improve operational MJO predictions.
 - To understand how the partitioning of variability between intra-seasonal and diurnal timescale depends on model resolution and the use of convective parameterization.
- One possible new tool is the WRF model: nonhydrostatic limited-area model run in a tropical-channel mode.
- Benefits:
 - mesoscale resolution @O(10 km): to better resolve complex coastlines and terrain, especially in MC;
 - regionally adapted deep convective scheme: to remove model rainfall biases and improve its variability, to put in cloud-radiation interaction;
 - capable of further nesting: even higher resolution @ O(1 km) for explicit representation of convection and land-air interaction in MC.
- Cost lies mainly in increased computational and storage load.

JJAS 2008 AVERAGED PRECIPITATION RATE (mmhr⁻¹)

Adapting BMJ scheme for the global tropics in WRF model

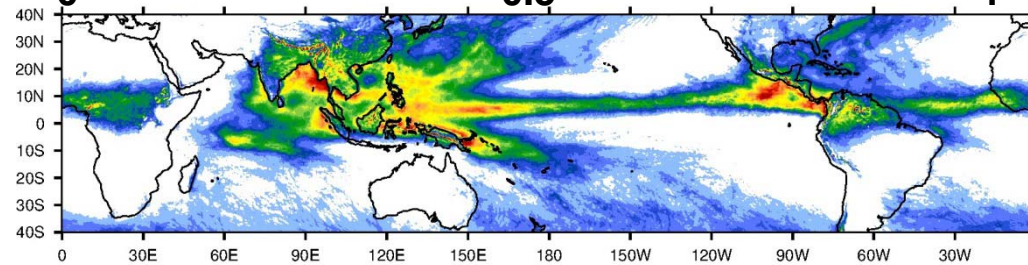
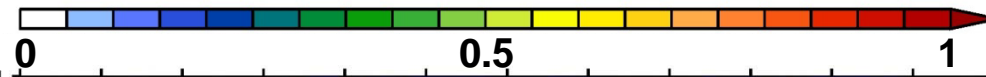
- 30-km resolution
- CFSR b.c.

These preliminary results from Fonseca et al. (2015) have been submitted for publication.

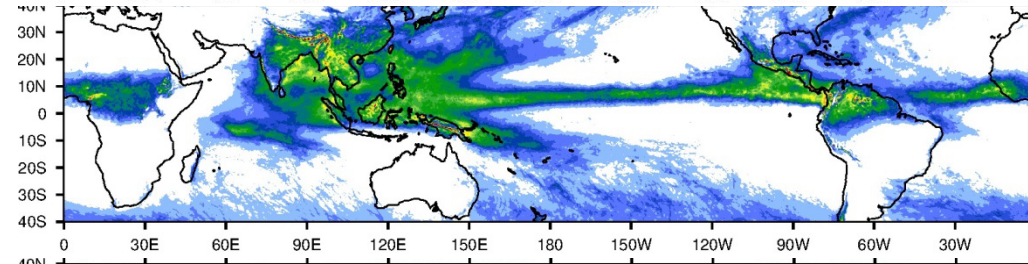


TRMM

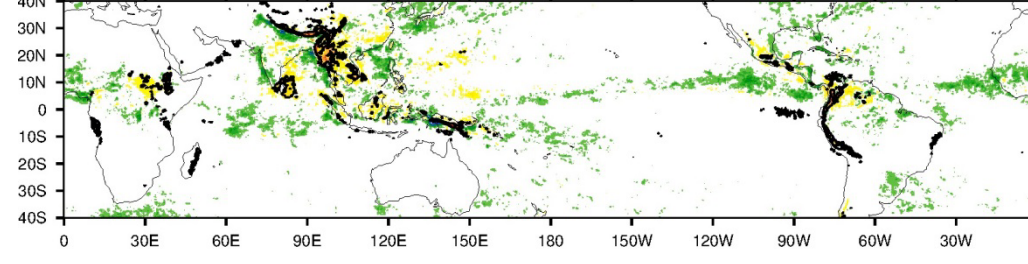
Boreal
SUMMER



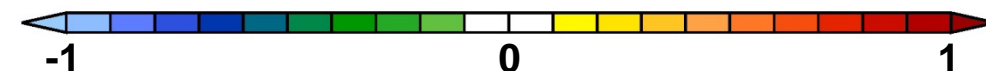
WRF:
Grid Nudge +
Original BMJ



WRF:
Grid Nudge +
adapted BMJ



BIAS (mmhr⁻¹) [shade]
NBIAS = ± 0.3 [contour]
Normalized Bias*
NBIAS = bias / stdev;
|NBIAS| < 0.3 implies < 5%
contribution of BIAS to RMSE so
that bias is negligible in practice



* Koh, T. Y. et al. (2012), "A diagnostic suite to assess NWP performance", *J Geophys Res*, 117, D13109, doi:10.1029/2011.ID017103