Update on YOTC MJO Task Force Activities

Eric D. Maloney, Colorado State University

With help from Daehyun Kim, Jim Benedict, and others

YOTC MJO Task Force

Official name:

WCRP/WWRP-THORPEX YOTC MJO Task Force

Overall goal:

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

Members:

Duane Waliser (co-chair until Fall)
***Eric Maloney (co-chair Fall 2011)**
Ken Sperber
John Gottschalck
Chidong Zhang
Augustin Vintzileos
Dave Raymond
Hai Lin

Matt Wheeler (co-chair)
Xiouhua Fu
Harry Hendon
Richard Neale
Daehyun Kim
Frederick Vitart
Masaki Satoh

Task Force Activities

1. Further development and promotion of process-oriented diagnostics/metrics that improve insight into the physical mechanisms for robust simulation/prediction of the MJO and that facilitate improvements in convective and other physical parameterizations relevant to the MJO.

2. Develop, coordinate, and promote analyses of the multi-scale interactions 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.

Task Force Activities

3. Promote the ongoing evaluation of real-time MJO forecasts. Expand efforts to develop and implement MJO forecast metrics under operational conditions, including a boreal summer focus and multi-model ensemble development.

4. Develop an experimental modeling framework (e.g.,hindcast experiment/dataset) to assess MJO predictability as well as forecast skill of the MJO and closely related phenomena from contemporary/operational models.

Task Force Activities

5. Interact with the proposed activity to simulate monsoon ISOs under the WCRP monsoon cross cut activity, including application of MJO diagnostics to outputs and integration of these simulations with the overall MJO experimental modeling framework.

6. Organize workshops and meetings of opportunity to further the work of the Task Force

Motivation

- CLIVAR MJO WG developed diagnostics that makes it possible to diagnose the MJO in order to assess simulation and track improvements (e.g. amplitude):

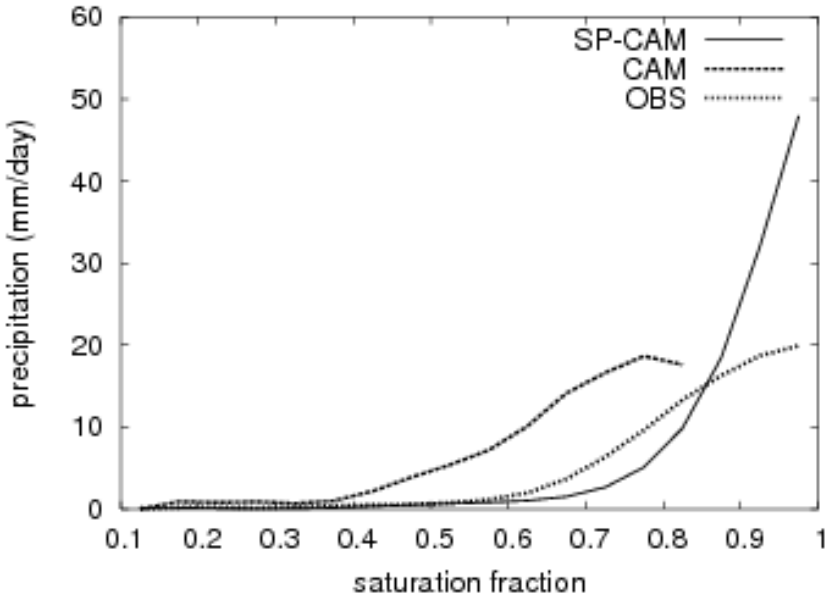
- We can say confidently whether one model simulates the MJO and another doesn't but we need diagnostics that provide insight as to why

- Need to develop diagnostics that focus on physical processes of relevance to the MJO so as to deepen understanding of simulation and promote improved simulation

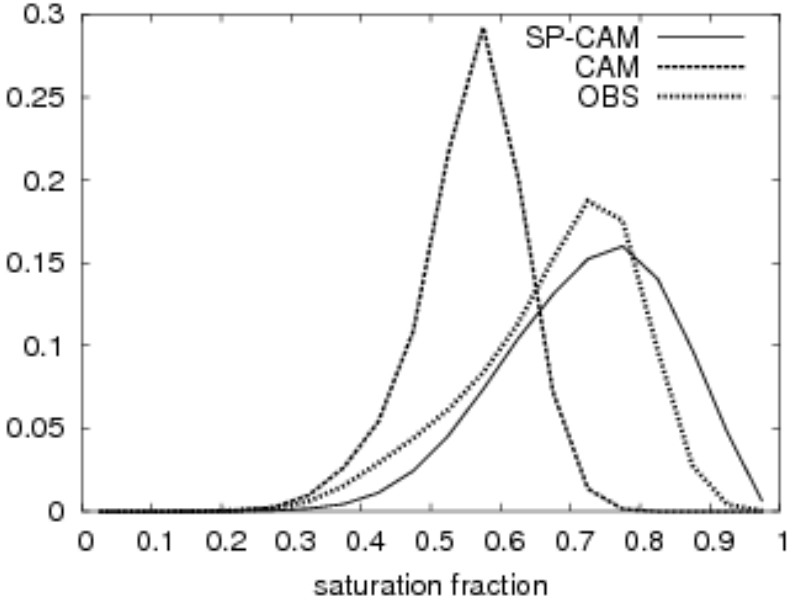
- Provide physical insight and ideas of how parameterization should be improved for better MJO in a climate model

Simple Diagnostics

Precipitation vs. Saturation fraction

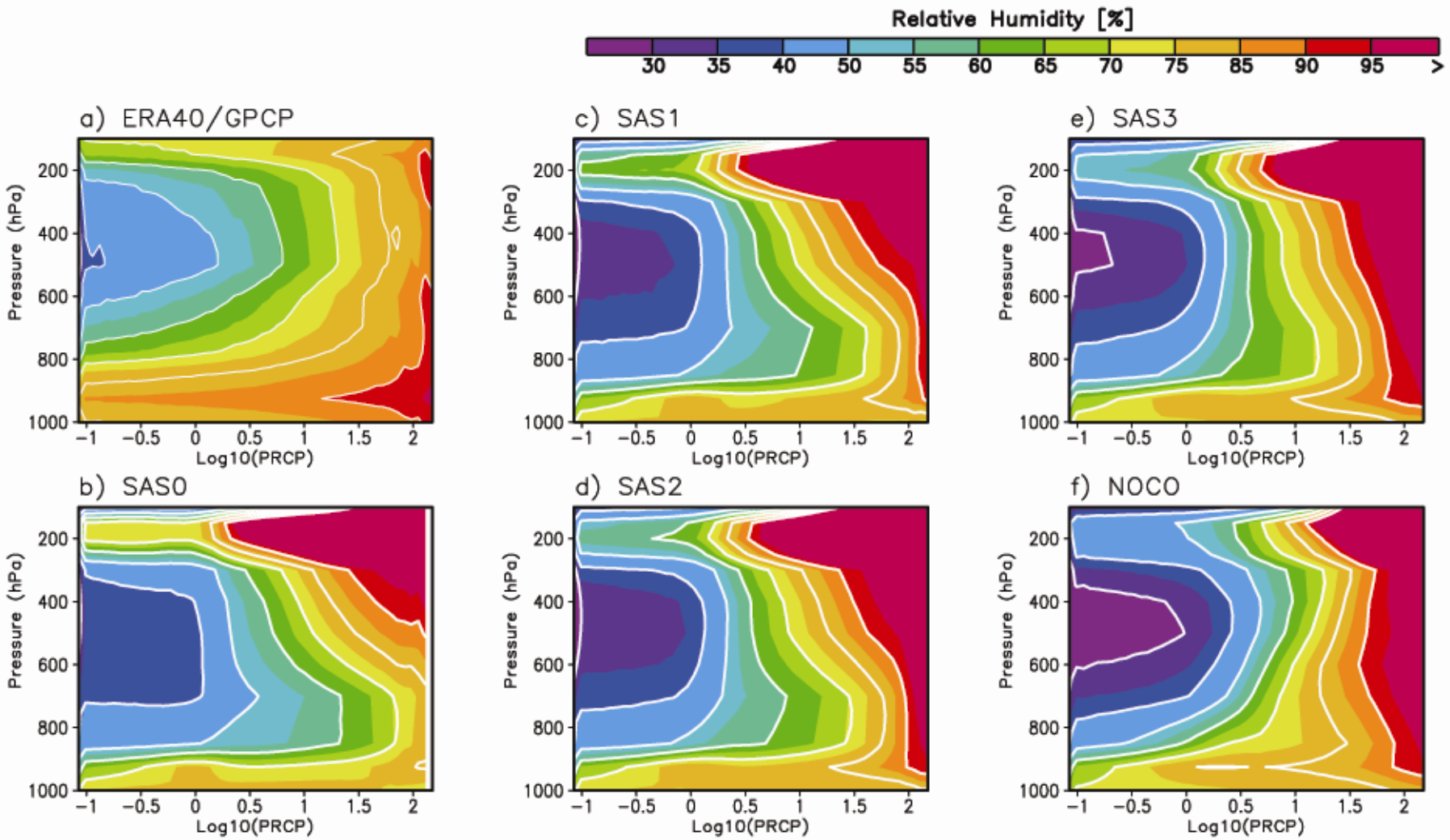


PDF of saturation fraction



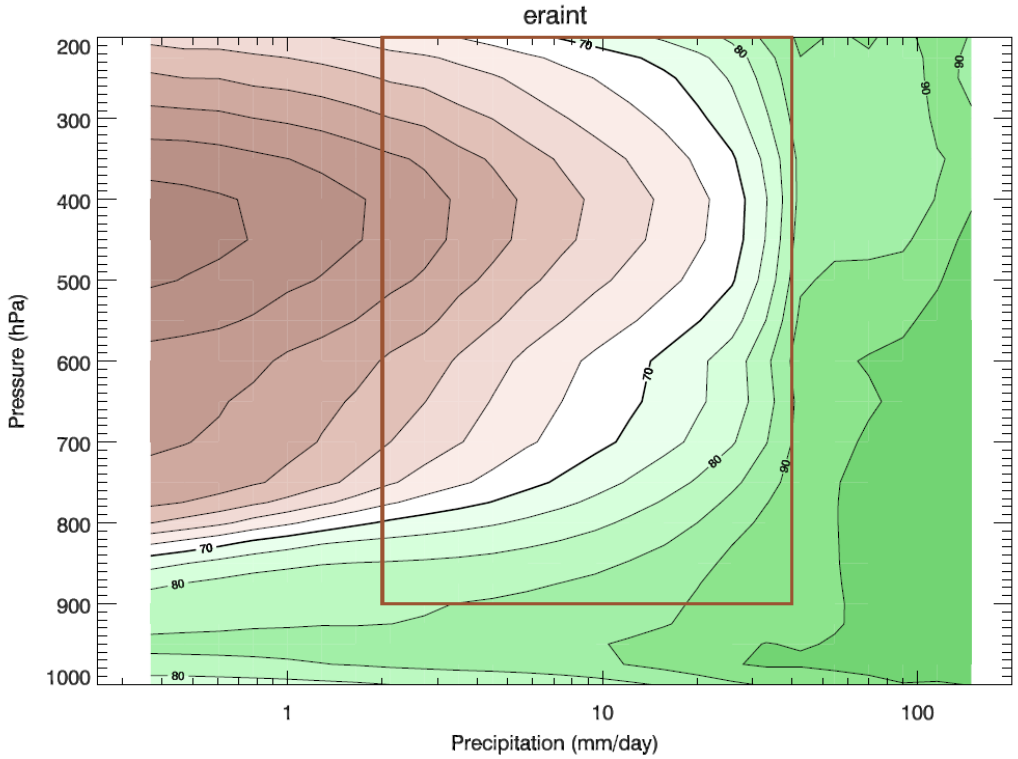
CAM vs. SPCAM
(Zhu et al. 2009)

Relative Humidity Composites



Kim et al. (2010), based on initial analysis of Thayer-Calder and Randall (2009)

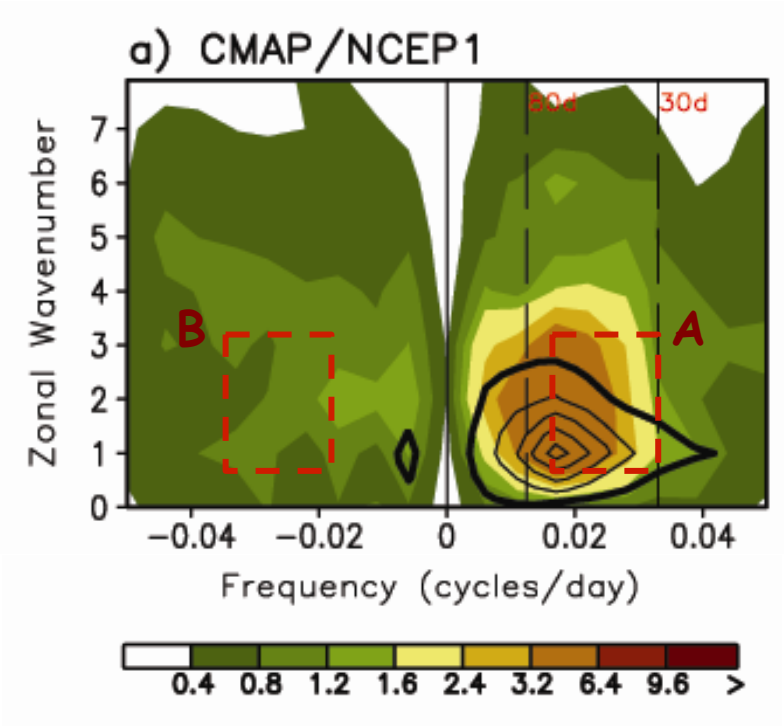
Definition of process oriented metric



- **rh_comp_pcor**: Spatial correlation of RH between the model and ERA-Interim in the marked box (2-34mm/day, 900-200hPa).
- **rh_comp_rmse**: RMSE of model against ERA-interim in the marked box
- **pcor/rmse** = rh_comp_pcor/rh_comp_rmse

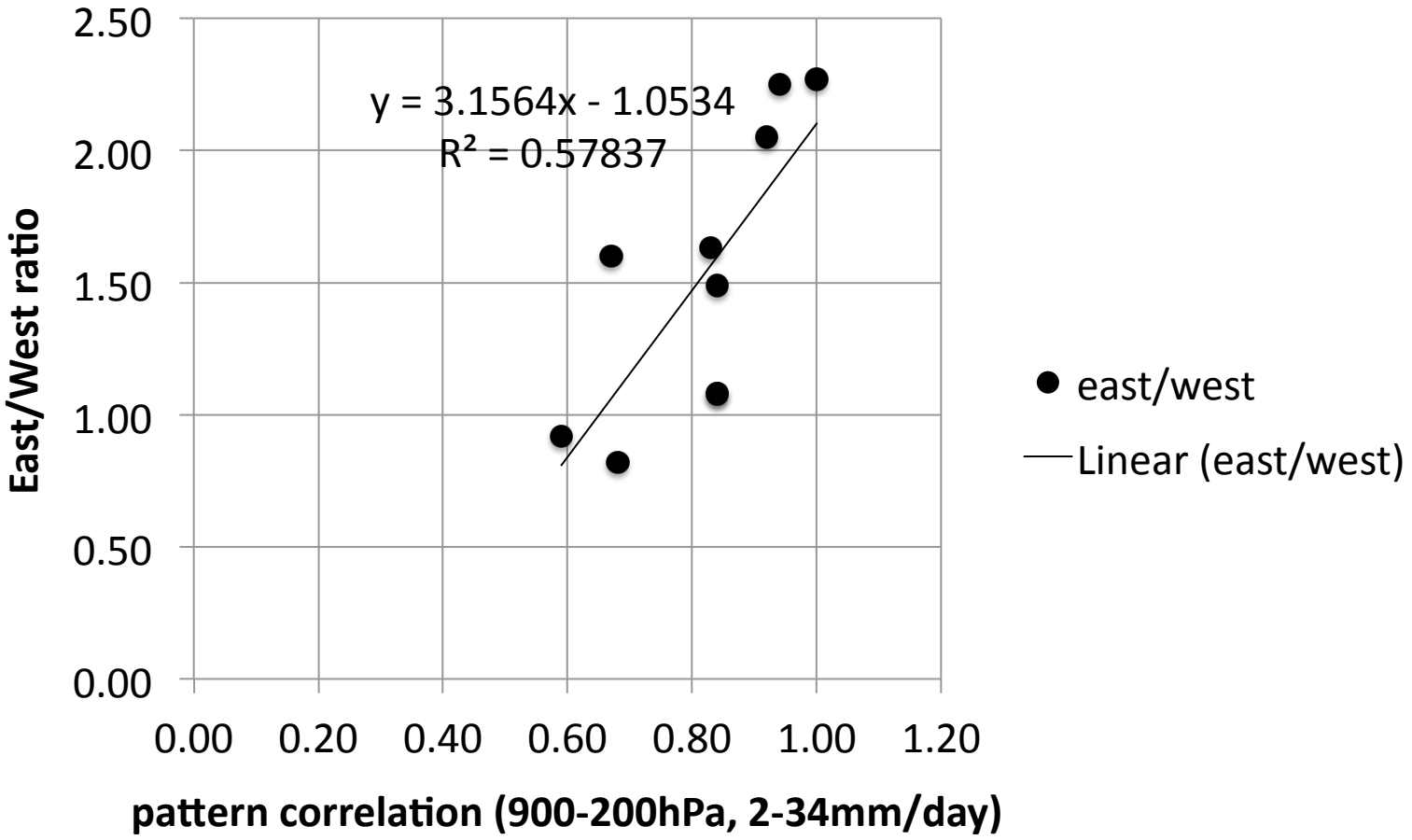
MJO metric

Wavenumber-frequency power spectra



- **east** = sum of spectral power within box A (wavenumber 1-3, period 30-70 days)
- **east/west** = (sum of spectral power within box A)/(sum of spectral power within box B)
- **(east/west)*east**

example of a scatter



Column-Integrated MSE Advection Binned by Some Measure of Convective Activity

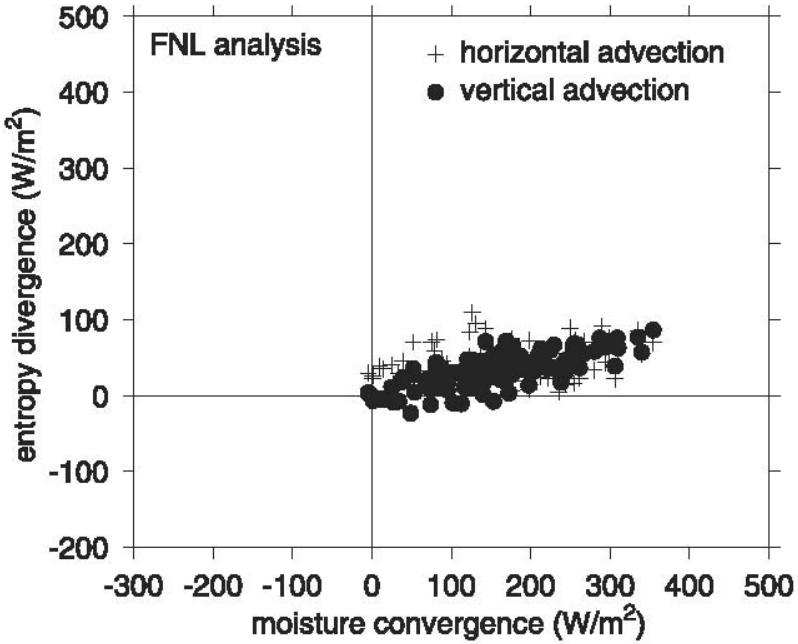
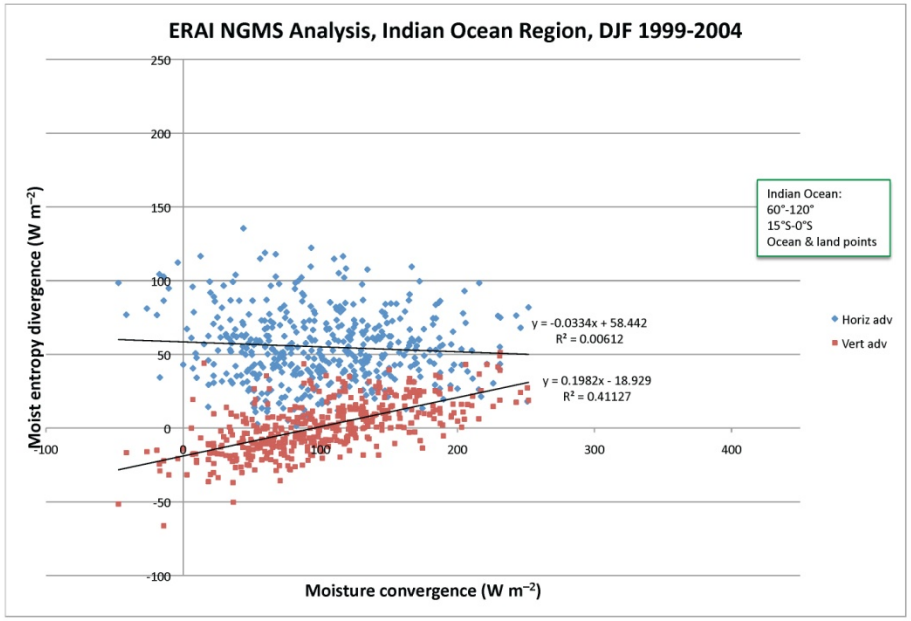
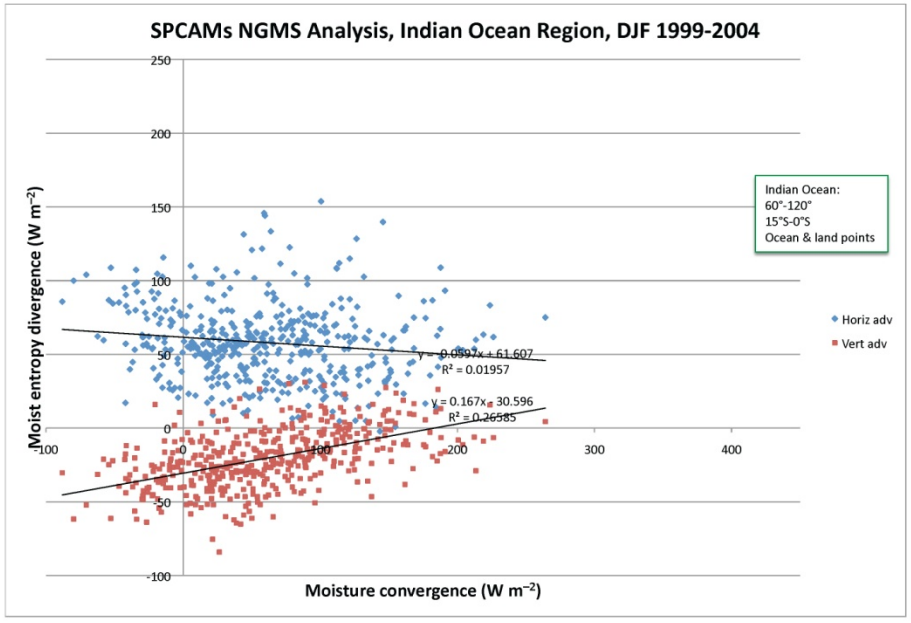


FIG. 12. As in Fig. 9, except for the FNL.

Raymond and Fuchs (2009)

- Analysis from NCEP FNL analysis
- For positive column-integrated moisture convergence, vertical MSE advection is positive even for periods of modest convergence
- Raymond and Fuchs (2009) argue that negative gross moist stability may be needed for successful MJO simulation



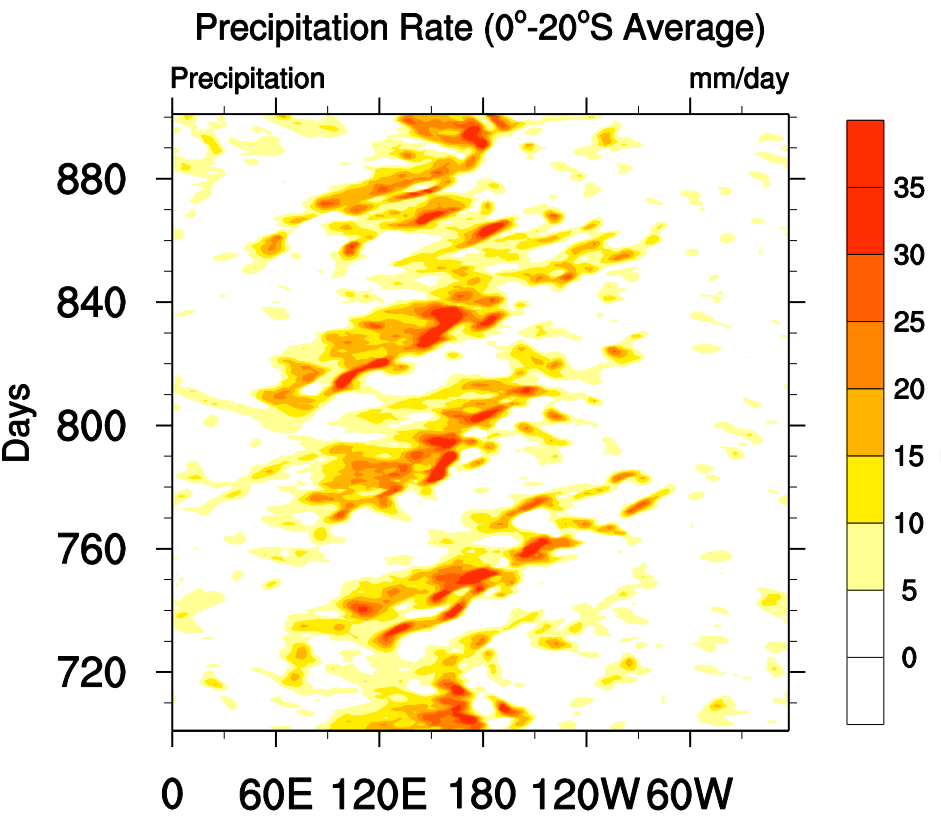


MSE Advection Analysis for ERA-I and SP-CAM (with SOM)

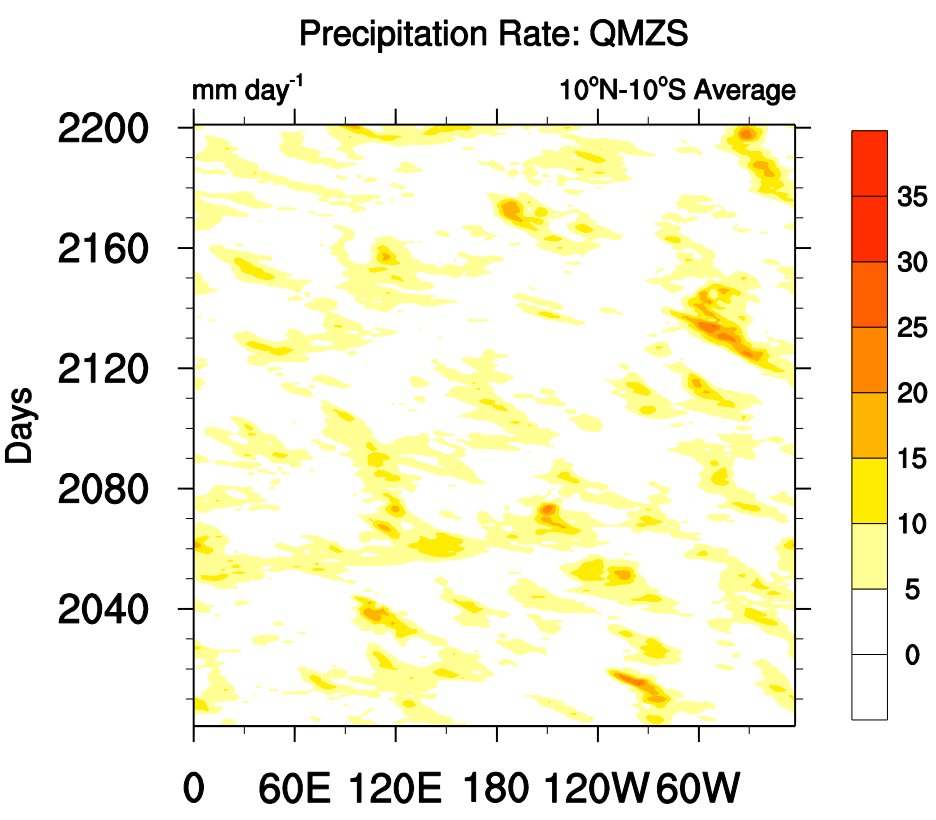
From Jim Benedict

Why Does a Zonally Symmetric Simulation Produce a Realistic MJO?

Control



Zonally Symmetric



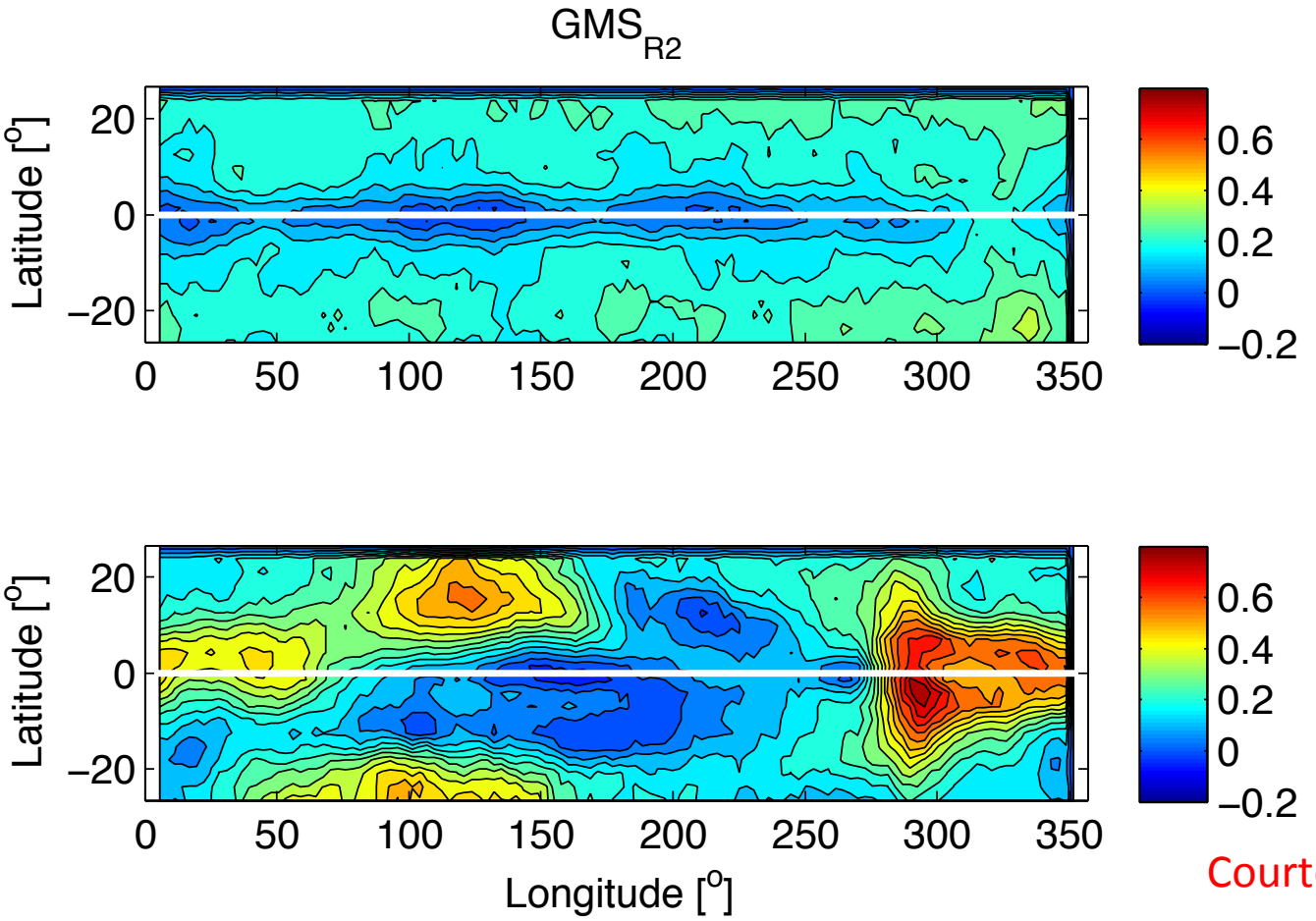
- Suggests importance of basic state westerlies to destabilization and propagation characteristics in the model

Landu and Maloney (2011)

Why Does A Zonally Symmetric Simulation Not Produce a Realistic MJO?

$$\frac{\langle m\nabla\cdot\mathbf{v}\rangle}{\langle s\nabla\cdot\mathbf{v}\rangle}$$

For weak temperature gradient conditions, measure of how effectively convection dries the atmosphere per unit convective activity



Courtesy of Stipo Sentic

Conclusions/Outstanding Issues

1. Development of process-oriented diagnostics is progressing, although is a difficult endeavor, much more so than simply diagnosing whether a model has a good MJO
2. Reconciling differences in diagnostics among observational datasets is needed
3. Suggestions for diagnostics?
4. CMMAP might be suited to contribute to diagnostic development