WGNE MJO Task Force 2018 face-to-face meeting

September 15, Boulder, CO

Venue: Mesa lab. NCAR
*Room: **ML-680-Tower B**. South tower, very top floor (penthouse, 'PH' in elevator, take from 2nd floor)

Attendees
1. Daehyun Kim (Co-chair)
2. Steve Woolnough (Co-chair)
3. Charlotte DeMott
4. Samson Hagos (remotely)
5. Xianan Jiang (remotely)
6. Hyemi Kim
7. Nick Klingaman
8. Tieh-Yong Koh
9. Tomoki Miyakawa
10. Rich Neale
11. Prince Xavier (remotely)

Apologies
1. Eric Maloney

Agenda

Time	Title	Presenter
0845-0900	Logistics	Daehyun Kim/Steve Woolnough, Rich Neale
TF Business		
0900-0930	TF membership discussions	Daehyun Kim/Steve Woolnough
MJO teleconnection		
0930-0950	MJO-Atlantic storm track/NAO	Steve Woolnough

0950-1010	MJO-teleconnection (Pacific) in climate models	Hyemi Kim
1010-1040	Discussion	
MJO process-oriented diagnostics & MJO-mean state relationship		
1040-1100	MJO in CAM6 and in E3SM (DOE model)	Rich Neale
1100-1130	Mean state and MJO propagation	Xianan Jiang
1310-1320	Mean state bias and MJO propagation across MC in MetOffice model	Prince Xavier
1200-1300	Lunch	
1300-1320	Coupled vs uncoupled models	Charlotte DeMott/Nick Klingaman
1320-1330	Coupled vs uncoupled models: NASA GISS GCM	Daehyun Kim
1330-1350	MJO in aquaplanet NICAM simulations	Tomoki Miyakawa
1350-1420	Discussion	
MJO prediction skill assessment		
1430-1450	MJO prediction skill in S2S models	Charlotte DeMott
1450-1510	MJO prediction skill in SubX models	Hyemi Kim
1510-1530	Discussion	
1530-1550	Break	
MJO-MC interaction		
1550-1610	The disruption of the propagation of the Madden-Julian Oscillation across the Maritime Continent	Samson Hagos
1610-1630	ENSO’s influence on MJO-Diurnal Cycle interaction in the Maritime Continent evidenced by TRMM rainfall estimates	Tieh-Yong Koh
1630-1650	GCM simulations with perturbed convection in the MC island	Daehyun Kim

1650-1720	Discussion	
TF Business 2		
1720-1750	Preparation of Report/Update for WGNE-33 (October 2018)	Steve Woolnough/Daehyun Kim
1750	Adjourn	

TF Membership (DK/SW)

Camille Risi, Jon Gottschalck and Ken Sperber have stood down as members of the TF and we thank them for their contributions.

Samson Hagos (PNNL) and Xianan Jiang (UCLA) have been invited to join the TF

We're still looking to recruit an additional member the TF, we discussed recruiting a member BMKG to further research on the influence of the MJO on the weather of the region. SH will speak to Donaldi Permana about joining the TF or suggesting a member to join the TF. (Draft an e-mail, and circulate to DK and SW)

MJO Teleconnections:

SW presented work on the dependence of the MJO teleconnection to the North Atlantic European (NAE) Sector on the phase of ENSO. The observed teleconnection to the NAO+ regimes is stronger in El Nino years, and largely absent during La Nina years. The teleconnection NAO- is also sensitive to ENSO, with the strongest teleconnections in ENSO neutral years. In La Nina years the teleconnection to NAO- is delayed compared to neutral and weaker. In El Nino years the NAO- response seems to be related to an in situ development from the NAO+ → Atlantic Ridge → NAO-. The observed regime teleconnections are consistent with changes in the distribution of the latitudinal location of the NA jet. The ENSO dependence of the NAE regimes is likely partly dependent on the ENSO dependent changes in the Pacific jet and its connections to the North Atlantic Jet.

HK showed multi-model comparison (29 climate modes, CMIP5, YOTC/GASS, ECMWF) of MJO-teleconnection simulation as a basis for developing MJO-teleconnection metrics. As previous studies have found (Henderson et al. 2017), realistic simulation of MJO-teleconnection largely depends on both MJO and basic state. Various MJO-teleconnection metrics (Z500 variance, pattern, amplitude, persistence) are compared with various MJO metrics (MJO propagation, amplitude, shift, period) and basic state metrics (Jet shift, expansion, amplitude) to examine the relative importance of the MJO vs. basic state to MJO-teleconnection fidelity. Models which have more realistic MJO convection patterns, amplitude, East/West ratio, and slower MJO propagation tend to simulate better MJO-teleconnections patterns and amplitude. Models with a longitudinal shift of Pacific Jet (U250) tend to have lower MJO-teleconnection pattern skill.

Action items:
- MJO-TF to develop set of MJO Teleconnection Metrics in collaboration with other projects (discuss with YTMIT primarily, but also NOAA TF and S2S)
- **HK** will share a detailed document of MJO-teleconnection metrics by the end of Oct.
- MJO-teleconnection Telecon in mid-November.

MJO Processes Oriented Diagnostics and Mean State Relationship

RN: Analysis of MJO in versions of recently released NCAR model (CESM2/CAM6) and US Dept. of Energy Model (E3SM: Energy Exascale Earth System Model. CAM6 much improved with propagation into the W. Pacific. But this is only true for a coupled version of CAM6 (CESM2). CAM6 is very different from CAM5 in the representation of physics, but small stability sensitivity changes in the existing Zhang McFarlane convection scheme appear responsible for the charge. E3SM includes increased vertical velocity (L72), different dynamical core (spectral element) and different ocean (MPAS), a representation of convective gustiness (Redelsperger et al., 2000) and it produces a similar MJO to CESM2. Problems persist in CAM6 hindcast/CAPT simulations that show a spurious increase in cloud/long-wave cloud forcing and decrease in OLR at day 2-5 before returning to normal at day 8.

Propagating wave activity in the APE atlas
http://www.met.reading.ac.uk/~mike/APE/atlas/final/APE_ATLAS.Chapters.5.pdf

XJ presented three examples on large-scale control of the MJO propagation, including 1) the observed year-to-year variability in MJO propagation over the western Pacific sector associated with changes in lower-tropospheric mean moisture pattern and winds. The MJO eastward propagation is largely suppressed while a westward propagating intraseasonal mode picks up over the western Pacific during winters when wet and easterly anomalies are present in the lower-troposphere over the equatorial west-central Pacific; 2) the distinct seasonal (winter vs summer) variations of the observed MJO propagation due to seasonal changes of mean background low-level moisture pattern; 3) distinguished MJO propagation directions based on idealized aqua-planet model experiments by using ECHAM4 forced by different zonally uniform SST profiles. It is found that propagation direction of model “MJO” is closely associated with the low-level mean meridional moisture gradient. Therefore, in addition to the equatorial wave dynamics, large-scale environment plays a critical in regulating model “MJO” propagation.

PX (via video conference) presented results on his analysis of MJO propagation in the Met Office Unified Model (MetUM) coupled and uncoupled versions. Most (almost 80%) of the MJO event in the atmospheric model (GA7) are stationary in the Indian Ocean while the coupled model (GC3) produces much more propagating events that crosses over to the Maritime

Continent and the Western Pacific. His analysis investigates the role of warm SST biases and how it aids the MJO propagation in GC3. There is evidence that the dry humidity bias over the Indian Ocean and Maritime Continent in GA7 is much reduced in GC3, suggesting a possible enhancement of surface fluxes and low-level humidity in GC3. GA7 forced with SST from GC3 shows signs of improved propagation under a warmer mean SST state, however the exact role of modified air-sea interactions under a warmer mean state will need to be addressed using GA7 coupled to a mixed layer ocean model constrained by GC3 SST mean state.

MJO and AIr-sea interaction

CD presented analyses of the simulated MJO in four pairs of coupled and uncoupled GCMs (models are SPCAM3, ECHAM, MetUM, and CNRM). Monthly mean (or, in some cases, 31-day running mean) SSTs from the coupled simulation were prescribed to the respective uncoupled simulation. Each coupled-uncoupled model pair therefore has identical SST mean state and low-frequency variability. In all four models, coupling leads to improved MJO propagation, and meridional moisture gradients that are more "peaked" on the Equator than in the uncoupled simulation. The more peaked moisture gradients are consistent with enhanced moistening by meridional moisture advection east of MJO convection, and the improved MJO propagation in the coupled simulations. Reasons for the more peaked meridional moisture gradient have so far remained elusive. They do not appear to be driven by changes in the MJO itself, by changes in convection-radiative feedbacks, or by direct ocean feedbacks (i.e., such as reduced surface fluxes at the poleward limits of the Warm Pool). Coupling also enhances the anomalous zonal pressure gradient force, which drives stronger easterly wind anomalies east of MJO convection. The zonal pressure gradient changes are highly correlated with surface pressure reductions in the Rossby wave part of the MJO "Gill pattern." The more intense Rossby waves in coupled simulations may be a direct response to ocean coupling: as MJO convection expands meridionally as it traverses the Indian Ocean, energy stored in the upper ocean is transferred (via fluxes) to the atmosphere, invigorating the convectively coupled ER wave, and its associated surface low pressure. Understanding whether changes to the mean state moisture, or changes to the MJO circulations are primarily responsible for improved MJO propagation will be assessed by computing moisture advection as the product of coupled model moisture combined with uncoupled model winds, and vice versa. Work to understand the changes in mean state moisture is ongoing.

MJO and Prediction Skill

HK presented MJO prediction results from six subseasonal hindcast experiment (SubX) models and two S2S models. MJO prediction skill, propagation characteristics and processes, and mean biases were compared. MJO prediction skill in SubX ranges from 3-4.5 weeks which is comparable to S2S models. The biases in eastward propagation may partly be attributed to the weaker moisture advection in the Maritime Continent due to the lower-tropospheric dry mean biases in the models, consistent to the S2S results by Lim et al. (2018). In addition, models tend to have more frequent occurrence of moderate rain (<20mm/day) than the observed, which is a common problem in climate models (Rushley et al. 2018, CMIP5 models). How these mean biases feedback on each other and to MJO propagation and prediction skill warrant further study.

CD presented results of her analysis of MJO propagation skill in five coupled forecast models included in the S2S database: BoM, CMA, CNRM, ECMWF, and NCEP CFSv2. Changes in MJO forecast skill (BCOR) were significantly (and positively) correlated to changes in zonal and meridional moisture gradients in two of the five models (and negatively correlated in some models). Correlations between BCOR and moisture gradients were complicated by skill changes that appear to be associated with “initialization shock” adjustments early in the forecast integration followed by a more monotonic drift in both BCOR and mean state metric. BCOR was significantly correlated with anomalous low-level zonal pressure gradients in three of the five models. Current efforts are focused on understanding the extent to which ocean feedbacks may contribute to MJO skill.

MJO and the Maritime Continent

DK presented results of GCM simulations with which the role of Maritime Continent (MC) land convection on MJO propagation was investigated. The GCM used is the Seoul National University Atmosphere Model Version 0 (SAM0) with a unified convection scheme (UNICON) of Park (2014), which simulates a decent MJO. In addition to the control simulation, two idealized experiments were configured to artificially enhance (strongMLC) and suppress MC (weakMLC) land convection and weak MC Land Convection. Compared to the control simulation, MJO propagation was weaker in strongMLC and is stronger in weakMLC over the both equatorial MC region (5ºS-5ºN, 100-140ºE) and southern MC region (15ºS-5ºS, 100-140ºE). In the equatorial MC region, strong MC land convection lowers the “alpha” parameter of Chikira (2014) by reducing vertical moisture gradient. In the southern MC region, strong MC land convection weakens the MJO-related horizontal moist static energy (MSE) advection by reducing horizontal moisture gradient. The results suggest that strong MC land convection interrupts MJO propagation by reducing moisture gradient vertically and horizontally over the MC. The effect of the diurnal cycle of precipitation was briefly discussed.

Preparation for Report/Update for WGNE

DK agreed to attend the WGNE meeting and present on behalf of the group and everyone agreed to provide a 1-page slide summarizing their work.