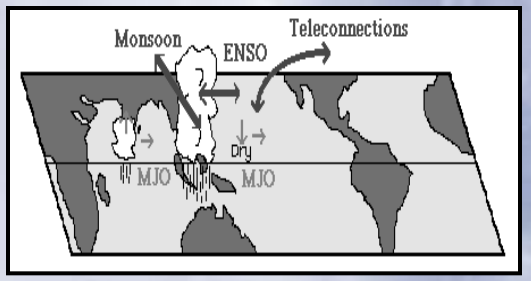
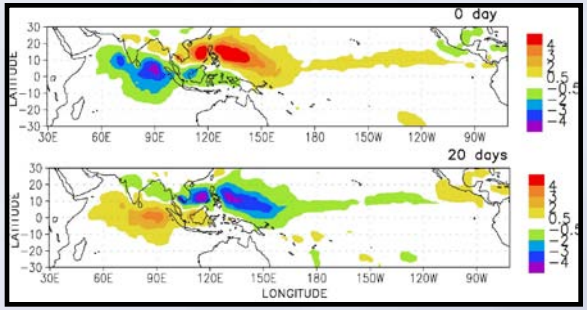
An Update on MJO Task Force Activities and Plans





WCRP World Climate Research Programme

THORPEX A World Weather Research Programme

WWRP World Weather Research Programme

YOTC

MJO Task Force : Background

- Established in early 2010 for an initial term of 3 years
- Sponsor: WCRP-WWRP/THORPEX under their YOTC Project
- Follow on from the US CLIVAR MJO Working Group
- Website: www.ucar.edu/yotc/mjo.html

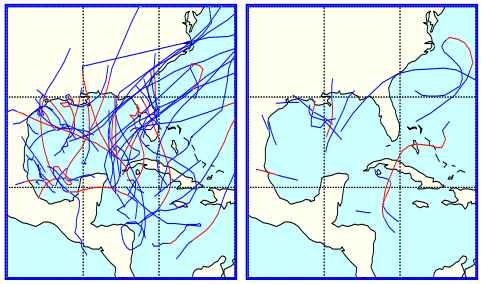
Members

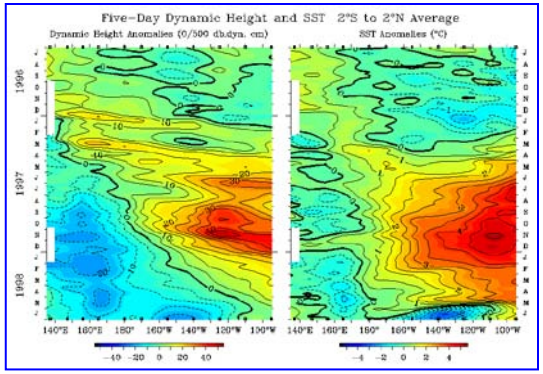
Matthew Wheeler	Centre for Australian Weather and Climate Research **(co-chair)**
Eric Maloney	Colorado State University **(co-chair)**
Duane Waliser	Jet Propulsion Laboratory/Caltech
Ken Sperber	PCDMI/Lawrence Livermore National Laboratory
Xiouhua Fu	University of Hawaii
Jon Gottschalck	National Centers for Environmental Prediction
Richard Neale	National Center for Atmospheric Research
Chidong Zhang	University of Miami
Daehyun Kim	Columbia University
Augustin Vintzileos	National Centers for Environmental Prediction
Masaki Satoh	Frontier Research Center for Global Change
Hai Lin	Environment Canada
Prince Xavier	UK Met Office
June-Yi Lee	University of Hawaii
Steve Woolnough	University of Reading

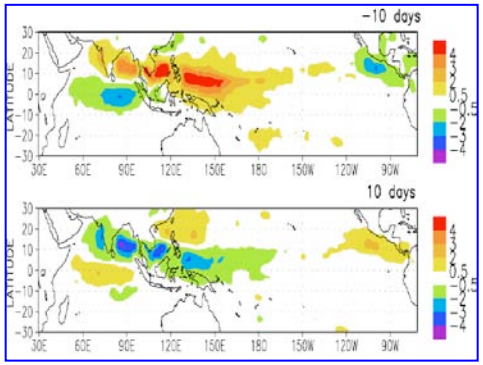
Important others and former members

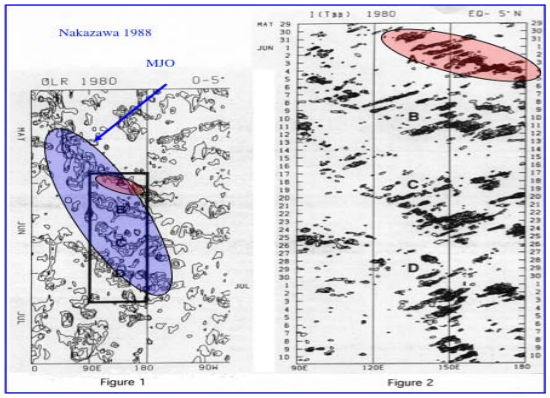
X. Jiang, N. Klingaman, J. Petch, F. Vitart, J. Benedict, H. Hendon, D. Raymond

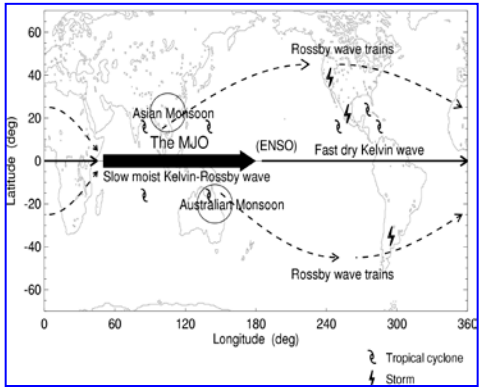
Motivation

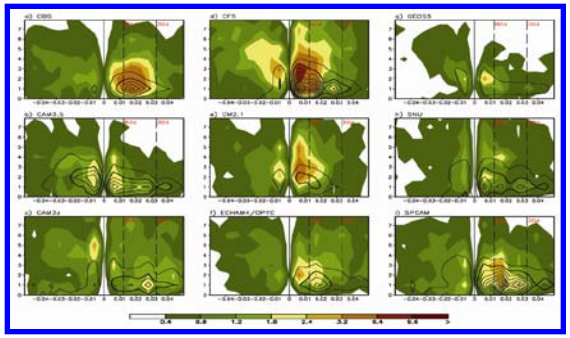












Figures: Maloney, PMEL/TAO, Nakazwa, MJO WG, Lin, Waliser

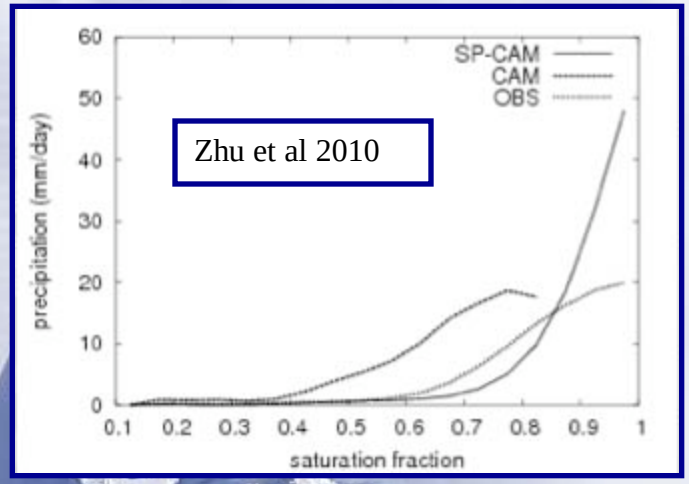
- The MJO is the dominant form of intraseasonal variability in the Tropics.
- The MJO impacts a wide range of weather & climate phenomena.
  - Monsoon Onset & Breaks
  - ENSO+IOD IInteractions
  - Tropical Cyclone Modulation
  - Midlatitude Weather Impacts
  - Organization of Chl, Aerosols, Ozone, etc variability.
- Our weather & climate models have a poor representation of the MJO.
- Great benefit could be derived from better predictions of the MJO - Helps to bridge the gap between weather and seasonal predictions.
- See NAS 2010 ISI Report.

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.

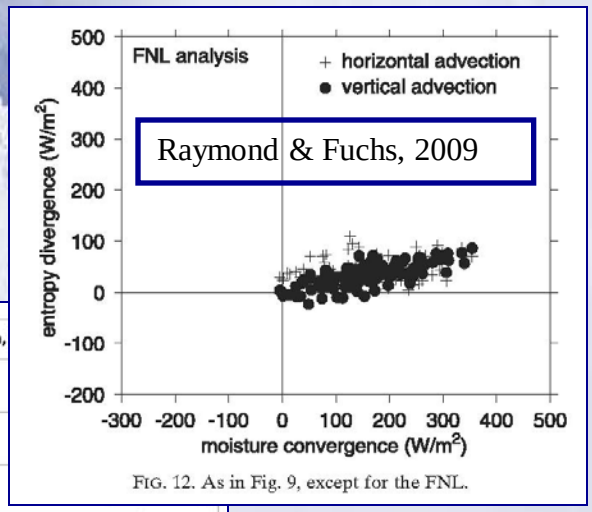
Organized into 4 Subprojects

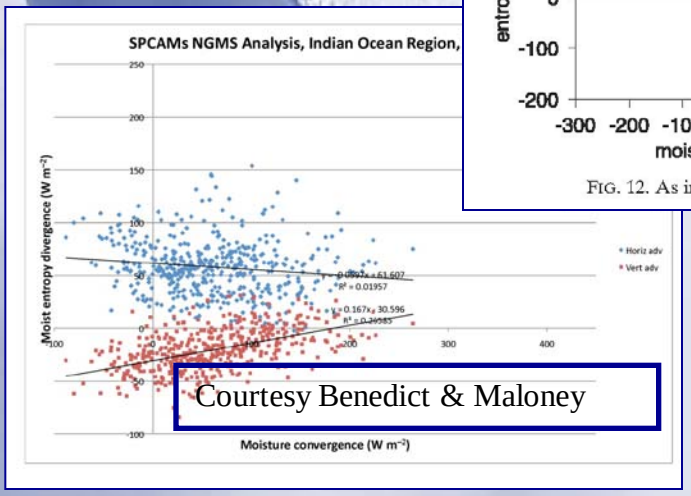
- Process-oriented diagnostics/metrics for MJO simulation
  (leads: D. Kim, P. Xavier, E. Maloney)
- Boreal summer monsoon ISV monitoring and forecast metrics
  (leads: J.-Y. Lee, M. Wheeler, A. Vintzileos)
- MJO metric(s) for WGNE/WGCM Climate Metrics Panel
  (leads: K. Sperber, D. Kim)
- MJO TF + GASS Multi-Model Diabatic Processes Experiment
  (leads: D. Waliser, X. Jiang, J. Petch, P. Xavier, S. Woolnough, N. Klingaman)

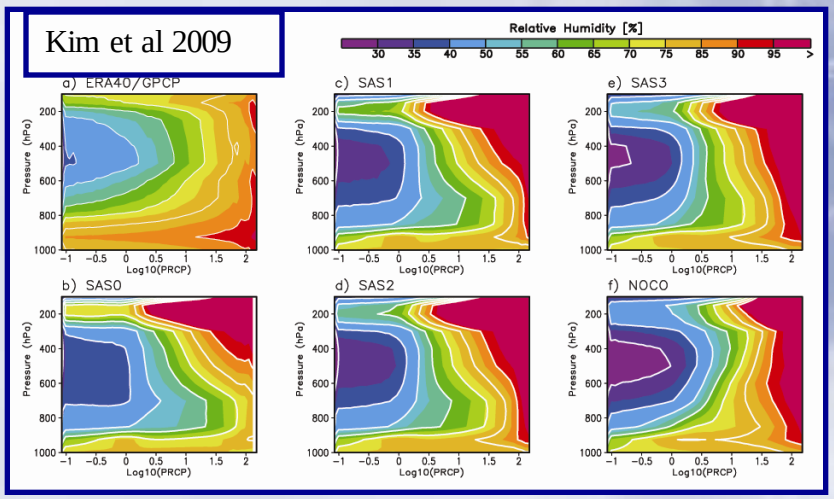
MJO TF Subproject: Process-Oriented Diagnostics/Metrics



- Exploring Diagnostics/Metrics that provide more insight into why a model may have a good/poor MJO.
- Provide more guidance to model development activities

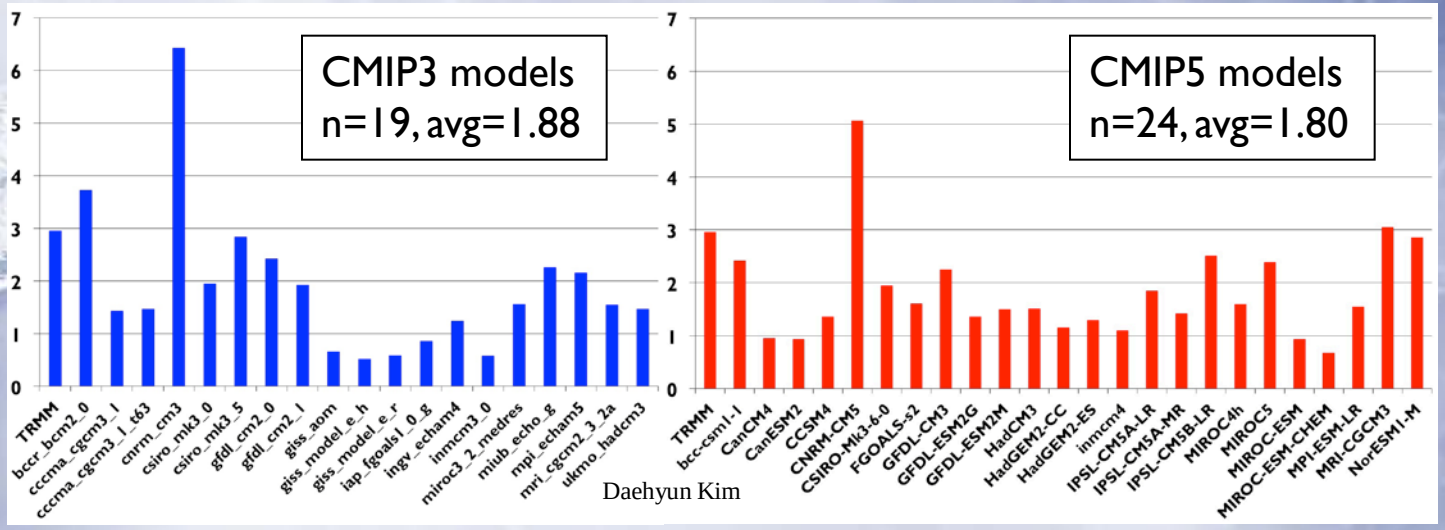






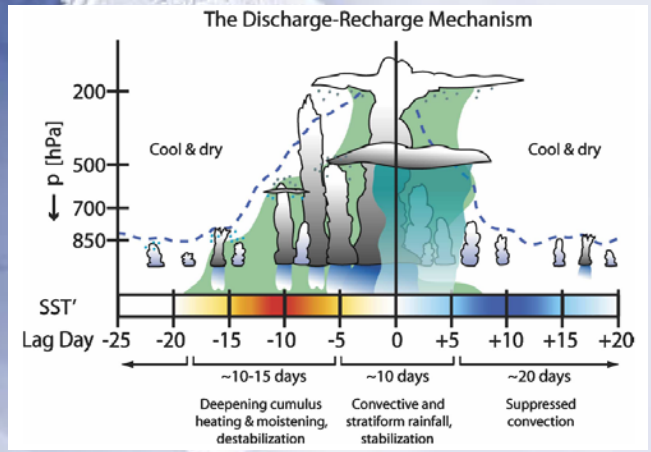
Latest results (being presented at Pan-GASS conference this week)

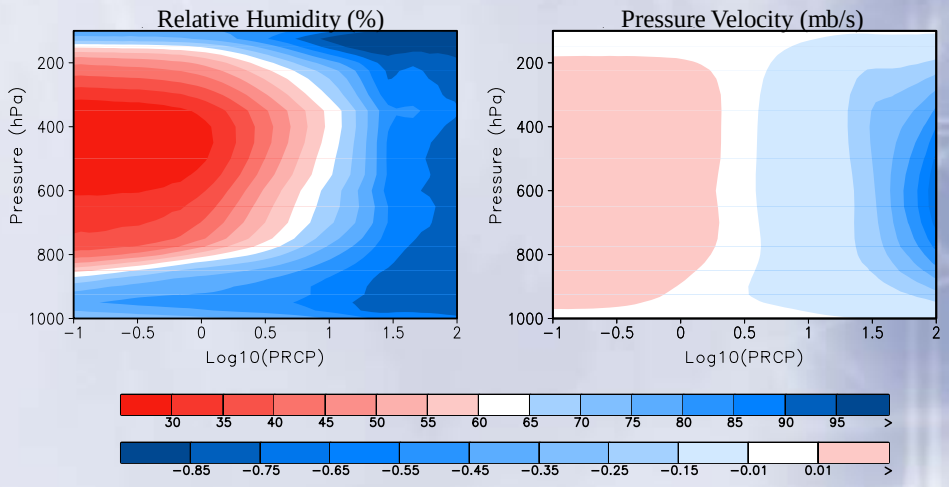
East/West ratio (wavenumber1-3, periods 30-70 days)



Daehyun Kim

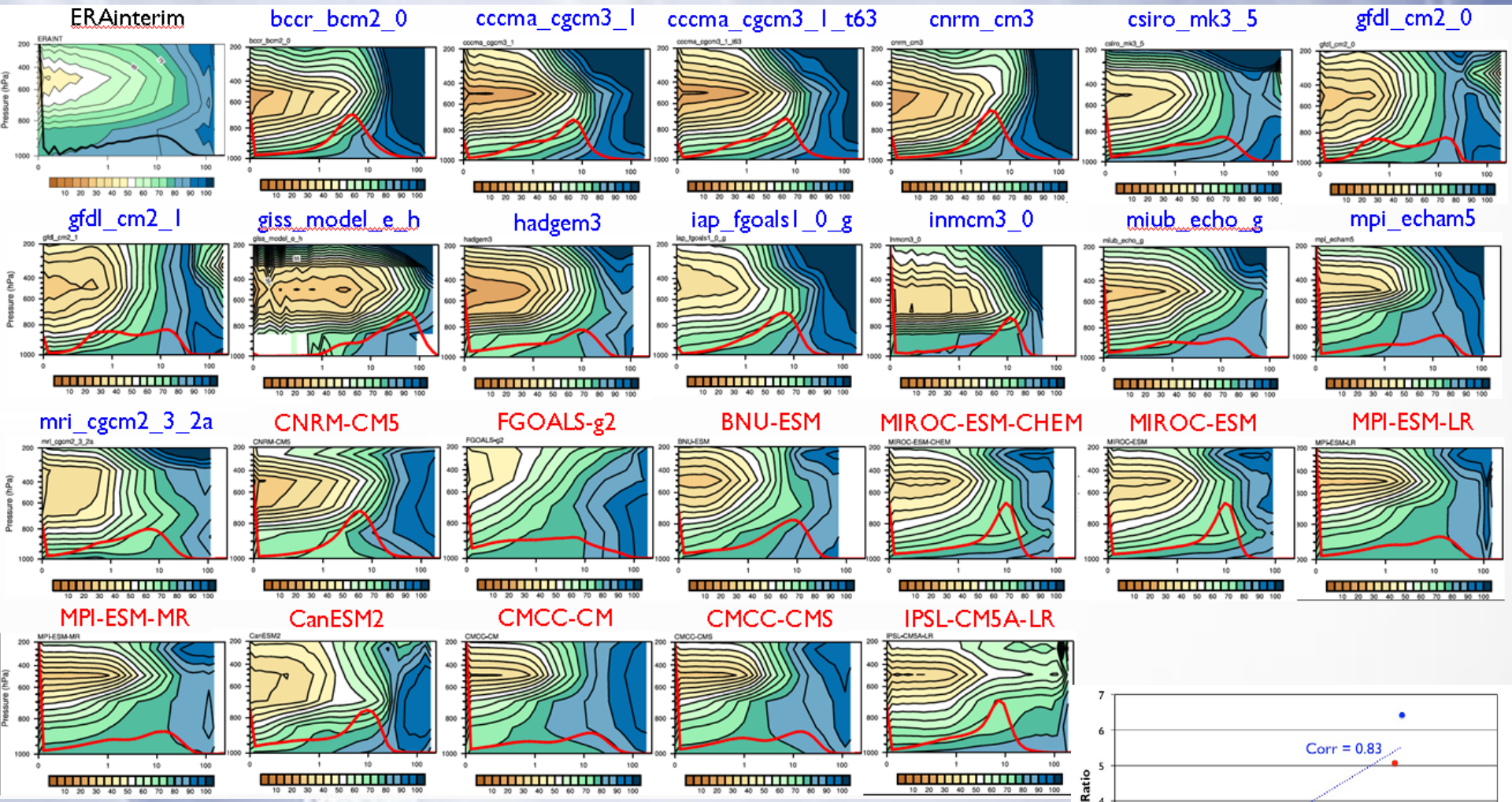
Despite huge efforts in the development of climate models, simulations of the MJO are still unsatisfactory. The above figures compare the capability of CMIP5 models to simulate the MJO with that of the CMIP3 models using one metric based on east/west ratio; not much improvement has occurred in general.





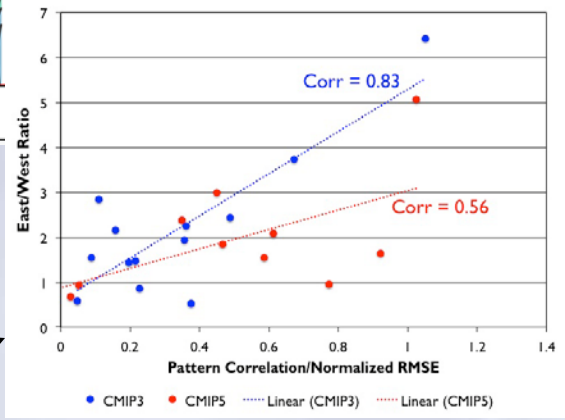
As one of the process-oriented diagnostics under development, we propose a diagnostic to better understand the relationship between relative humidity and precipitation, where vertical profiles of relative humidity over the warm pool are averaged for different precipitation amounts (Thayer-Calder and Randall 2009). This diagnostic is relevant to the "discharge-recharge" mechanism of the MJO (Blade and Hartmann 1993).

Applying the RCP (**R**elative humidity **C**omposites as a function of **P**recipitation) diagnostic to a subset of CMIP3 and CMIP5 models



A metric is derived from the RCP diagnostic by calculating a pattern correlation and normalized RMSE of the relative humidity composite diagrams against the observed plot. For this, a specific area (10-34 mm/day, 900-200 hPa) which includes the transition period between dry and moist regime is chosen. After determining two numbers we divide the pattern correlation by the normalized RMSE to have one metric from the RCP diagnostic.

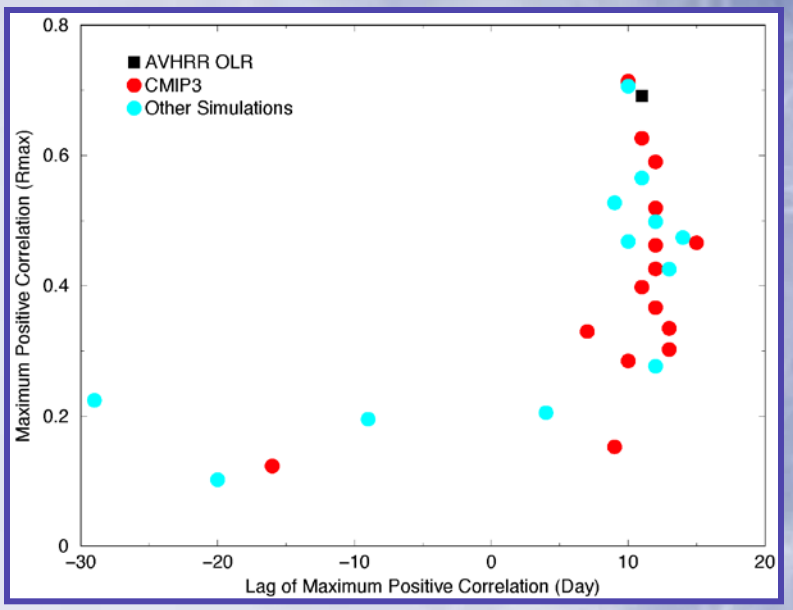
This scatter plot shows the good relationship between this metric and model's MJO strength.



MJO TF Subproject: Metrics for WGNE/WGCM Climate Metrics Panel

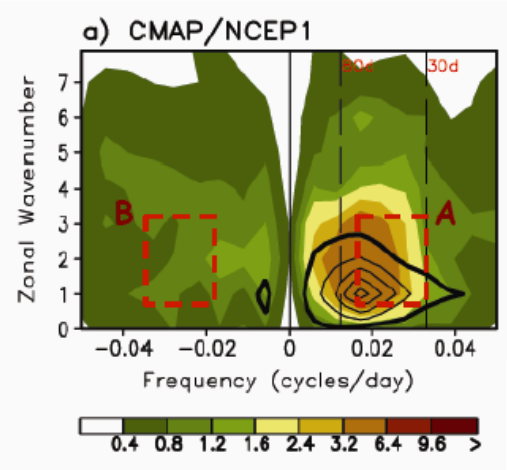
Offering guidance on simple MJO performance metrics for assessing CMIP models.

Metric #1 Project 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).



Metric #2 East/west power ratio from wavenumber-frequency spectral analysis of convection.

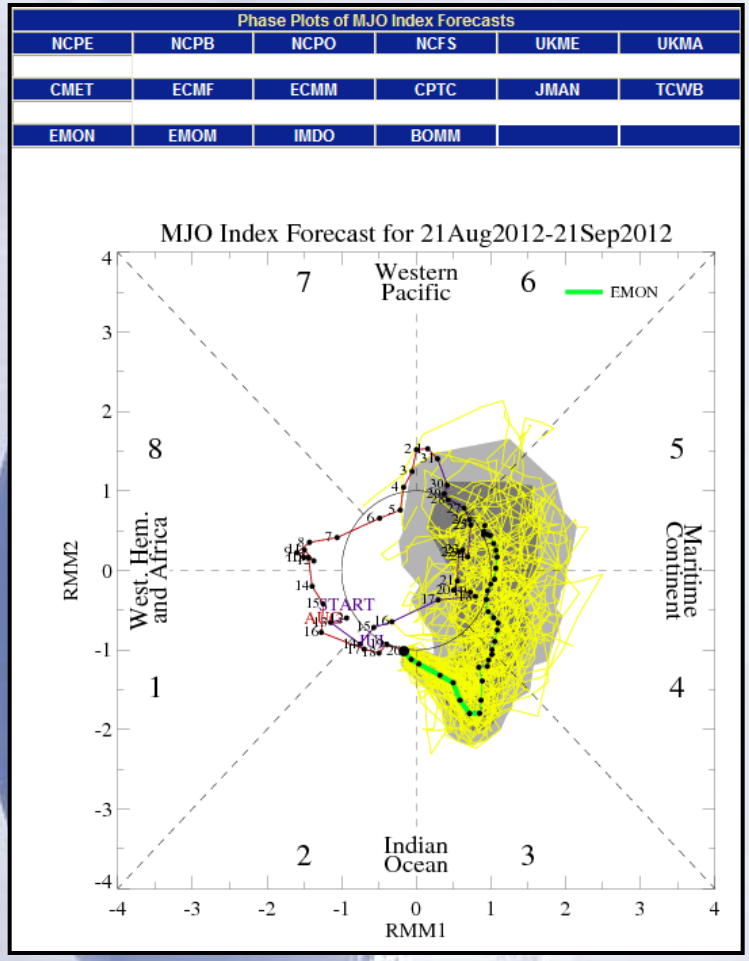
Wavenumber-frequency power spectra



- **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**

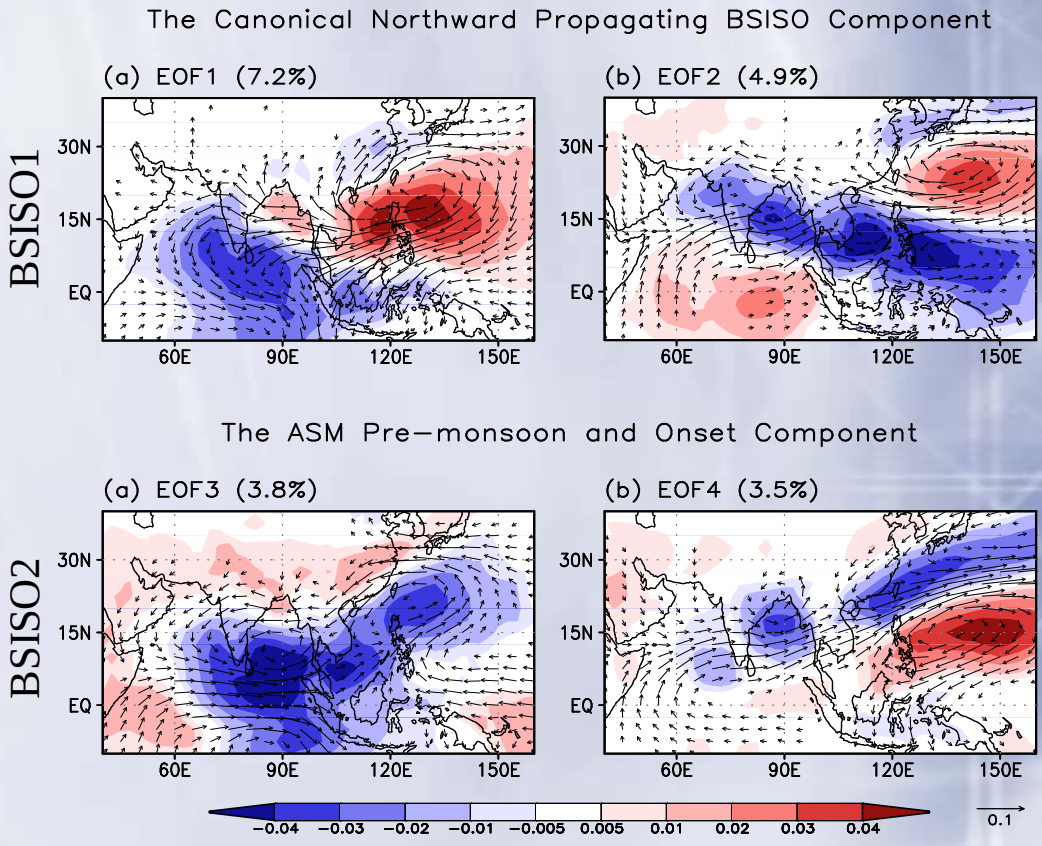
MJOWG et al. 2008
Kim et al 2009

MJO TF Subproject: Boreal Summer ISV Forecast Metric



This plot is from the CPC web-site display of dynamical model MJO index forecasts, one of the successes of the MJO Working Group (Gottschalck et al. 2010).

Following our success with the Wheeler-Hendon (WH04) Real-time Multivariate MJO (RMM) index, we have sought to develop new indices for the boreal summer ISO (BSISO; Lee et al. 2012).

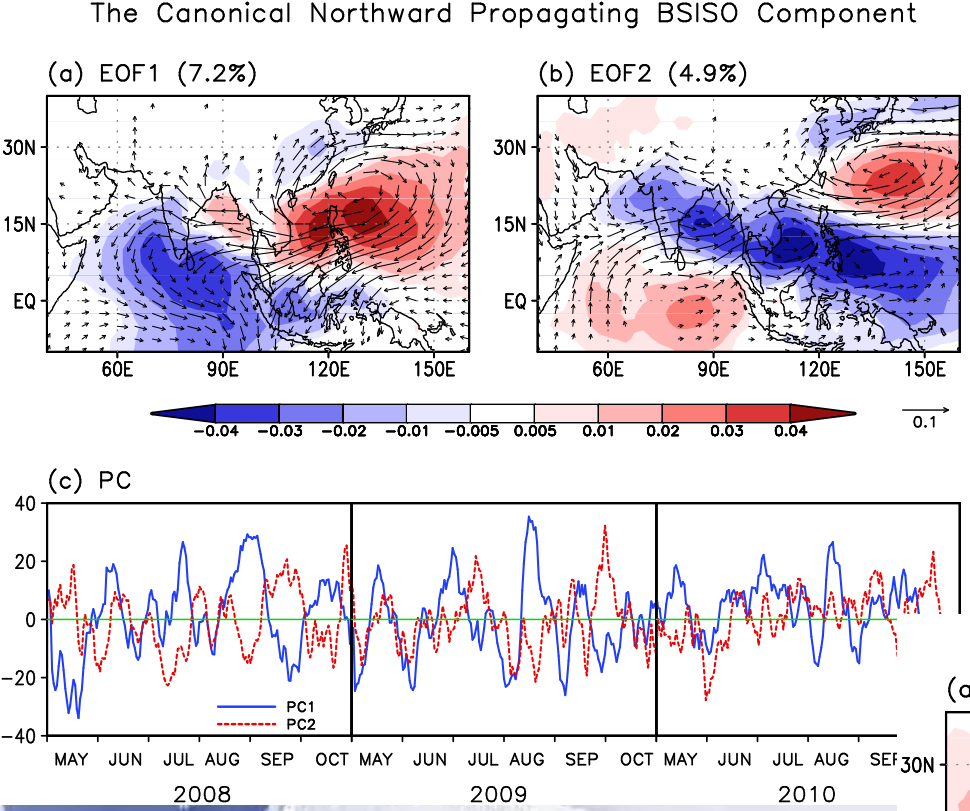


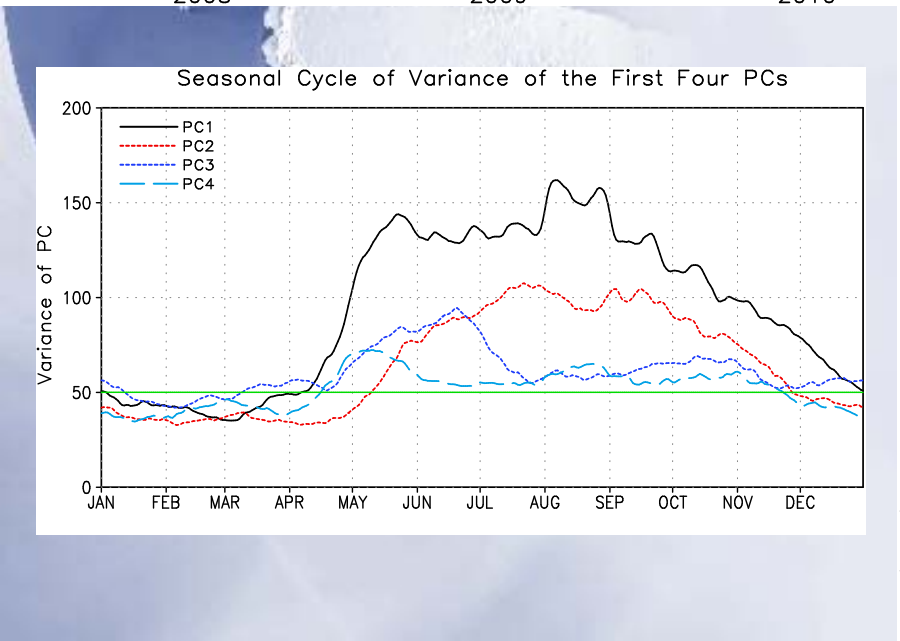
http://iprc.soest.hawaii.edu/users/jylee/miso/miso.htm

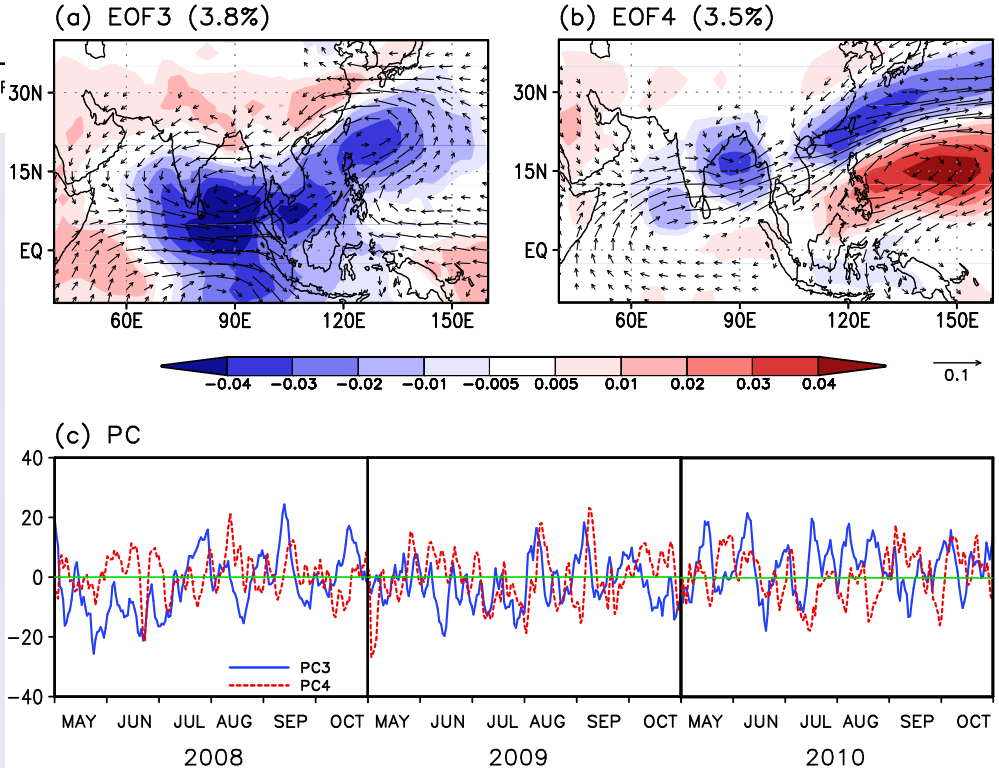
Like WH04, multivariate EOFs of winds and OLR are used to define the new indices.

EOF1 and EOF2 are combined to form the BSISO1 index.

EOF3 and EOF4 are combined to form the BSISO2 index.







Vertical Structure and Diabatic Processes of the MJO: *Global Model Evaluation Project*

MJO TF **GASS**

MJO Phenomena/Modeling Expertise + Model Diagnostic/Development Expertise

- Characterize observed and modelled temperature, moisture, and cloud structures within the multi-scale convective systems during the MJO life cycle and determine the roles of various heating, moistening and momentum mixing processes.
- Evaluate the ability of current models to hindcast MJO events, and characterize the evolution of the "error" growth in the profiles of moistening, diabatic heating, etc.
- Elucidate key model deficiencies in depicting the MJO physical process evolution, and provide guidance to model development/improvement efforts.
- Based on above analyses, develop more targeted physics/detailed process model studies as well as formulate plans for needed observations (in-situ, airborne, satellite).

WCRP World Climate Research Programme | MJO TF | THORPEX A World Weather Research Programme | WWRP World Weather Research Programme | GASS | GEWEX Atmospheric System Studies | YOTC

Vertical Structure and Diabatic Processes of the MJO: *Global Model Evaluation Project*

MJO Task Force/YOTC and GASS

Time step / 2 –Day Physics Errors

Daily / Weekly Forecast Errors

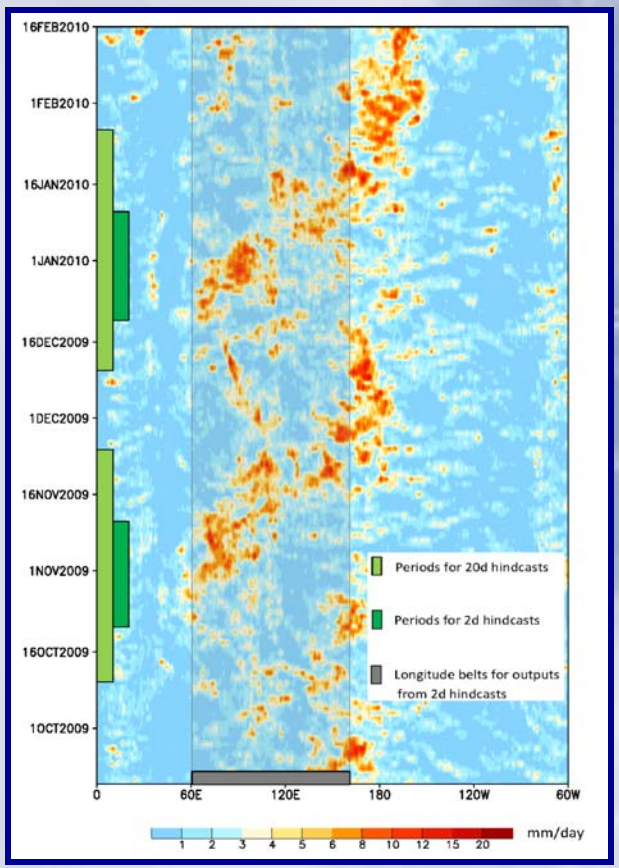
Long-Term Climate Simulation Errors

1. **climate simulation** – multi-year simulations coupled or atmosphere only

2. **short range hindcasts** – daily 48hr lead during ~20 days of the MJO

3. **medium range hindcasts** – daily 20-day lead time

www.ucar.edu/yotc/mjodiab.html



Vertical Structure and Diabatic Processes of the MJO: *Global Model Evaluation Project*

MJO Task Force/YOTC and GASS

www.ucar.edu/yotc/mjodiab.html

	Model Experiment	Science Focus	Exp. POC
I.	**20 Yr Climatological Simulations** (1991-2010 if AGCM) 6-hr, Global Output Vertical Structure, Physical Tendencies	Model MJO Fidelity Vertical structure Multi-scale Interactions: (e.g., TCs, Monsoon, ENSO)	**UCLA/JPL** X. Jiang D. Waliser
II.	**2-Day MJO Hindcasts** YOTC MJO Cases E & F (winter 2009)* Time Step, Indo-Pacific Domain Output Very Detailed Physical/Model Processes	Heat and moisture budgets Model Physics Evaluation (e.g. Convection/Cloud/BL) *Short range Degradation*	**Met Office** P. Xavier J. Petch
III.	**20-Day MJO Hindcasts** YOTC MJO Cases E & F (winter 2009)* 3-hr, Global Output Elements of I & II	MJO Forecast Skill State Evolution/Degradation Elements of I & II	**NCAS/Walker in.** N. Klingaman S. Woolnough

*DYNAMO Case TBD

Commitments: Over 40 Modeling Groups with AGCM and/or CGCM

Status and Plans

- Over 40 modelling groups signed up; 13 groups started/completed upload.
- *Initial results to be presented and discussed at Pan-GASS Meeting Sep 10-14, 2012.*
- *Would like to identify subsequent case(s) from **Dynamo** at Pan-GASS or Dynamo Spring 2013 meeting.*
- *Identify critical / poorly-constrained processes for subsequent detailed GASS process modelling studies.*
- *Dovetails with MJO TF Diagnostics/Metrics Work.*

Model	POC	Institution	Experiment		
			Climatological simulation	Short-term Hindcast	Long-term Hindcast
GEOS-5 AGCM	Siegfried Schubert	NASA	X	X	X
	Hailan Wang	NASA/GMAO			
IPRC GCM	Xiouhua Fu	University of Hawaii	X	X	X
	Baoqiang Xiang	University of Hawaii			
SPCAM	David Randall	Colorado State University	X	X	X
	Charlotte Demott	Colorado State University			
	Mike Pritchard (UW)	UCSD			
NASA GISS	Daehyun Kim	LDEO	X	X	X
	Anthony Del Genio	LDEO			
GEM model	Hai Lin	Environment Canada	X	X	X
NICAM	Masaki Satoh	AORI, Univ. of Tokyo	-	X	X
	Tomoe Nasuno	JAMSTEC			
SINTEX	Jingjia Luo	JAMSTEC			
LMDZ	Jean-Philippe Duvel	LMD, Paris	X	-	-
	Sandrine Bony	LMD, Paris			
MRI-GCM	Eiki SHINDO	MRI	X	X	X
	Akio Kitoh	MRI			
CWB AGCM	Mong-Ming LU	CWB, Taiwan	X	X	X
	Hsin-Hsing CHIA	CWB, Taiwan			
	Hsiao-Chung TSAI	CWB, Taiwan			
WRF	Samson M Hagos	PNNL	X	X	X
CCSM4	David Straus	COLA and GMU			
	Ben Kirtman	University of Miami			
	Joe Tribbia	NCAR			
CFS T62L60	Kyong-Hwan Seo	PNU, Korea	X	X	X
	Sooraj K P	PNU, Korea			
IFS	Frederic Vitart	ECMWF	-	X	X
ECHAM	Traute Crueger	ZMAW			-
MetUM GA3.0	Prince Xavier	Met Office UK			X
INGV	Silvio Gualdi	CMCC			
HiRAM	Ming Zhao	GFDL			X
CCSM4, CESM1	Rich Neale	NCAR			X
NAVGEM	Jim Ridout	NRL			
	Young-Joon Kim	NRL			X
	Maria Flatau	NRL			
AM3/CM3	Bill Stern	GFDL			
CAM3/CAM5	Guang Zhang	UCSD			
Global WRF	Zhiming Kuang	University of Harvard	-	-	X
SPCAM	Zhiming Kuang	University of Harvard	-	-	X
CFSv2	Wanqiu Wang	NCEP/CPC	X	-	-

More, Full List Available on Project Website

www.ucar.edu/yotc/mjodiab.html

WCRP MJO TF THORPEX WWRP GASS YOTC

ISVHE

Intraseasonal Variability Hindcast Experiment

Designed for MJO & other ISV Prediction & Predictability Analysis

Contacts:
Bin Wang & June-Yi Lee

- 20-Year Climatological Simulations.
- 45-day hindcasts at least 3 times per month for 20 years with at least 5 membere ensembles.

At least 19 modeling groups with about 10 having submitted data.

ONE-TIER SYSTEM

	Model	Control Run	ISO Hindcast		
			Period	Ens No	Initial Condition
ABOM	POAMA 1.5 (ACOM2+BAM3)	CMIP	1980-2006	10	The first day of every month
APCC (not collected)	CCSM3	CMIP (20yrs)	1981-2008		The first day of every month
CMCC	CMCC (ECHAM5+OPA8.2)	CMIP (20yrs)	1989-2008	5	Every 10 days
ECMWF	ECMWF (IFS+HOPE)	CMIP(11yrs)	1989-2008	15	The 15th day of every month
GFDL	CM2 (AM2/LM2+MOM 4)	CMIP	1982-2008	10	The first day of every month
JMA	JMA CGCM	CMIP (20yrs)	1989-2008	6	Every 15 days
NCEP/CPC	CFS (GFS+MOM3)	CMIP (100yrs)	1981-2008	5	Every 10 days
PNU (not collected)	CFS with RAS scheme	CMIP (13yrs)	1981-2008	3	Every 10 days
SNU	SNU CM (SNUAGCM+MOM3)	CMIP (20yrs)	1989-2008	1	Every 10 days
UH/IPRC	UH CM (ECHAM4+IOM)	CMIP	1989-2008	6	Every 10 days during MJJAS

TWO-TIER SYSTEM

	Model	Control Run	ISO Hindcast		
			Period	Ens No	Initial Condition
CWB	CWB AGCM	AMIP (25yrs)	1981-2005	10	Every 10 days
MRD/EC	GEM	AMIP (21yrs)	1985-2008	10	Every 10 days
NASA/GMAO (not collected)	NSIPP	AMIP	1989-2008	10	Every day

Programmatic & Funding Sponsors
APCC, YOTC/MJOTF, AMY, NOAA CTB

Summary

- Actively working on 4 subprojects, each of which is addressing our overall goal.
- During the week of 10-14th September, most members of the Task Force will be participating in the 1st Pan-GASS conference in Boulder, with a follow-on meeting of the Task Force on 17th September.

Thank you for your participation and support of these activities over the last several years.