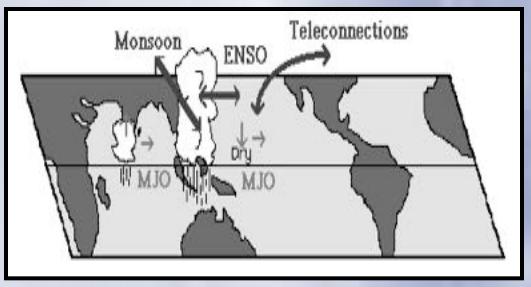
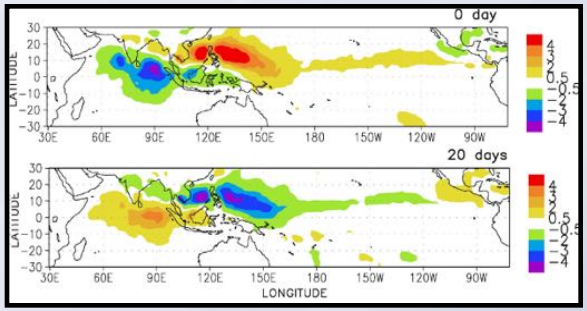
An Update on MJO Task Force Activities and Plans

Duane Waliser
JPL/Caltech/USA
Matthew Wheeler
ABOM/Australia





36th Annual CDPW
CPC/NCEP/NOAA
Fort Worth, TX; Oct 2011

WCRP World Climate Research Programme
THORPEX A World Weather Research Programme
WWRP World Weather Research Programme
YOTC

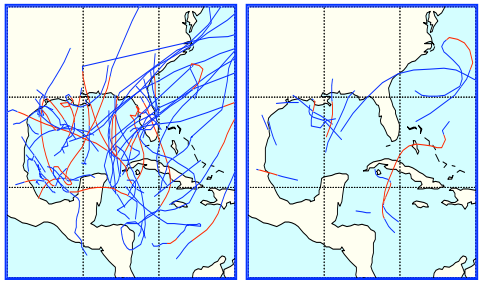
MJO Task Force : Background

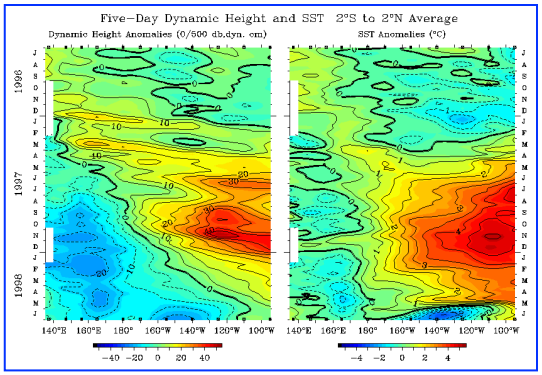
- Established in early 2010.
- Sponsor: WCRP-WWRP/THORPEX under their YOTC Project
- Follow on from the US CLIVAR MJO Working Group
- Website: www.ucar.edu/yotc/mjo.html

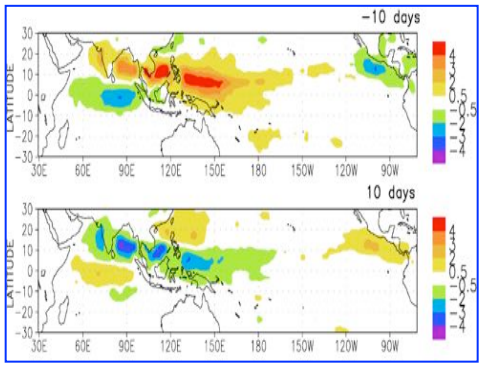
Duane Waliser (co-chair)	Jet Propulsion Laboratory/Caltech
Matthew Wheeler (co-chair)	Centre for Australian Weather and Climate Research
Ken Sperber	Program for Climate Model Diagnostics and Intercomparison
Harry Hendon	Centre for Australian Weather and Climate Research
Eric Maloney	Colorado State University
Xiouhua Fu	University of Hawaii
John Gottschalck	National Centers for Environmental Prediction
Richard Neale	National Center for Atmospheric Research
Chidong Zhang	University of Miami
Daehyun Kim	Lamont-Doherty Earth Observatory of Columbia University
Augustin Vintzileos	National Centers for Environmental Prediction
Frederic Vitart	European Centre for Medium-range Weather Forecasting
Dave Raymond	New Mexico Institute of Mining & Technology
Masaki Satoh	Frontier Research Center for Global Change
Hai Lin	Environment Canada
Prince Xavier	UK Met Office

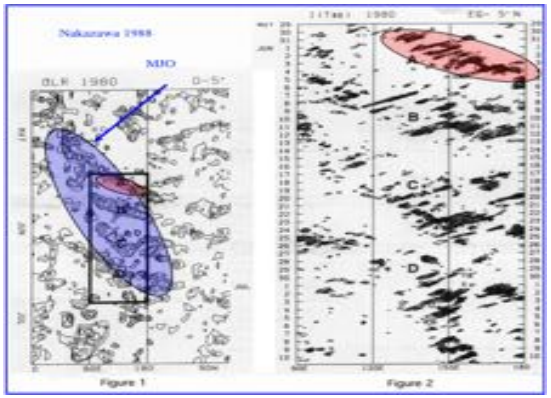
Overall Goal: Facilitate improvements in the representation of the MJO in weather and climate models in order increase the predictive skill of the MJO and related weather and climate phenomena.

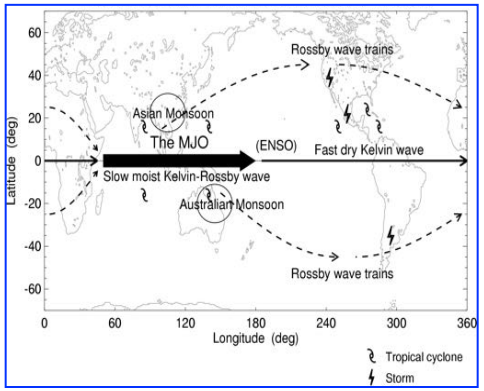
Motivation

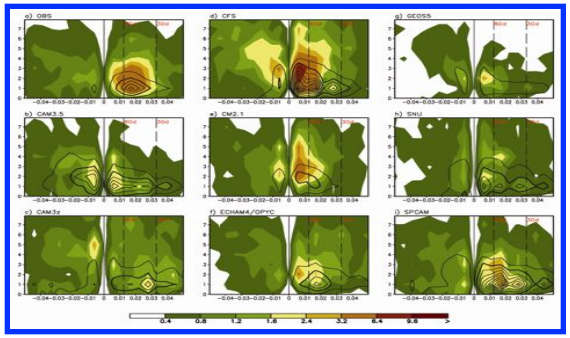












Figures: Maloney, PMEL/TAO, Nakazwa, MJO WG, Lin, Waliser

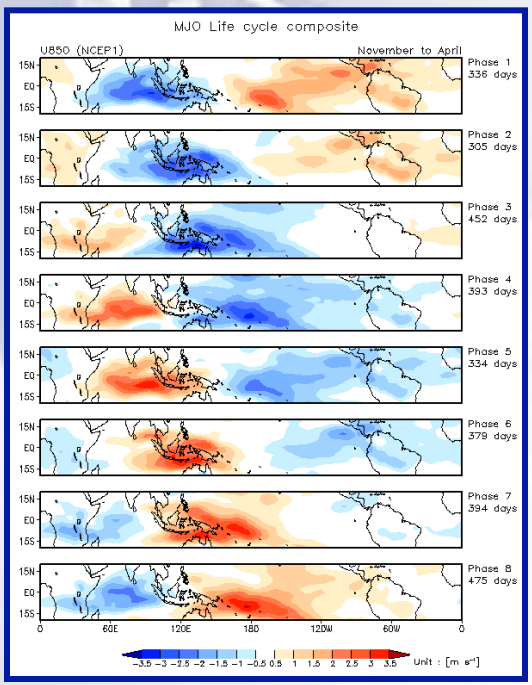
- The MJO is the dominant form of intraseasonal variability in the Tropics.
- The MJO impacts a wide range of weather & climate phenomena.
  - Monsoon Onset & Breaks
  - ENSO+IOD IInteractions
  - Tropical Cyclone Modulation
  - Midlatitude Weather Impacts
  - Organization of Chl, Aerosols, Ozone, etc 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.

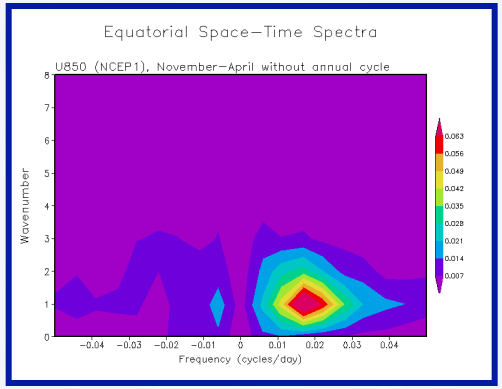
CLIVAR MJO WG Item I : MJO Simulation Diagnostics for GCMs

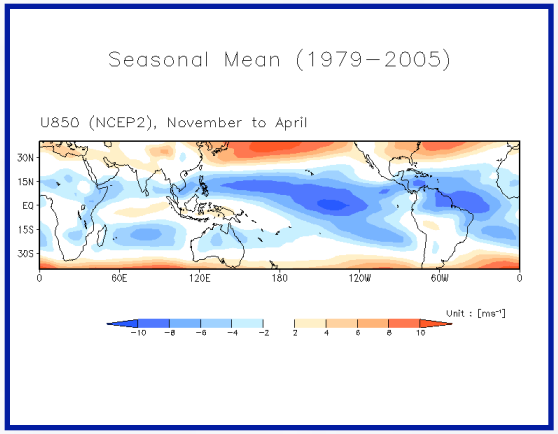
(MJOWG, J. Climate, 2009)

Observation-Based Diagnostics

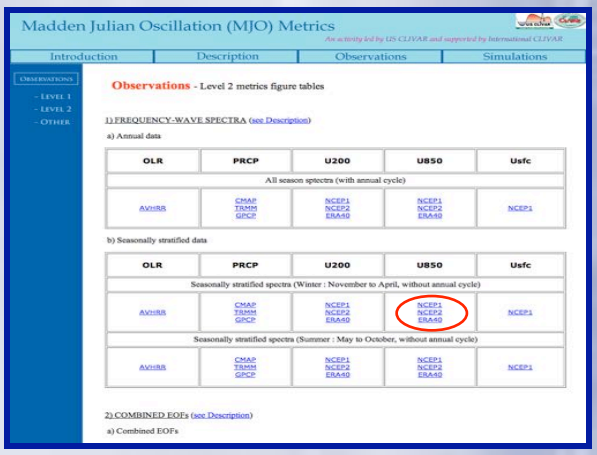
- Variability
- Life Cycle
- Mean-State
- Data Set Sensitivity



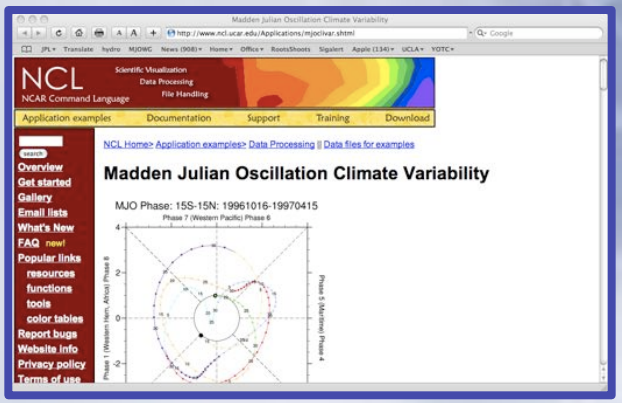




Web Display and Code Availability



Adopted by NCAR/NCL



www.usclivar.org/mjo.php

CLIVAR MJO WG Item II : Application of Diagnostics to GCMs

(Kim et al. J. Climate, 2009)

Model (group)	Horizontal Resolution -AGCM	Vertical Resolution (top level) -AGCM	Cumulus parameterization	Integration	Reference
CAM3.5 (NCAR)	1.9° lat x 2.5° lon	26 (2.2hPa)	Mass flux (Zhang and McFarlane 1995)	20 years 01JAN1986-31DEC2005	Neale et al. (2007)
CAM3z (SIO)	T42(2.8°)	26 (2.2hPa)	Mass flux (Zhang and McFarlane 1995)	15 years 29JAN1990-23JUL1995	Zhang et al. (2005)
CFS (NCEP)	T62(1.8°)	64 (0.2hPa)	Mass flux (Hong and Pan 1998)	20 years	Wang et al. (2005)
CM2.1 (GFDL)	2° lat x 2.5° lon	24 (4.5hPa)	Mass flux (RAS; Moorthi and Suarez 1992)	20 years	Delworth et al. (2006)
ECHAM4/OPYC (PCMDI)	T42(2.8°)	19 (10hPa)	Mass flux (Tiedtke 1989, adjustment closure Nordeng 1994)	20 years	Roeckner et al. (1996), Sperber et al. (2005)
GEOS5 (NASA)	1° lat x 1.25° lon	72 (0.01hPa)	Mass flux (RAS; Moorthi and Suarez 1992)	12 years 01DEC1993-30NOV2005	To be docume nted
SNUAGCM (SNU)	T42(2.8°)	20 (10hPa)	Mass flux (Numaguti et al. 1995)	20 years 01JAN1986-31DEC2005	Lee et al. (2003)
SPCAM (CSU)	T42(2.8°)	26 (3.5hPa)	Superparameterization (Khairoutdinov and Randall 2003)	19 years 01OCT1985-25SEP2005	Khairoutdinov et al. (2005)

Applied to 8 GCMs

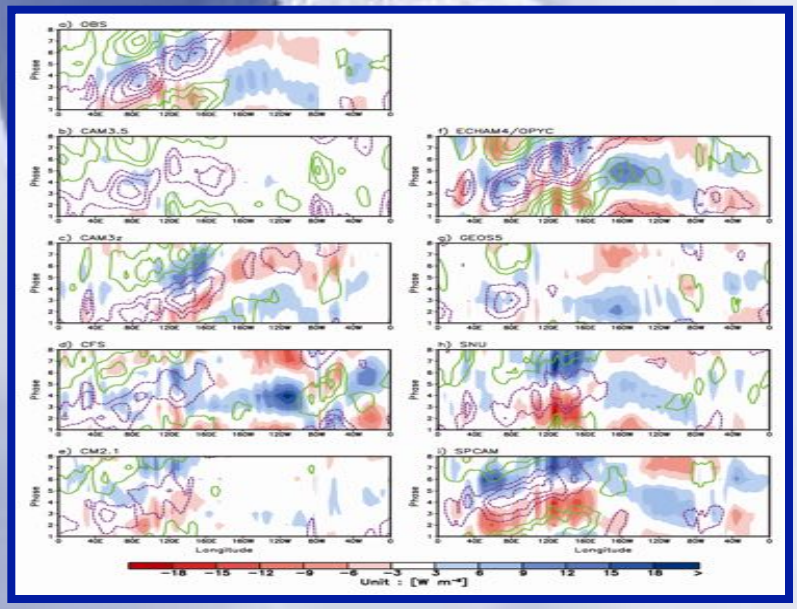
CAM3.5, CAM-3Z, SPCAM, ECHAM4/OPYC,

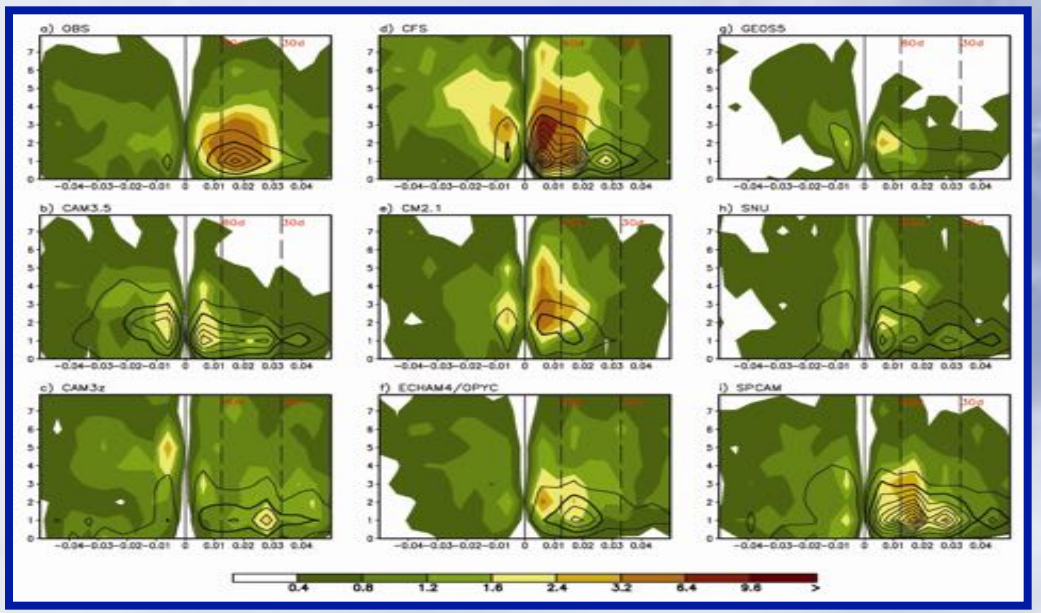
CFS, SNU, GFDL, GEOS5

CMMAP – MMF (uncoupled)

ECHAM4/OPYC (coupled)

Performed best. Still Challenges





CLIVAR MJO WG Item III: Operational MJO Forecast Metric

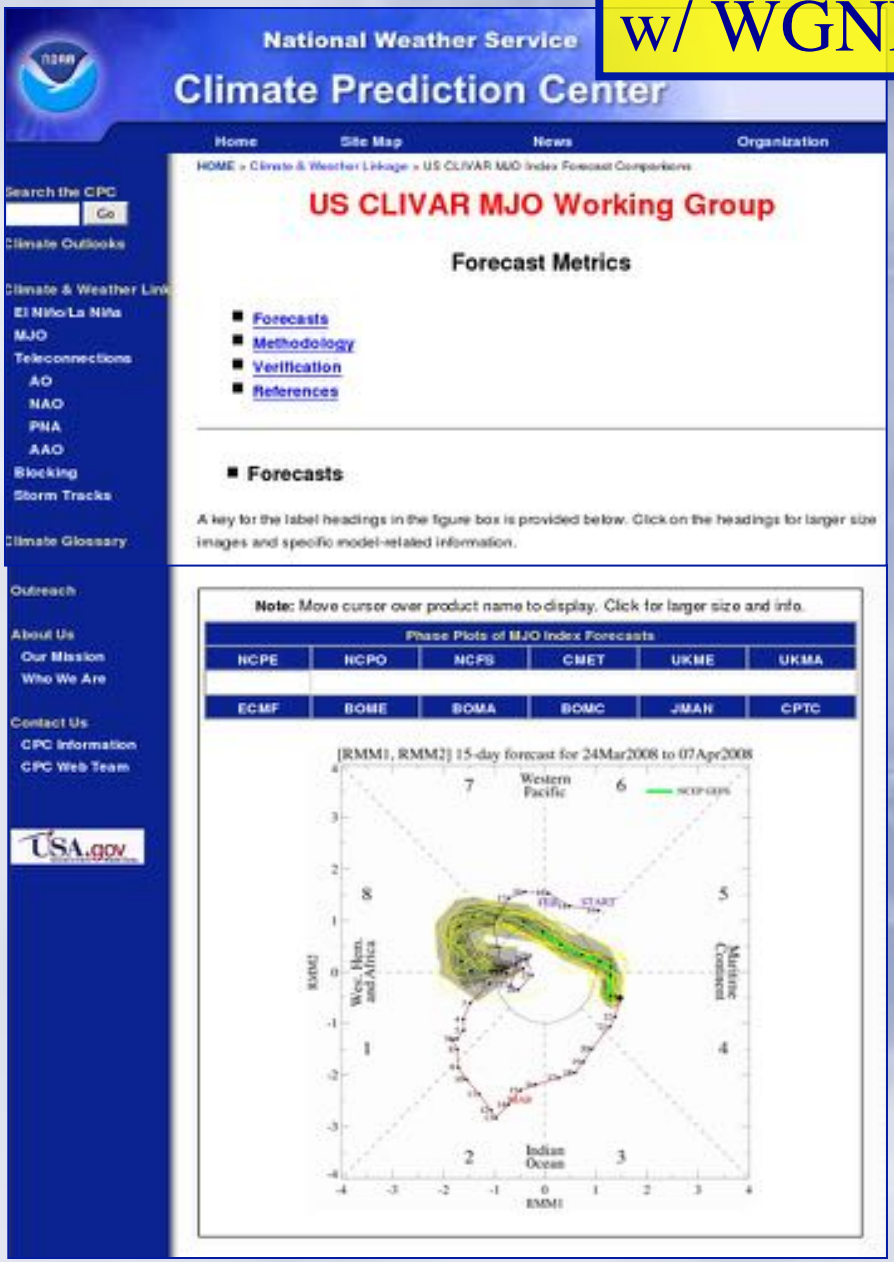
(Gottschalck et al. BAMS, 2010)

w/ WGNE

Use of a common metric allows for:

- quantitative forecast skill assessment.
- targeted model improvements.
- friendly competition to motivate improvements.
- developing a multi-model ensemble forecast.

10 operation centers, 20 data streams, 13 ensemble forecasts (with 4 – 51 members)



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

CLIVAR MJO WG Item IV: MJO Workshops

I. MJOWG Sponsored, Irvine, CA 2007

New Approaches to Understanding, Simulating, and Forecasting the Madden-Julian Oscillation

Sperber and Waliser
BAMS Meeting Summary 2008

II. MJOTF + CLIVAR AAMP, Busan, 2010

Monsoon Intraseasonal Variability Modeling Workshop

Hendon, Sperber, Waliser and Wheeler
BAMS Meeting Summary 2011

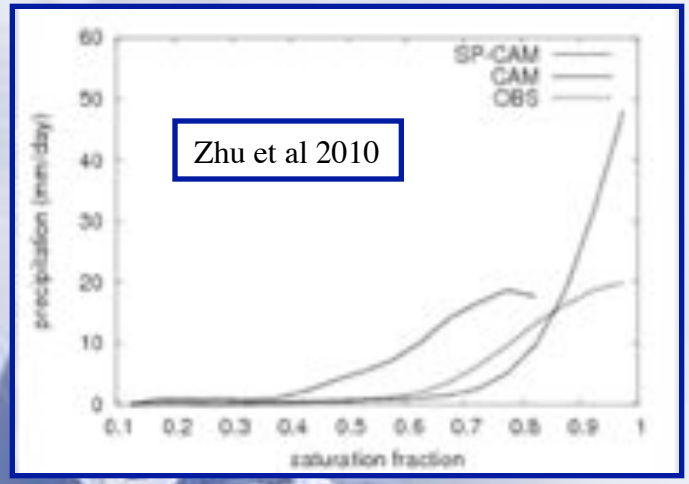
MJO TF Focus Areas

Organized into 4 Subprojects

- Process-oriented MJO diagnostics/metrics
  (leads: D. Kim, P. Xavier, E. Maloney)
- Boreal summer monsoon ISV forecasting metrics
  (leads: J.-Y. Lee, M. Wheeler, J. Gottschalck)
- Recommend MJO metric(s) to Climate Metrics Panel
  (leads: K. Sperber, H. Hendon)
- MJO TF + GASS Multi-Model Diabatic Processes Experiment
  (leads: D. Waliser, X. Jiang, J. Petch, P. Xavier, S. Woolnough, N. Klingaman)

Under consideration: Modulation of Tropical Cyclones activity by the MJO/ISV in order to improve their prediction.

MJO TF Subproject: Process-Oriented MJO Diagnostics



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

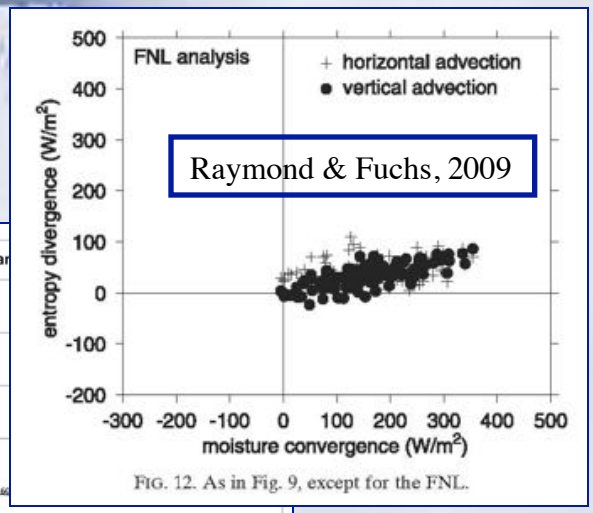
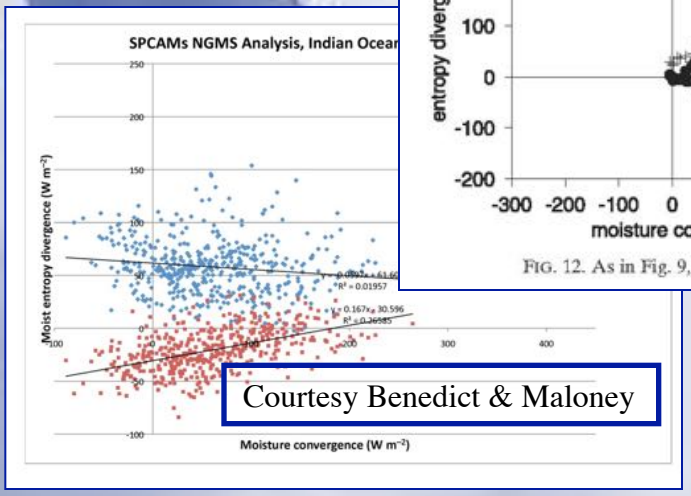
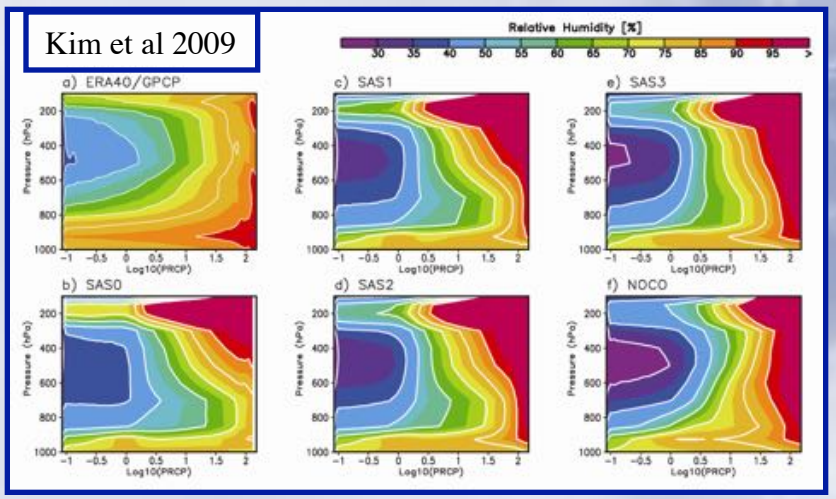


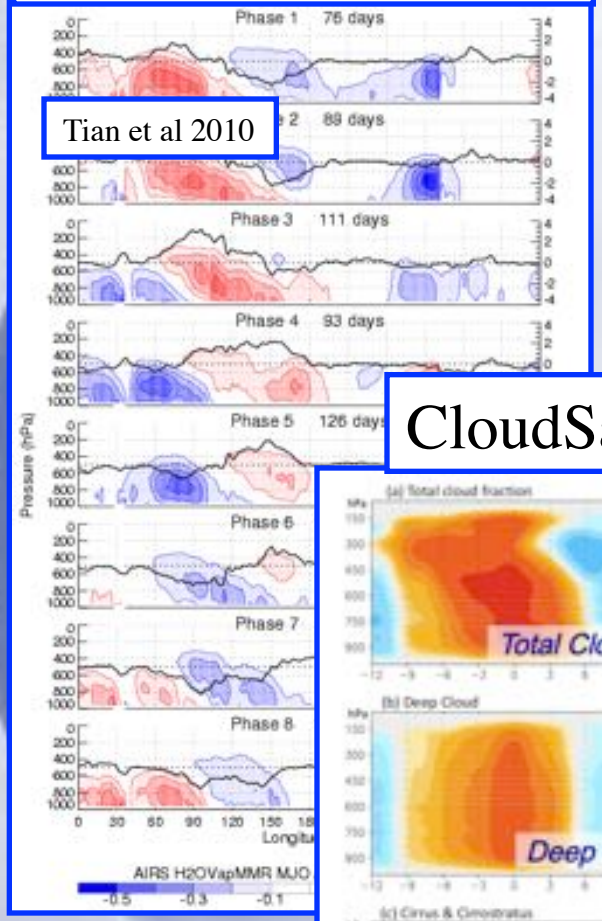
FIG. 12. As in Fig. 9, except for the FNL.





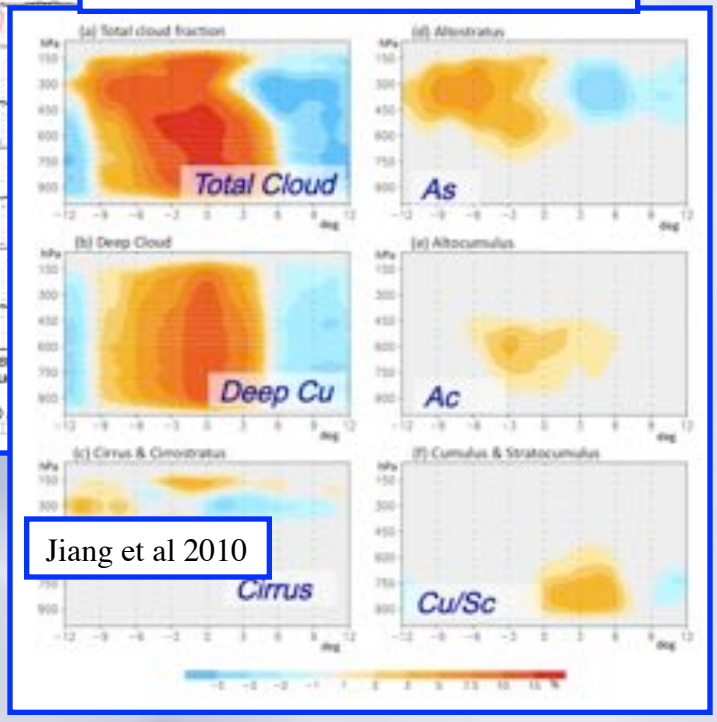
MJO TF Subproject: Process-Oriented MJO Diagnostics

AIRS Temp and WV



Tian et al 2010

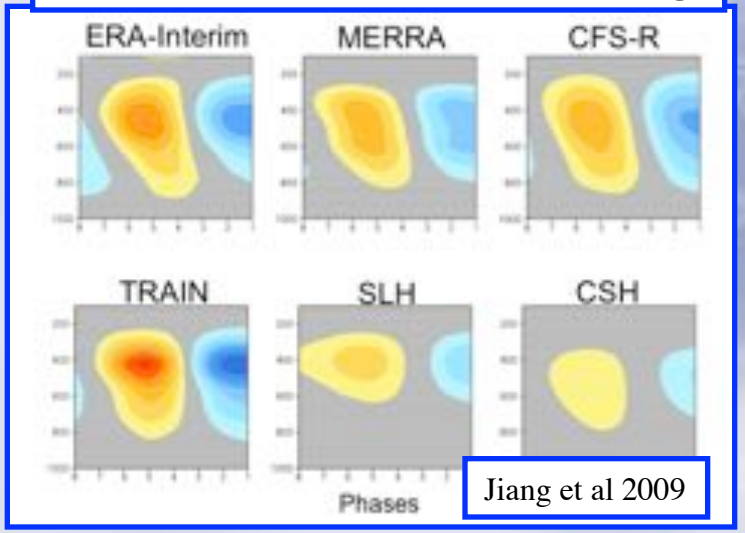
CloudSat Retrievals



Jiang et al 2010

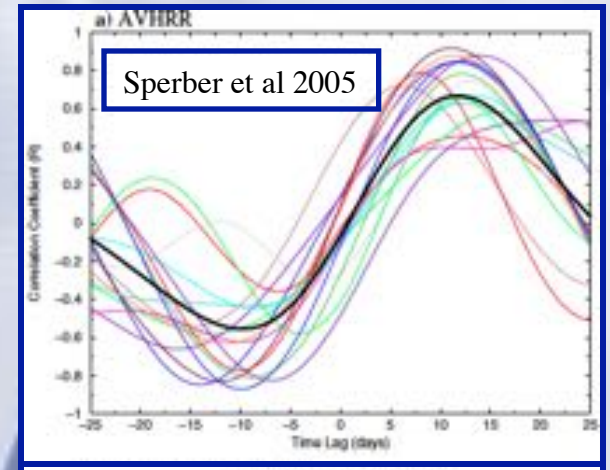
Contemporary Satellite Resources Provide New Opportunities for Profiling Vertical Structure

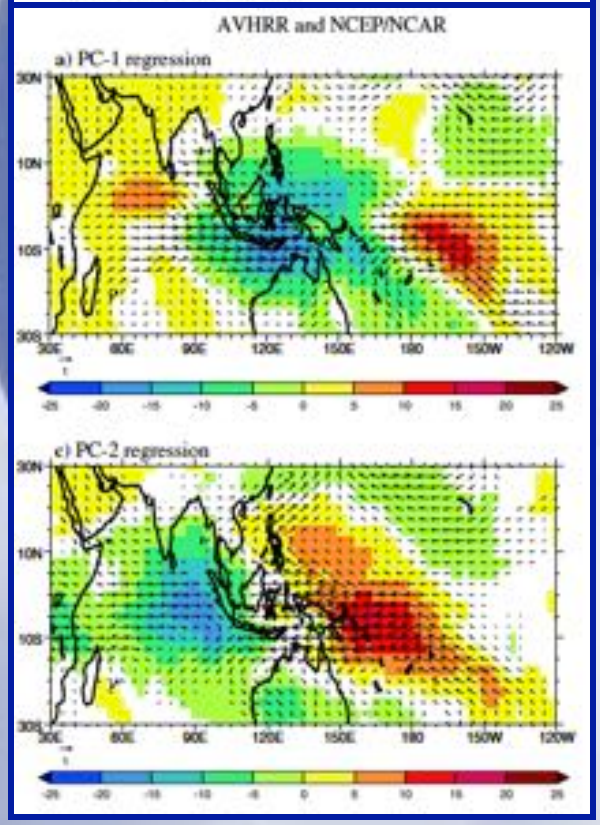
TRMM Diabatic Heating



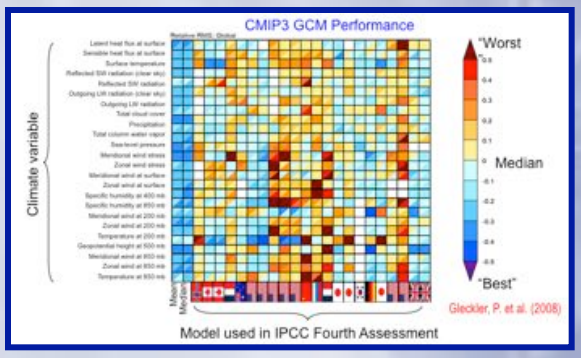
Jiang et al 2009

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

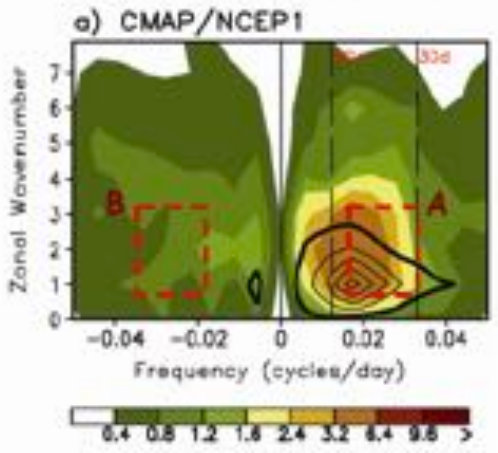




Offering guidance on simple MJO performance metrics for assessing CMIP models.



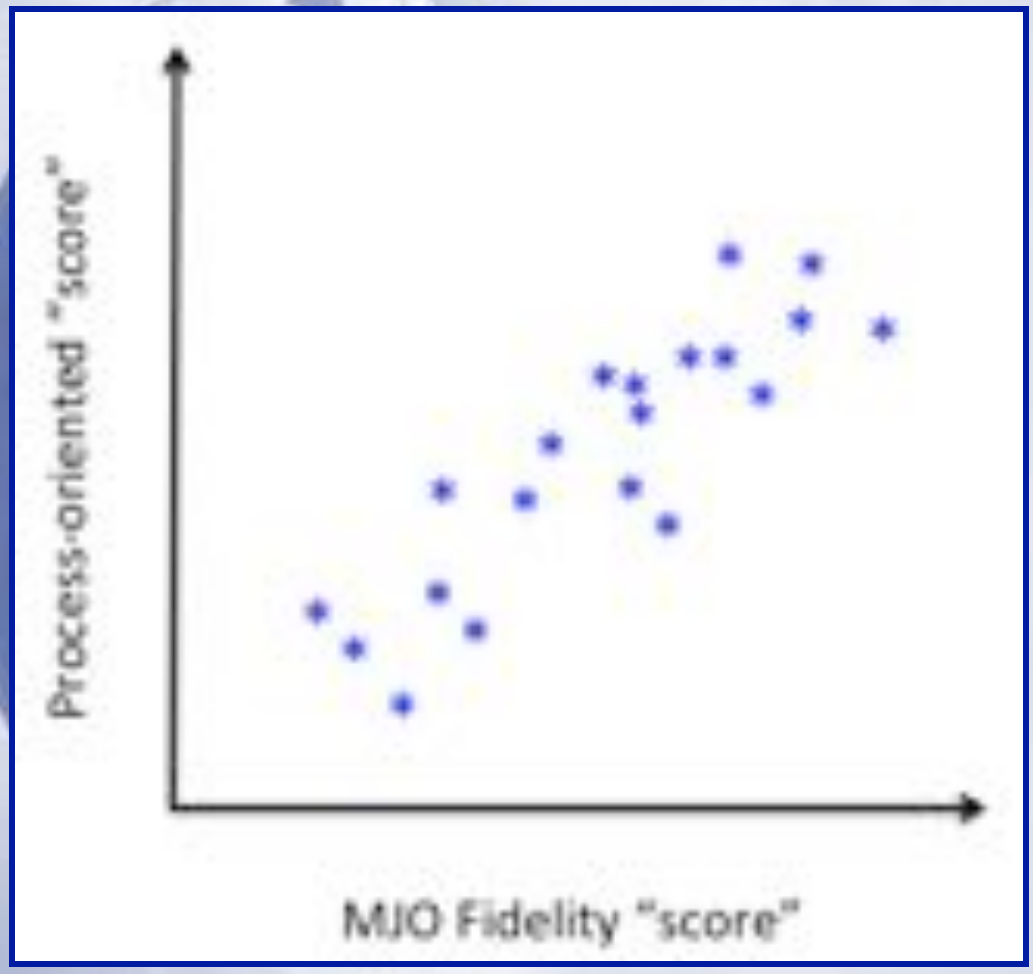
Wavenumber-frequency power spectra



- **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**

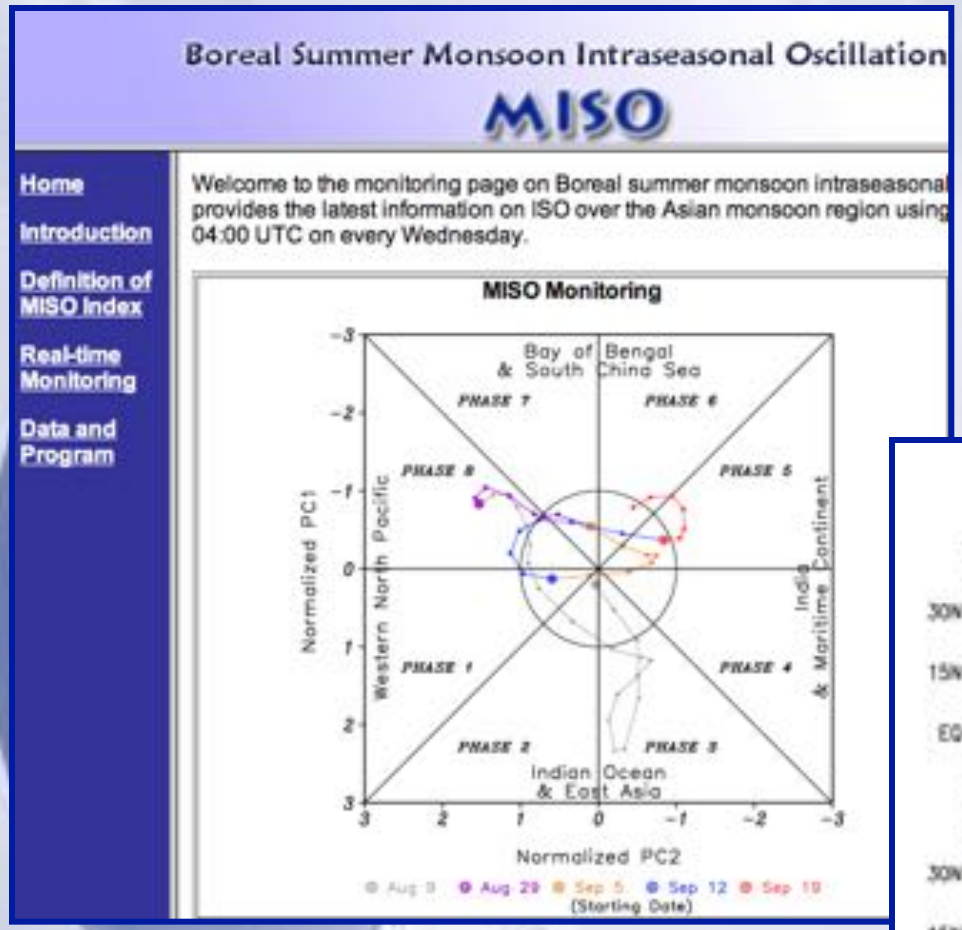
MJOWG et al. 2008
Kim et al 2009

MJO TF Subproject: Metric/Diagnostic Goals

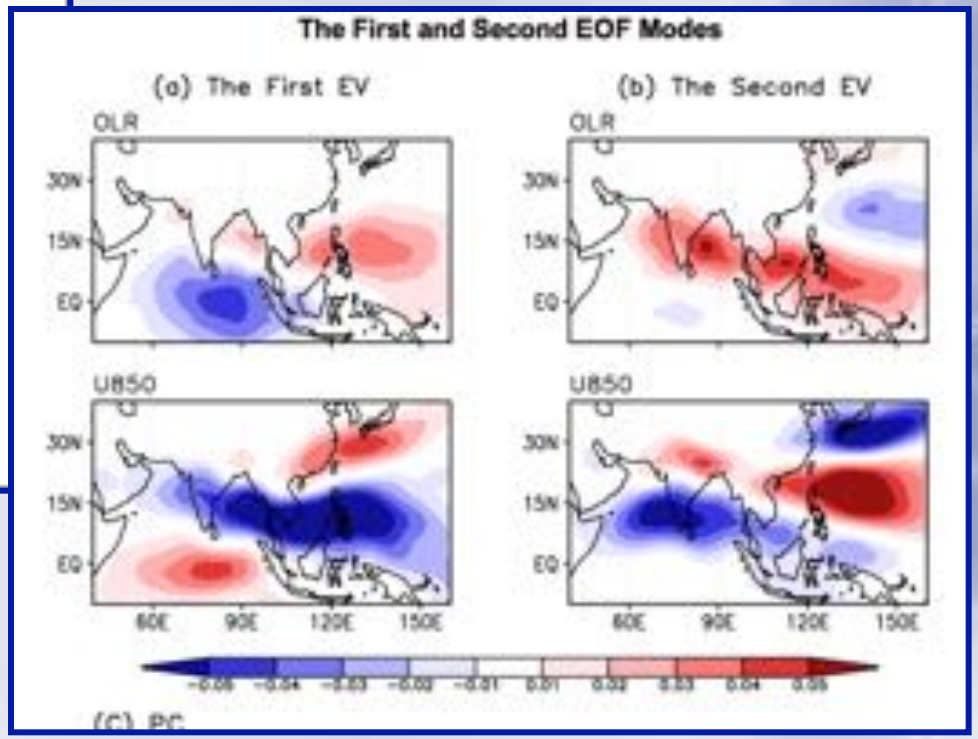


Combine performance metrics (x-axis) and process diagnostic (y-axis) to provide pathways to understanding and improving MJO model performance.

MJO TF Subproject: Boreal Summer ISV Forecast Metric



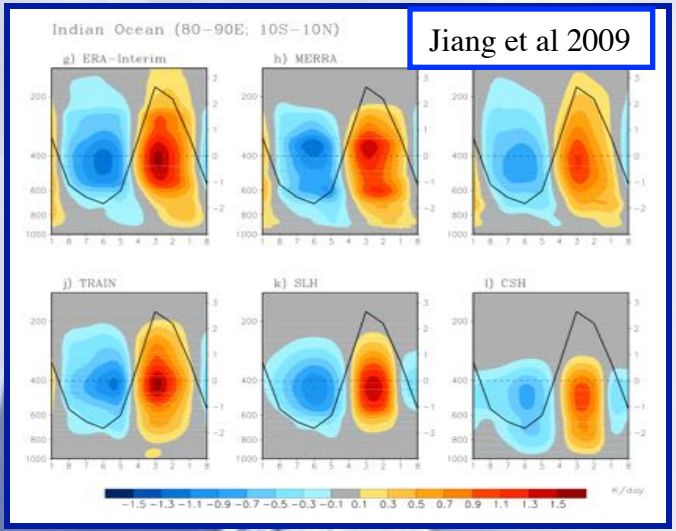
An metric tailored for boreal summer ISV operational monitoring and forecasting applications.



Contacts:
June-Yi Lee & Bin Wang
IPRC/U. Hawaii

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

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



Jiang et al 2009

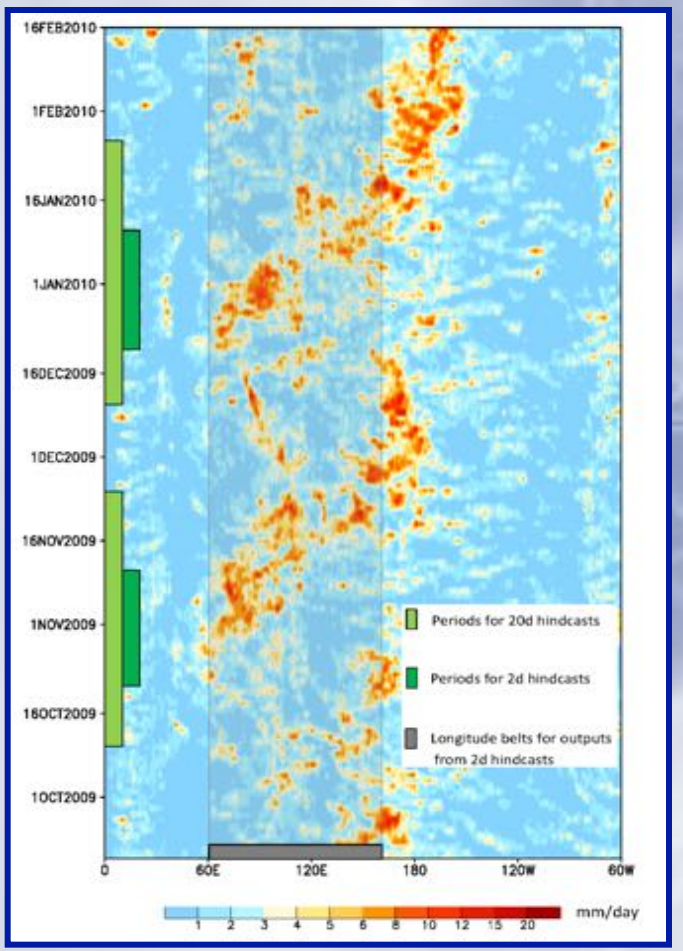
WCRP World Climate Research Programme | MJO TF | THORPEX A World Weather Research Programme | WWRP World Weather Research Programme | GASS Global Atmospheric System Studies | YOTC

www.ucar.edu/yotc/mjodiab.html

Model Experiment	Science Focus
I. 20 Yr Climatological Simulations (1991-2010 if AGCM) 6-hr, Global Output Vertical Structure, Physical Tendencies	Model MJO Fidelity Multi-scale Interactions (e.g., TCs, CCEWs, MJO, Monsoon, ENSO)
II. 2-Day MJO Hindcasts YOTC MJO Cases E & F (winter 2009)* Time Step, Indo-Pacific Domain Output Very Detailed Physical/Model Processes	Model Physics Eval & Imp Diabatic Processes Convection/Cloud/BL State Evolution/Degradation
III. 20-Day MJO Hindcasts YOTC MJO Cases E & F (winter 2009)* 3-hr, Global Output Elements of I & II	MJO Forecast Skill Elements of I & II

*DYNAMO Case TBD

About 20 Modeling Groups with AGCM and/or CGCM



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

- Please consider utilizing community MJO simulation diagnostics/metrics.
- Offer suggestions for process-oriented diagnostics associated with the MJO.
- Refer to, explore uses, and provide feedback on operational MJO/ISV forecast metrics.
- Participate in , contribute to, and/or analyze the community modeling experiments such as the ISVHE and MJOTF/GASS projects.

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