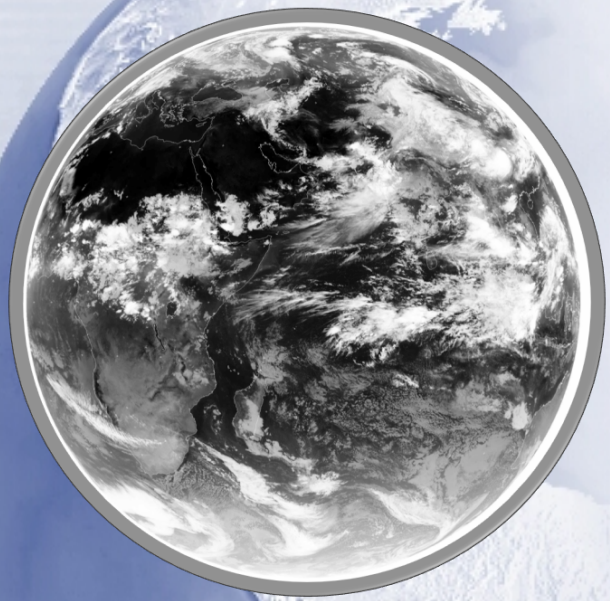
Year of Tropical Convection (YOTC)

Major/Recent Accomplishments and Plans



Mitch Moncrieff, NCAR
Duane Waliser, JPL/Caltech
Co-chairs, YOTC Science Planning Group

WWRP WORLD WEATHER RESEARCH PROGRAMME
THORPEX
A World Weather Research Programme

WMO

WCRP

A Contribution to Seamless
Weather-Climate Prediction

WGNE, Boulder, CO; Oct 2011

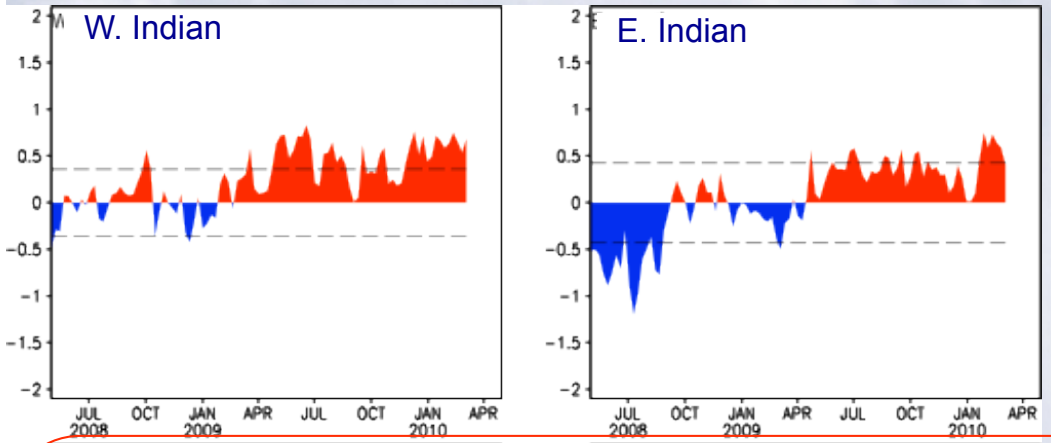

Global Prediction
High-resolution analyses
forecasts & physical processes
data base
Integrated Observations
Satellite, field-campaign, *in-situ*
data base
Organized Tropical Convection
YOTC
Year of Tropical
Convection
Global Interaction
Research
Diagnostic studies of global data bases; parameterized,
superparameteterized & explicit convection in regional-to-global
models; theoretical studies

YOTC: Progress & Plans

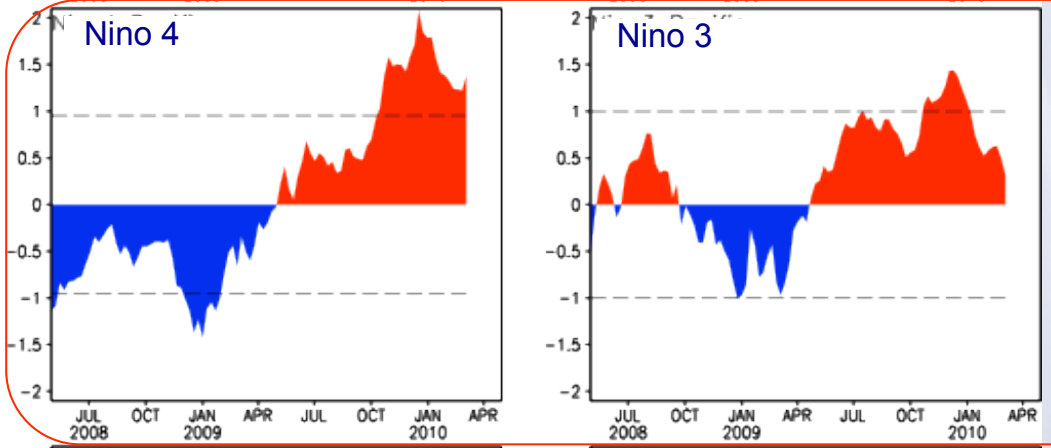
- Science Plan – Drafted and Discussed/Approved at Meeting in Washington DC, November 13-14, 2007. WMO Technical Document.
- Program Support/Information Specialist – (Part-time): US THORPEX Exec Committee funding via U.S. NSF, NOAA, NASA.
- Web site: http://www.ucar.edu/yotc
- Implementation Plan Drafted/Discussed/Approved at IP Meeting in Honolulu, July 13-15, 2009.
- WCRP-WWRP/THORPEX MJO Task Force – Est. Dec 2009 (see later slide)
- YOTC Science Sessions– Fall AGU'08, AMS'09, Spring AGU'09, Fall AGU'09, WP-AGU'10, AGU of Americas'10, Fall AGU'10, Fall AGU'11.
- MJO TF Meeting and MJO Workshop, Busan, June 2010.
- YOTC+AMY Science Symposium, CMA/Beijing, China, May 2011.
- Data Sets: High-Res ECMWF Analysis & Satellite Archive/Tools
- Model and Analysis Activities: T-AMIP, ISVHE, MJO TF/GCSS-Diabatic, etc
- BAMS Synoptic Overview (in press), BAMS Science Motivation (in review), BAMS Meeting Summary (submitted).

Background Conditions & Low Frequency SST

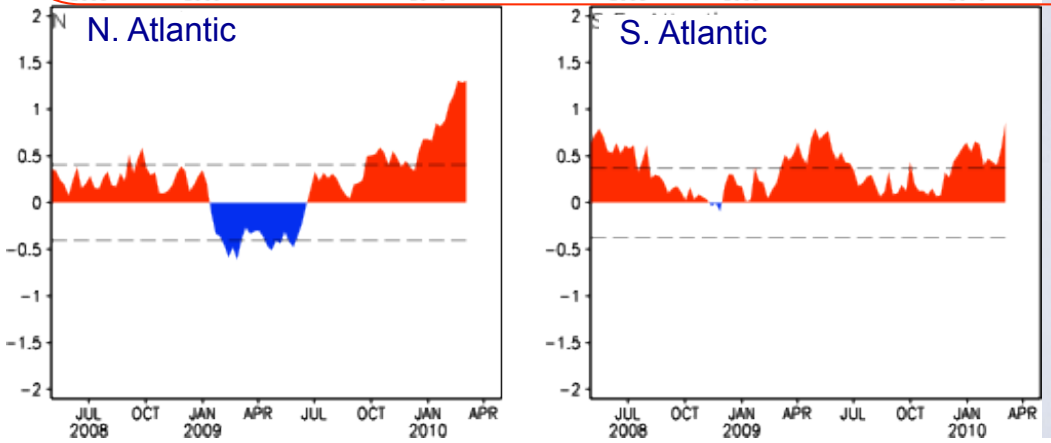
Tropical SSTs



Warm in Year 2
Mostly +DMI



Year 1 – Modest La Nina
Year 2 – Modest El Nino



Mostly Warm Atlantic

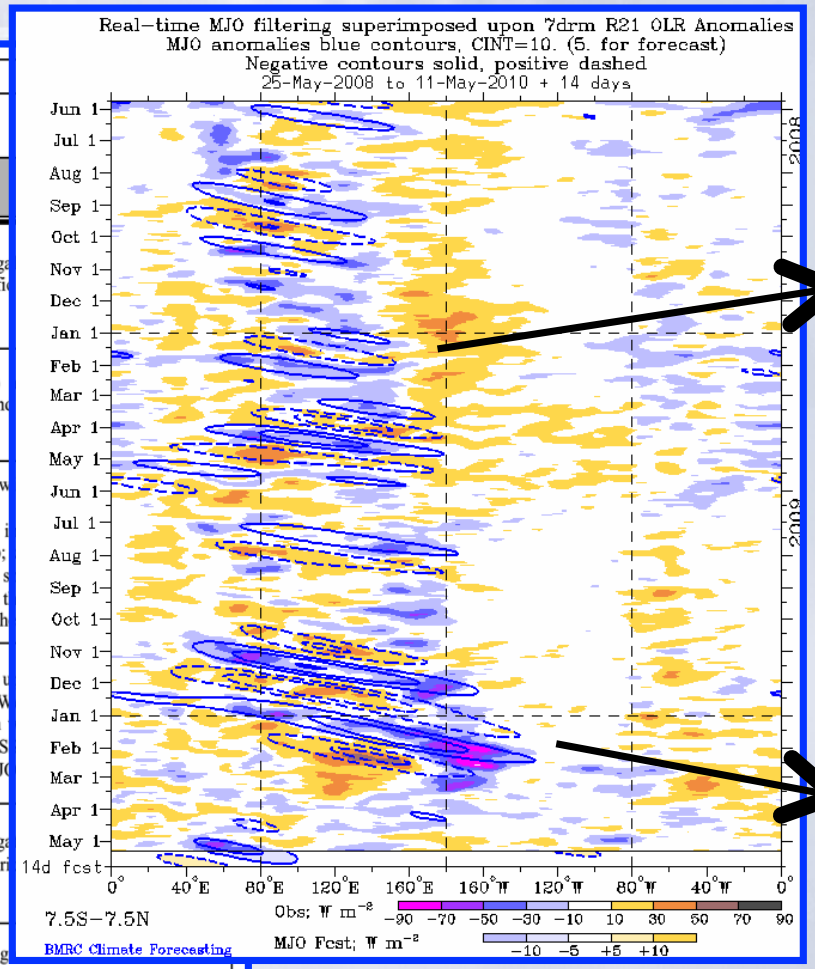
MJO & CCEWs

M. Wheeler

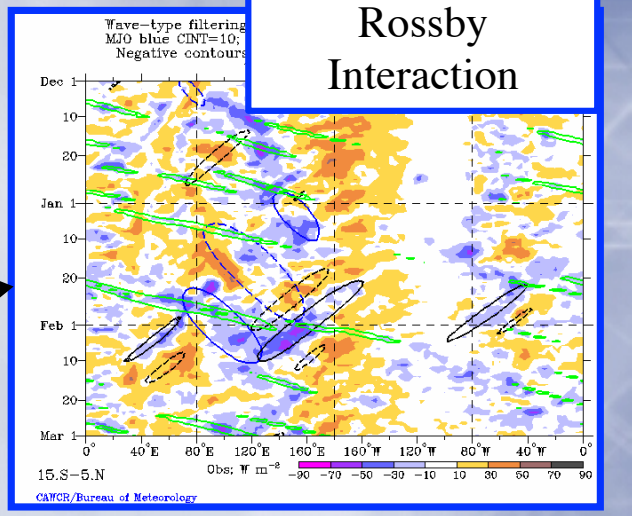
a) b) c) d)

01-May 2008 | 30-Jun | 15-Aug | 01-Nov | 01-Jan 2009 | 28-Feb | 01-Apr | 31-May

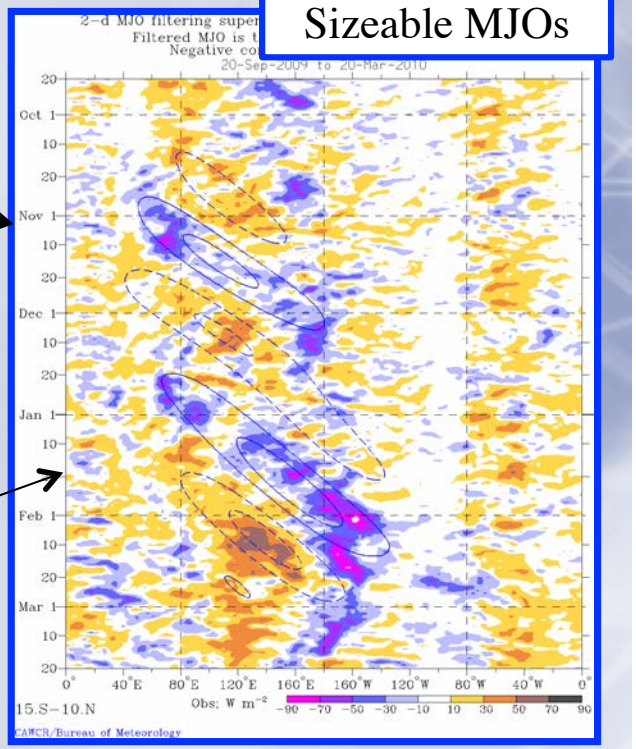
Target Periods (priority)	Features
a) 01MAY2008 - 30JUN2008 (4)	- fast propagation of MJO into Bay of Benga - caused strong modulation of eastern Pacifi embedded TCs.
b) 15AUG2008 - 01NOV2008 (5)	- MJO convective onset (in central IO) suppressed period in mid-Sept, the second Ocean occurred around Oct 12.
c) 01JAN2009 - 28FEB2009 (3)	- Weak sequence of the MJO that started w IO from about 10-20 Jan. - MJO convection onset then followed i propagating into N Australia in early Feb; Australia; strong compensating descent to s temperature in NSW/Victoria that affected t cyclones, i.e., association with severe weath
d) 01APR2009 - 31MAY2009 (2)	- strongest MJO in the YOTC period u confined to Indian Ocean and Tropical W propagation; convectively coupled Kelvin westerly anomalies in Pacific; basin-wide S for MJO between La Nina and El Nino; MJ
e) 20OCT2009 - 20DEC2009 (1)	- strong MJO onset in Indian ocean; propaga El Nino conditions; effects on N-hemispher climate.
f) 20DEC200 - 20FEB2009 (1)	- strong MJO onset in Indian Ocean; propag southward in mid-Pacific region.



Kelvin & Rossby Interaction



Sizeable MJOs



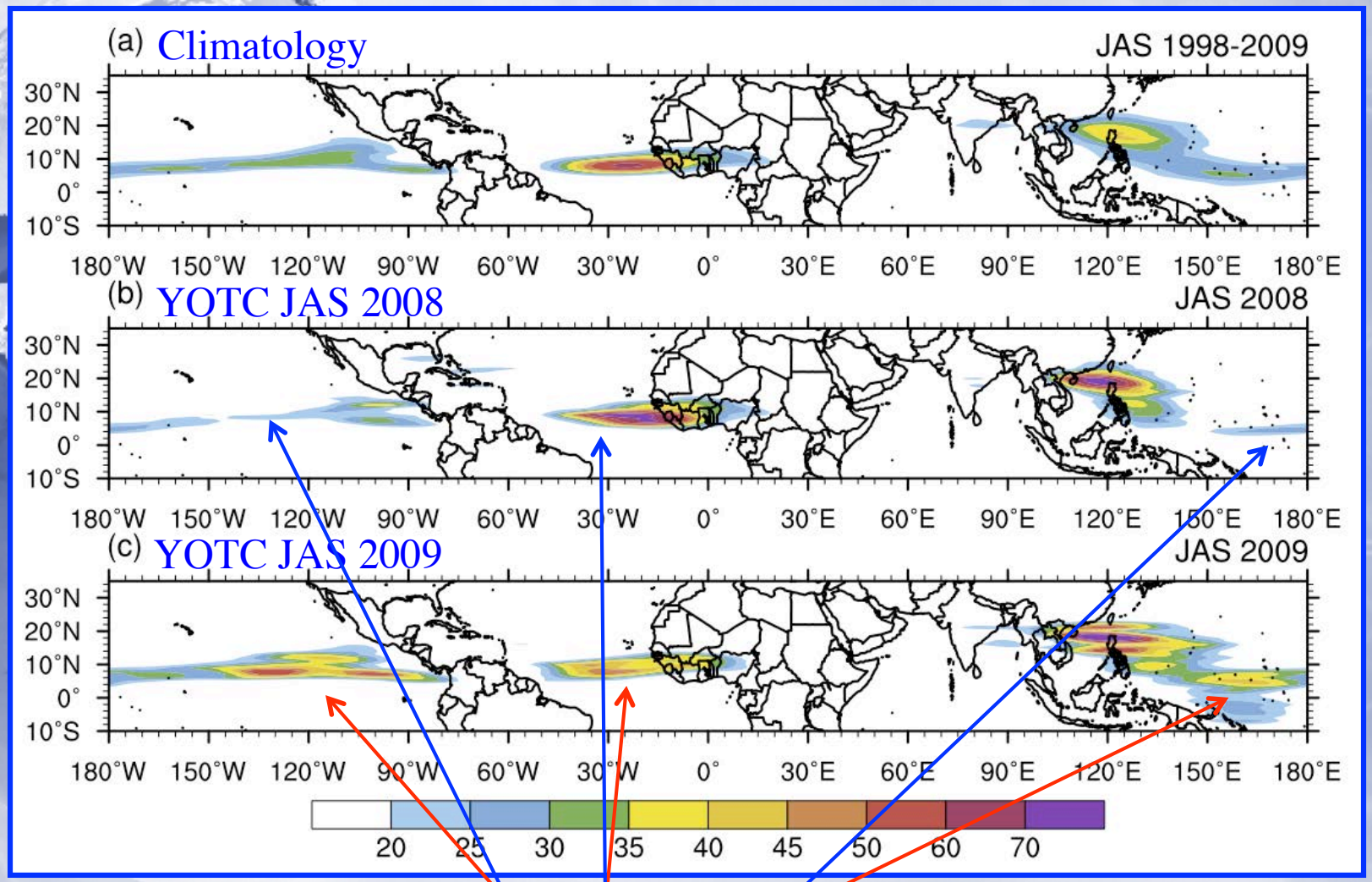
Case Studies for MJO TF & GCSS Diabatic Heating Expt

C. Thorncroft
Y. Serra
M. Janiga
H. Nguyen

Easterly Wave Activity

Variance of TRMM3B42 TD-filtered RainRate

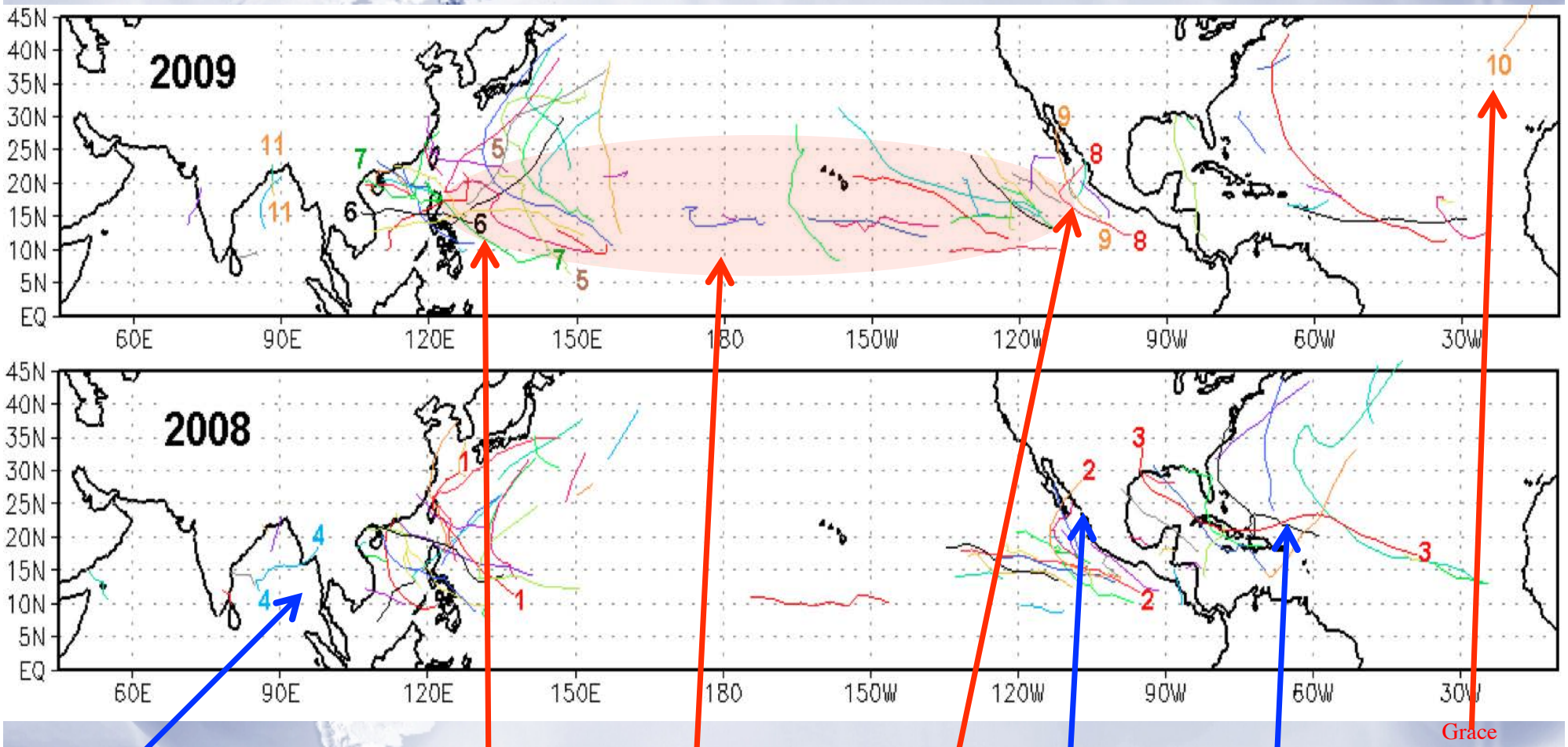
Wavenumber -20 To -6 & Period 2 To 5 Days



Tropical Cyclone Occurrence During YOTC

Boreal Summer

Julian Hemming



Nargis, landfall over Myanmar, huge storm surge, 100,000 lives

Parma-1.8 m Rainfall

El Nino Modulation

Rick, 2nd Strongest In E. Pacific Ever

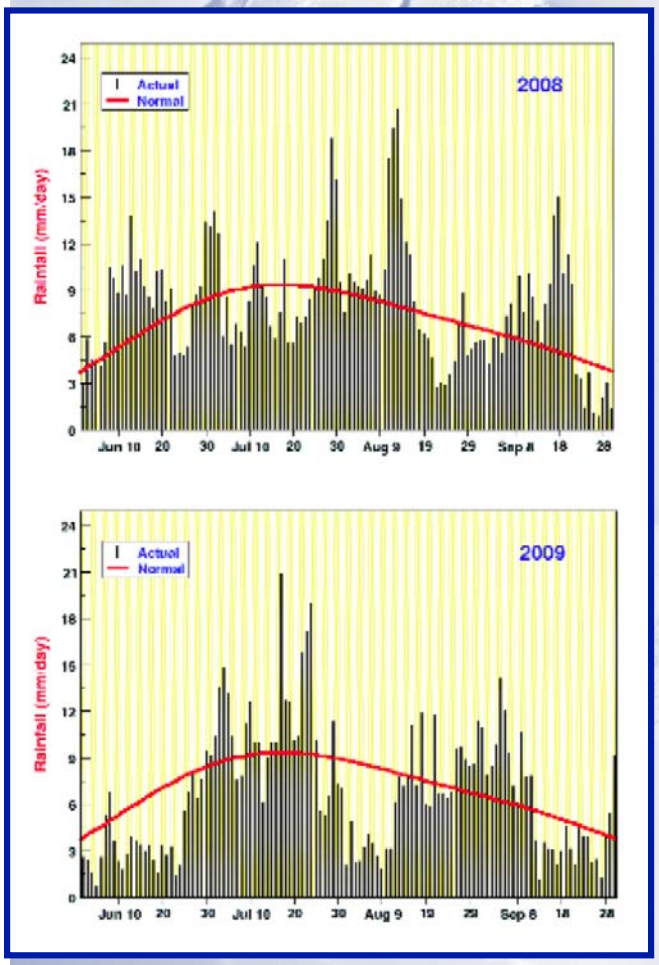
3 landfalls in Mexico

Ike - Largest size & Marko - smallest TC ever in this basin.

Summer Monsoons During YOTC

India
BN Goswami

S. America
Jose Marengo



2008

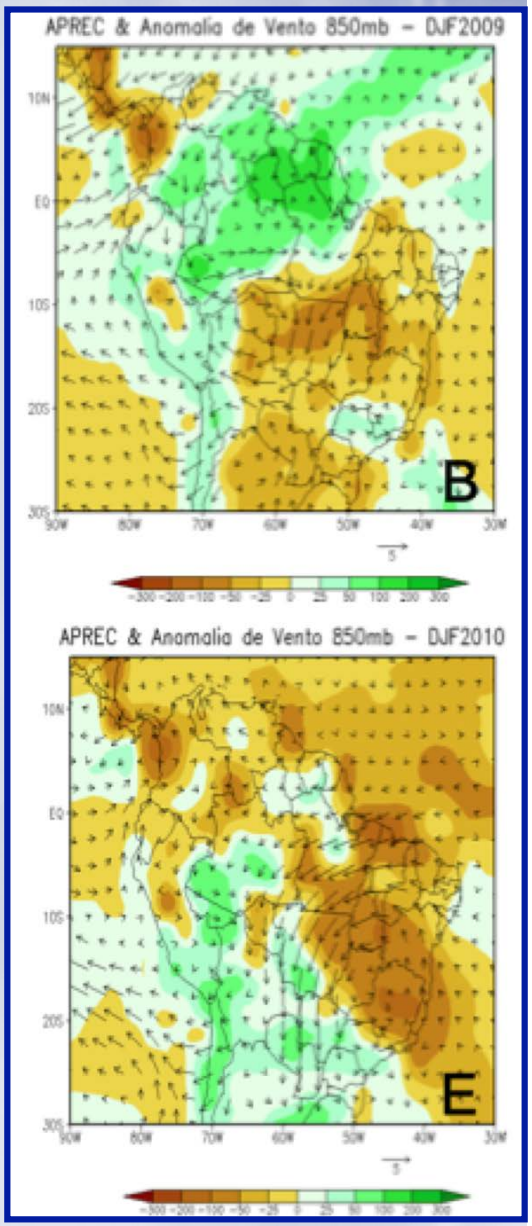
"Normal"
98% AIR

Wet-north
Dry-south

2009

Very Large
Drought
78% AIR

Dry-northeast
Wet-south

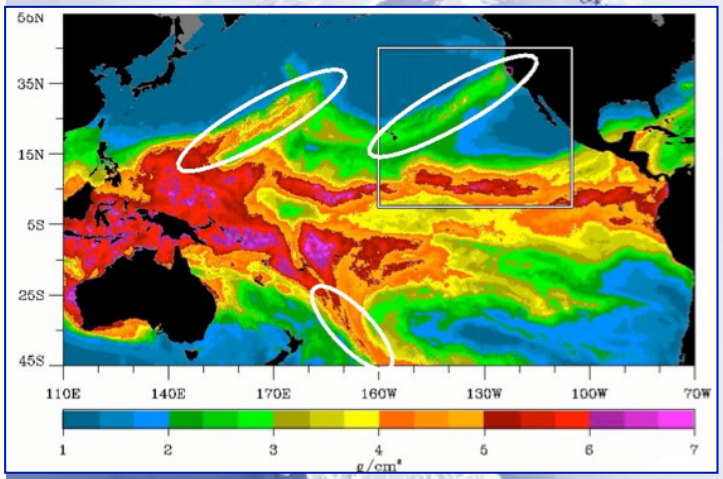


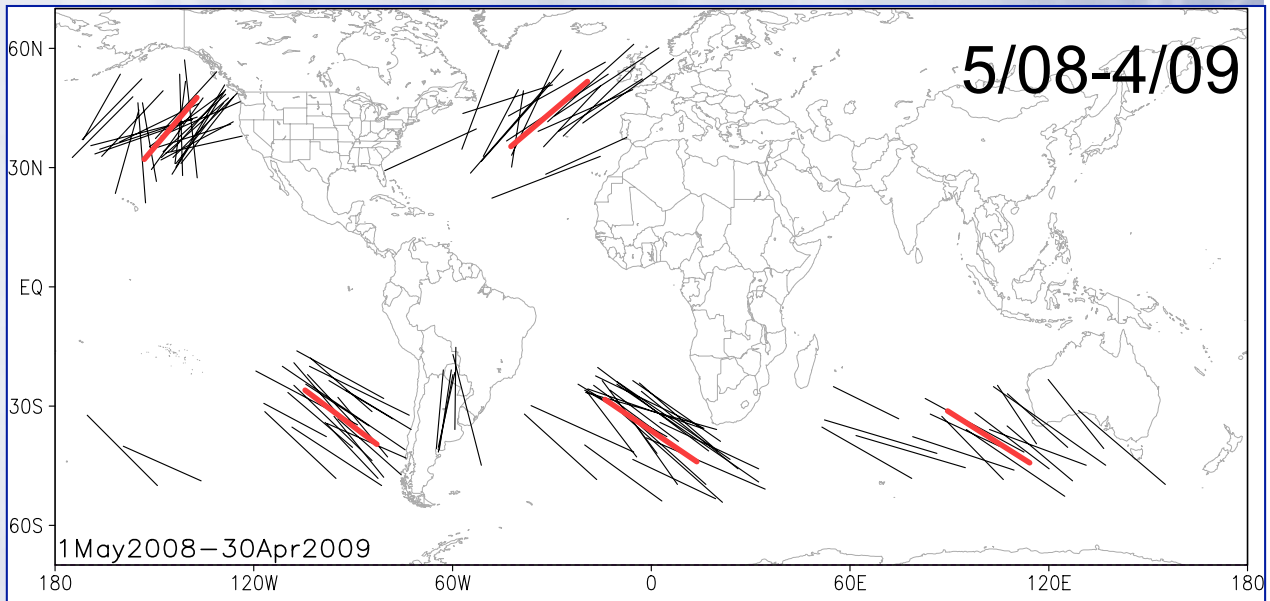
Breaks influenced by ISV

Atmospheric Rivers During YOTC

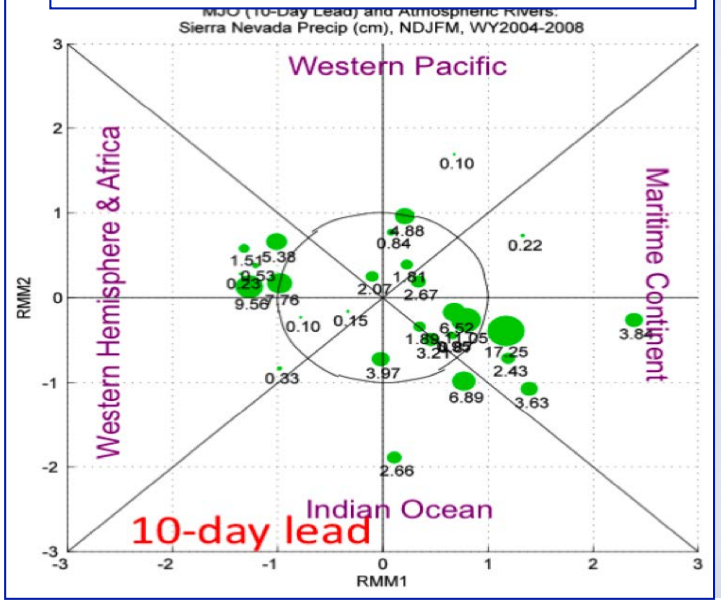
Tropical-Extratropical Interactions

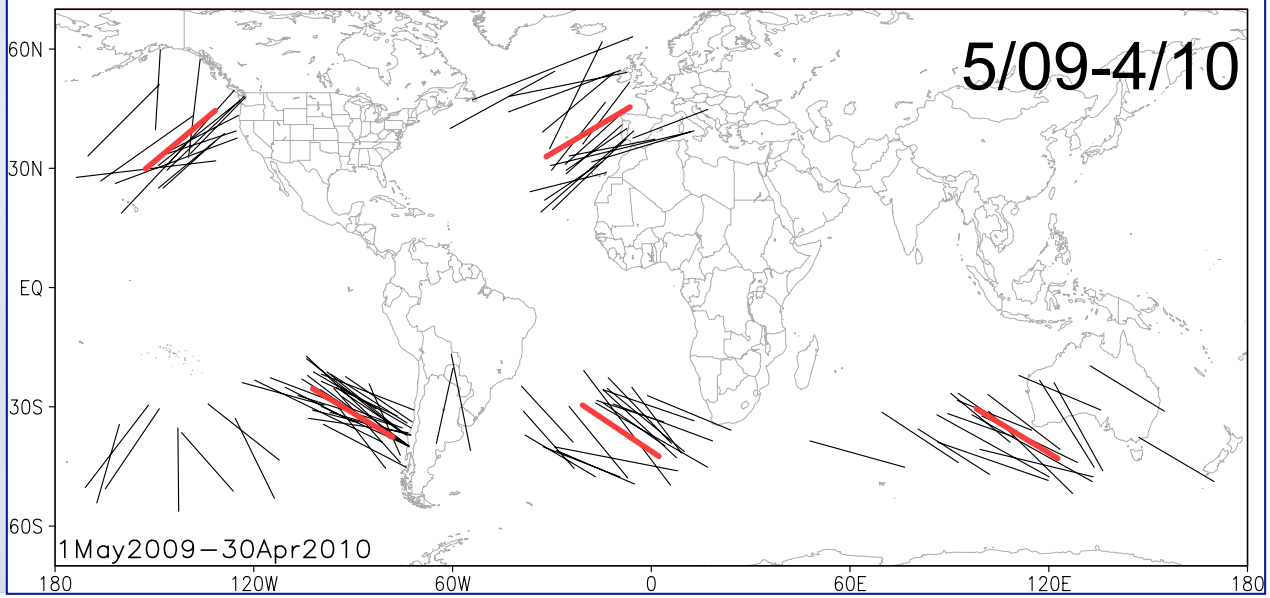
Bin Guan



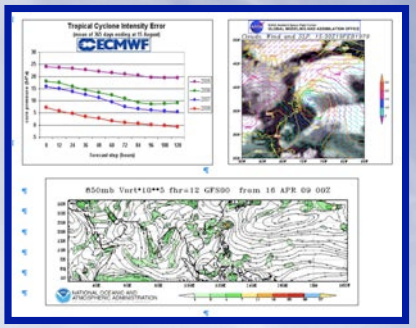


MJO -> AR -> CA Precip

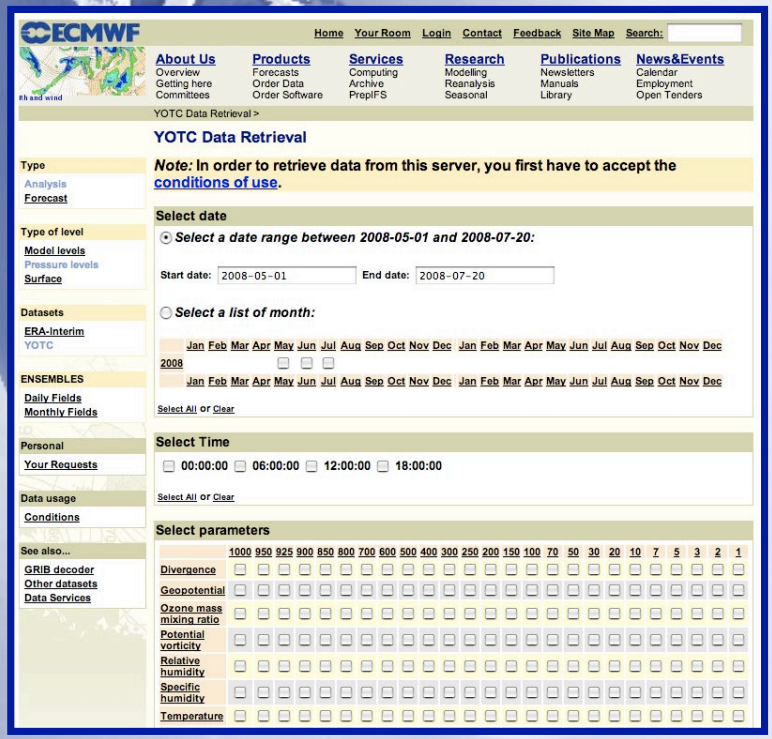


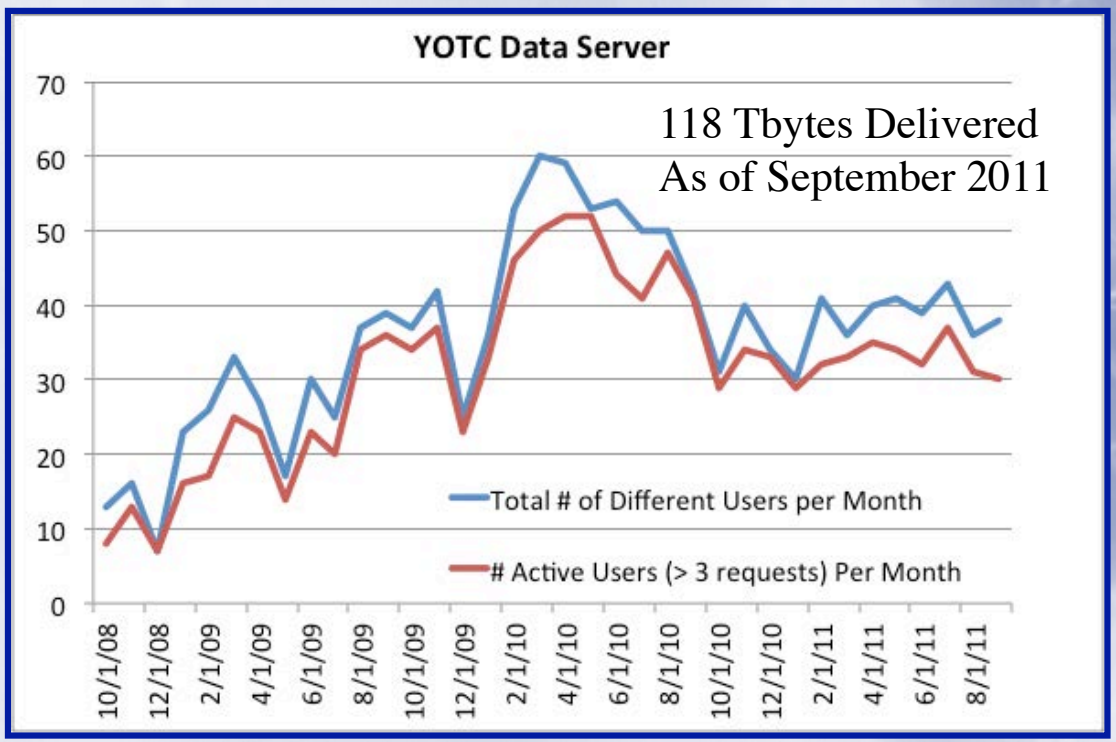


YOTC: Analyses, Forecasts & Special Diagnostics



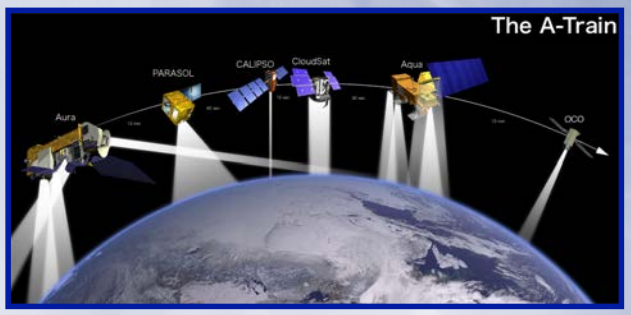
- High-resolution, global analysis and forecast data sets are being made available to the community from ECMWF, NCEP and GMAO/NASA. e.g. T799 = 25km ECMWF + diagnostic fields *(as of Jan'10, T1279 = 16kms)*



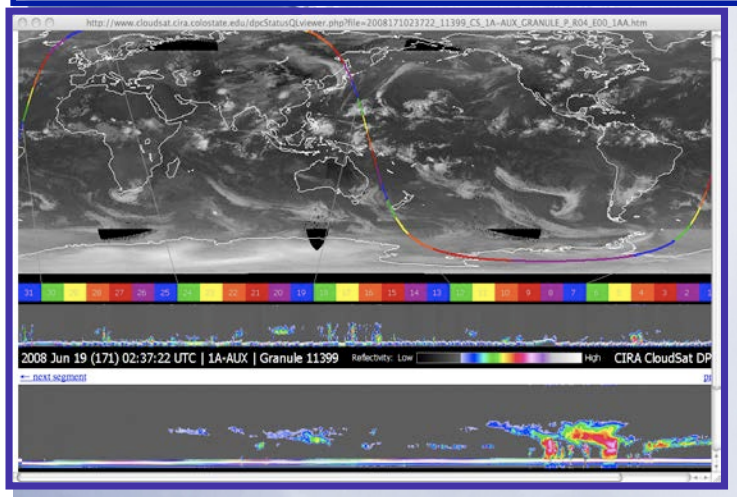


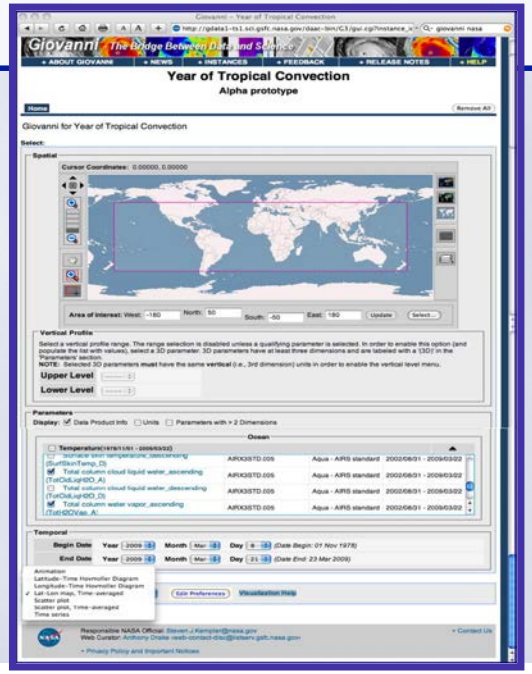
NEW: ECMWF-YOTC Replicated at NCAR.

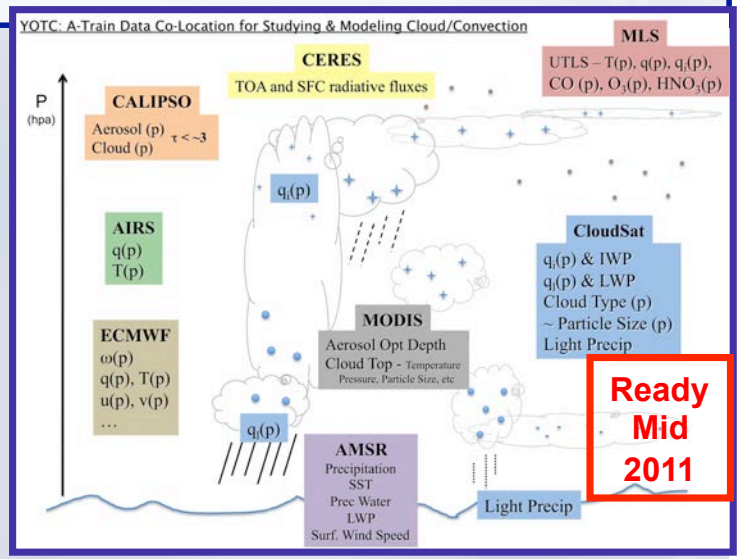
YOTC: Satellite Data



- Key satellite data (e.g., NASA A-Train, TRMM) have been identified and funding secured from NASA for the:
  - NASA Giovanni-based dissemination framework.
  - NEW Multi-sensor CloudSat-Centric A-Train Data Set – archive & dissemination underway at CloudSat Data Processing Center.







Transpose AMIP

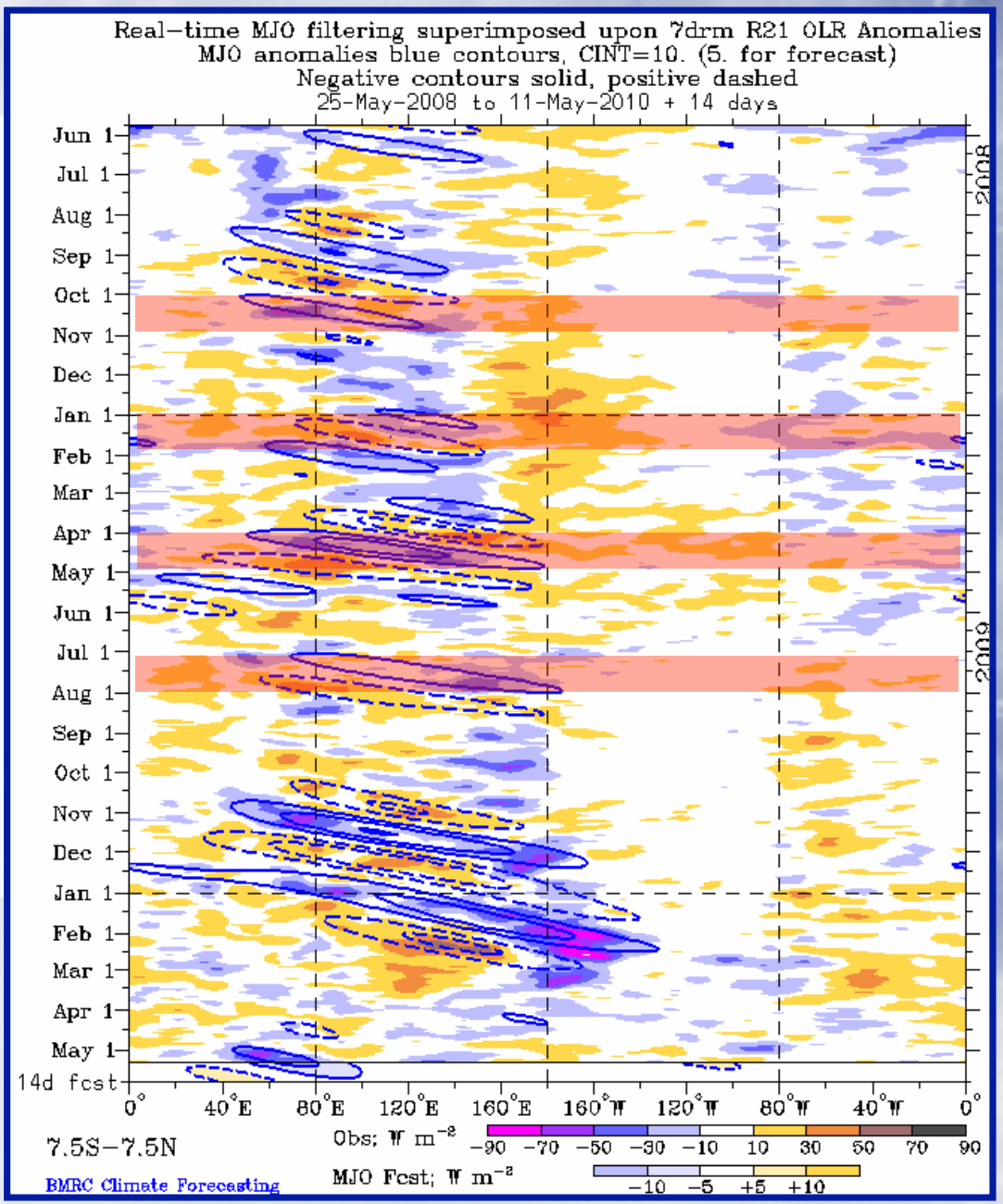
CMIP5 Model Evaluations

- 4 periods; 16 5-day hindcasts in each
- 9 proposed subprojects – e.g. Cloud Regimes, Wiliams; MJO, Moncrieff.
- Modeling Group Pledges
  - EC-Earth (Frank Selten)
  - IPSL (Sandrine Bony)
  - Met Office (Keith Williams)
  - Meteo France (Michel Deque)
  - MIROC (Masahide Kimoto)
  - MPI (Bjorn Stevens)
  - MRI (Masahide Kimoto)
  - NCAR (David Williamson)

hadobs.metoffice.com/tamip

Other T-AMIP
EUCLIPS/Siebesma

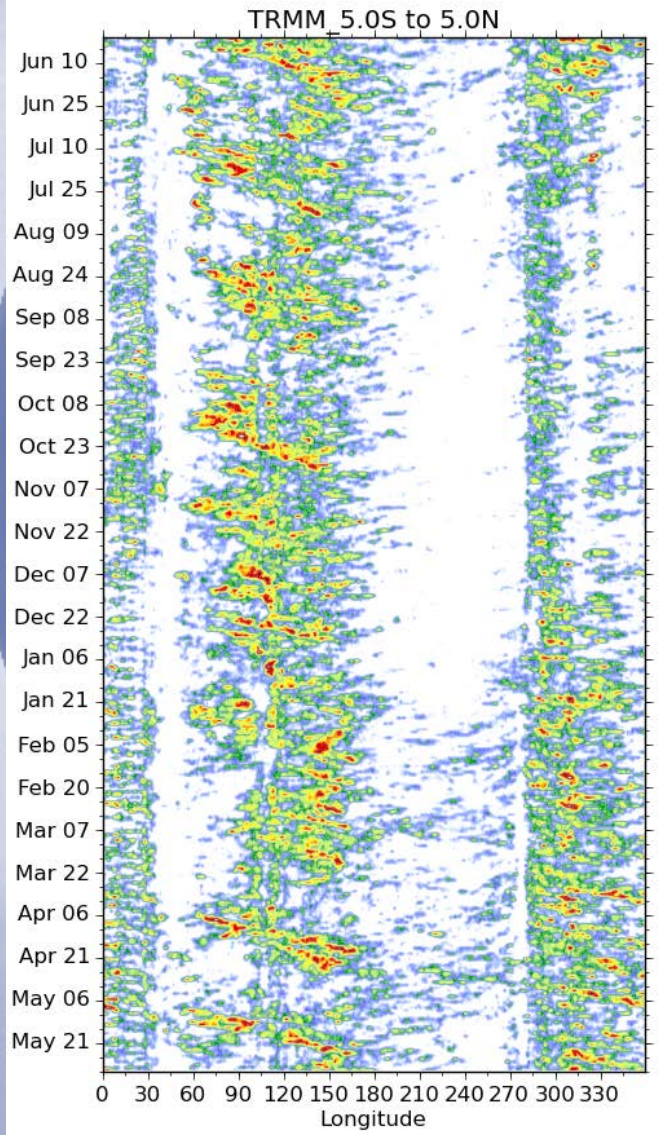
YOTC Period



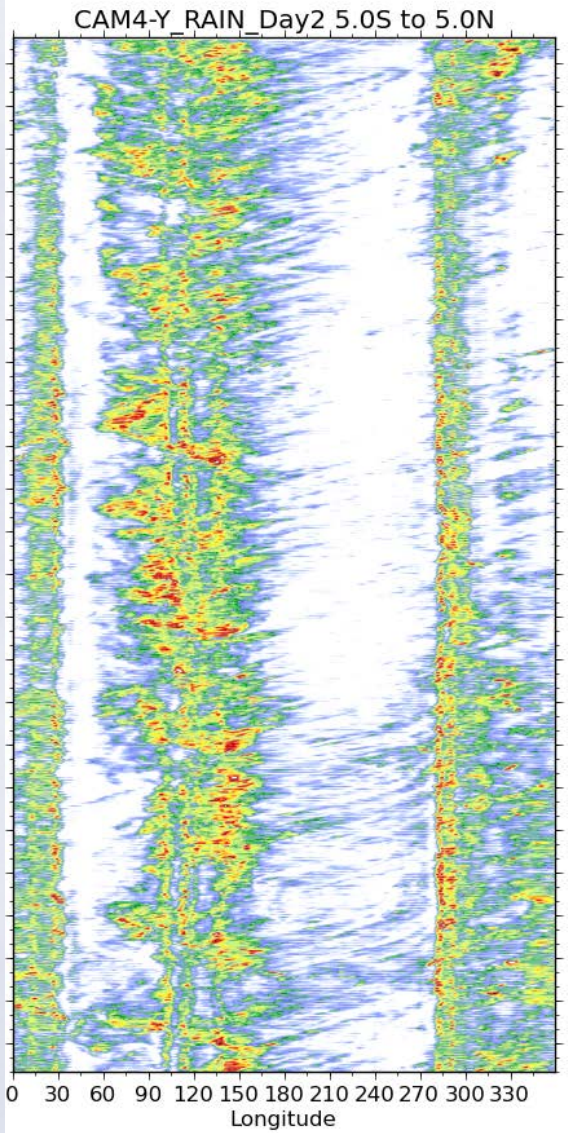
Transpose AMIP – CAPT/DOE

Utilizing YOTC Period/ECMWF Analysis

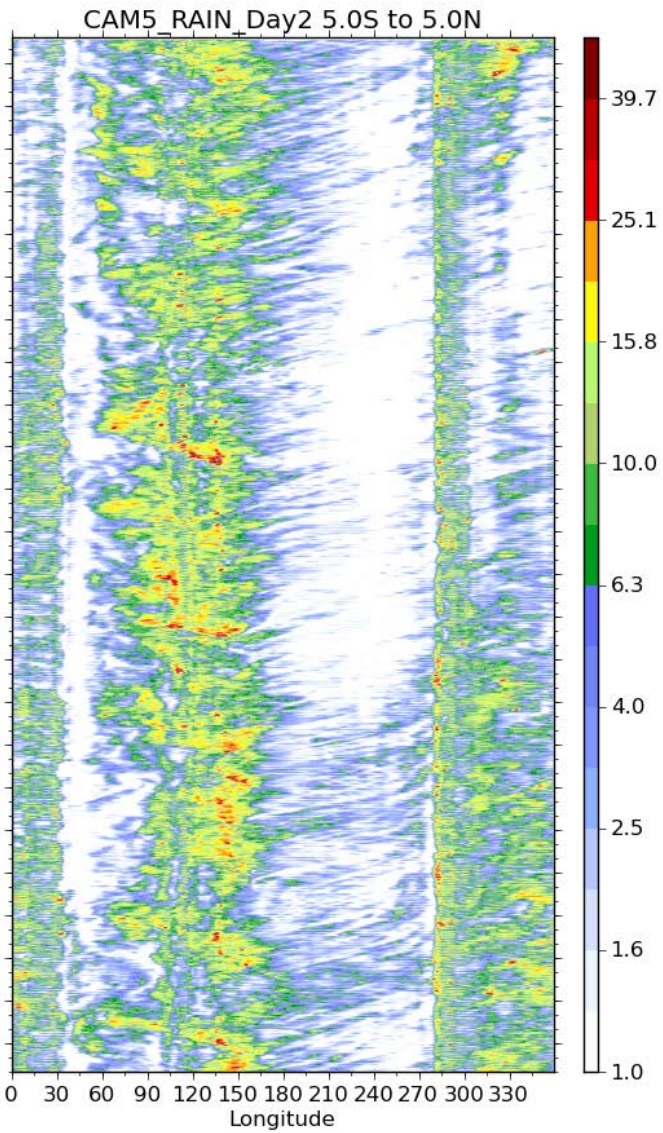
TRMM



CAM4 – Day 2

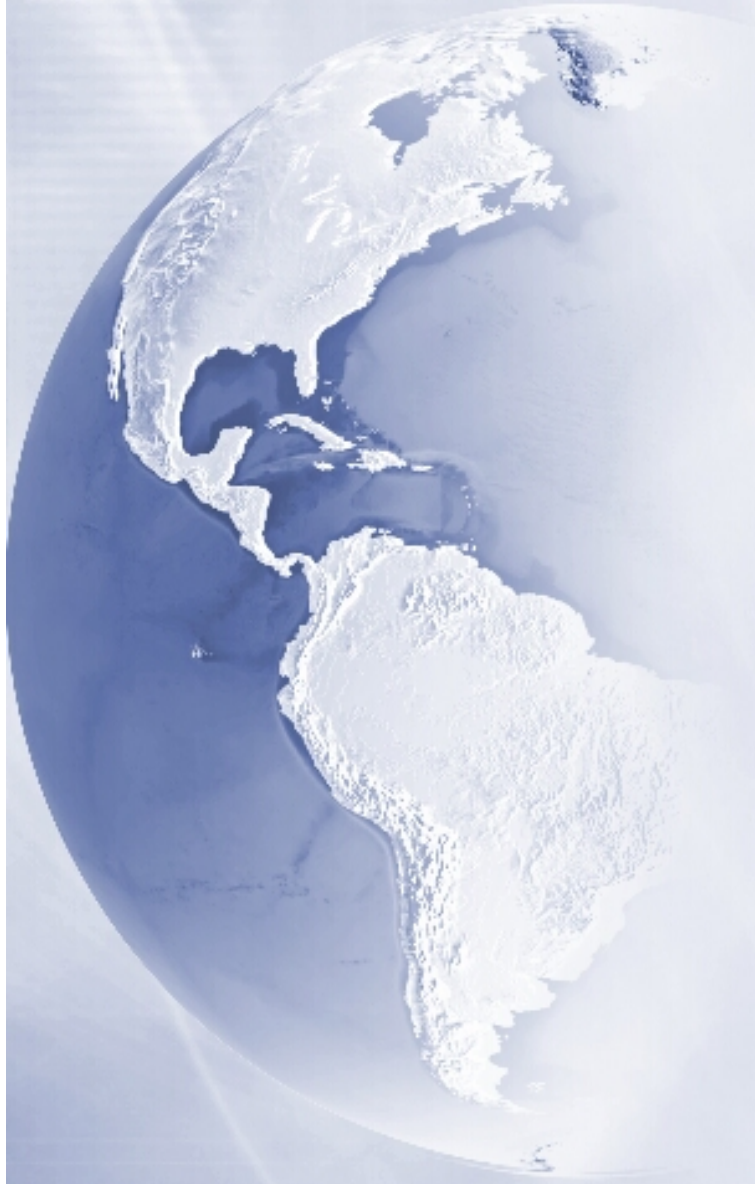


CAM5 – Day 2



Courtesy S. Klein (PCMDI)

MJO TF, YOTC & GEWEX GASS Diabatic Heating MJO Exp

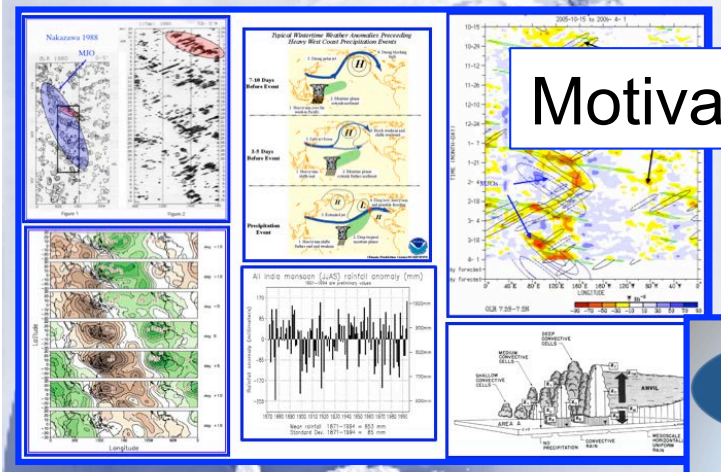


Addressed Later

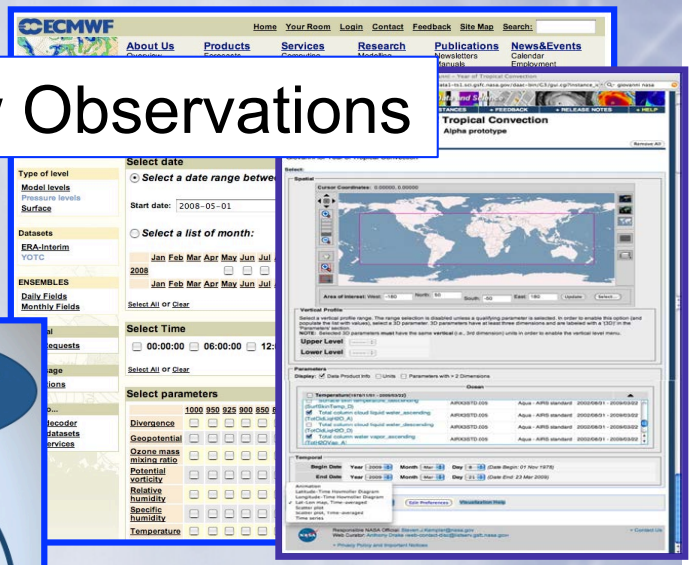
YOTC

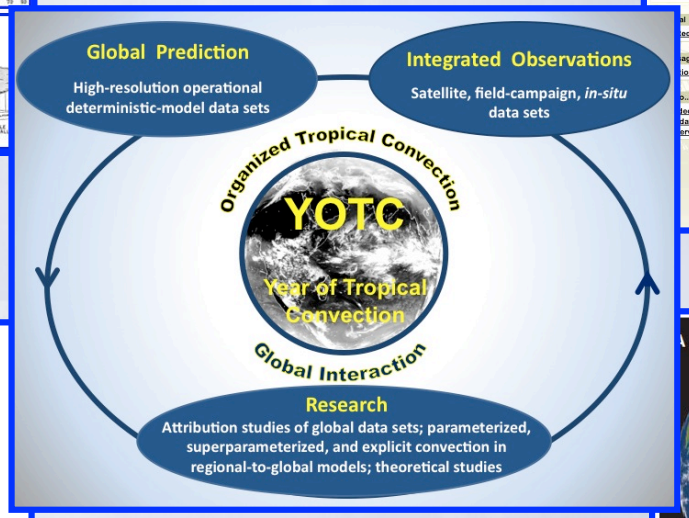
One Approach to Advancing our Understanding and Forecasting Capabilities of Tropical Convection

Motivation

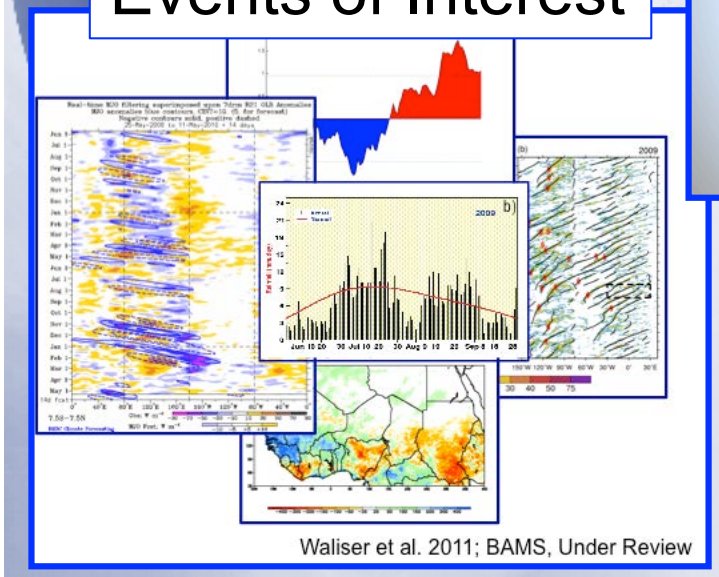


New Observations

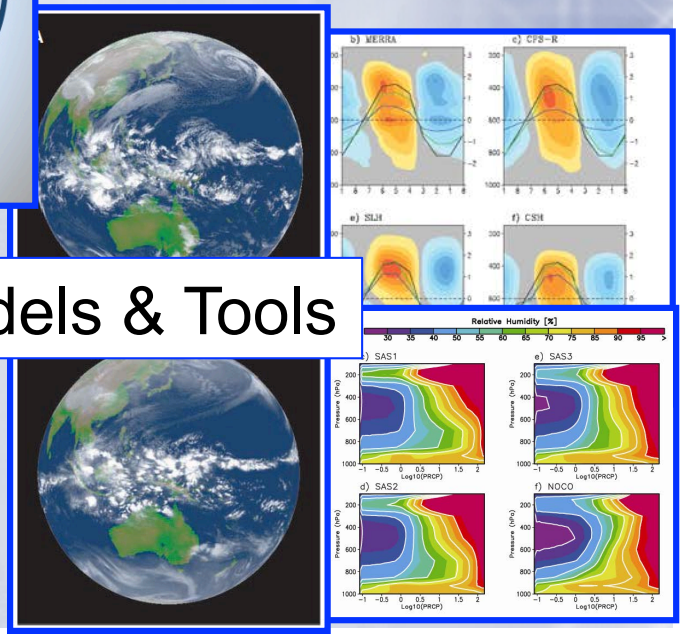




Events of Interest



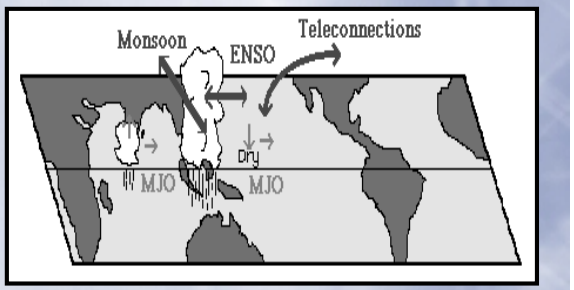
Models & Tools

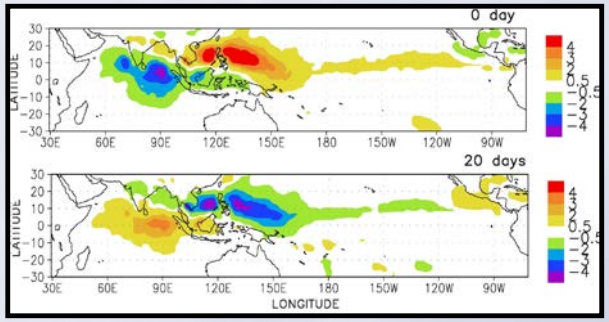


Thank You

An Update on MJO Task Force Activities and Plans

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





WGNE, Boulder, CO; 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

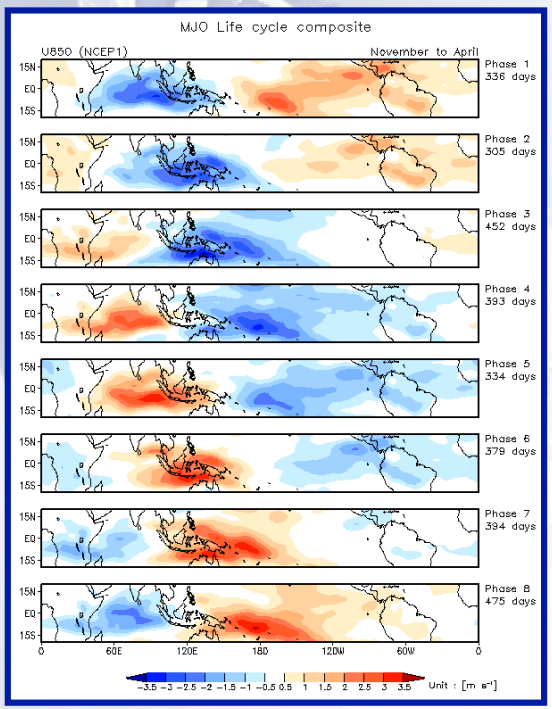
Overall Goal: Facilitate improvements in the representation of the MJO in weather and climate models in order increase the predictive skill of the MJO and related weather and climate phenomena.

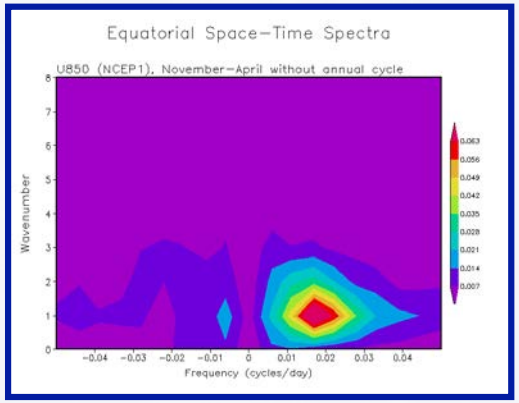
CLIVAR MJO WG Item I : MJO Simulation Diagnostics for GCMs

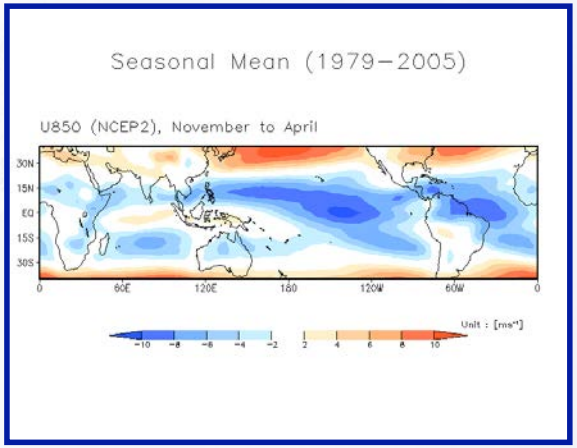
(MJOWG, J. Climate, 2009)

Observation-Based Diagnostics

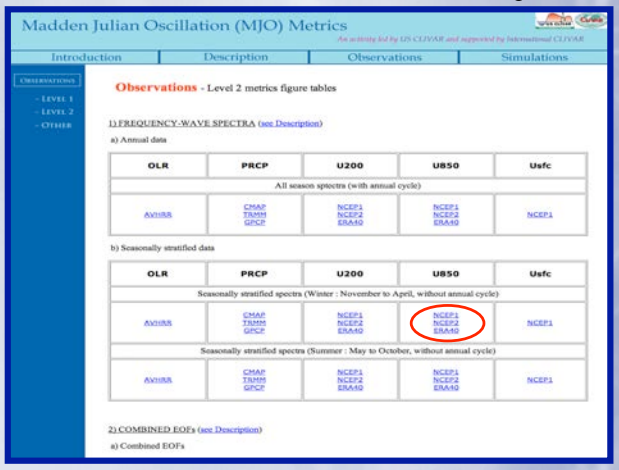
- Variability
- Life Cycle
- Mean-State
- Data Set Sensitivity



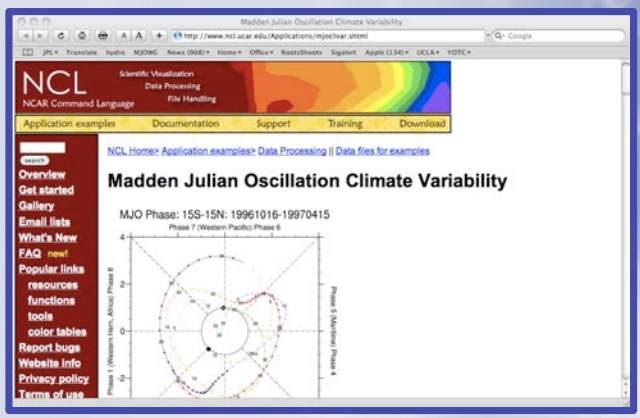




Web Display and Code Availability



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 29JAN1980-23JUL1995	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/OPYC3 (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 documented
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

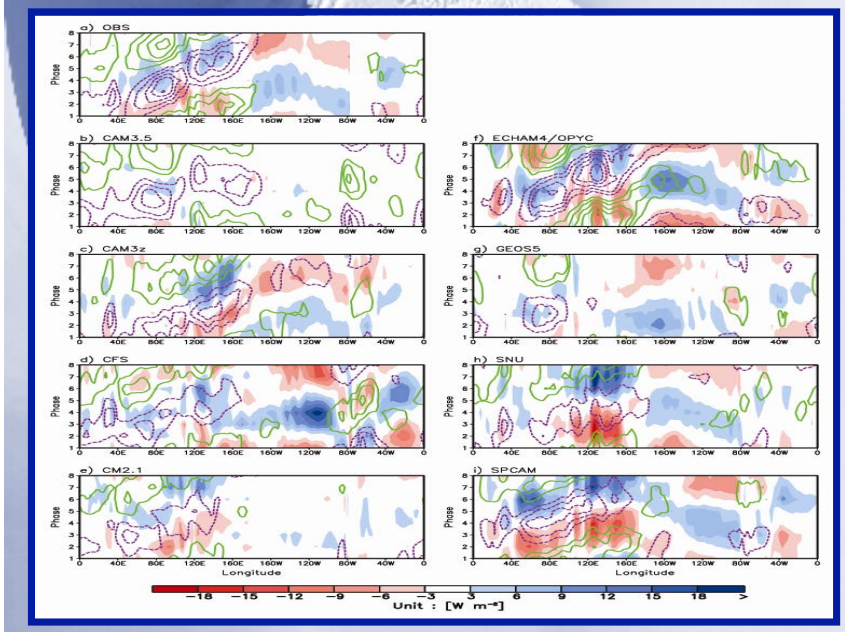
CAM3.5, CAM-3Z, SPCAM, ECHAM4/OPYC,

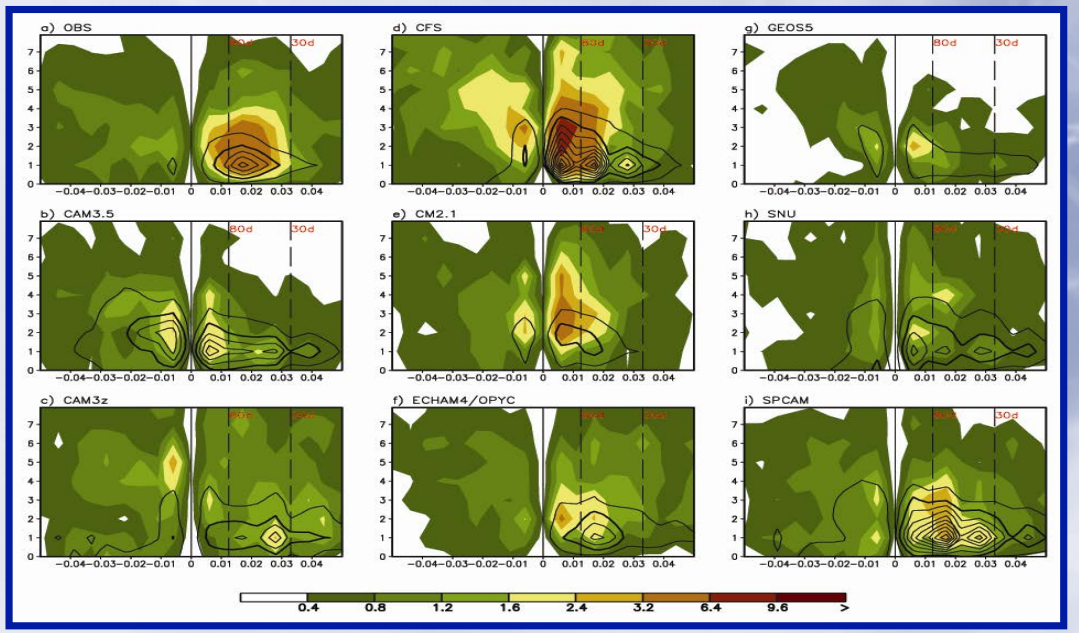
CFS, SNU, GFDL, GEOS5

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.

Center Participation

US – NCEP

ECMWF

United Kingdom

Brazil

US – NRL

India

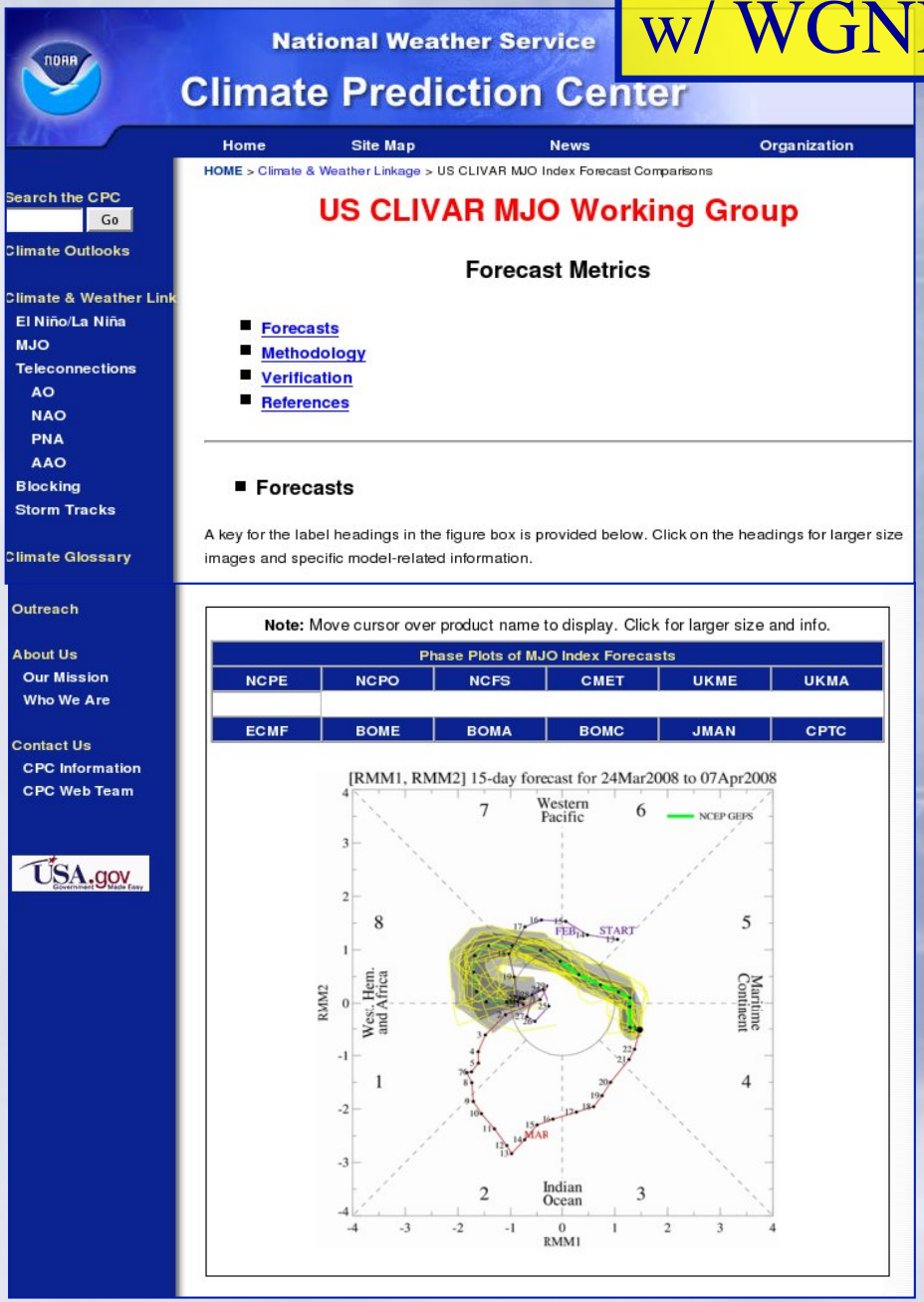
Taiwan

Australia

Japan

Canada – CMC

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

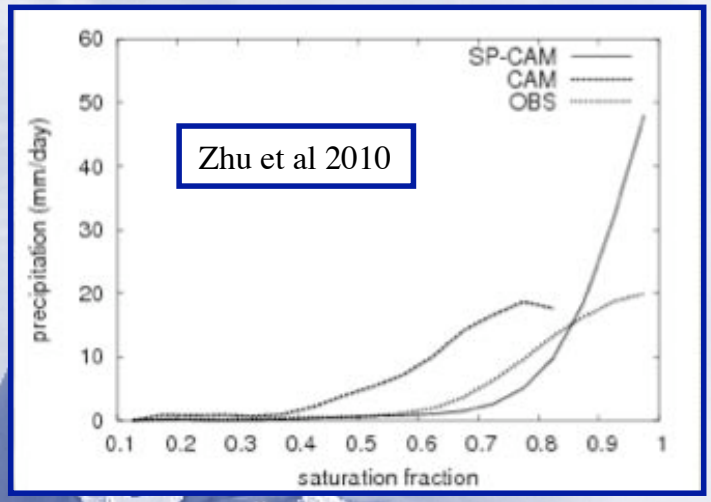
MJO TF Focus Areas

Organized into 4 Subprojects (leverage MJO WG activities)

- 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

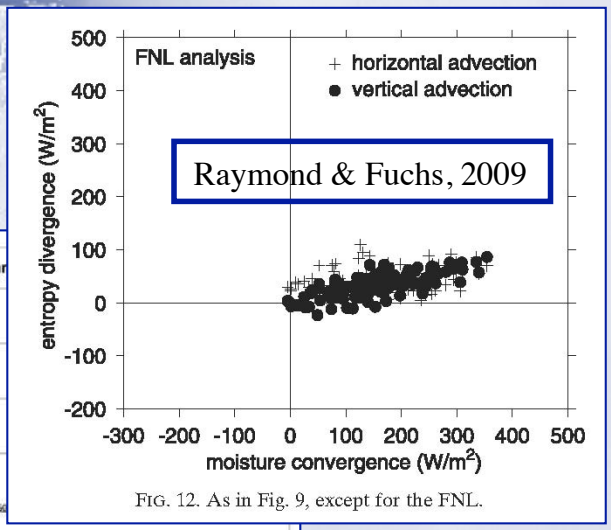
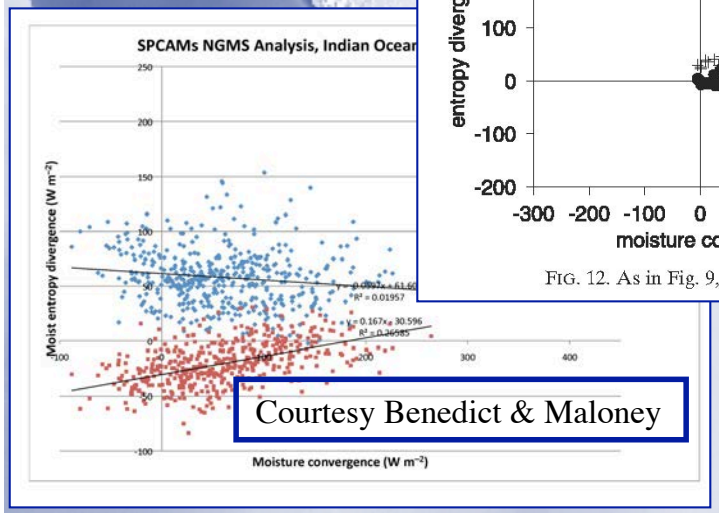
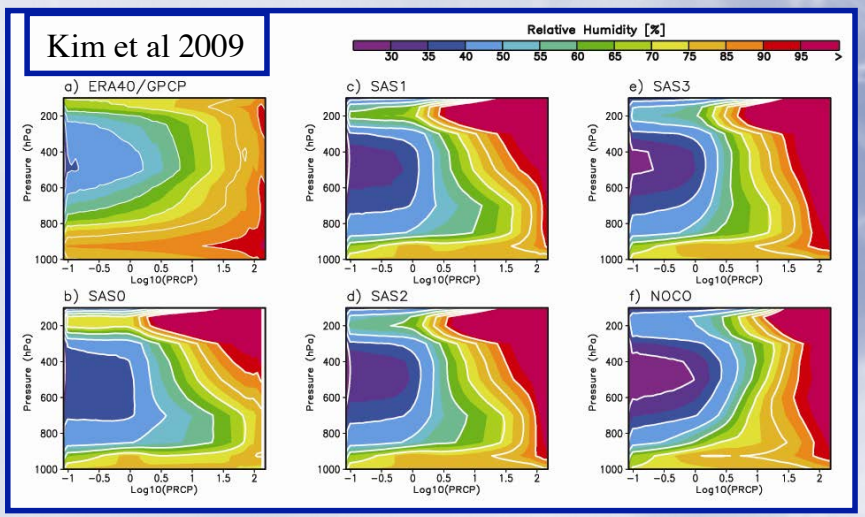


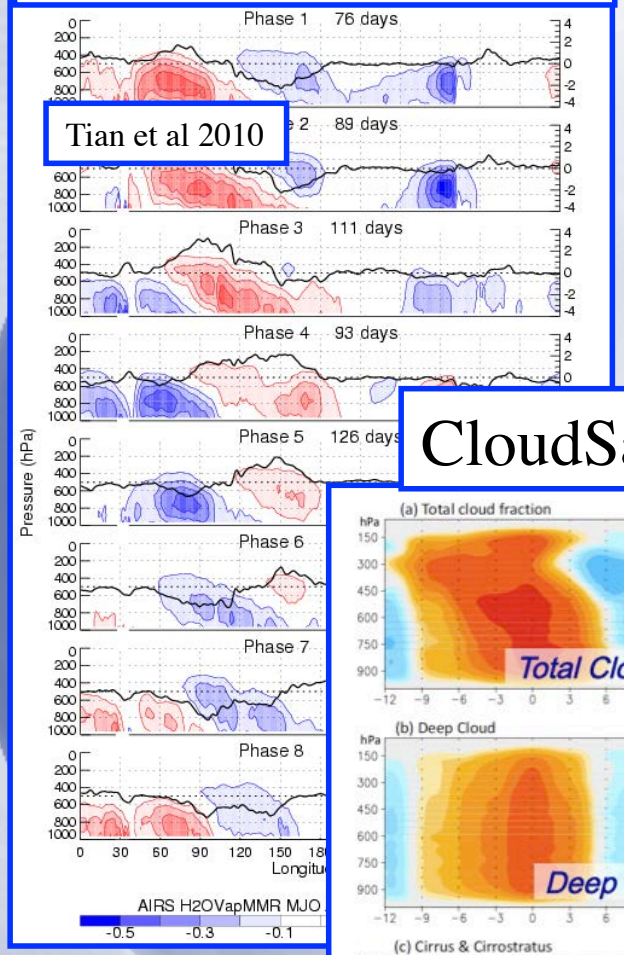
FIG. 12. As in Fig. 9, except for the FNL.





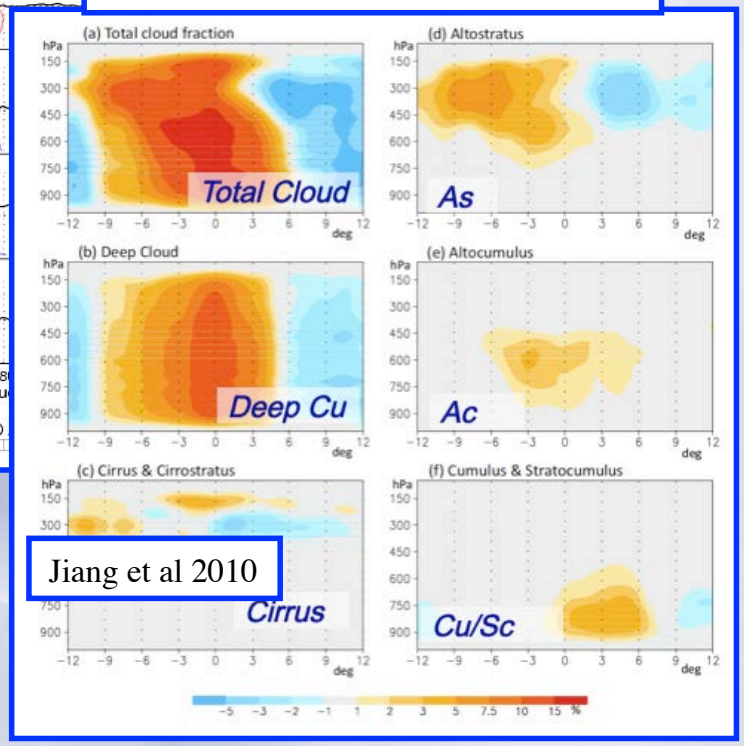
MJO TF Subproject: Process-Oriented MJO Diagnostics

AIRS Temp and WV



Tian et al 2010

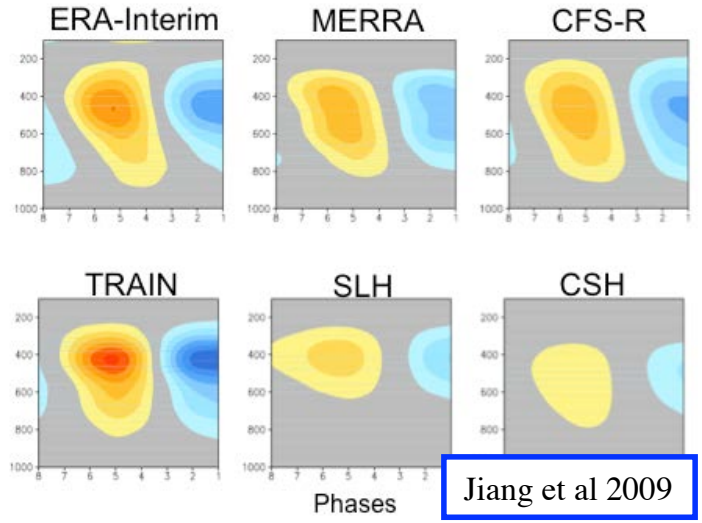
CloudSat Retrievals



Jiang et al 2010

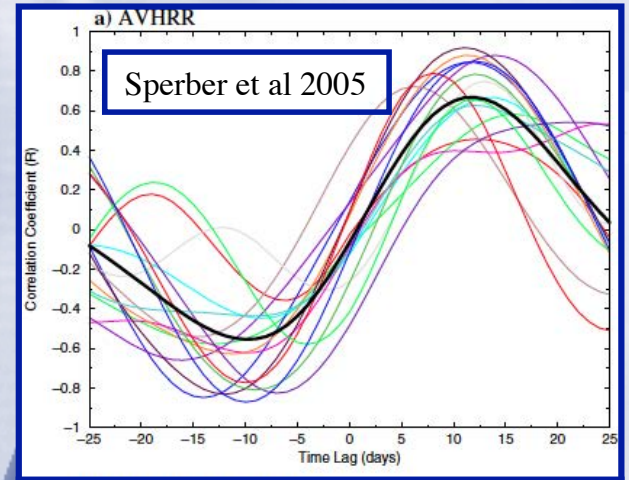
Contemporary Satellite Resources Provide New Opportunities for Profiling Vertical Structure

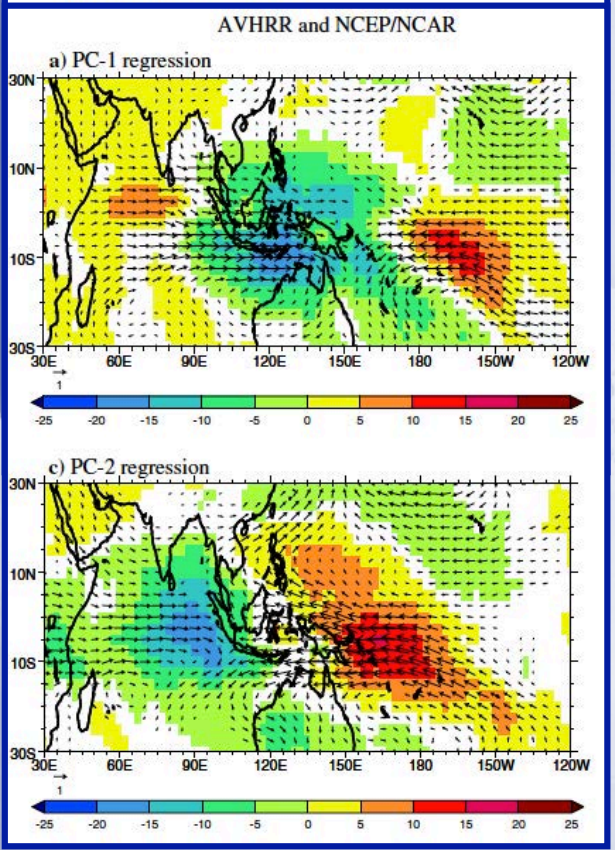
TRMM Diabatic Heating



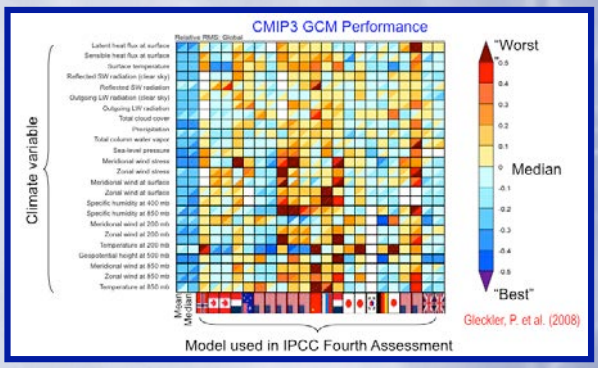
Jiang et al 2009

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

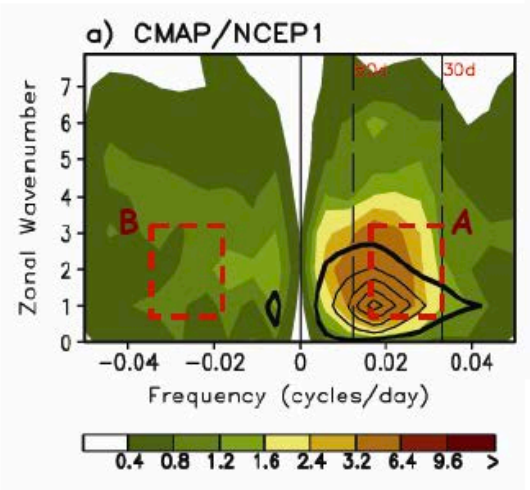




Offering guidance on simple MJO performance metrics for assessing CMIP models.



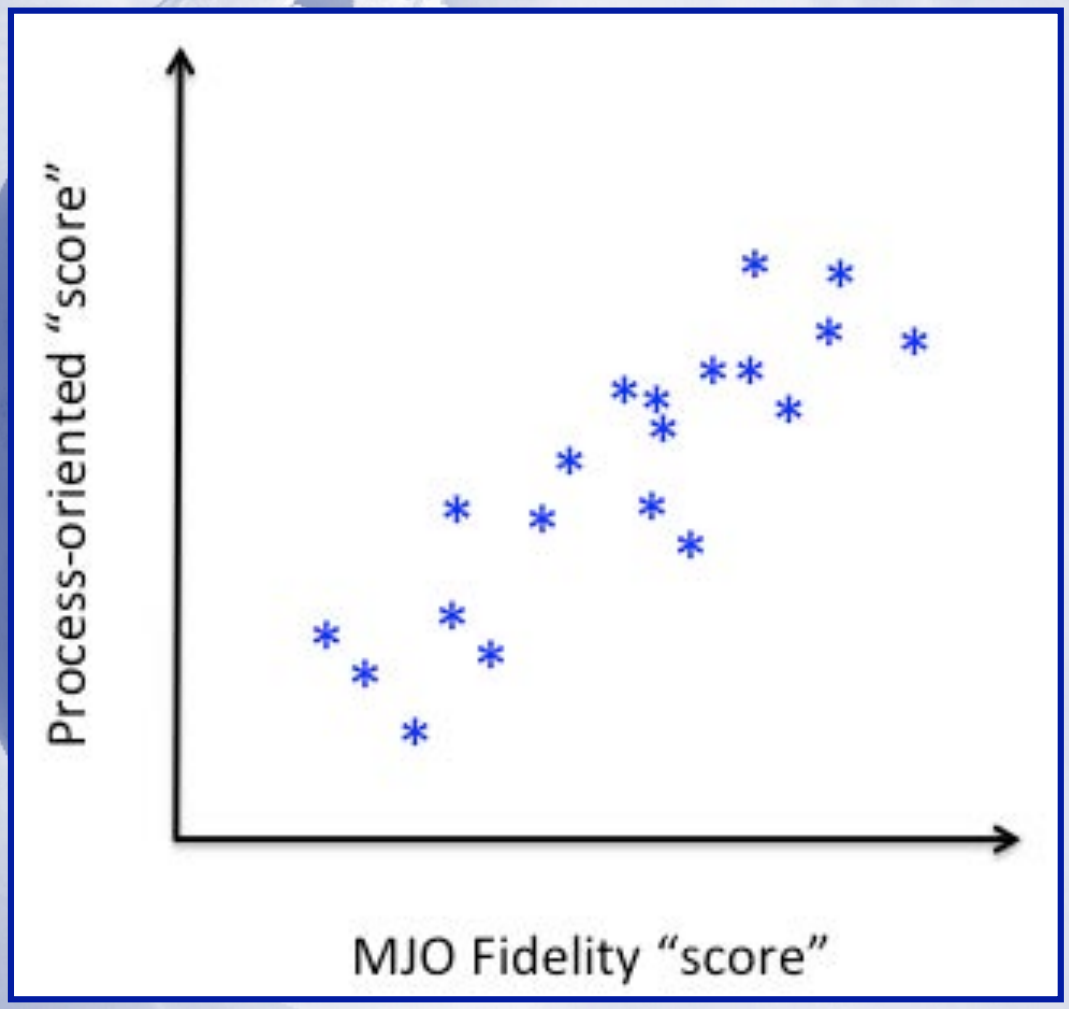
Wavenumber-frequency power spectra



- **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**

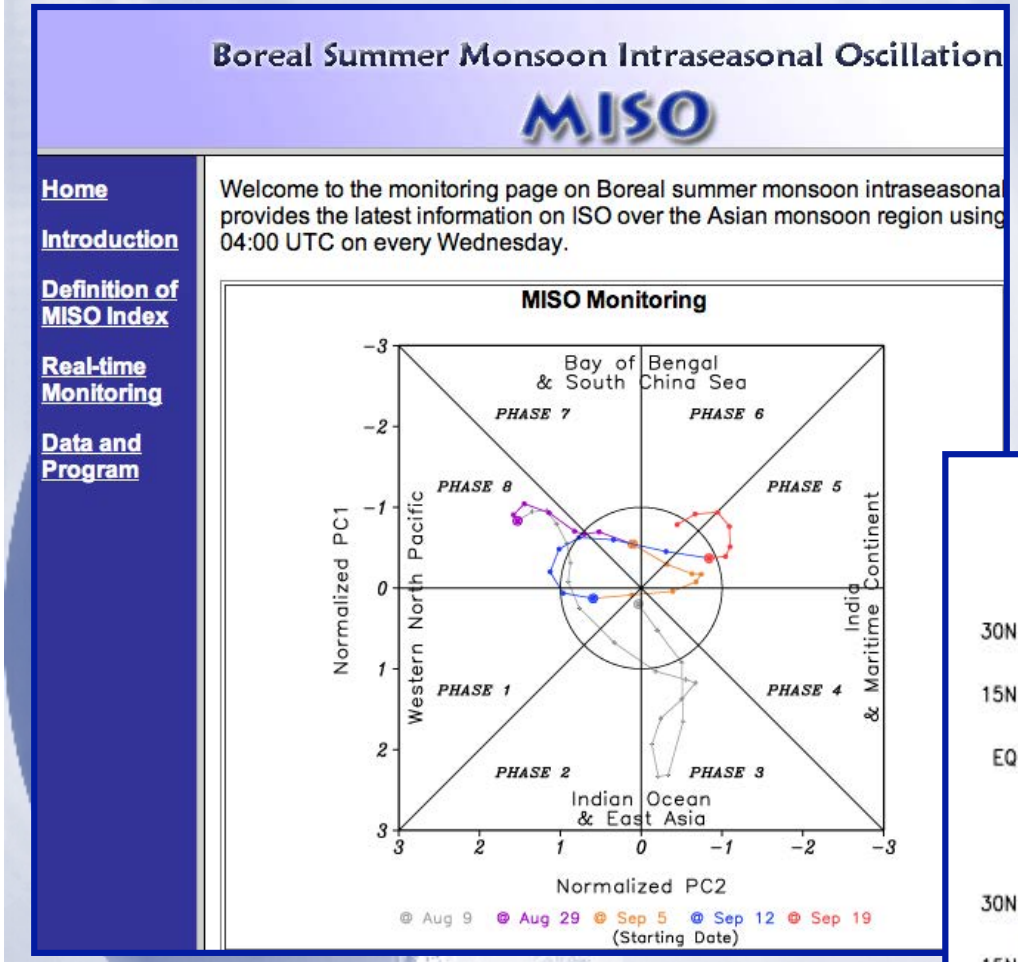
MJOWG et al. 2008
Kim et al 2009

MJO TF Subproject: Metric/Diagnostic Goals

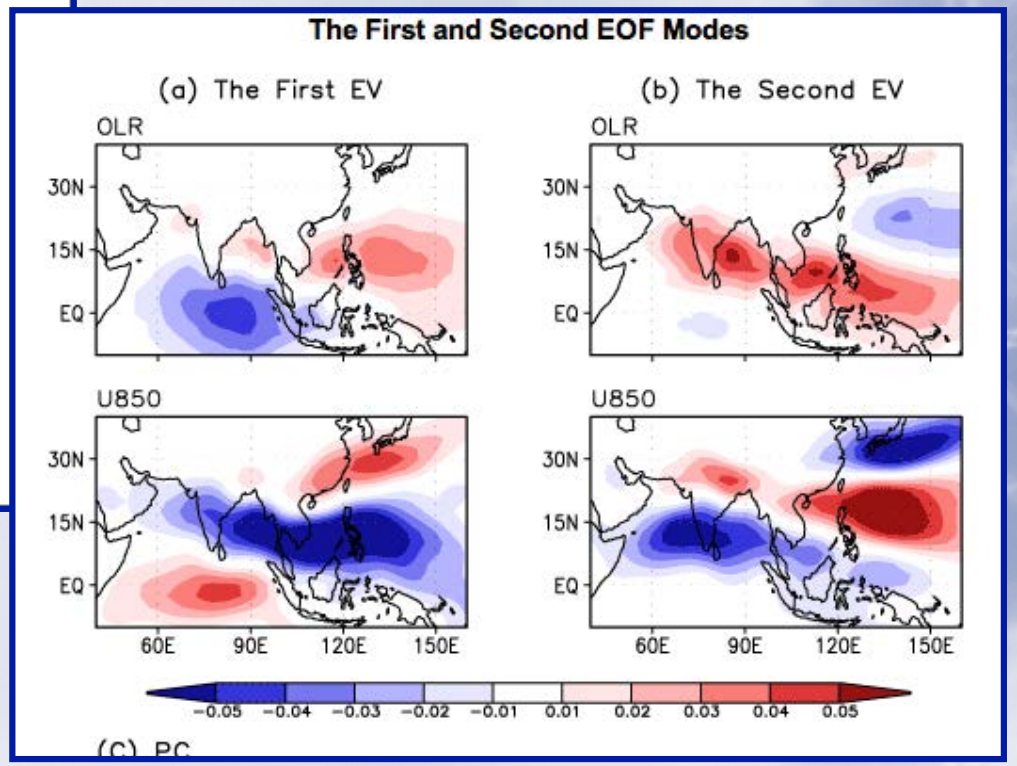


Combine performance metrics (x-axis) and process diagnostic (y-axis) to provide pathways to understanding and improving MJO model performance.

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

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

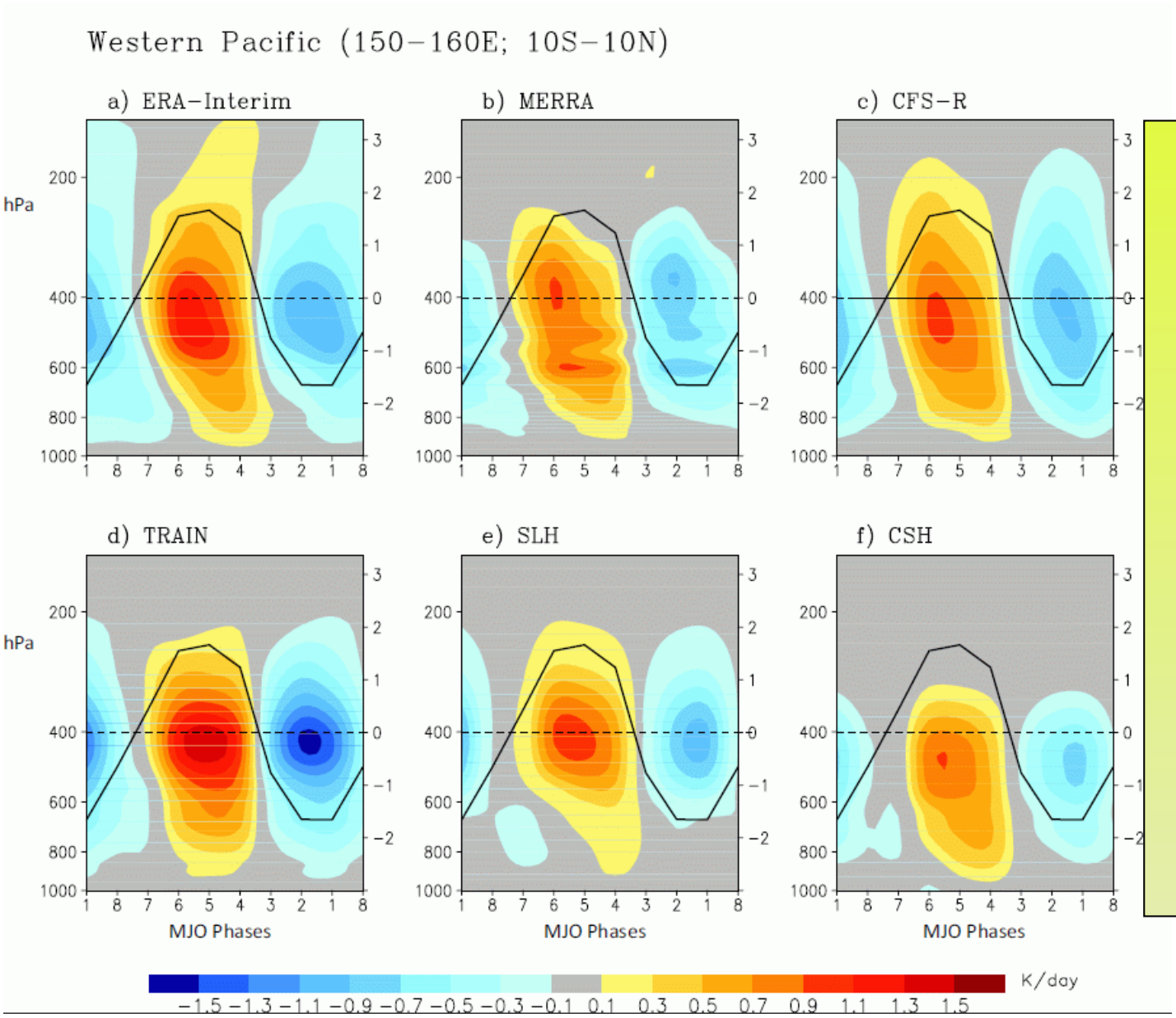
Vertical Structure and Diabatic Processes of the MJO: *Global Model Evaluation Project*

MJO Task Force/YOTC and GASS

Jon Petch (Met Office), Duane Waliser (JPL)
Xianan Jiang (JPL/Caltech), Prince Xavier (Met Office)
Nick Klingaman & Steve Woolnough (NCAS - Climate)

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

MJO Task Force/YOTC and GASS



Observational products and reanalysis are starting to give estimates of vertical diabatic heating but what do the models look like? Are the observations good enough?

Jiang et al. 2011

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

MJO Task Force/YOTC and GASS

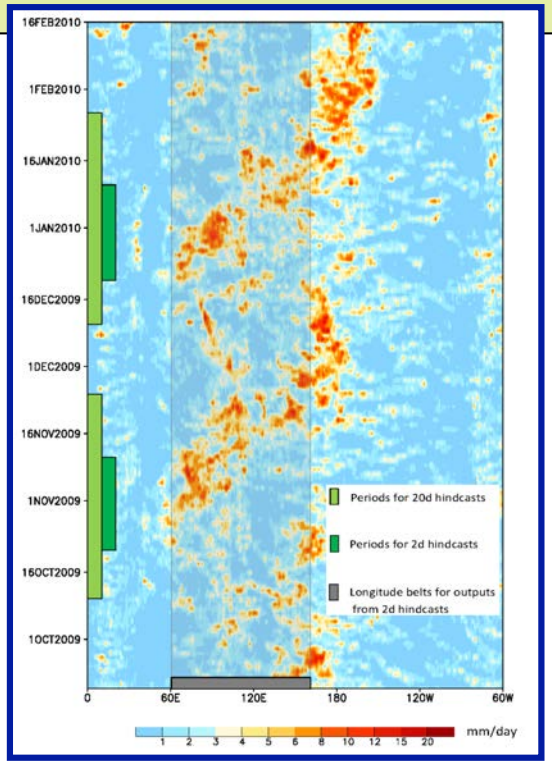
Specific objectives of the model inter-comparison are to characterise the diabatic heating and moistening profiles associated with the MJO in climate models and consider:

- the contributions of the models physical parametrizations
- the evolution as a function of forecast lead time
- the utility of the satellite and reanalysis products in evaluating model simulations of the MJO

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

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

3. **medium range hindcasts** – 20 day initialized forecasts



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

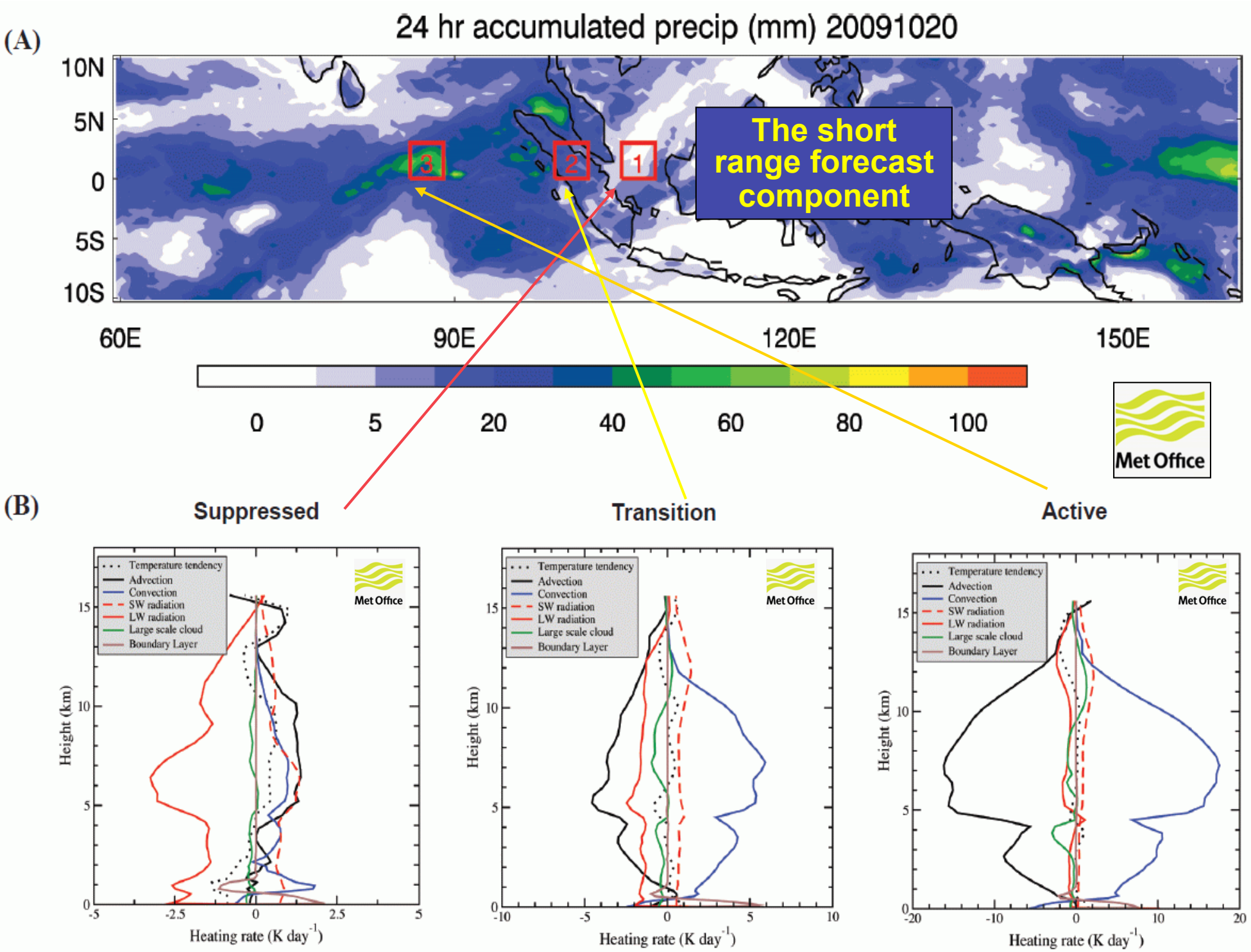
MJO Task Force/YOTC and GASS

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: About 20 Modeling Groups with AGCM and/or CGCM


(A)
24 hr accumulated precip (mm) 20091020
10N
5N
0
5S
10S
60E
90E
120E
150E
3
2
1
The short range forecast component
0
5
20
40
60
80
100
Met Office
(B)
Suppressed
Transition
Active
Temperature tendency
Advection
Convection
SW radiation
LW radiation
Large scale cloud
Boundary Layer
Met Office
Height (km)
Heating rate (K day-1)

Likely Participants (So Far)

Integrations Due Win/Spr 2012

First Results Discussion & Presentation

Pan-GASS Mtg Fall 2012

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	X	-	-
MetUM GA3.0	Prince Xavier	Met Office UK	X	X	X
INGV	Silvio Gualdi	CMCC			
HiRAM	Ming Zhao	GFDL	X	X	X
CCSM4, CESM1	Rich Neale	NCAR	X	X	X
NAVGEM	Jim Ridout	NRL	X	X	X
	Young-Joon Kim	NRL			
	Maria Flatau	NRL			
AM3/CM3	Bill Stern	GFDL	X	-	-
CAM3/CAM5	Guang Zhang	UCSD	X	-	-
Global WRF	Zhiming Kuang	University of Harvard	-	-	X
SPCAM	Zhiming Kuang	University of Harvard	-	-	X
CFSv2	Wanqiu Wang	NCEP/CPC	X	-	-

WCRP MJO TF THORPEX GASS YOTC