Year of Tropical Convection (YOTC)

Accomplishments and Near-Term Activities

A Paradigm for Applying the Benefits of Field Campaign Focus to the Study of Multi/Global-Scale Study of Earth System Processes

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

Plus
MJO Task Force

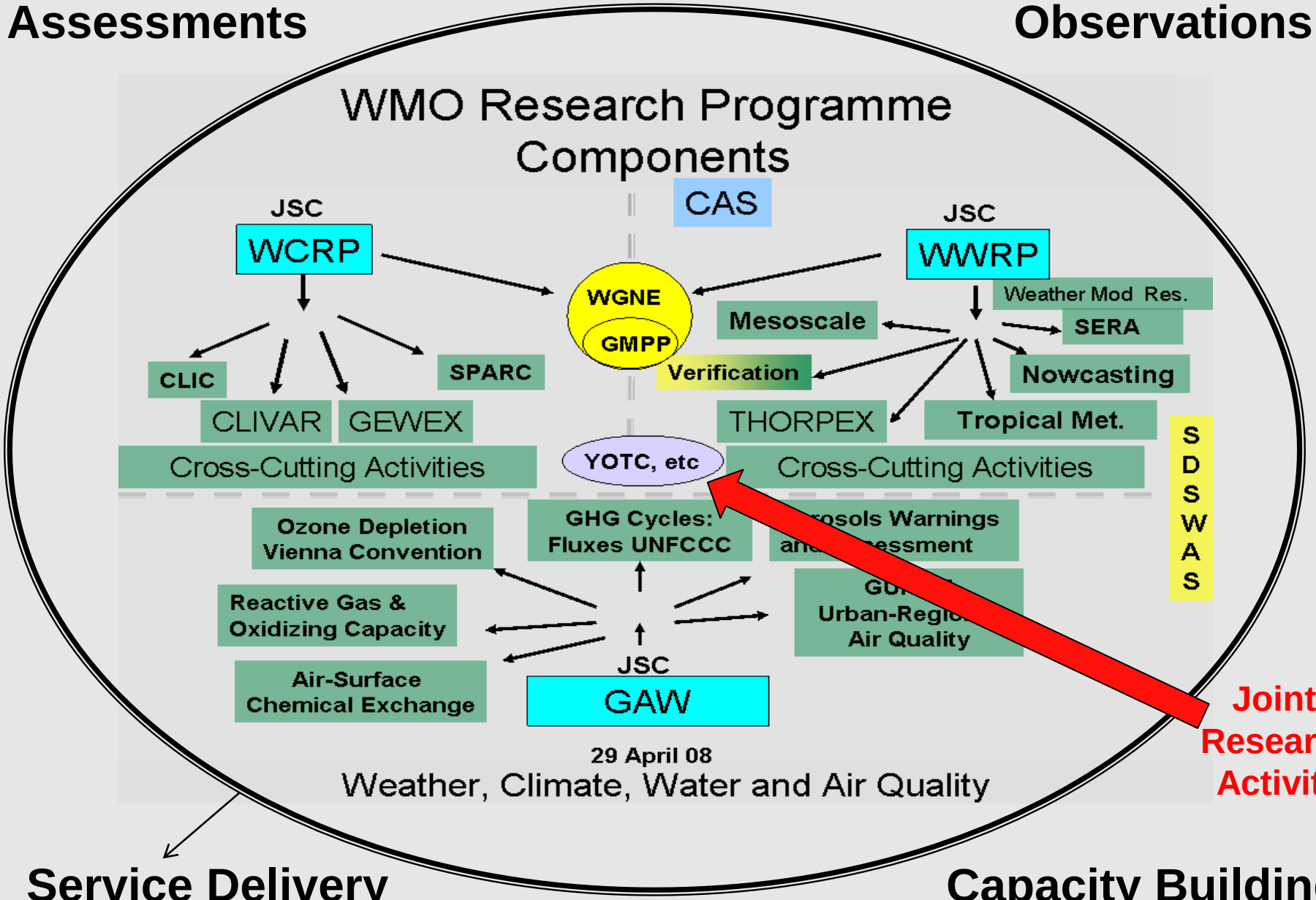
WGNE
Toulouse, France
Nov 2012

*** Weather-Climate Intersection Research ***
*** Seamless Prediction ***

Prediction

Assessments

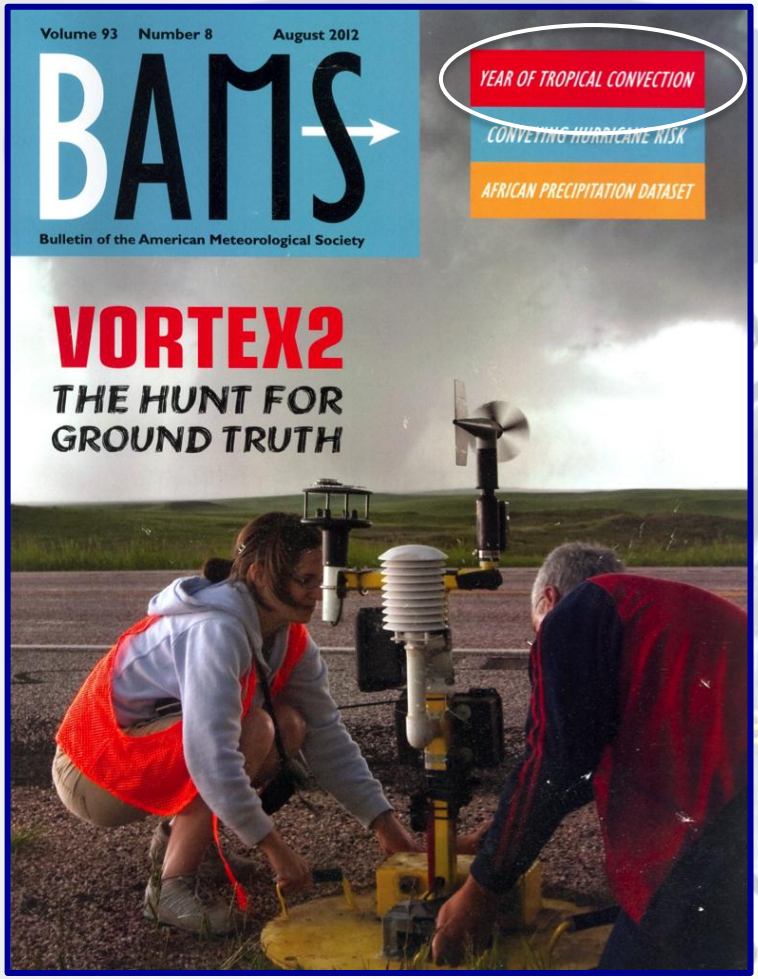
Observations



Joint Research Activity

Service Delivery

Capacity Building



MULTISCALE CONVECTIVE ORGANIZATION AND THE YOTC VIRTUAL GLOBAL FIELD CAMPAIGN

BY MITCHELL W. MONCRIEFF, DUANE E. WALISER, MARTIN J. MILLER, MELVYN A. SHAPIRO, GHASSEM R. ASRAR, AND JAMES CAUGHEY

Vastly improved satellite and in situ measurements, data assimilation, and modeling make possible a virtual field study of multiscale Earth system problems, such as convective organization and its interaction with larger-scale circulation.

THE "YEAR" OF TROPICAL CONVECTION (MAY 2008–APRIL 2010)

Climate Variability and Weather Highlights

BY DUANE E. WALISER, MITCHELL W. MONCRIEFF, DAVID BURRIDGE, ANDREAS H. FINK, DAVE GOCHIS, B. N. GOSWAMI, BIN GUAN, PATRICK HARR, JULIAN HEMING, HUANG-HSUING HSU, CHRISTIAN JAKOB, MATT JANIGA, RICHARD JOHNSON, SARAH JONES, PETER KNIPPERTZ, JOSE MARENGO, HANH NGUYEN, MICK POPE, YOLANDE SERRA, CHRIS THORNCROFT, MATTHEW WHEELER, ROBERT WOOD, AND SANDRA YUTER

May 2008–April 2010 provided a diverse array of scientifically interesting and socially important weather and climate events that emphasizes the impact and reach of tropical convection over the globe.

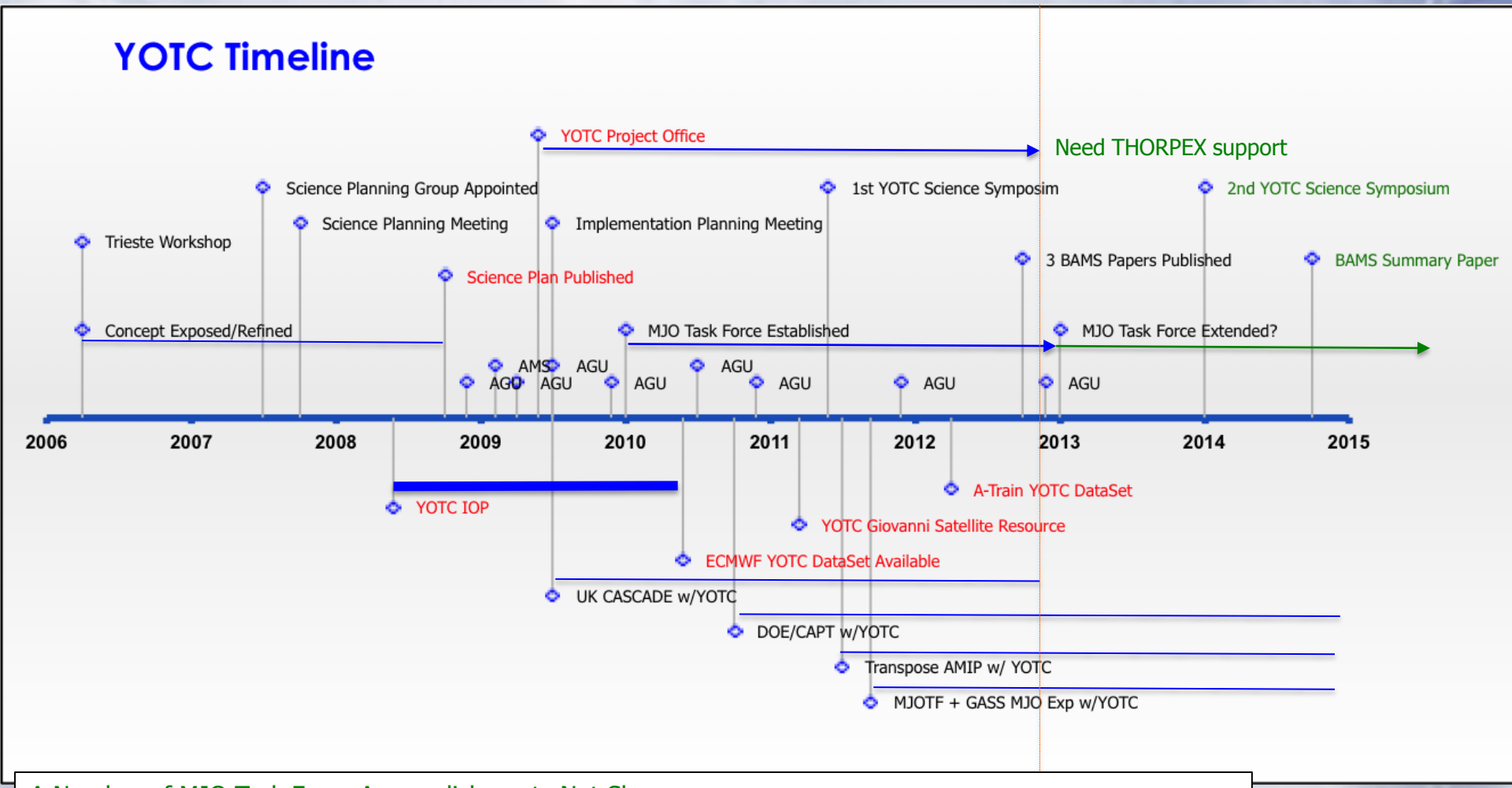
PROGRESS AND DIRECTION IN TROPICAL CONVECTION RESEARCH

YOTC International Science Symposium

BY MITCHELL W. MONCRIEFF, DUANE E. WALISER, AND JAMES CAUGHEY

Also Over 40 publications referencing YOTC

YOTC: Summary of Progress & Timeline



A Number of MJO Task Force Accomplishments Not Shown

- MJO Metric for CMIP & Climate Metrics Panel (Sperber and Kim, 2012)
- Operational Implementation of MJO Forecast Metric (Gottschalck et al. 2010) w/ WGNE
- Develop Forecast Metric for Boreal Summer Subseasonal Variability (Lee et al. 2012)
- MJO Workshop on Modeling Monsoon Intraseasonal Variability, Busan, 2011, (Hendon et al. 2011, BAMS)
- Significant ongoing work on process-oriented MJO/Atmos Physics Metrics (2-3 papers in preparation)
- Co-support/develop first robust multi-model hindcast experiment for subseasonal variability; ISVHE.

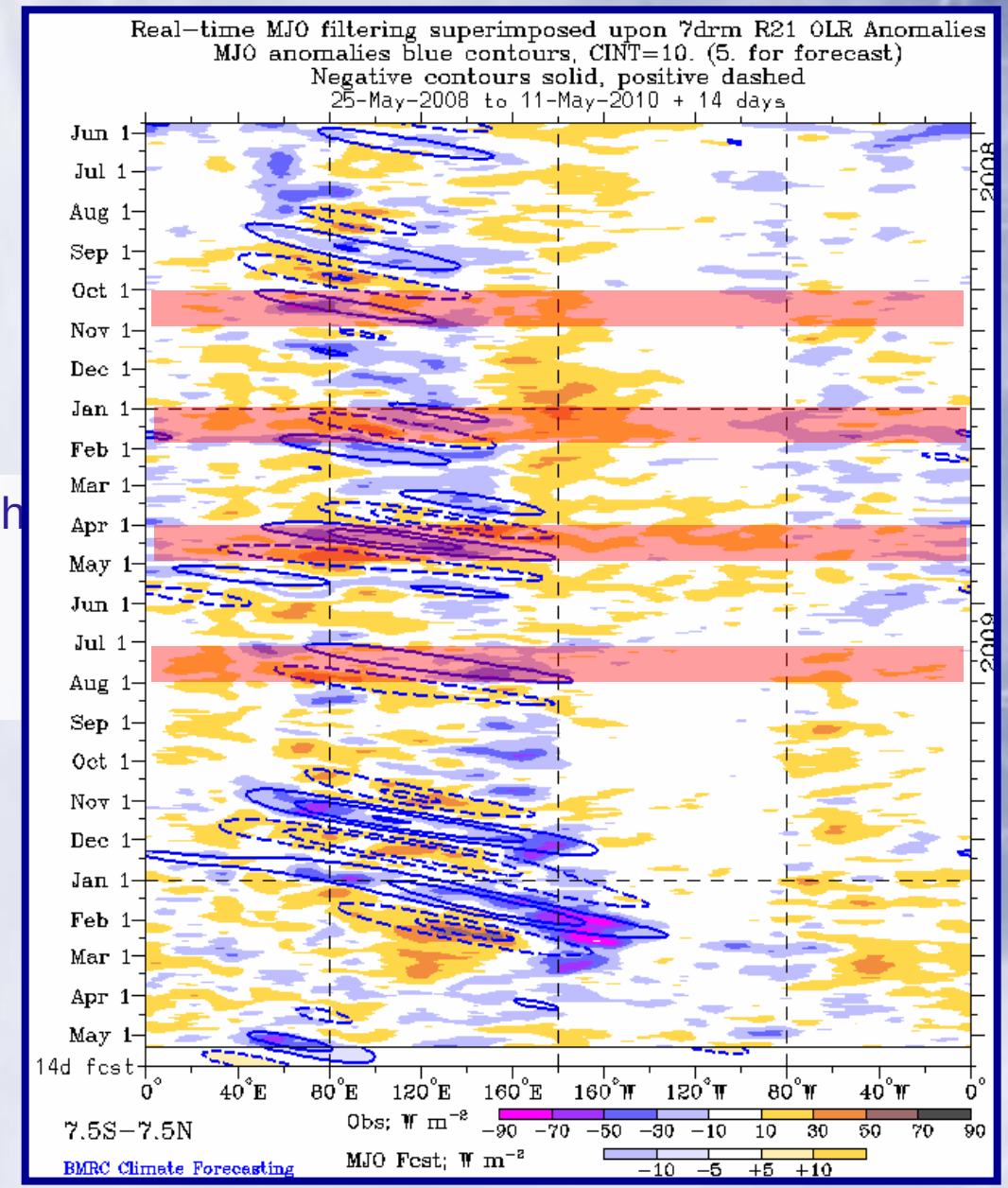
Transpose AMIP

CMIP5 Model Evaluations

- 4 periods; 16 5-day hindcasts in each
- 9 Subprojects.
- 8 Modeling Groups

hadobs.metoffice.com/tamip

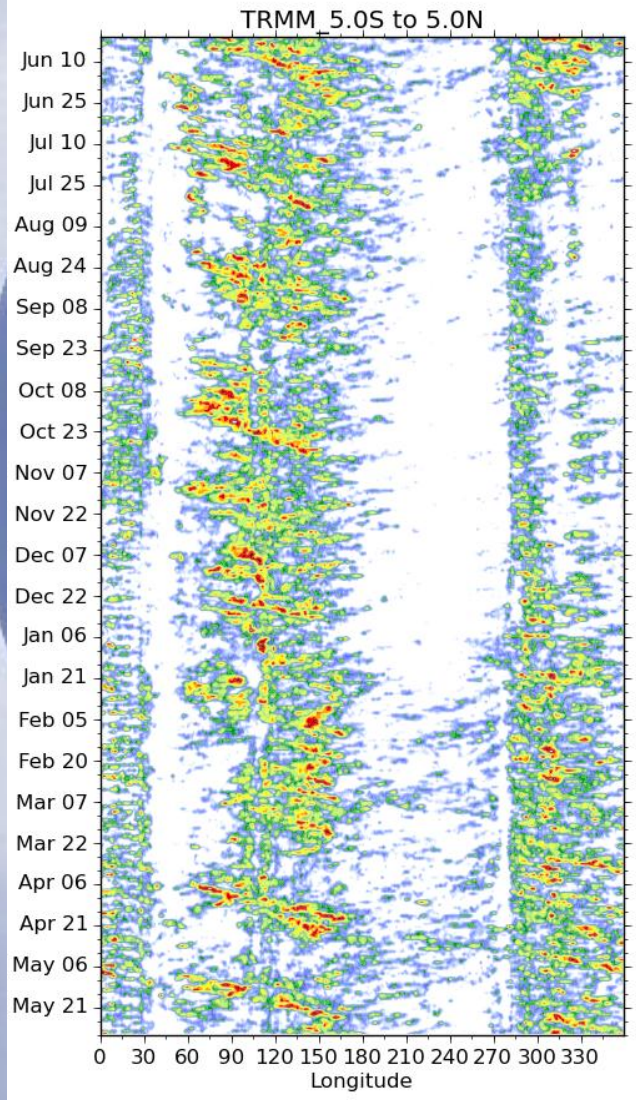
YOTC Period



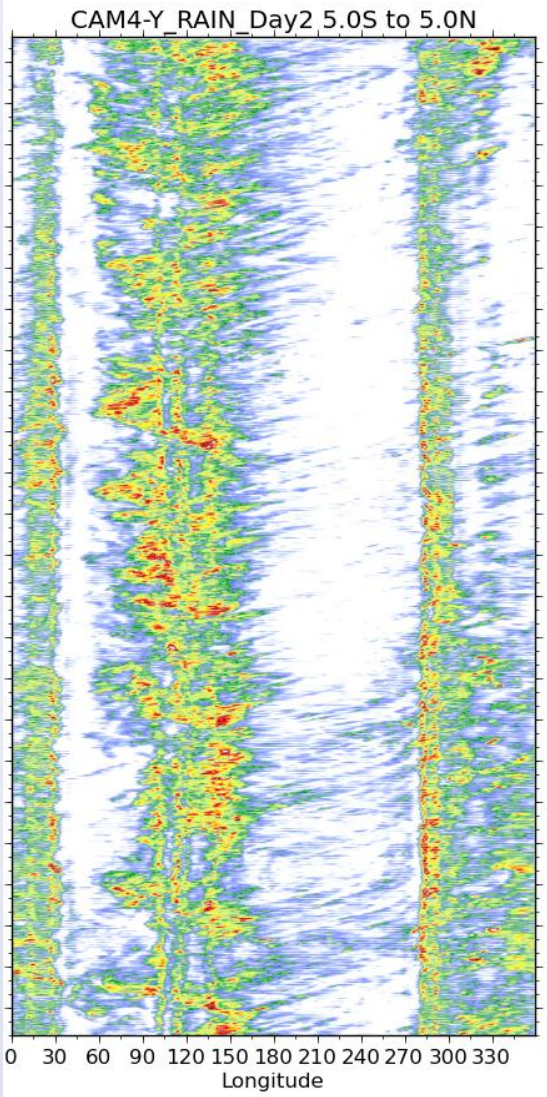
Transpose AMIP – CAPT/DOE

Utilizing YOTC Period/ECMWF Analysis

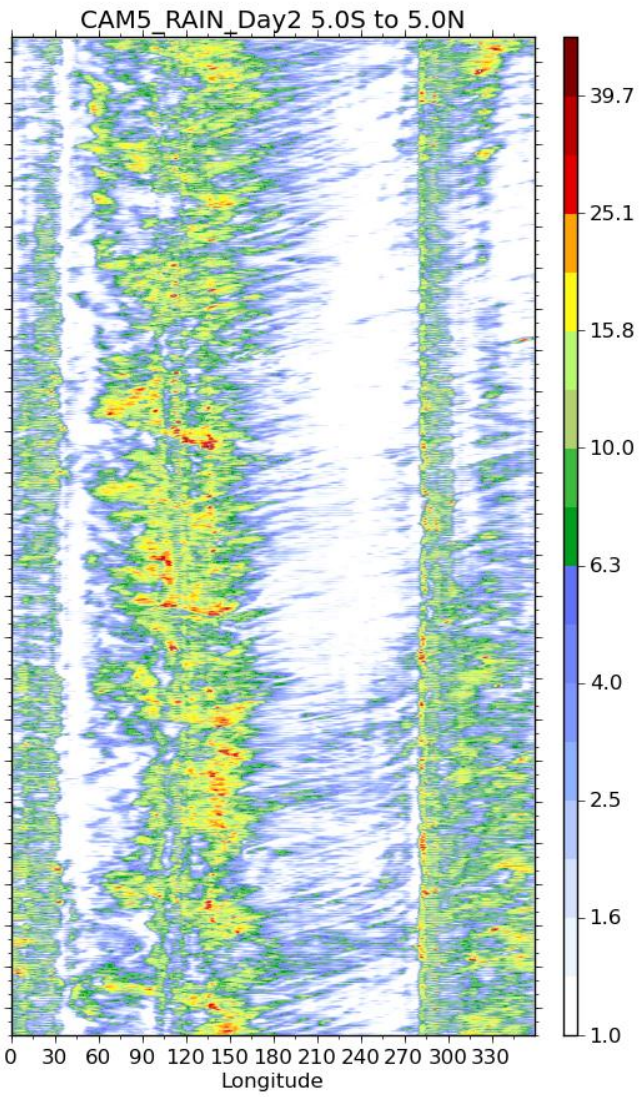
TRMM



CAM4 – Day 2



CAM5 – Day 2



Courtesy S. Klein (PCMDI)

Cascade

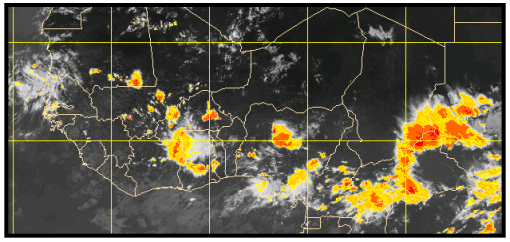
Organized convection and scale interactions in the tropical atmosphere

Cascade uses the UK Met Office Unified Model at cloud-system-resolving resolutions over large, limited-area tropical domains.

Case Studies

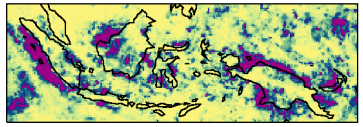
West Africa (AMMA cases)

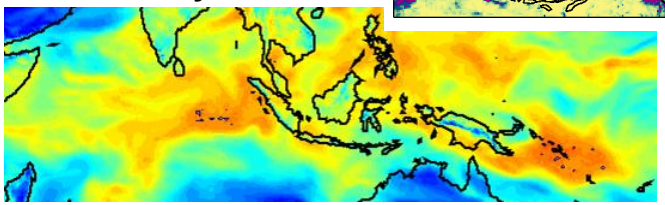
- African Easterly Waves
- Diurnal Cycle



Warm Pool (using YOTC ECMWF for lateral boundaries and sci. analysis)

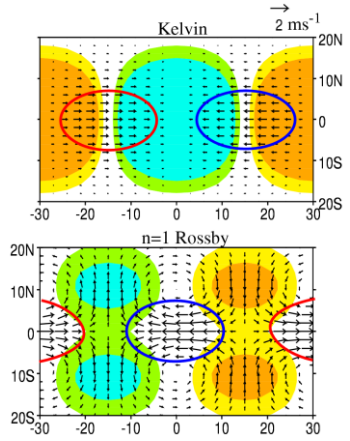
- MJO (YOTC cases)
- Maritime Continent
- Diurnal Cycle





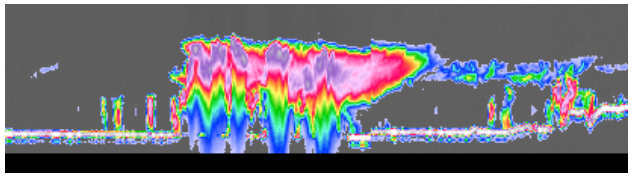
Idealised

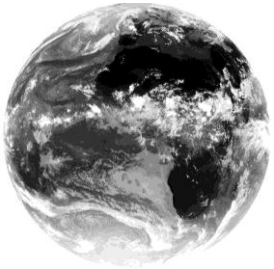
- Warm Pool Convection
- Equatorial Waves



Model Evaluation against Observations

- CloudSat/CALIPSO: vertical cloud properties
- GERB/SEVIRI/MTSAT: horizontal and time



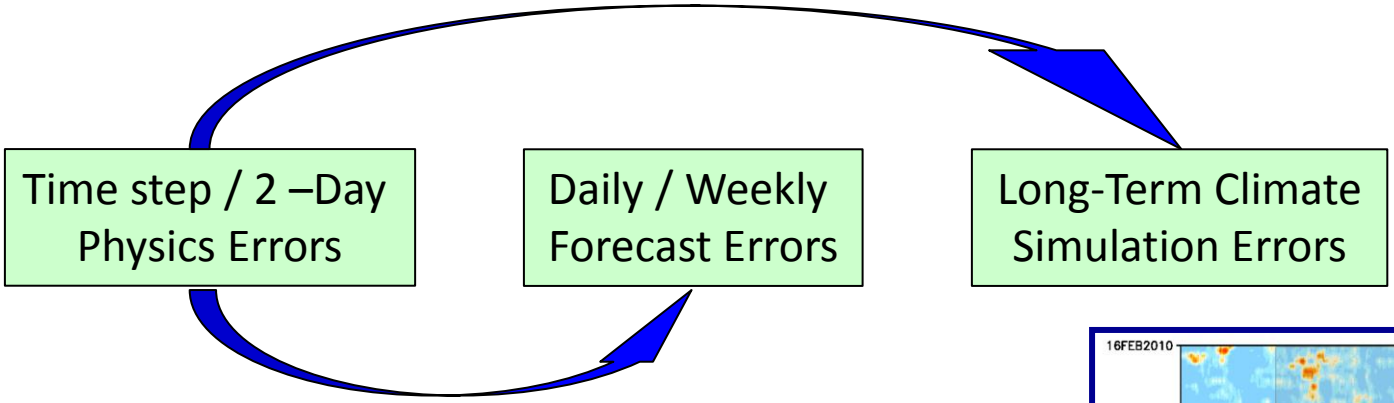


Synthesis

- Analysis of scale interactions
- Insight into physical processes
- Compare with climate / NWP resolution
- Conclusions for parameterization

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

MJO Task Force/YOTC and GASS

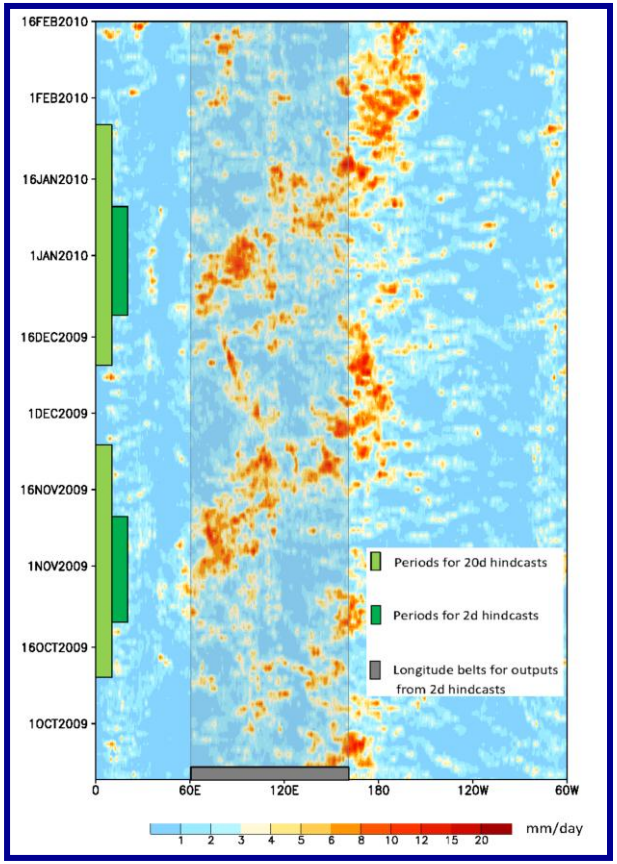


1. **climate simulation** – multi-year simulations coupled or atmosphere only

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

Participants

No	Model	Point of Contact	Institution	Experiment		
				Climatological Simulation	Short-term Hindcast	Long-term Hindcast
01	GEOS-5 AGCM	Siegfried Schubert; Hailan Wang	NASA/GMAO	X	X	X
02	IPRC GCM	Xiouhua Fu; Baoqiang Xiang	University of Hawaii	X		
03	SPCCSM / SPCAM	David Randall; Charlotte Demott; Cristiana Stan	Colorado State University COLA	X		
		Mike Pritchard (UW)	UCSD		X	X
04	NASA GISS	Daehyun Kim; Anthony Del Genio	LDEO	X		X
05	GEM model	Hai Lin	Environment Canada	X		
06	NICAM	Masaki Satoh ; Tomoe Nasuno	AORI, Univ. of Tokyo JAMSTEC	-		X
07	MIROC	Tomoki Miyakawa	AORI/Univ. Tokyo	X	X	X
10	MRI-GCM	Eiki SHINDO; Akio Kitoh	MRI	X	X	X
11	CWB AGCM	Mong-Ming Lu; Hsin-Hsing Chia; Hsiao-Chung Tsai	CWB, Taiwan	X		
12	WRF	Samson M Hagos	PNNL		X	
15	IFS	Frederic Vitart	ECMWF	-	X	X
16	ECHAM	Traute Crueger	ZMAW	X	-	-
17	MetUM GA3.0	Prince Xavier	Met Office UK		X	X
22	NAVGEM	Jim Ridout; Maria Flatau	NRL	X		X
24	CAM3/CAM5	Guang Zhang	UCSD	X	-	-
27	CFSv2	Wanqiu Wang	NCEP/CPC	X	-	-
30	GFSv2	Arindam Chakraborty	Indian Institute of Science	-	-	X
31a	CNRM_AM	Gilles Bellon	CNRM/France	X	-	-
31b	CNRM_CM					
34	CanCM4	John Scinocca; Bill Merryfield; Ajaya Mohan	CCCma	X	X	X
35	BCCAGCM2.1	Tongwen Wu, Jie Zhang	National Climate Center, China	X		
36	FGOALS2.0-s	Wenting Hu	LASG/IAP, China	X	-	-
37	ECHAM5-SIT	Wan-Ling Tseng; Noel Keenlyside	Univ of Bergen	X	-	-
39	Modified CAM4	Courtney Schumacher; Cara-Lyn Lappen	TAMU	X		
40	METUM	Hongyan Zhu	BoM, Australia	X	-	-
43	ISUGCM	Xiaoqing Wu	Iowa State University	X	-	-

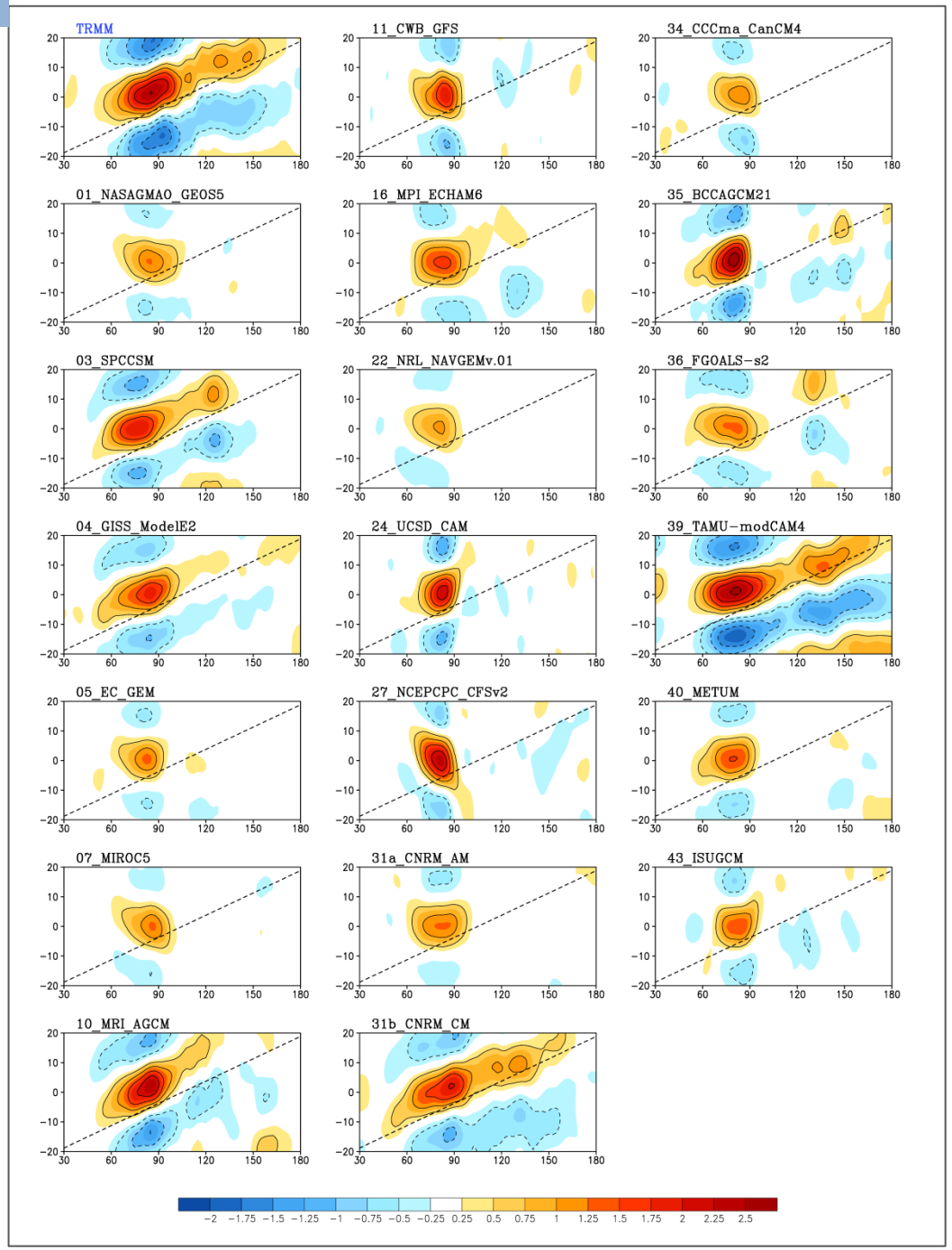
www.ucar.edu/yotc/mjodiab.html

20 8 11

Lag-regression of rainfall with Indian Ocean (70-90E; 5S-5N) base point

20-90day filtered

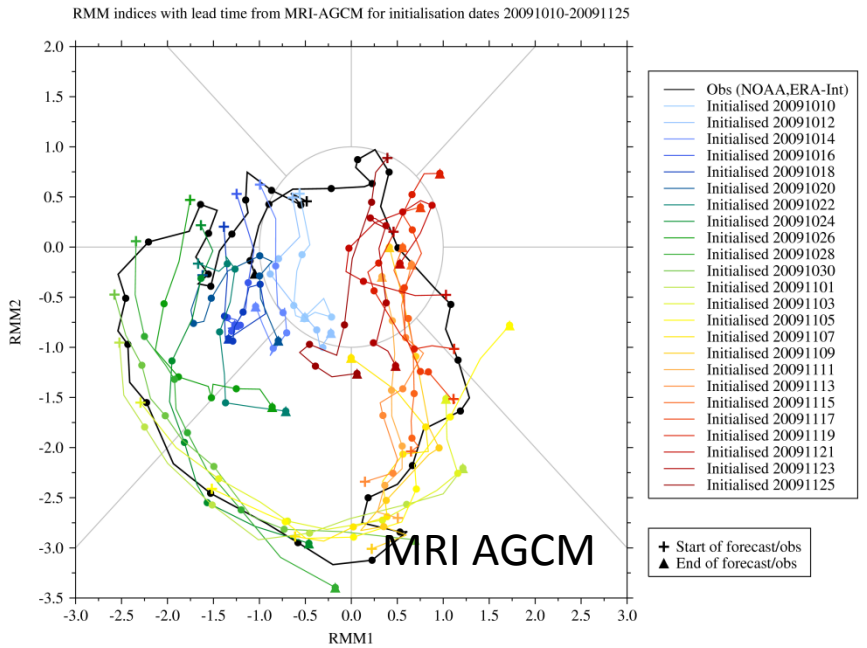
dash line – 5 m/s

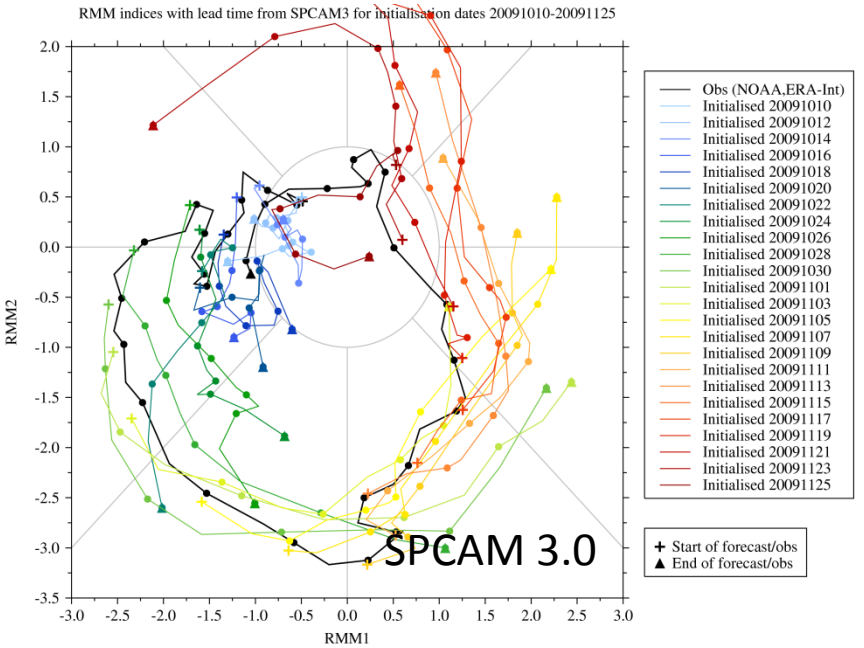


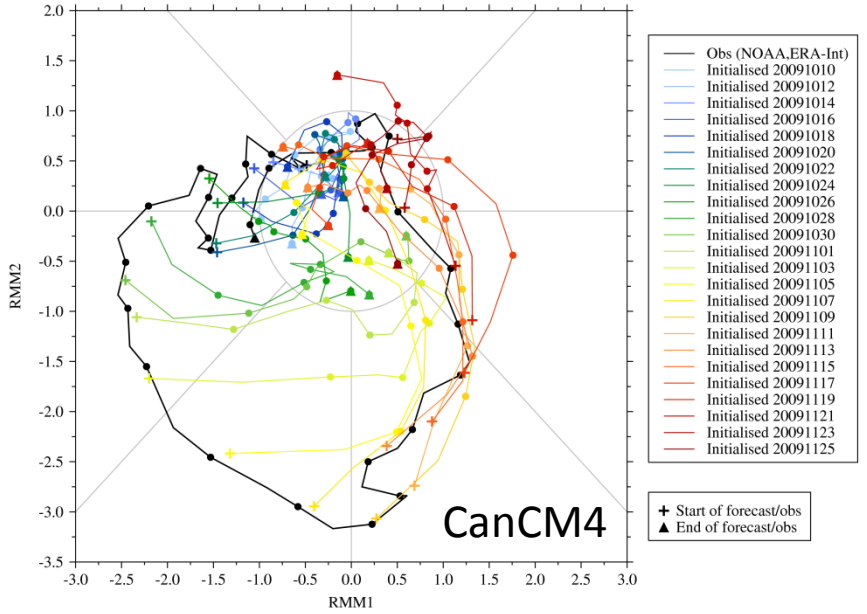
JPL UCLA

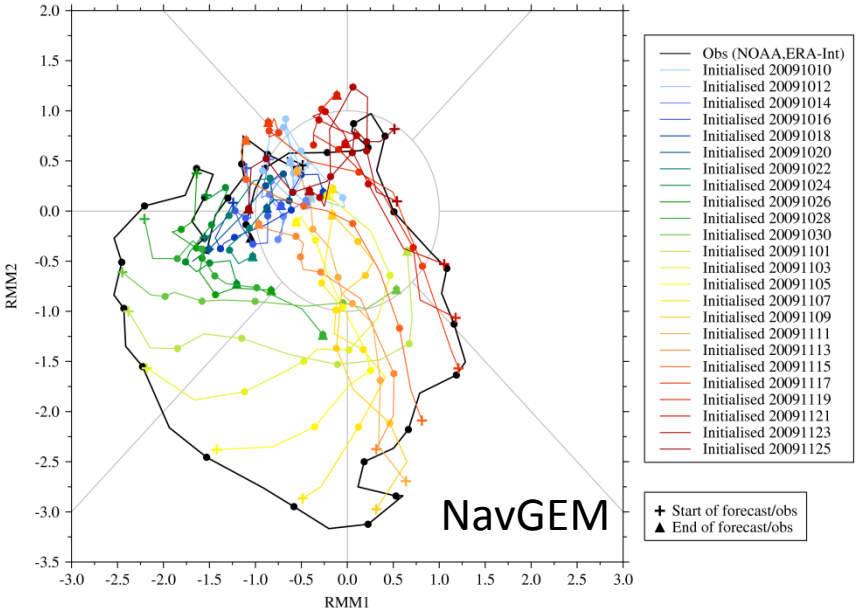
RMM indices at constant start date

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL



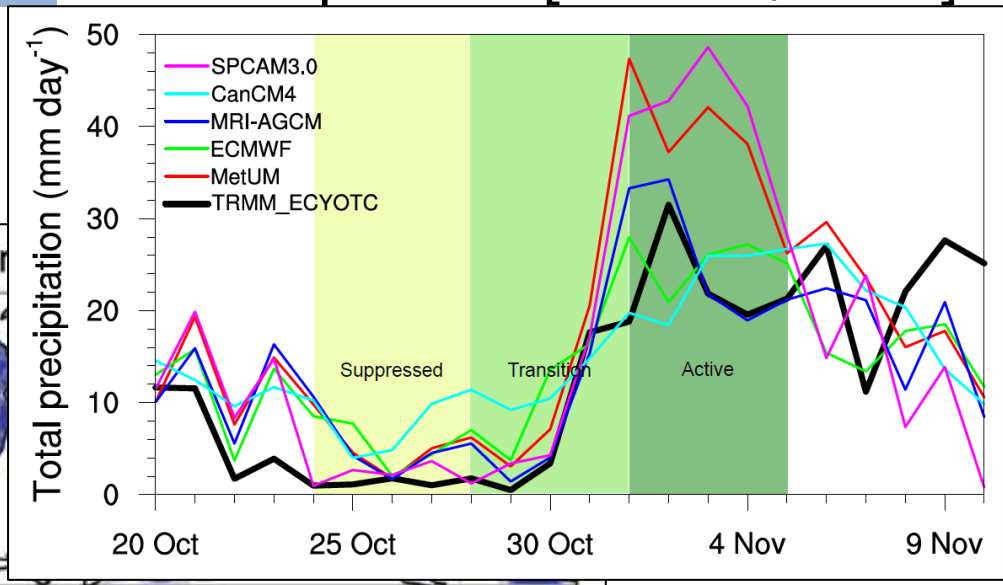


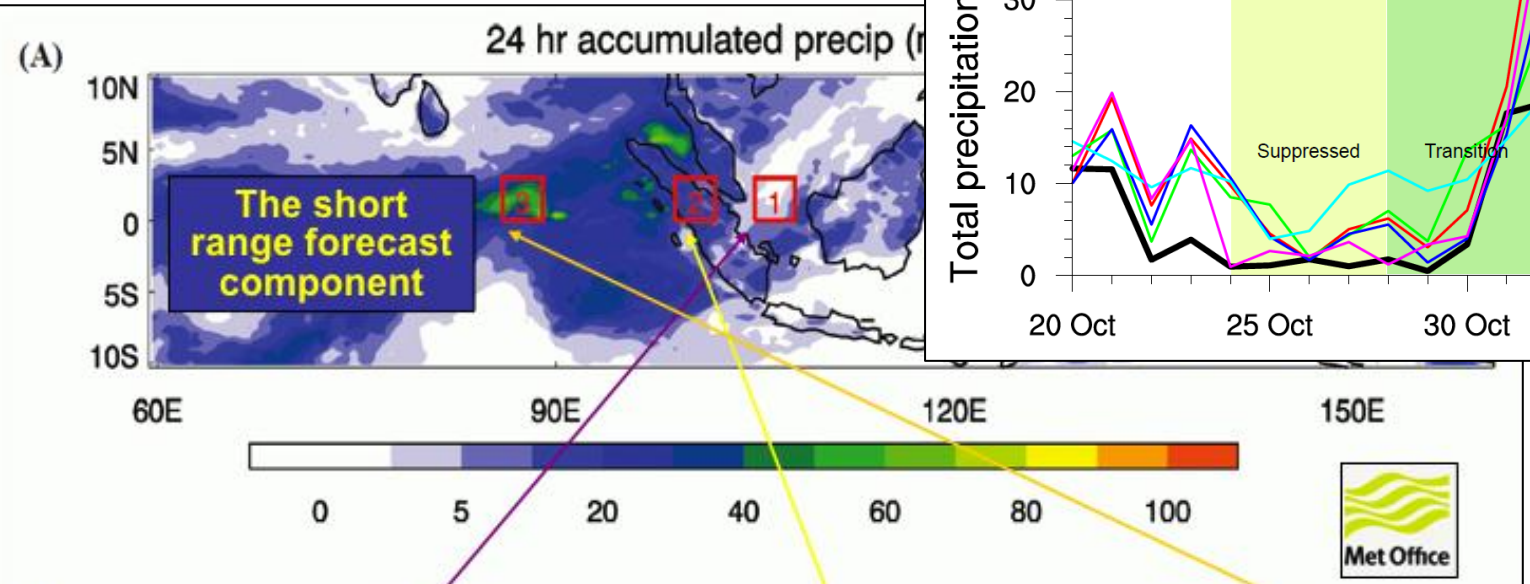


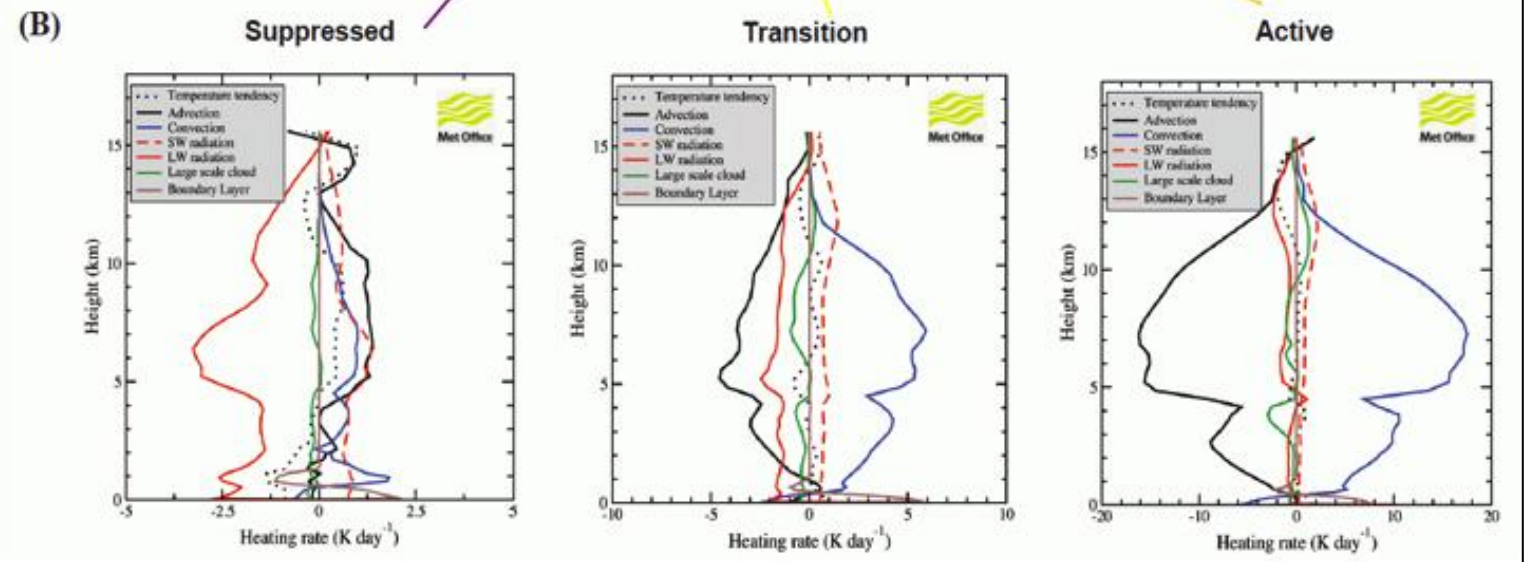


2- Day Hindcast Component: Prince Xiavier

Precipitation [75-80E, 0-5N]







Plans and Approximate Timeline

Apr 2012 : Initial Deadline for Model Submission

Sep 2012 : Very Preliminary Results at Pan-GASS Meeting

-> Alert Modeling Groups of 3rd Hindcast Case from DYNAMO

Dec 2012 : FINAL Deadline for Submissions for Initial Publications

-> Adjust exp framework based on experience to optimize DYNAMO case

-> Call for DYNAMO case

Apr 2013 : Potential Side Workshop w/ WGNE SE Workshop

Jun 2013 : Draft Papers & Public Availability of Model Output

Sep 2013 : Submission of 3 Initial Papers on 3 Components

Fall 2013 : Summary Paper/Workshop: Recommend high-priority process modelling needs identified from the 3 initial analyses.

-> Likely to utilize DYNAMO case for GASS-like process modelling study

WCRP MJO TF THORPEX WWRP GASS GEWEX YOTC

www.ucar.edu/yotc/mjodiab.html

MJO Task Force : Background

- Established in Jan 2010 for an initial term of 3 years
- Sponsor: WCRP-WWRP/THORPEX under their YOTC Project
- Follow on from the success of 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

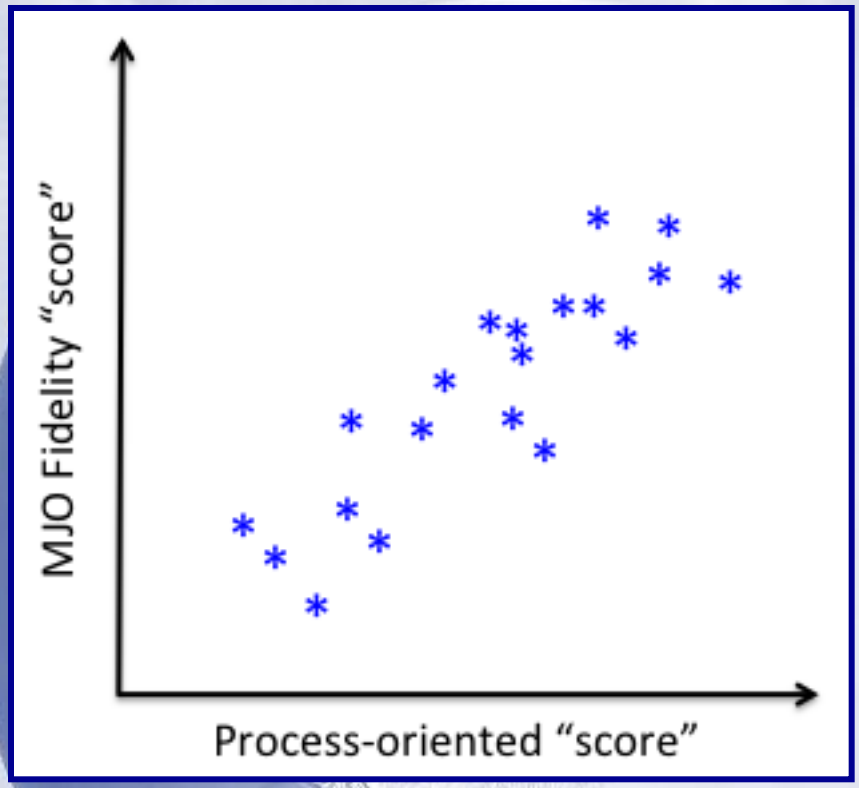
Overall Goal: Facilitate improvements in the representation of the MJO in weather and climate models in order increase the predictive skill of the MJO and related weather and climate phenomena.

Organized into 4 Subprojects

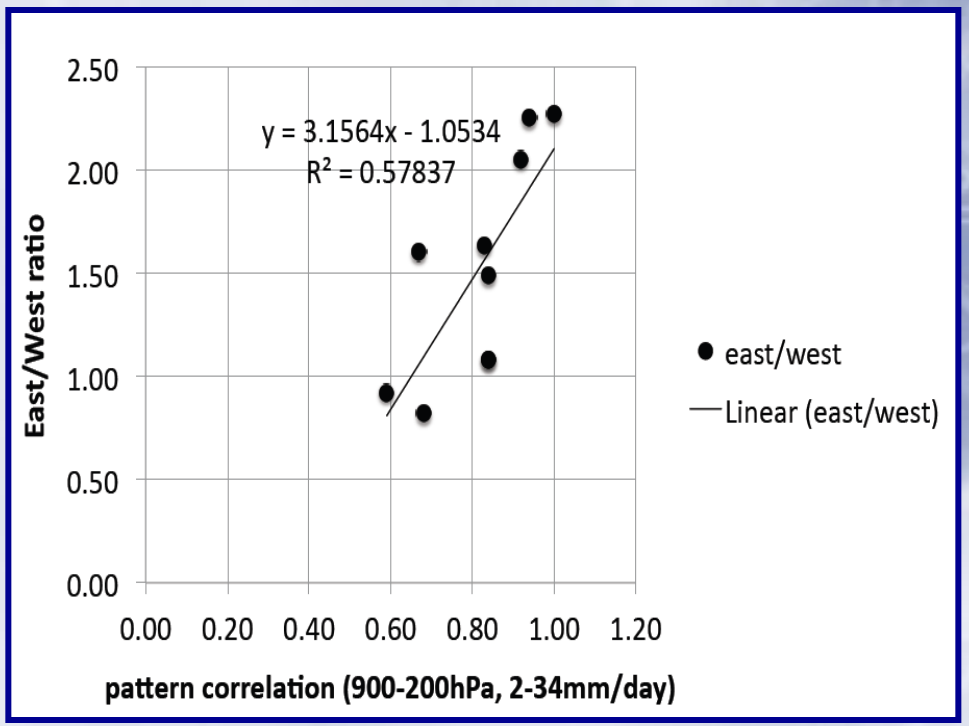
- MJO metric(s) for WGNE/WGCM Climate Metrics Panel
  (leads: K. Sperber, D. Kim)
- Process-oriented diagnostics/metrics for MJO simulation
  (leads: D. Kim, P. Xavier, E. Maloney)
- Boreal summer monsoon ISV monitoring and forecast metrics
  (leads: J.-Y. Lee, M. Wheeler, A. Vintzileos)
- MJO TF + GASS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

Recently Request to WWRP/THORPEX & WCRP for continuation, in part to support S2

MJO TF Subproject: Metric/Diagnostic Goals



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



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

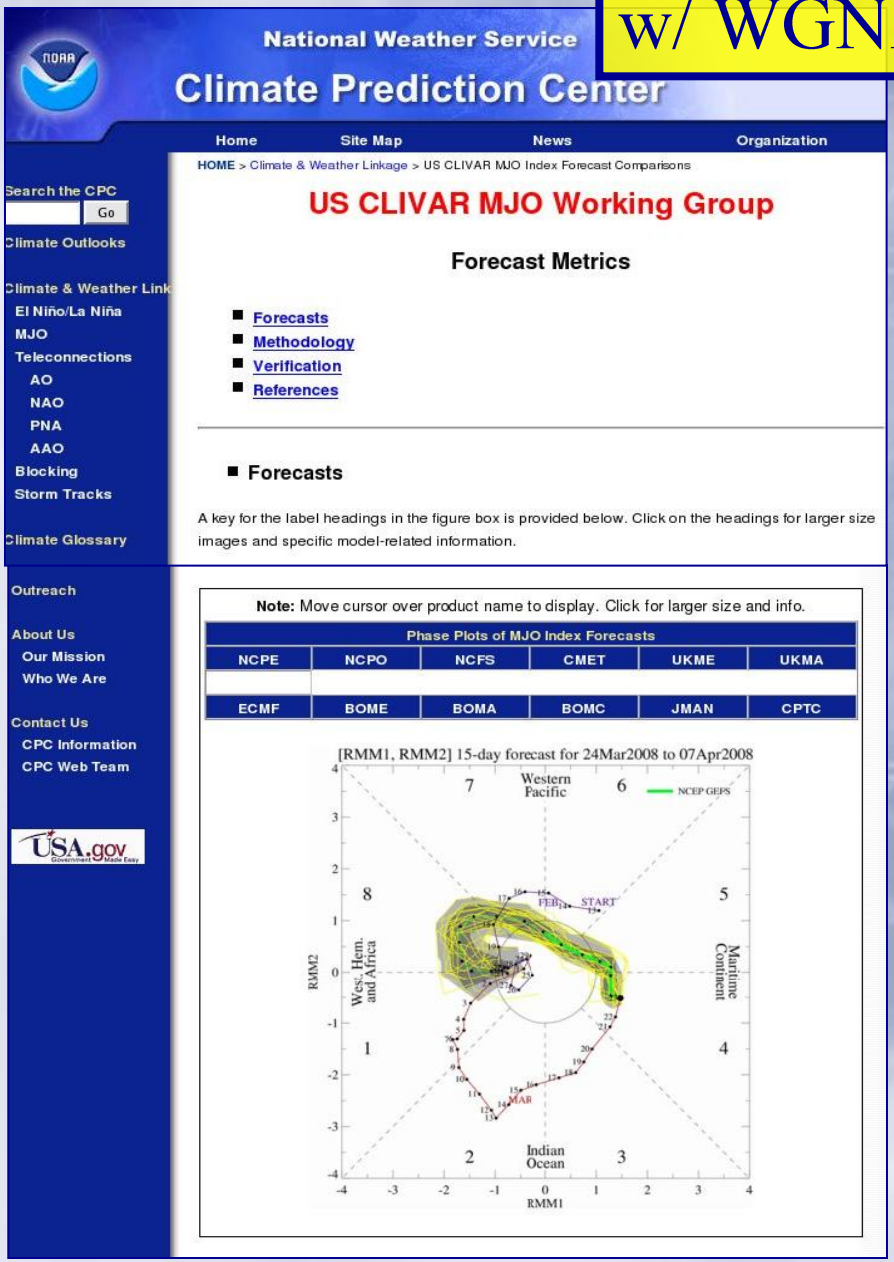
Taiwan

Australia

Japan

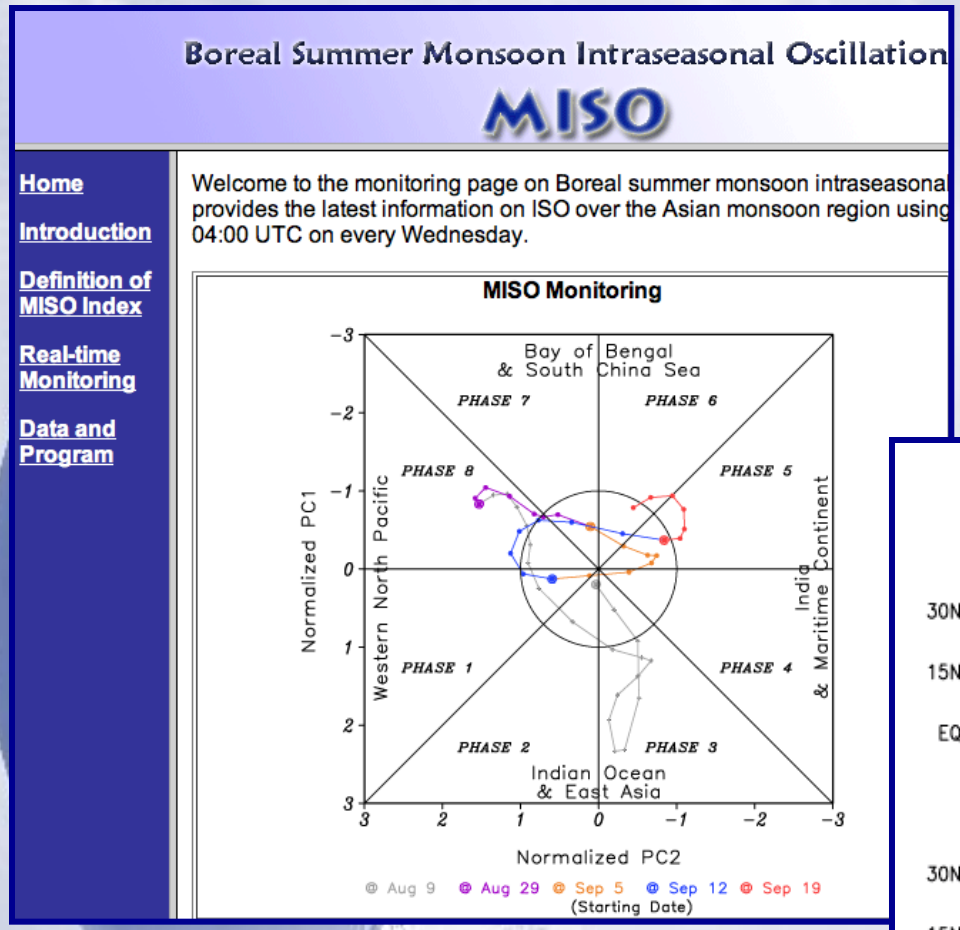
Canada – CMC

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



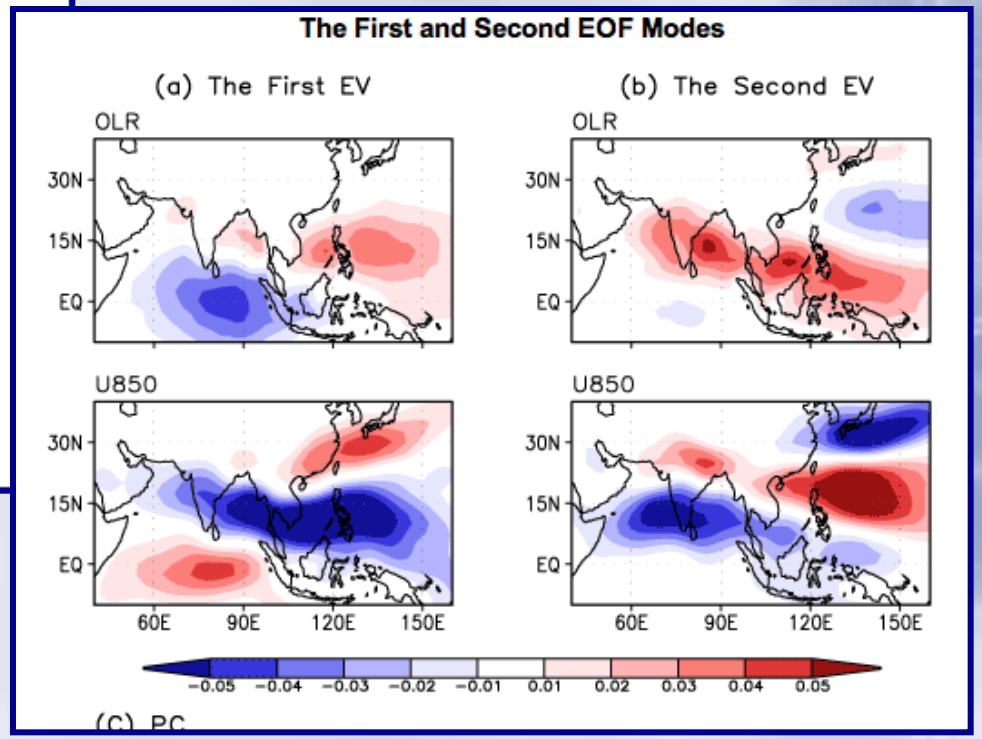
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CLIVAR/clivar_wh.shtml

MJO TF Subproject: Boreal Summer ISV Forecast Metric



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

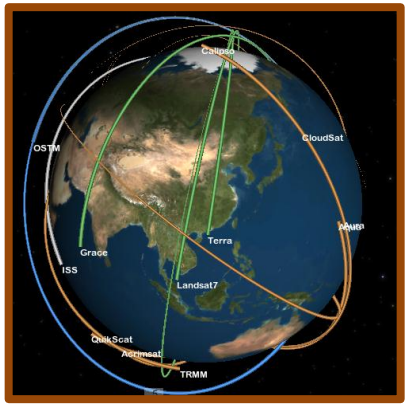
Based on Lee et al. (2012)

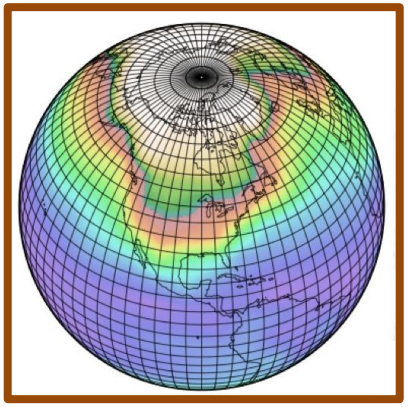


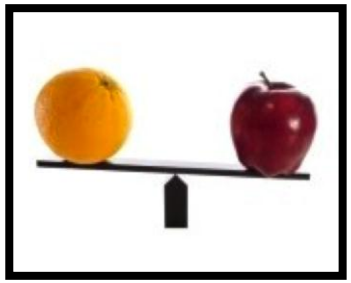
Contacts:
June-Yi Lee & Bin Wang
IPRC/U. Hawaii

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

Satellite observations for CMIP5/IPCC Model Evaluation



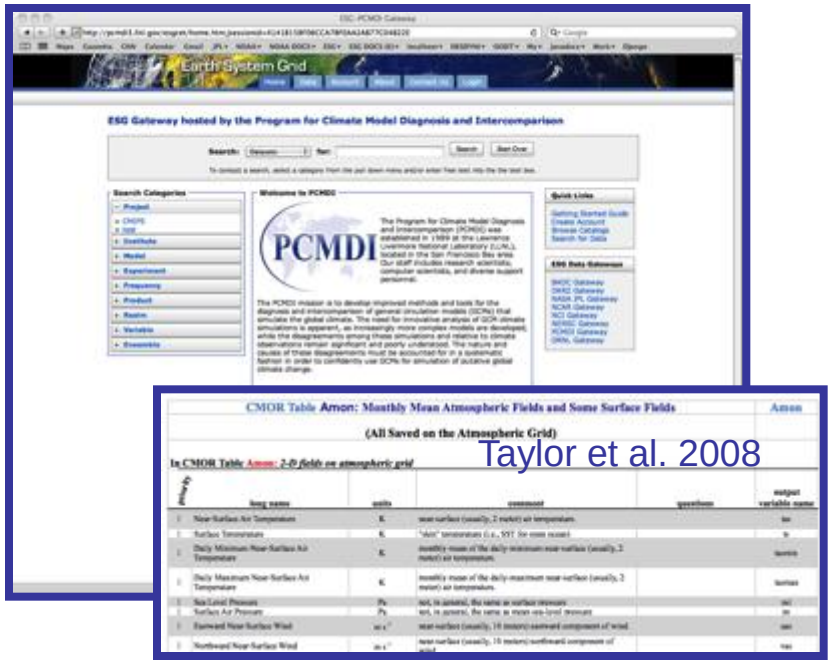




Many Acknowledgements
JPL/NASA, PCMDI
NASA obs4MIPs Working Group
WCRP encouragement/support via WGCM/CFMIP
Significant IT support via ESGF developments, PCMDI & NASA
Many data providers NASA, NOAA, CFMIP, CNES, etc

Model and Observation Overlap

For what quantities are these comparisons viable?



Taylor et al. 2008

~120 ocean
~60 land
~90 atmos
~50 cryosphere

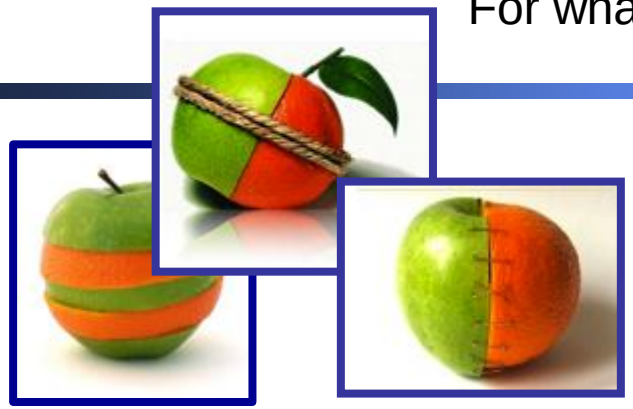
Current NASA Missions ~14
Total Missions Flown ~ 60
Many with multiple instruments
Most with multiple products (e.g. 10-100s)
Many cases with the same products

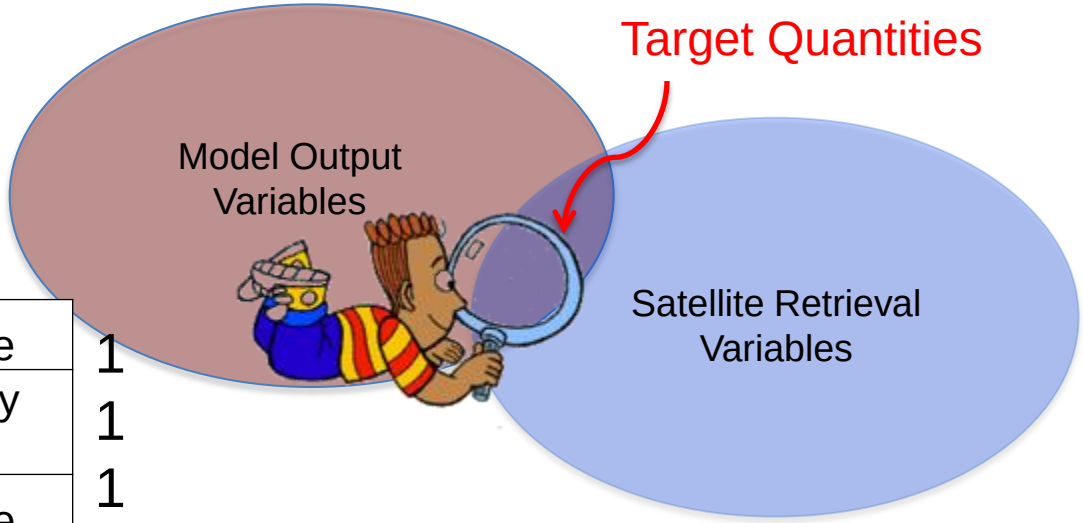
Over 300 Variables in (monthly) CMIP Database

Over 1000 satellite-derived quantities

Model and Observation Overlap

For what quantities are these comparisons viable?





AIRS (≥ 300 hPa)	Atm temp profile	1
	Specific humidity profile	1
MLS (< 300 hPa)	Atm temp profile	1
	Specifc humidity profile	1
QuikSCAT	Ocean surface winds	~4
TES	Ozone profile	1
AMSR-E	SST	1
TOPEX/JASON	SSH	1
CERES	TOA radiation fluxes	~6
TRMM	Total precipitation	1
MODIS	Cloud fraction	1
	Net primary production	3

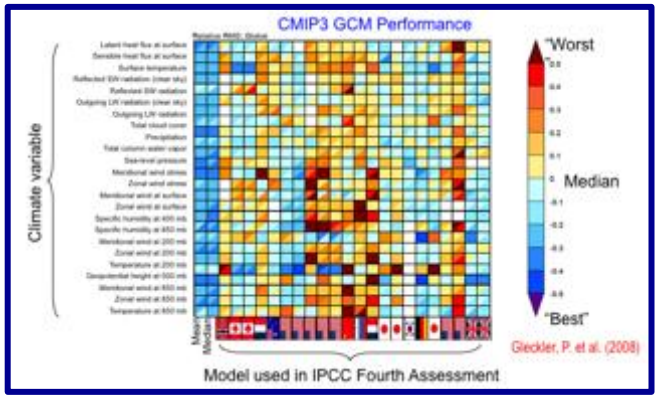
Present efforts are working to provide:

- CFMIP cloud-related products (much of this completed)
- MISR (land) and MODIS (ocean) AOD
- Sea Ice (NSIDC)
- CALIPSO Aerosol Optical Extinction Profile
- CERES surface radiation budget
- MODIS Land (e.g. albedo, LAI, FPAR)

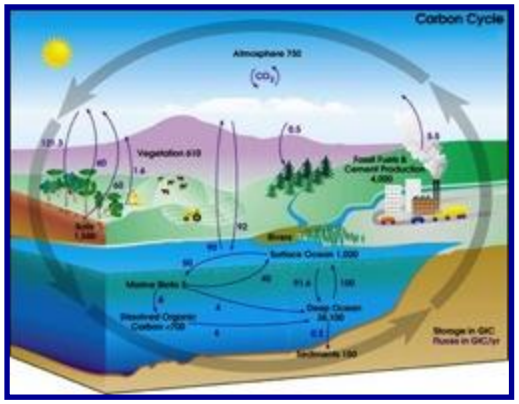
Discussions with ESA's CMUG & CEOS Climate Working Group & WDAC to expand holdings.

Satellite Observations for CMIP and IPCC ARs

Why is this timely for AR5 and beyond?

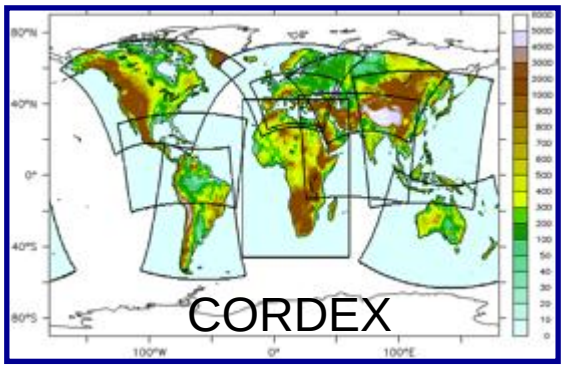


Model Scoring w/ Observations: "1 model – 1 vote" to weighting projections based on obs metrics (e.g. WGCM/WGNE Metrics Panel)



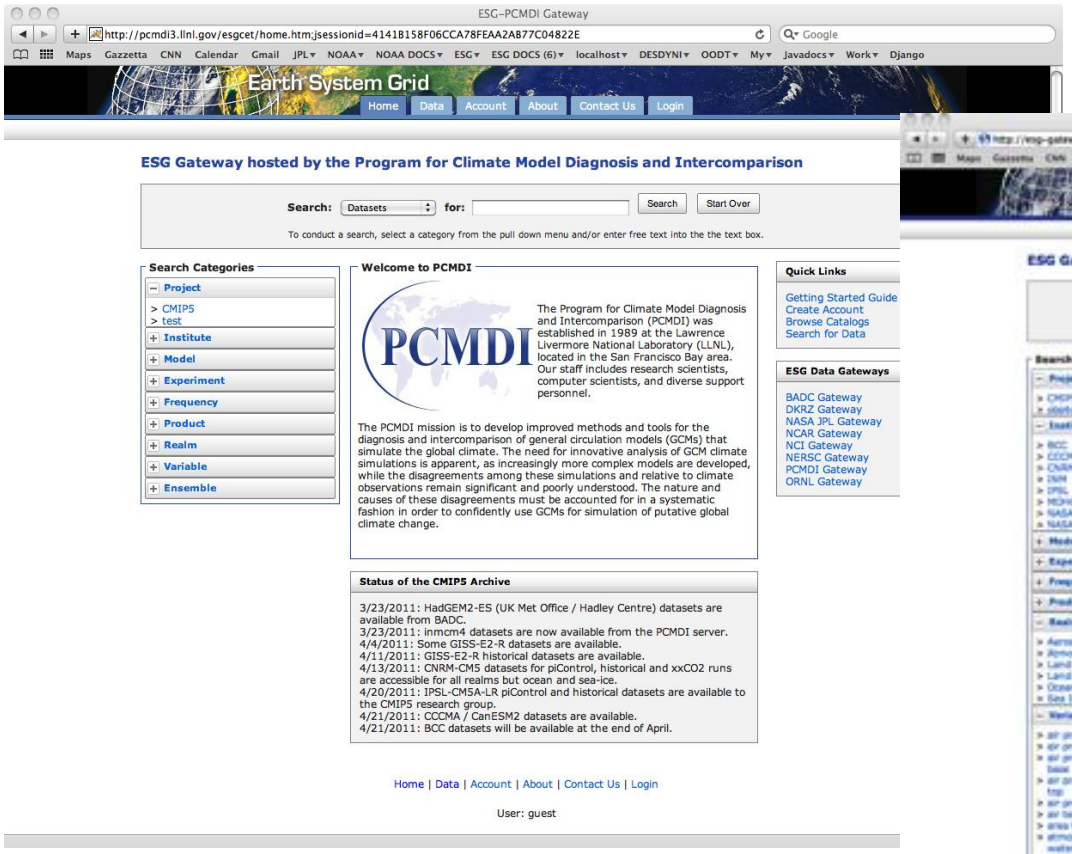
Earth System Modeling (e.g. Coupled Carbon-Climate): added complexity, more degrees of freedom, need for observational constraints; many assets here / on horizon.

Decadal Predictions: Downscaling GCMs with regional models is key to many decision-support issues; systematic application of observations for regional model evaluation is even less mature than for GCMs.



Satellite Observations for CMIP5 Simulations

Data Available Now on Earth System Grid



PCMDI Gateway

NASA & IPSL Nodes

Satellite Observations for IPCC / Climate Modeling

Future Emphases and Needs

- Identify additional observations to include in this activity (broader participation). Efforts to provide broader governance are underway WCRP (e.g. WDAC).
- Continue links to WGCM/WGNE Climate Metrics Panel.
- Continue to work with the ESG community and PCMDI to facilitate the means to utilize the satellite data.
- Encourage missions to develop products analogous to model output, including satellite simulators for more direct comparisons with observed quantities (e.g. COSP, but for other processes/ES components).
- Encourage modeling community to develop the means to output quantities analogous to satellite retrieved quantities.
- Workshop planned for fall 2013 to begin planning for CMIP6.

- Cultivate more coherent input from the modeling community on observations critical to model development/evaluation and reducing projection uncertainties. *This could/should include WGNE, WGCM, WMAC/WDAC.*

NASA Planned New Missions (2011-2023)