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

MJO Task Force and GASS

Organizers

Duane Waliser & Xianan Jiang --- JPL/UCLA

Jon Petch & Prince Xavier --- Met Office

Steve Woolnough & Nick Klingaman --- U. Reading

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

AGU
San Francisco, CA
December, 2012

Central role of vertical structure & diabatic/moistening processes in MJO mechanisms/theories & simulation quality

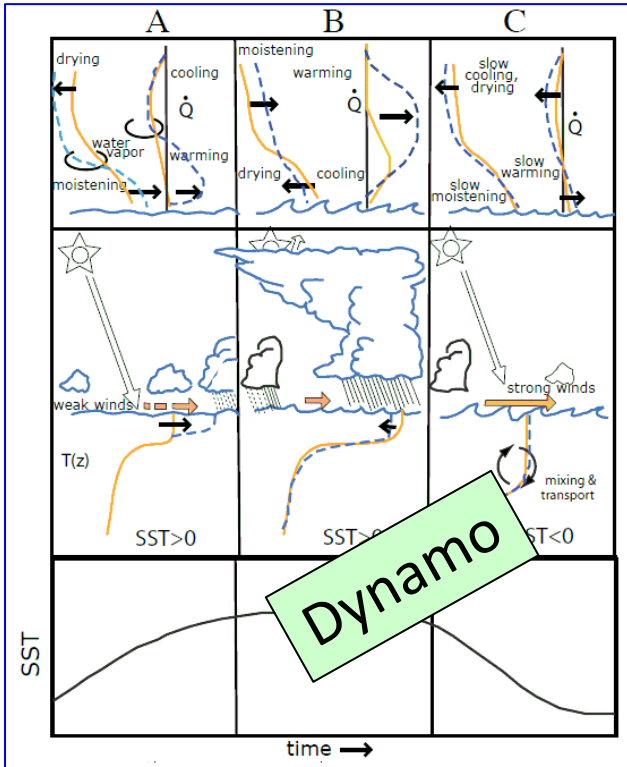
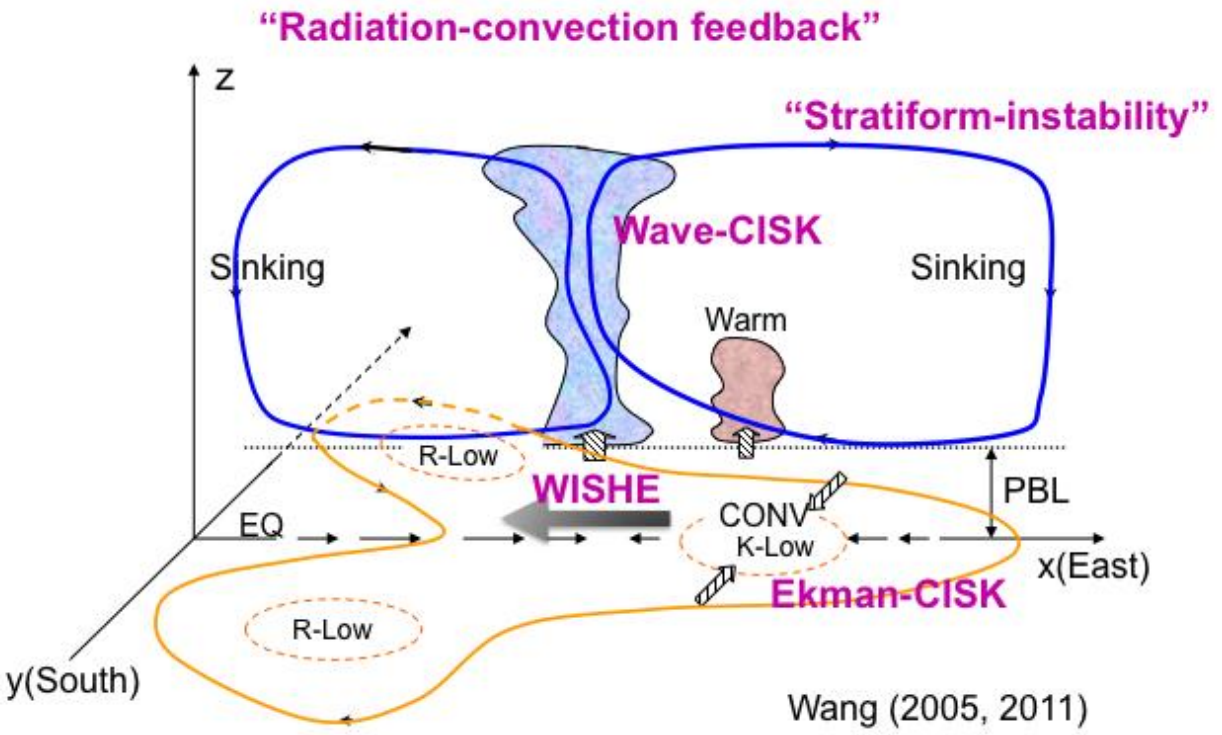


Figure 4 Schematic of a conceptual model for MJO initiation processes at a fixed location over the Indian Ocean. Upper panels illustrate tendency of moisture and diabatic heating profiles; middle panels depict cloud compositions, surface winds, and upper-ocean temperature profiles; lower-panel shows the SST evolution. (After Stephens et al. 2004)



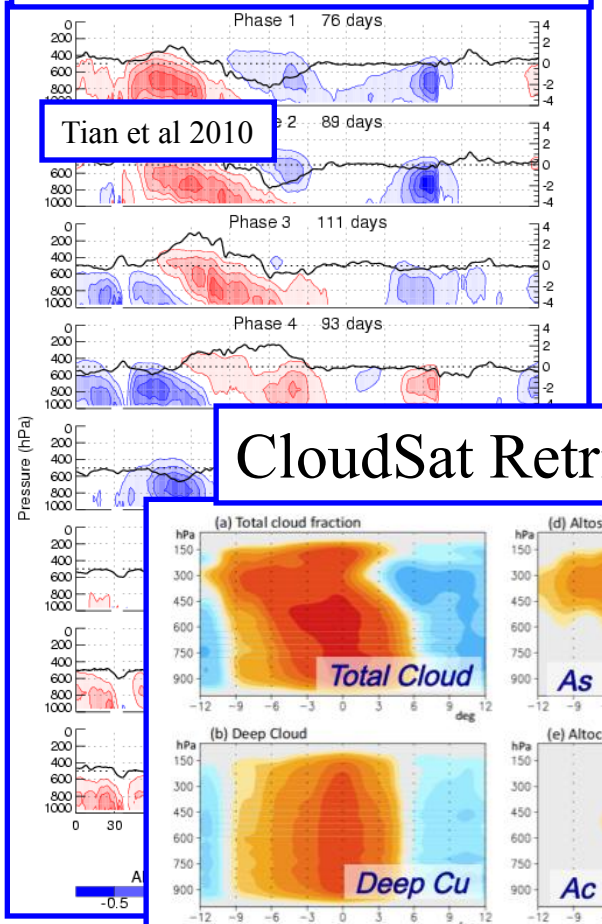
Beyond interactions between heating components and large-scale circulation => multi-scale interaction, moistening processes and convective momentum transport.

Majda and Stechmann (2011)

Detailed Experimentation and Comparison to Observed Vertical Structures Sorely Needed.

Availability of Vertical Profiling Satellite Products

AIRS Temp and WV

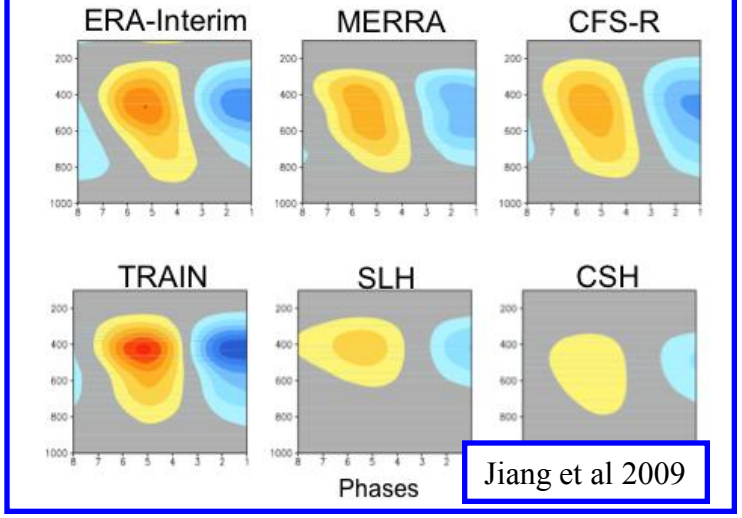


Tian et al 2010

+ MLS, ISCCP, Calipso

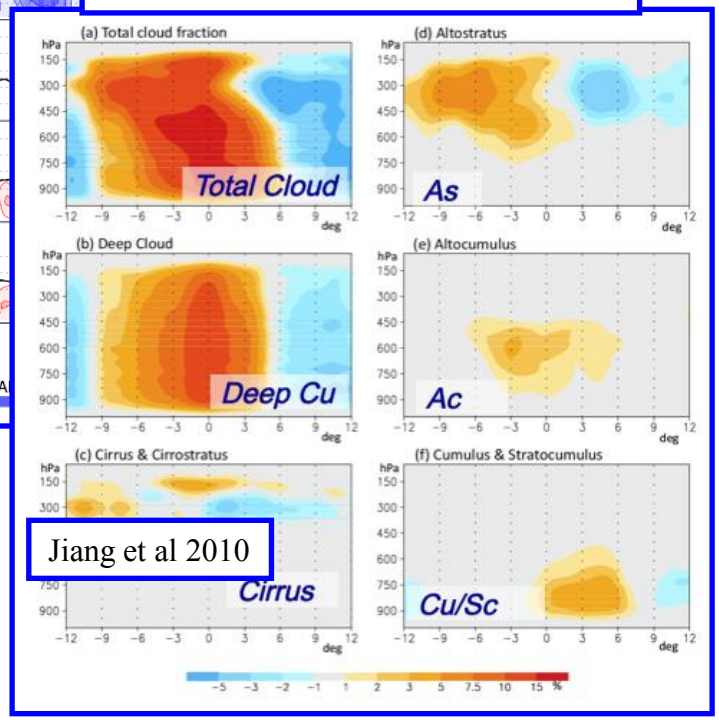
C. Zhang (2011)

TRMM Diabatic Heating



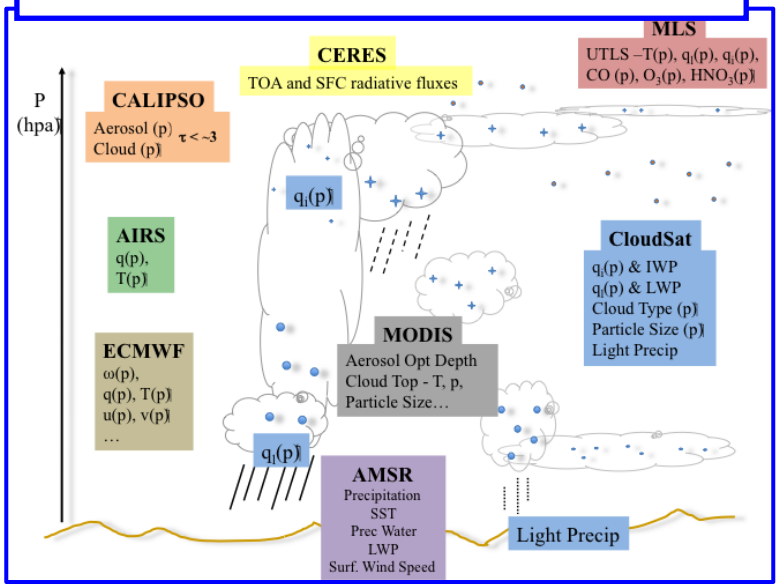
Jiang et al 2009

CloudSat Retrievals



Jiang et al 2010

YOTC Collocated A-Train



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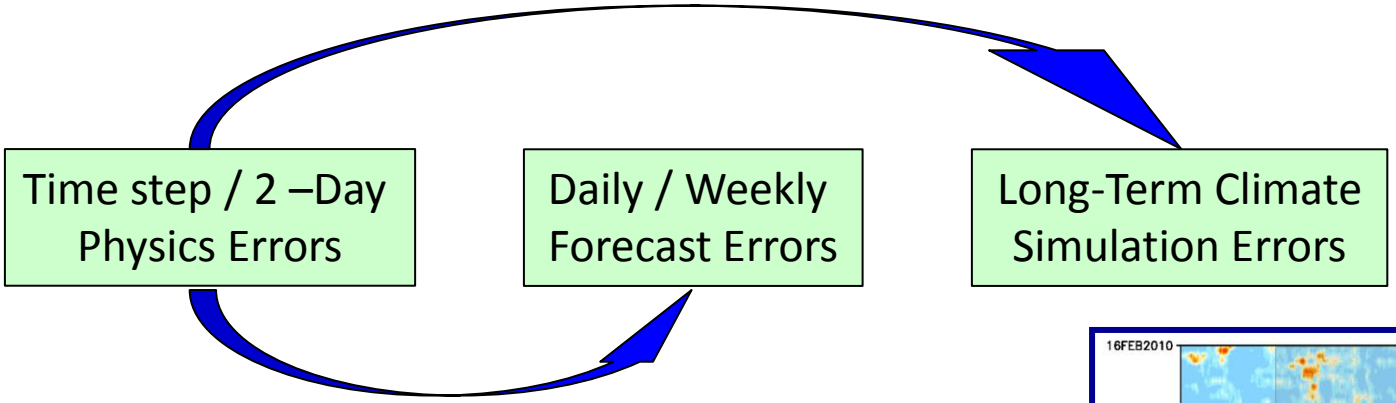
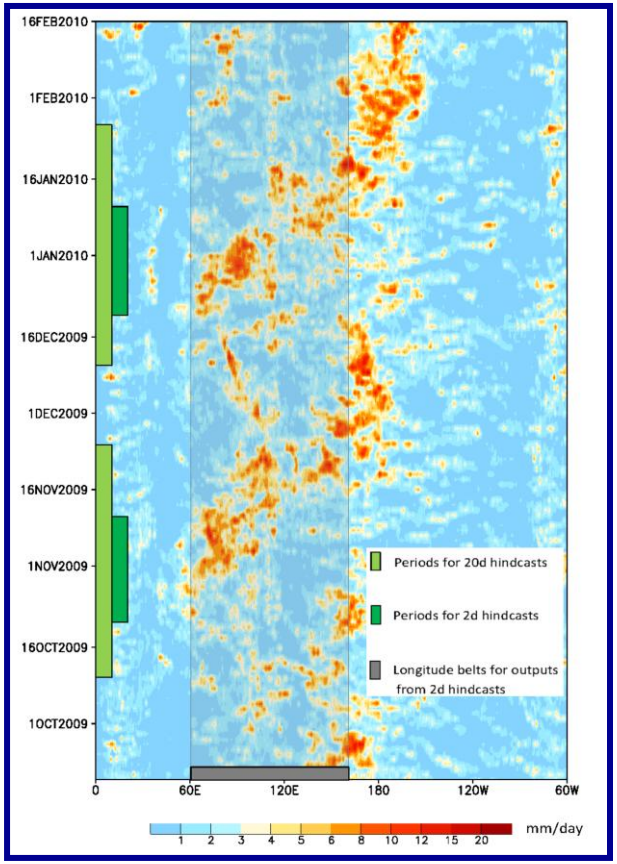


1. climate simulation – multi-year simulations coupled or atmosphere only

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*

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	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 20 Time Step, Indo-Pacific Domain Ou Very Detailed Physical/Model Proce		**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

All experiments have 3D tendency terms for T, q, u, v, condensate budgets, radiative profiles, surface fluxes, etc.

*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	-	-

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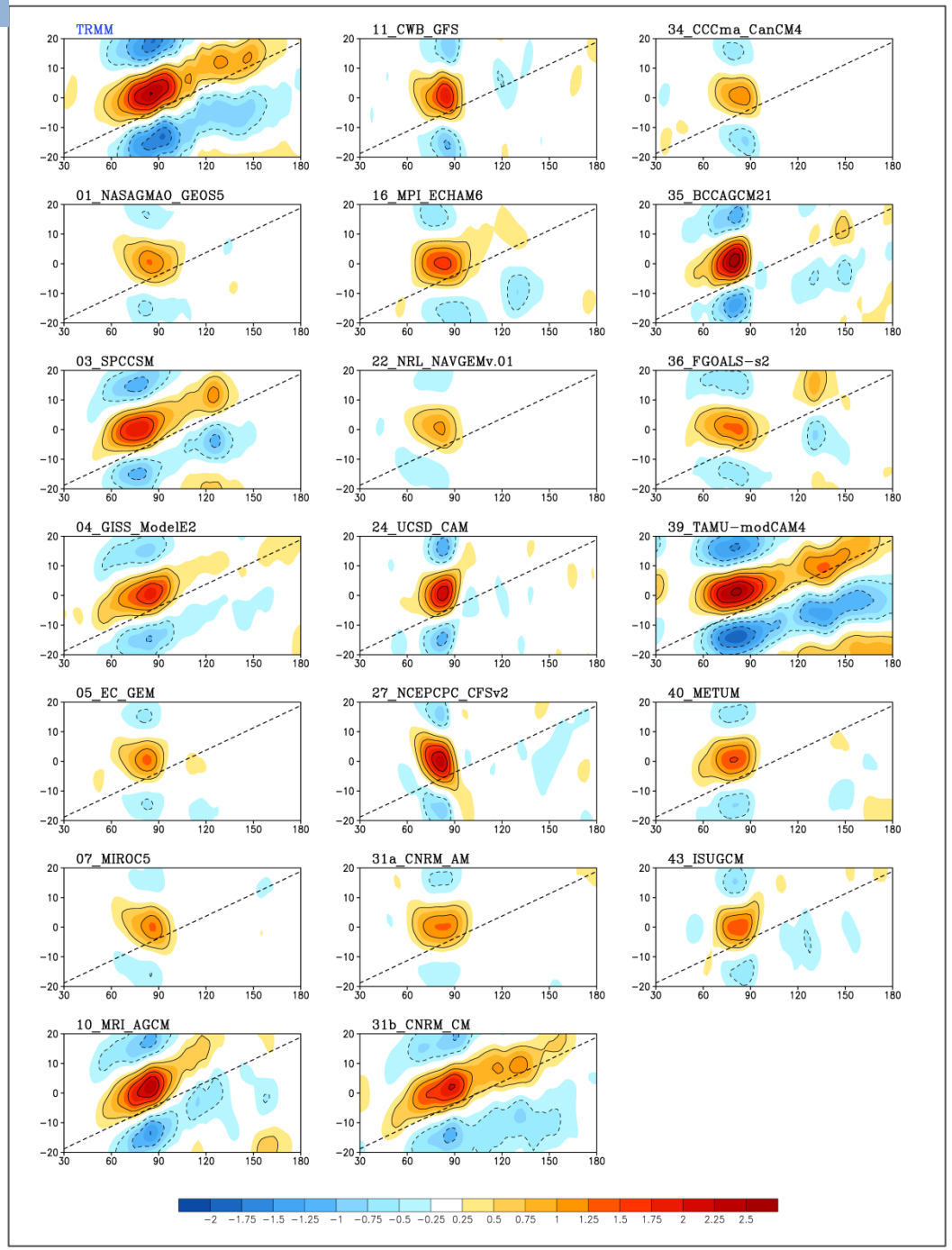
Lag-regression of rainfall with Indian Ocean (70-90E; 5S-5N) base point

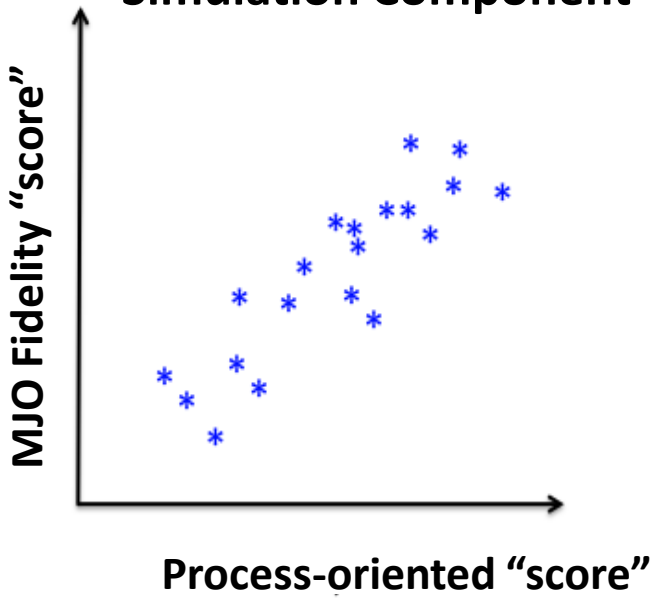
20-90day filtered

dash line – 5 m/s

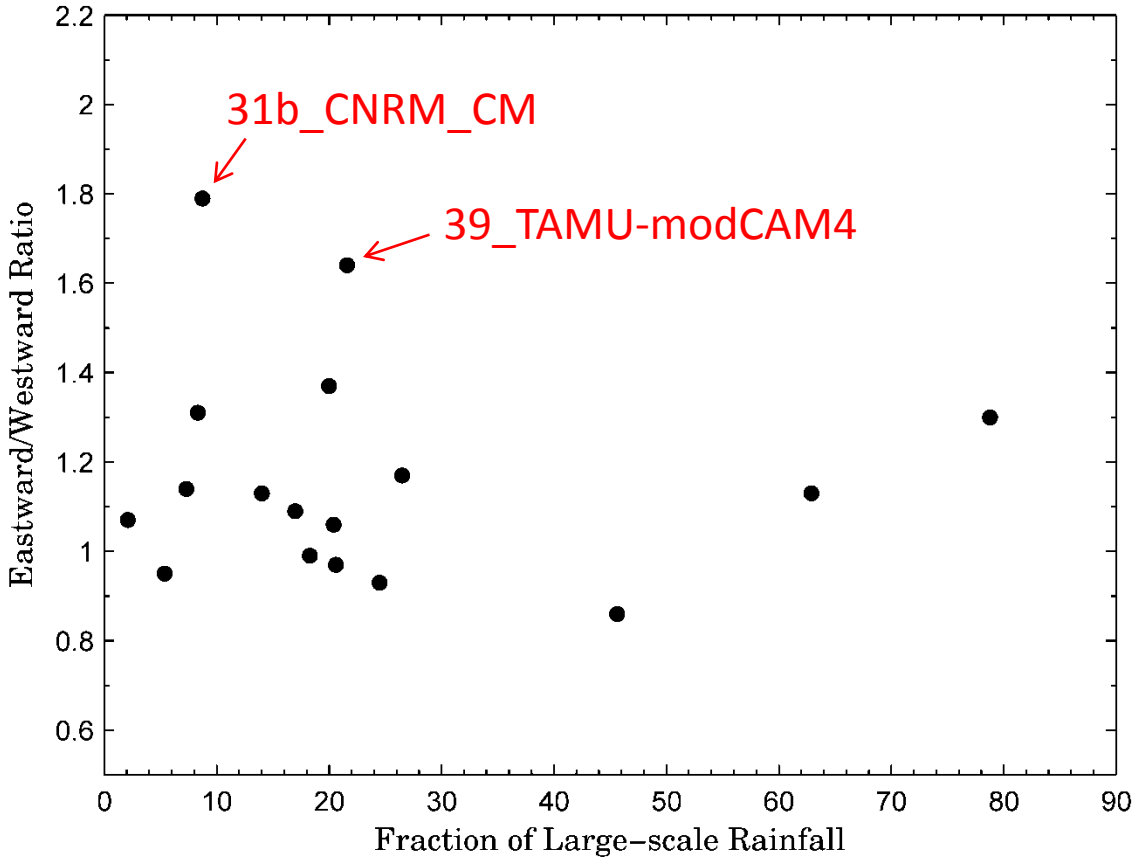


JPL UCLA

A Goal of the Climate Simulation Component



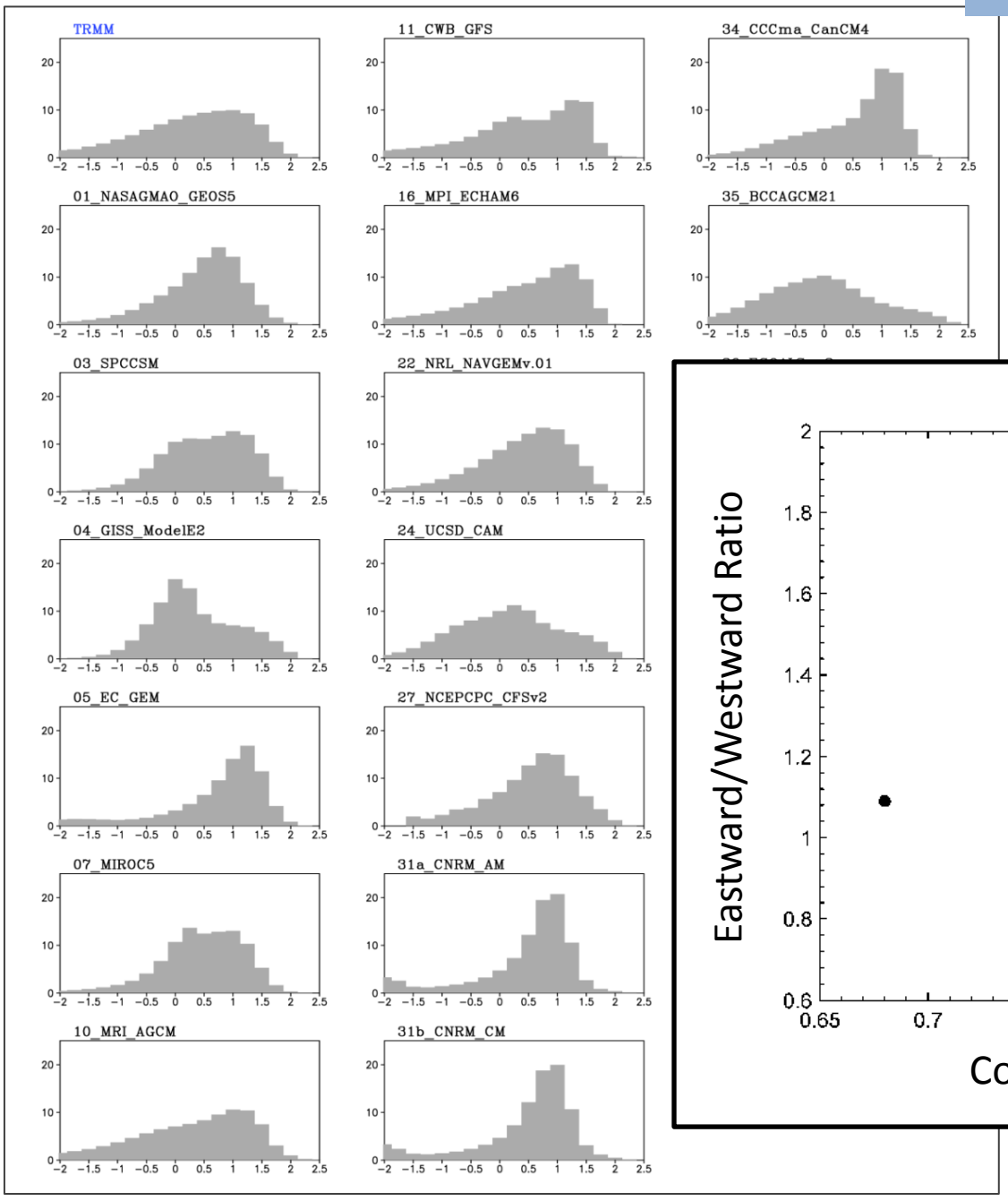
MJO Fidelity vs Large-scale Rainfall Fraction

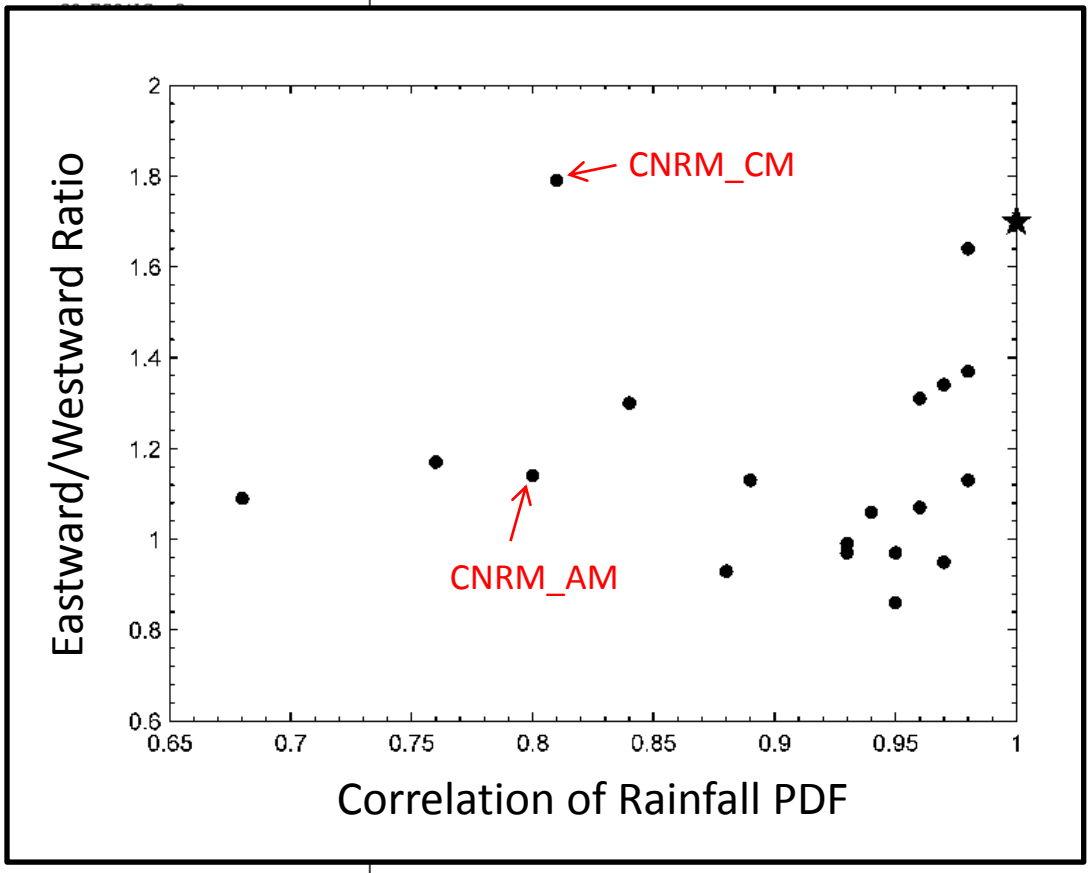


JPL UCLA

MJO fidelity vs Rainfall PDF

(15°S-15°N; 50-180°E)
Nov-Apr





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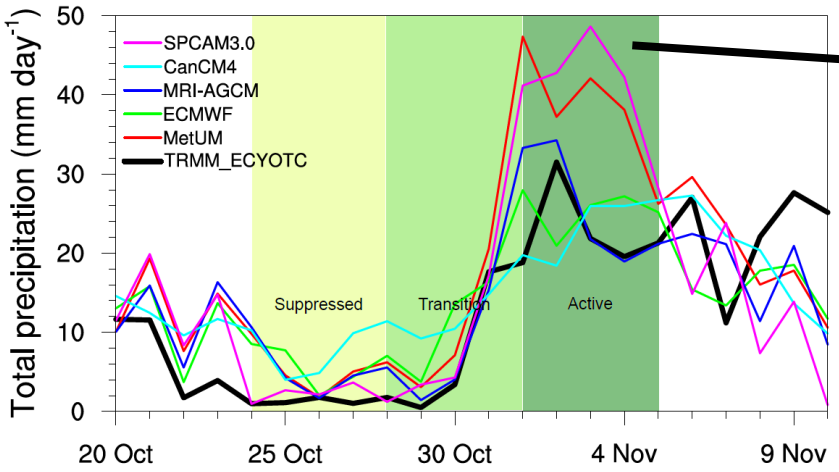
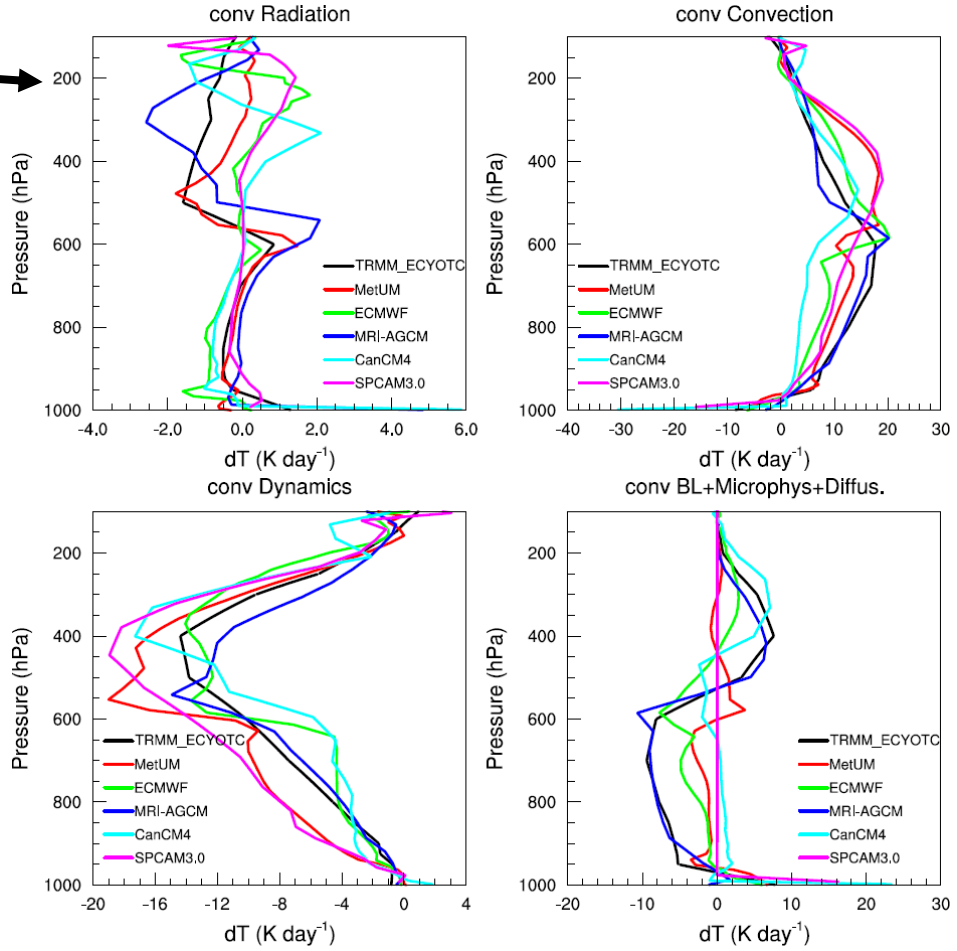
Phase selection



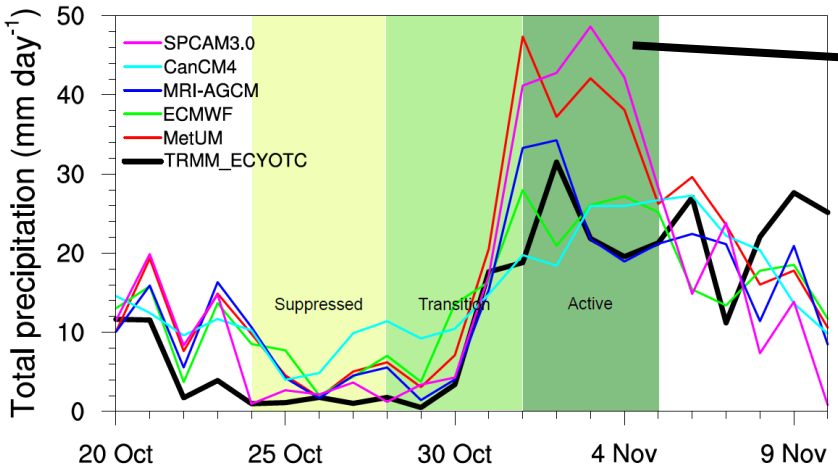
dT convective phase

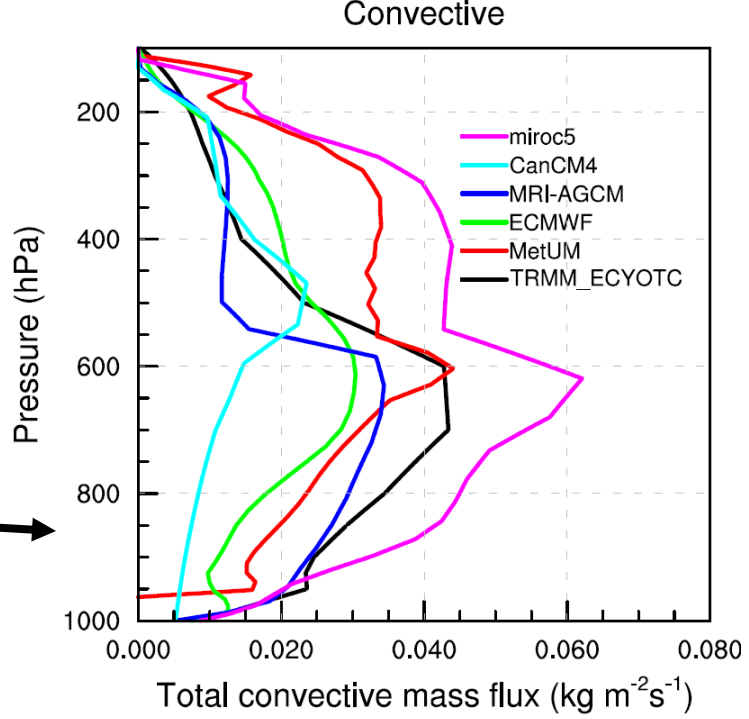


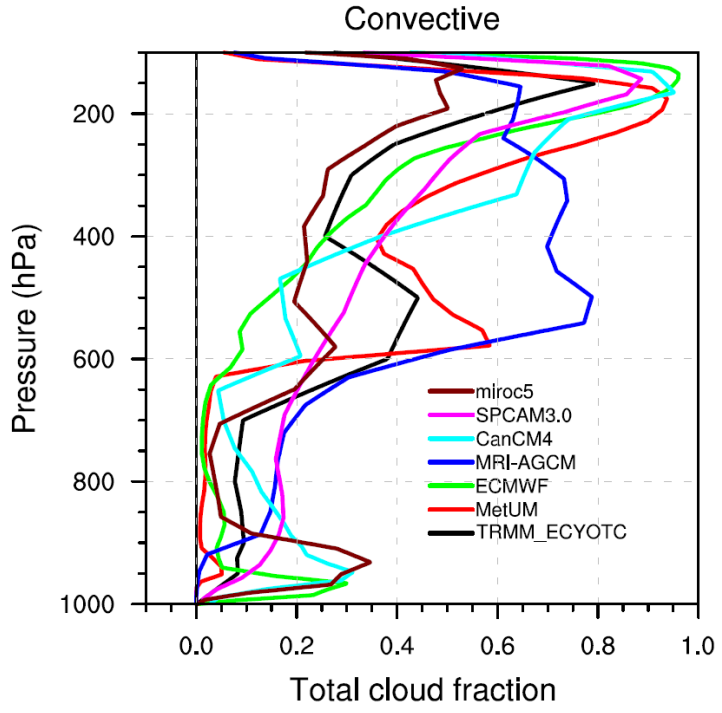
Indian Ocean
75-80E, 0-5N

YOTC Case E

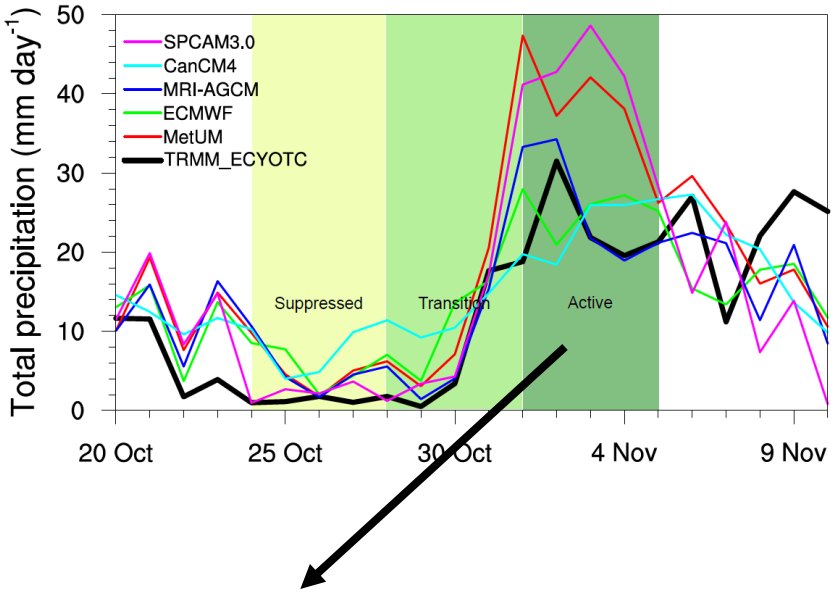
2- Day Hindcast Component: Prince Xavier

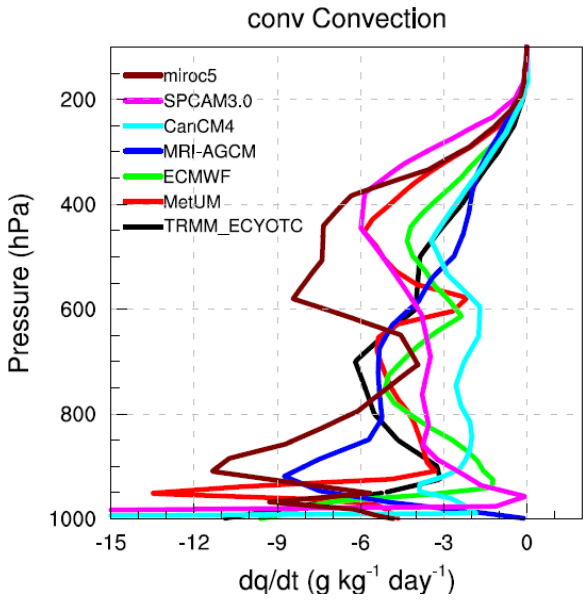


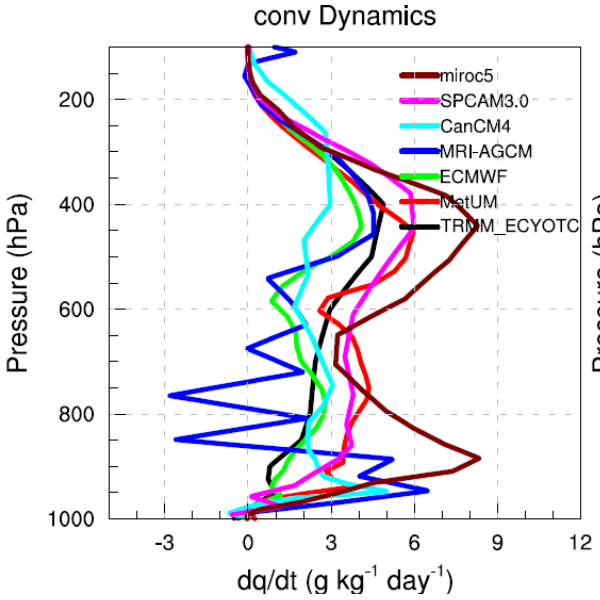


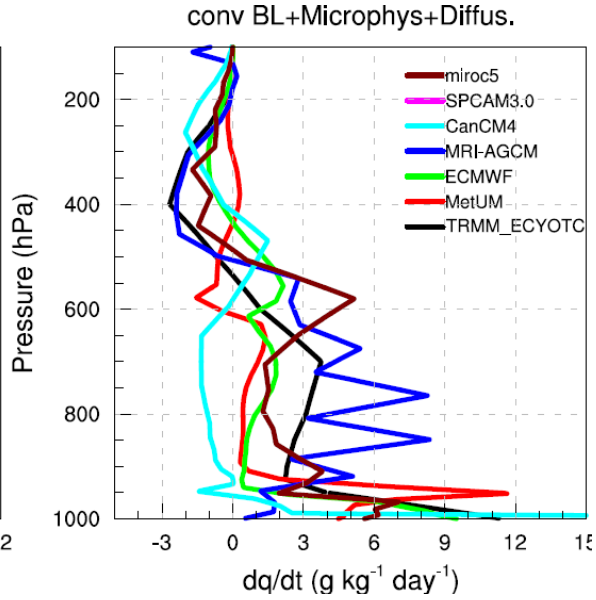


2- Day Hindcast Component: Prince Xavier









RMM indices at constant start date

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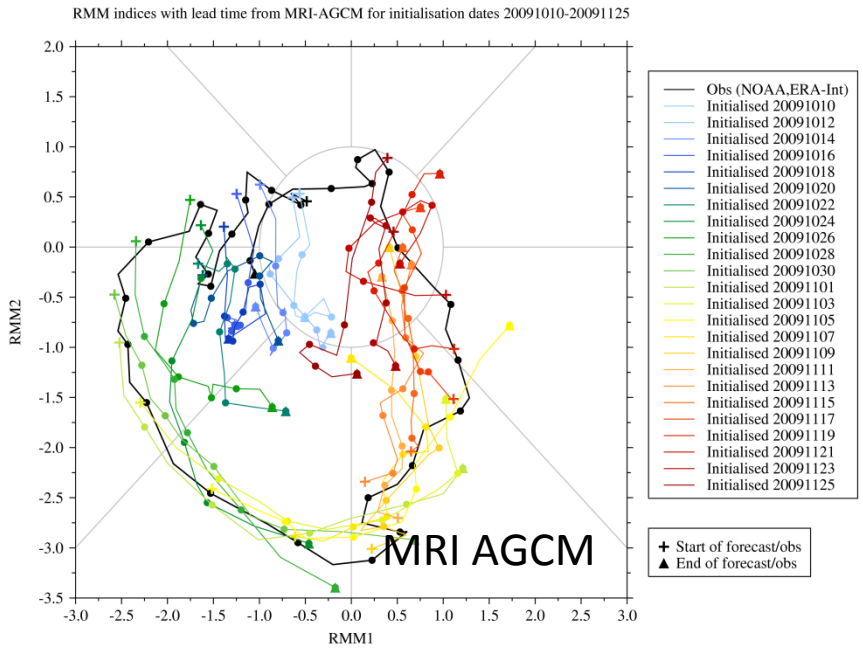

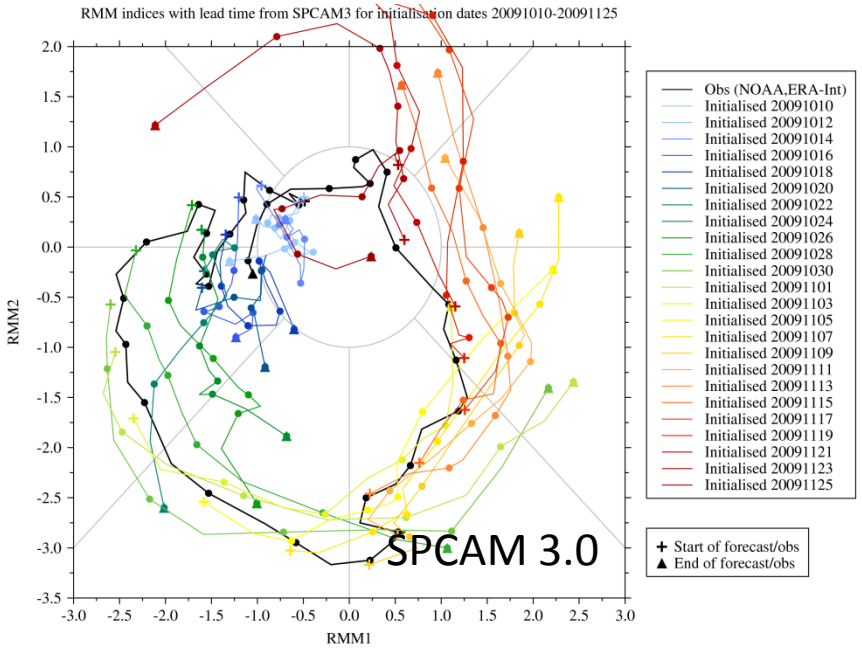

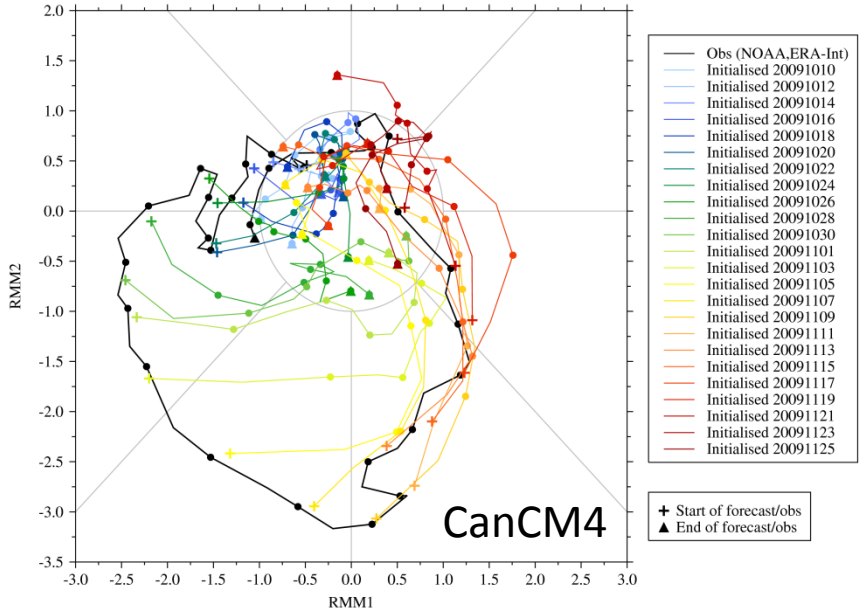

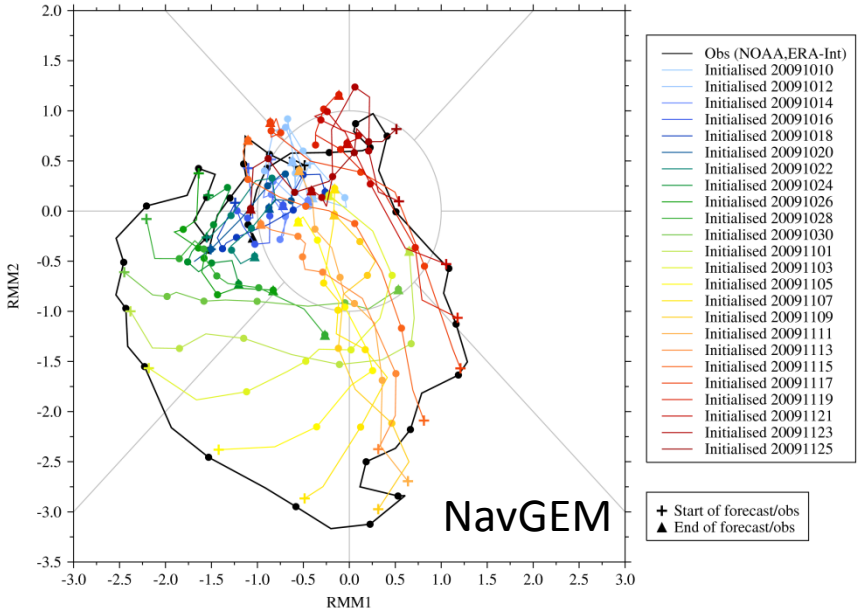

Physics moistening tendencies

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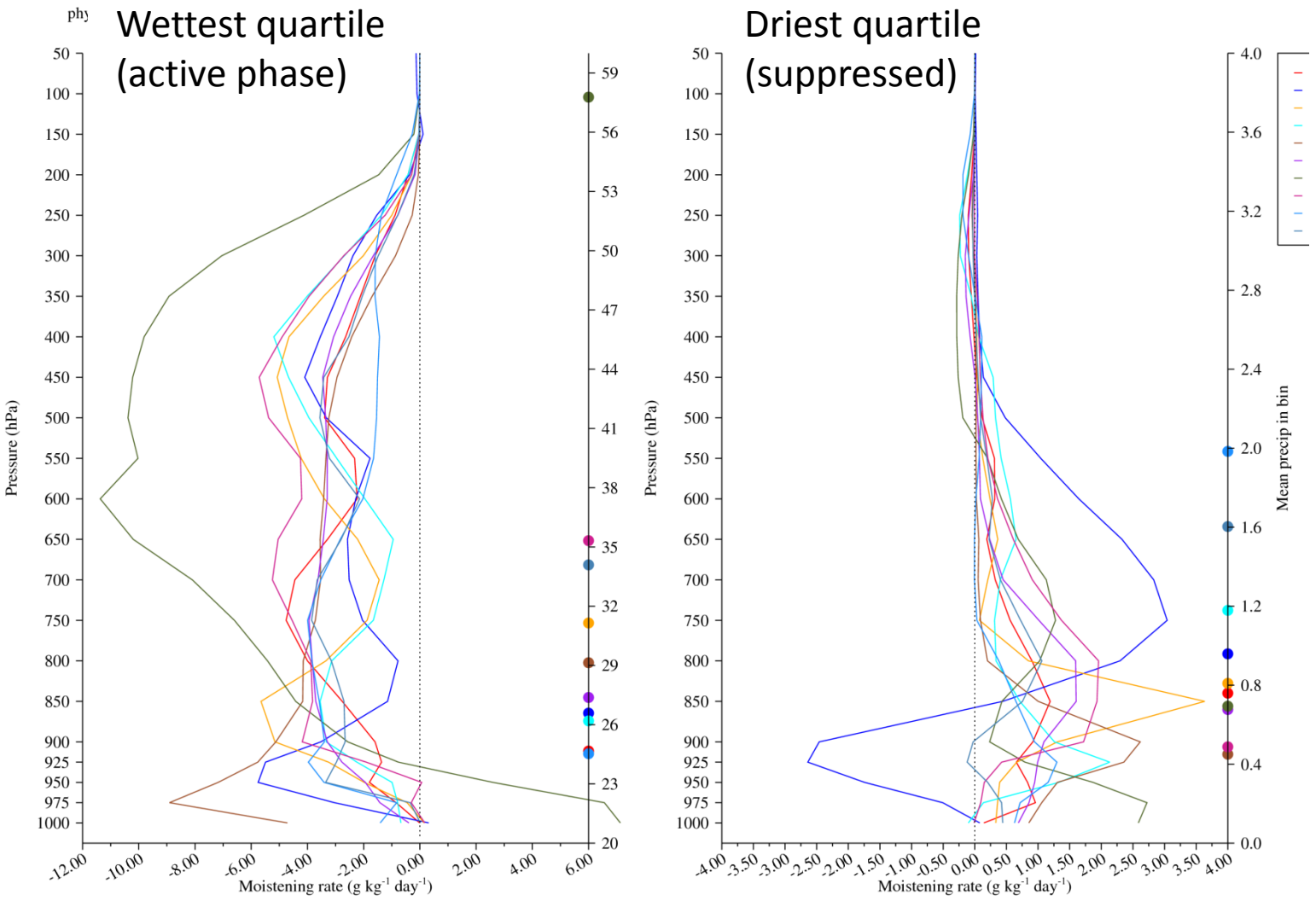

Note:
Mean rain rate for each profile is shown as coloured dot on right-hand vertical axis.

For a box in the western Indian Ocean (10S-10N, 60-80E), dq/dt from physics at a lead time of **1 day** for start dates 10/10/2009 through 25/11/2009 (YoTC case E). Computed from three-hourly values.

Physics moistening tendencies

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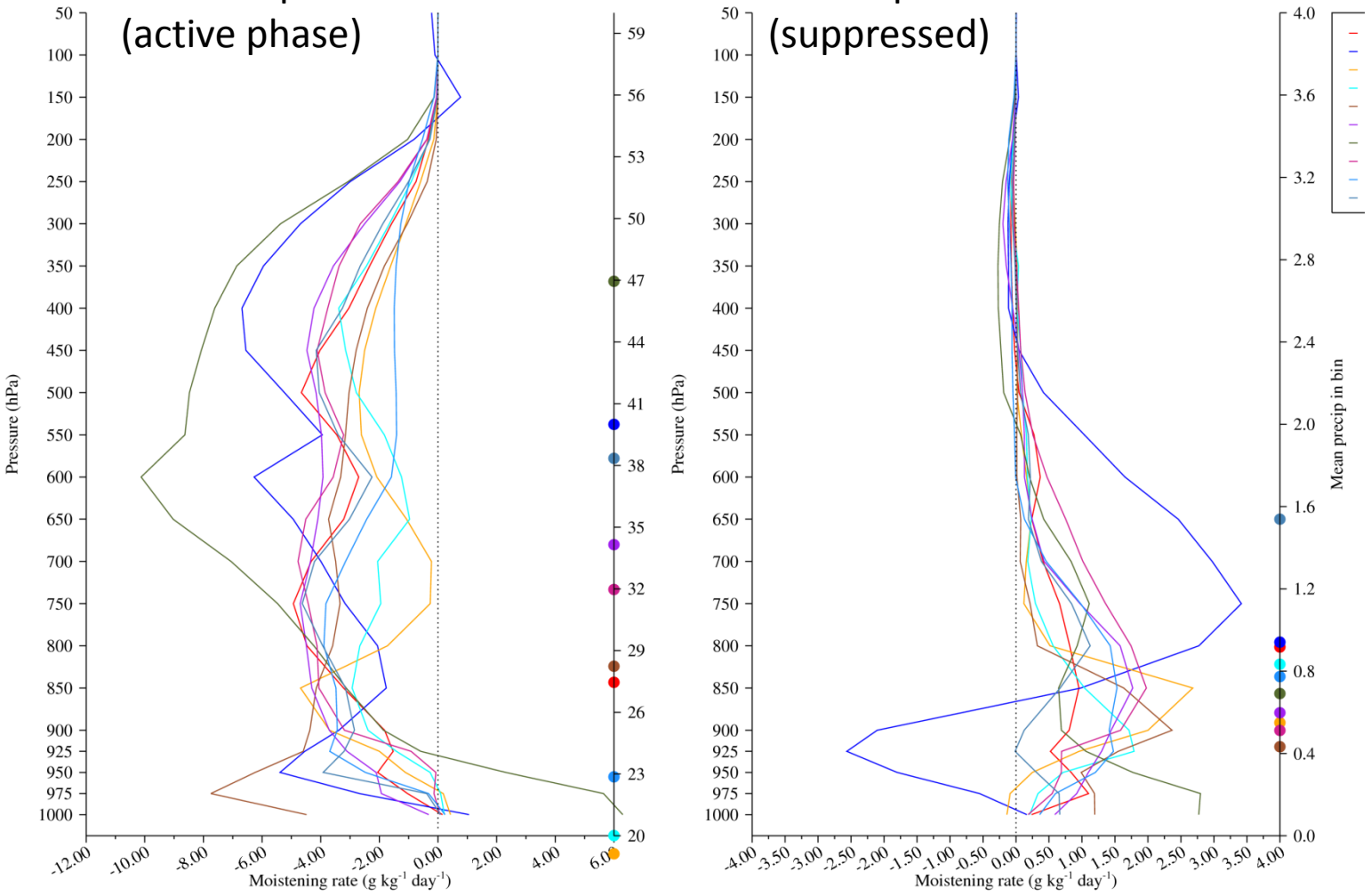
Wettest quartile (active phase)

Driest quartile (suppressed)



Note:
Mean rain rate for each profile is shown as coloured dot on right-hand vertical axis.

For a box in the western Indian Ocean (10S-10N, 60-80E), dq/dt from physics at a lead time of **9 days** for start dates 10/10/2009 through 25/11/2009 (YoTC case E). Computed from three-hourly values.

Plans and Approximate Timeline

Apr 2012 : Initial Deadline for Model Submission

Sep 2012 : Very Preliminary Results at Pan-GASS Meeting

Sep 2012: 3rd Hindcast Case from DYNAMO Identified

Dec 2012 : FINAL Deadline for Submissions for Initial Publications

Exp framework optimized for DYNAMO case; Initial call to modeling groups

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