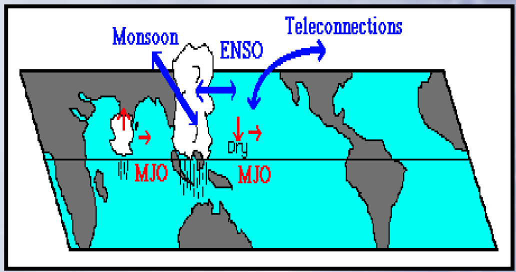
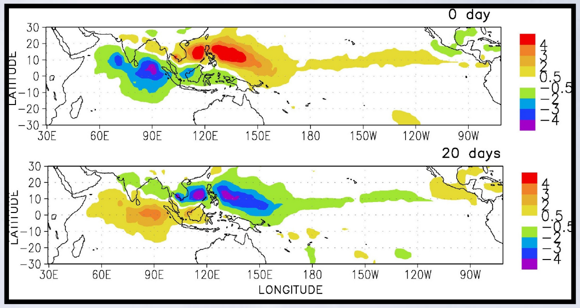
WCRP-WWRP/THORPEX MJO Task Force

Follows from the US CLIVAR MJO Working Group

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

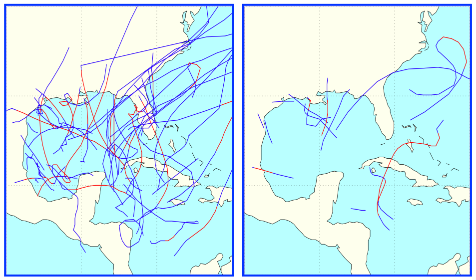


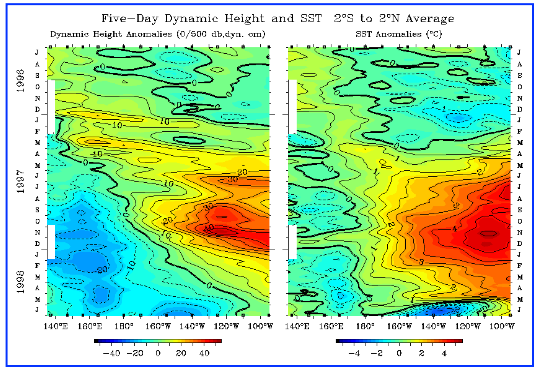


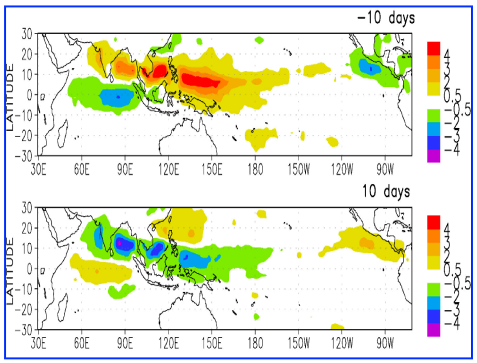
Membership =>
Established 2010

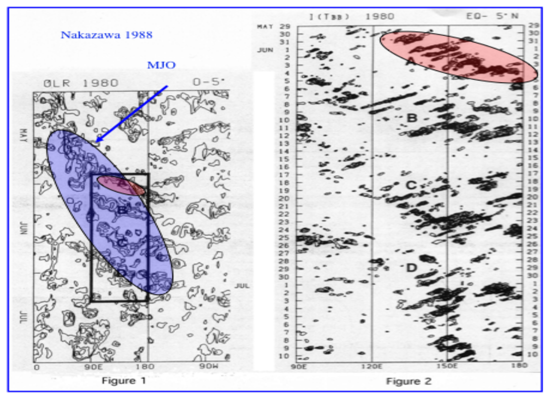
Duane Waliser (co-chair)	Jet Propulsion Laboratory/Caltech
Matthew Wheeler (co-chair)	Centre for Australian Weather &Climate Research
Ken Sperber	Program for Climate Model Diagnostics and Intercomparison
Harry Hendon	Centre for Australian Weather and Climate Research
Eric Maloney	Colorado State University
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	Seoul National University
Augustin Vintzileos	National Centers for Environmental Prediction
Frederick 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

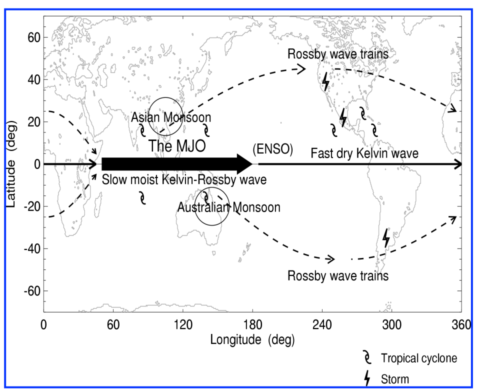
Motivation

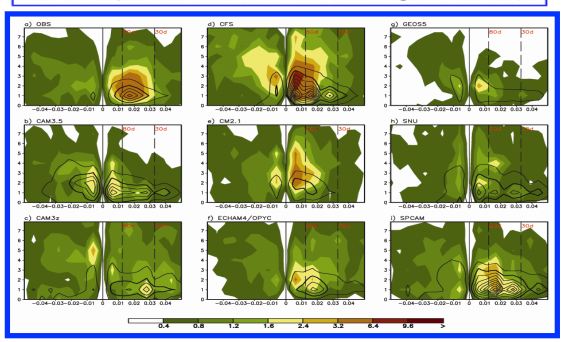












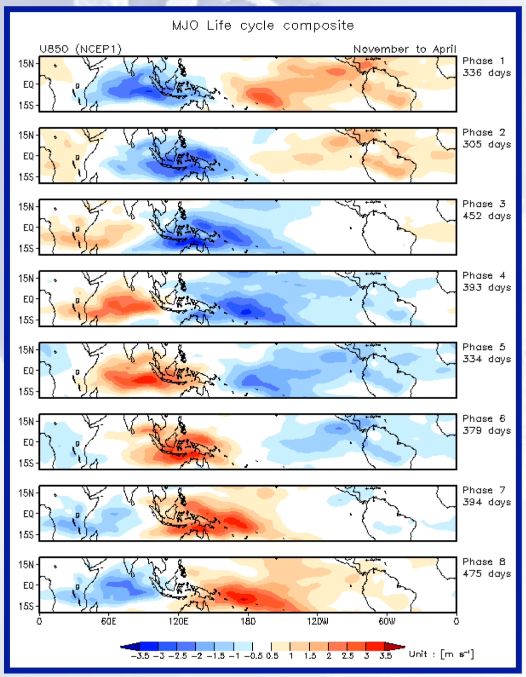
Figures: Maloney, PMEL/TAO, Nakazwa, MJO WG, Lin, Waliser

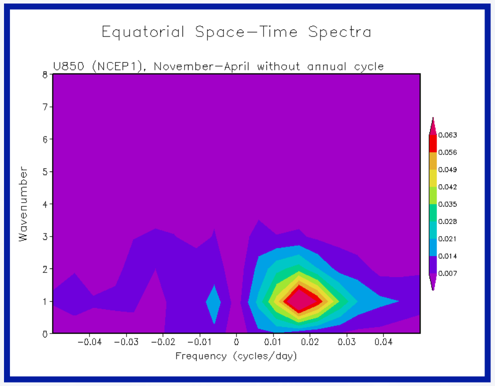
- The MJO is the dominant form of intraseasonal variability in the Tropics.
- The MJO impacts a wide range of weather & climate phenomena.
  - Monsoon Onset & Breaks
  - ENSO+IOD IInteractions
  - Tropical Cyclone Modulation
  - Midlatitude Weather Impacts
  - Organization of Chl, Aerosols, Ozone, etc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

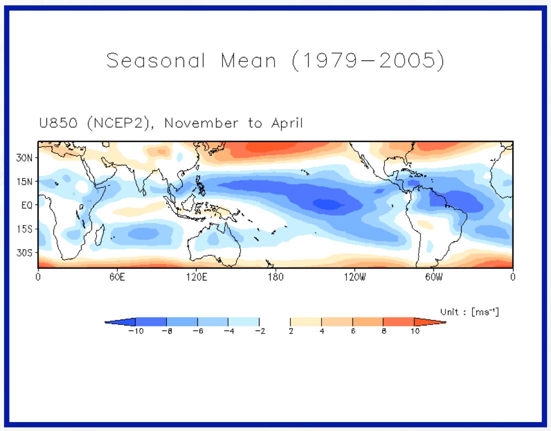
MJO Simulation Diagnostics for GCMs (MJOWG, J. Climate, 2009)

Observation-Based Diagnostics

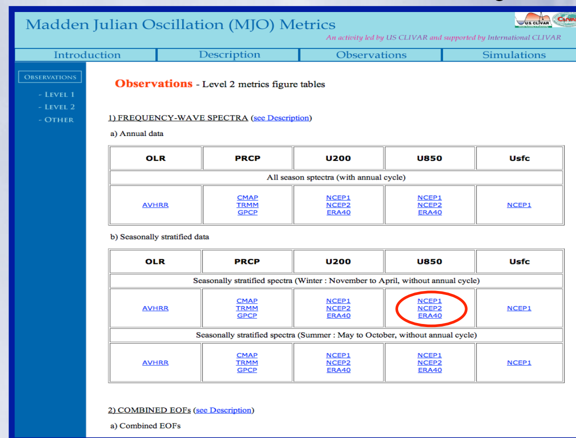
- Variability
- Life Cycle
- Mean-State
- Data Set Sensitivity



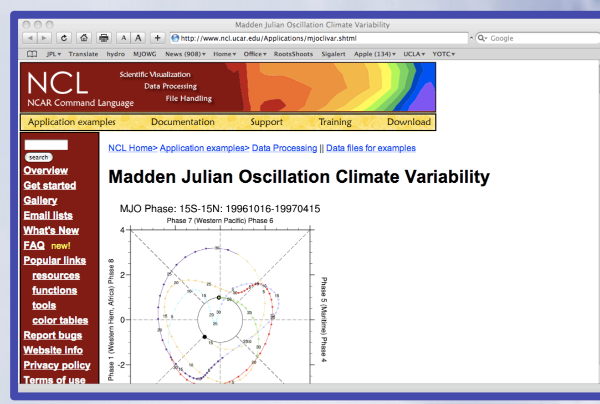




Web Display and Code Availability



Adopted by NCAR/NCL



www.usclivar.org/mjo.php

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/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 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)

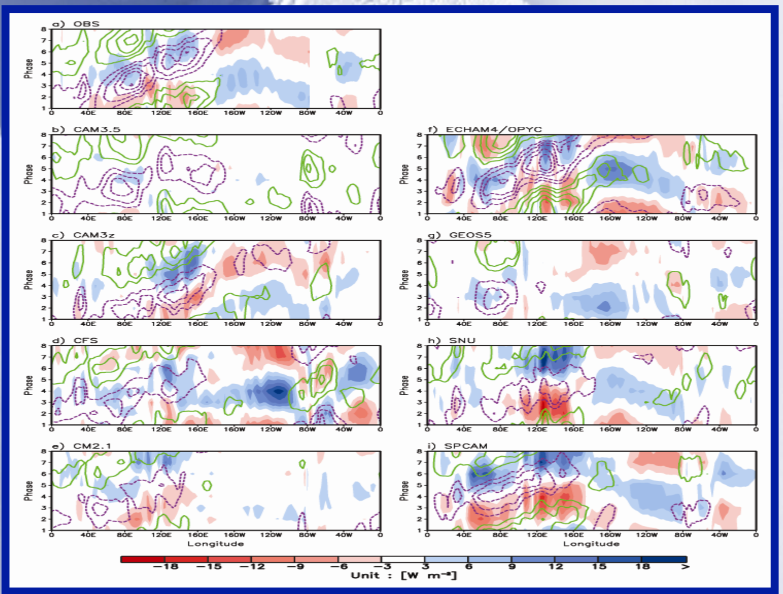
Applied to 8 GCMs

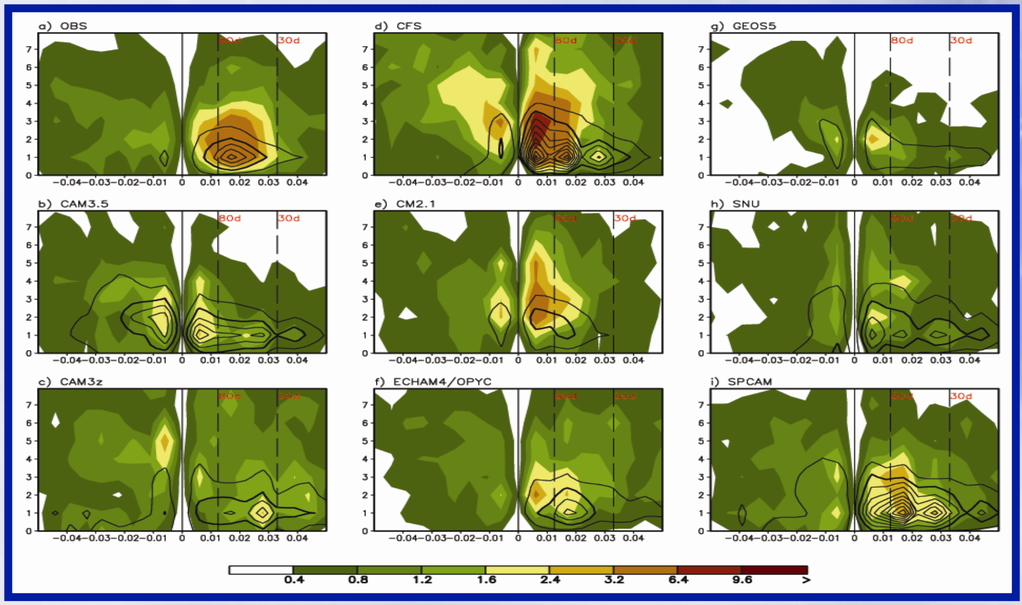
CAM3.5, CAM-3Z, spcam, ECHAM4/OPYC, CFS, SNU, GFDL, GEOS5

CMMAP – MMF (uncoupled)

ECHAM4/OPYC (coupled)

Performed best. Still Challenges





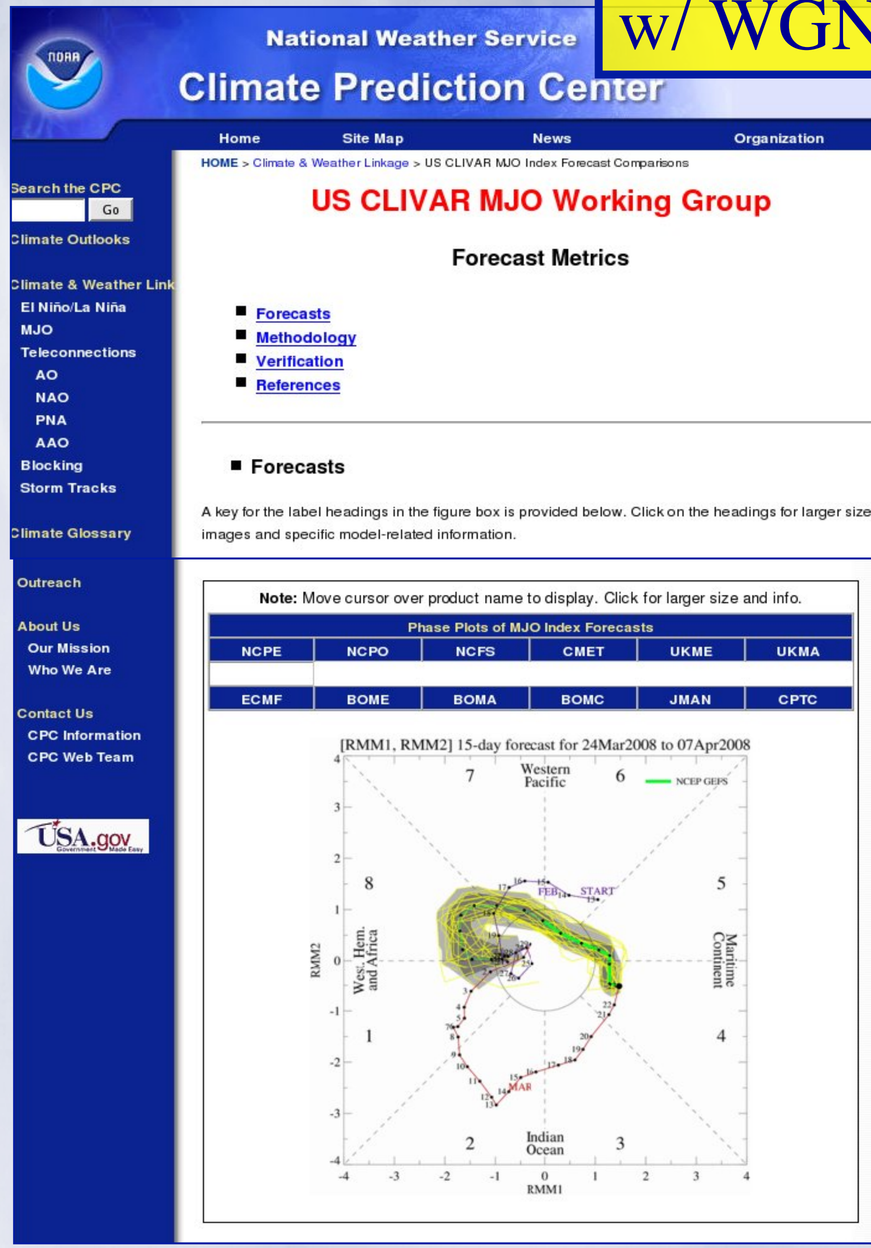
Operational Forecast Metric (Gottschalck et al. BAMS, 2010)

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

MJO Workshops

I. CLIVAR MJOWG Sponsored, Irvine, CA 2007

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

Sperber and Waliser
BAMS Meeting Summary 2008

II. WCRP/WWRP MJOTF + CLIVAR AAMP, Busan, 2010

Monsoon Intraseasonal Variability Modeling Workshop

BAMS Meeting Summary
In Preparation

In late 2009, follow-on WCRP/WWRP Task Force established: "…. the MJO Task Force should be formed within the framework of the joint WWRP/THORPEX/WCRP YOTC activity, and report to the JSC-WWRP, ICSC THORPEX and the SSG-CLIVAR."

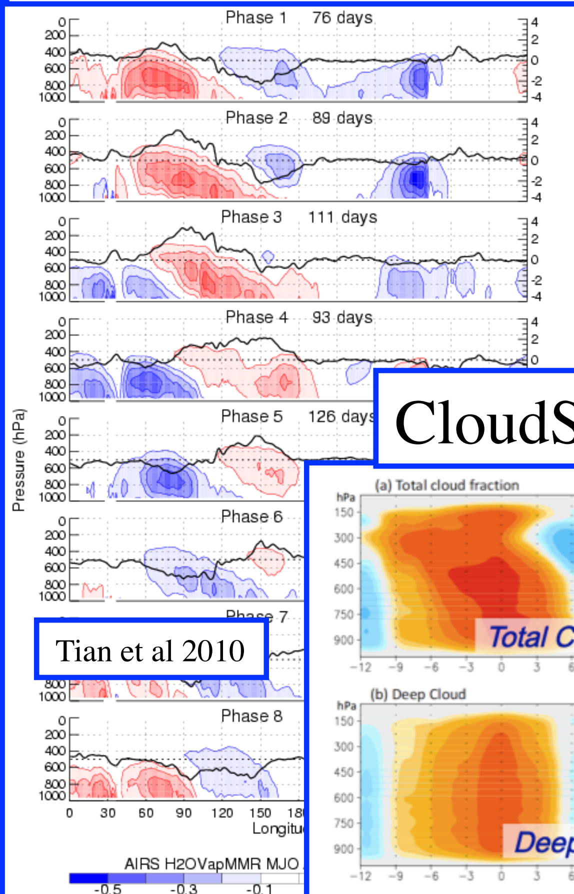
TORs

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

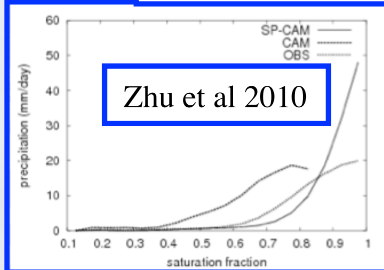
- Develop process-oriented diagnostics/metrics to assess/guide physics and take advantage of more modern data (e.g. A-Train)
- Explore MJO multi-scale interactions and with emphasis on vertical structure and diabatic processes.
- Expand MJO forecast metrics: e.g., boreal summer & ensemble development.
- Coordinate community MJO activities (e.g. WCRP monsoon).

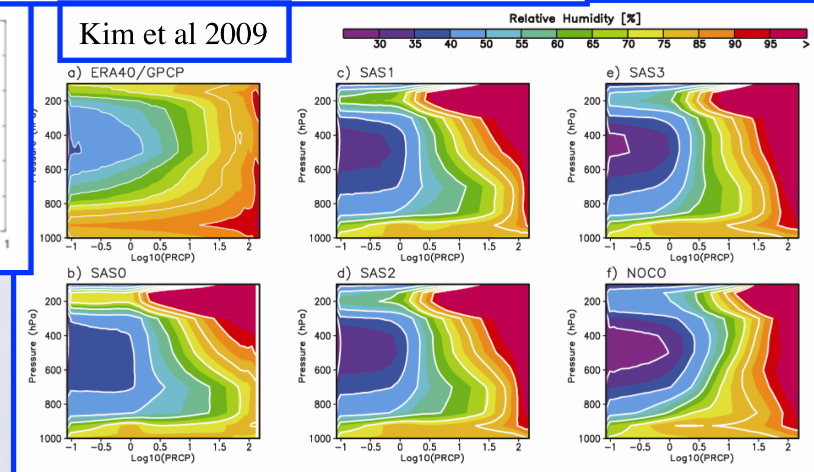
Process Oriented / Vertical Structure Diagnostics & Metrics

AIRS Temp and WV

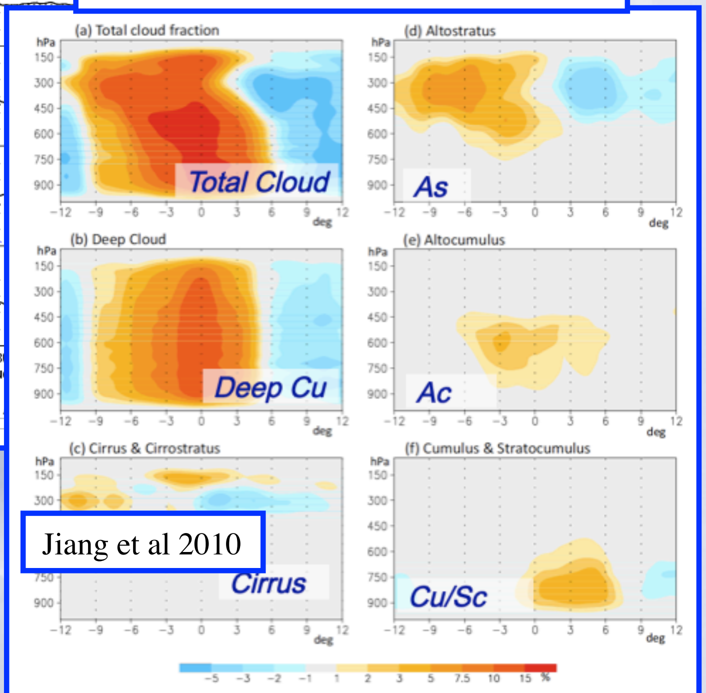


Moisture Precip Relationships

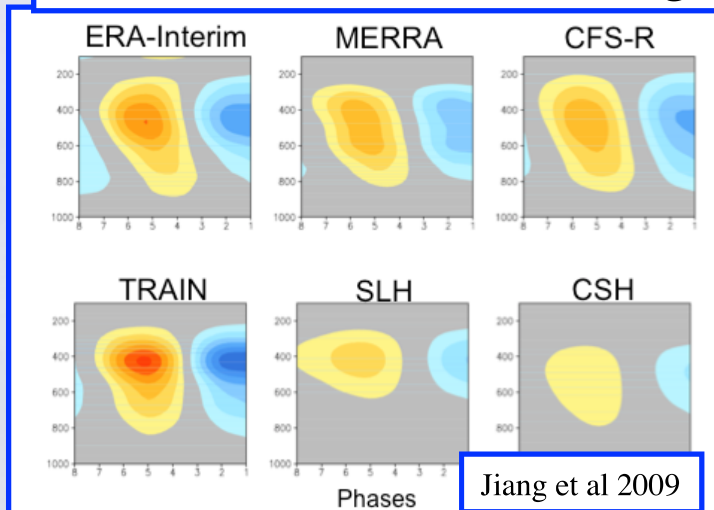




CloudSat Retrievals



TRMM Diabatic Heating



Intraseasonal Variability Hindcast Experiment (ISVHE)

Joint Sponsorship: APCC, NOAA-CPO, MJO WG/TF, AAMP

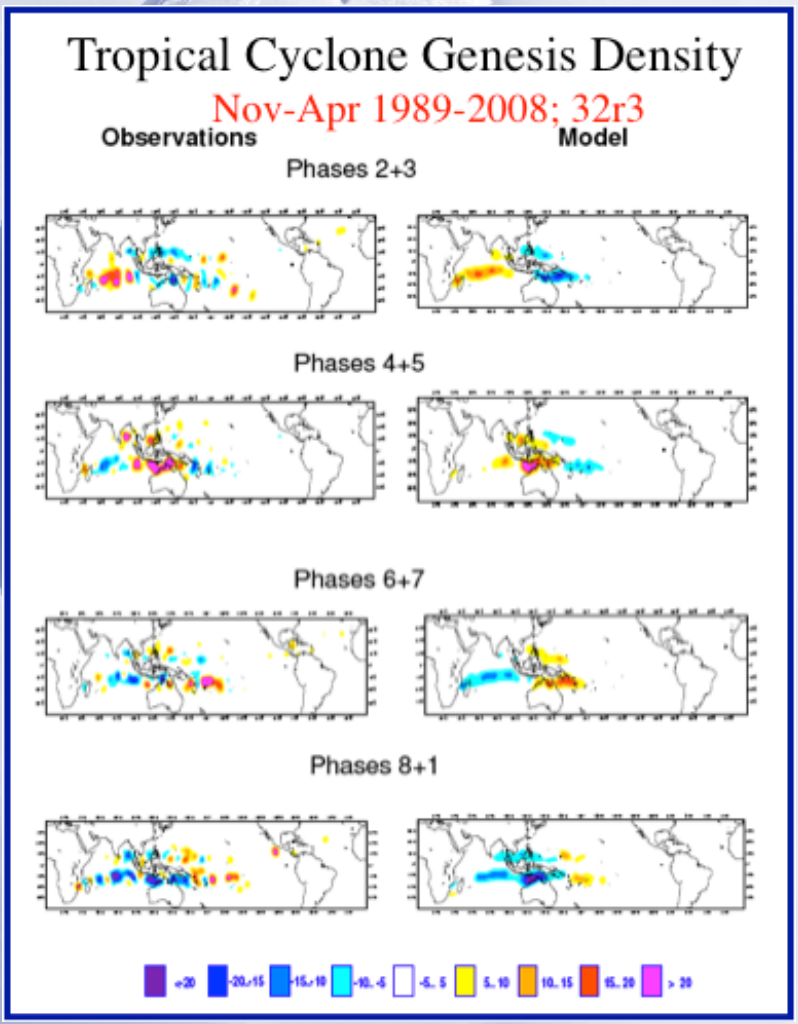
Organizers: B. Wang, J. Y. Lee, H. Hendon, D. Waliser, I.S. Kang, Shukla

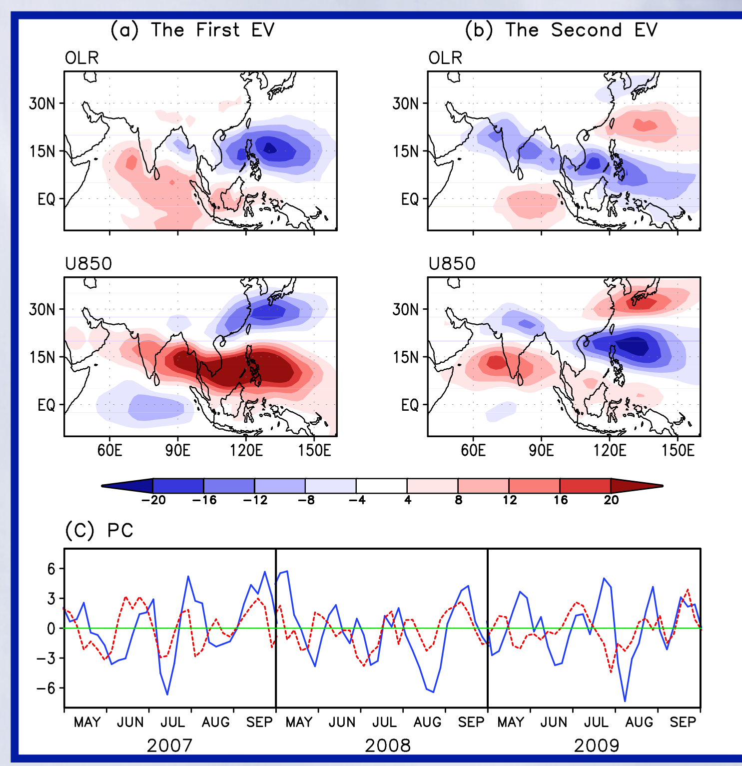
NOAA and Operational Support Led from U. Hawaii; B.Wang and J.Y. Lee

- Multi-year hindcast experiment specifically designed for ISV / MJO.
- Long simulation plus ensembles of ~45 day integrations every 5-10 days for 20 years.
- 19 modeling groups participating in the experiment, 7 groups have submitted their data and 4 groups will submit their data within a month (as of June).
- Plans for predictability, prediction skill, impacts, simulation capability/diagnostic studies.

Extensions to MJO Forecast Metric Activity

- More Center Participation
- Asian Summer Monsoon
- Multi-Center Ensembles
- Impacts e.g. TC Modulation





Other Items & Recommendation

- Planning for MJO TF Meeting – Possibly at WCRP OSC
- YOTC Transpose AMIP and other High-Res Experiments

  Multi-model (e.g., CMIP5, CAM, SPCAM), 5-day forecast every YOTC day; also NICAM, GEOS, SPCAM for selected events
- DYNAMO (MJO Initiation/Indian Ocean) Support
- Items of Note:
  - NRC Report on ISI Prediction/Predictability
  - ECMWF and POAMA Dynamical MJO Skill > Empirical

Recommendation: GCSS Subproject on MJO

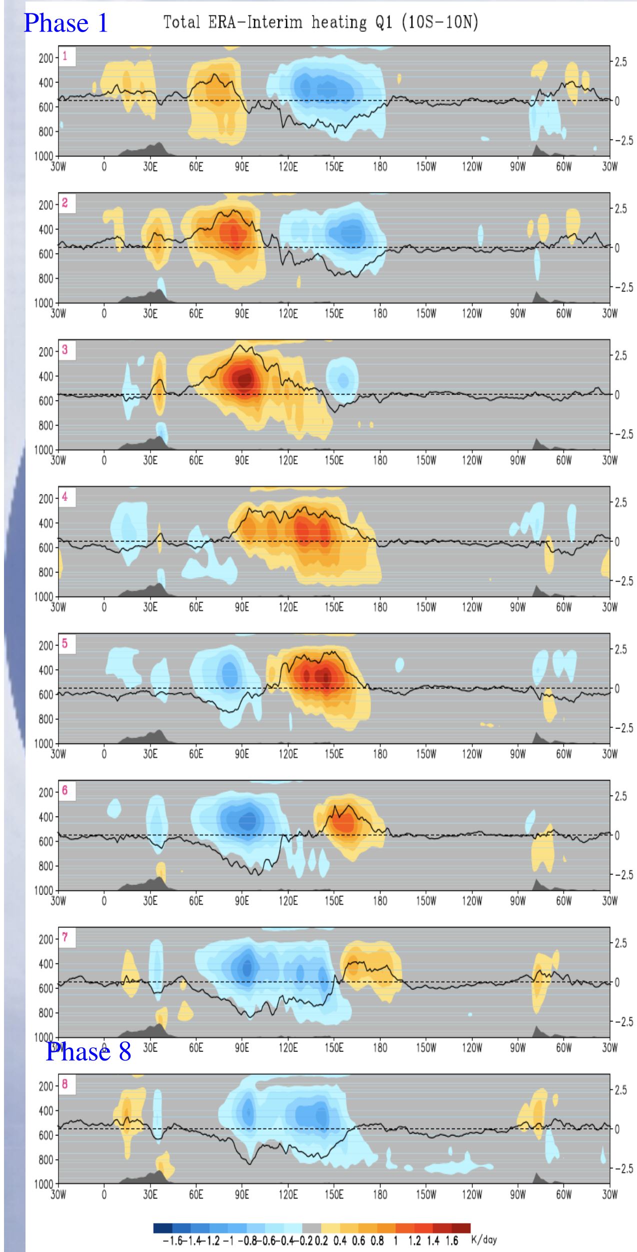
- Leverages existing MJO programmatic framework and expertise but with need for GCSS expertise.
- Integrating cloud theme: shallow cu, congestus, deep cu, stratiform/anvil, cirrus
- Pan-WCRP/GEWEX/CLIVAR Cross-Cut Activity

Q_1 (10S-10N)

Jiang et al. 2010

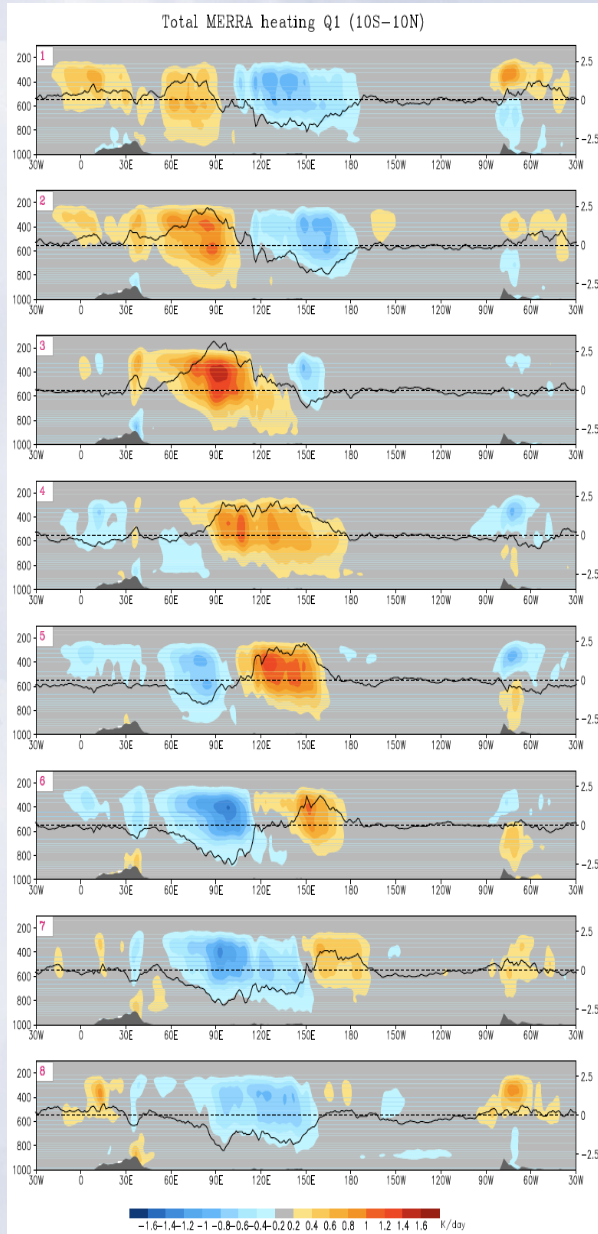
ERA-Interim

Phase 1

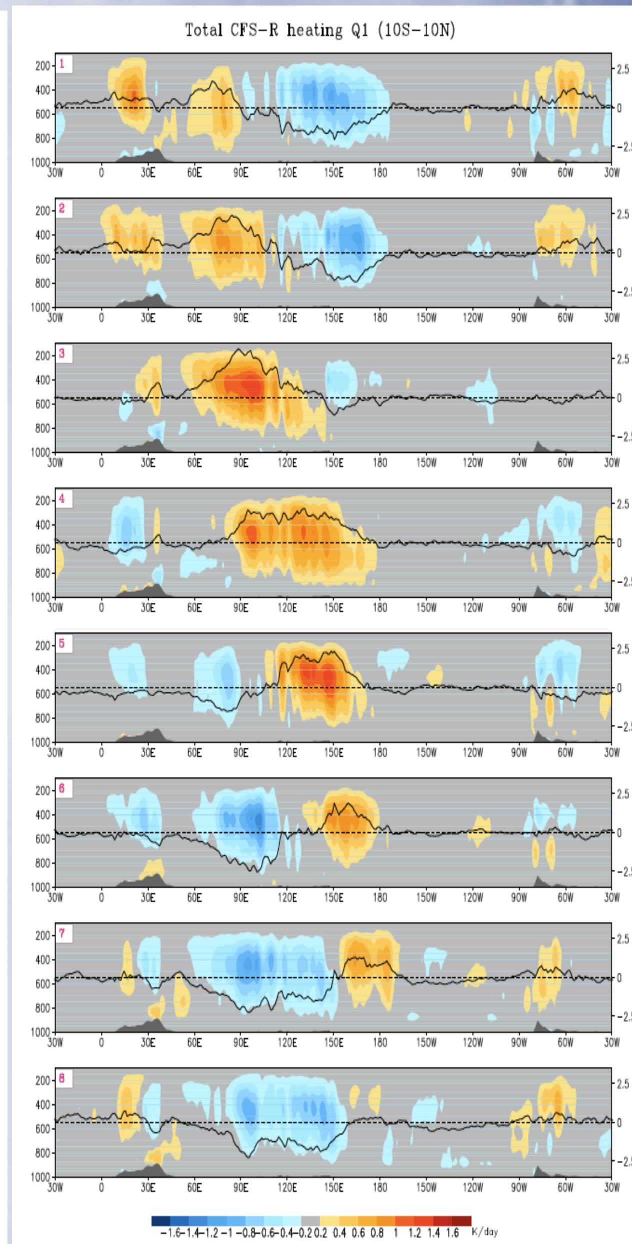


Phase 8

MERRA



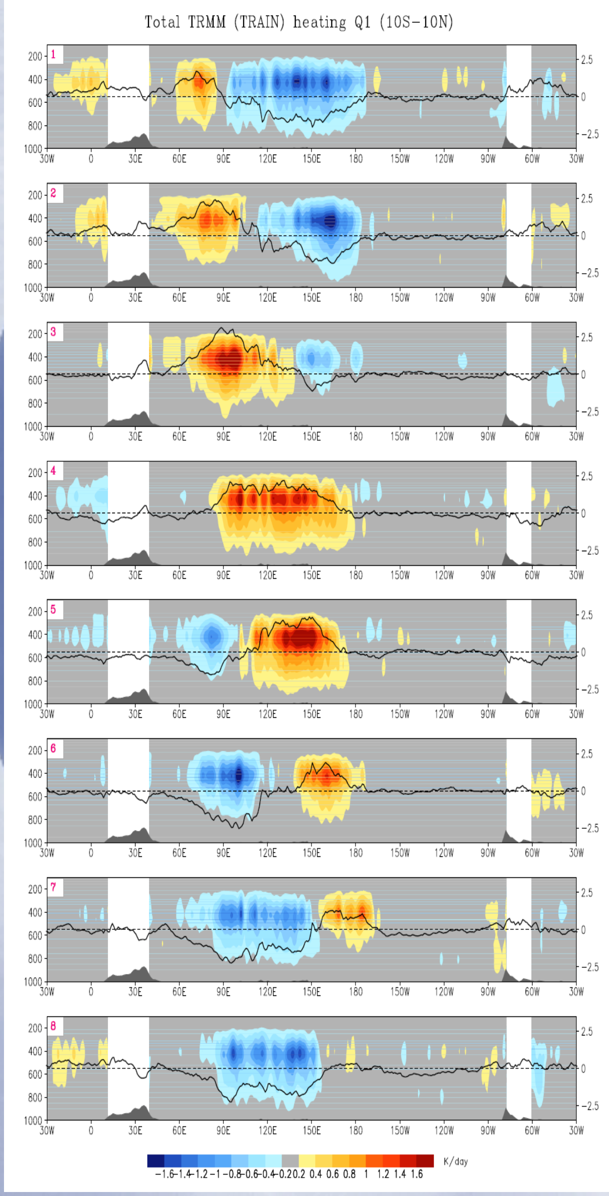
CFS-R



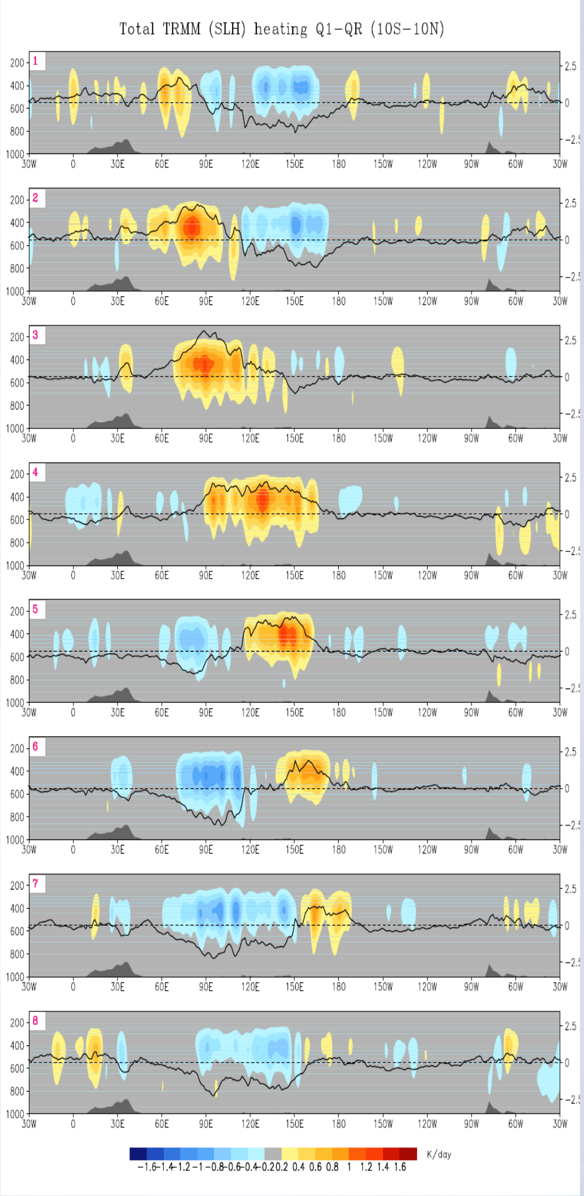
Q_1 (10S-10N)

Jiang et al. 2010

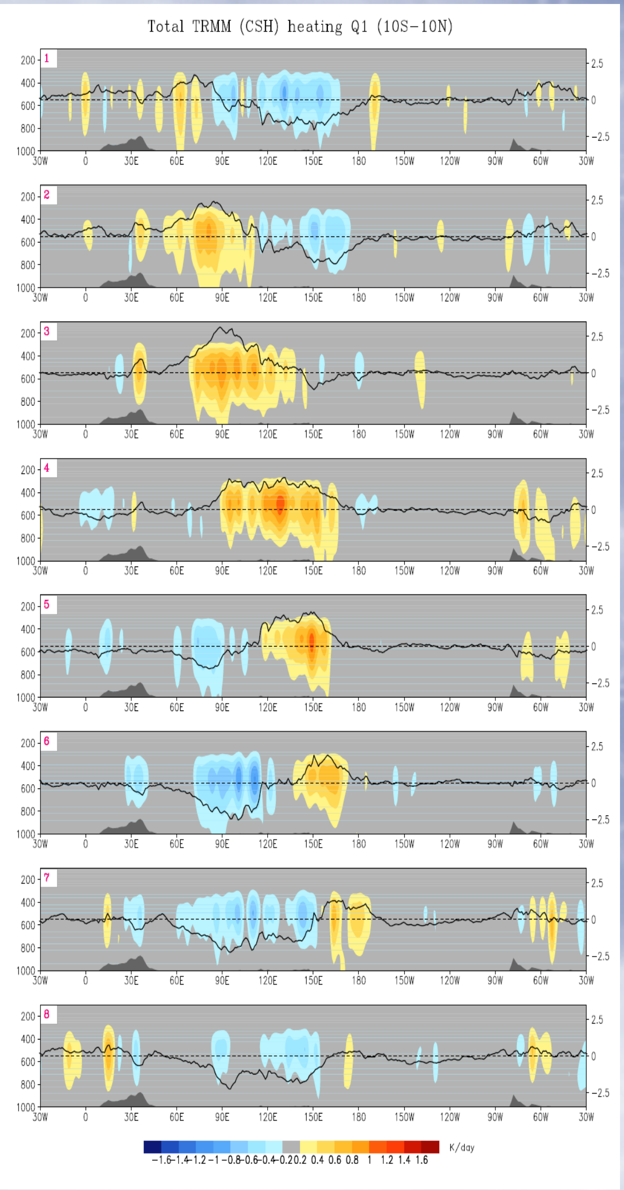
TRAIN



SLH



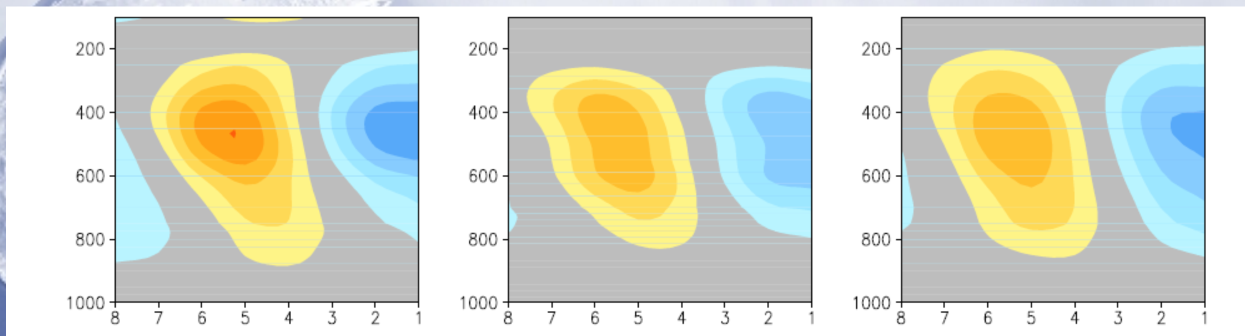
CSH



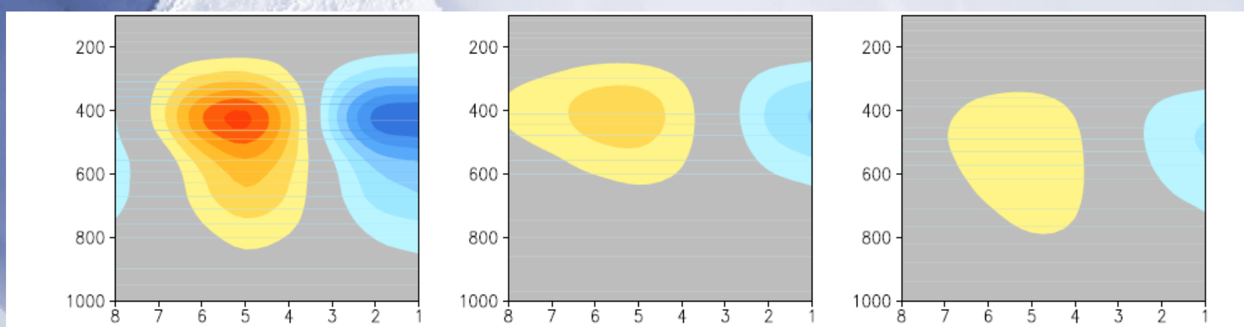
Jiang et al. 2010

Q_1 (150-160oE; 10oS-10oN; ~ TOGA-COARE)

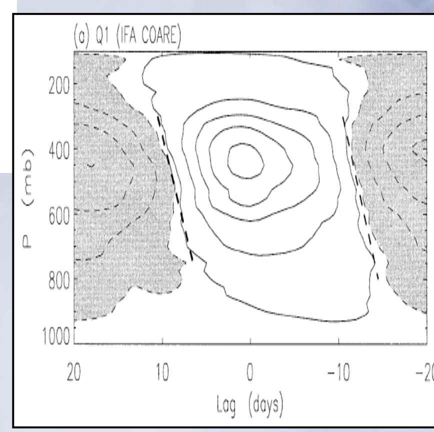
ERA-Interim MERRA CFS-R



TRAIN SLH CSH



Lin et al. 2004 (TOGA-COARE)



Jiang et al. 2010

Figure 5 Vertical-longitudinal profiles of Radiative heating associated with MJO