

# MMAP initiatives and CloudSat

Many fruitful areas of synergy

- shallow cloud and warm rain processes
- aerosol, cloud and precipitation
- Cirrus properties
- Cloudiness of convection
- Cloud-radiation interaction

MMAP initiatives  
Microphysics  
Radiation  
Model evaluation  
and fundamental  
understanding

Year (2008) of coordinated observations, modeling and forecasting - a proposed contribution to the UN year of Planet Earth\* and an initiative of WCRP and Thorpex

**\*January 5, 2006: The United Nations General Assembly, meeting in New York, has proclaimed the year 2008 to be the United Nations International Year of Planet Earth. The Year's activities will span the three years 2007-2009.**

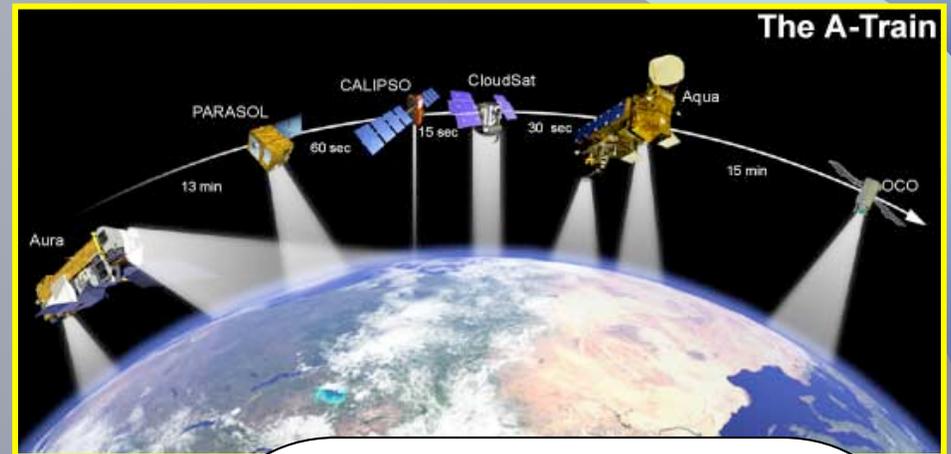
<http://www.yearofplanetearth.org/proclamation.htm>

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# EOS-ERA OF SATELLITE OBSERVATIONS HAS ARRIVED

*Here is just a sample, consider where we were 10-15 years ago...*



TOPEX: sea surface height  
QuickScat: ocean surface winds  
TMI: sea surface temperature w/clouds  
TRMM: tropical precipitation  
AIRS: temperature and water vapor profiles  
CloudSat: cloud profiles, water/ice  
Calipso: aerosol/thin-cloud profiles  
AMSRE: ocean precip, water vapor, liquid water  
MLS: upper tropospheric water vapor, cloud ice, temperature  
CERES: TOA and surface radiative fluxes  
MODIS: cloud characteristics, ocean color, land characteristics  
AURA platform: atmospheric composition/chemistry  
MISR: aerosol and cloud structure

COARE: 120-day IOP  
~6000 soundings

Tropical Soundings:

AIRS: ~100,000/day

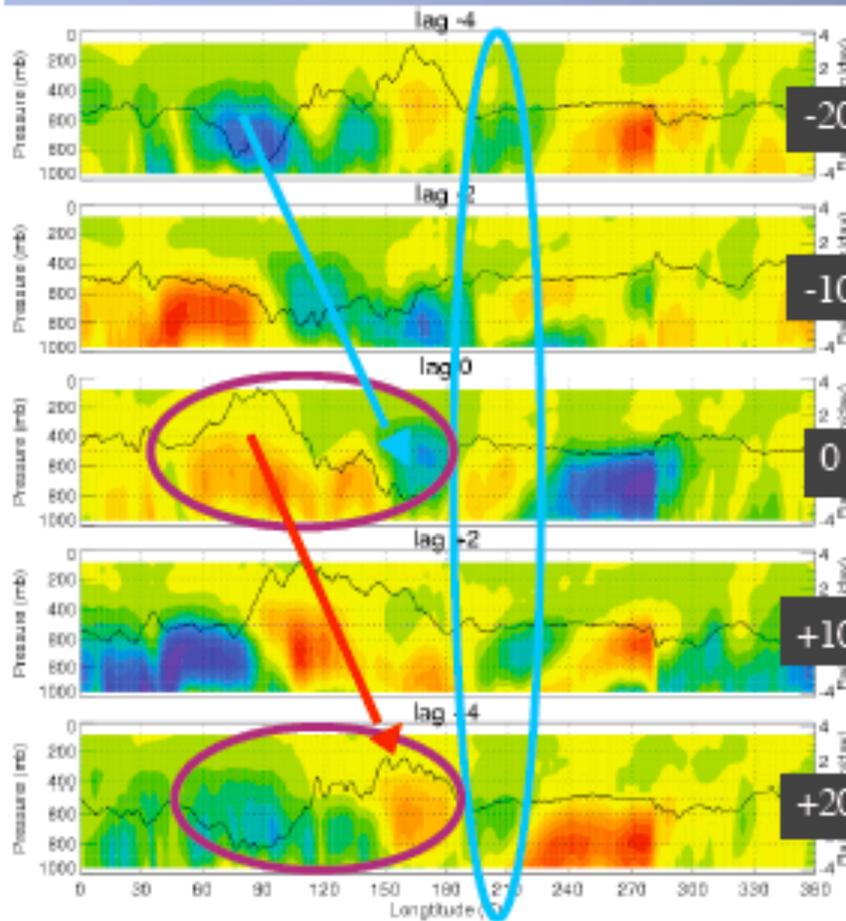
CloudSat: ~90,000 cloudy  
/day



Pressure-Longitude Diagrams of Water Vapor Anomaly Along Equator for the MJO  
 TRMM Rainfall Anomaly Shown as Line Plot (right axis); Panels Separated by 10 Days

AIRS

NCEP/NCAR



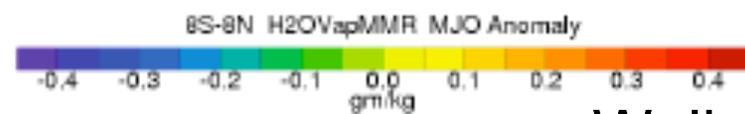
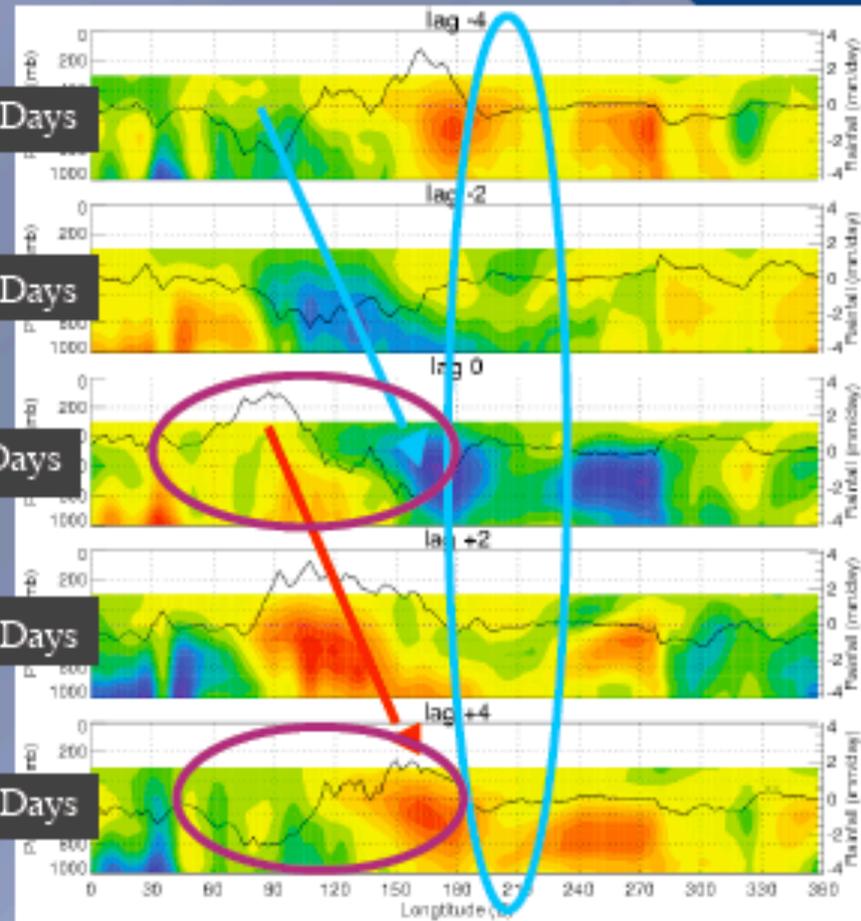
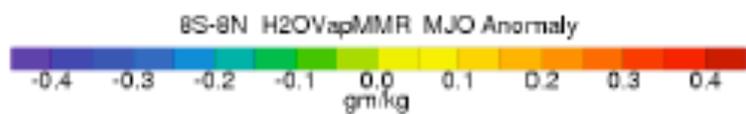
-20 Days

-10 Days

0 Days

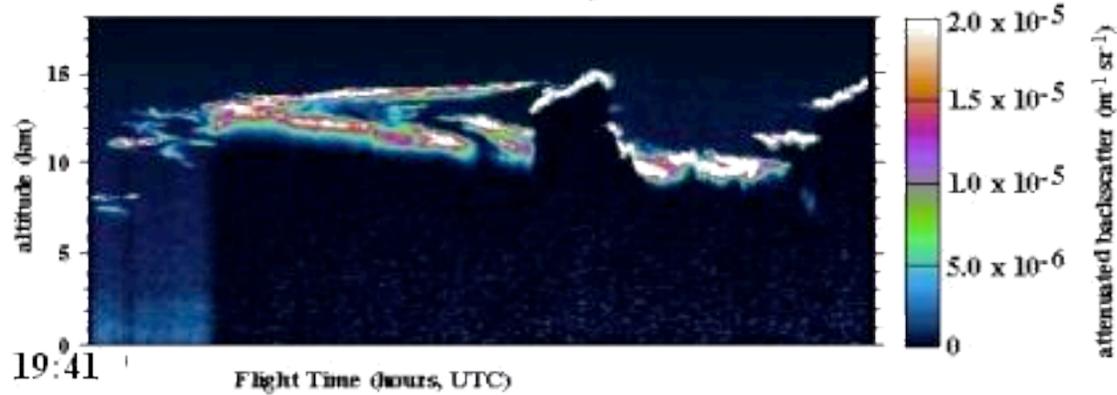
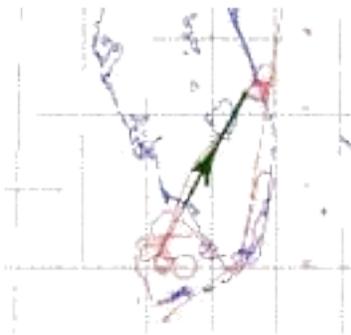
+10 Days

+20 Days

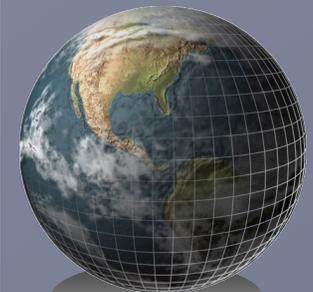
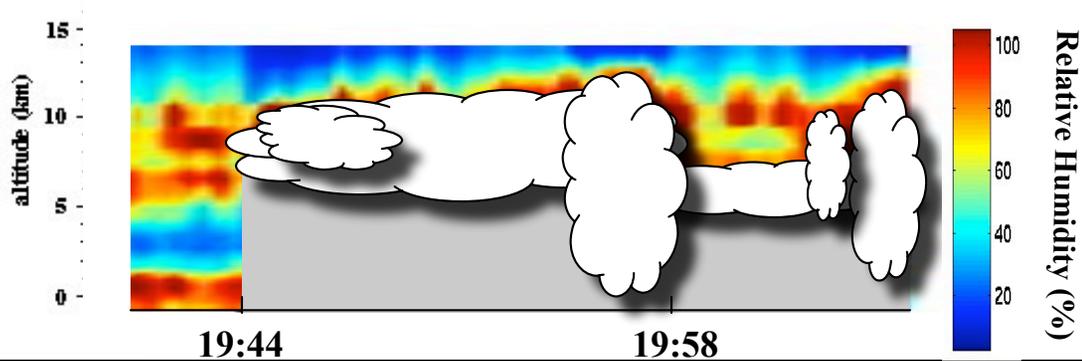
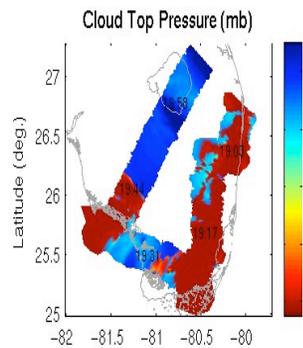
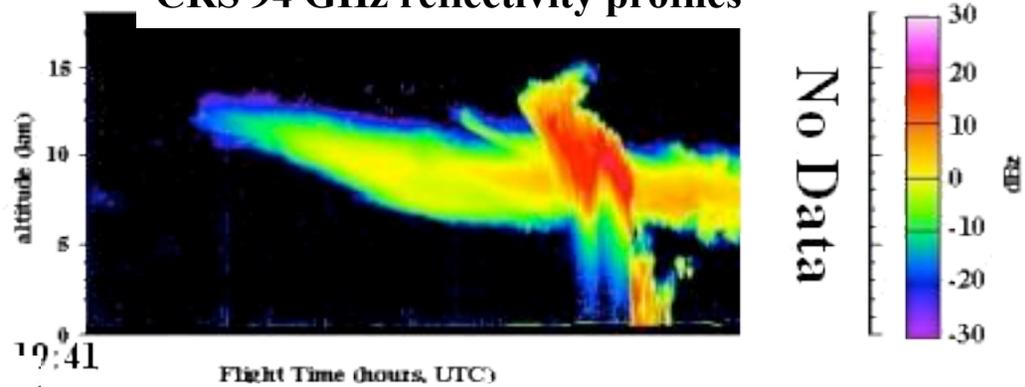
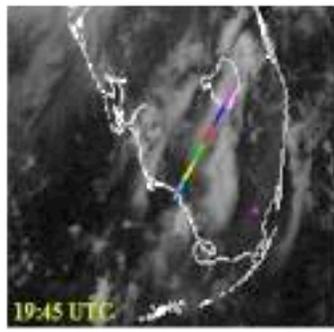


# An A-Train-like example

## CPL 532 nm NRB profiles



## CRS 94 GHz reflectivity profiles

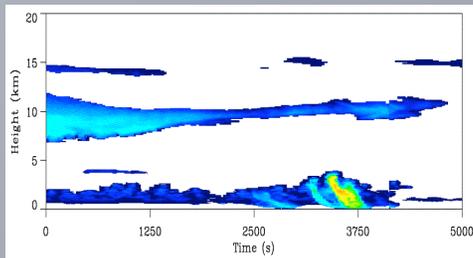


# The fundamental nature of the cloudiness of Tropical convection

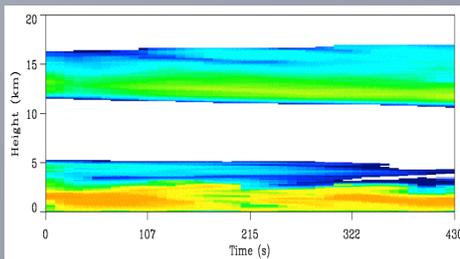
Observations of the *structure and evolution* of tropical cloud systems are essential for evaluation of models and parameterizations (esp convection)

## Common Modes of Occurrence:

- Shallow cloud with mid-level (4-10 km cloud)



- Shallow / mid level cloud with (thick) cirrus, particularly *before* the OLR min



Stephens and Wood, 2006  
Haynes and Stephens, 2006

## What fraction of time do multi-layered modes exist when rain is falling?

- Stratiform regimes (**A**, **B**): > 50%
- Convective regime (**C**, **D**): < 30%

~40% of time precipitation is observed, it is as part of a multi-layer mode

Overall, ~ 40% of the observed precip during the MJO cycle is from multi-layered systems. Possible implications for depth of atmosphere heating in this mode?

A few 'regimes' of tropical convection, regardless of the mode of forcing, emerge and are repeatable, the RFO however, is forcing dependent

All results derive from surface mm radar



# YEAR OF COORDINATED OBSERVING, MODELING AND FORECASTING OF THE TROPICS

Leveraging the vast amounts of new data and computational resources becoming available in conjunction with the development of new / high-resolution modeling frameworks in order to better characterize, understand, model and forecast multi-scale convective/dynamic interactions and processes in the Tropics.

*We are in a new era. In the Tropics, we have an: “IOP every day”*

## **Proposed Focus:**

**Time:** ~1+ Years; Start: late 2007/early 2008

**Region:** ~ 40N - 40S

**Time Scales:** Diurnal to Seasonal

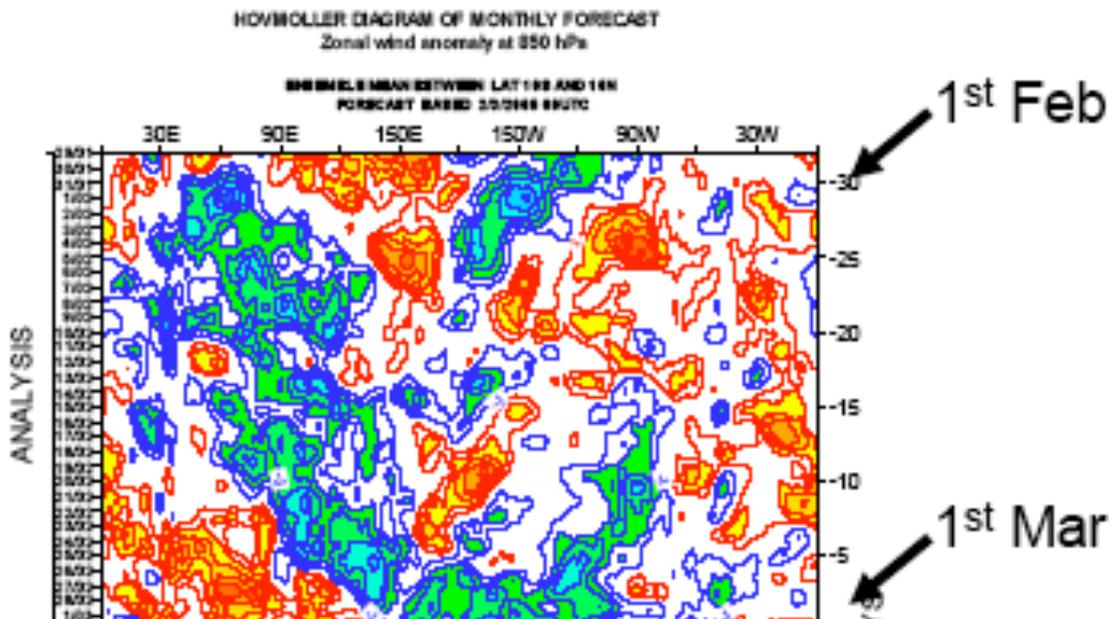
## **Case Study/Event Identification and Detailed Analyses:**

MJO events, convectively-coupled waves, active/break monsoon, typhoon/hurricanes, easterly waves, mesoscale systems, etc.

**Central repository** to store/disseminate data as well as information on results, activities, etc.

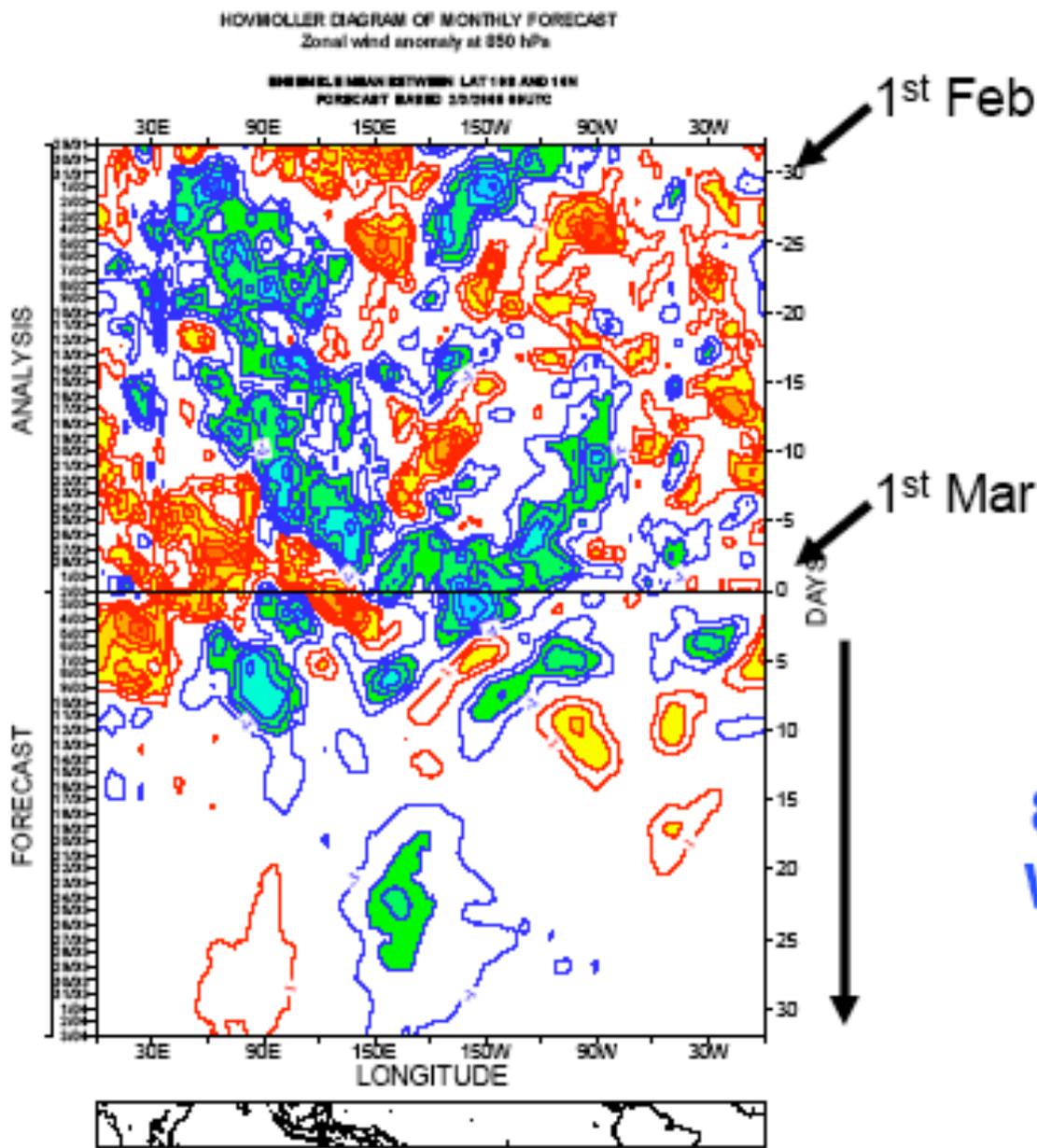
**Leverage/Coordinate existing resources.**

*No New (Big) \$\$\$ Required*



850 hPa Zonal  
Wind Anomaly

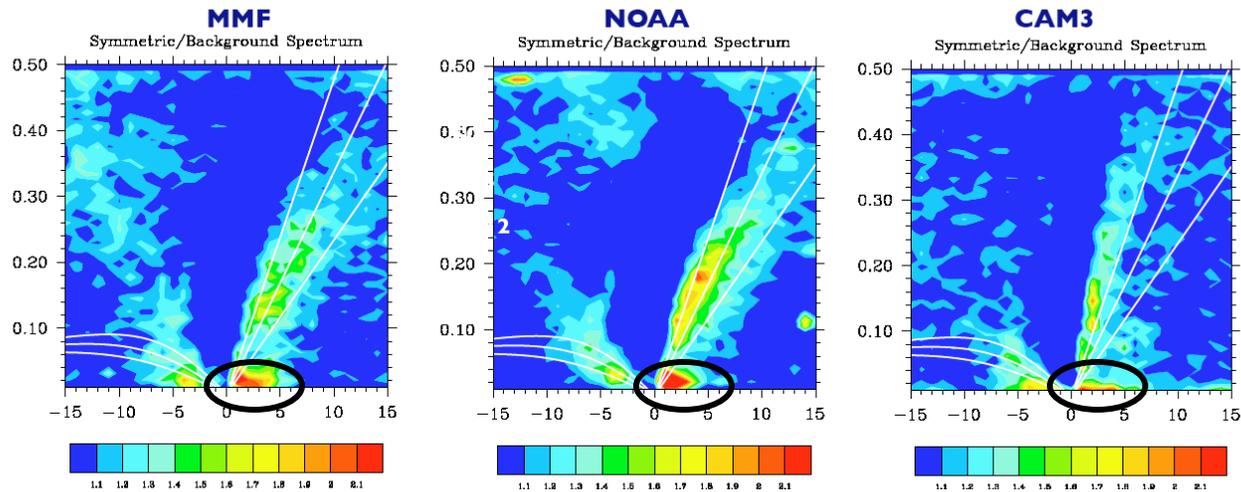




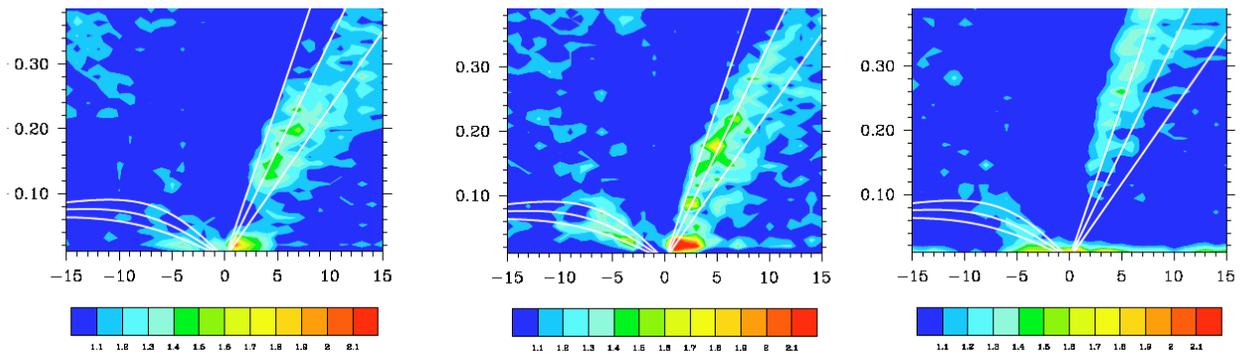
850 hPa Zonal  
Wind Anomaly



## Outgoing Longwave Radiation



The obvious question - why an MJO in the MMF and why not in 'conventional' models?



Courtesy of Marat K



## Summary

The timing seems incredibly right to march forward toward improving our ability to understand and predict the 'freshwater in the sky' with advances in models being linked to advances in observations (and vice-versa) and with an energized focus on selected key modes of variability of 'weather' → climate



## YEAR OF COORDINATED OBSERVING, MODELING AND FORECASTING OF THE TROPICS

- **Satellite Resources** : Already Discussed
- **Field Programs**: Leverage Overlapping Activity and Maximize Its Impact & Investment: IO, AMMA, TC4, CTCZ, Thorpex, TACE, VOCALS, etc
- **(Re-)Analyses and Forecasting/Hindcasting**: Operational & *Re-Analyses*, “Seamless” Global Predictions, Limited Domain Forecasts: *Examine forecast error growth to investigate model parameterization shortcomings as well as initial condition errors, with special emphasis on identified cases/events.*
- **Model Simulations**: global and regional CRM, channel models, AGCMs, CGCMs: *improving understanding and modeling of organized convection, and transitioning this knowledge into improved parameterizations and forecasts.*



# YEAR OF COORDINATED OBSERVING, MODELING AND FORECASTING

THE LAST 10-15 YEARS HAVE MARKED EXTRAORDINARY GAINS IN OUR OBSERVATIONAL, MODELING AND TECHNOLOGICAL INFRASTRUCTURE. IN PARTICULAR:

- PROGRESS TOWARDS A GOOS HAS BEEN SUBSTANTIAL
- EOS-ERA OF SATELLITE OBSERVATIONS HAS ARRIVED
- GLOBAL CLOUD-RESOLVING MODEL CAPABILITY

IN ADDITION, WE HAVE COME TO APPRECIATE, IN MANY CASES:

- SHORT-TERM WEATHER ERRORS  $\leftrightarrow$  LONG-TERM CLIMATE BIASES

THESE ADVANCES IN RESOURCES, TECHNOLOGY AND THINKING NEED TO BE AND CAN BE WOVEN TOGETHER TO MAXIMIZE THEIR RETURN ON INVESTMENT.

