



# YEAR OF TROPICAL CONVECTION (YOTC)

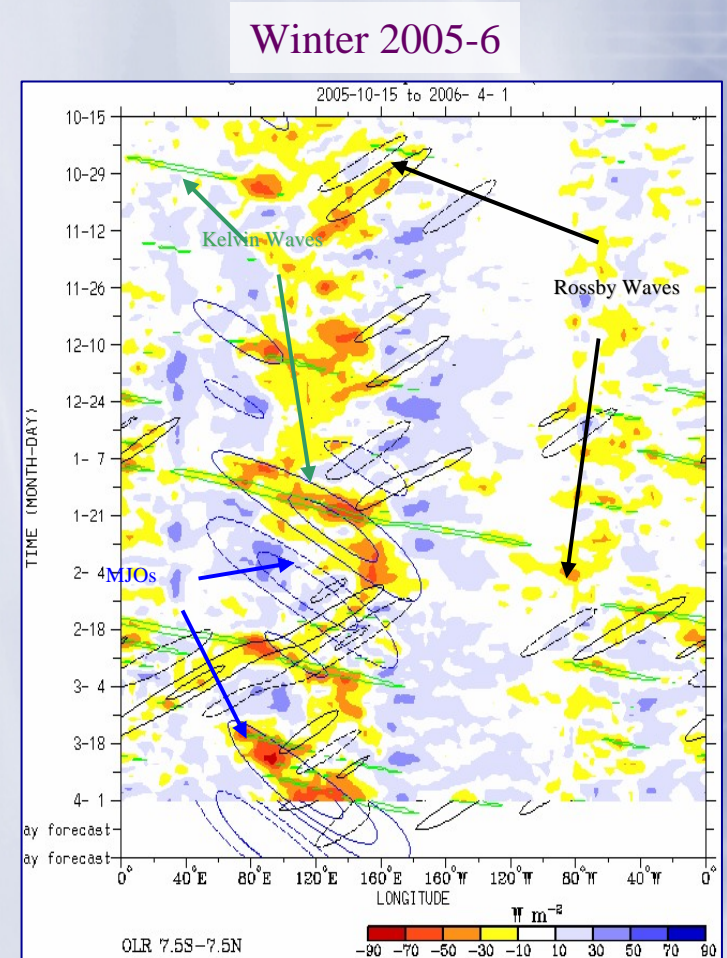
COORDINATED OBSERVING, MODELING AND FORECASTING TO  
ADDRESS THE CHALLENGE OF ORGANIZED MULTISCALE  
TROPICAL CONVECTION

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# SHORTCOMINGS IN TROPICAL CONVECTION SEVERELY LIMIT THE REPRESENTATION OF KEY PHYSICS IN WEATHER & CLIMATE MODELS

- DIURNAL CYCLE - STRONGEST “FORCED” SIGNAL IN THE CLIMATE SYSTEM.
- SYNOPTIC WAVES AND EASTERLY WAVES, INCLUDING DEVELOPMENT & EVOLUTION OF HURRICANES AND TROPICAL CYCLONES
- MADDEN-JULIAN OSCILLATION (MJO) AND OTHER LARGE-SCALE CONVECTIVELY-COUPLED WAVES
- MONSOON VARIABILITY, INCLUDING ONSET AND BREAK ACTIVITY.
- TROPICAL-EXTRATROPICAL INTERACTION
- MEAN STATE, INCLUDING ITCZ AND DISTRIBUTIONS OF RAINFALL OVER OCEANS & CONTINENTS



Dominant Convectively-Coupled Tropical Waves Projected onto OLR Anomalies. Wheeler and Weickmann, 2001

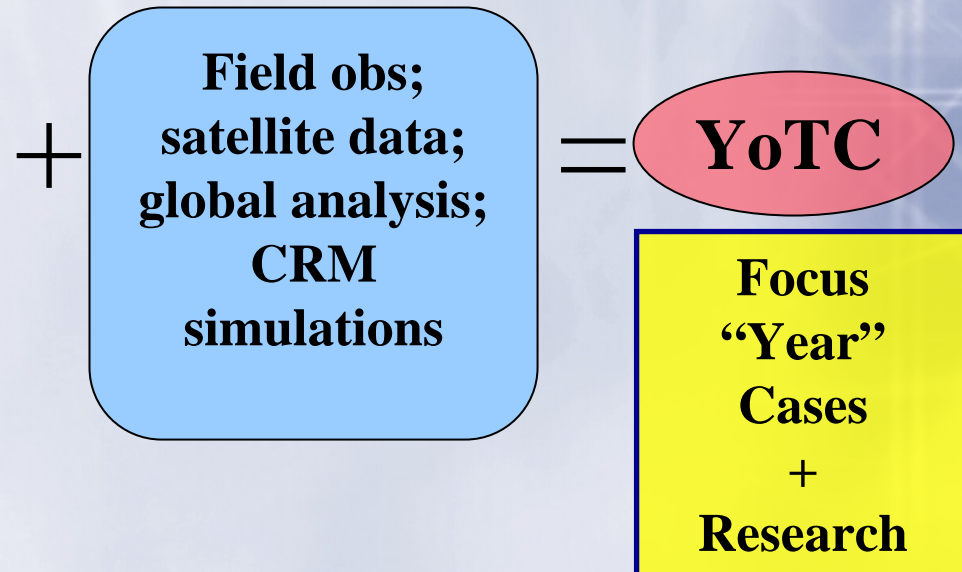
# NEW STEPS TO MAKE PROGRESS

*Tropical Atmosphere-Ocean-Land System has never been so well observed but integration is required...*

## New/Improved Resources

- Satellite Observations (e.g., EOS, A-train)
- In-Situ Networks (ARM, CEOP)
- GOOS (e.g., TAO, PRADA, drifters)
- IOPs (e.g., AMMA, VOCALS, T-PARC, AMY, others)
- High Resolution Modeling & Analyses
- Cloud-system resolving models (CRM)

## Integration



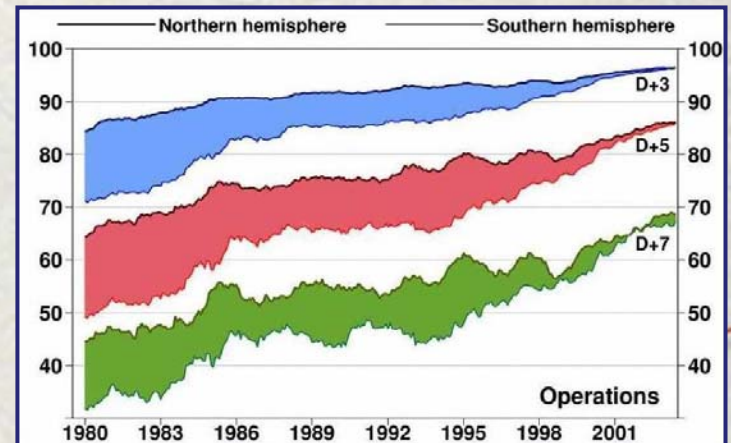
## Strategy: Target Phenomena with Focused Working Groups

- **Madden-Julian Oscillation (MJO/CCEWs)** **US CLIVAR MJO WG** modeling capabilities in the MJO are expected to lead to significant untapped predictability in both tropical weather forecasts, monsoon onsets and breaks, extra-tropical weather, and provide a bridge between weather and climate predictions. Underlying the MJO are CCEWs, considered to be important building blocks of tropical convective variability and its organization on a wider range of time scales.
- **Easterly Waves / Tropical Cyclones** - Easterly waves are important triggering mechanisms for tropical storms and cyclones and the latter represent one of the most severe of the high impact weather events that warrant continued improvements in track and intensity prediction. **UK Cascade US CMMAP**
- **Diurnal Cycle** - Our shortcomings in representing arguably the most basic and strongest forced mode of variability demands attention. Moreover, studies indicate that the diurnal scale can rectify onto longer scales. **Asian Monsoon Years**
- **Monsoons** - These are complex multi-scale processes and within the proposed activity could be considered as the ultimate challenge or integrating theme as their variability is strongly influenced by the diurnal cycle, CCEWs, the MJO, and land-atmosphere interactions. **THORPEX**
- **Tropical/Extratropical Interactions** - It is well known that convective variability in the tropics influences mid-latitude weather and climate. However, our predictions of the latter suffer due to poorly understood and simulated tropical convection. Moreover, there are still significant questions regarding the manner that the extra-tropics influences convection in the Tropics.

## Overarching Goals

Through better understanding, improved data assimilation techniques/resources, and modeling capabilities, achieve significant gains in forecast skill:

- **Short-to-Medium-range tropical weather forecasts, particularly disturbed conditions associated with organized convection.**
- **Extended-range/subseasonal forecasts of the MJO.**
- **Medium-to-extended range extratropical forecasts derived from improved tropical weather/climate and tropical-extratropical interactions.**



Courtesy A. Simmons & M. Miller

# YoTC : PUBLICATION PLANS

- SCIENCE PLAN
  - ✓ WMO TECHNICAL DOCUMENT
  - ✓ SEAMLESS PREDICTION: 1 OF 5 COORDINATED *BAMS ARTICLES*
- IMPLEMENTATION PLAN
  - ✓ IMPLEMENTATION WORKSHOP: JULY 13-15, 2009

# YoTC : FOCUS YEAR “SYNOPTIC” EVENT IDENTIFICATION & DOCUMENTATION

- GENERAL TROPICS (MJOS, TCs, MONSOON) : *NCEP HAZARD ASSESSMENTS*
- EASTERLY WAVES & TCs : *AMMA, T-PARC*
- MONSOON : *ASIAN MONSOON YEARS - AMY*
- MJO : *VARIOUS, INCLUDING DYNAMO*
- TROPICAL/EXTRA-TROPICAL INTERACTION: THORPEX
- E. PACIFIC VARIABILITY : CLIVAR - VOCALS

**ABOVE ACTIVITIES NEED COORDINATION.**

# YOTC MODELING, ANALYSES & FORECASTS

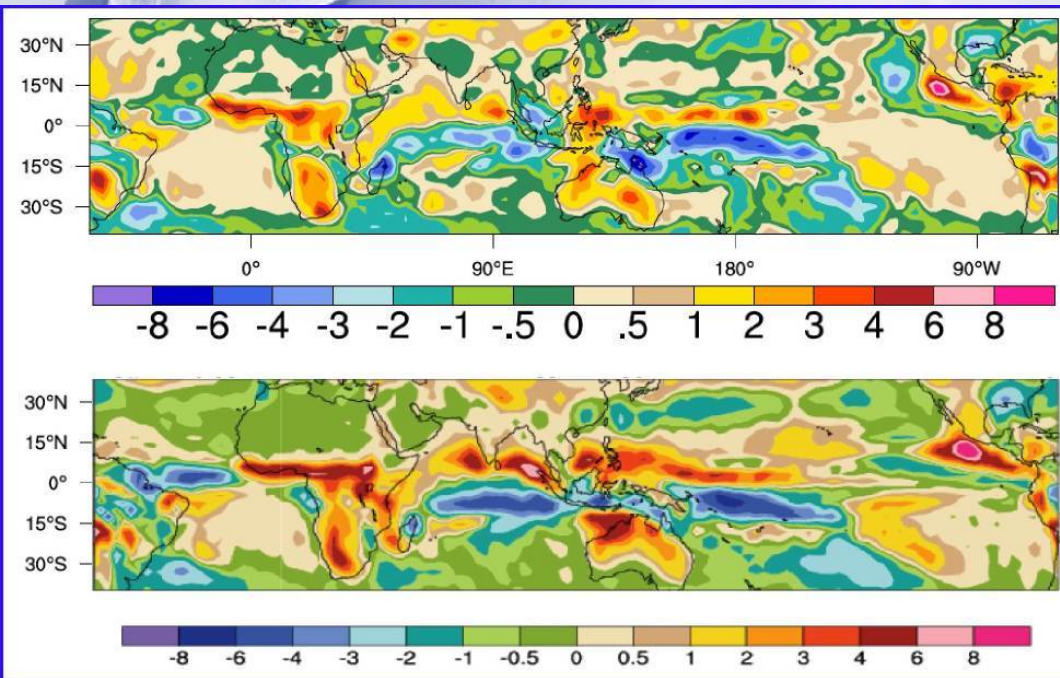
- ECMWF ANALYSES & FORECASTS – ACQUIRING (MAY 2008 –OCTOBER 2009)
- NCEP & NASA/MERRA ANALYSES – STARTED
- RESEARCH-ORIENTED MODELING
  - ✓ GLOBAL CRMS & REGIONAL CRMS
  - ✓ MMFs (E.G., CSU & NASA SUPERPARAM)
  - ✓ TROPICAL CHANNEL MODELS (E.G., NCAR)
  - ✓ AGCMs/CGCMs
- OPERATIONAL MJO FORECASTS – US CLIVAR MJO WG
- UK CASCADE, NSF CMMAP, GEWEX GCSS

ABOVE ACTIVITIES NEED SIGNIFICANT COORDINATION,  
PARTICULARLY RESEARCH MODELING.



# SHORT-TERM WEATHER ERRORS <-> LONG-TERM CLIMATE BIASES

*CAPT\* PROJECT RUNS CLIMATE MODELS IN WEATHER FORECAST MODE  
SUITED TO A "FOCUS YEAR" APPROACH*



NCAR Day 3 Precipitation Error for DJF 1992-93

NCAR Precipitation Error  
for DJF Climatology

*\*The CAPT project is a joint project at LLNL of the DOE CCPP and ARM Programs*

Courtesy S. Klein





# ***YOTC <-> DYNAMO***

- ✧ **Identify case(s) during the present YOTC archiving period (May 2008 – Oct 2009) – ECMWF, NCEP**
- ✧ **Prepare case(s) for discussion at July 13-15 2009 YOTC Implementation Workshop**
- ✧ **Argue for “YOTC2” ... whatever, get DYNAMO measurements on GTS for use by operational model data-assimilation procedures**

# YoTC

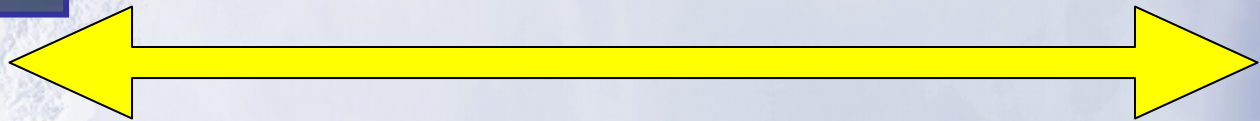


Forecast  
Simulate  
Assimilate

Compare  
With  
Observations

*ERRORS*

Improve  
Model, ICs,  
Methods



2008

2009

2010

diurnal cycle, synoptic systems,  
intraseasonal, annual cycle, mean,  
mesoscale-to-planetary-scale organization