Modeling MJO interactions and impacts in the Americas warm pool during boreal summer

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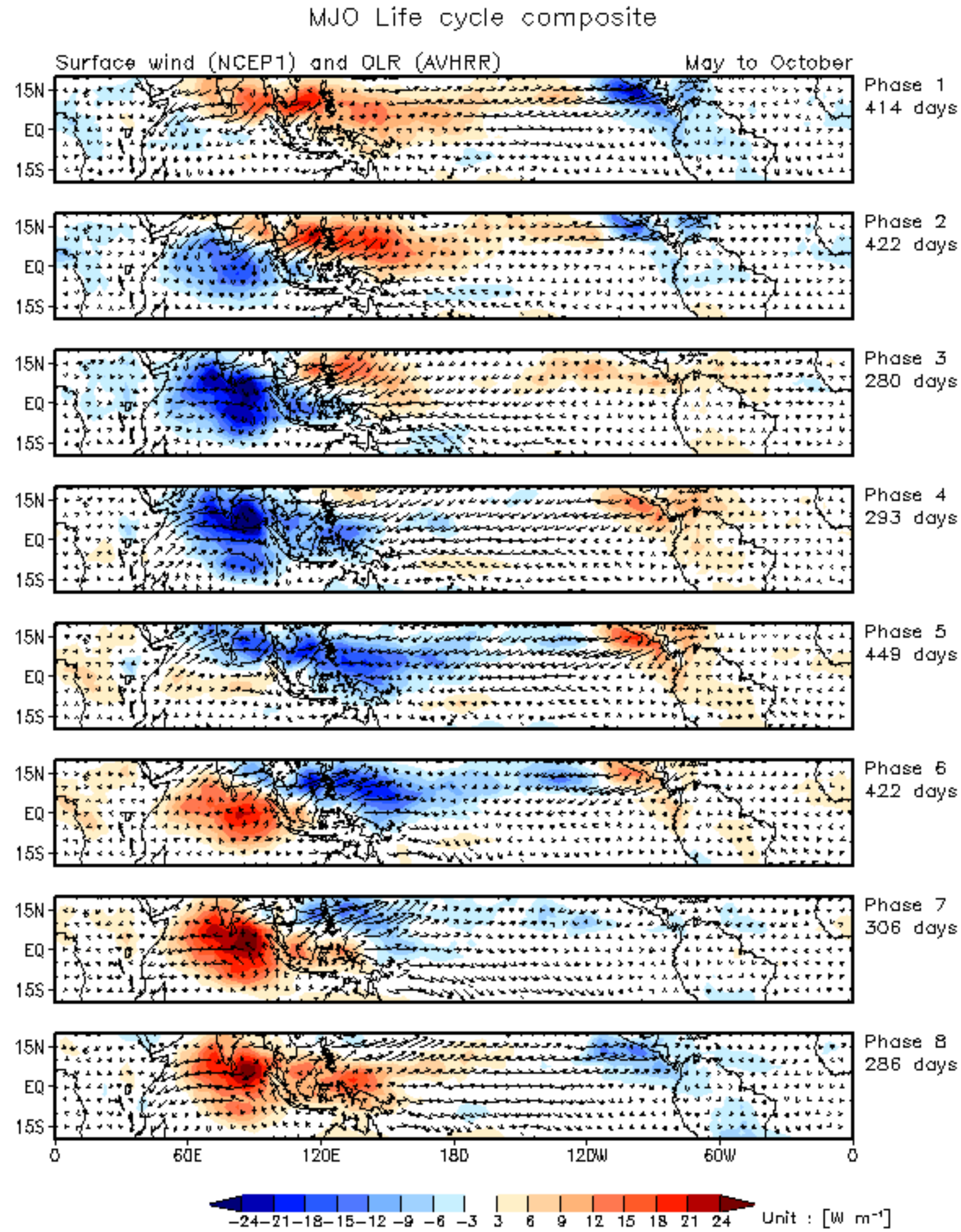
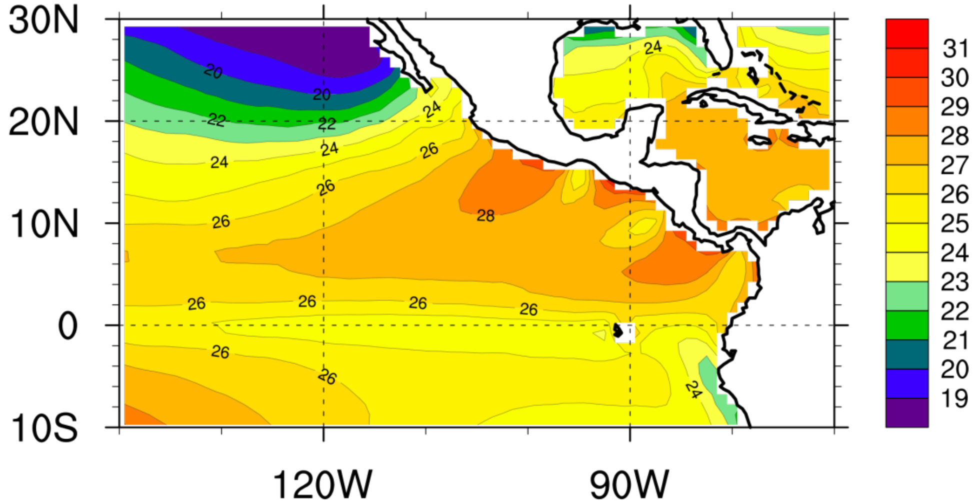
Composite Lifecycle of the MJO (Northern Hemisphere Summer)



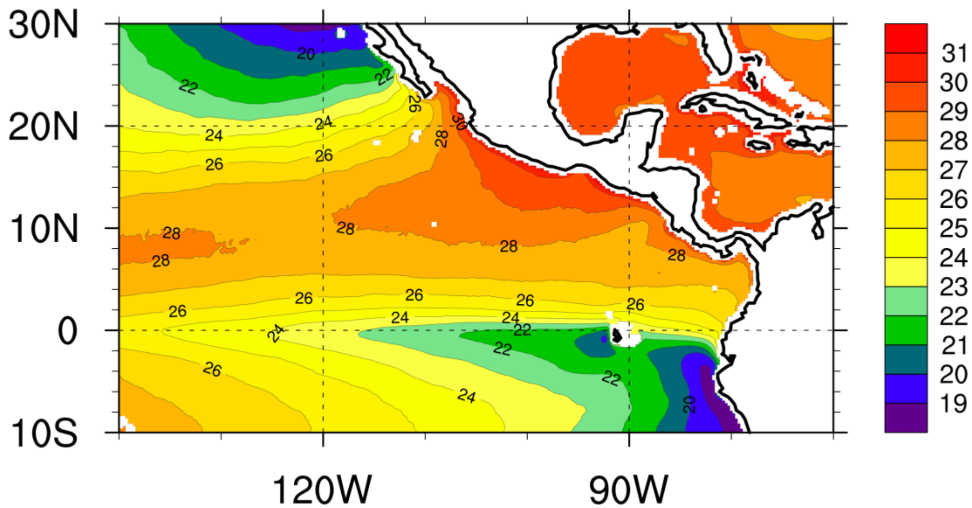
Courtesy of MJO Working Group

Boreal Summer vs. Winter Sea Surface Temperatures

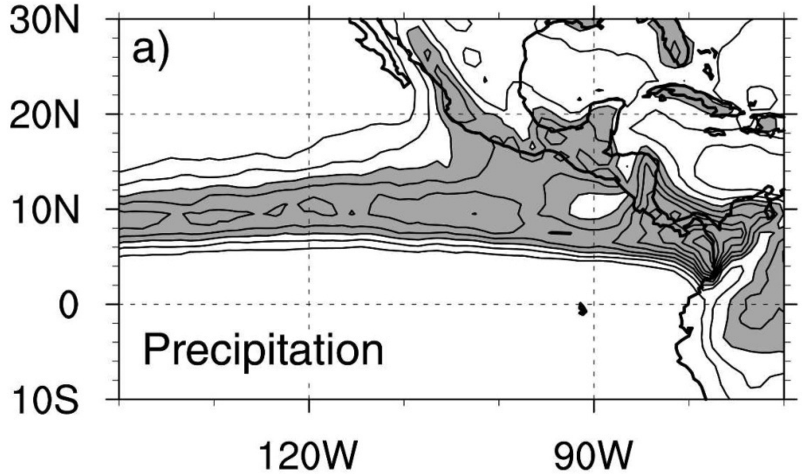
Mean November-April TMI SST



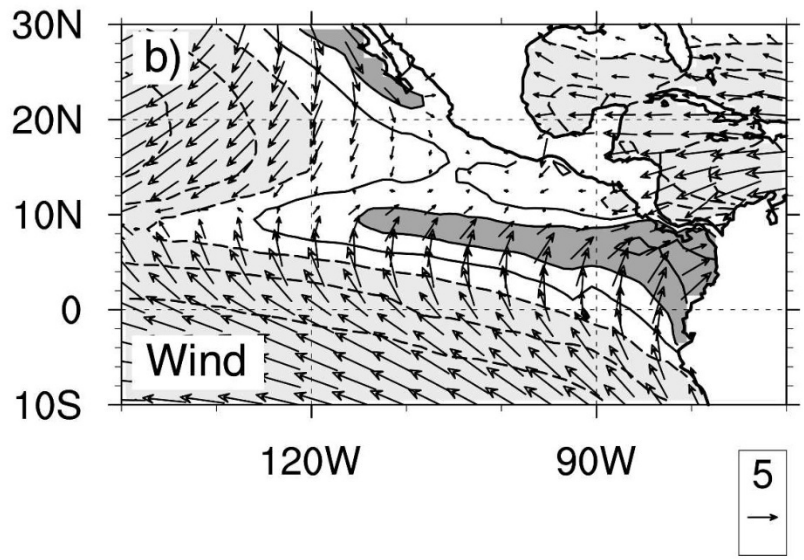
Mean June-October TMI SST



Boreal Summer Mean Precipitation and Wind (June-October)



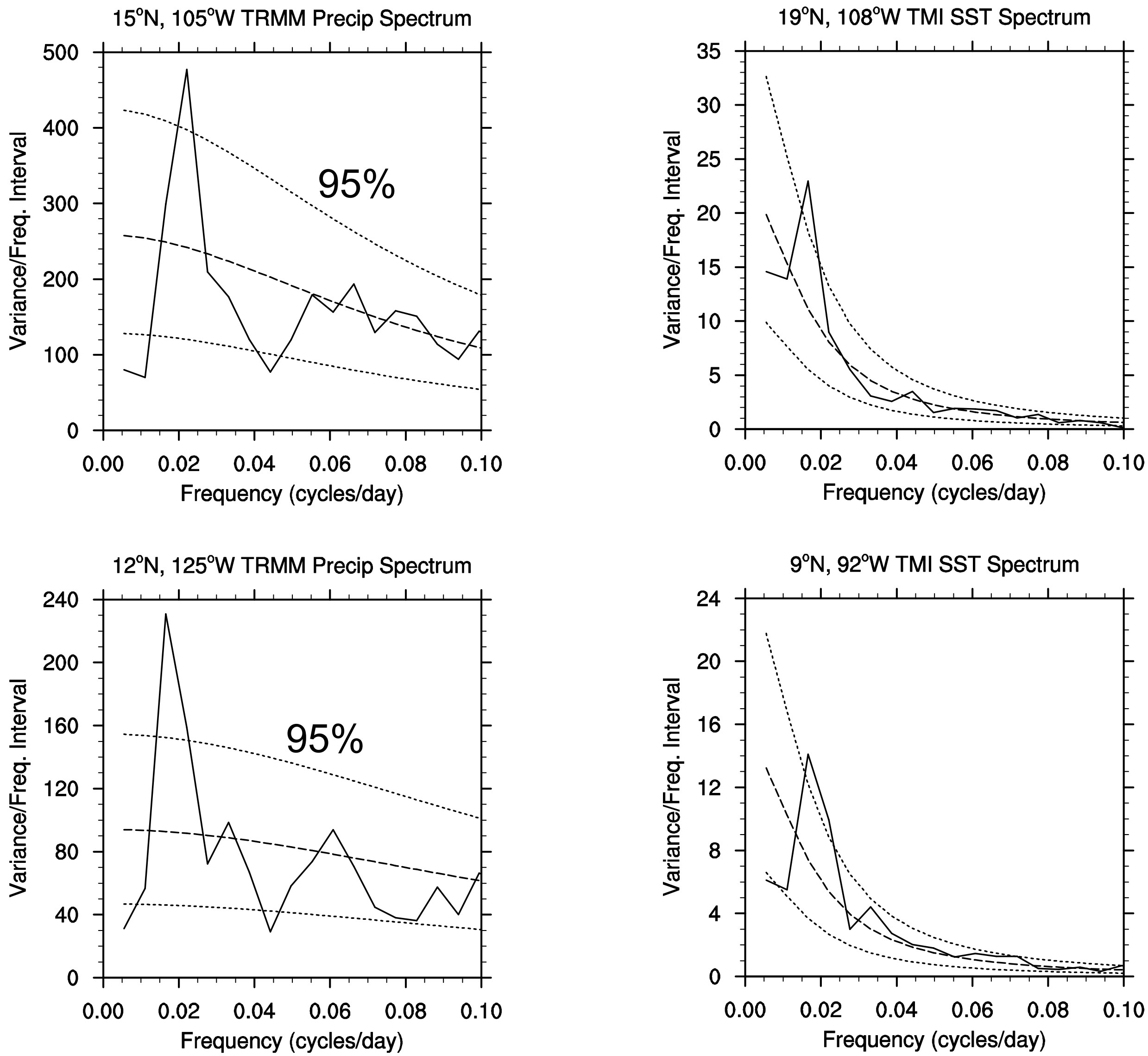
TRMM



QuikSCAT

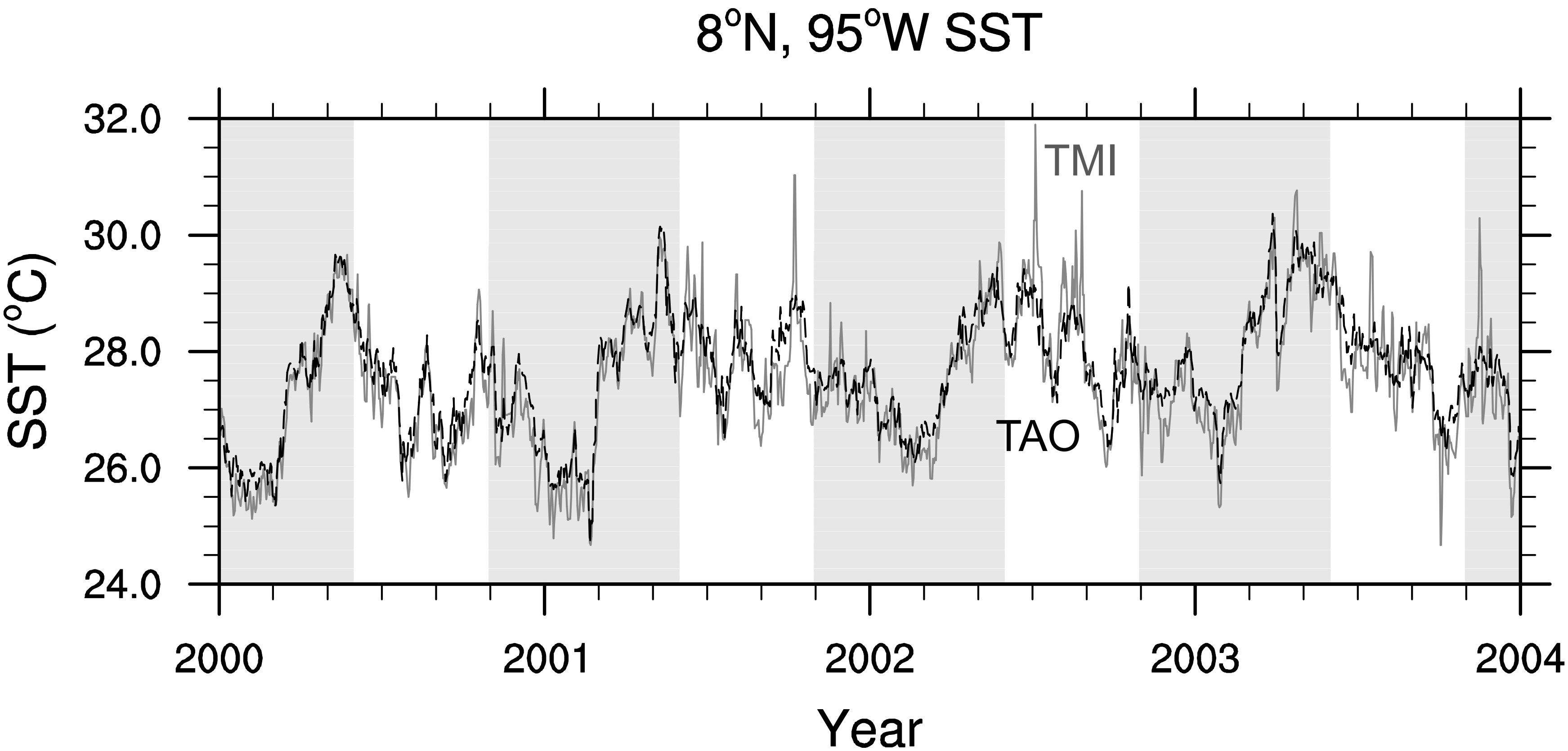
Maloney and Esbensen 2007

East Pacific Warm Pool Power Spectra



Maloney et al. (2008)

SST Variability at 8°N, 95°W

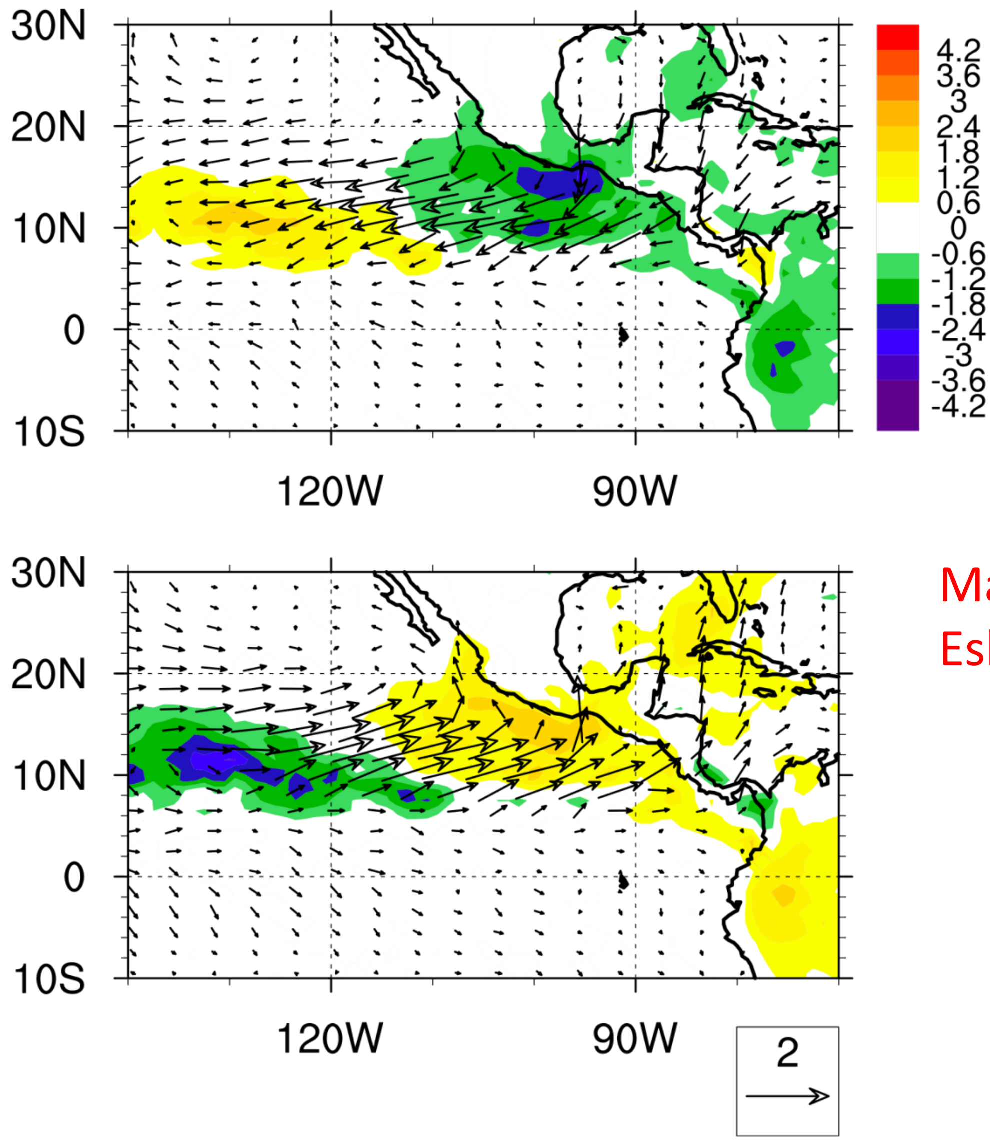


Maloney et al. (2008)

Intraseasonal Variability in the East Pacific (Opposite Phases)

East Winds/
Suppressed Precipitation

West Winds/
Enhanced Precipitation



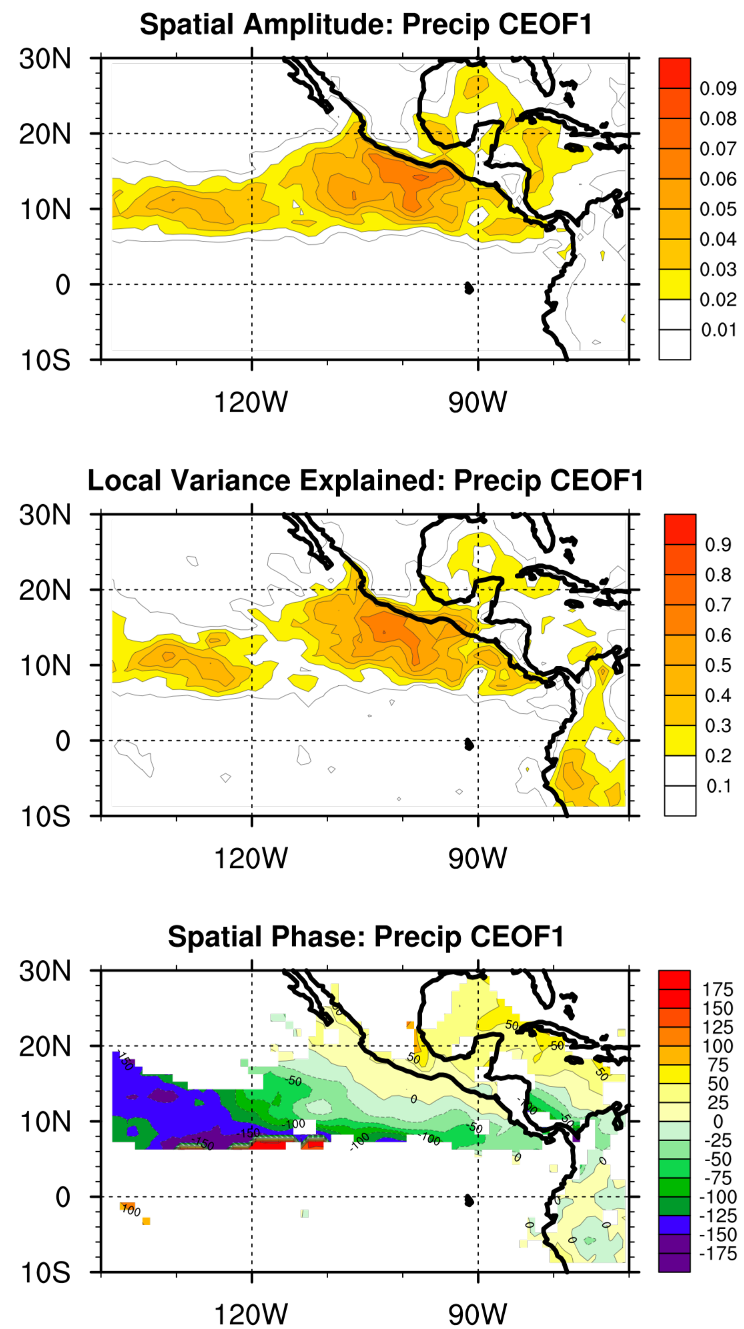
Maloney and Esbensen 2007

Precip: mm day^{-1}

20-100 day anomalies

Leading Complex EOF of 30-90 Day Precipitation

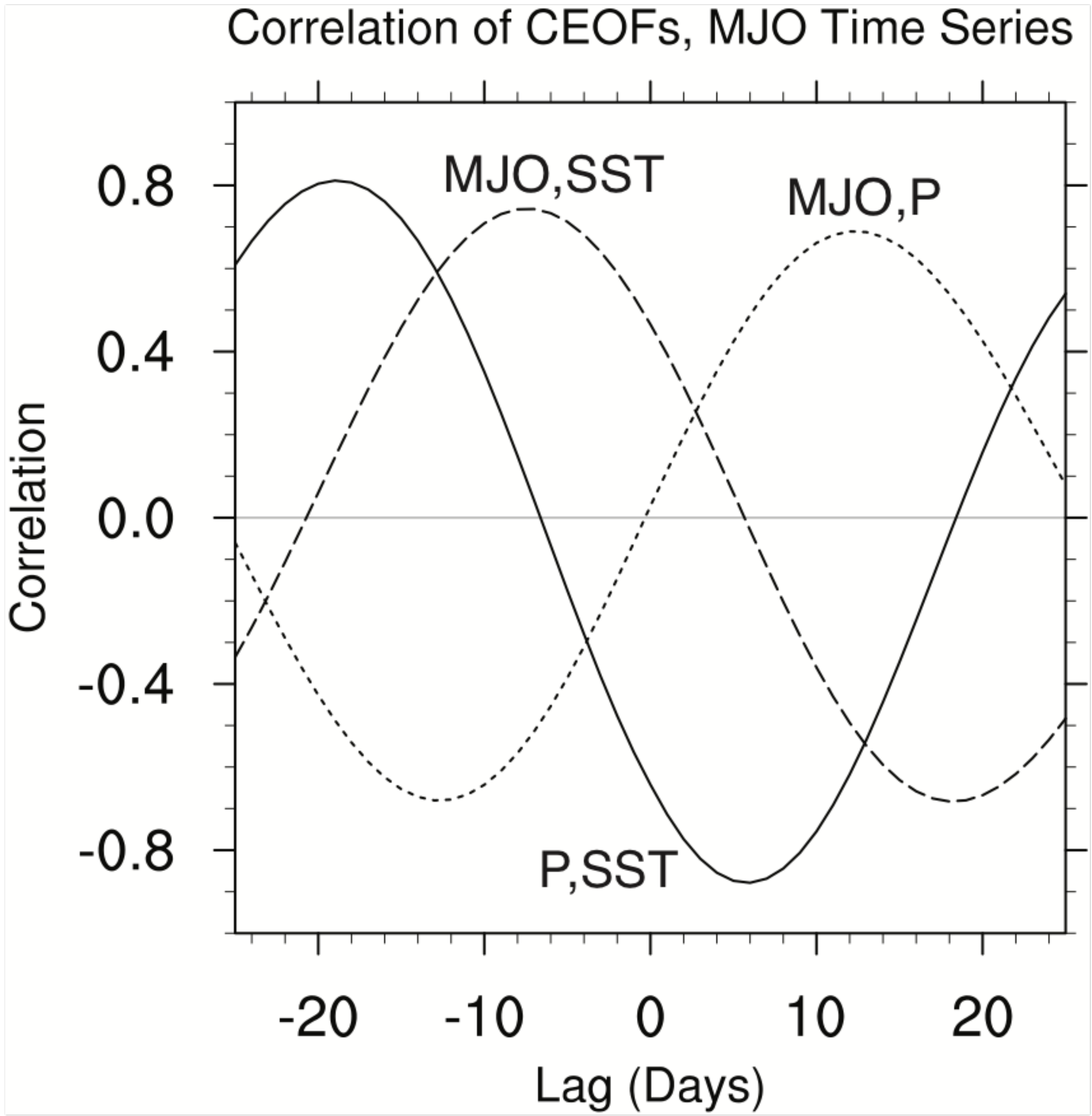
TRMM Precipitation



Maloney et al. (2008)

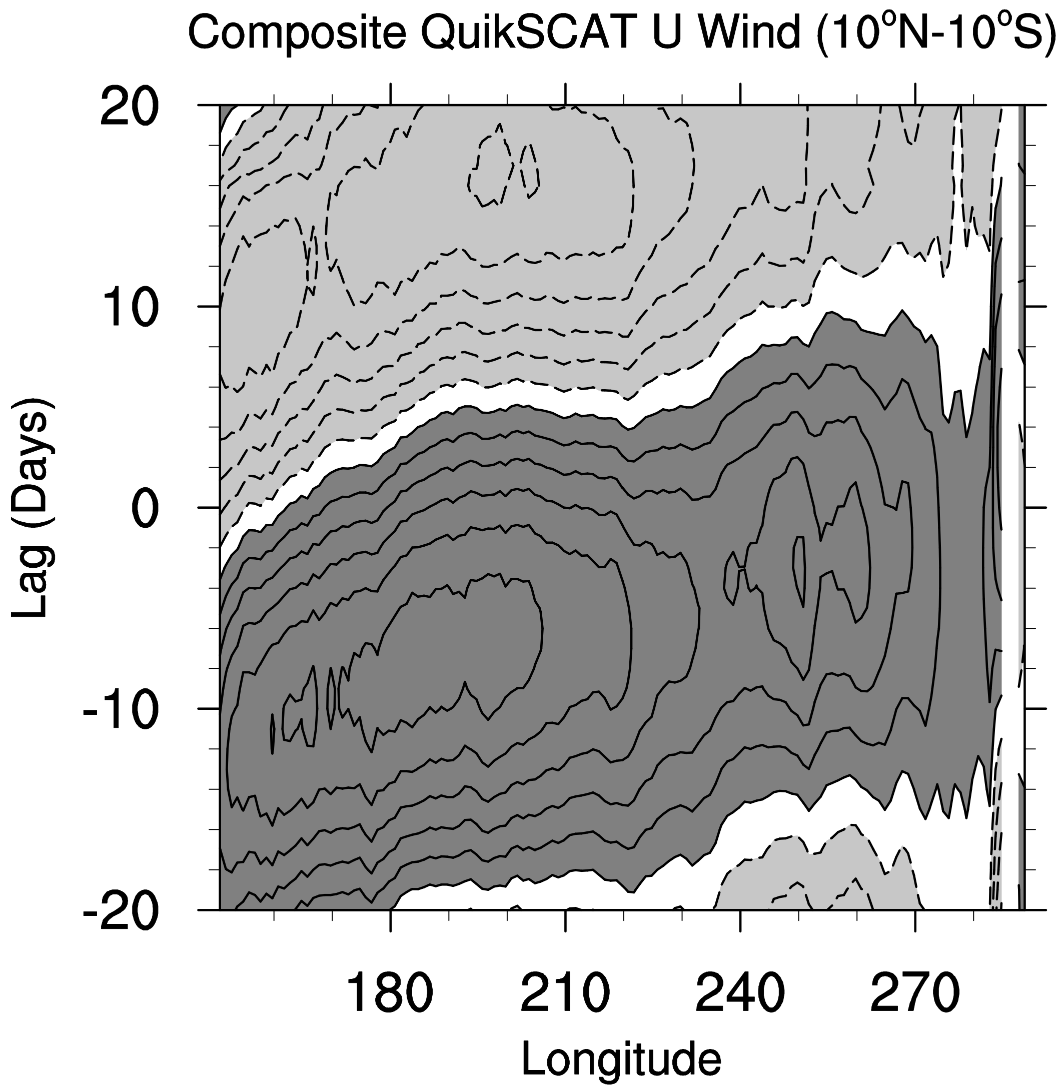
See also Xianan's poster

Lag Correlation: Leading Mode of East Pacific Variability with Global MJO Index

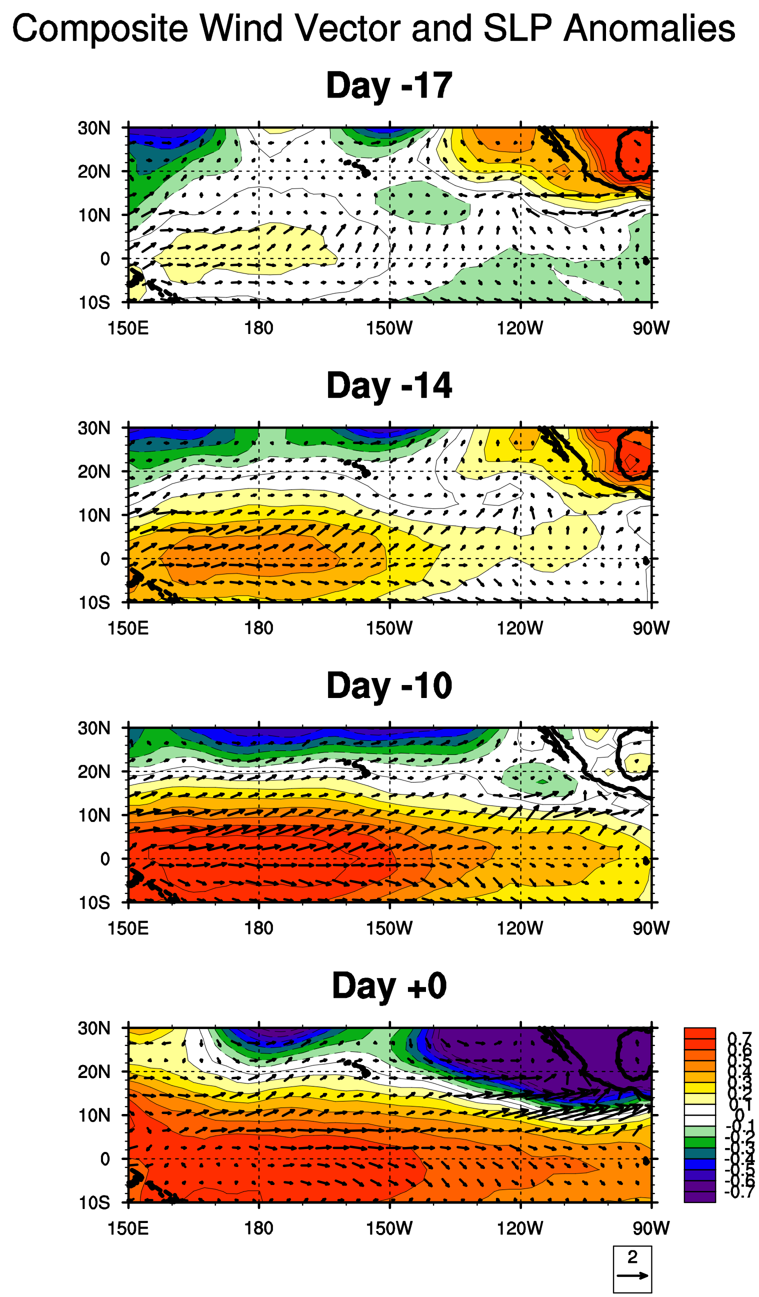


Maloney et al. (2008)

Dynamical Link to West Pacific

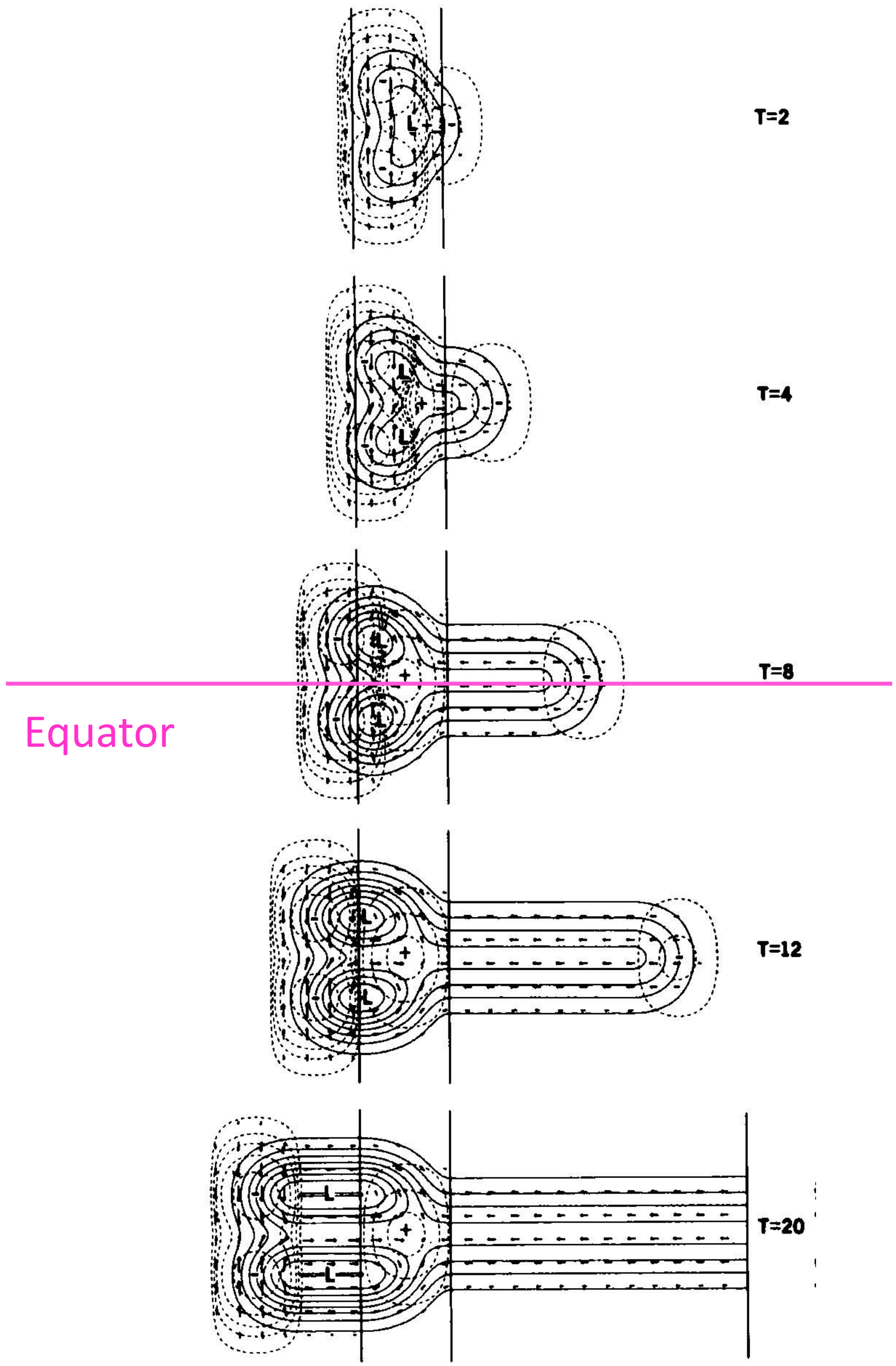


Kelvin-Wave Propagation into East Pacific (Keyed to East Pacific Wind Events)



Reminiscent of Heckley and Gill (1984) transient response to Suppressed Heating

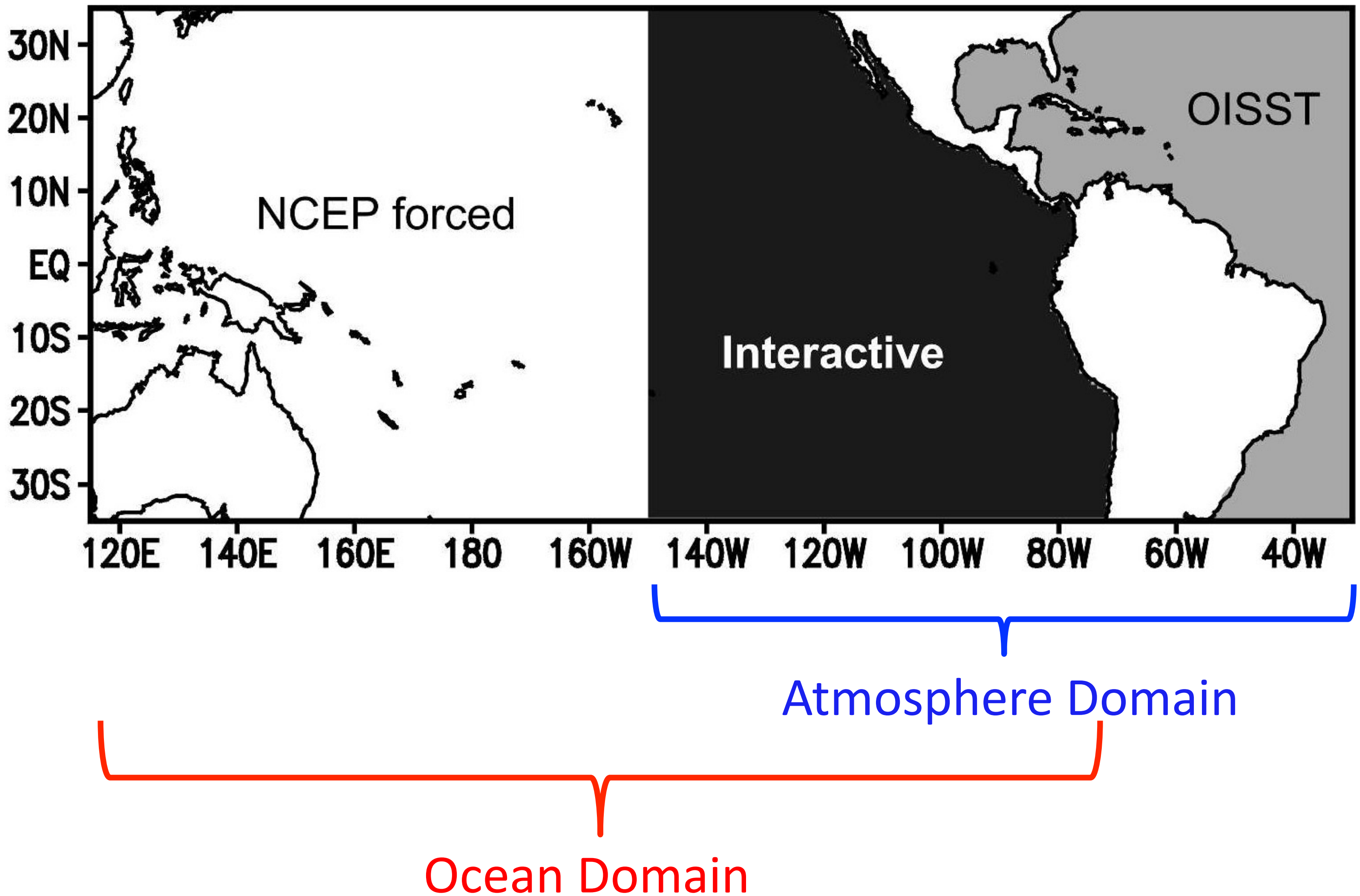
Adjustment of the Equatorial Wind and Pressure Field in Response a Heating (Indian Ocean?)



Heckley and Gill (1984)

Regional Model Work:
Toward Understanding the Remote Versus Local Regulation of East Pacific Intraseasonal Variability

IROAM Regional Coupled Model Setup



Small et al. (2010)

Modeling Study: Setup

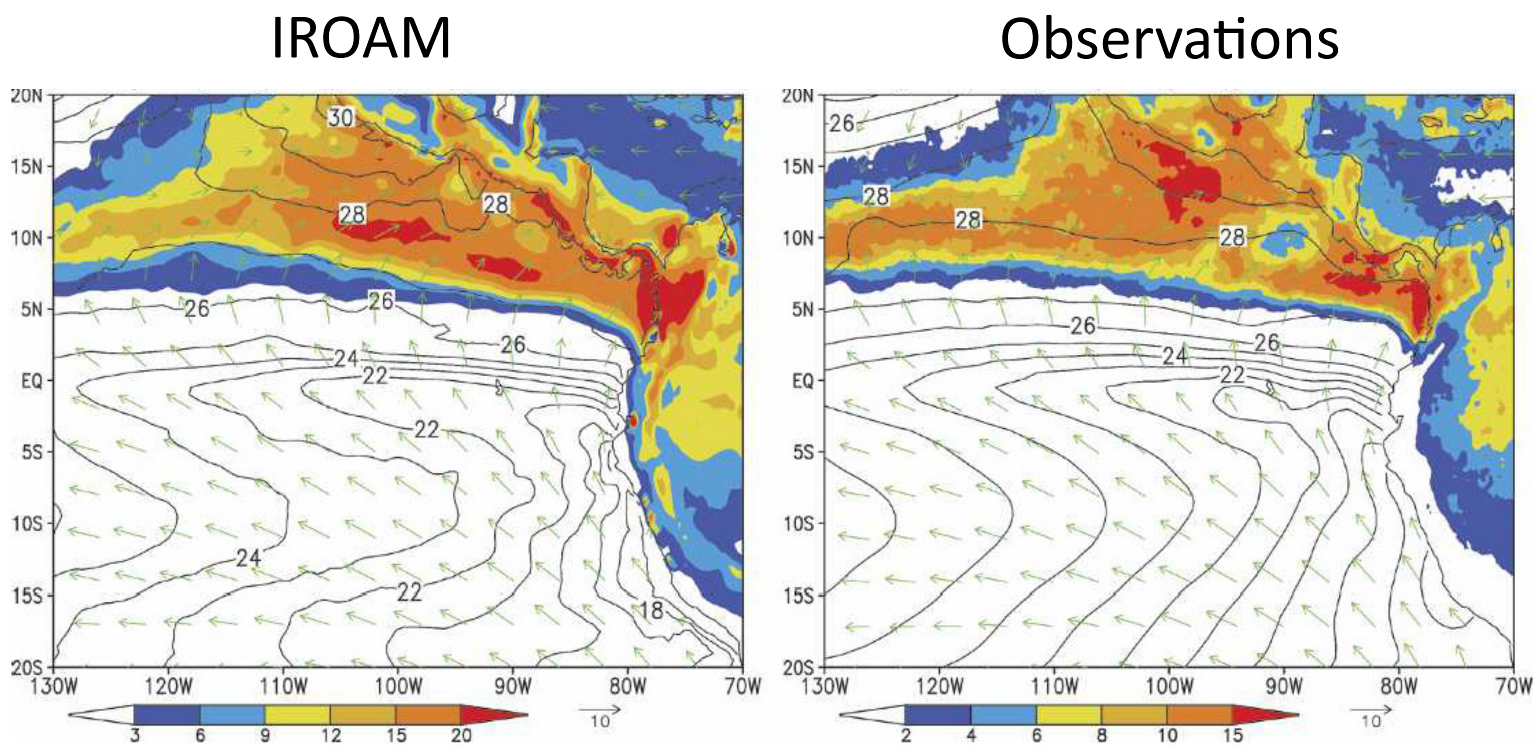
Ocean Model:

- Geophysical Fluid Dynamics Laboratory Modular Ocean Model (MOM2)
- 0.5° longitude by 0.5° latitude. There are 30 levels in the vertical, with 20 of them in the upper 400 m

Atmospheric Model

- IPRC regional atmospheric model
- Hydrostatic, Tiedtke deep convection parameterization
- 0.5° x 0.5° grid, and has 28 vertical levels with 11 of them below 800 hPa
- Model forced by NCEP reanalysis at the atmospheric boundaries

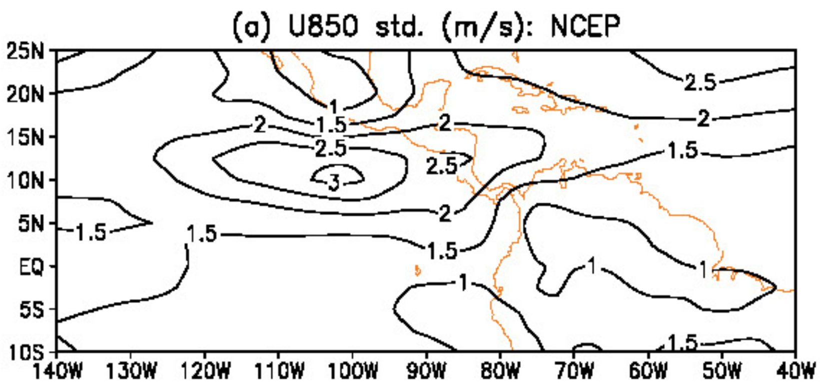
IROAM Simulation of Mean Climate (Precip, SST, Winds)



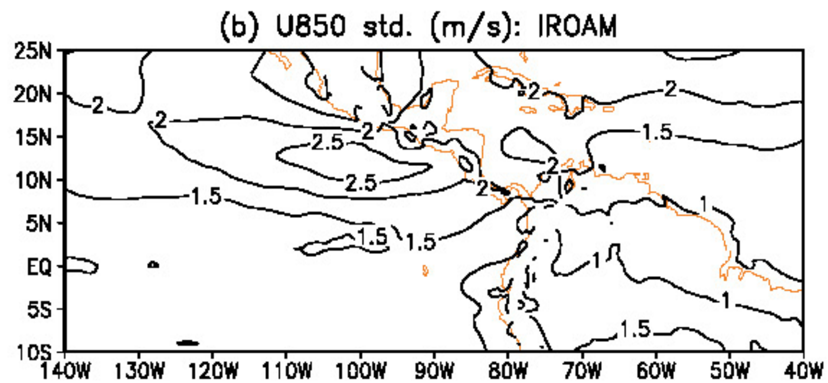
Small et al. (2010)

IROAM Simulation of 20-100 Day Wind Variability

IROAM

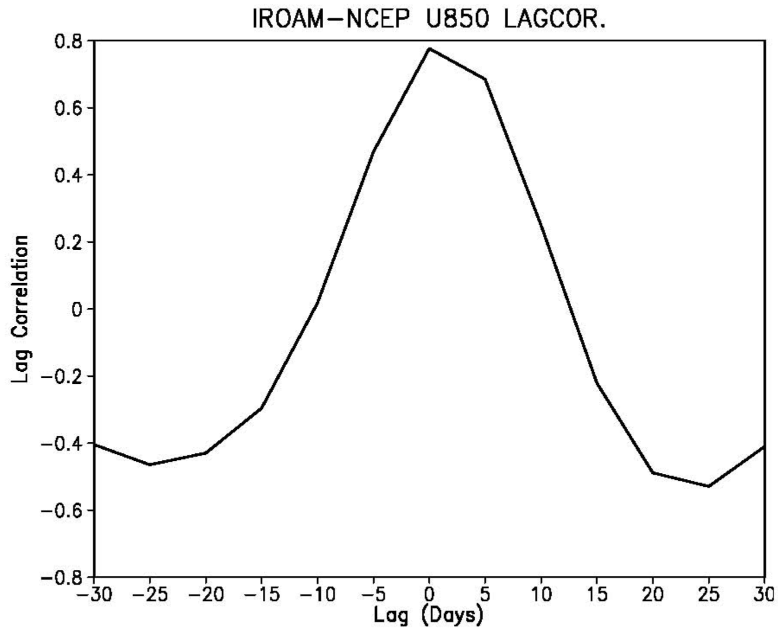


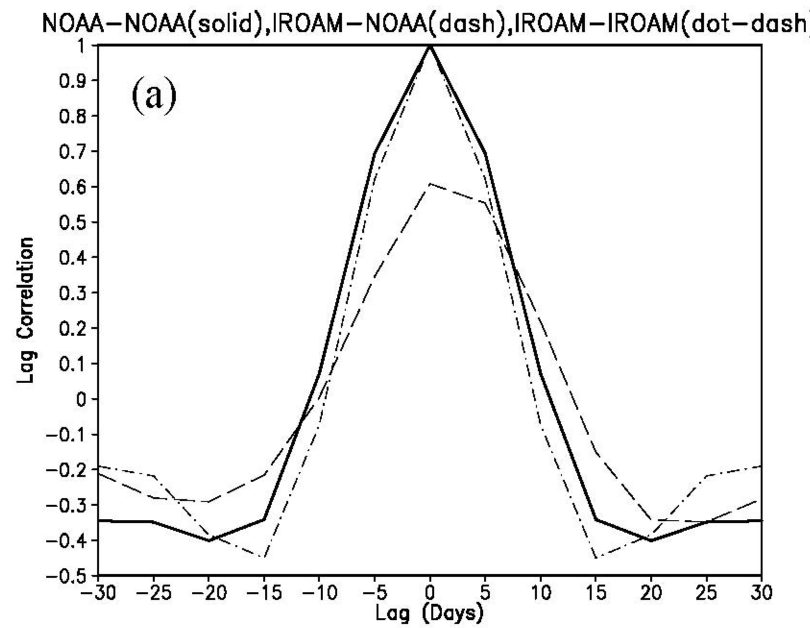
Observations



Small et al. (2010)

Correlation Between IROAM and Observed 20-100 Day Winds

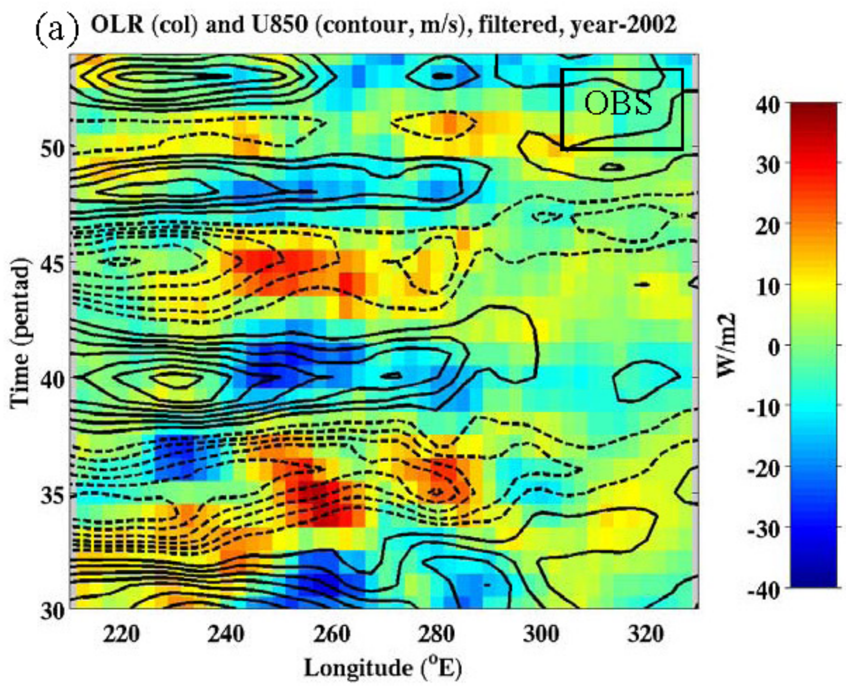




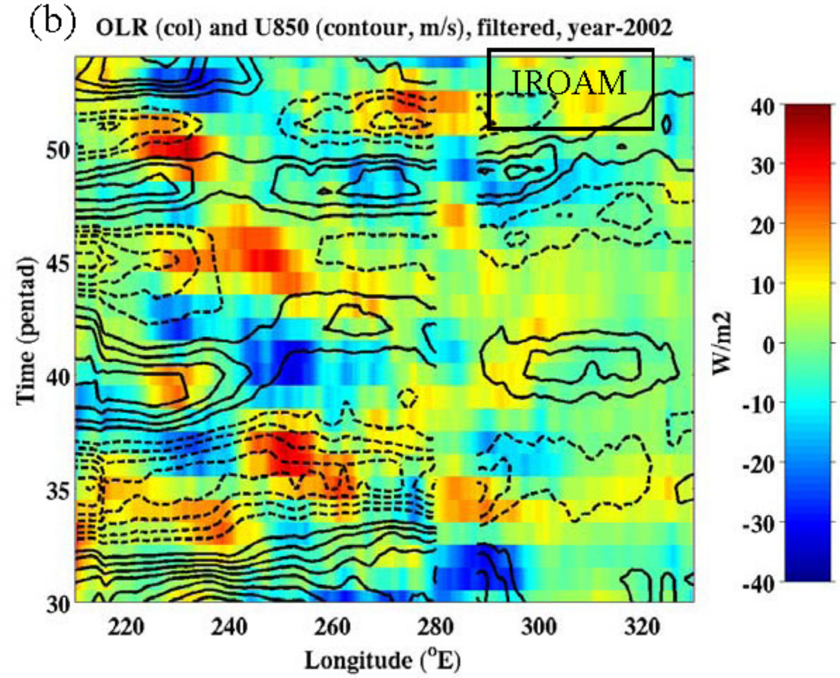
Small et al. (2010)

Western Boundary Propagation Appears to Initiate Intra Americas Seas Variability

Observed Convection and U850



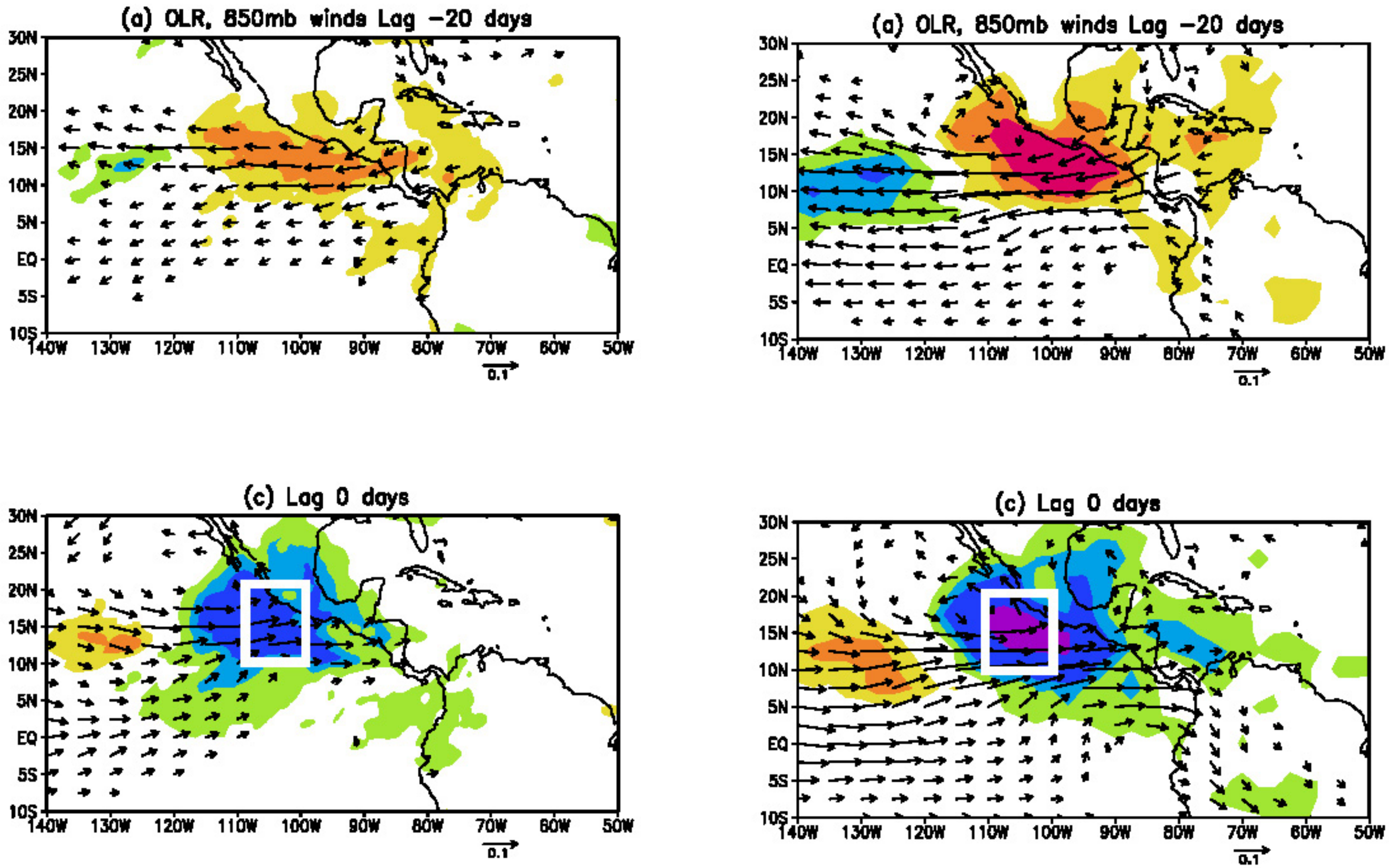
IROAM Convection and U850



Small et al. (2010)

IROAM Simulation of 20-100 Day Wind Variability

IROAM | Observations

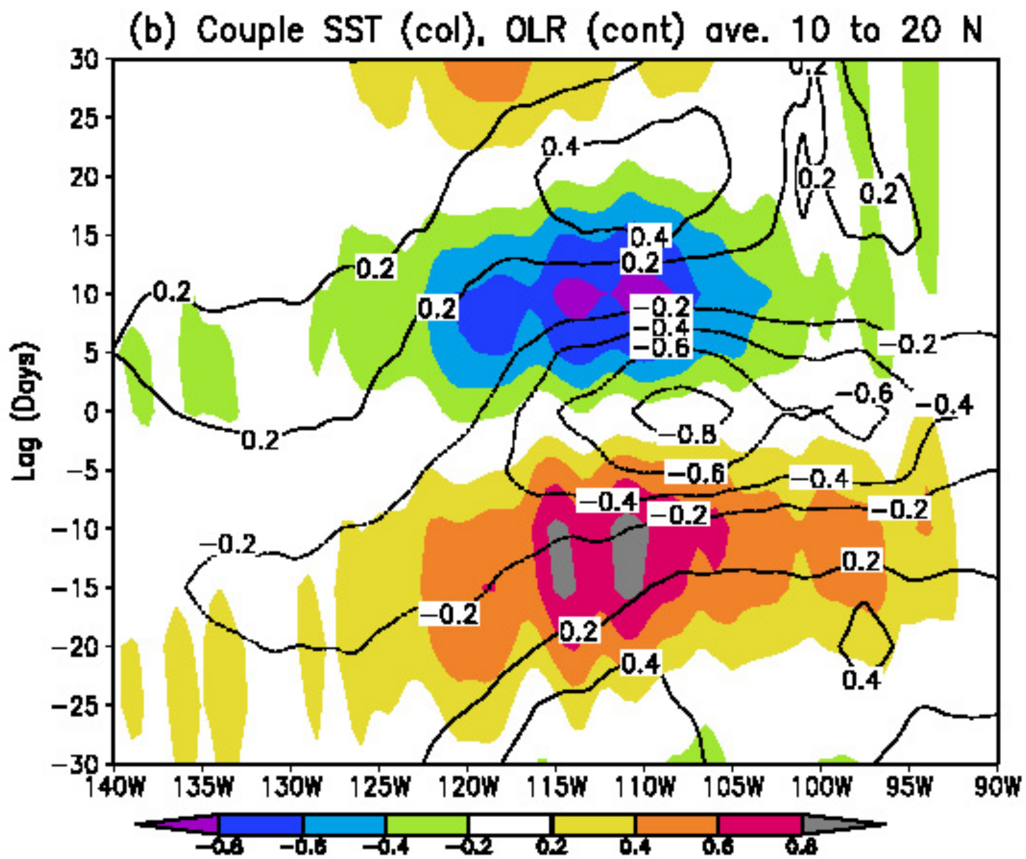


Small et al. (2010)

Effect of Ocean Coupling

Regional Model Does Produce Realistic SST Anomalies

SST and Outgoing Longwave Radiation

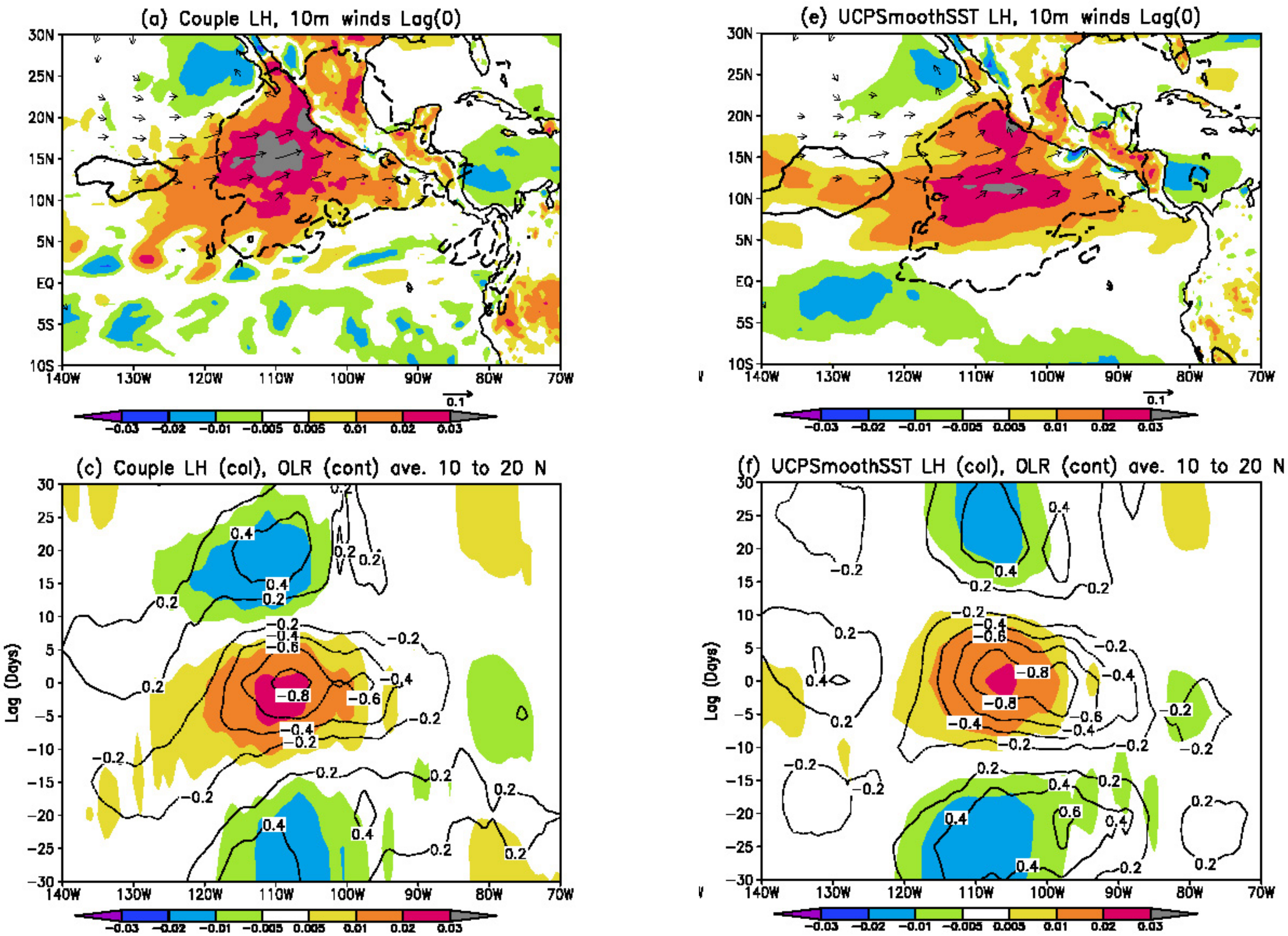


Small et al. (2010)

However, Removing SST Coupling Has Little Effect

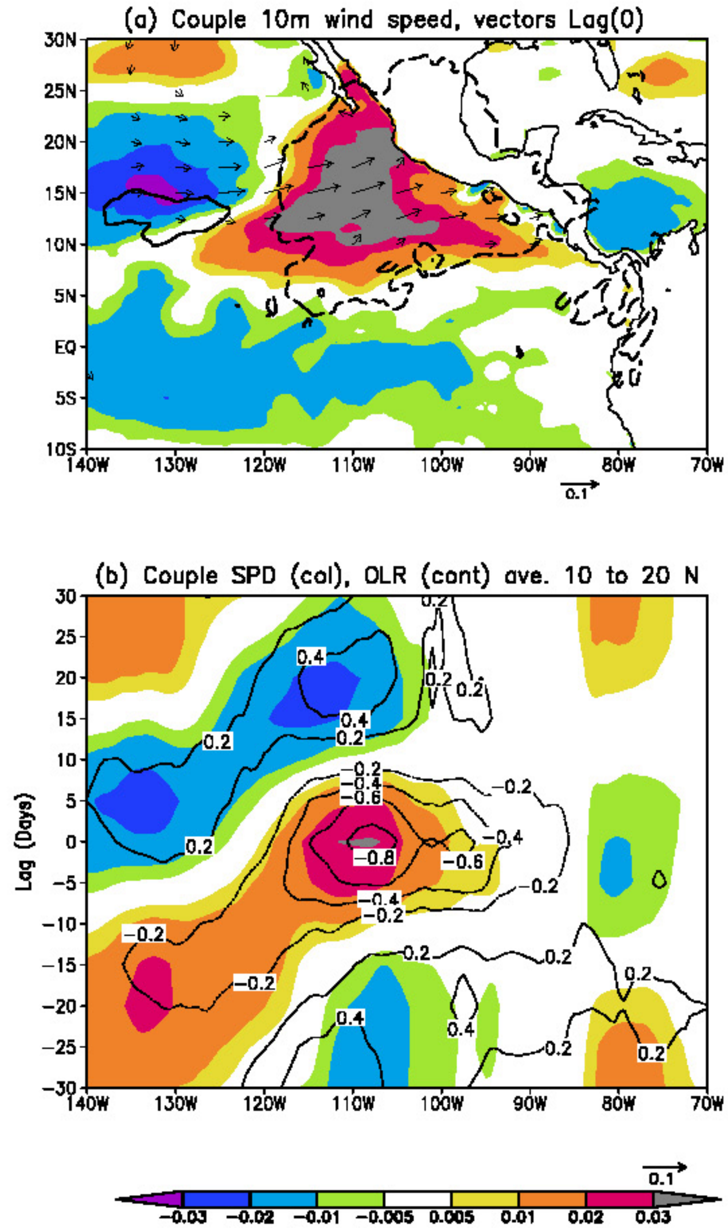
Coupled

Uncoupled



Small et al. (2010)

Composite Wind Speed, Wind Anomalies, OLR



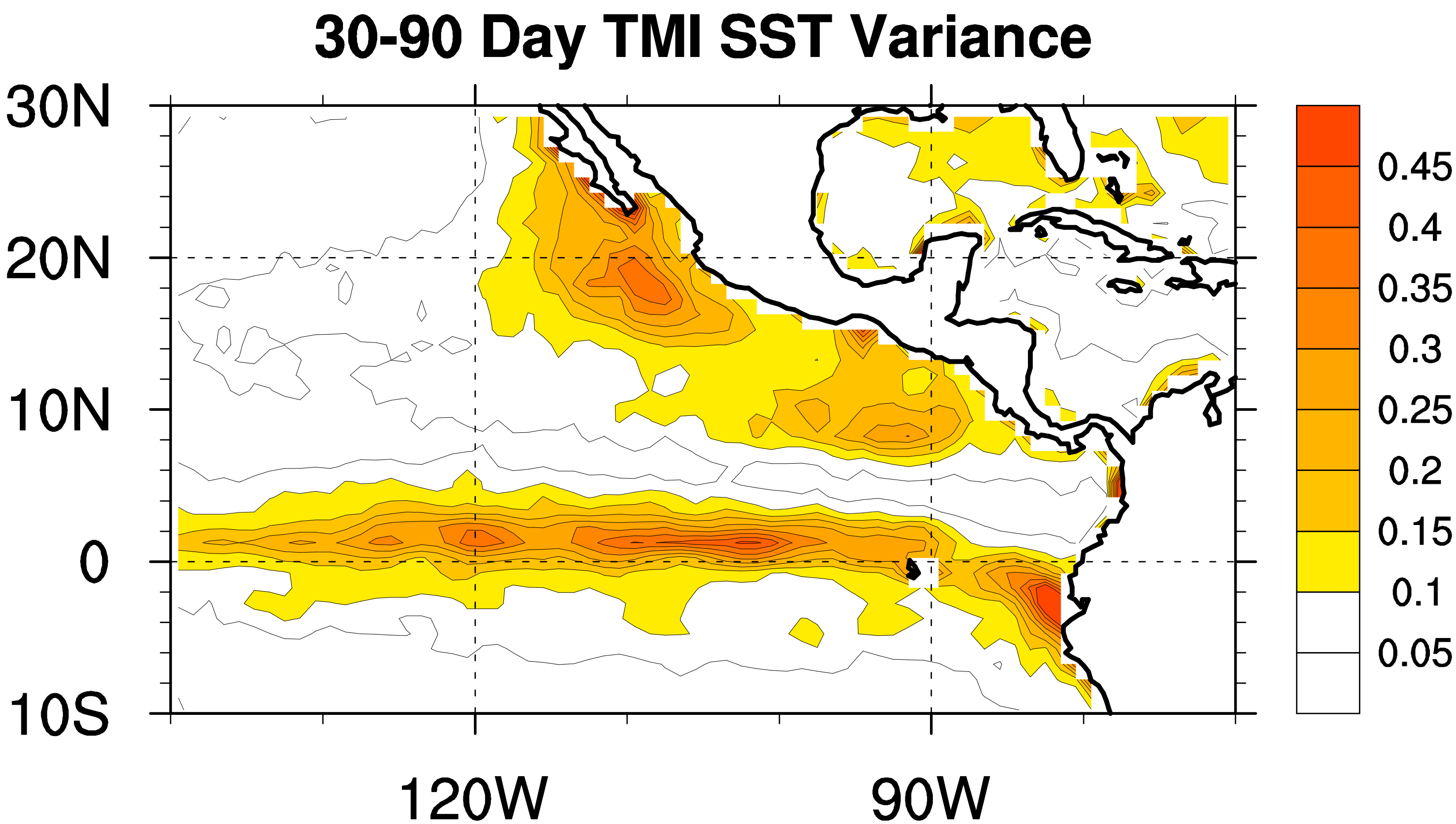
Small et al. (2010)

Future Work

- Remove intraseasonal anomalies in dynamical fields from the eastern and western boundaries to assess whether remote influences are necessary to produce intraseasonal variability in this region
- Observational analysis of Eastern Hemisphere and Western Hemisphere events and their coincidence
- Mechanism denial experiments (latent heat flux, radiative feedbacks)

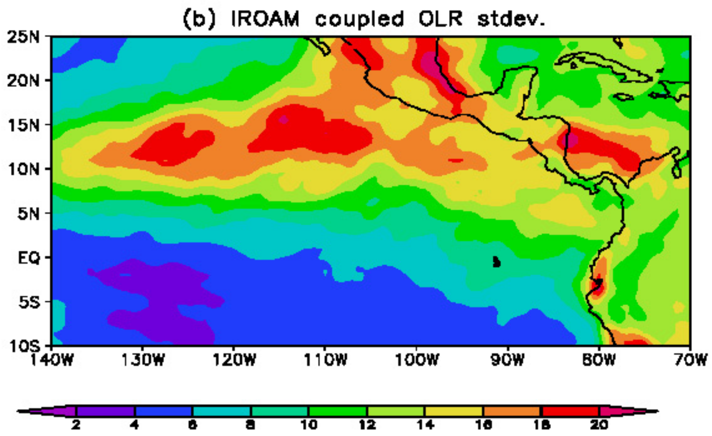

Thanks!

Observed Intraseasonal SST Variance

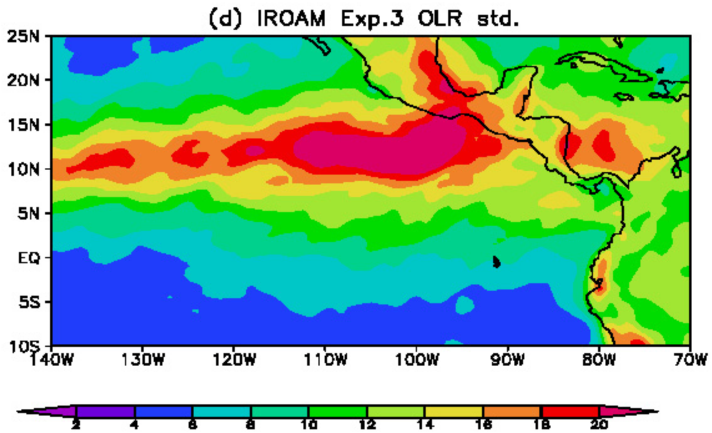


Maloney et al. (2008)

Effect of SST Coupling, OLR Variability

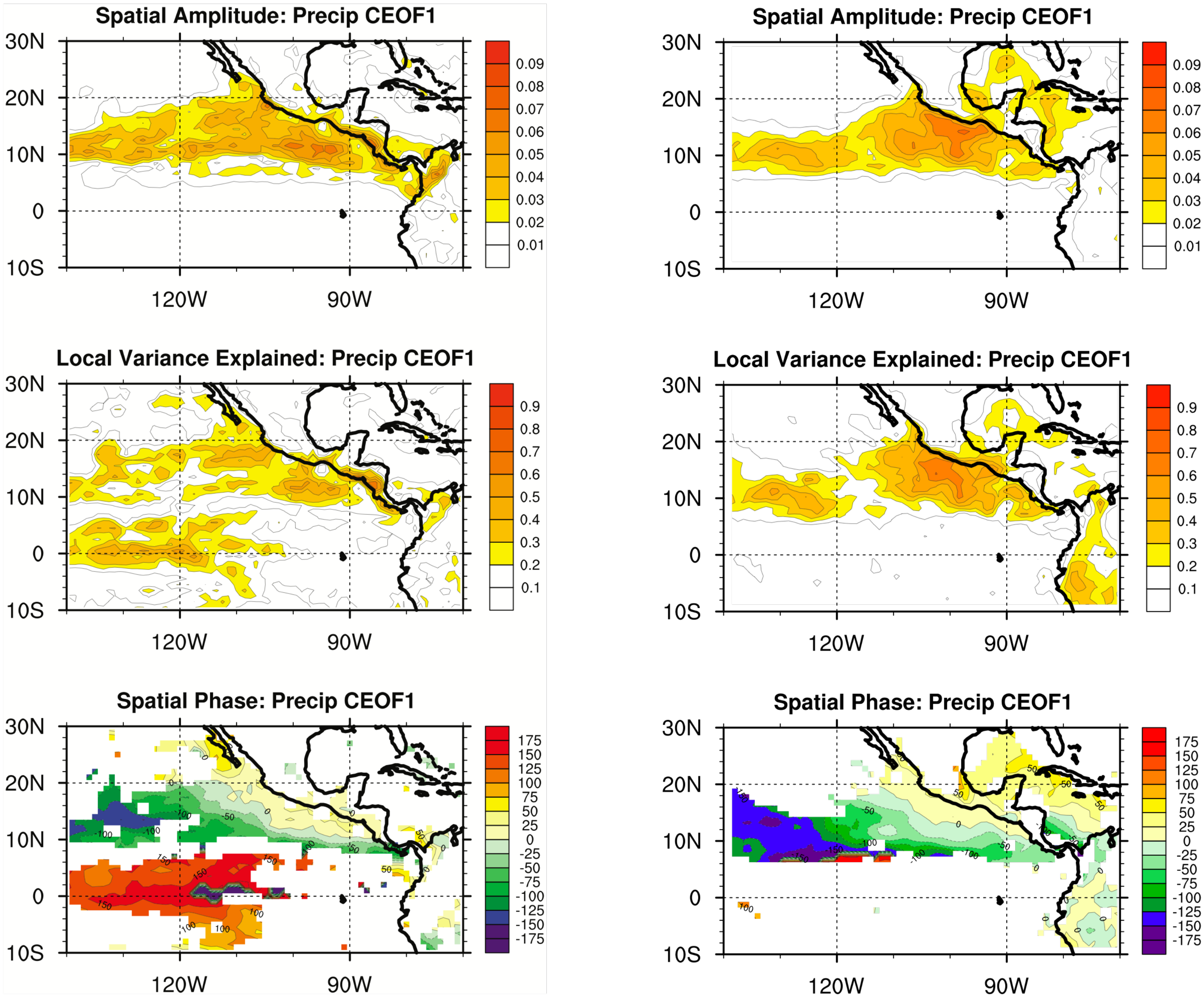


IROAM Coupled

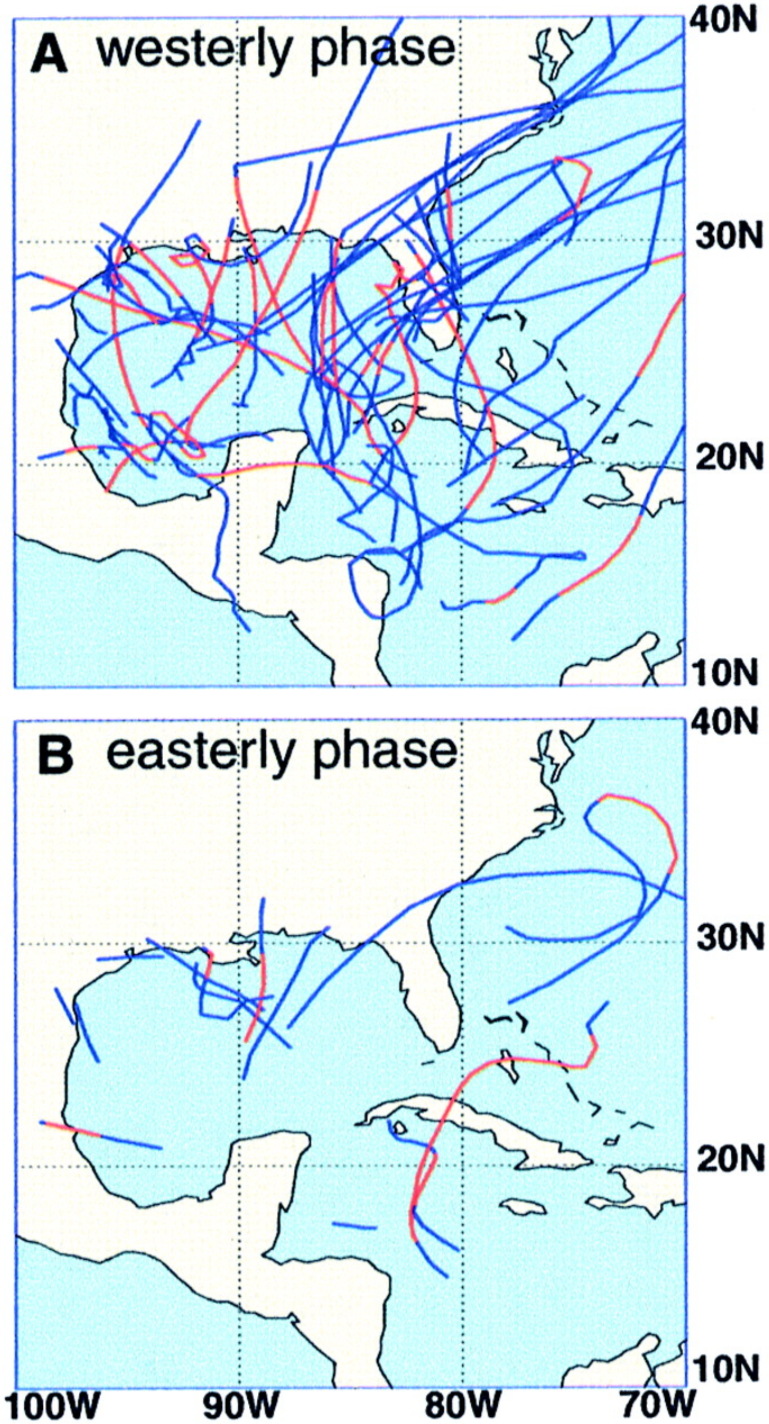


IROAM Uncoupled,
No Intraseasonal SST Anomalies

Small et al. (2010)


Spatial Amplitude: Precip CEOF1
Spatial Amplitude: Precip CEOF1
Local Variance Explained: Precip CEOF1
Local Variance Explained: Precip CEOF1
Spatial Phase: Precip CEOF1
Spatial Phase: Precip CEOF1
30N
20N
10N
0
10S
120W
90W
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
175
150
125
100
75
50
25
0
-25
-50
-75
-100
-125
-150
-175

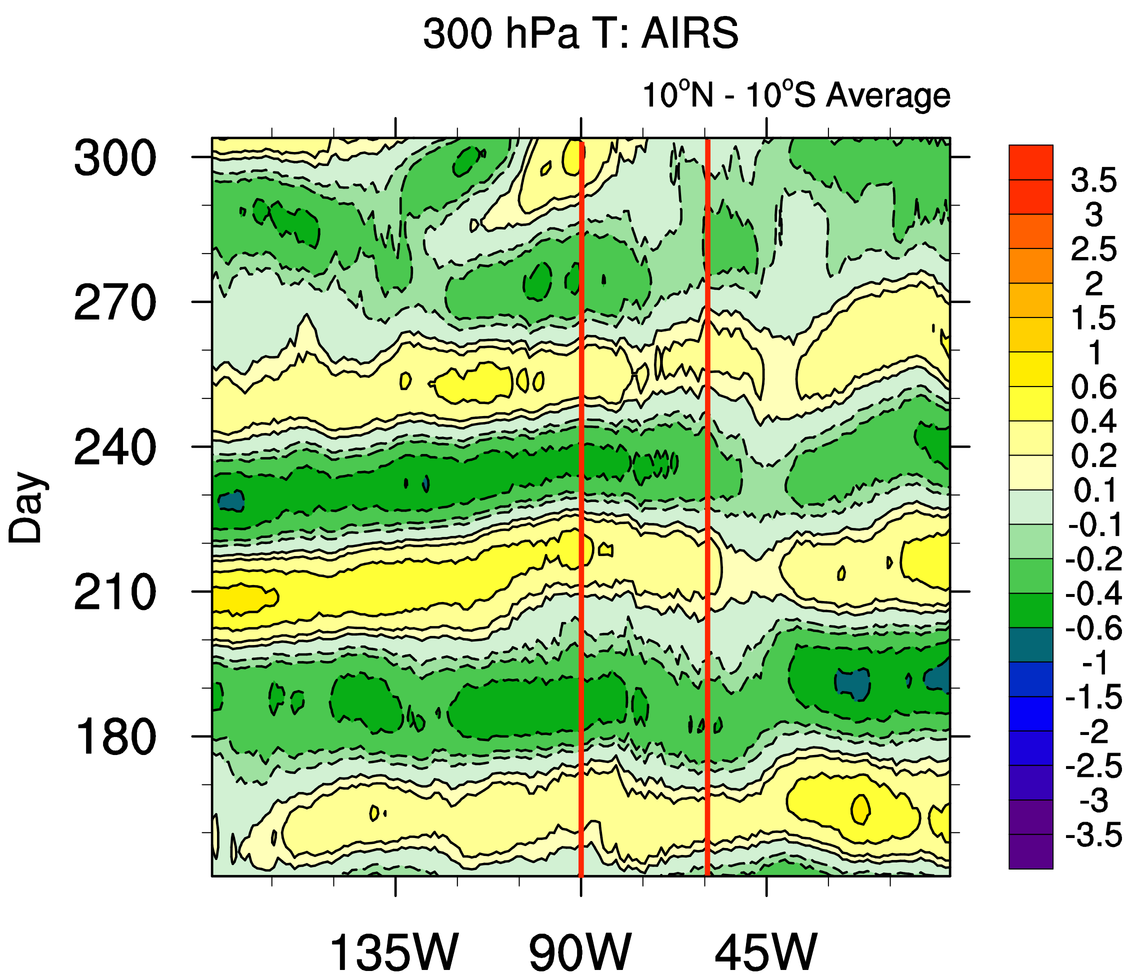
MJO Hurricane Modulation



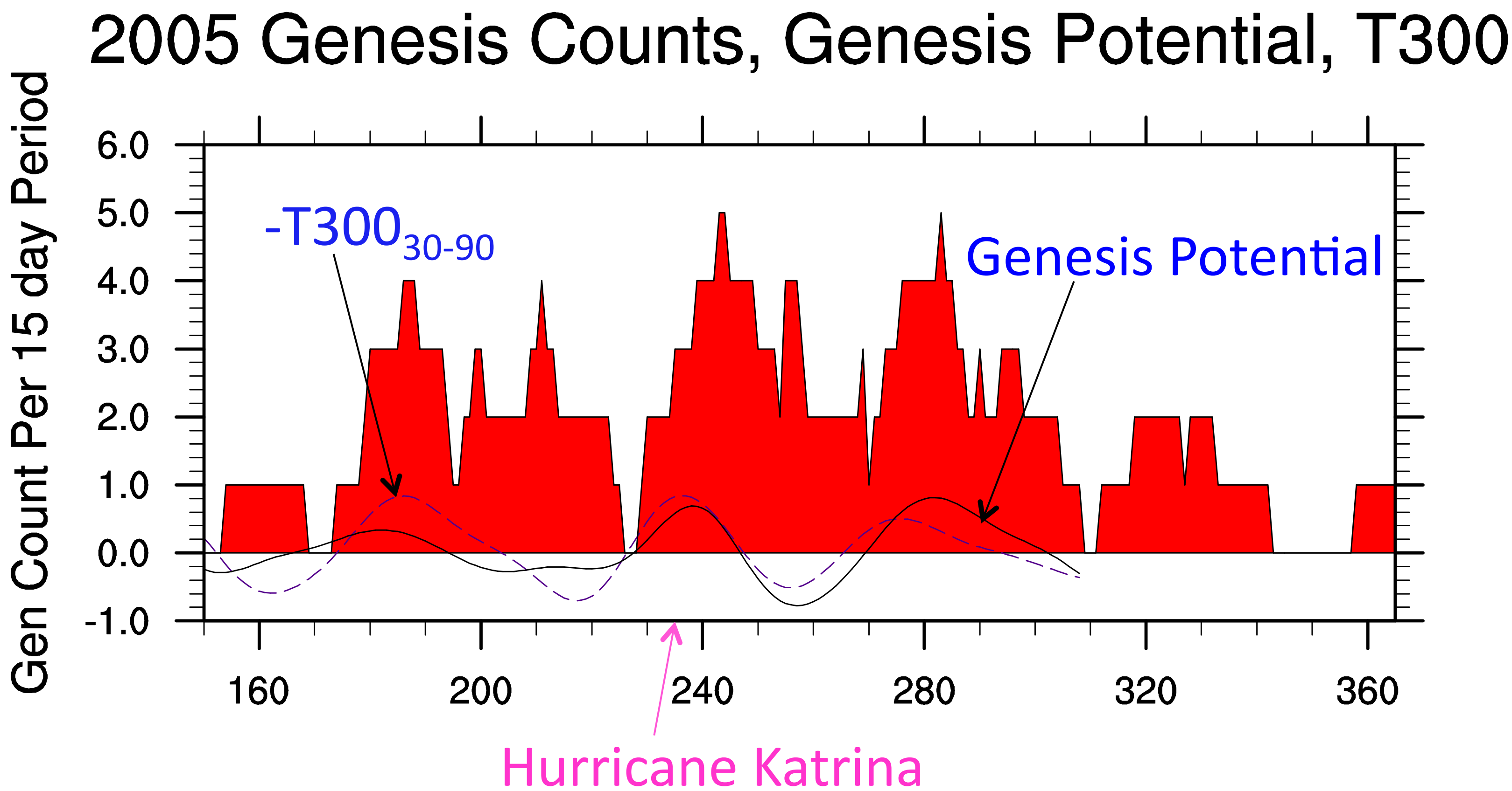
20-100 day anomalies

Maloney and Hartmann 2000

2005 AIRS 300 hPa Temperature Anomalies

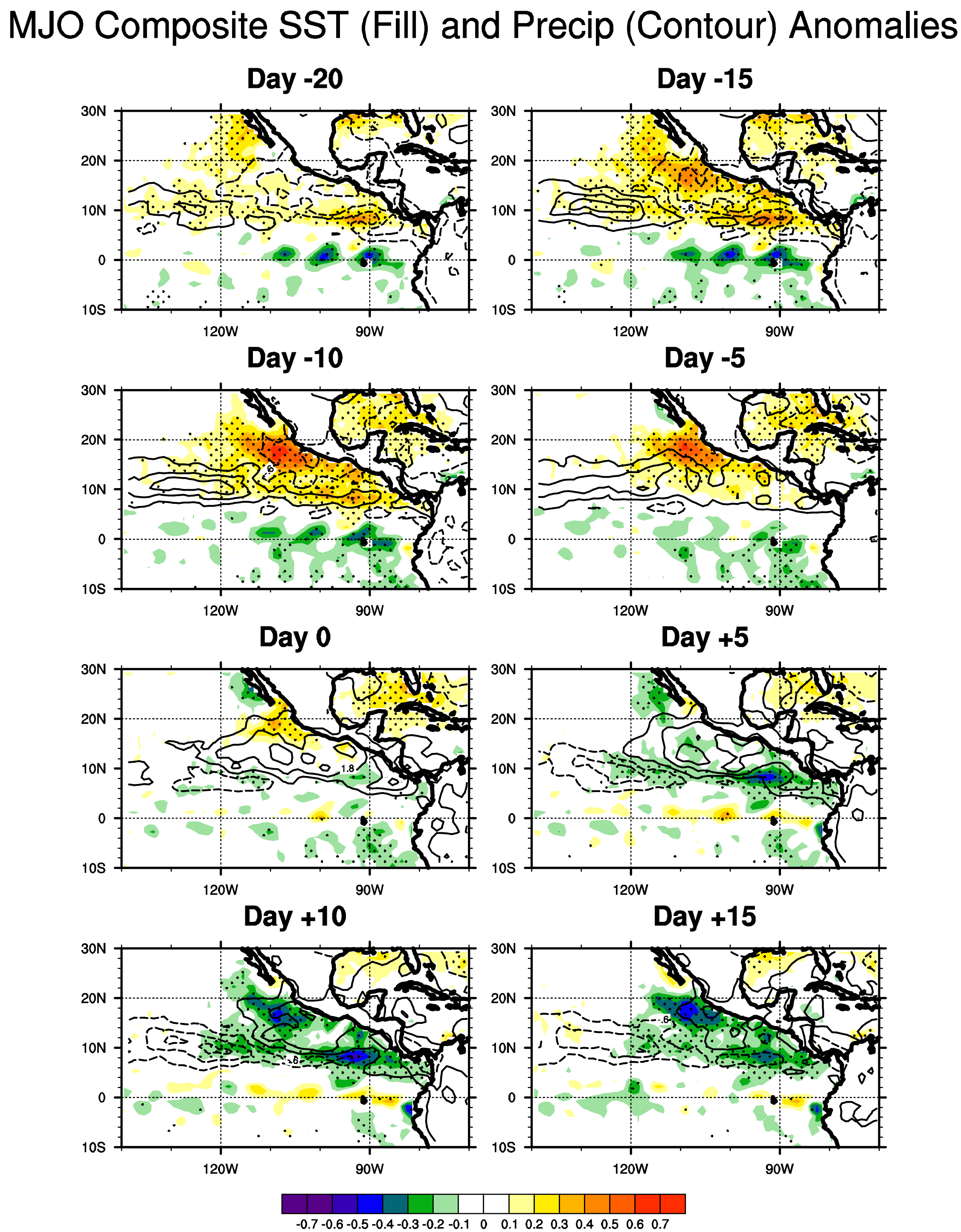


2005 Atlantic Genesis Events



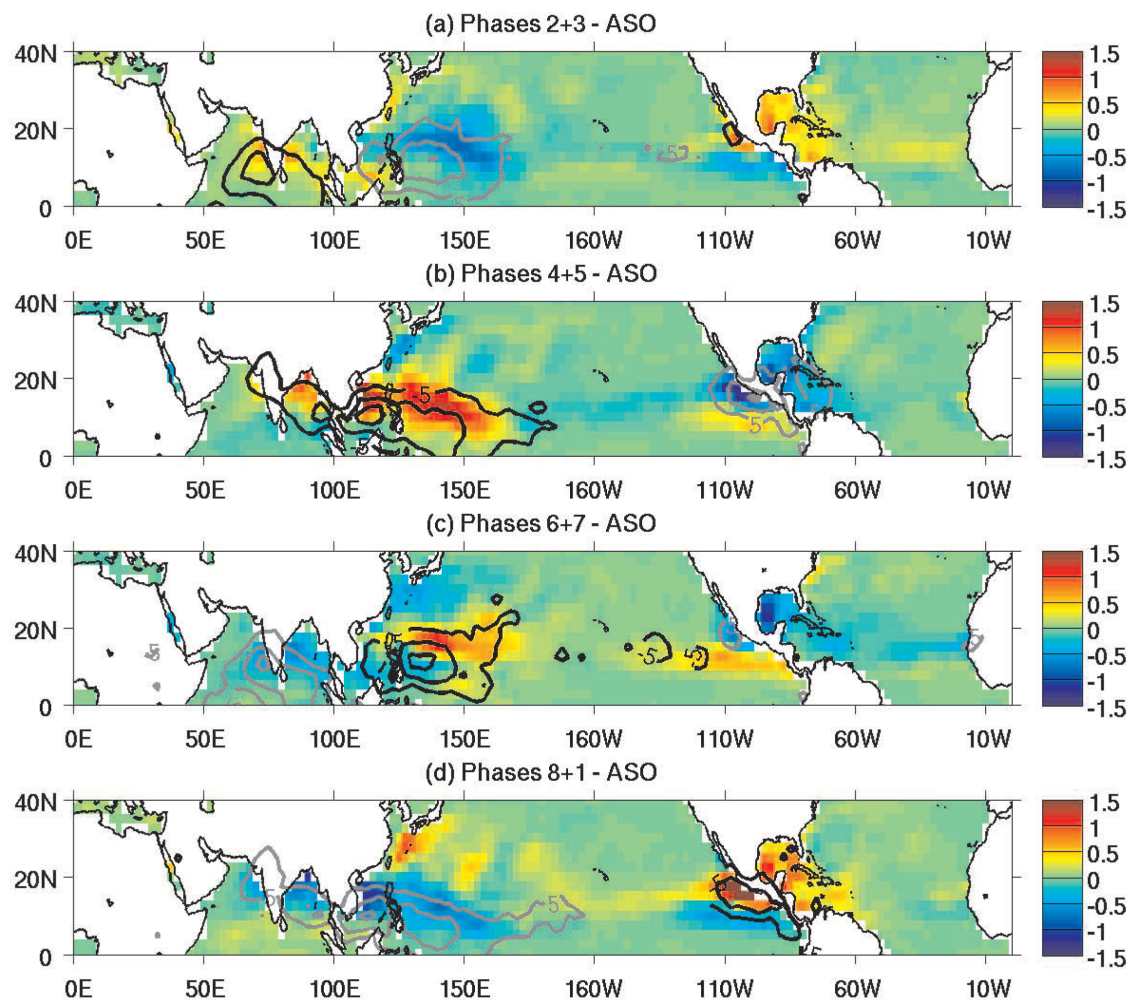
Using Nolan et al. (2007) Genesis Potential Index

Cycle of Precipitation and SST During MJO Events



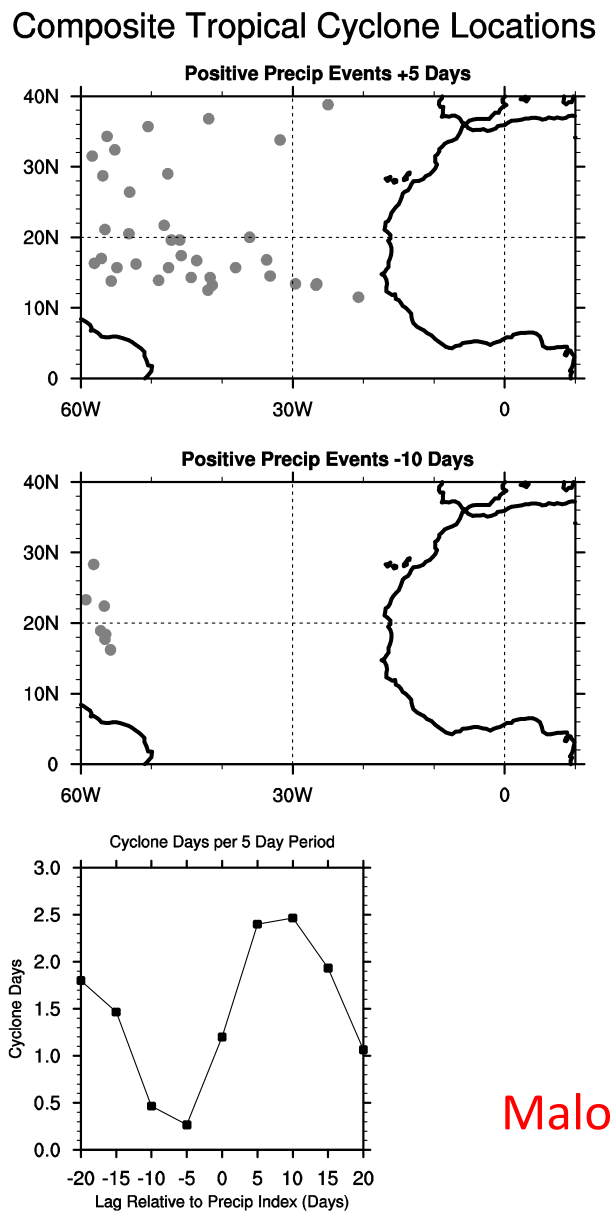
Maloney et al. (2008)

The Potential for Tropical Cyclone Genesis Varies by Phase of the MJO



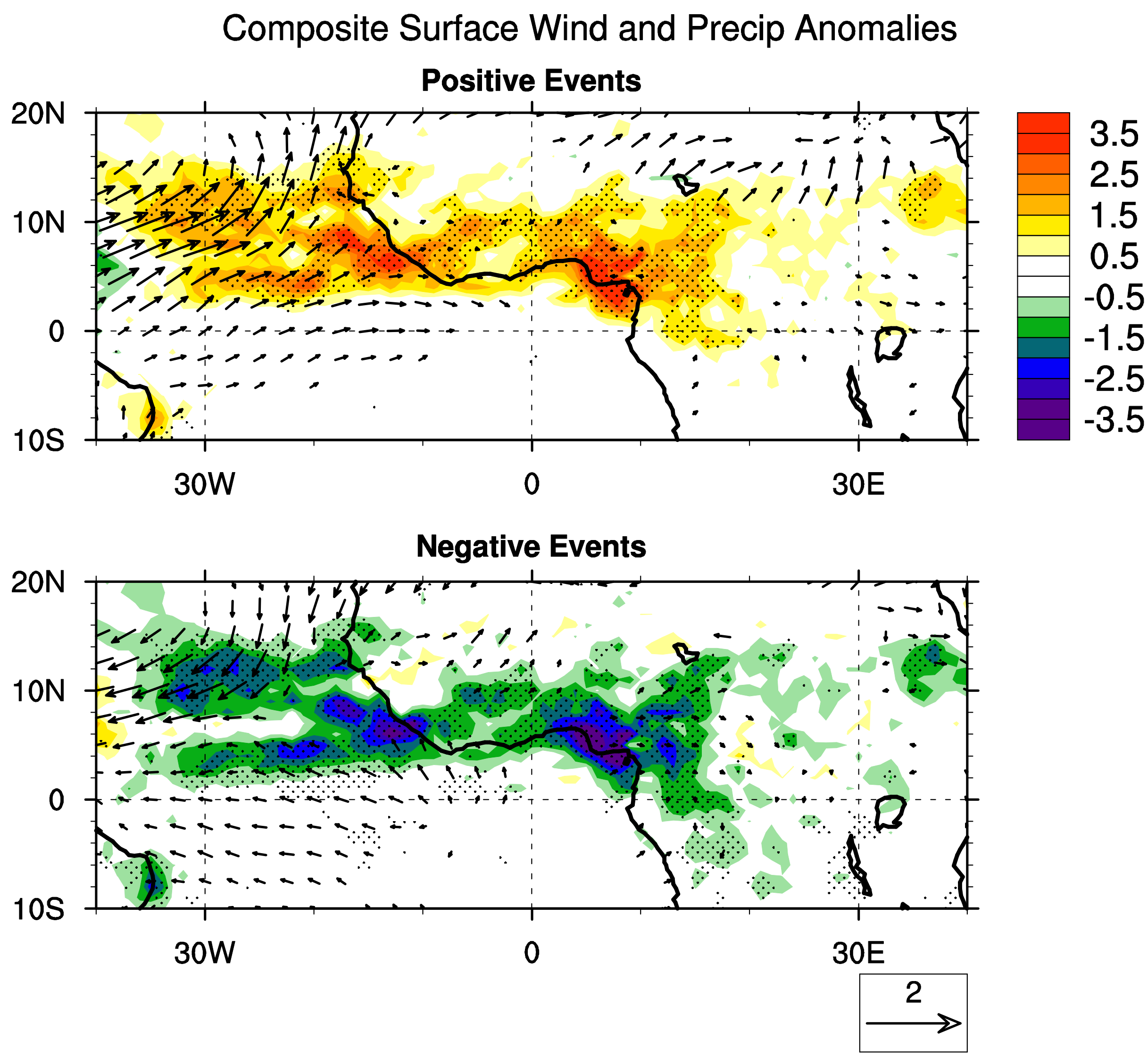
Camargo et al. (2009)

Modulation of tropical cyclones by the MJO Occurs Throughout the Global Tropics



Maloney and Shaman (2008)

Atlantic Precipitation Variability



Maloney and Shaman (2008)