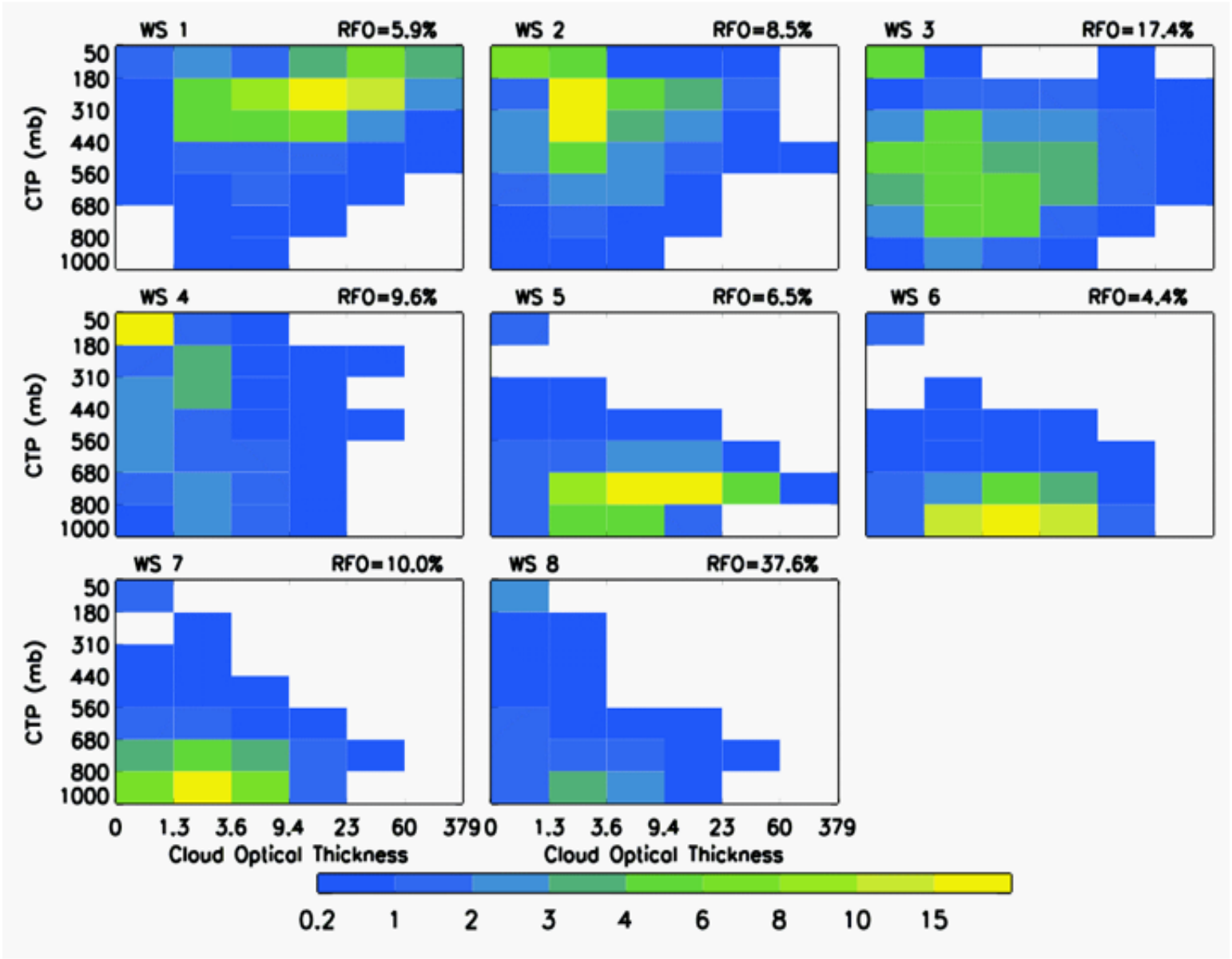
Variations of Different Convective Types During Annual Monsoons

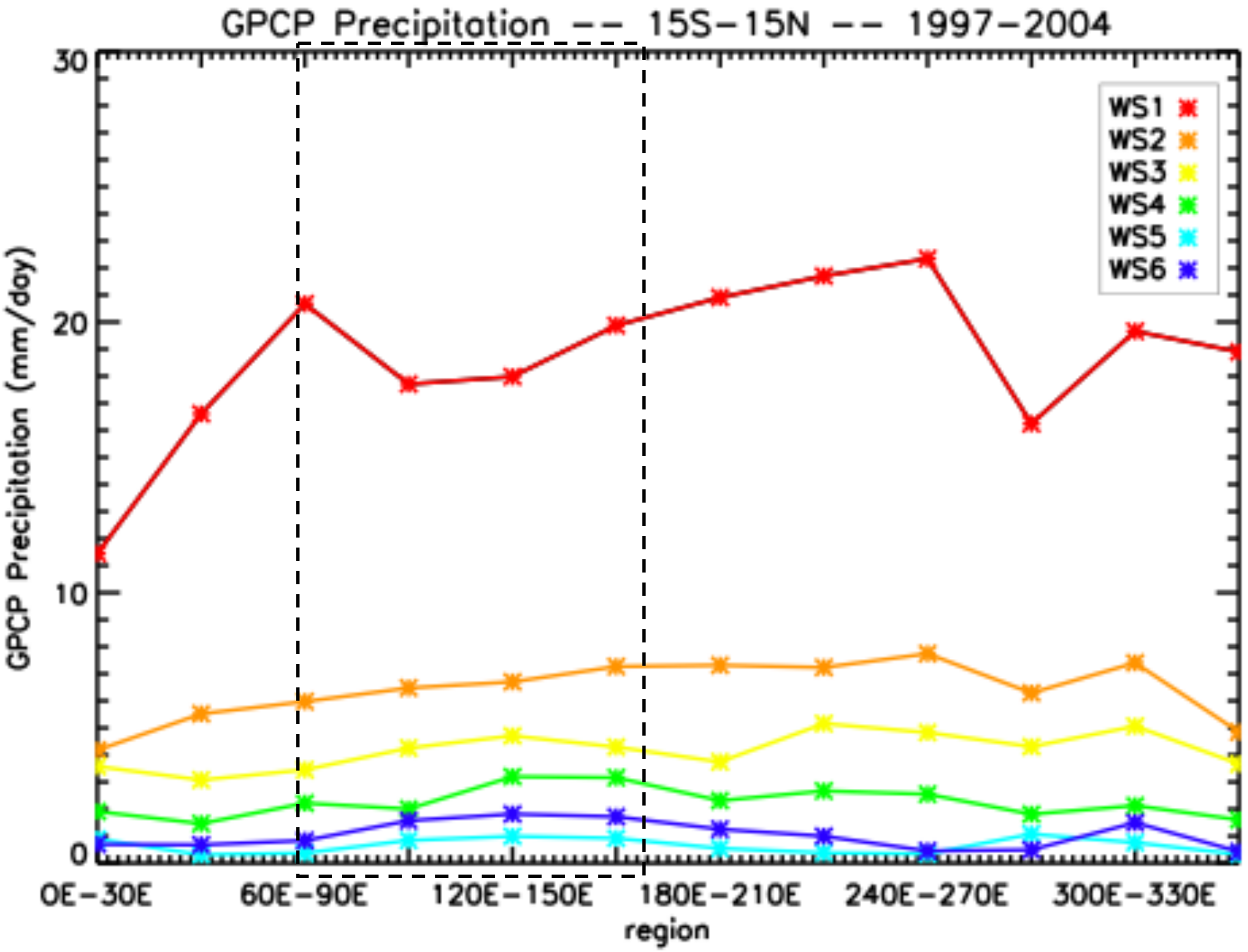
William B. Rossow
CREST at City College of New York

August 2010

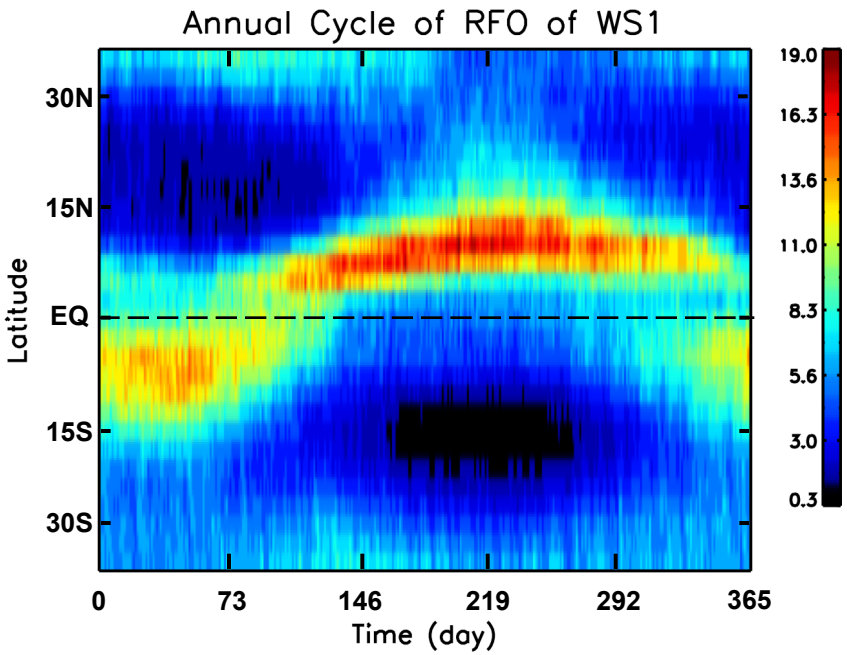
Weather States in the Tropics -- Subtropics (35S - 35N)

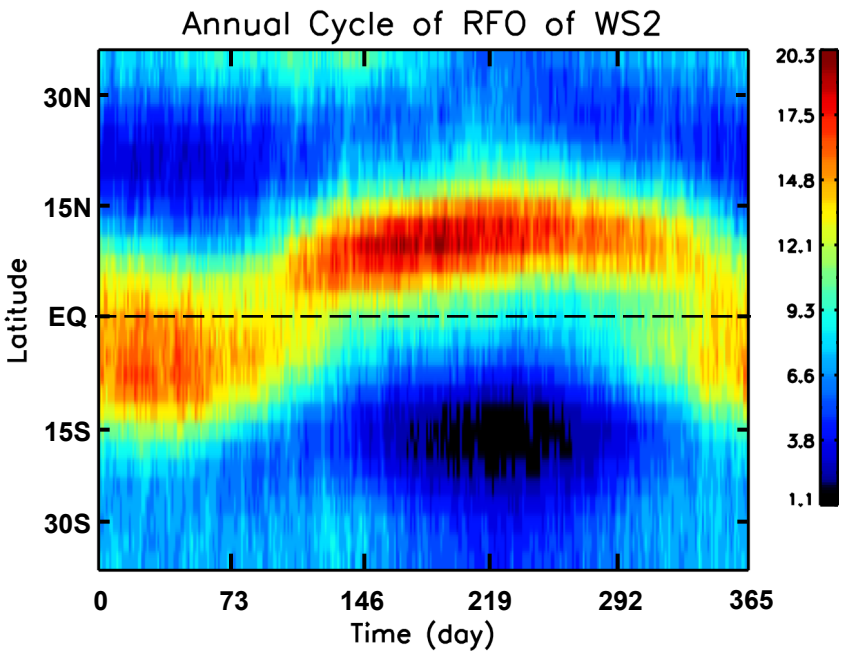


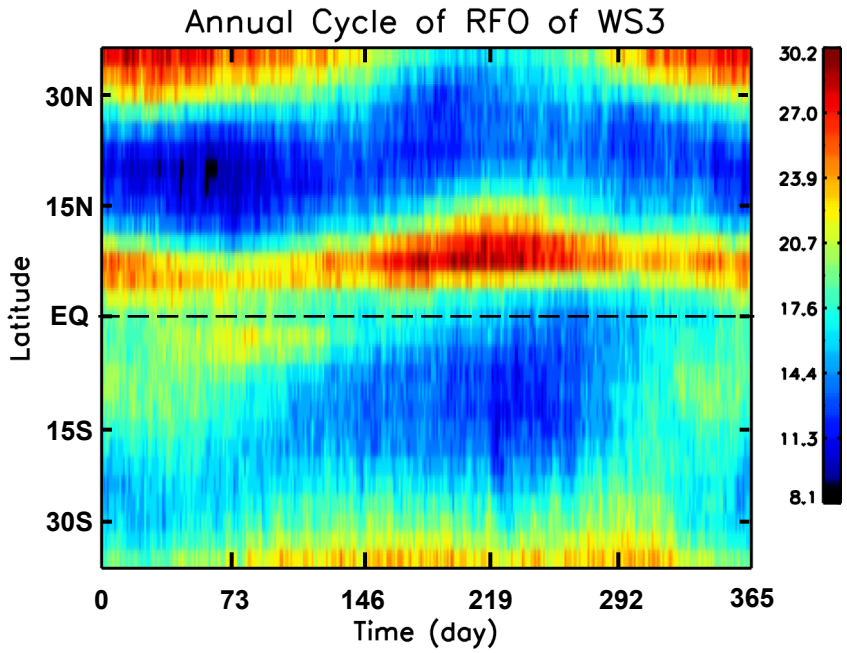
Composite of precipitation in Tropics (1997 - 2004)

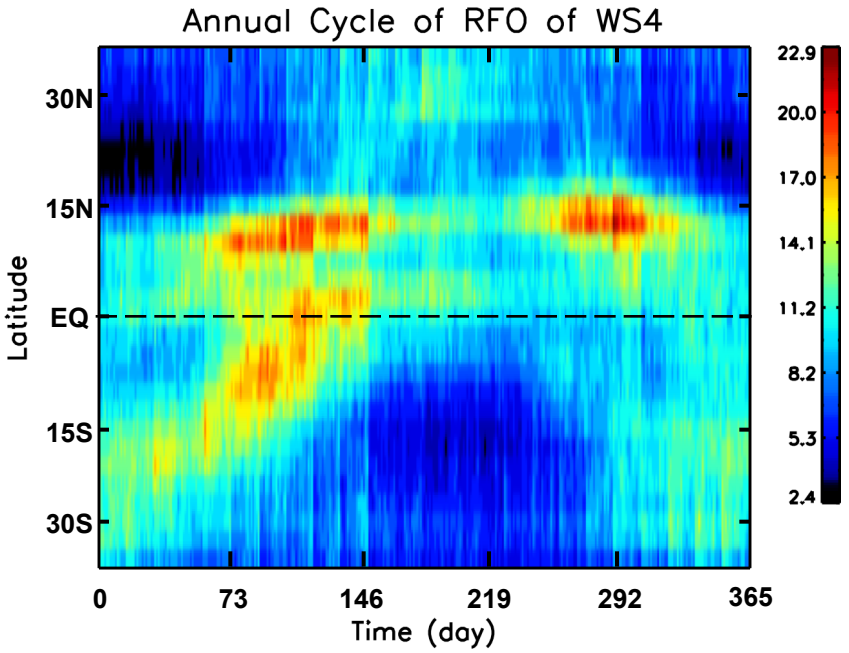


Composite of Annual Cycle of WS RFO (1984 - 2006)

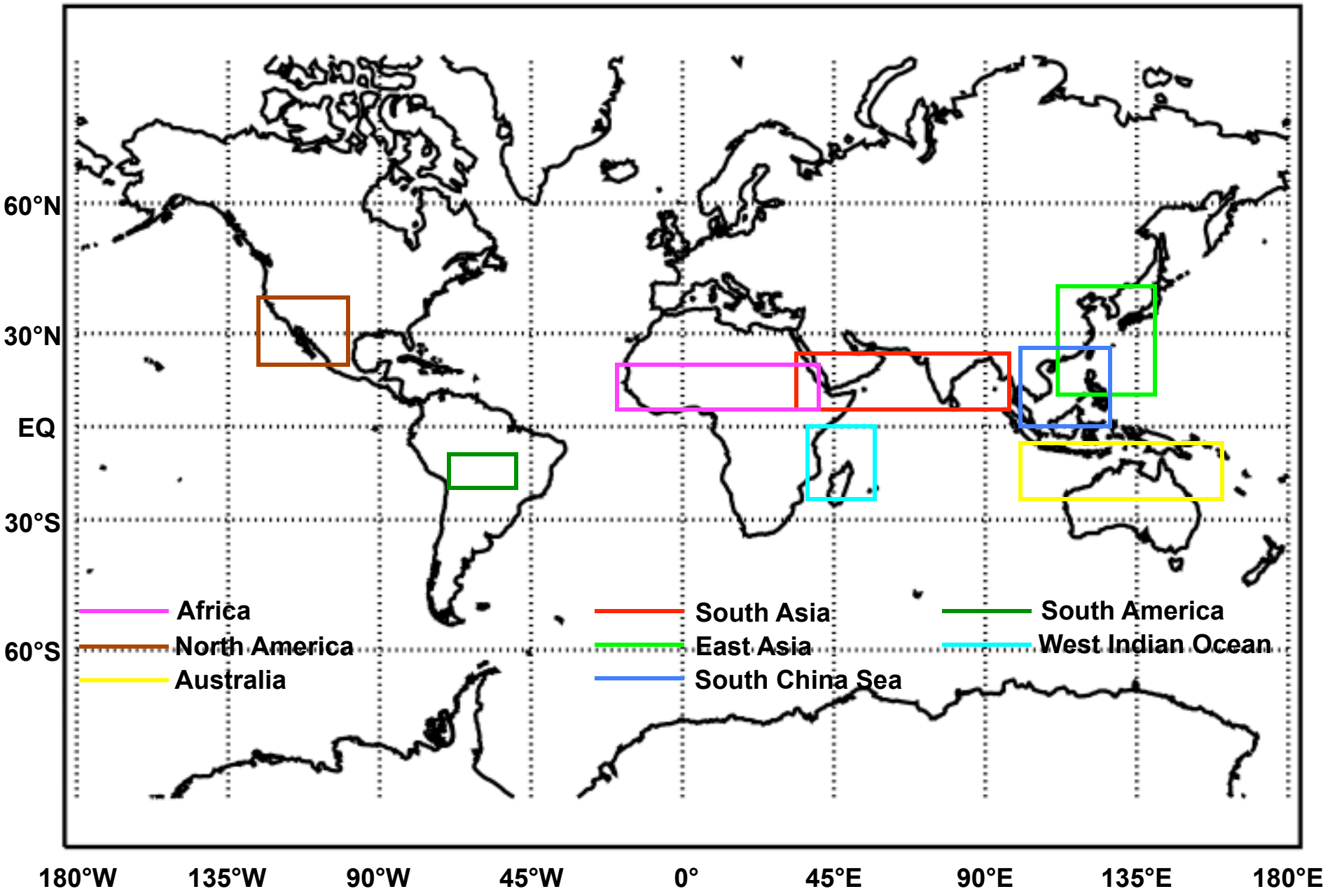




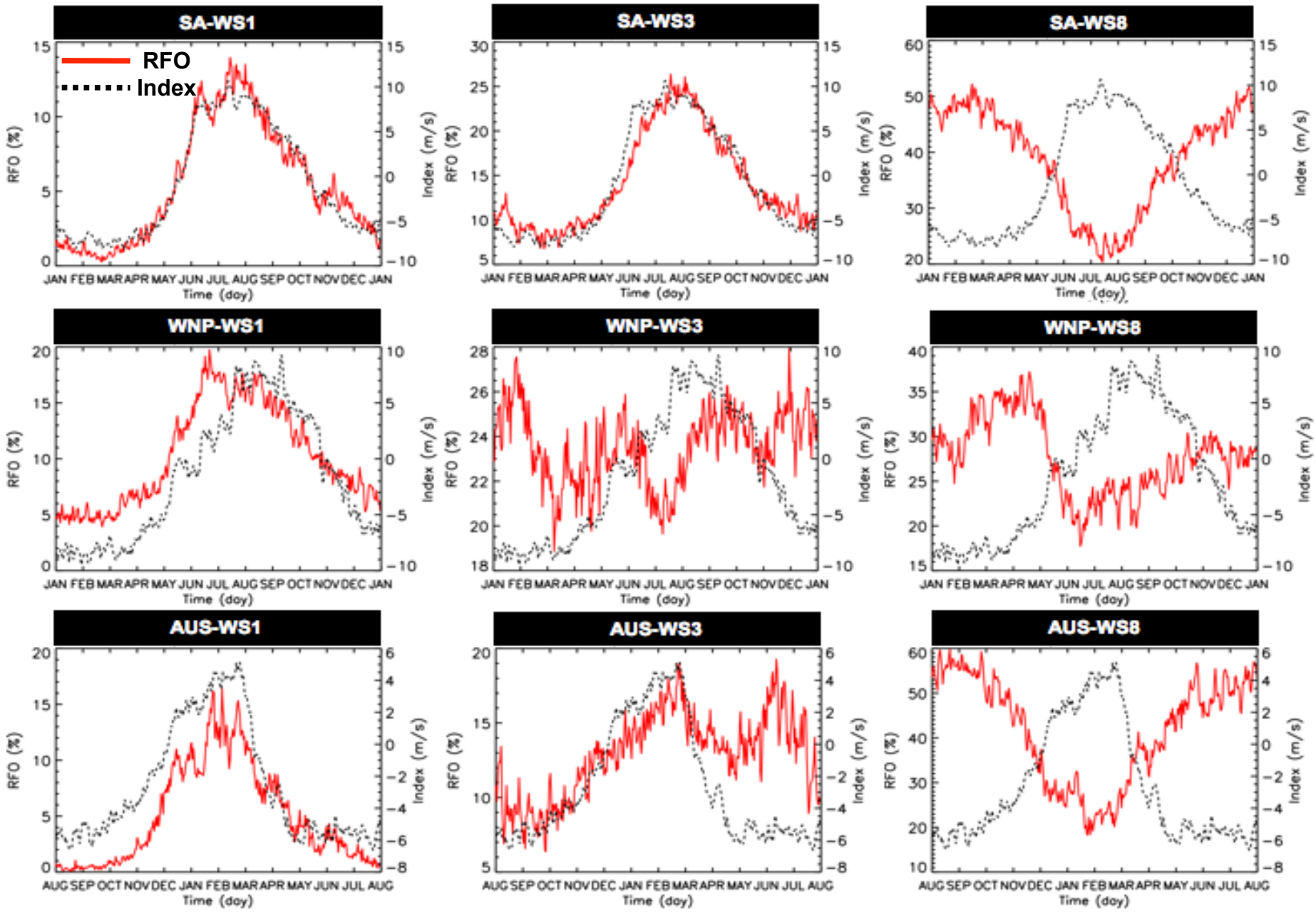




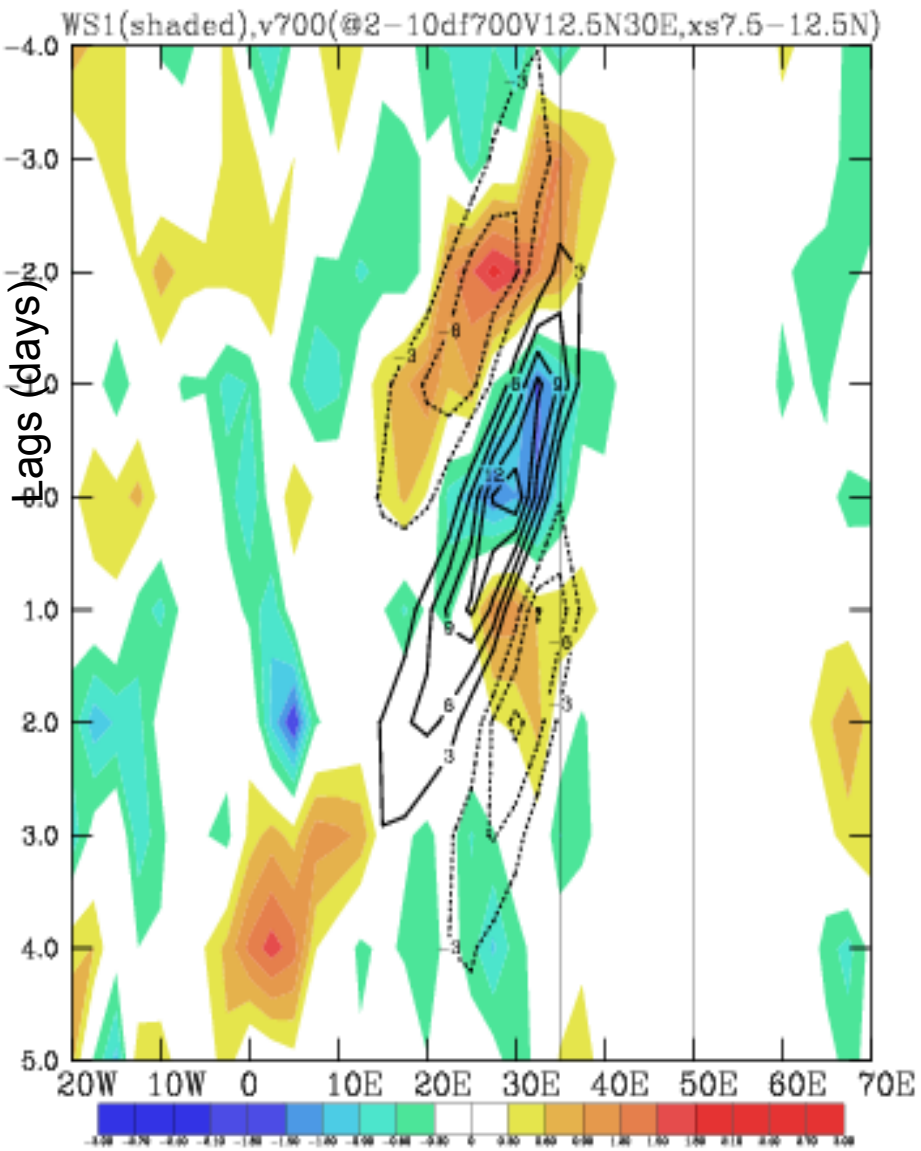
8 Monsoon Sectors



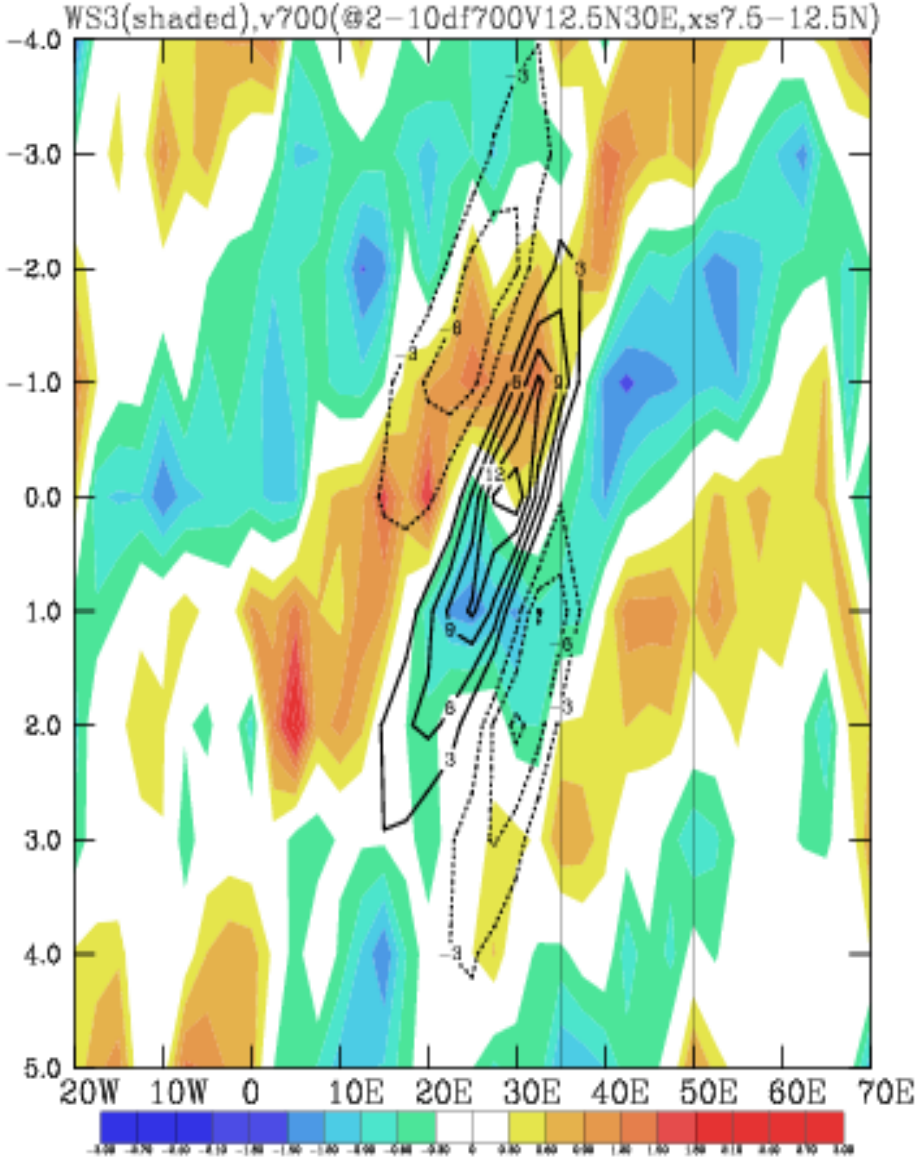
Annual Cycle of WS RFO and Index (1984 - 2006)



WS1, v'

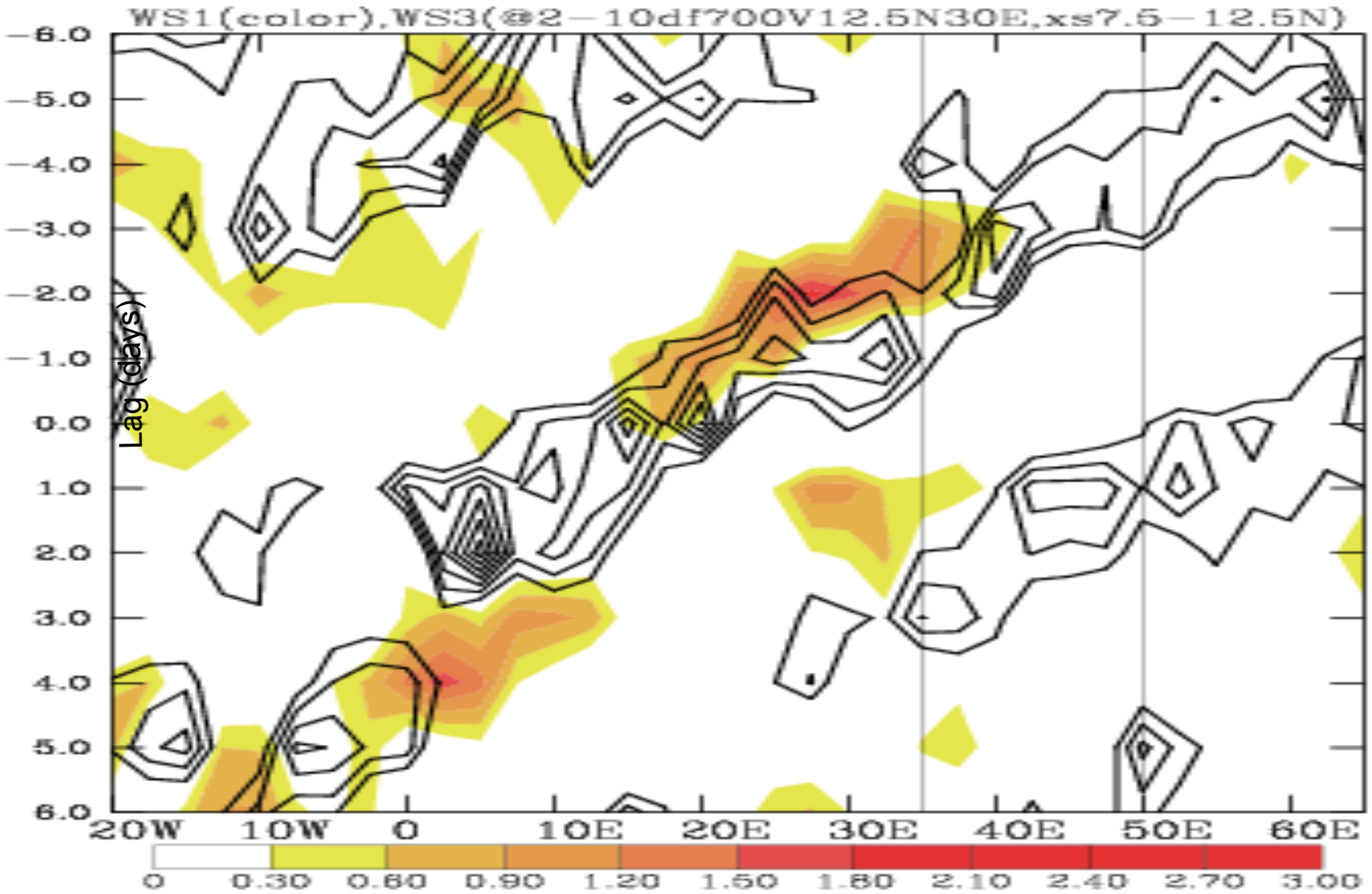


WS3, v'



WS1, WS3 (shaded, positive in red, negative RFO in blue), 700-hPa v' (contoured)

ANOMALIES IN WS1 and WS3 Projected onto v-wind



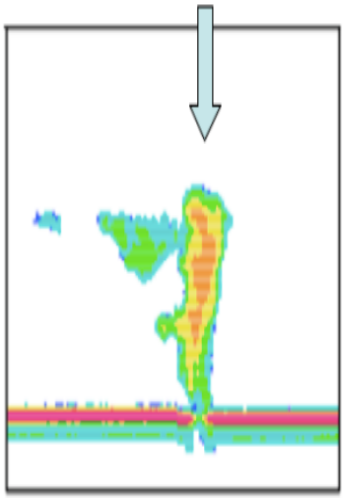
WS1 (shaded), WS3 (contoured) anomalies. Only positive anomalies are shown.

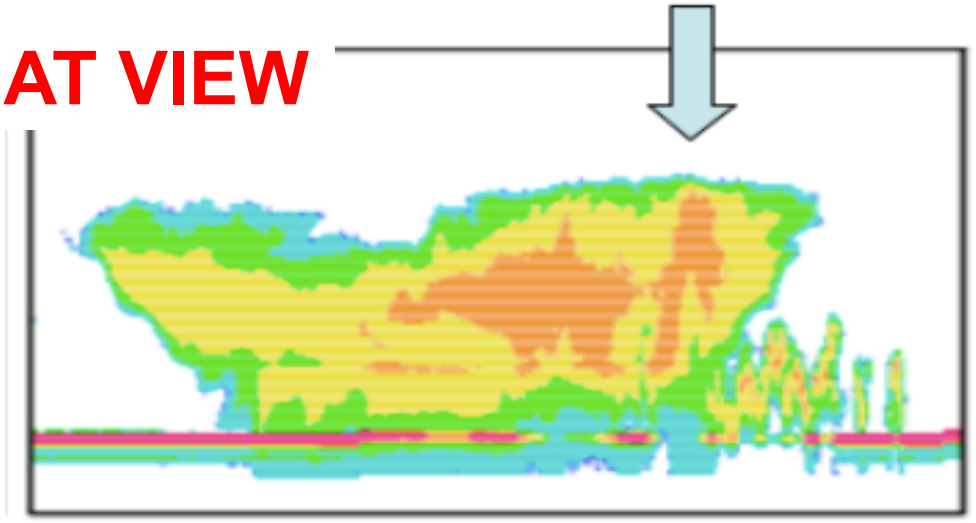
RECENTLY OBSERVED "TRENDS" IN THE TROPICS

- Adler et al note increasing tropical precipitation
- Solomon notes period of increasing stratospheric water vapor followed by period of constant values
- Tselioudis et al note similar periods of increasing followed by static WS1 frequency in the Western Pacific (but not WS3)
- Sohn et al note similar variations of low-level water vapor convergence in the Western Pacific suggesting changes in Hadley circulation strength

COMPARISON OF UNORGANIZED TO ORGANIZED CONVECTION

CLOUDSAT VIEW





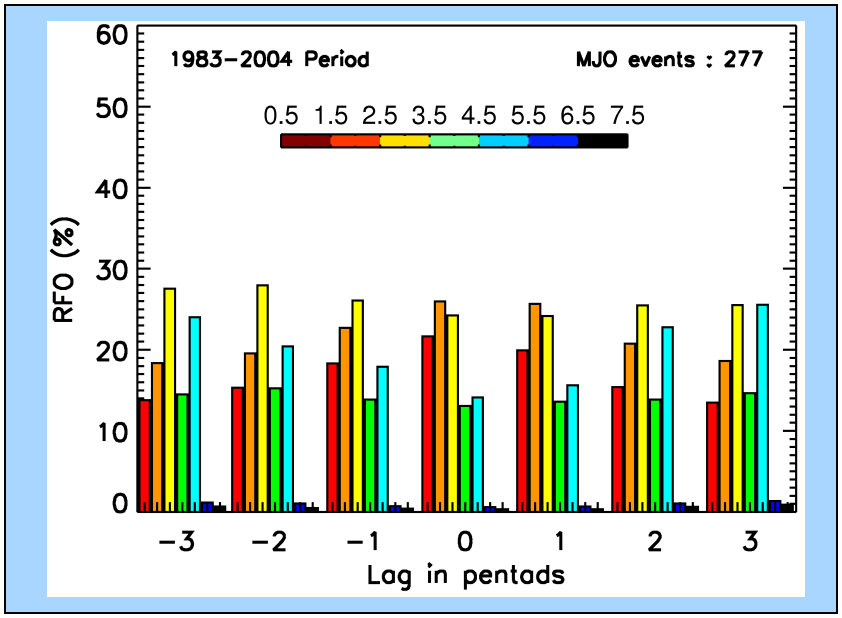
NO GCM TODAY

HAS TRANSITION FROM UNORGANIZED TO ORGANIZED CONVECTION

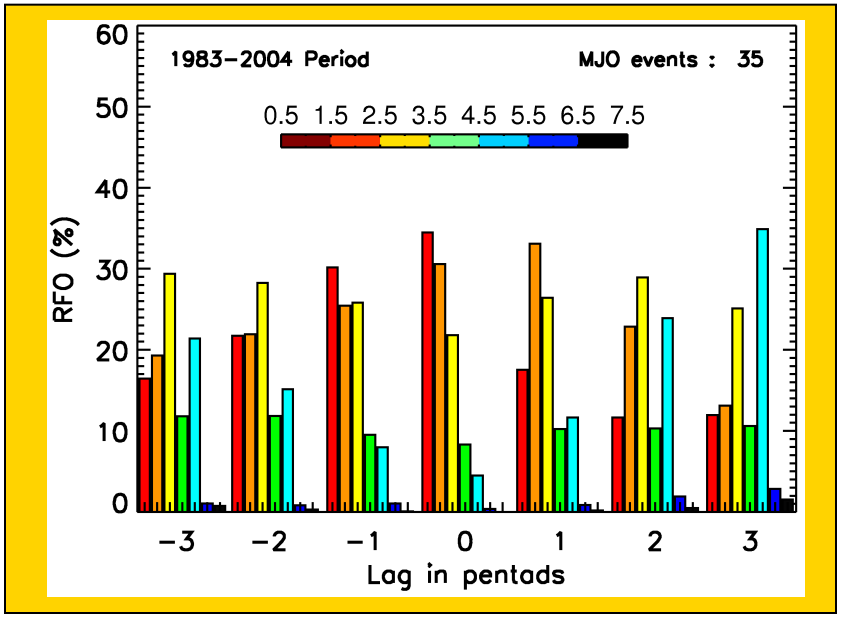
RFO of each cloud regime in 60E-180E region / 5S-5N latitude band

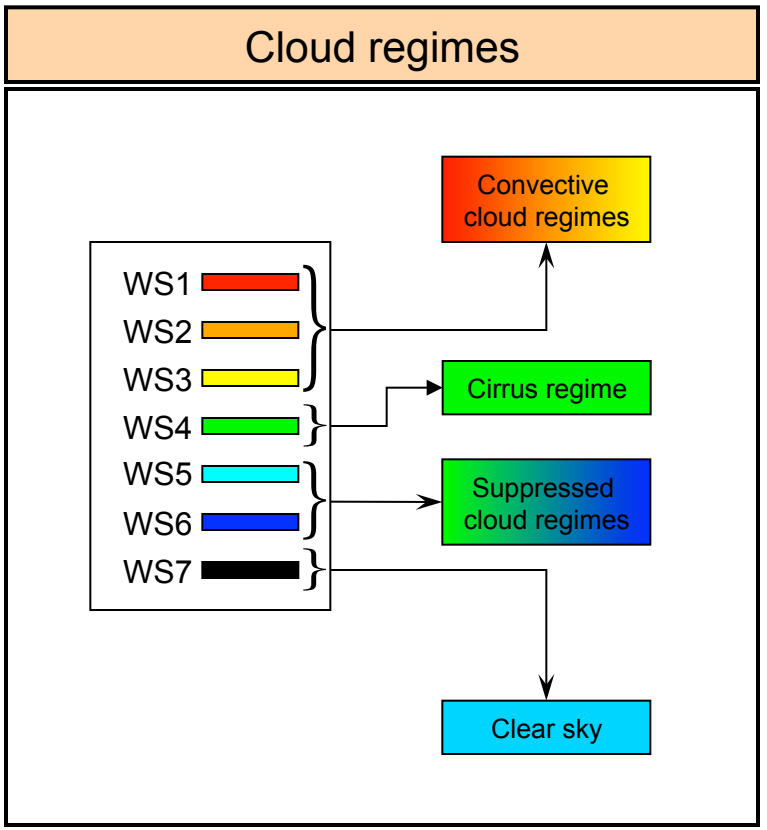
(MJO events in November-April periods from 1983 - 2004)

Weak MJO (index < -1)

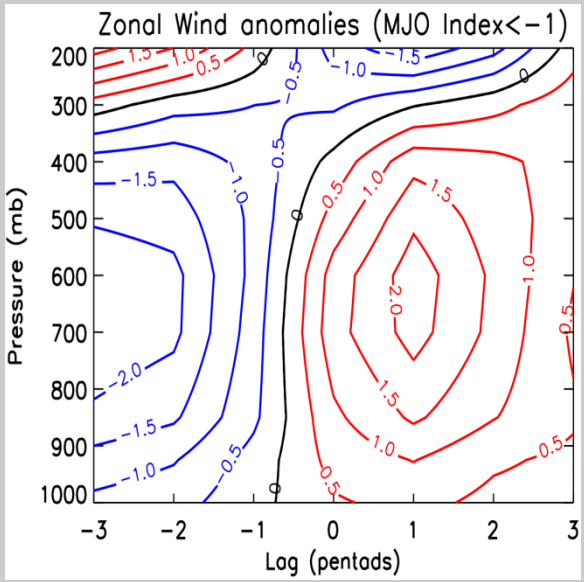
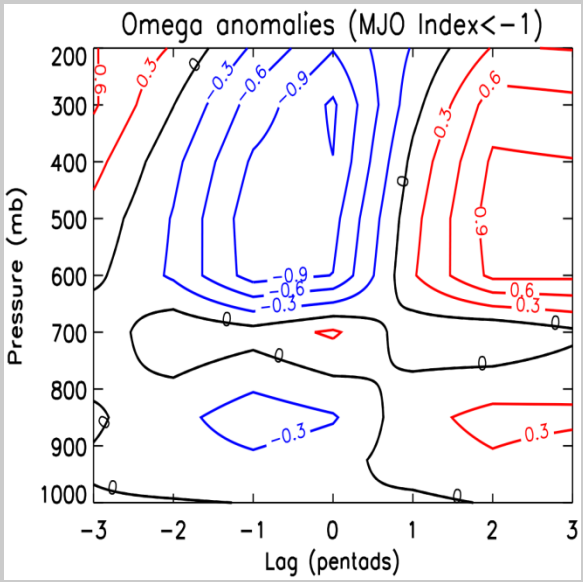
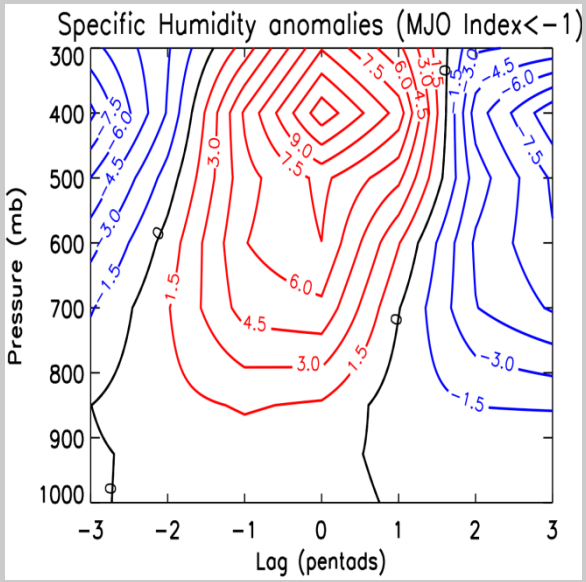
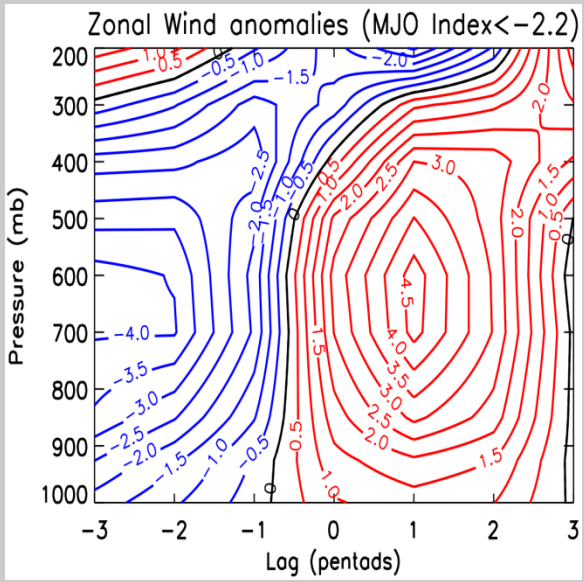
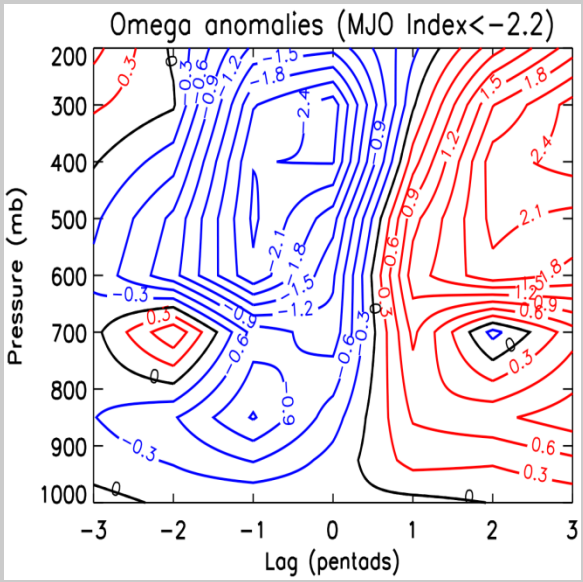
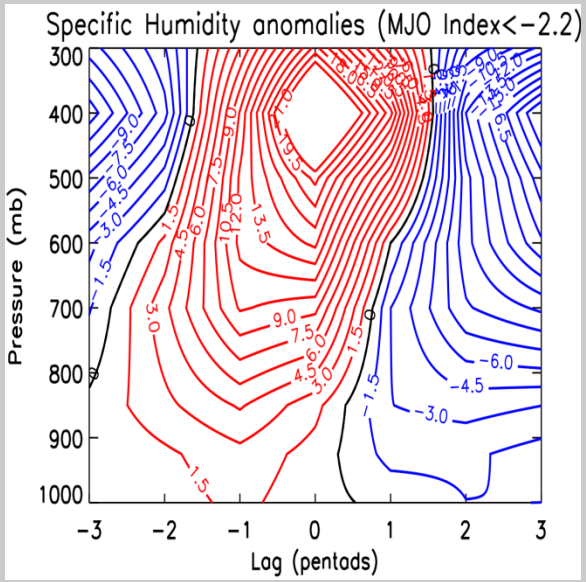


Strong MJO (index < -2.2)



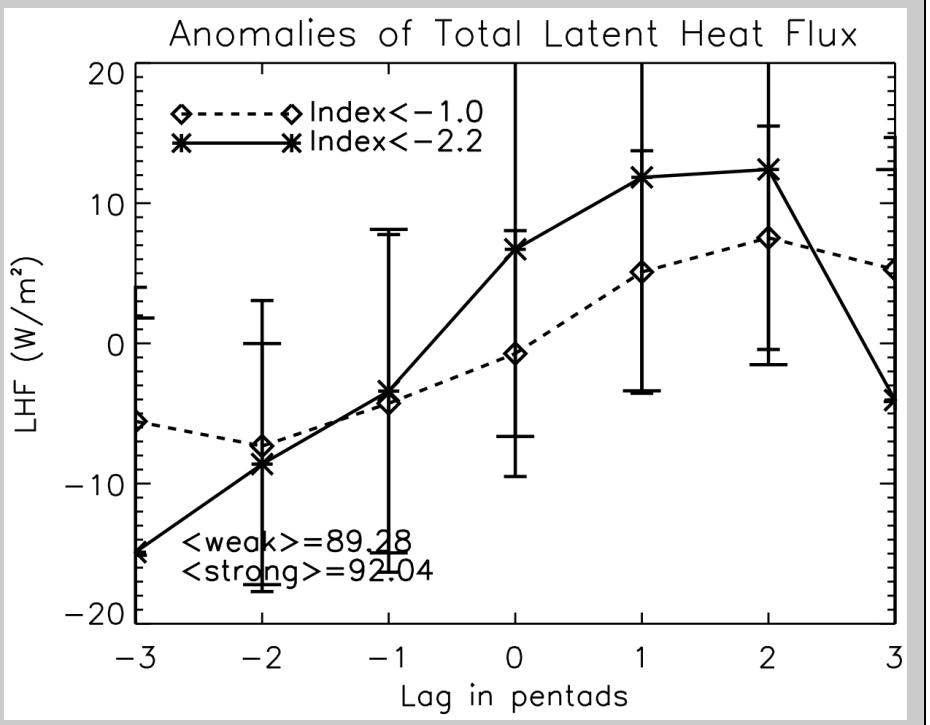


Anomaly cross sections in 60E-180E region / 5S-5N latitude band

	Zonal Wind anomalies	Omega anomalies	Specific Humidity anomalies
Weak MJO (index < -1)			
Strong MJO (index < -2.2)			

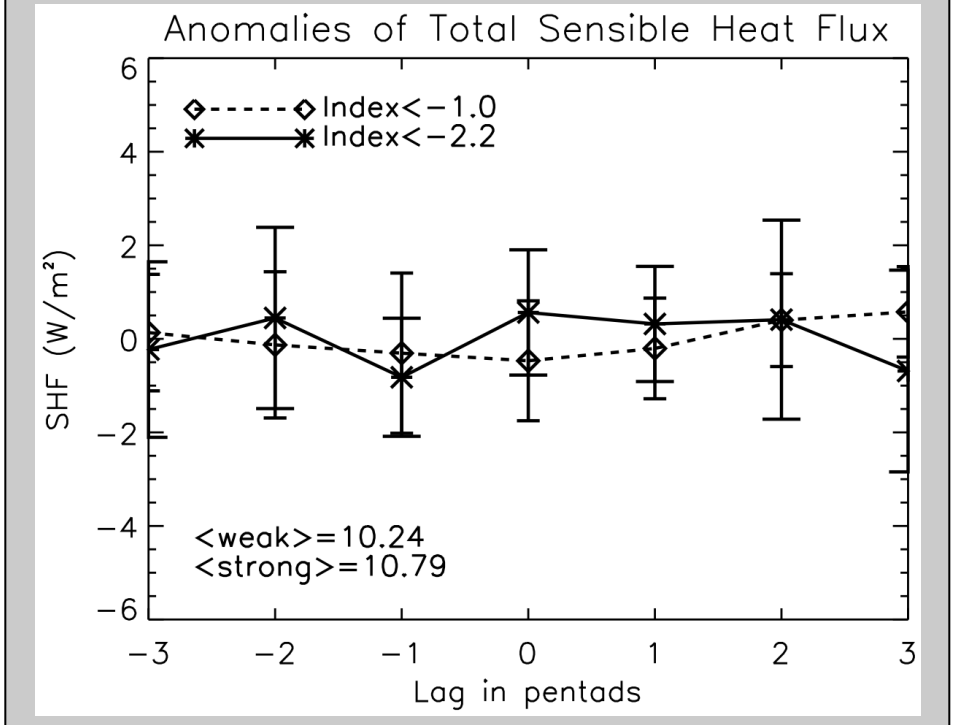
Composite Surface Heat Flux Anomalies in Tropics (1989 - 2000)

Latent Heat Flux Anomalies



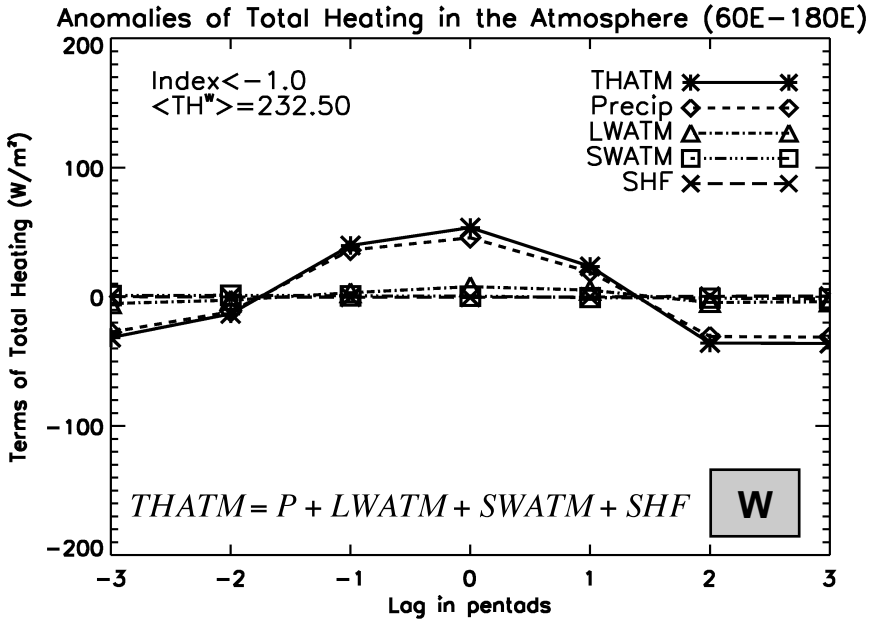
- Maximum of total Latent Heat Flux anomalies at lag 2
- Latent heat fluxes lag the convection
- Hint showing a weakness of the WISHE theory

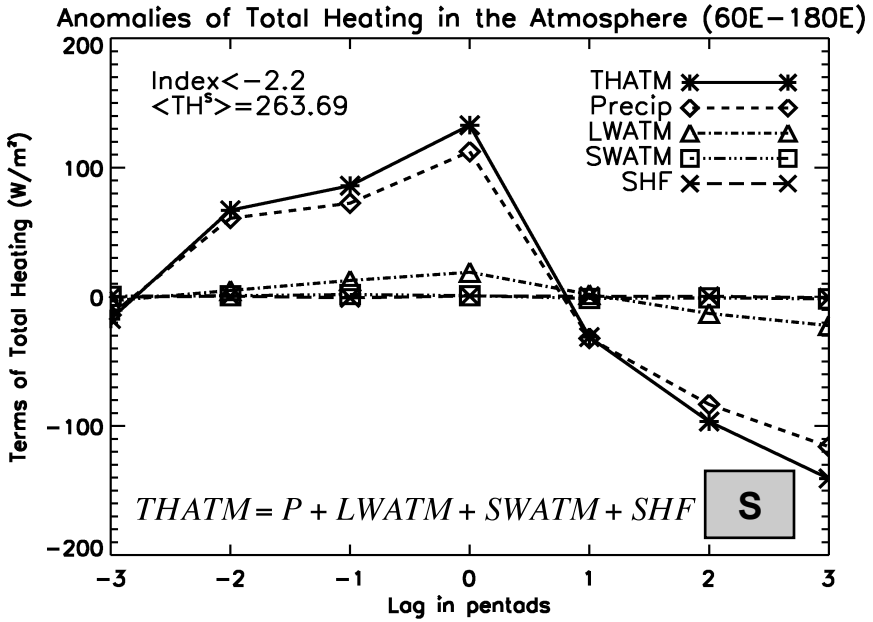
Sensible Heat Flux Anomalies

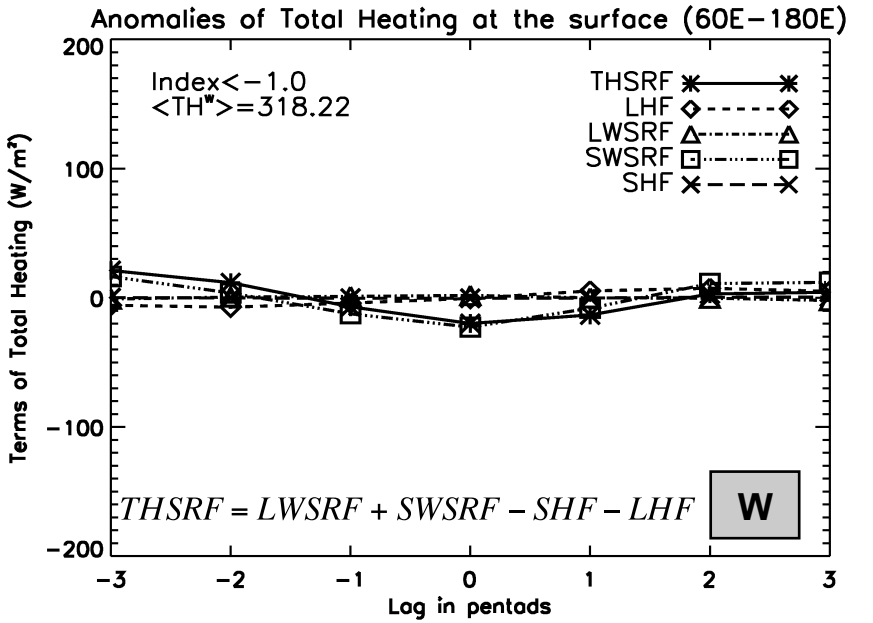


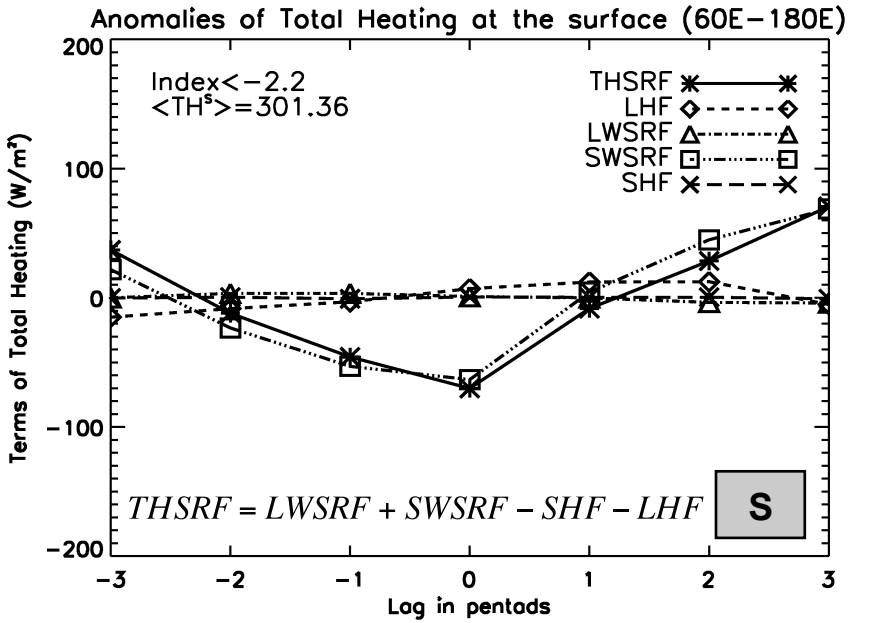
- Fluctuate around zero
- Not dependent with the MJO signal and the MJO phase

Variation of Energy Transfer associated with the MJO





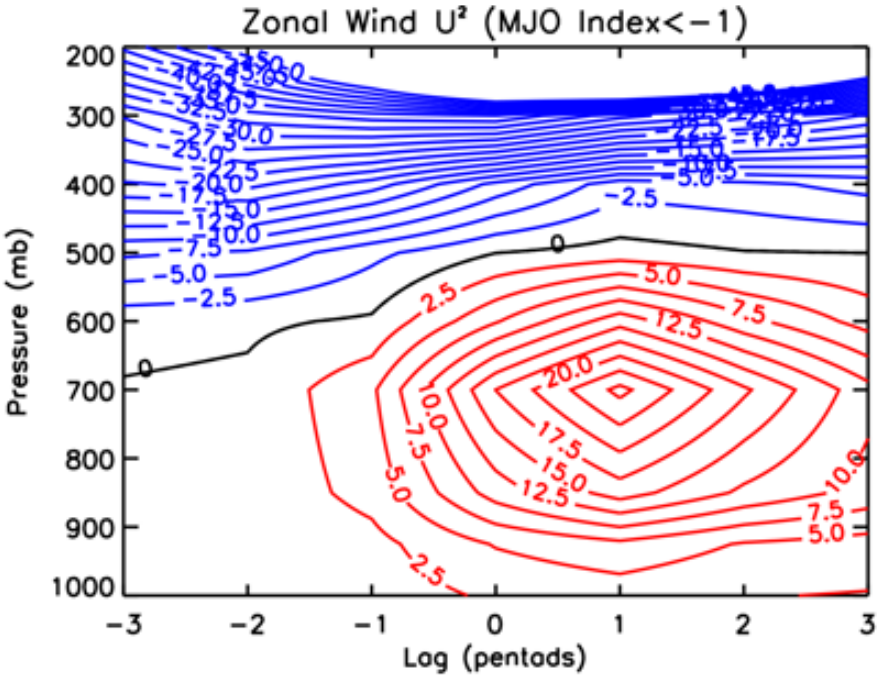




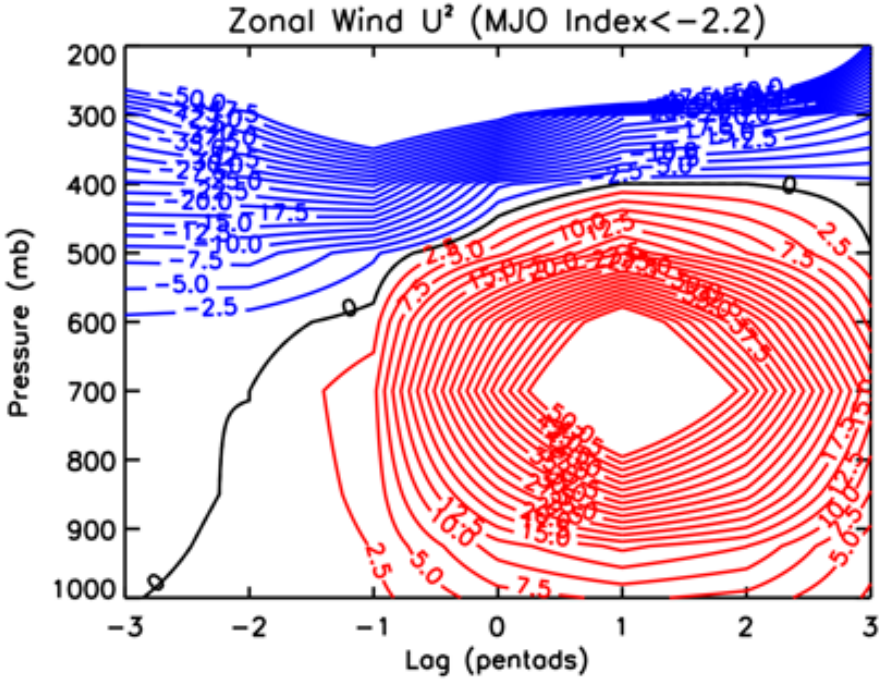
Composite Total Zonal Wind U^2 (m^2/s^2) Cross Sections in Tropics

(MJO events in November-April periods from 1983 - 2004)

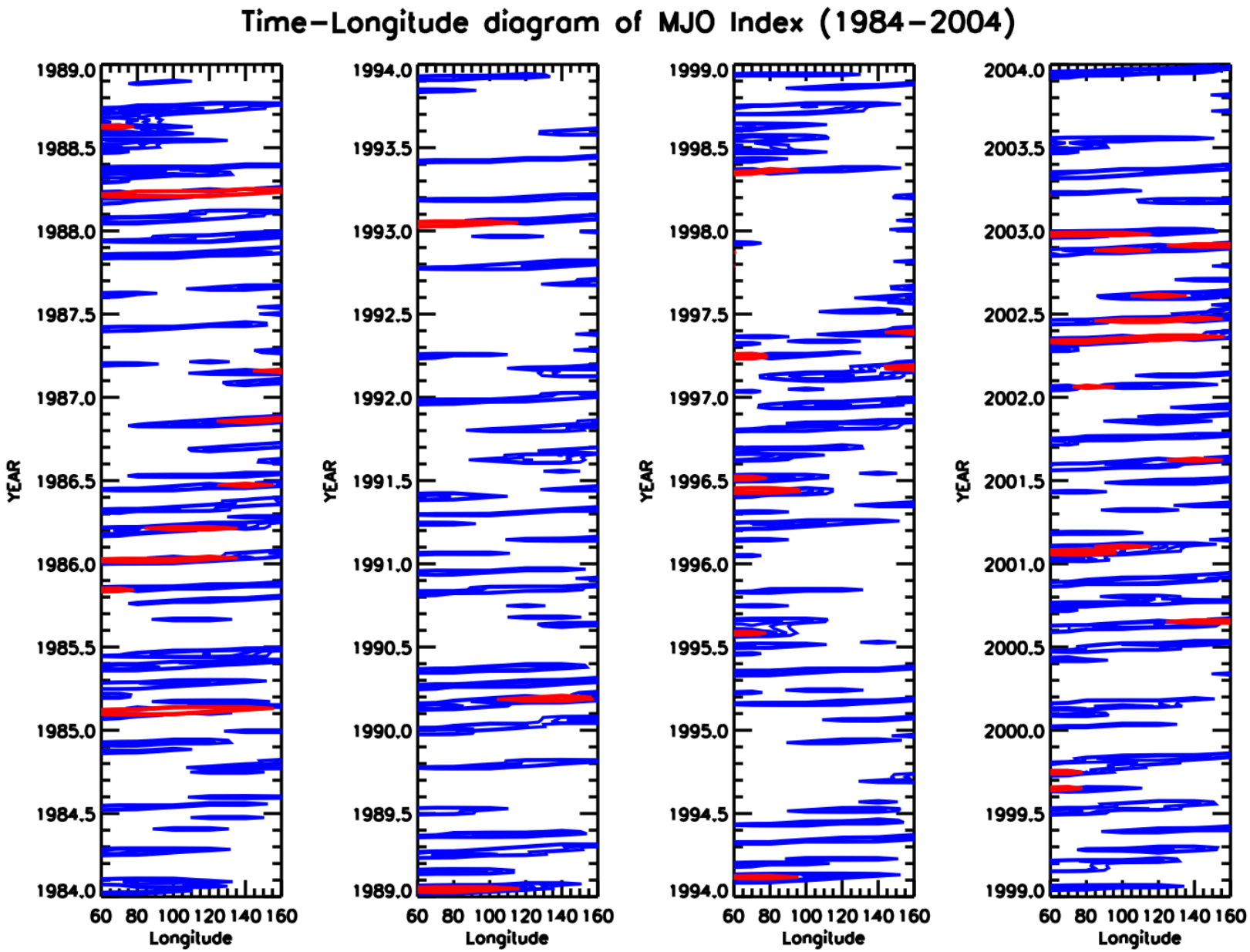
Weak MJO



Strong MJO



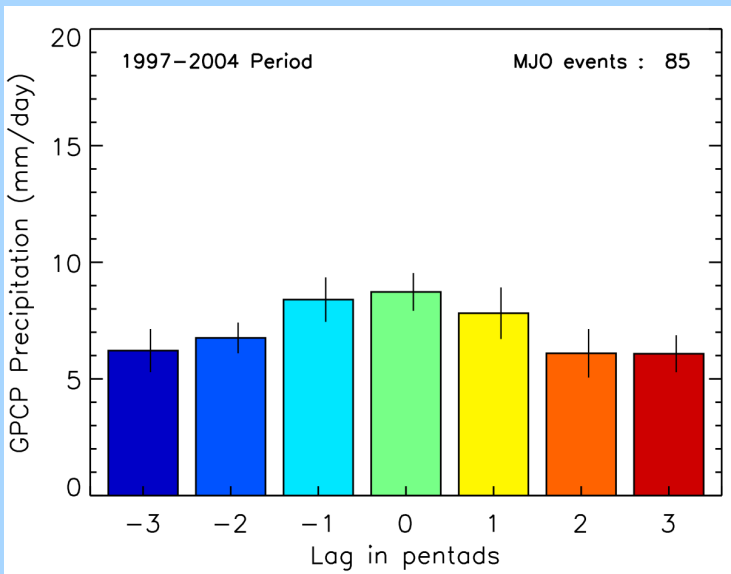
Time-Longitude diagram of MJO Index (1984 - 2004)

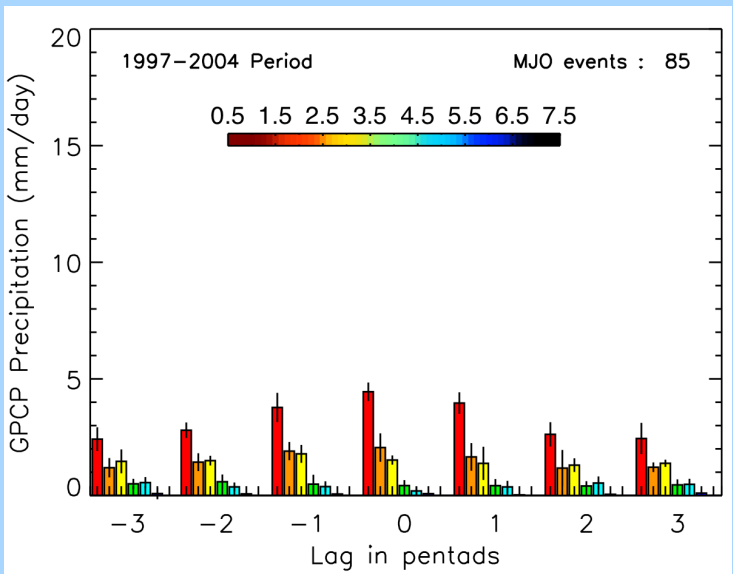


GPCP Precipitation and cloud regimes in 60E-180E region / 5S-5N latitude band

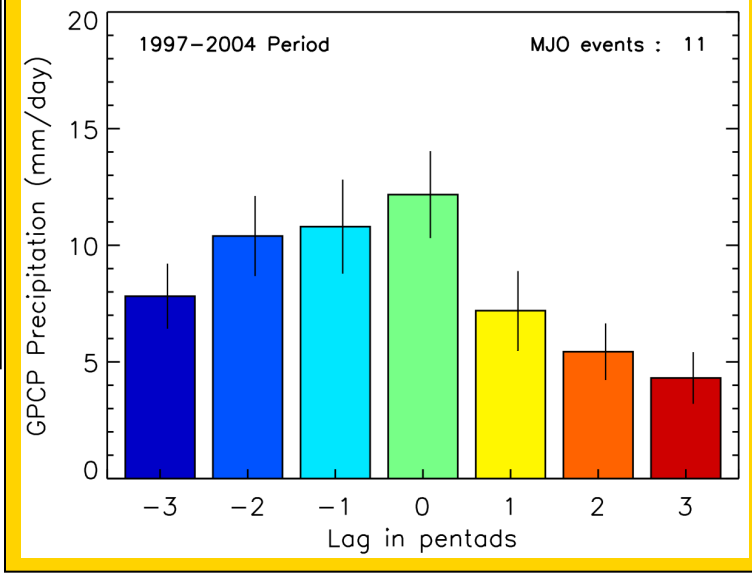
(MJO events in November-April periods from 1997 - 2004)

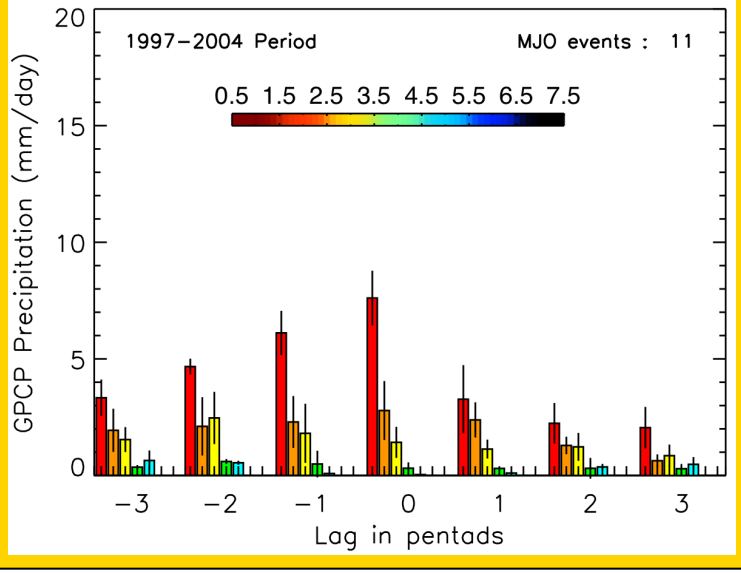
Weak MJO (index < -1)





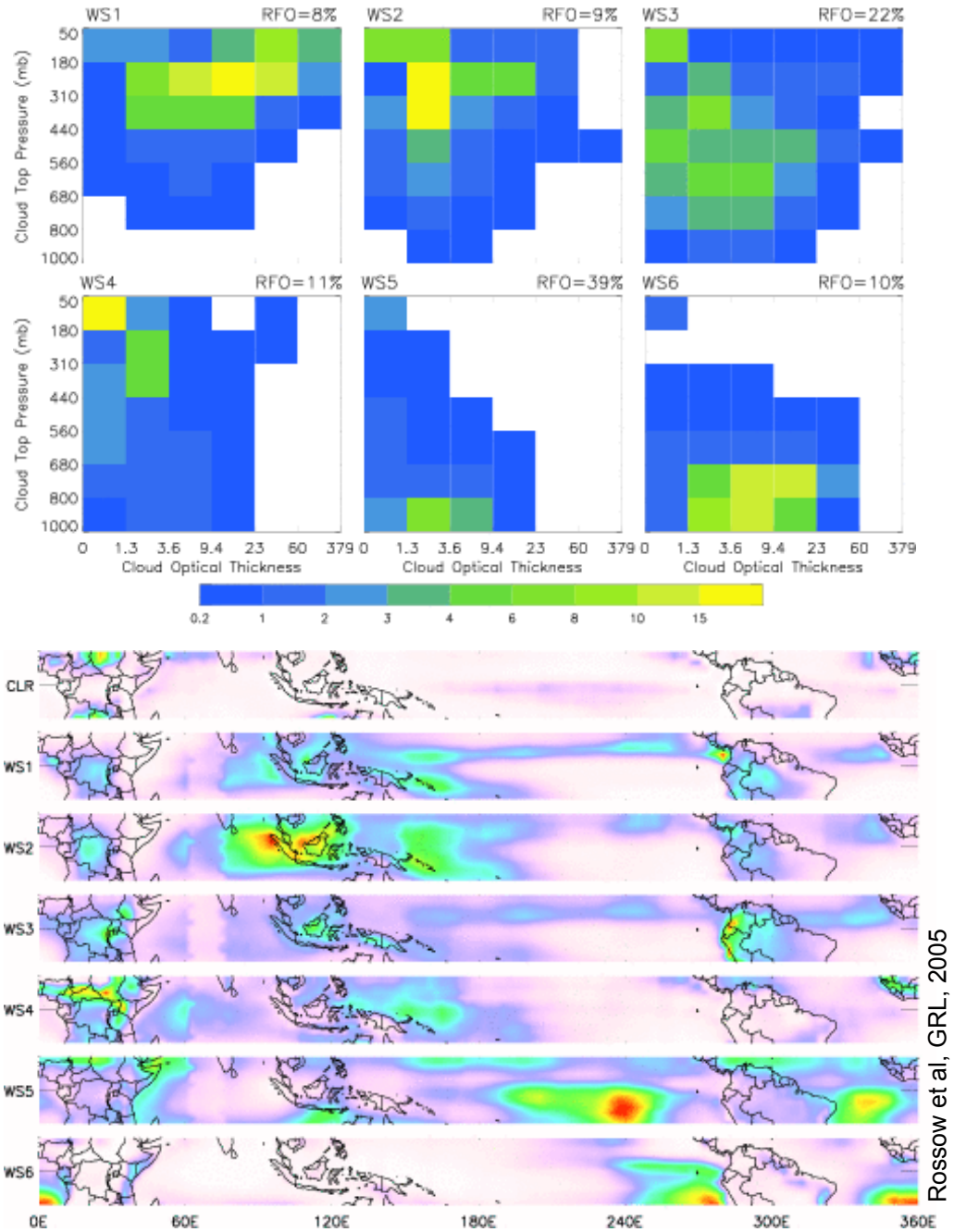
Strong MJO (index < -2.2)





ISCCP PC - TAU histogram pattern and Map in Tropics over 21.5 years

1983 - 2004 time period



Rossow et al, GRL, 2005

Cluster Analysis + ISCCP D1 data

WS1 : Deep cumulus clouds

WS2 : Anvils clouds

WS3 : Congestus clouds

WS4 : Cirrus clouds

WS5 : Shallow cumulus clouds

WS6 : Stratocumulus clouds