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Asian Summer Monsoon Intraseasonal Variability in General Circulation Models

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Auspices Statement

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Asian Summer Monsoon Intraseasonal Variability in General Circulation Models

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Goals

1) Analyze boreal summer Asian monsoon intraseasonal variability general circulation models

-How well do the models represent the eastward and northward propagating components of the convection?

-How well do the models represent the interactive control that the western tropical Pacific rainfall exerts on the rainfall over India and vice-versa?

2) Role of air-sea interactions

-prescribed vs. interactive ocean

3) Mean monsoon vs. variability

Data

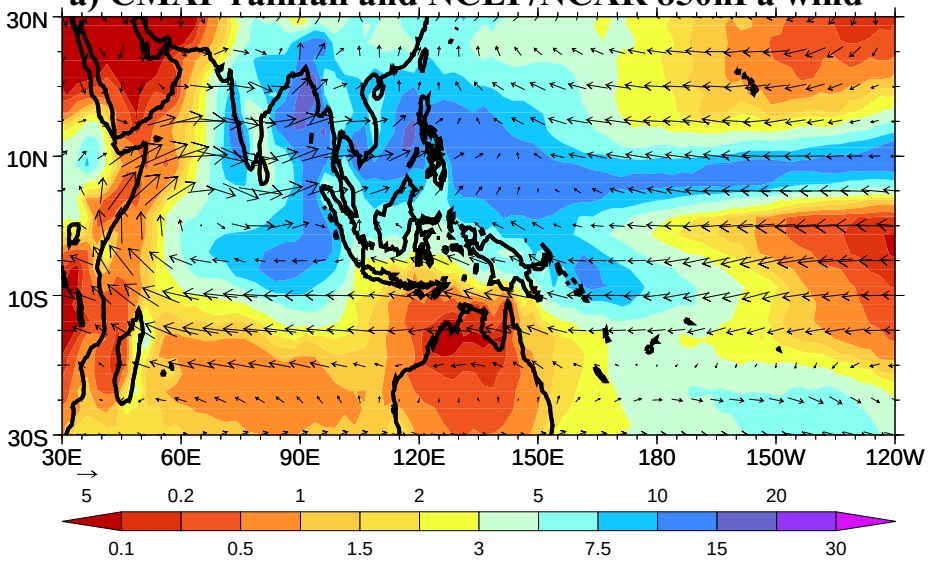
1) Observations (JJAS: 1979-95)
   - NCEP/NCAR Reanalysis
   - AVHRR OLR
   - CMAP Rainfall

2) ECHO-G (ECHAM4.6/HOPE) (JJAS: 19 years; CMIP2+)
   - flux corrected
   - has an excellent boreal winter MJO

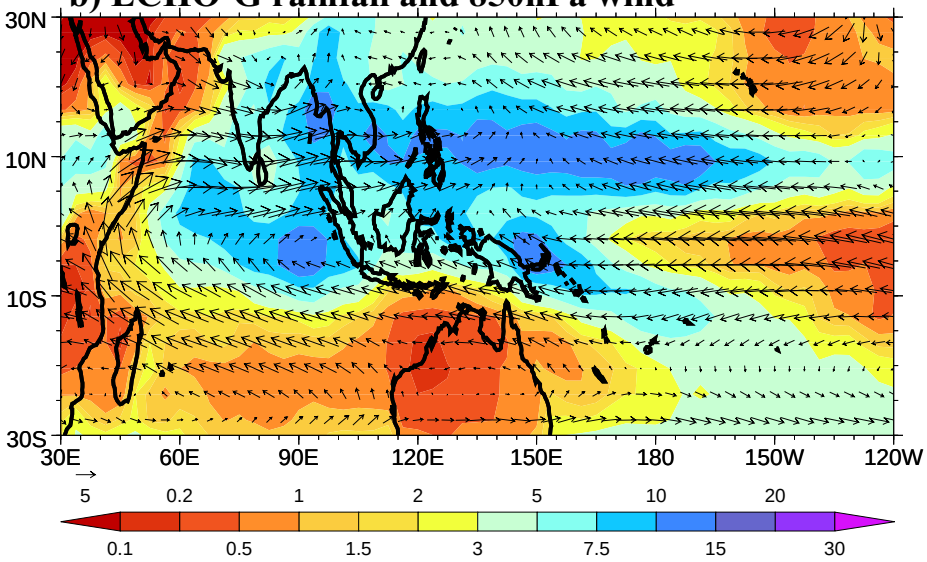
All data are filtered with a 20-100 day Lanczos filter

JJAS Climatology

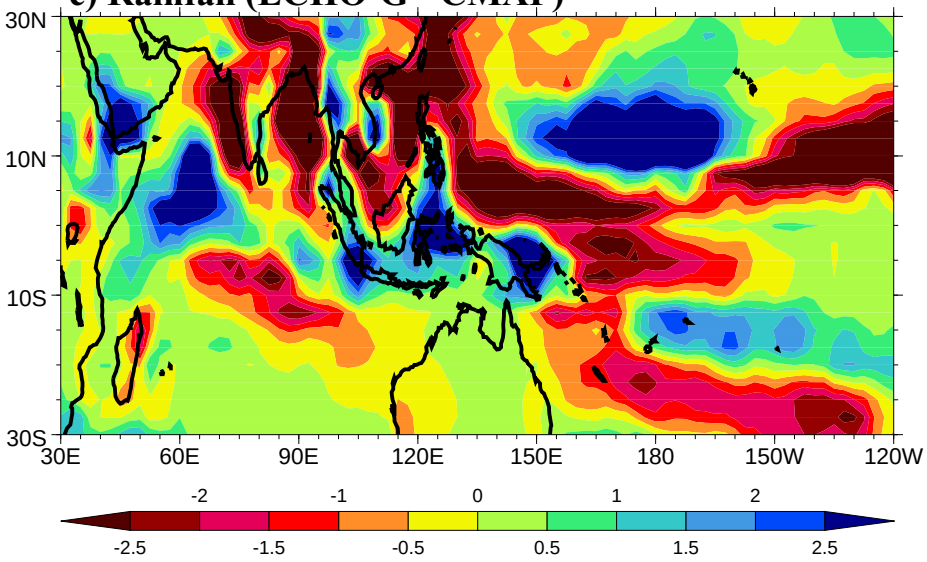
a) CMAP rainfall and NCEP/NCAR 850hPa wind



b) ECHO-G rainfall and 850hPa wind

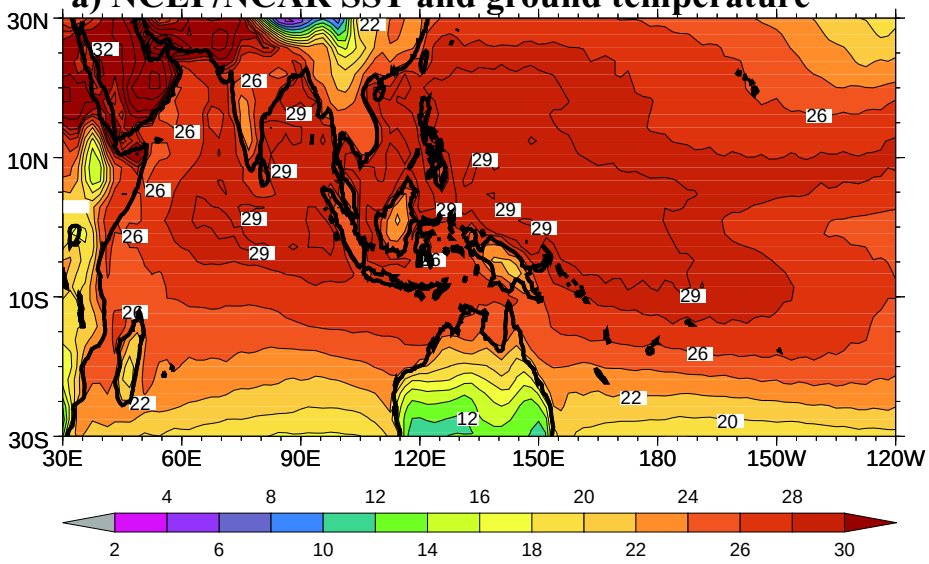


c) Rainfall (ECHO-G - CMAP)

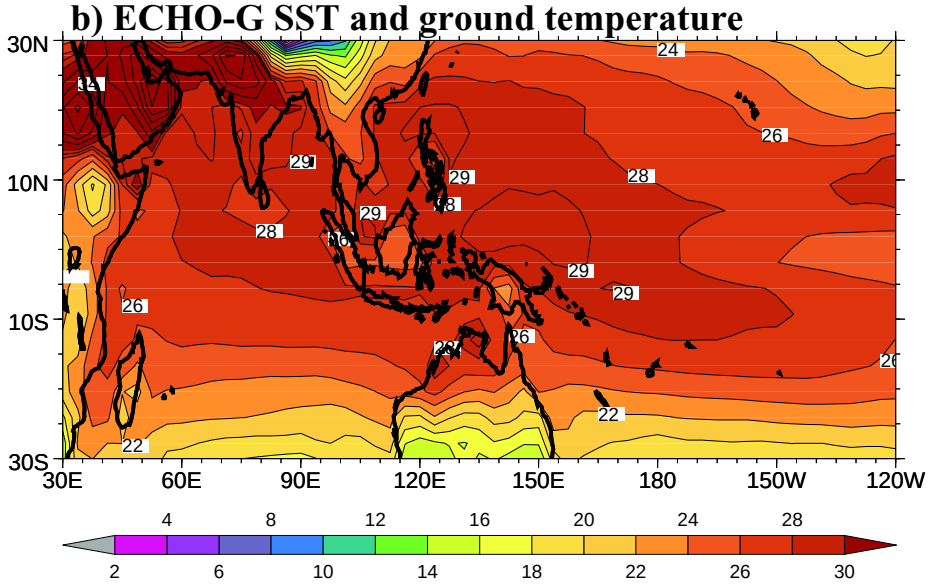


JJAS Climatology

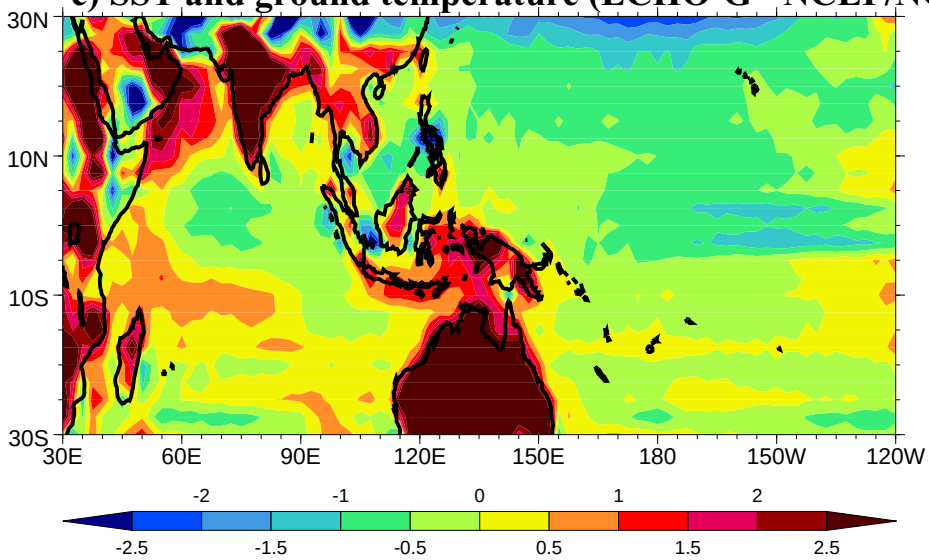
a) NCEP/NCAR SST and ground temperature



b) ECHO-G SST and ground temperature

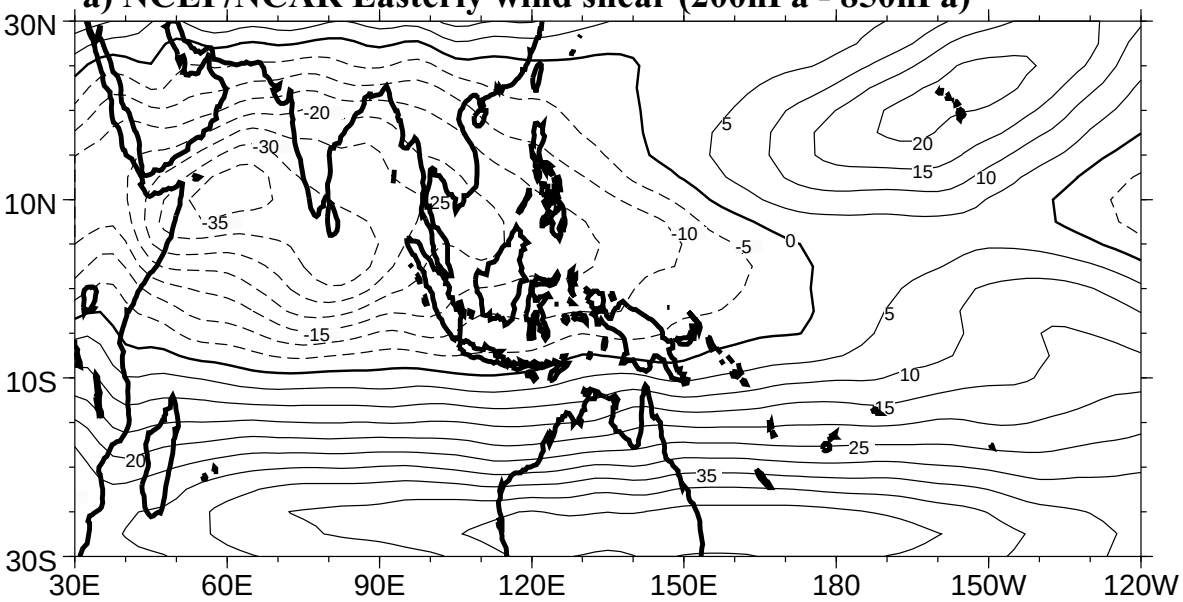


c) SST and ground temperature (ECHO-G - NCEP/NCAR)

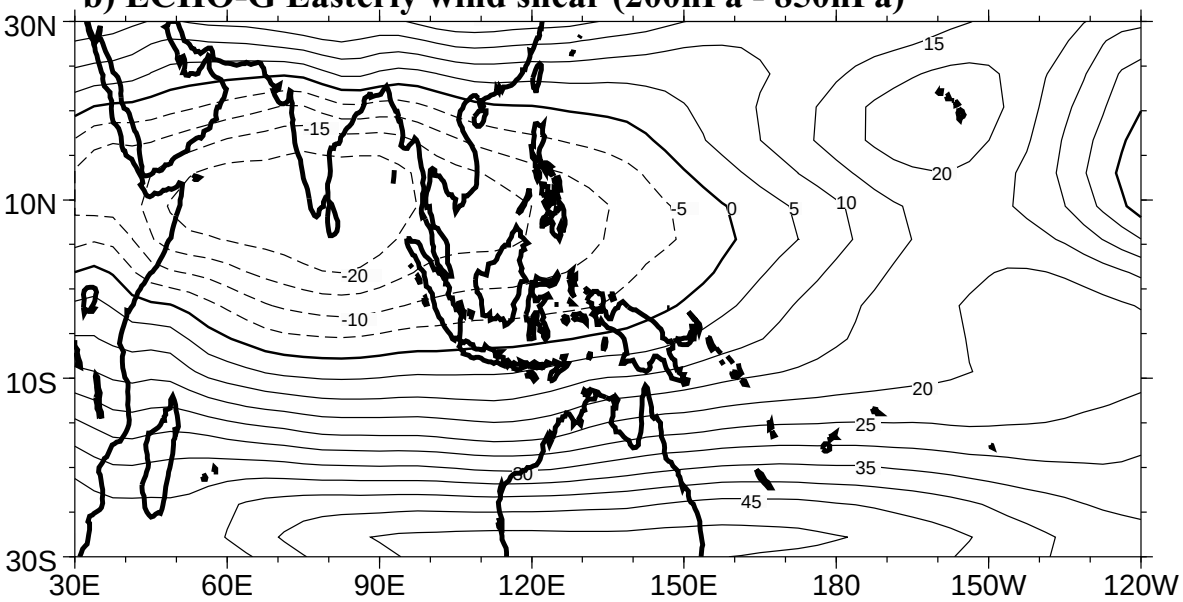


JJAS Climatology

a) NCEP/NCAR Easterly wind shear (200hPa - 850hPa)



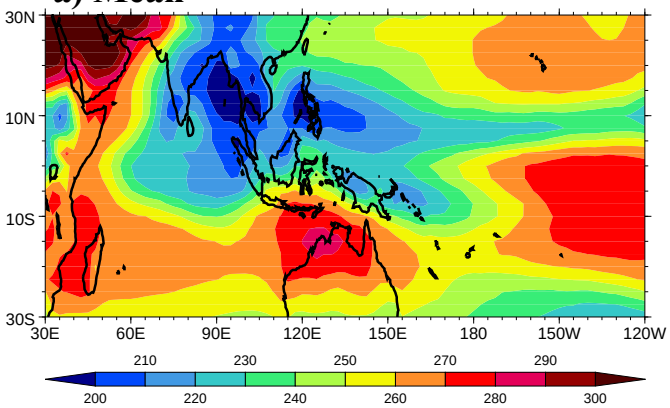
b) ECHO-G Easterly wind shear (200hPa - 850hPa)



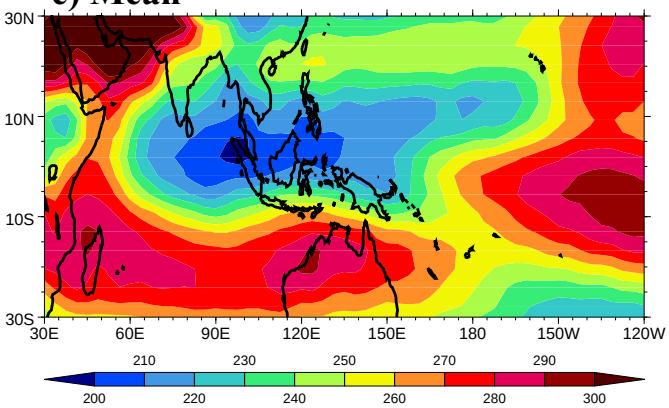
AVHRR OLR (1979-95: JJAS)

ECHO-G OLR (19 years: JJAS)

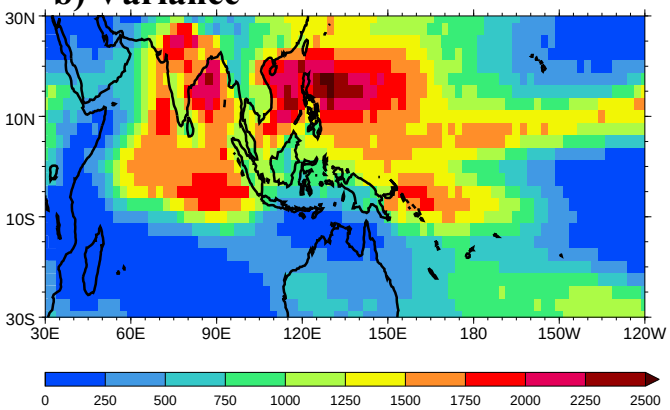
a) Mean



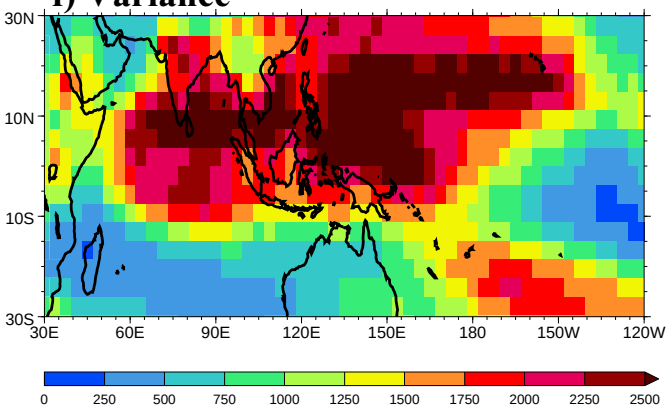
e) Mean



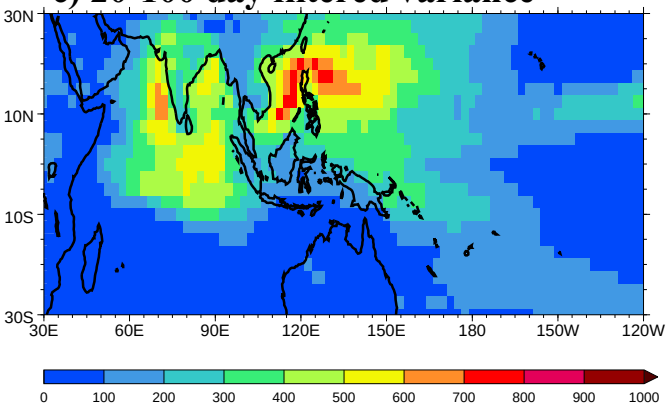
b) Variance



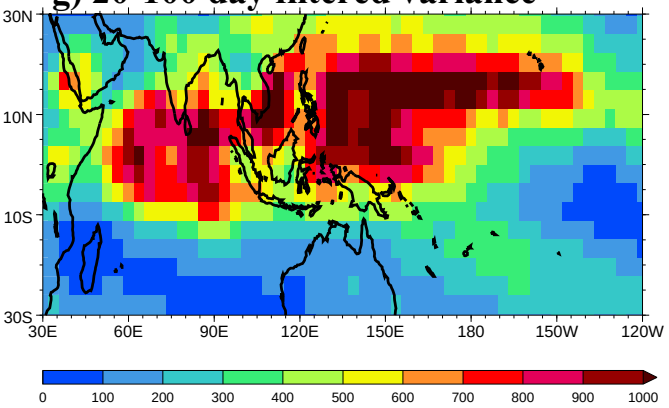
f) Variance



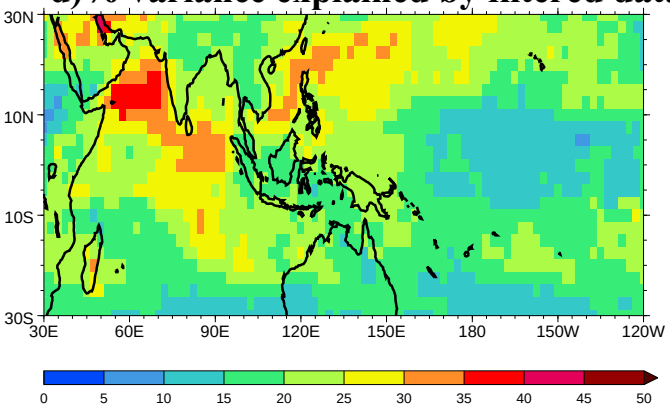
c) 20-100 day filtered variance



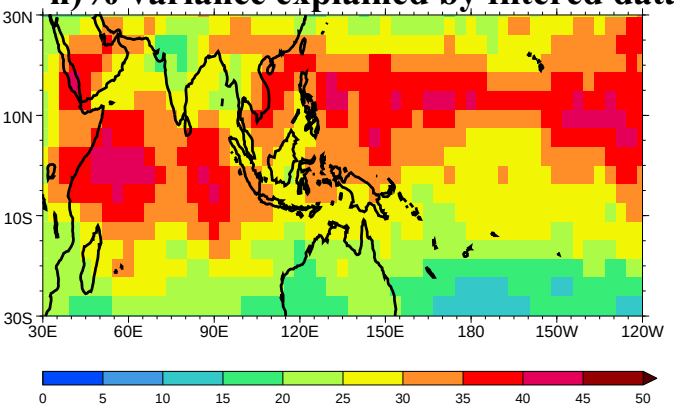
g) 20-100 day filtered variance



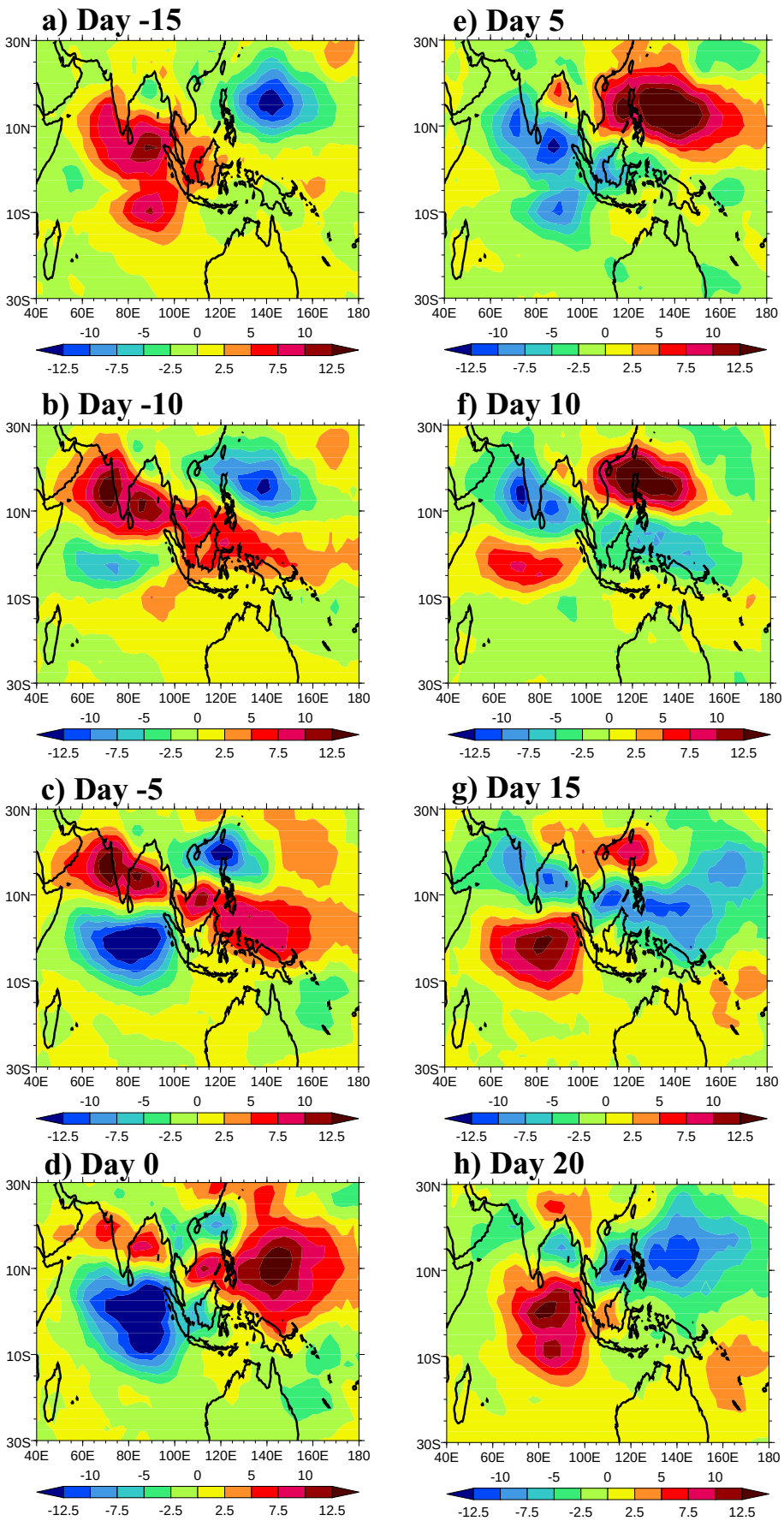
d)% variance explained by filtered data



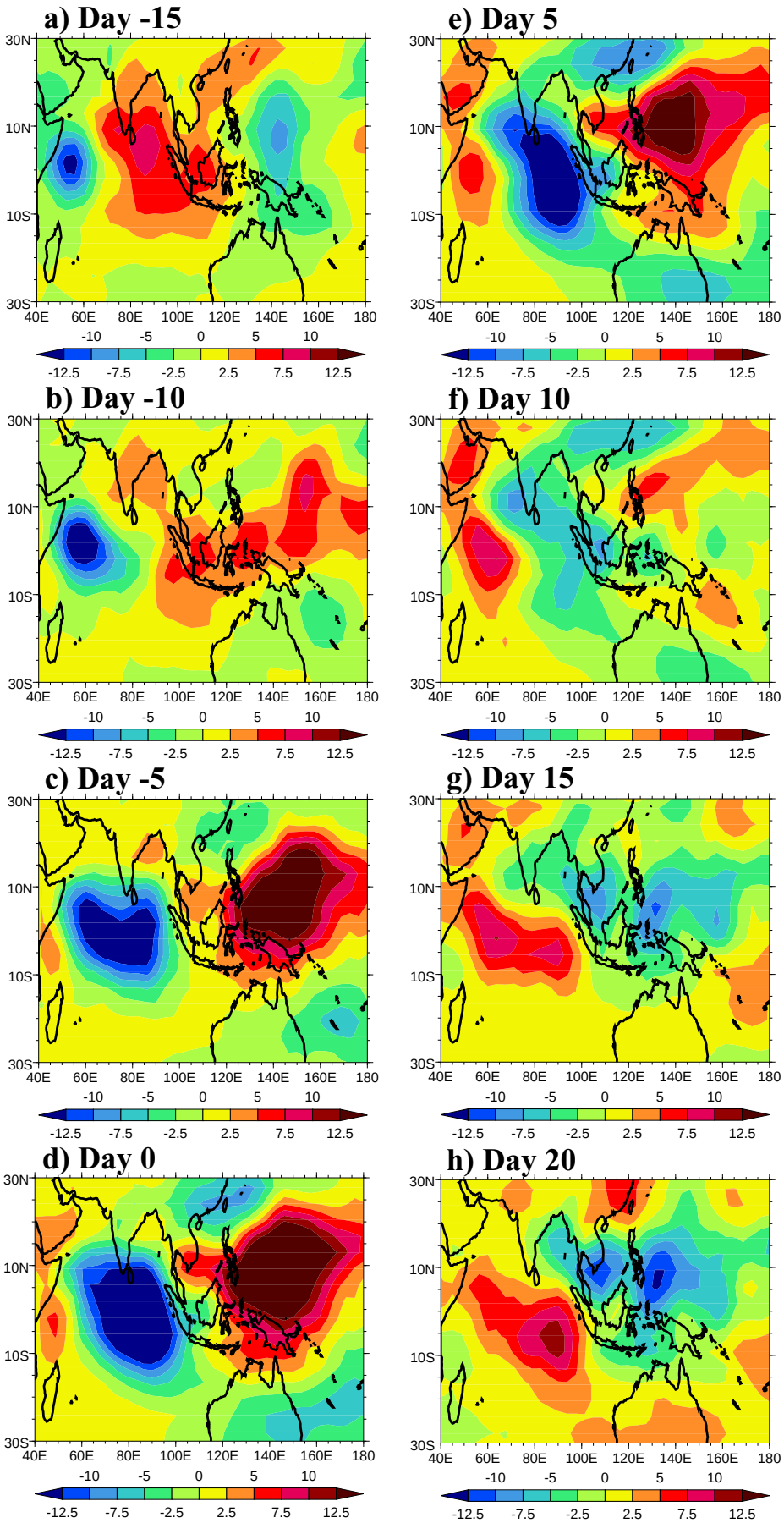
h)% variance explained by filtered data



AVHRR OLR (1979-95: JJAS)
Cyclostationary EOF's (40-day nested period)



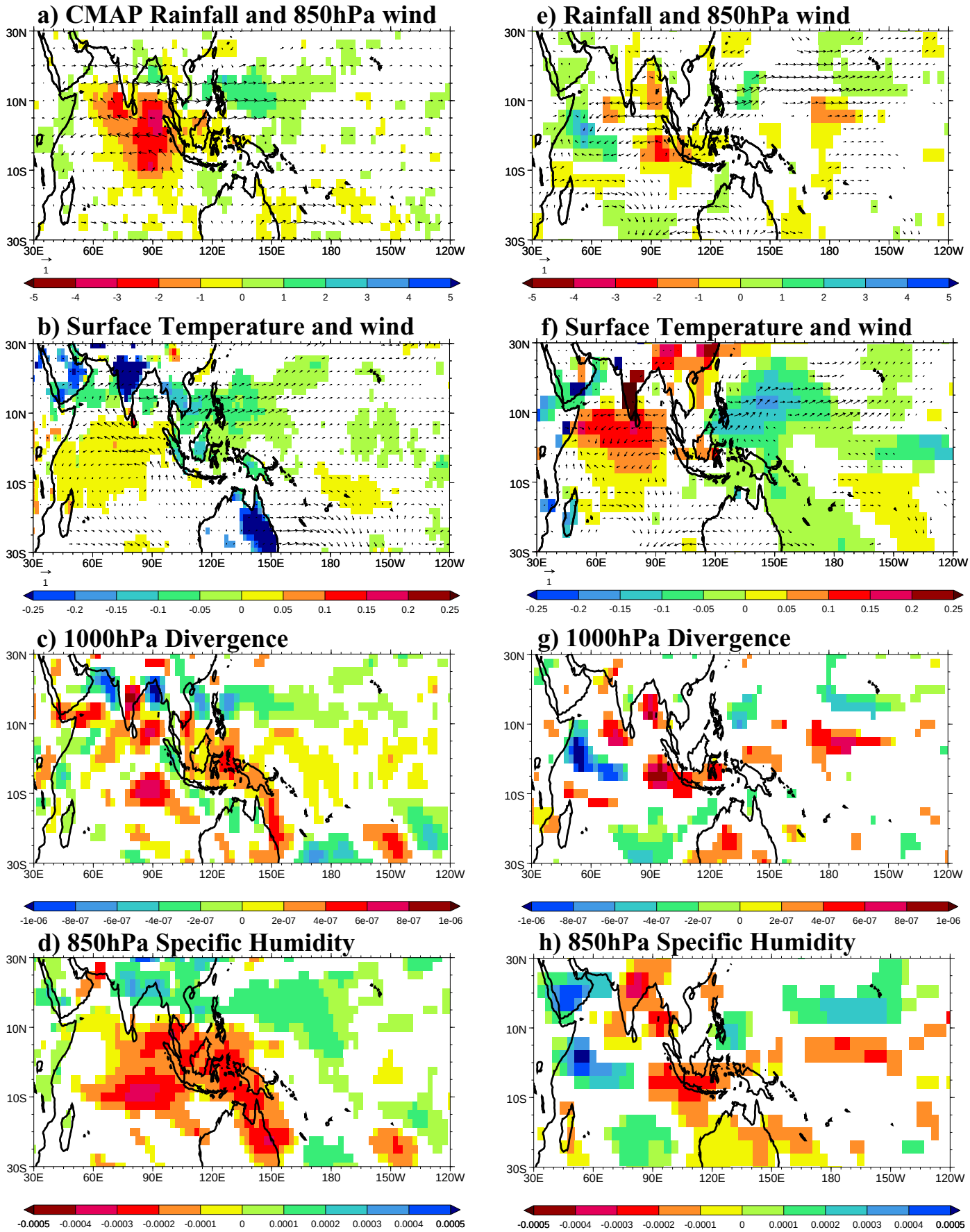
ECHO-G OLR (19 years: JJAS)
PC-4 Linear Regression with OLR



Onset in the Western Indian Ocean (Day -15)

Observations

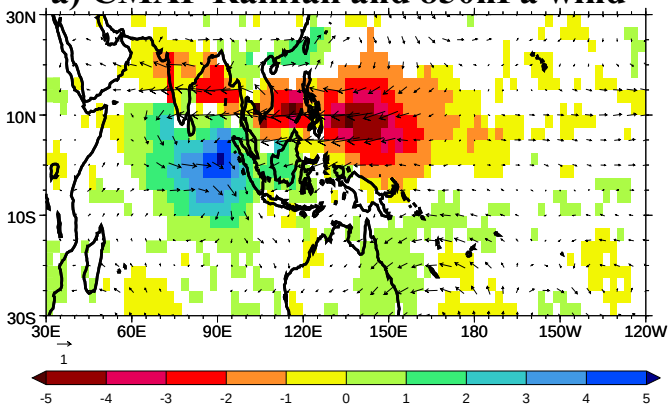
ECHO-G



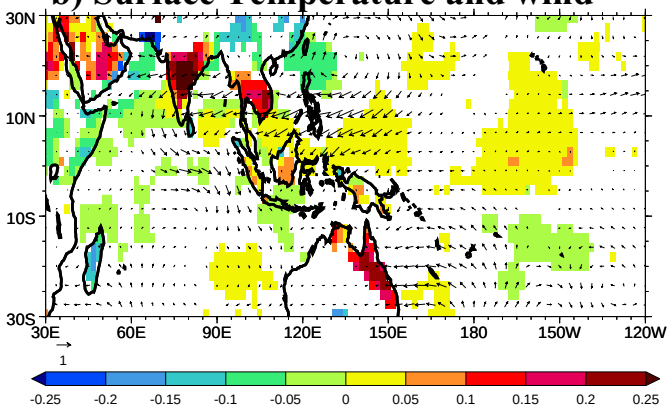
Northward Propagation of Convection Begins (Day 0)

Observations

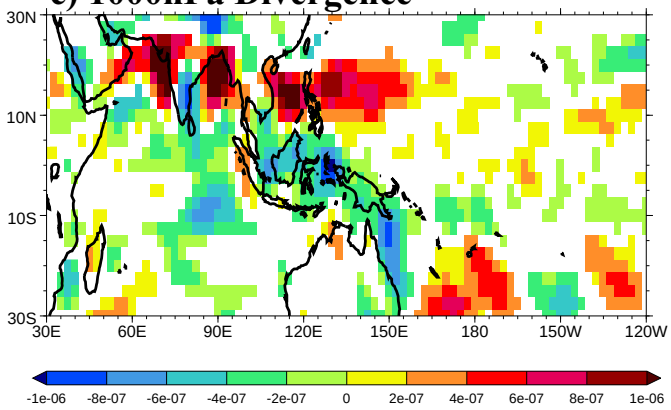
a) CMAP Rainfall and 850hPa wind



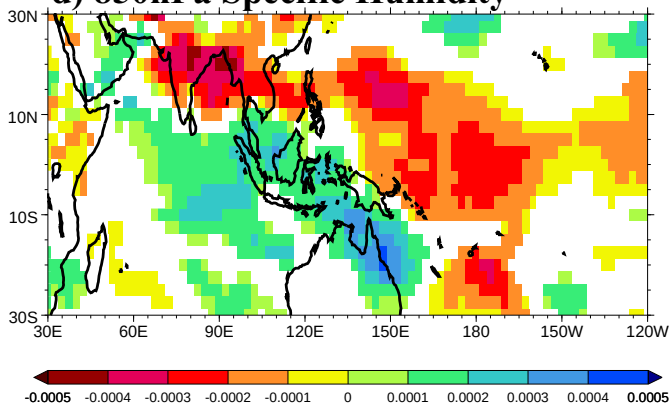
b) Surface Temperature and wind



c) 1000hPa Divergence

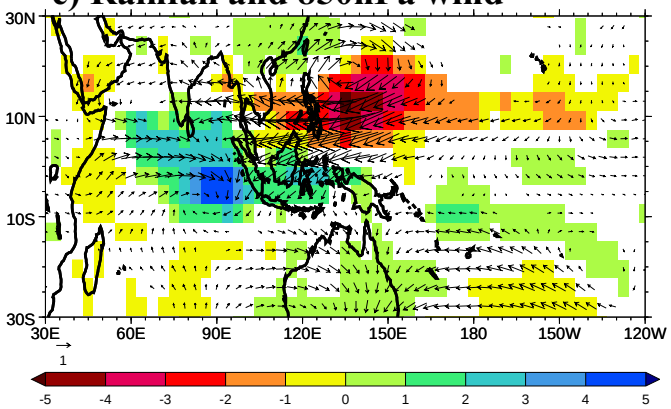


d) 850hPa Specific Humidity

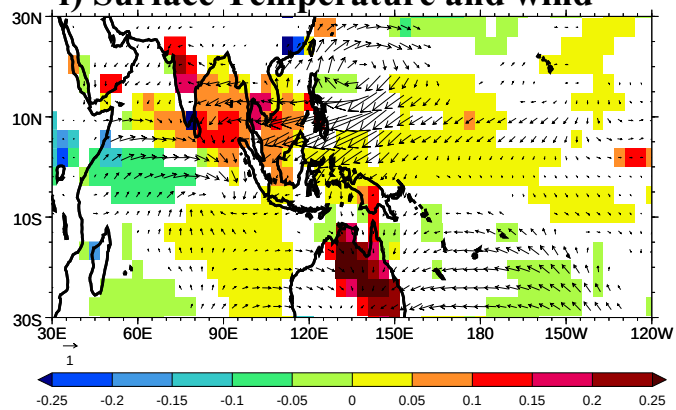


ECHO-G

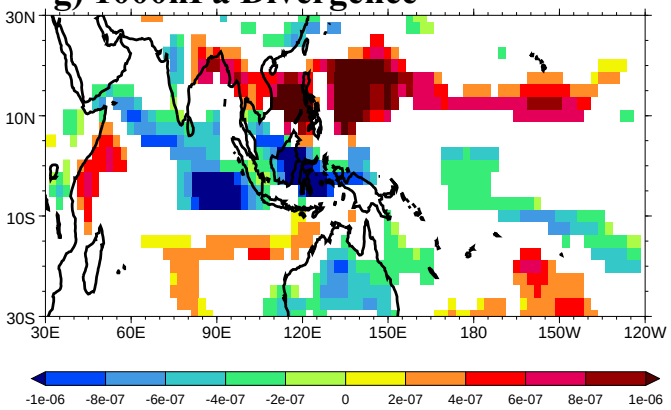
e) Rainfall and 850hPa wind



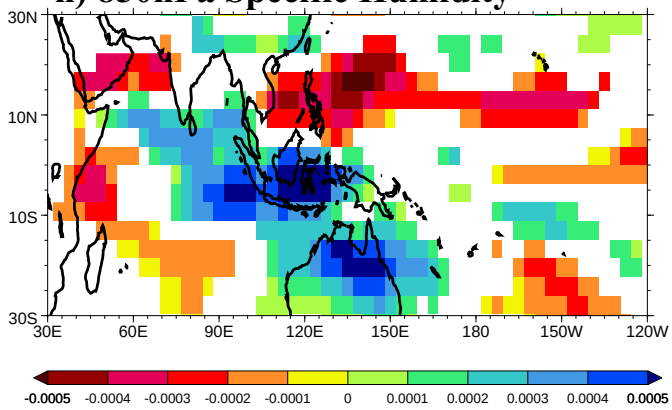
f) Surface Temperature and wind



g) 1000hPa Divergence



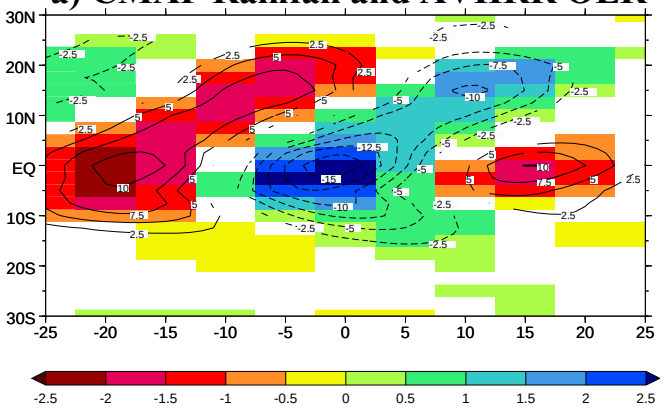
h) 850hPa Specific Humidity



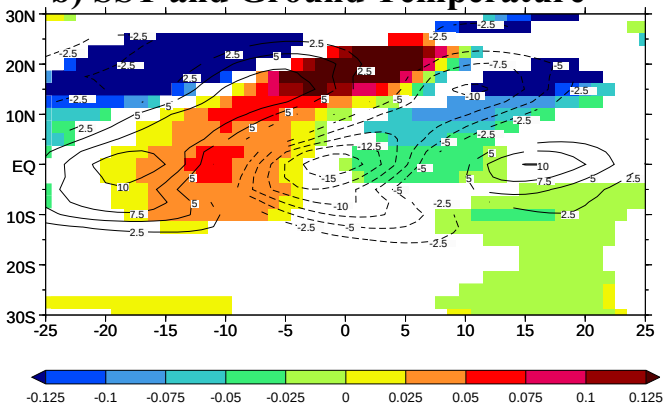
71.25°E-83.75°E Lag-Latitude Regressions

Observations

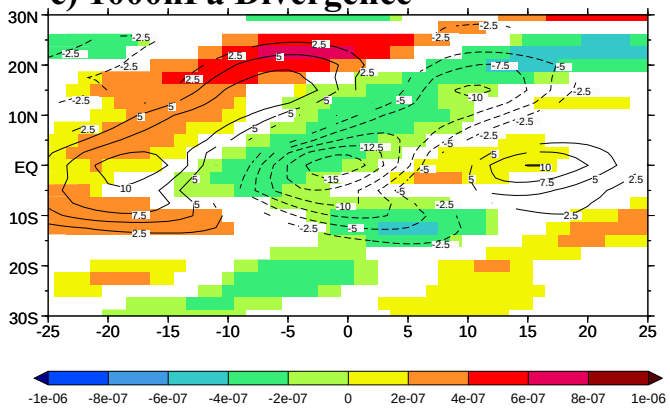
a) CMAP Rainfall and AVHRR OLR



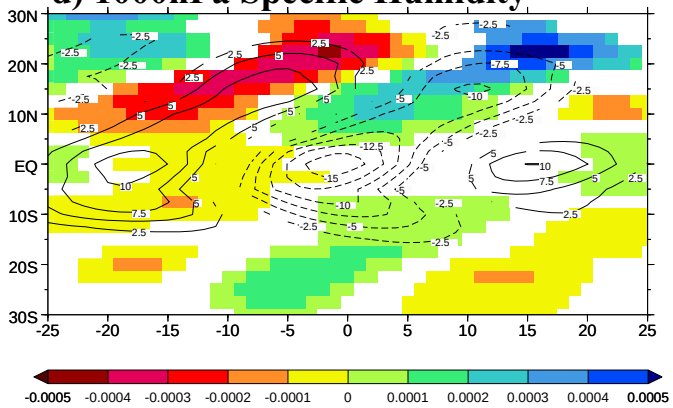
b) SST and Ground Temperature



c) 1000hPa Divergence

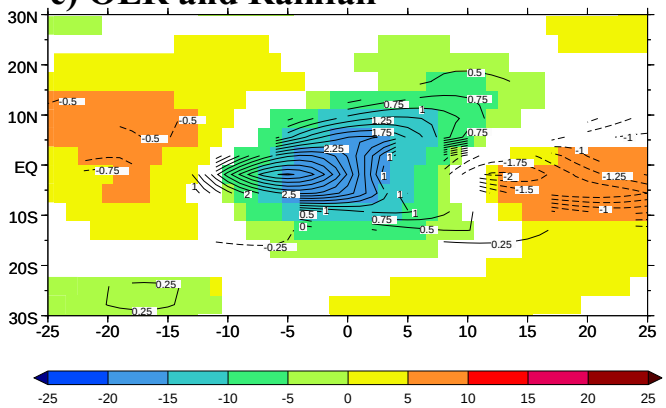


d) 1000hPa Specific Humidity

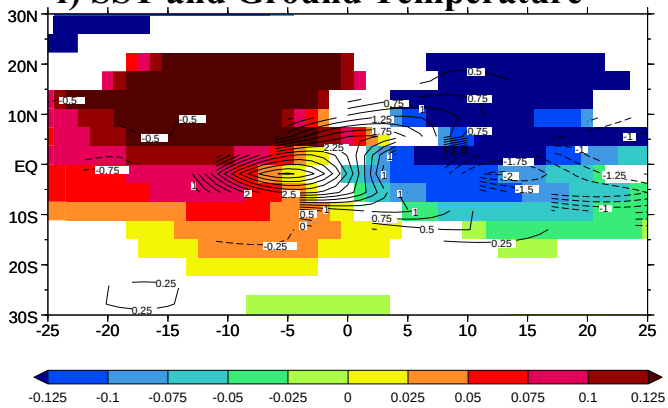


ECHO-G

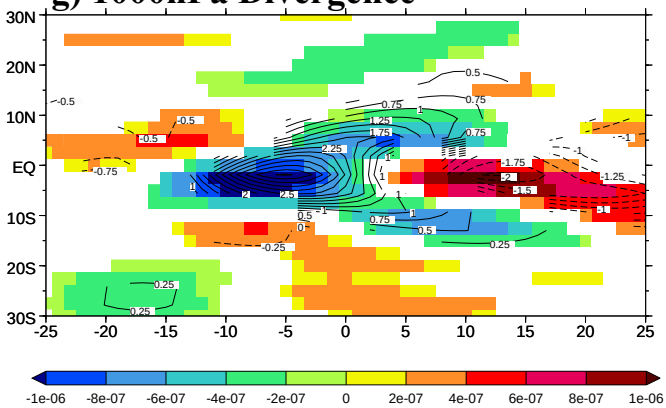
e) OLR and Rainfall



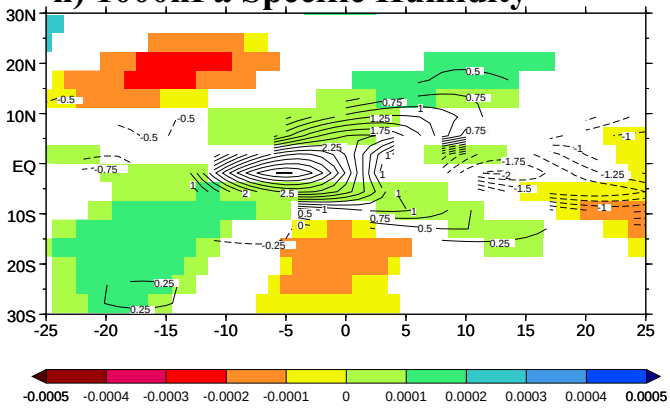
f) SST and Ground Temperature



g) 1000hPa Divergence



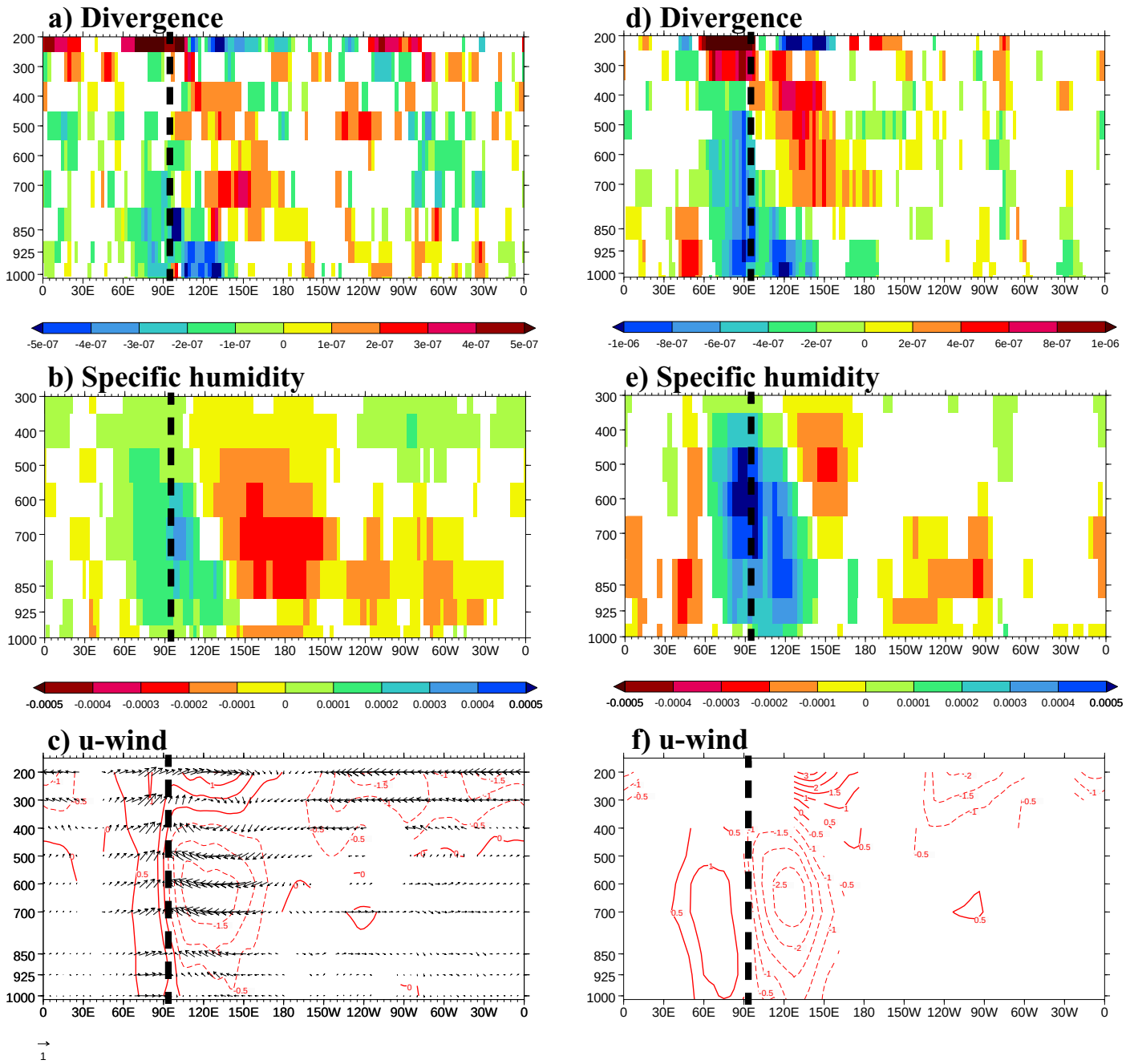
h) 1000hPa Specific Humidity



5°N-5°S Longitude-Pressure Level Regressions (Day 0)

Observations

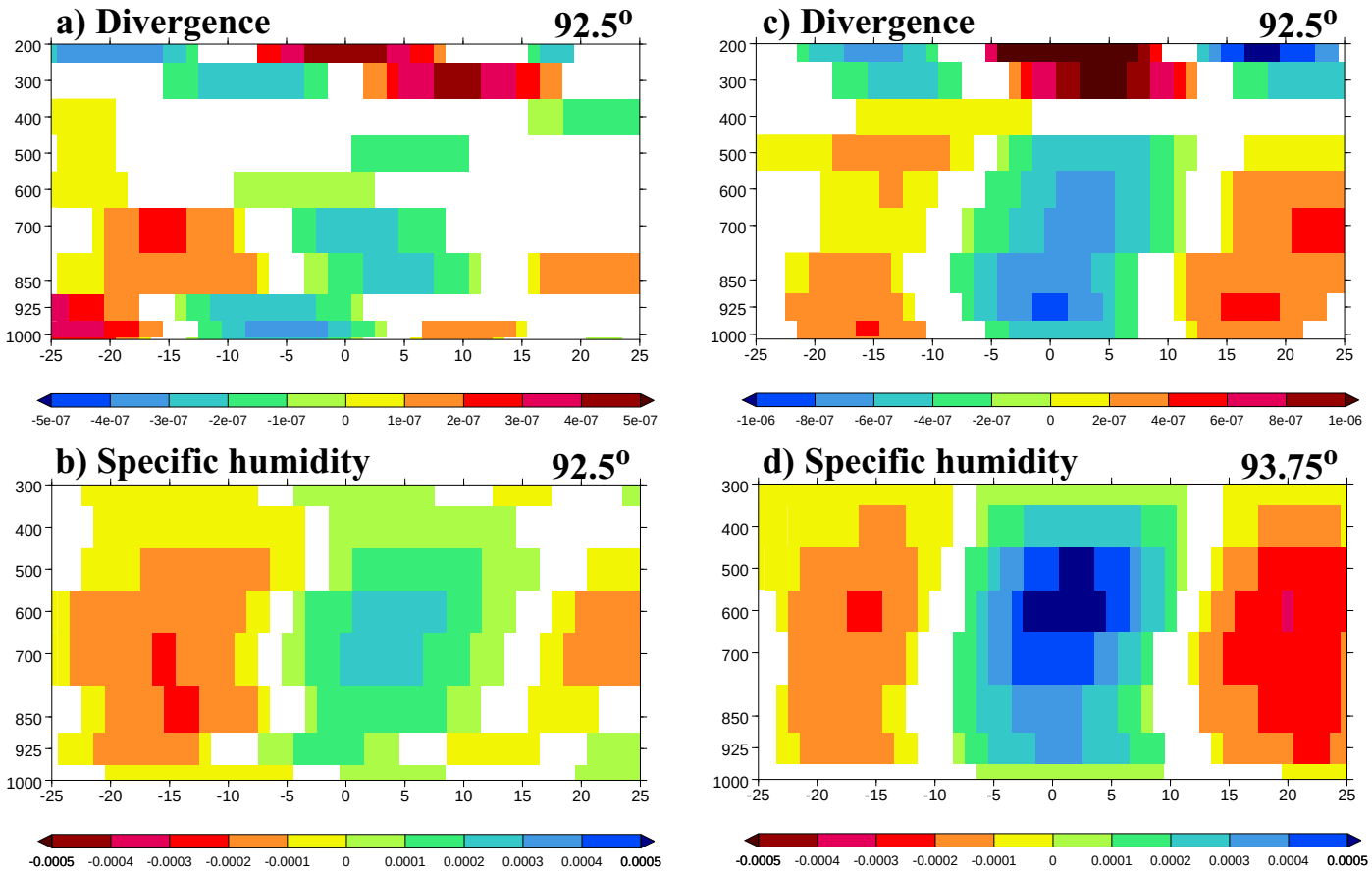
ECHO-G



5°N-5°S Lag-Pressure Level Regressions

Observations

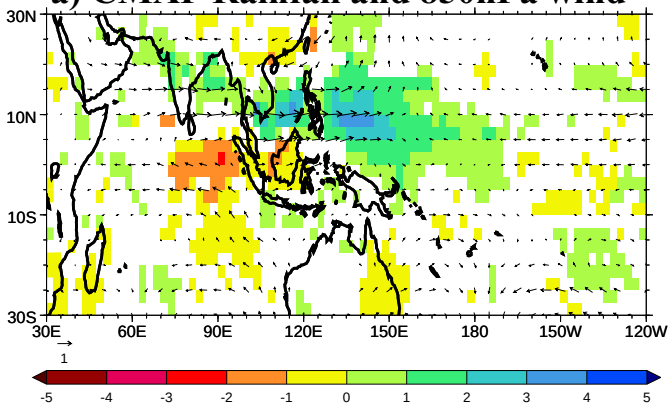
ECHO-G



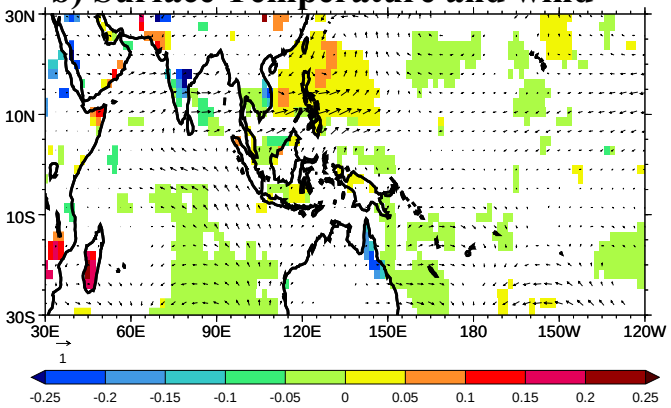
West Pacific Convection and Monsoon Break over India (Day 20)

Observations

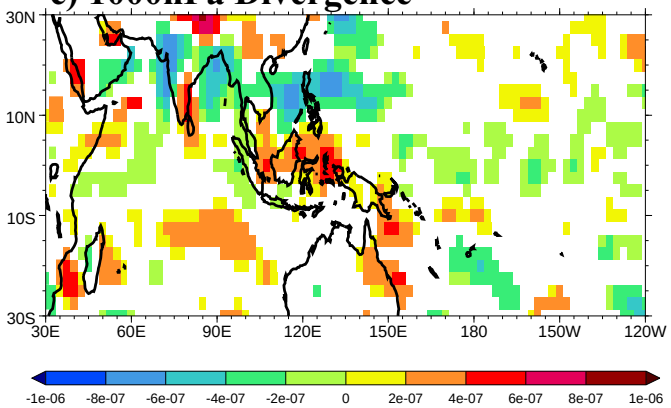
a) CMAP Rainfall and 850hPa wind



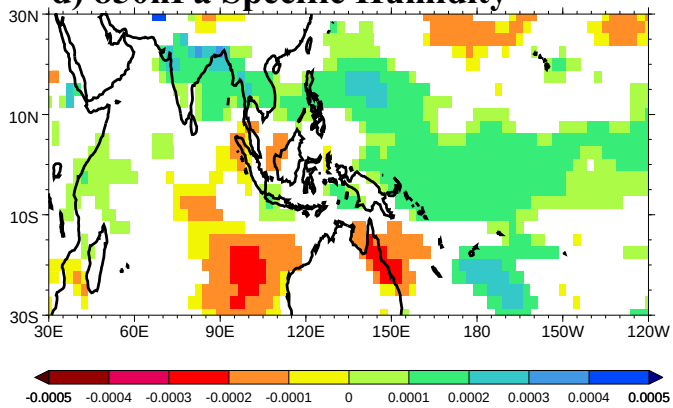
b) Surface Temperature and wind



c) 1000hPa Divergence

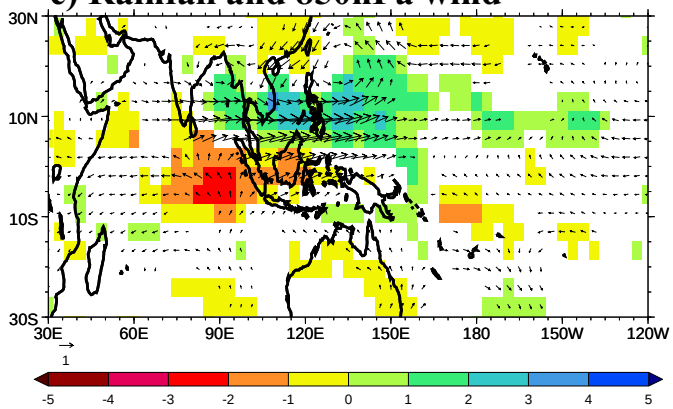


d) 850hPa Specific Humidity

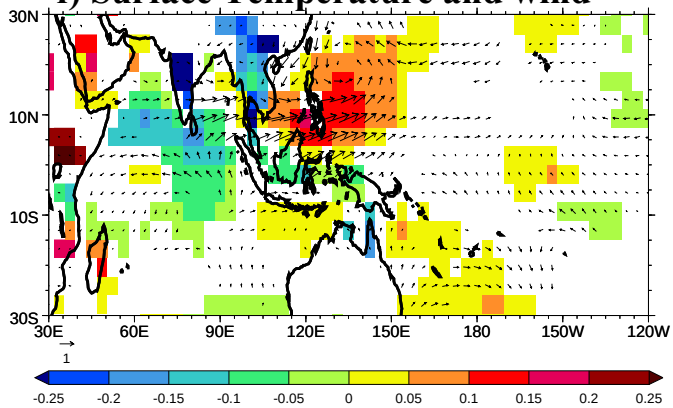


ECHO-G

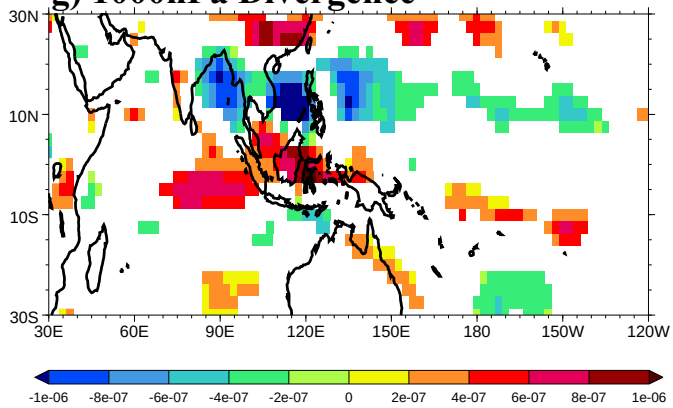
e) Rainfall and 850hPa wind



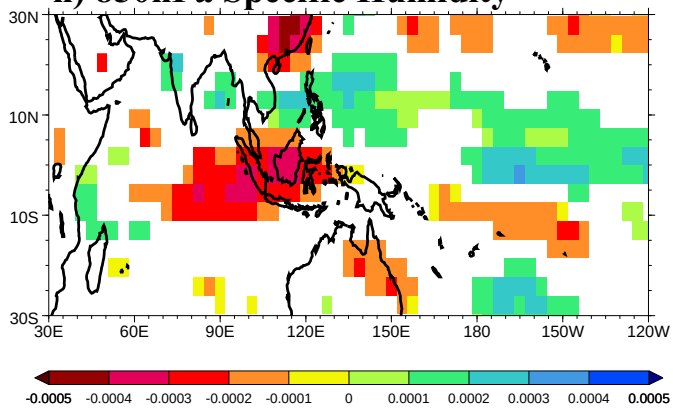
f) Surface Temperature and wind

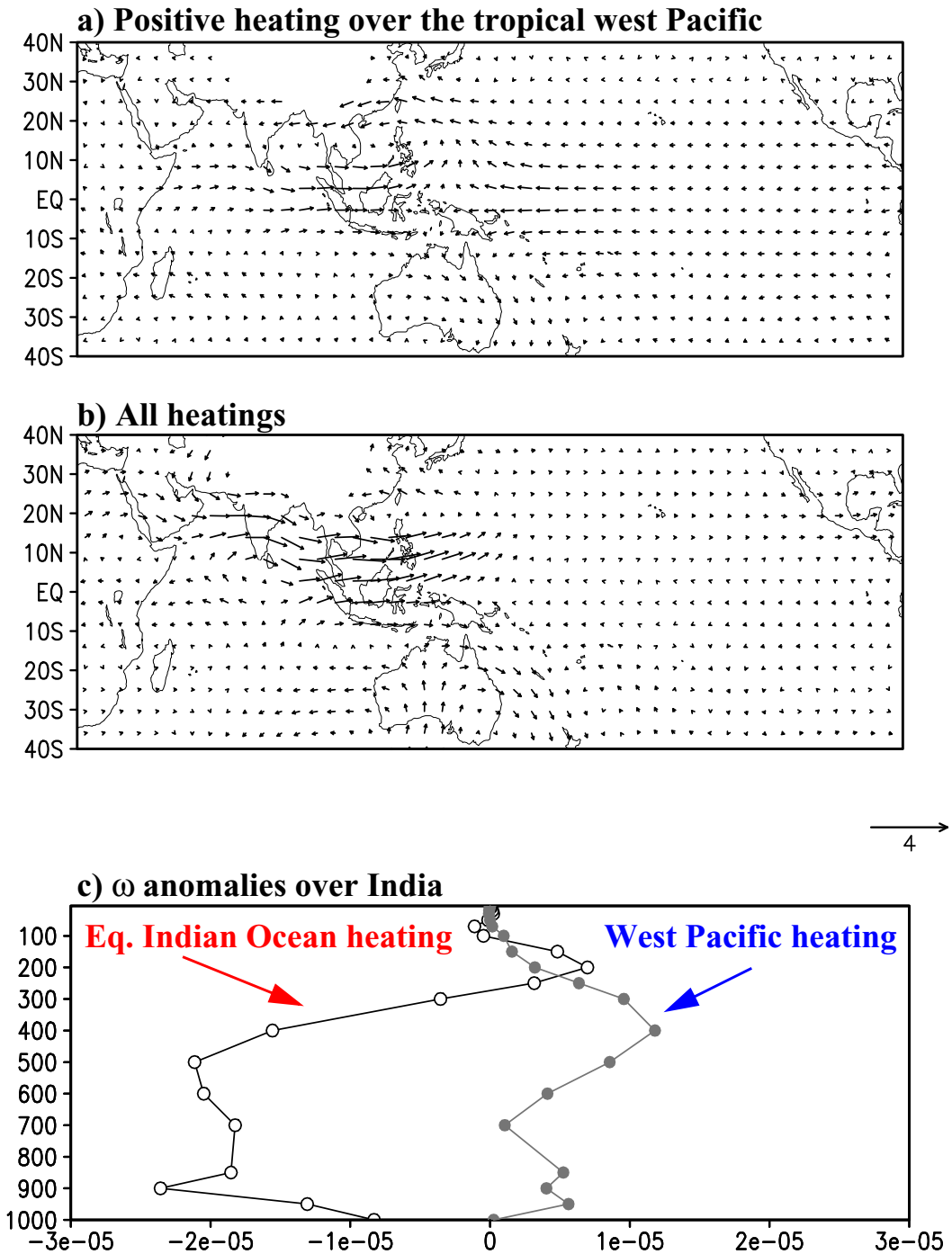


g) 1000hPa Divergence



h) 850hPa Specific Humidity




a) Positive heating over the tropical west Pacific
40N
30N
20N
10N
EQ
10S
20S
30S
40S
b) All heatings
40N
30N
20N
10N
EQ
10S
20S
30S
40S
4
c) ω anomalies over India
Eq. Indian Ocean heating
West Pacific heating
100
200
300
400
500
600
700
800
900
1000
−3e−05
−2e−05
−1e−05
0
1e−05
2e−05
3e−05

Preliminary Findings

1) The ECHO-G model captures the near-equatorial eastward intraseasonal propagation of convection, and its' poleward bifurcation over the eastern Indian Ocean

-the vertical structure and the low-level moisture convergence is consistent with the boreal winter MJO

2) In both model and observations above normal SST (and land surface temperature) lead the eastward and northward propagation of convection

3) For northward propagation, low-level moisture convergence leads the convection over the Indian longitudes, but not over the Bay of Bengal

4) However, the simulated northward propagation of convection over India is weaker than observed

5) The model represents the Annamalai and Sperber (2004) mechanism in which enhanced west Pacific convection helps trigger the monsoon break over India