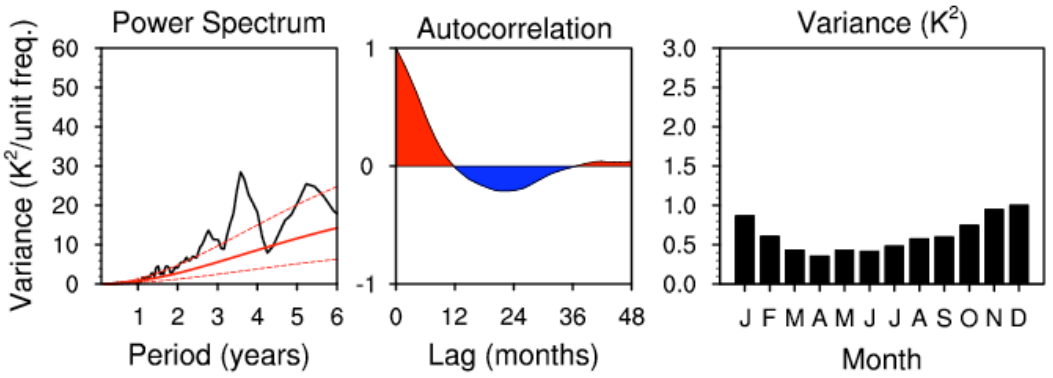
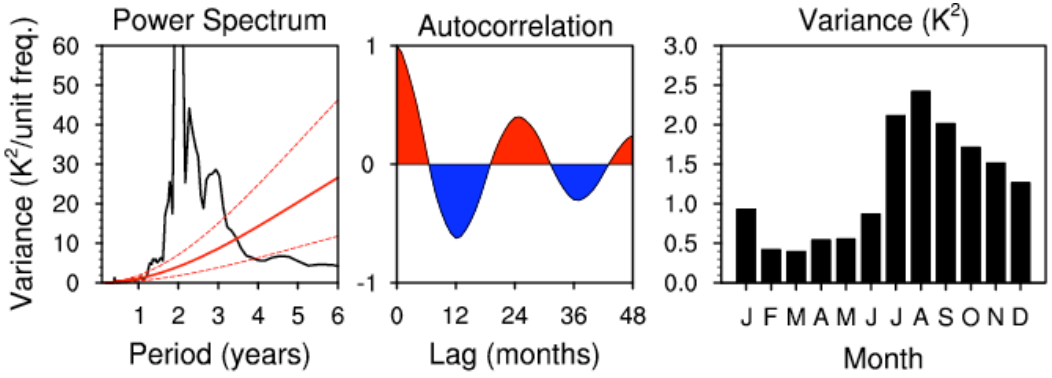
ENSO

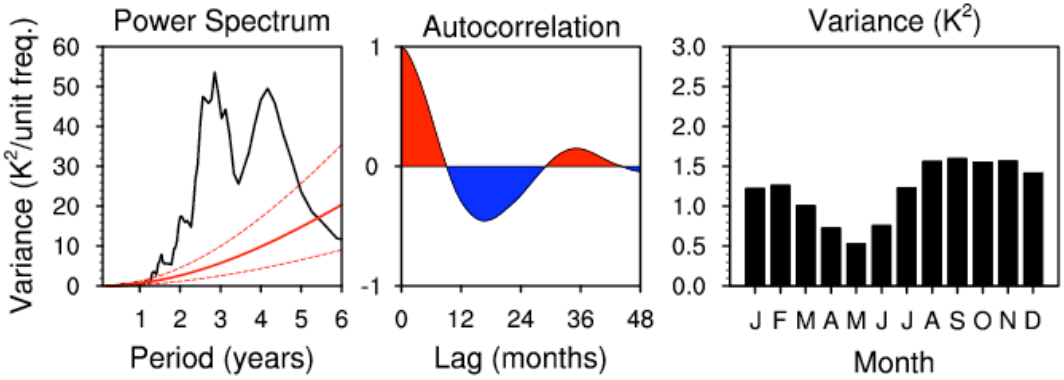
Nino-3 SST Anomalies



Observations



Control



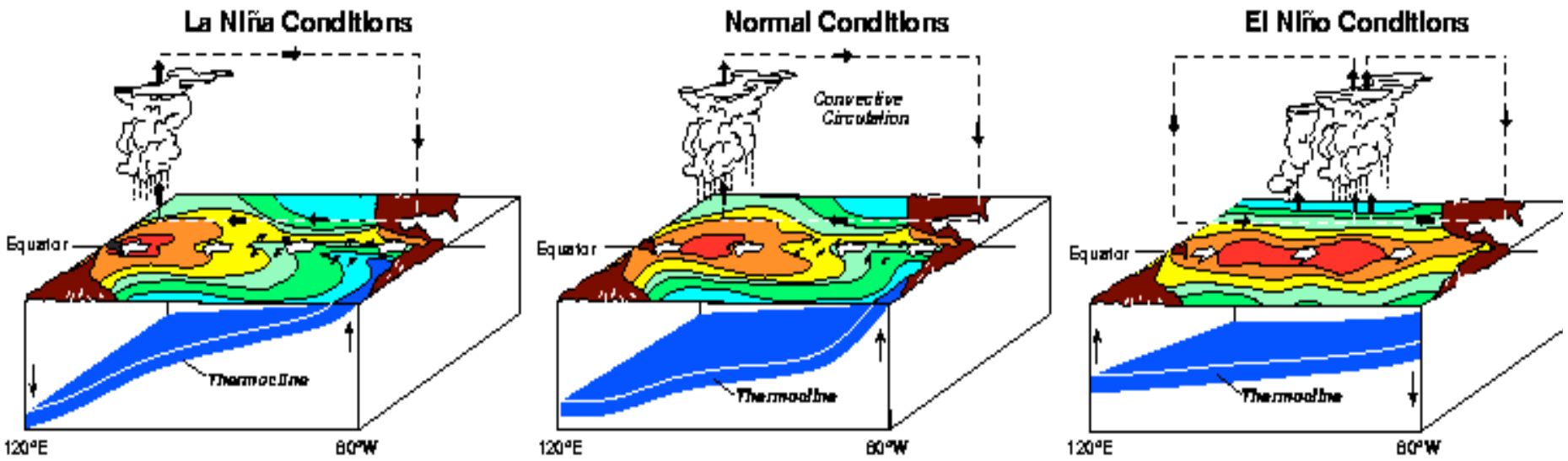
Neale-Richter

El Nino and Southern Oscillation (ENSO)

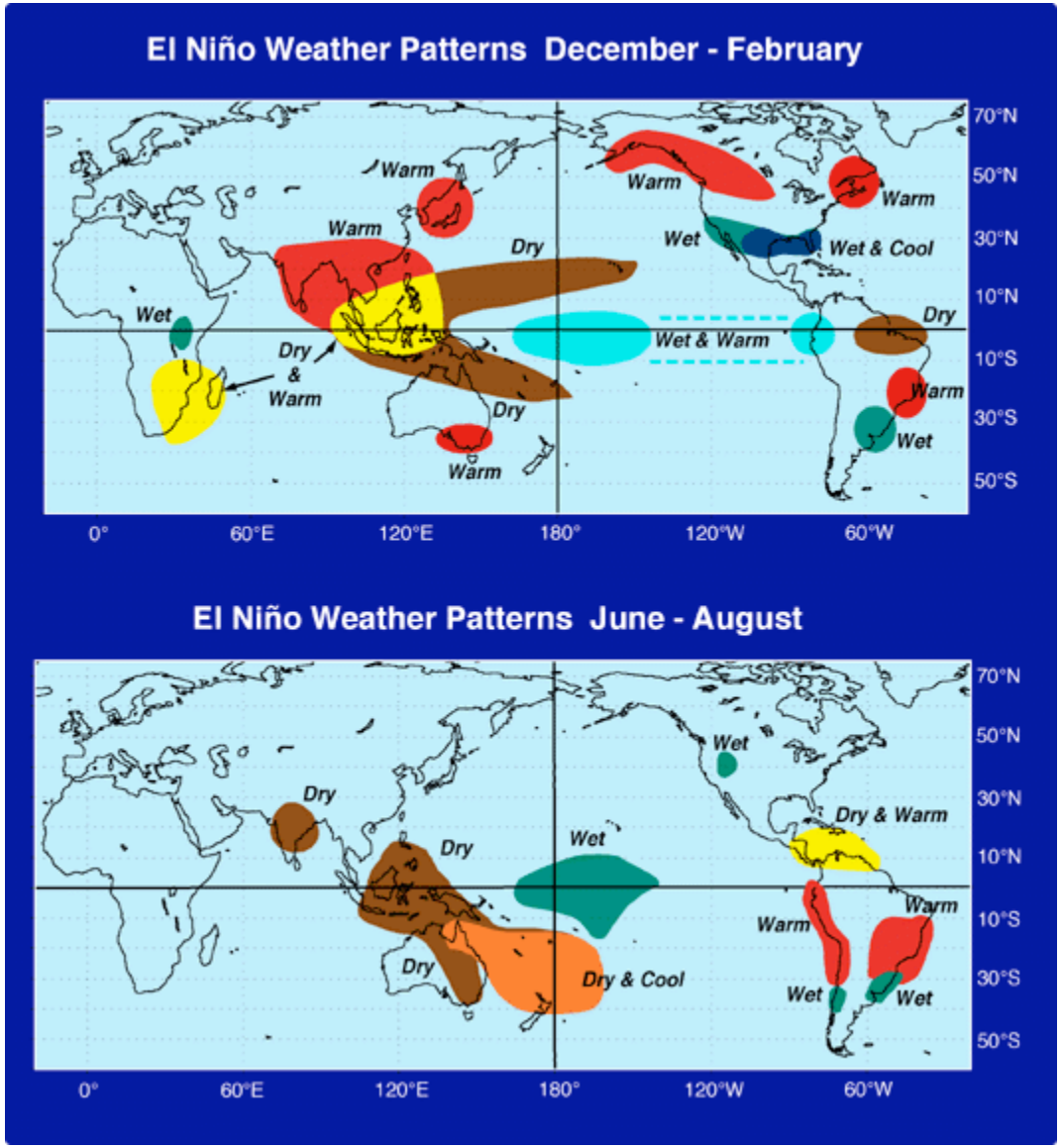
- what is ENSO?
- how does it work?
- why can't we predict it?

Markus Joc

The three stages of ENSO

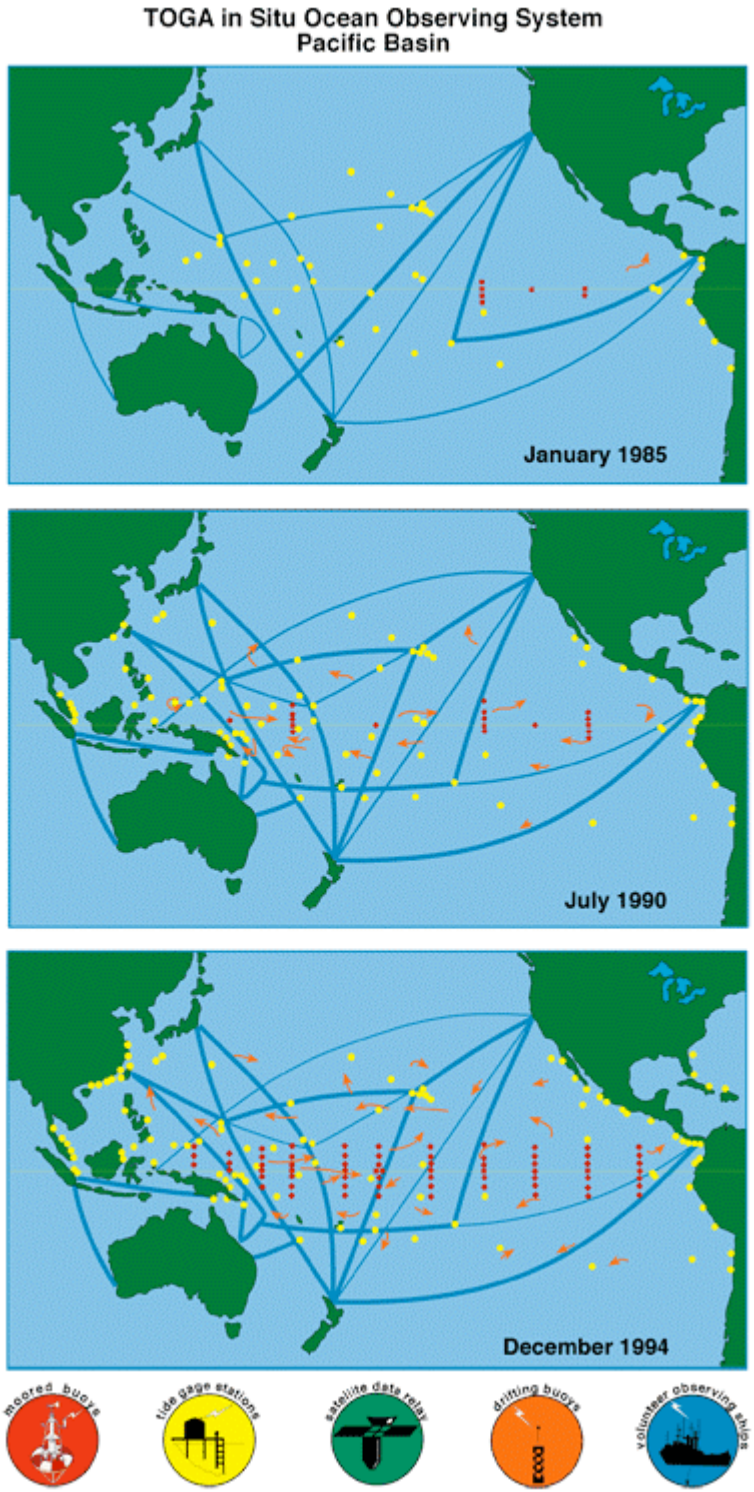


ENSO IMPACTS



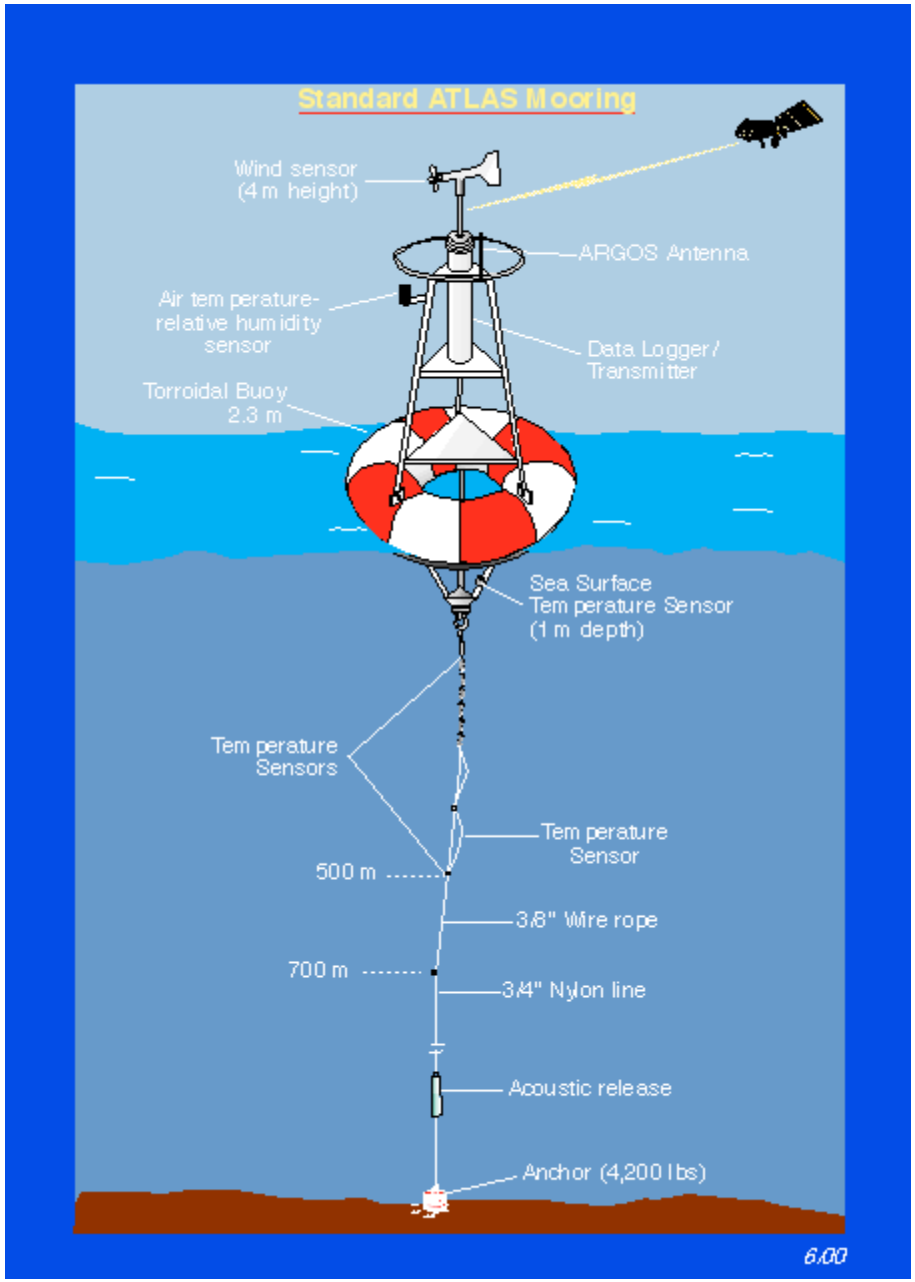
NOAA/

The Observing Platform



NOAA/PMEL

MOORING DESIGN

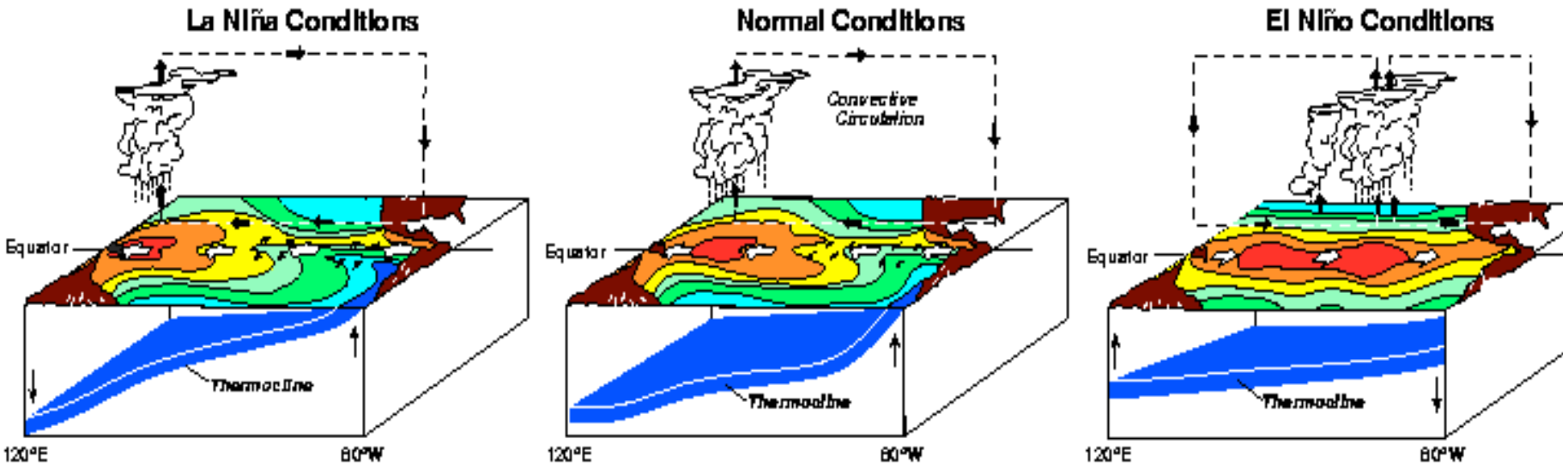


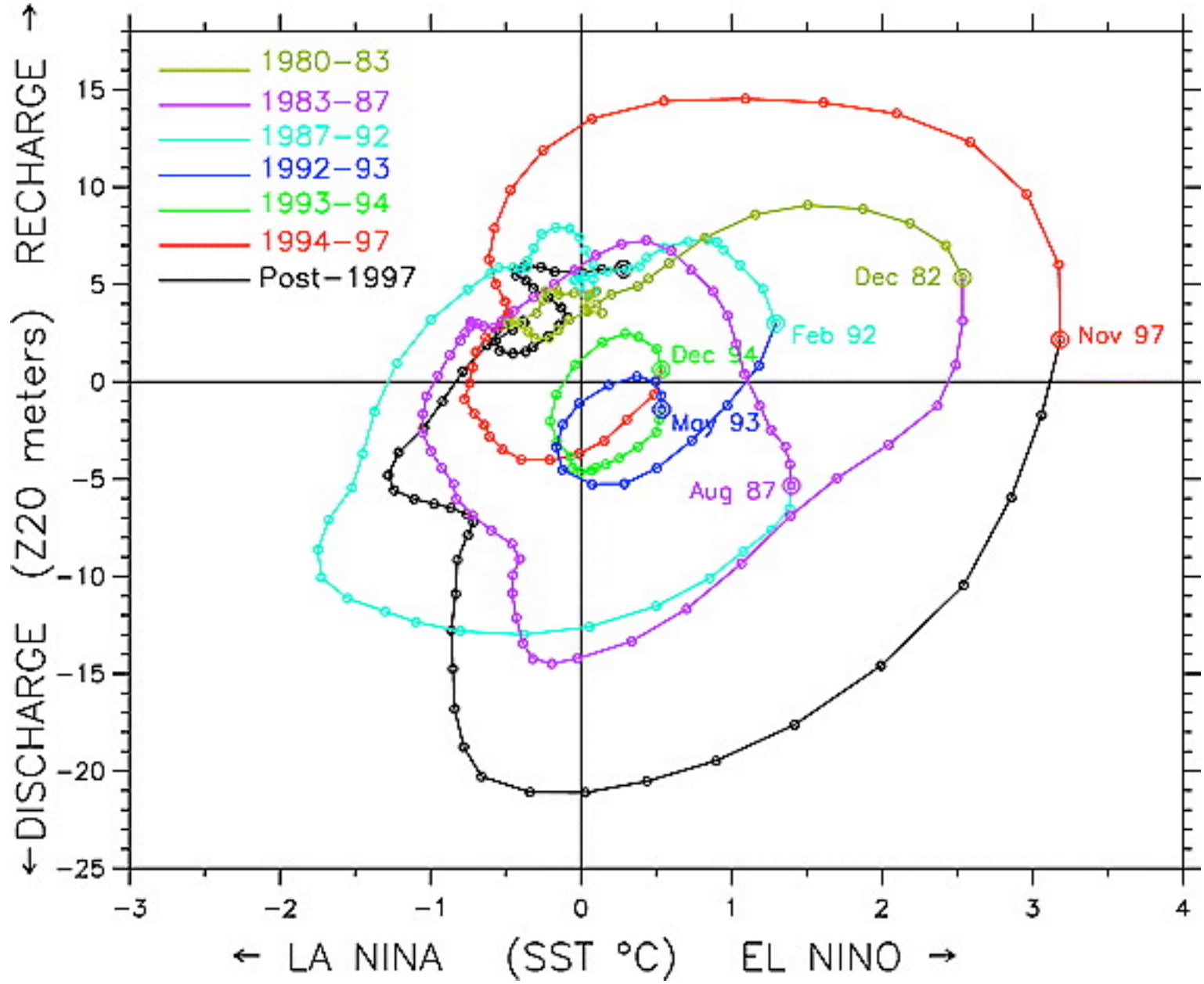
NOAA/PMEL

The Joys of Oceanography

NOAA

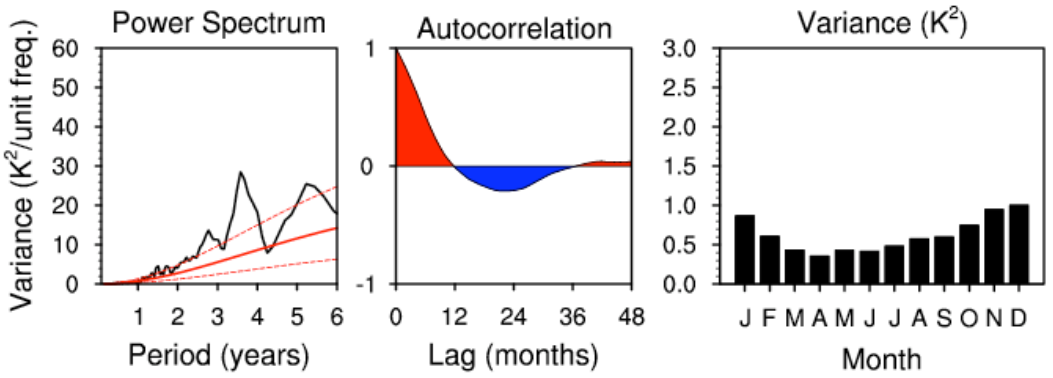
DETAILS


La Niña Conditions
Equator
Thermocline
120°E
80°W
Normal Conditions
Convective Circulation
Equator
Thermocline
120°E
80°W
El Niño Conditions
Equator
Thermocline
120°E
80°W

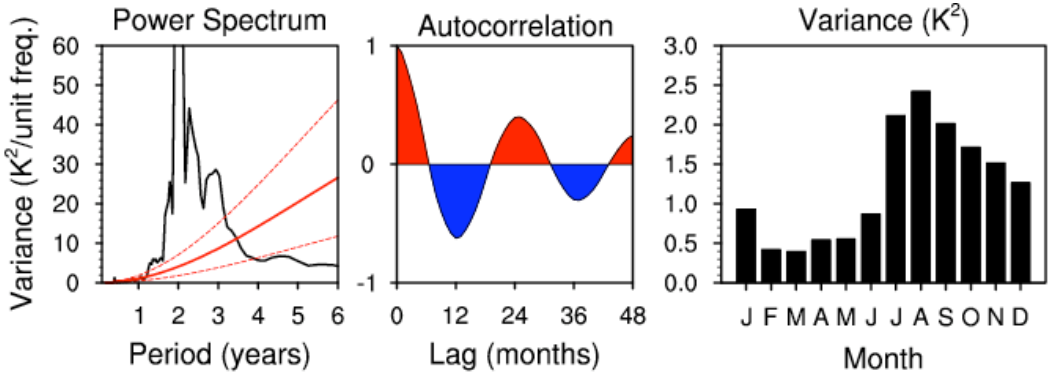

1980–83
1983–87
1987–92
1992–93
1993–94
1994–97
Post–1997
Dec 82
Feb 92
Nov 97
Dec 94
May 93
Aug 87
←DISCHARGE (Z20 meters) RECHARGE →
← LA NINA (SST °C) EL NINO →
15
10
5
0
−5
−10
−15
−20
−25
−3
−2
−1
0
1
2
3
4

ENSO – frequency and variance

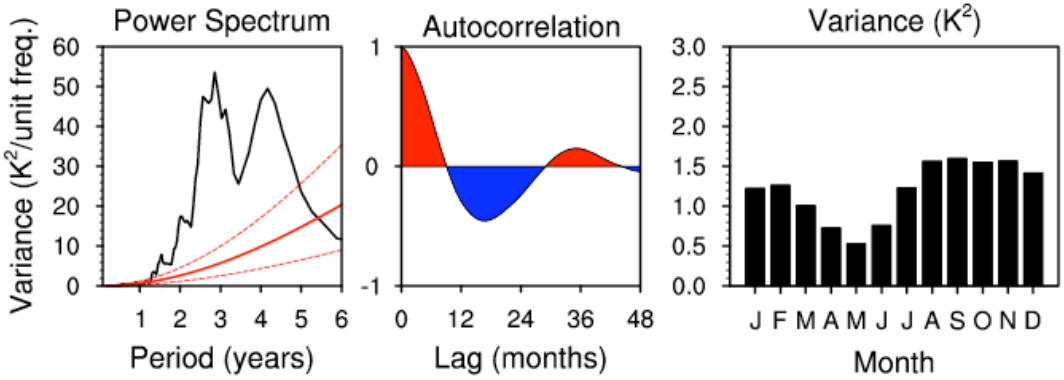
Nino-3 SST Anomalies



Observations

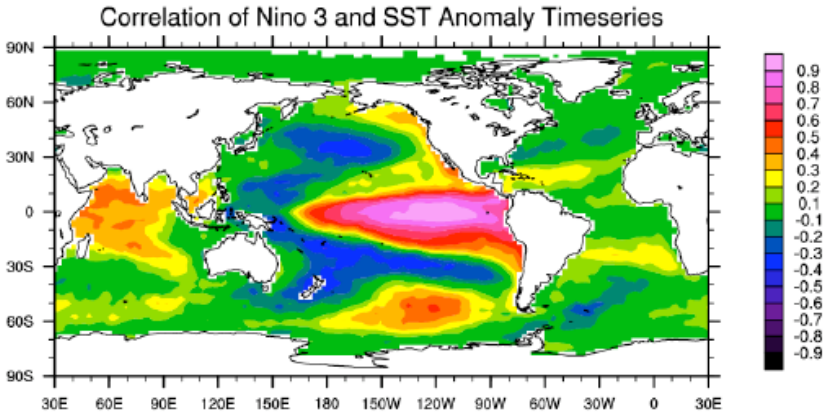


old CCSM

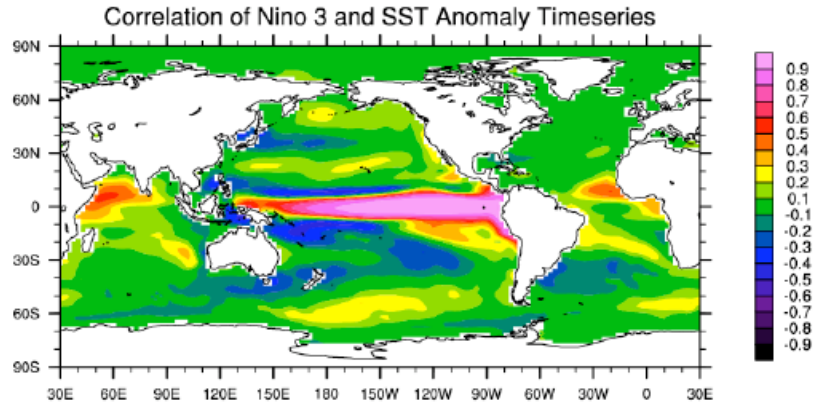


new CCSM

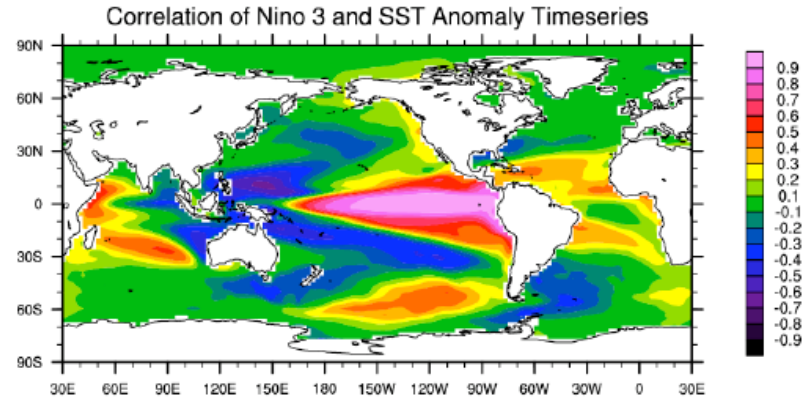
ENSO – spatial correlations



Observations



old CCSM

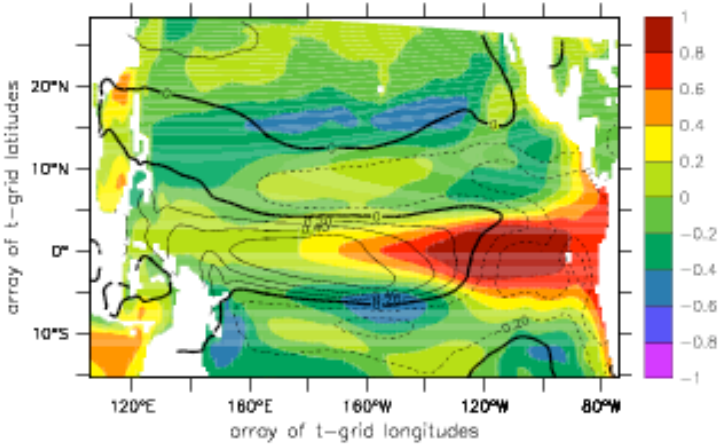


new CCSM

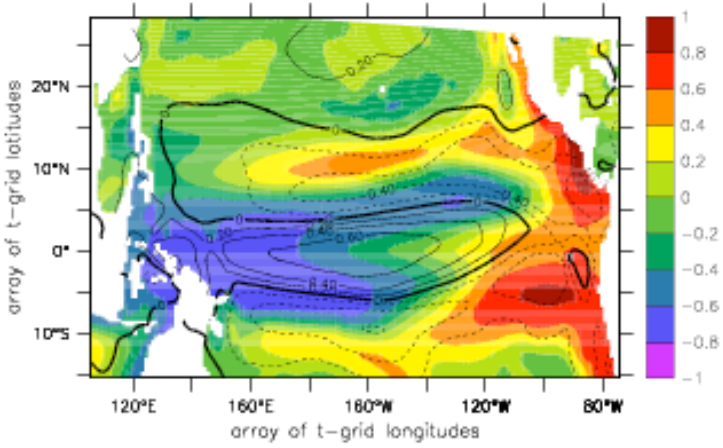
ENSO - MECHANSIMS

delayed oscillator or stochastically forced?

Correlation of anomalies of taux and z20 with z20 at 0N/120W

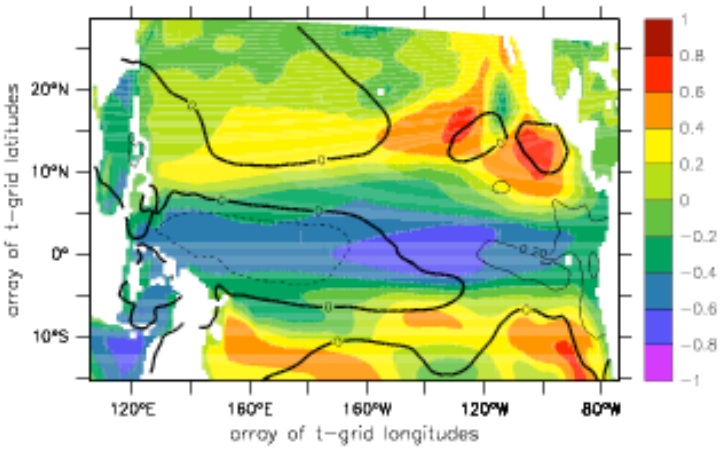


a) zero lag

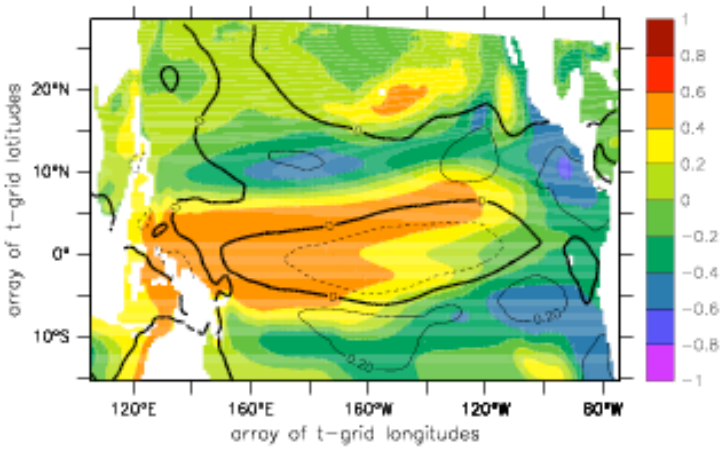


b) wind and z20 after 4 months

old CCSM

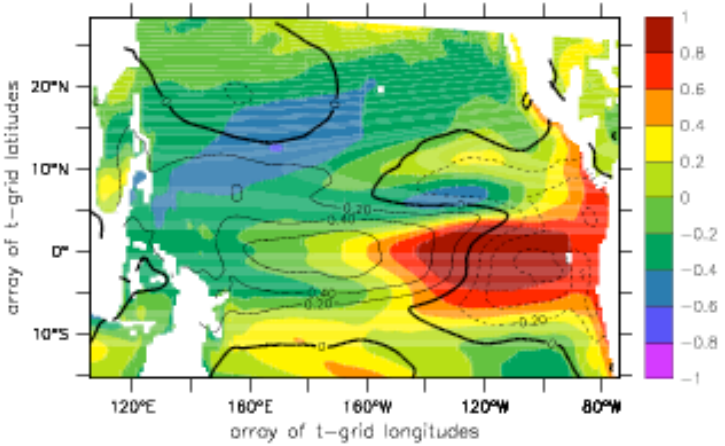


c) wind and z20 after 10 months

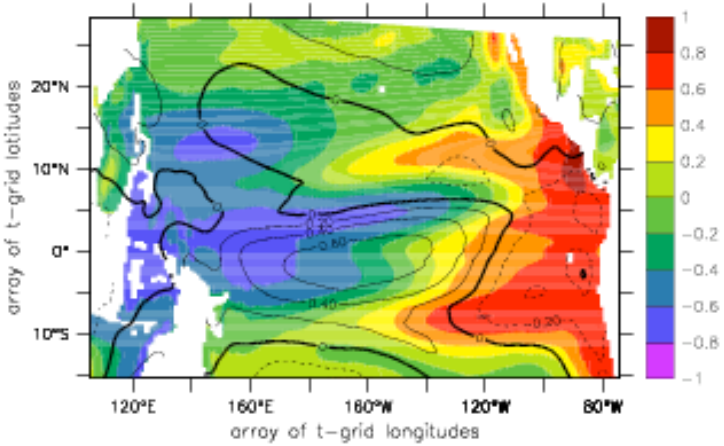


d) wind and z20 after 18 months

Correlation of anomalies of taux and z20 with z20 at 0N/120W

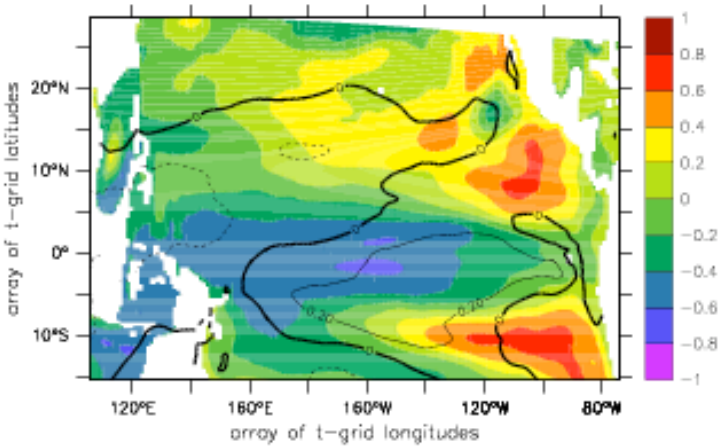


a) zero lag

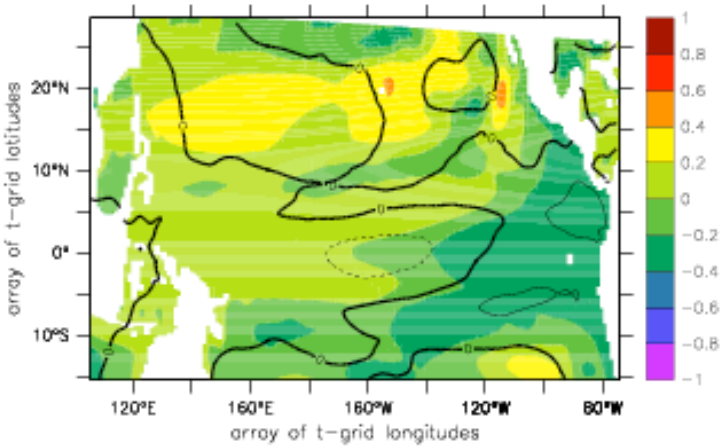


b) wind and z20 after 4 months

new CCSM

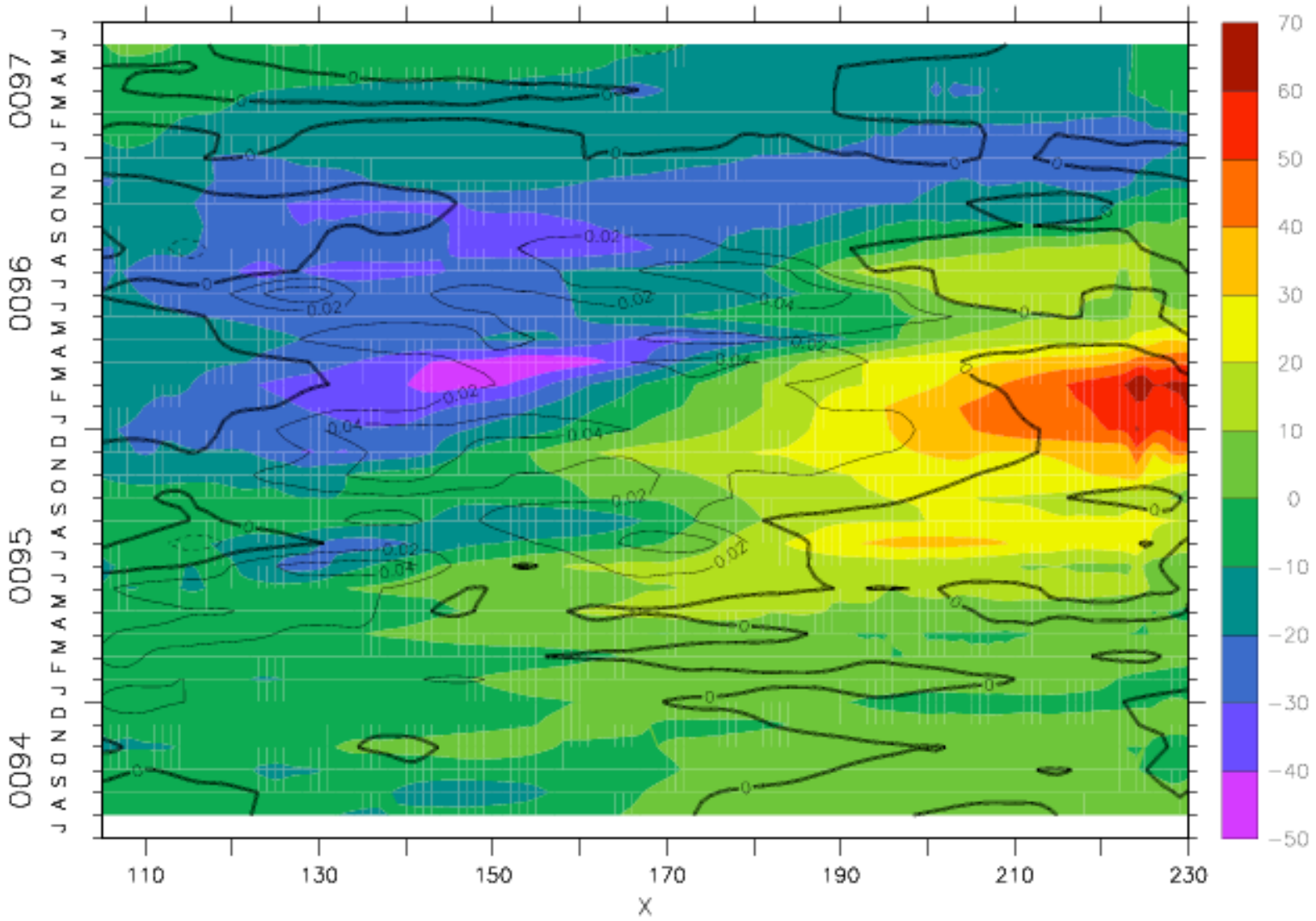


c) wind and z20 after 10 months

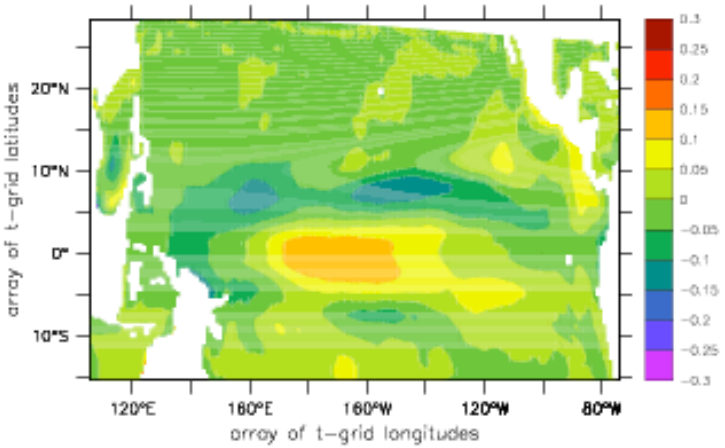


d) wind and z20 after 18 months

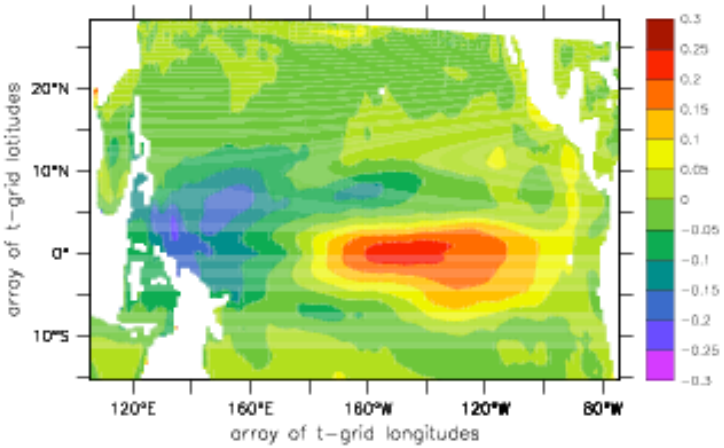
Hovmoeller diagram of z20 and taux anomaly along equator



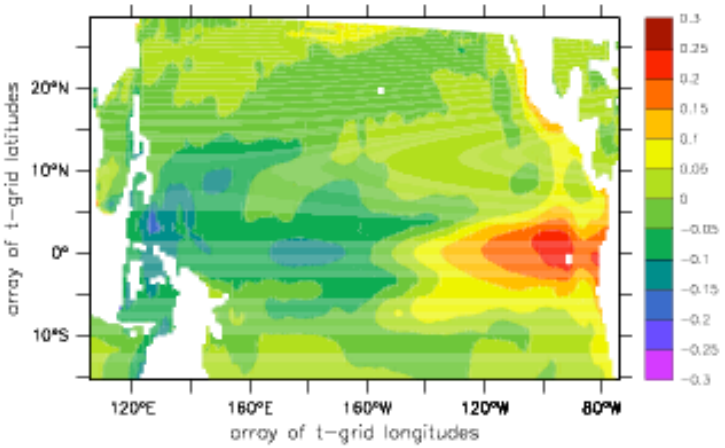
Correlation of highpass filtered taux at 0N/170E with z20



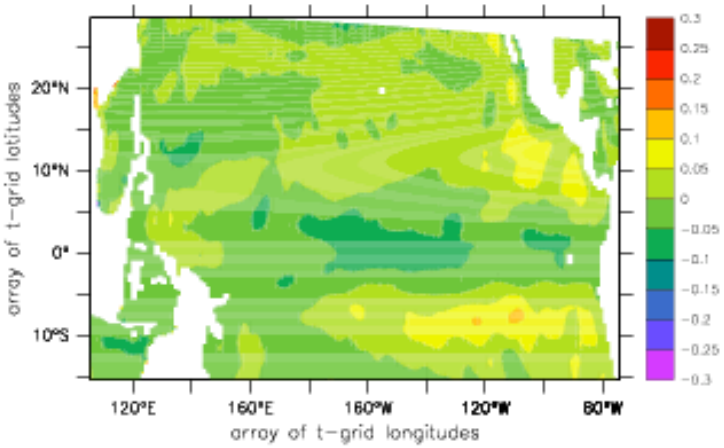
a) zero lag



b) 1 month lag

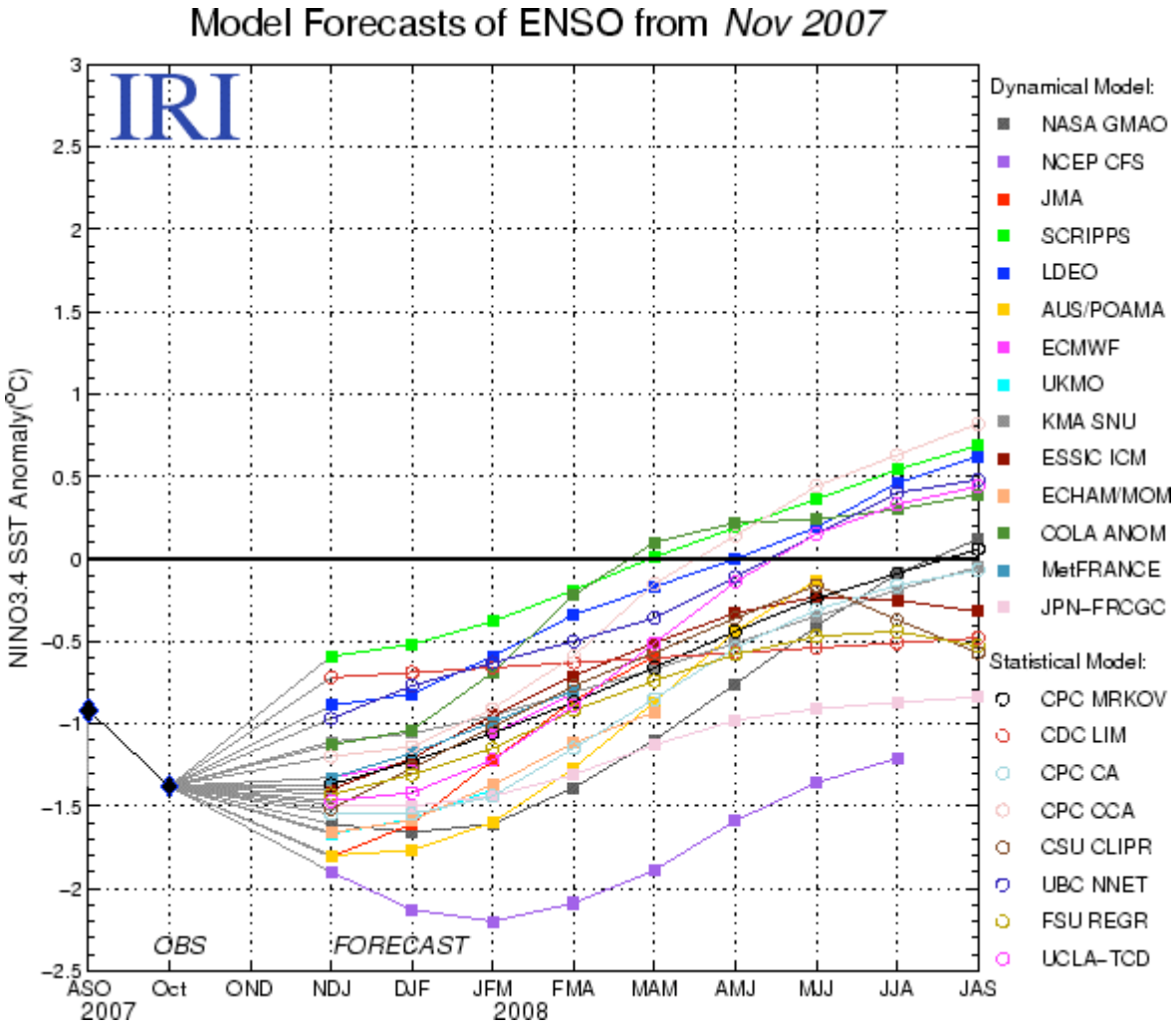


c) 2 months lag



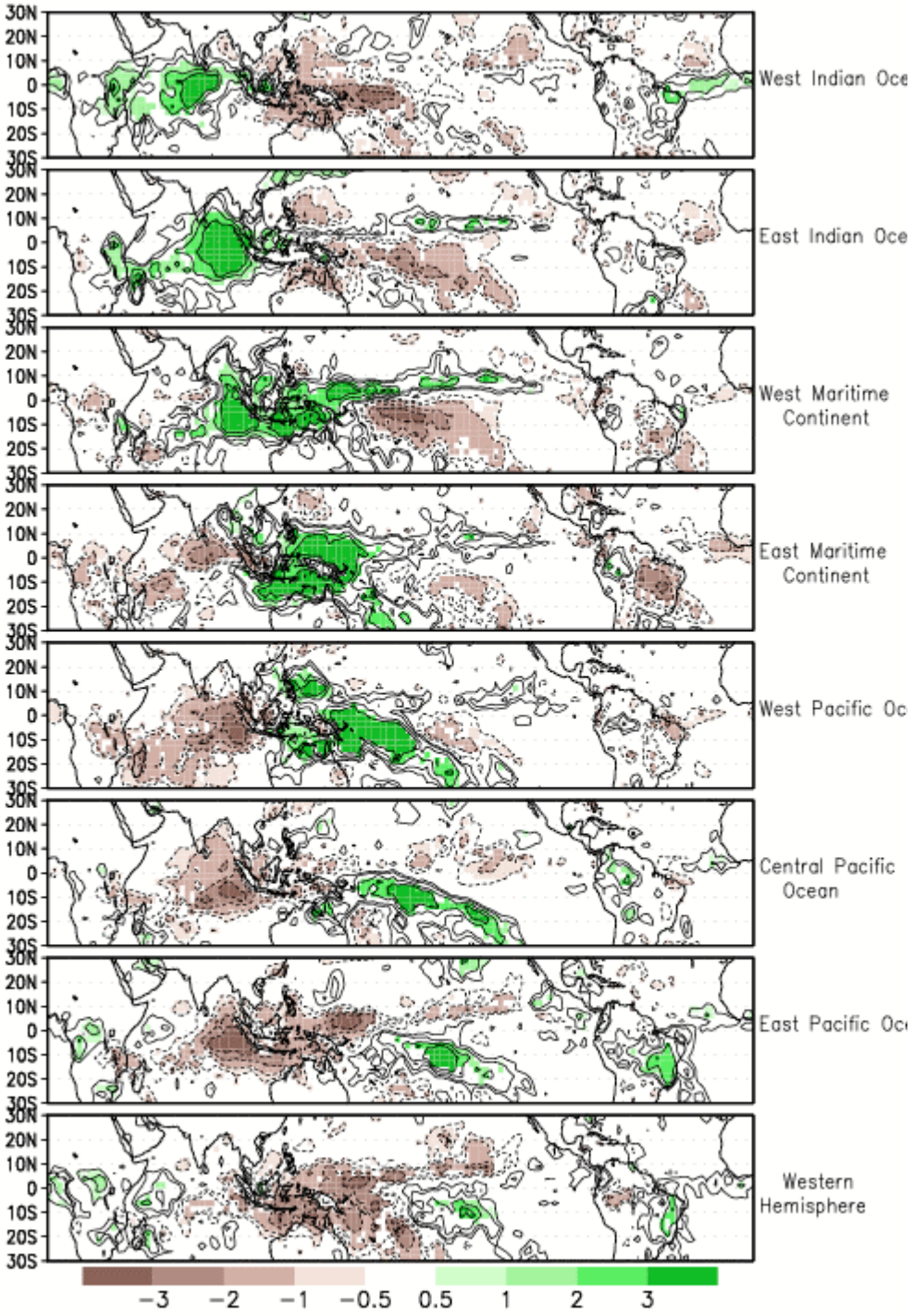
d) 5 months lag

Forecasts and Noise

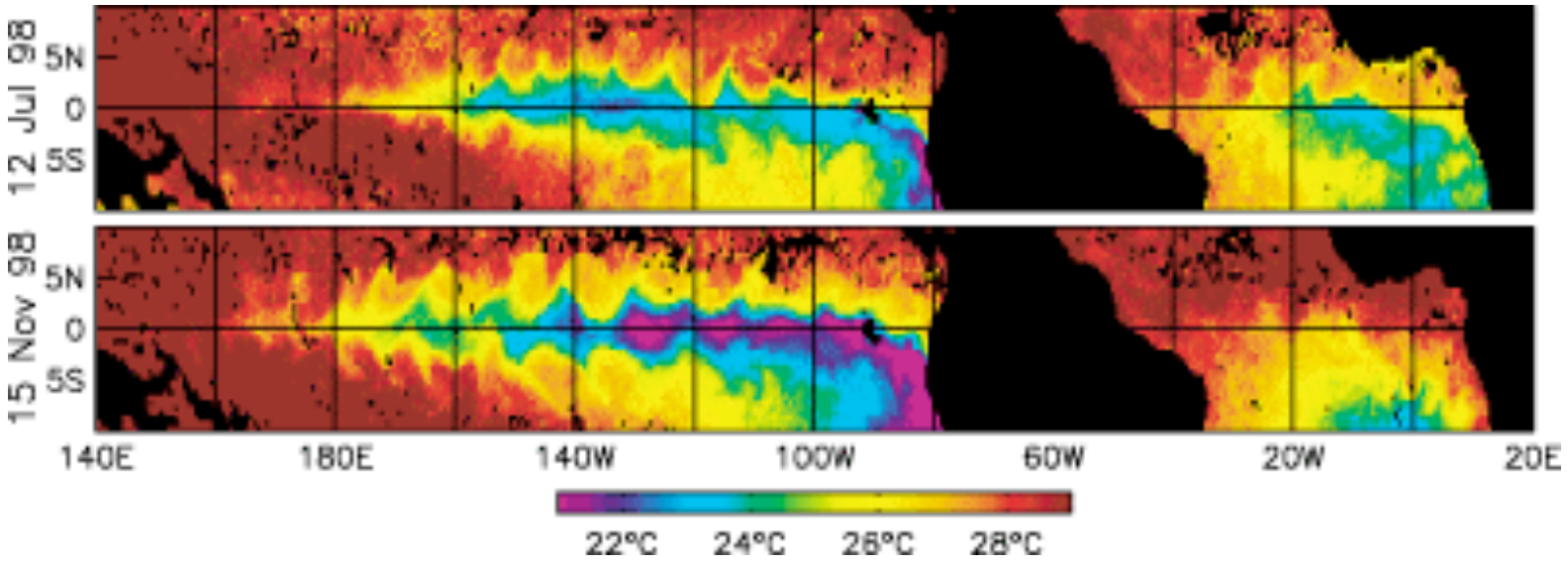

Model Forecasts of ENSO from *Nov 2007*
IRI
NINO3.4 SST Anomaly(°C)
3
2.5
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
−2.5
OBS
FORECAST
ASO
Oct
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
2007
2008
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN–FRCGC
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC OCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA–TCD

Madden-Julian Oscillation (MJO)

biweekly snaphots of rain



NOAA/CDC



Tropical Instability Waves in SST

Chelton et al. 2000

Today, you learned ...

- the tropical Pacific is the most important part of the ocean
- El Nino is triggered by westerly windbursts
- the oceanic Kelvin wave carries the signal from the western Pacific warmpool to the east
- our forecast capabilities are hindered by ocean and atmosphere weather (noise)

HOMEWORK

- go to the PMEL/TAO website

- download the temperature and fixed depth current data for 140W/0N

- make a plot of their mean and standard deviation

- plot the frequency spectrum of SST and zonal velocity at 100m depth

- state the software you used and the approximations you made

- do SST and velocity have different spectral peaks?