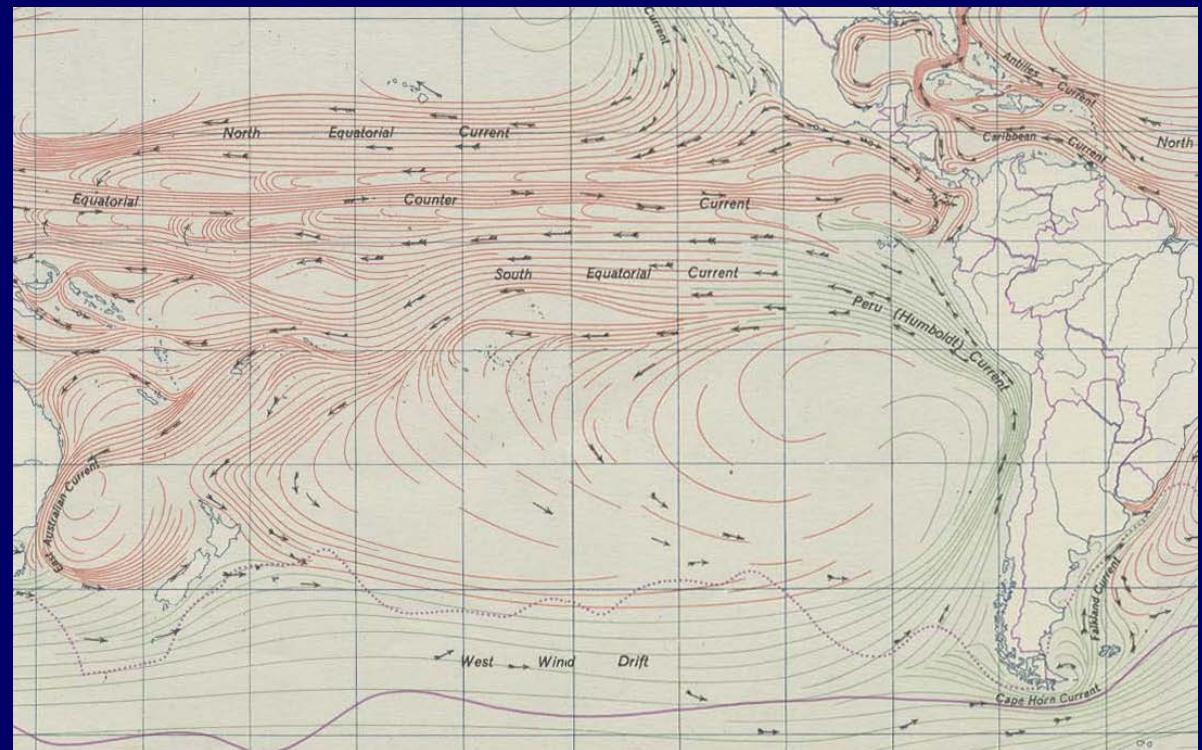


OBSERVED WIND ANOMALIES IN THE SOUTHERN PACIFIC AND THEIR IMPACT ON TROPICAL SSTs DURING LA NINA

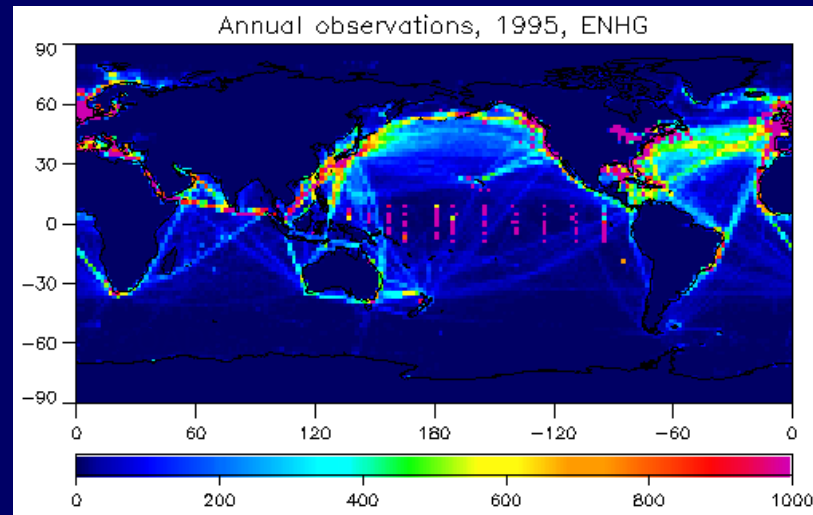
Lucrezia Ricciardulli and Frank Wentz
Remote Sensing Systems, Santa Rosa, CA, USA



* Funded by NASA OvwST

MOTIVATION

- **Studies on ENSO dynamics in the tropics and the NH greatly outnumber those in the SH**
- **Before the advent of satellites, observations in the SH were limited to few cruise ships and some buoys.**



- **The availability of 20 years of satellite data provides the opportunity to study the interplay of wind and temperature anomalies in the Southern Hemisphere.**

Satellite data: SSM/I

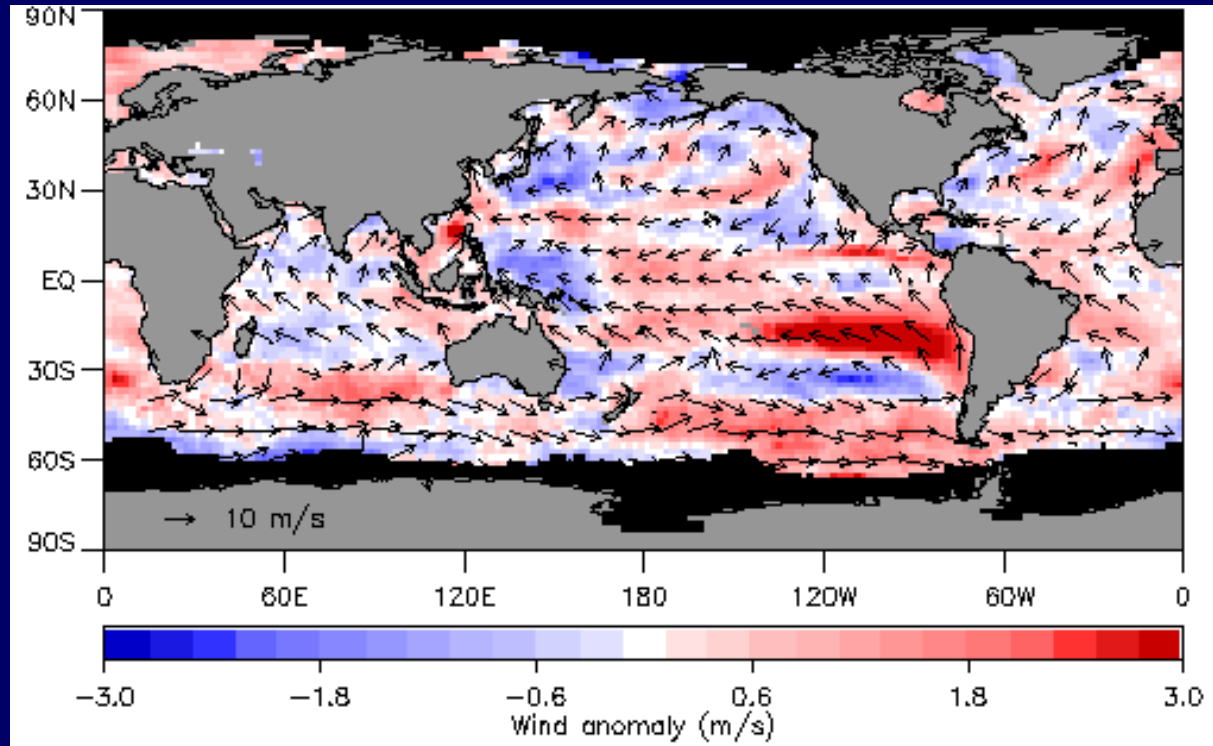
- **Special Sensor Microwave Imager, processed at Remote Sensing Systems**
- **1988-2007, monthly average surface wind speeds (10m).**
- **Global ocean, regridded 2 deg resolution; rain and ice mask applied**
- **Additional SSM/I data: monthly precipitation (PREC), water vapor (WV), cloud liquid water (CLW).**

Reanalysis data

- **NCEP/NCAR, NCEP/DOE, ERA40**
- **1988-2007, monthly average surface wind speeds derived from daily or sub-daily wind components.**
- **Regridded 2 deg resolution, ocean only (for comparison)**
- **Additional reanalysis data: Sea Level Pressure (SLP), 500hPa Geopotential height (Z500), 300 mb winds (U300).**

SSM/I WIND SPEED ANOMALY, August 2007

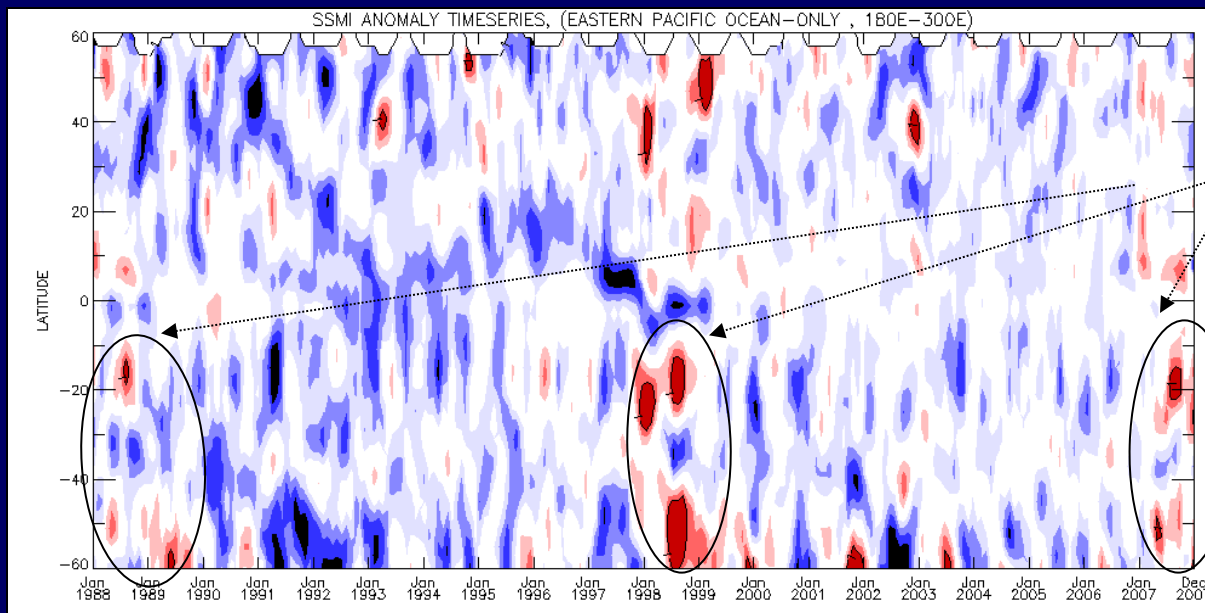
- Monthly climatology derived from 1988-2007 data
- Monthly wind anomalies determined as monthly average minus monthly climatology.



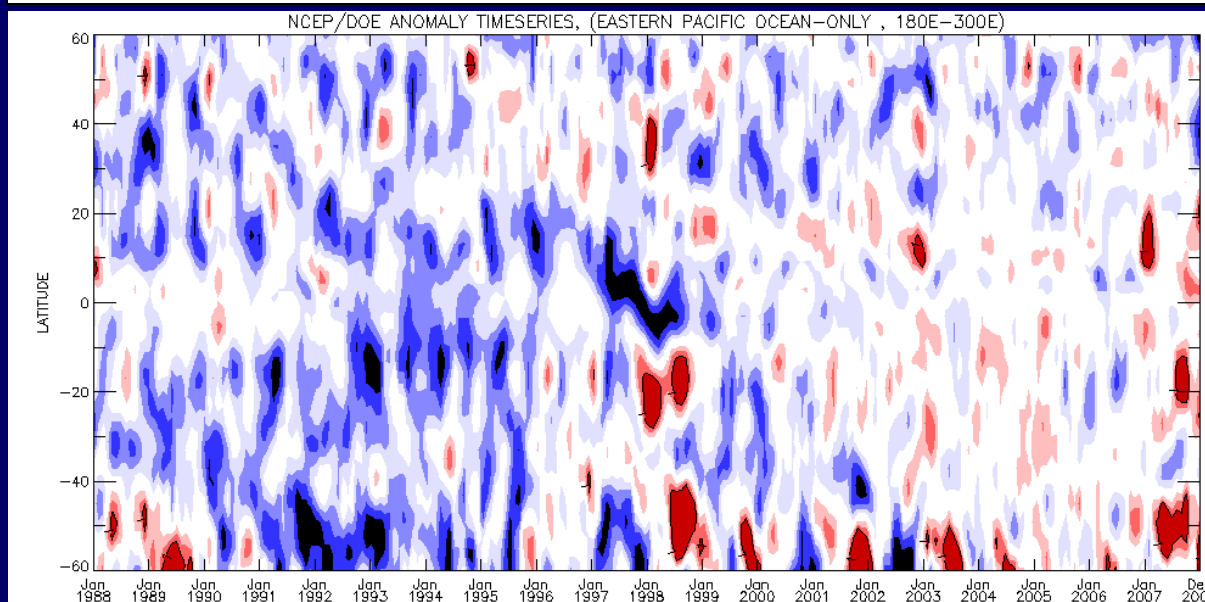
Note: Overimposed are the average wind vectors from Quikscat for the same month.

Eastern Pacific wind anomaly (1988-2007), zonal average

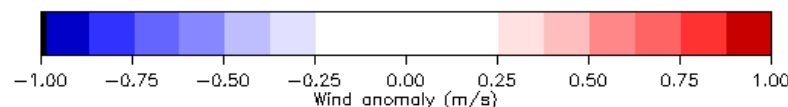
SSM/I



NCEP/DOE



1988



2007

60N

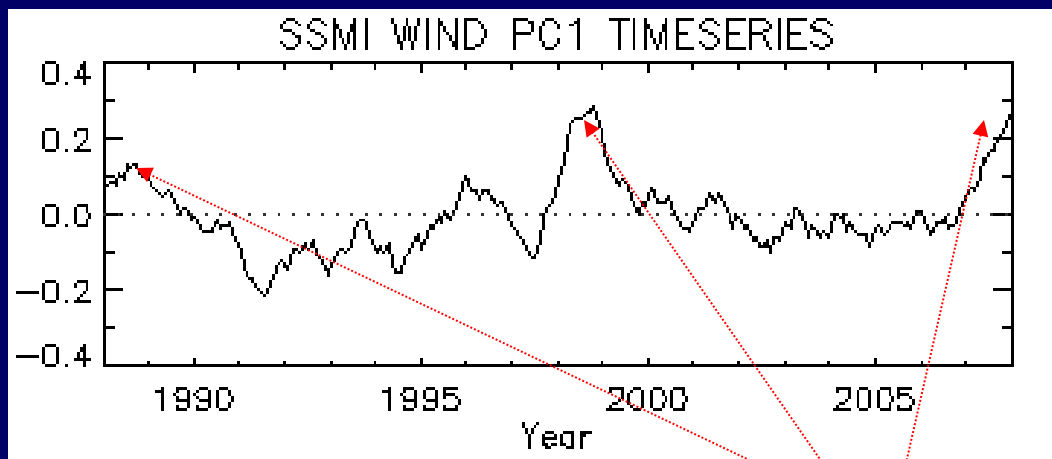
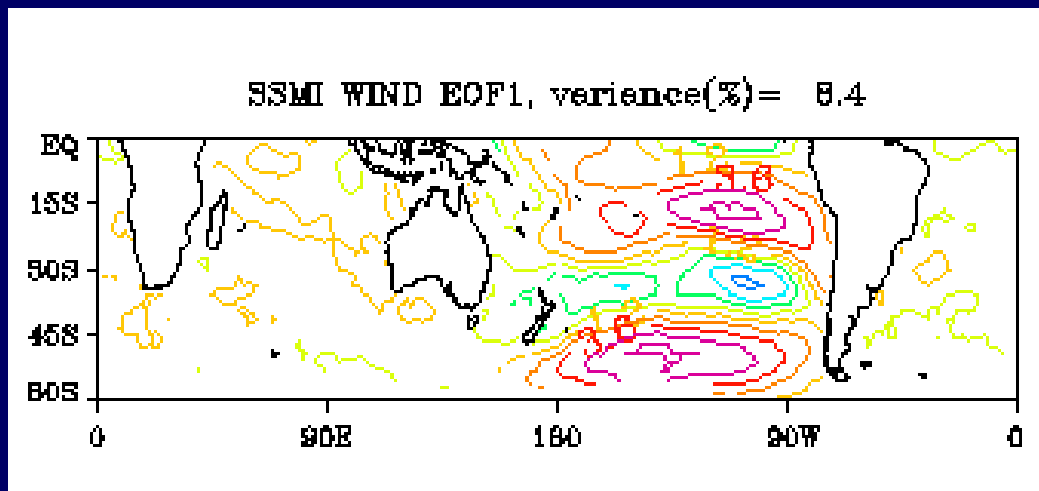
EQ

60S

EOF ANALYSIS

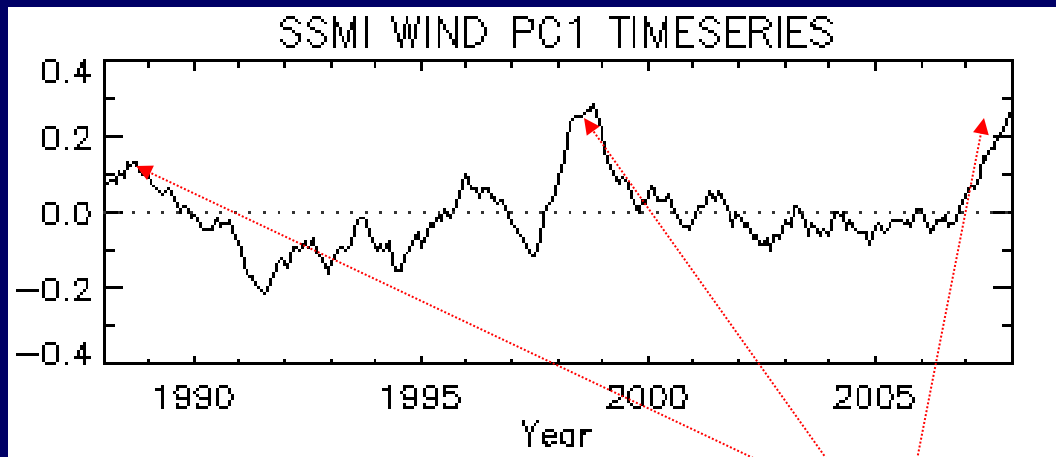
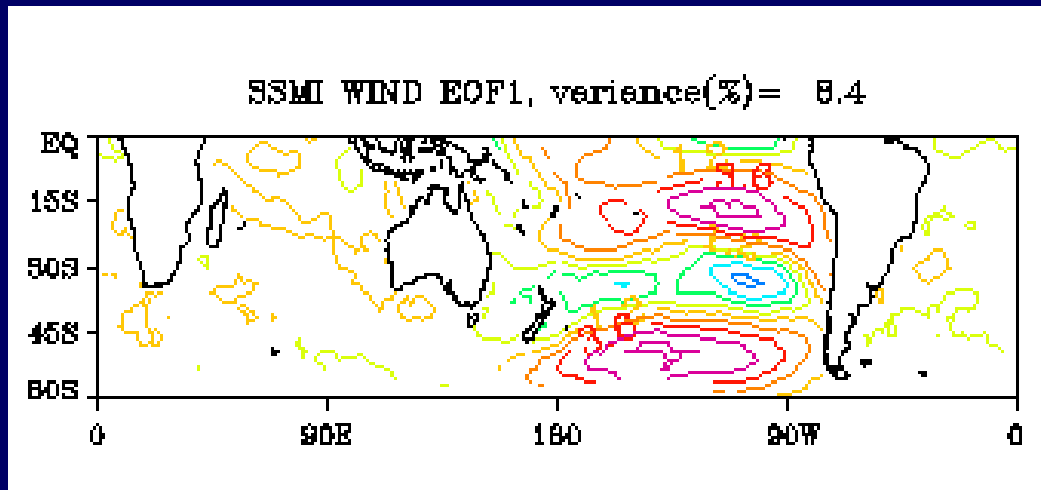
- We extracted the main modes of wind variability using EOF decomposition of the monthly anomaly timeseries.
- EOF analysis applied to satellite and reanalysis ocean-only wind data, for global Southern Hemisphere.
- Additional EOF decomposition of additional SSM/I (PREC, CLW, WV) and reanalysis fields (SLP, Z500, U300).

SSM/I Wind EOF-1



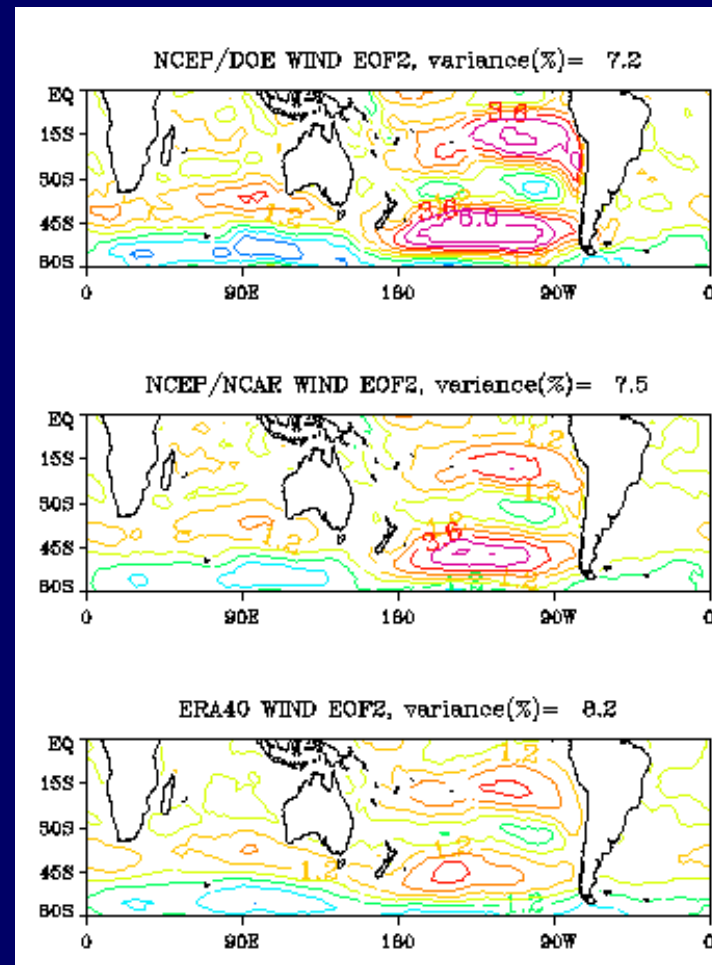
LA NINA

SSM/I Wind EOF-1



LA NINA

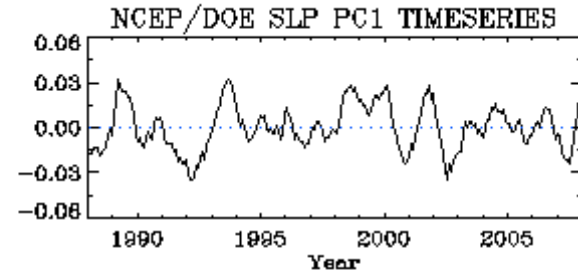
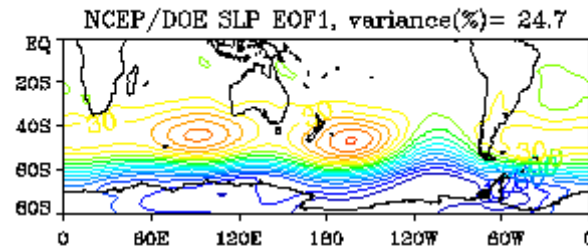
REANALYSES EOF-2



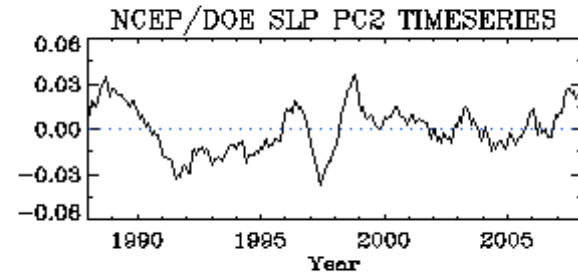
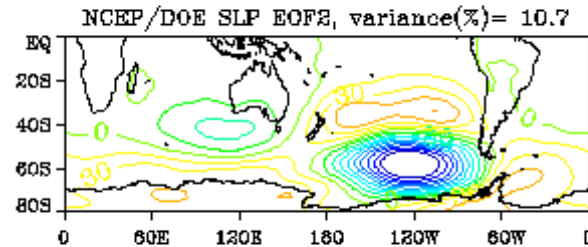
Note: in the reanalyses, the EOF-1 represent the Southern Annular Mode, absent in SSM/I because no reliable data at the ice edge

Sea Level Pressure EOFs

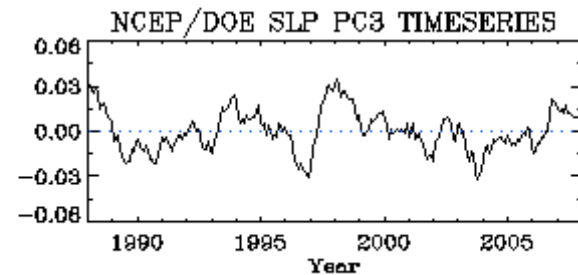
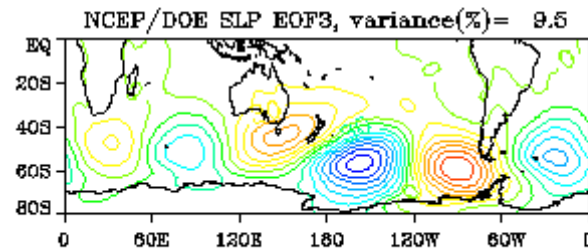
EOF-1
SOUTHERN
ANNULAR MODE



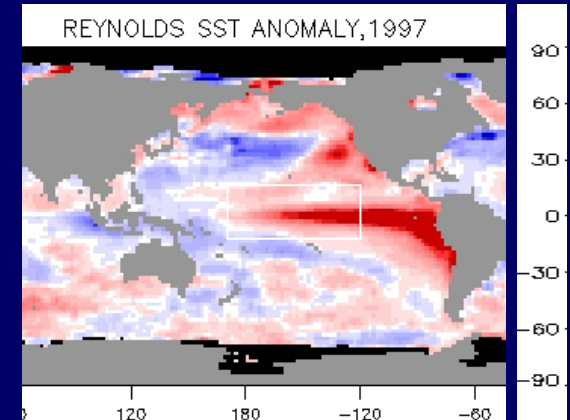
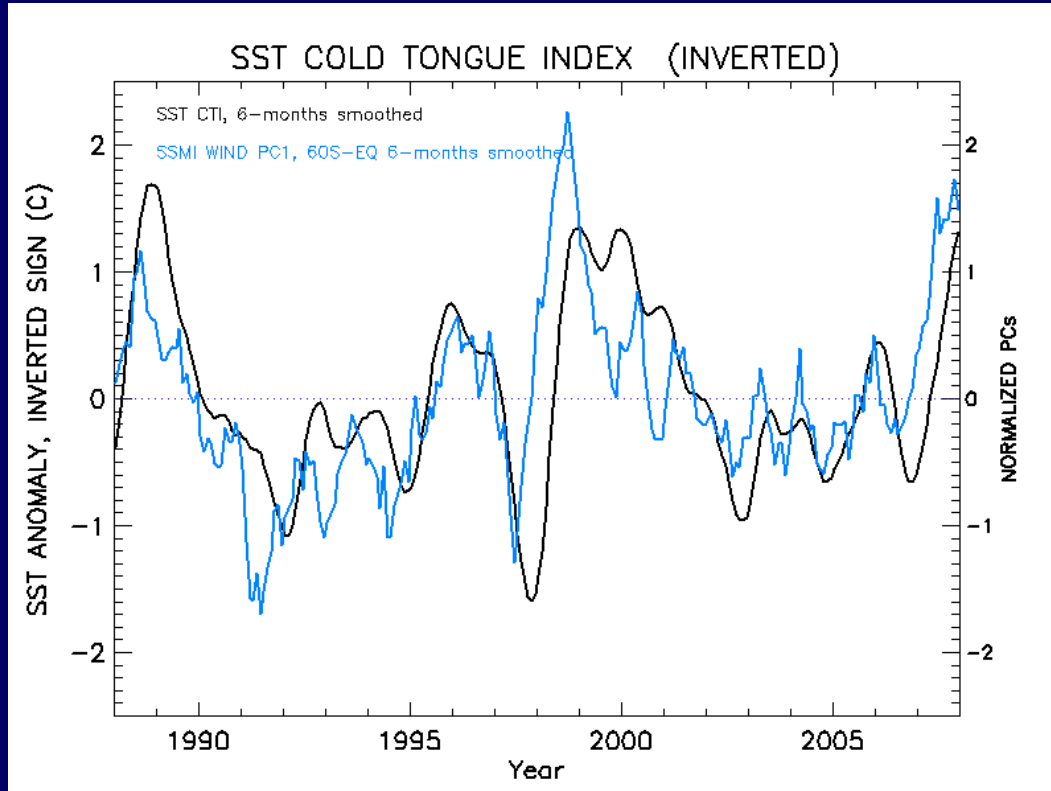
EOF-2
PACIFIC SOUTH
AMERICAN
PATTERN (PSA-1)



EOF-3
PACIFIC SOUTH
AMERICAN
PATTERN (PSA-2)



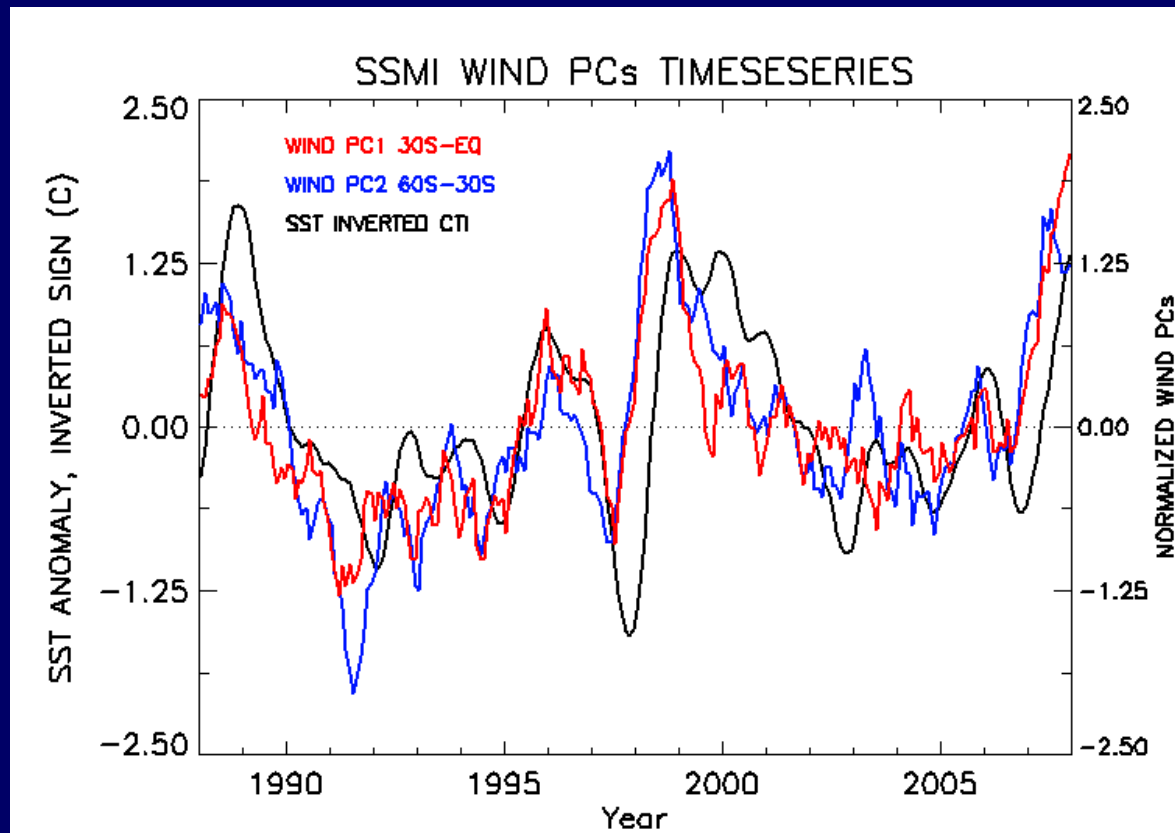
CORRELATION OF WIND AND TROPICAL SST ANOMALIES



The Cold Tongue Index is the SST anomaly in the boxed area

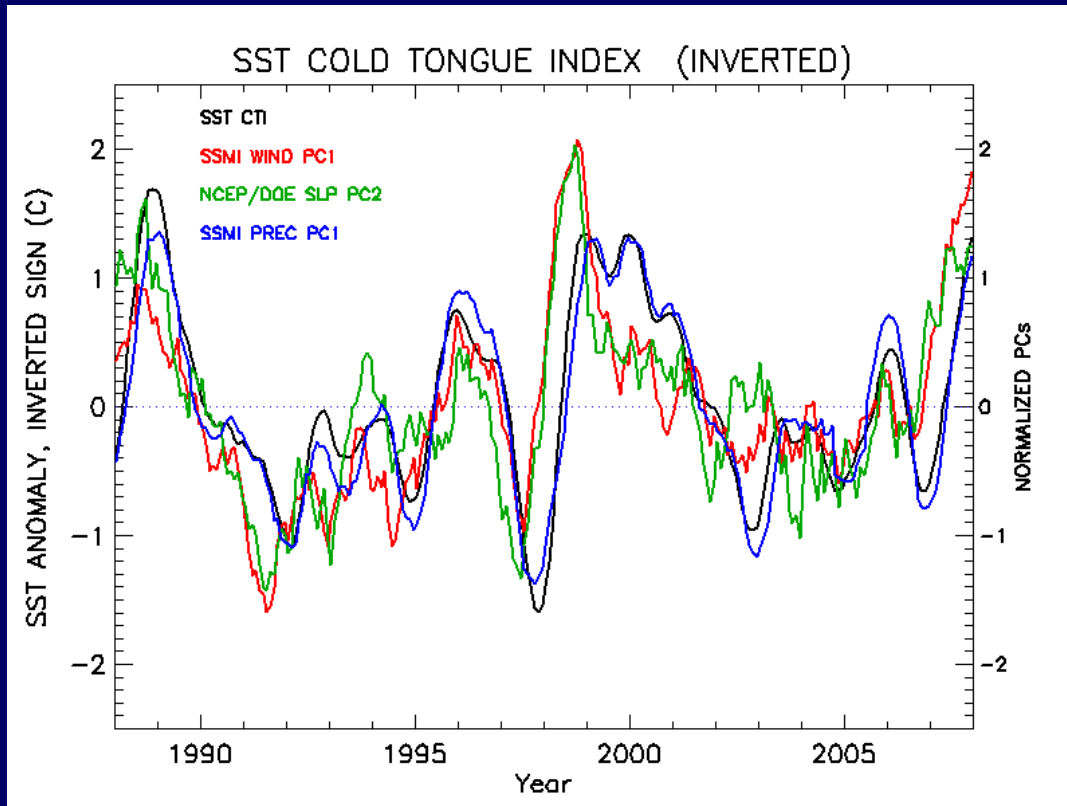
Wind-SST Lag-Correlation: 0.74, 4 months lead time
(0.47 for the unsmoothed timeseries)

COMPARISON OF TROPICAL VERSUS EXTRATROPICAL COMPONENT



Correlation **tropical** wind anomaly component: 0.64 (3-4 months lead)
Correlation **extratropical** wind anomaly component: 0.77 (5 months lead)

Correlation of SST Anomaly with other variables



Variable	Cross Correlation	Time lag compared to SST
SSMI wind	0.73	Lead 4 months
NCEP/DOE wind	0.54	Lead 4 months
NCEP/NCAR wind (*)	0.64	Lead 3 months
ERA40 wind (*)	0.67	Lead 5 months
NCEP/DOE SLP	0.75	Lead 5 months
NCEP/DOE Z500	0.75	Lead 4-5 months
NCEP/DOE U300	0.85	Lead 2 months
SSMI PREC (tropics)	0.96	No lag
SSMI WVAP (tropics)	0.90	Lag 0-1 months
SSMI CLW (tropics)	0.89	Lag 0-1 months

SUMMARY

- Using satellite observation of surface winds we extracted the leading mode of wind variability in the S. Hemisphere (EQ-60S).
- Double dipole pattern in the Pacific, associated with the PSA.
- Good correlation to SST anomalies in the equatorial cold tongue.

CONCLUSIONS

- Intensified winds in SH lead cold equatorial SST anomalies by 4 months.
- Extratropical wind anomaly is as relevant as the tropical one. Together, they form a pattern that affects the cold phase of ENSO.
- Wind anomaly pattern in the SH can be easily identified using satellite observations.
- Potential for La Nina predictability