Global Ocean Monitoring: Recent Evolution, Current Status, and Predictions

Prepared by

Climate Prediction Center, NCEP

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http://www.cpc.ncep.noaa.gov/products/GODAS/

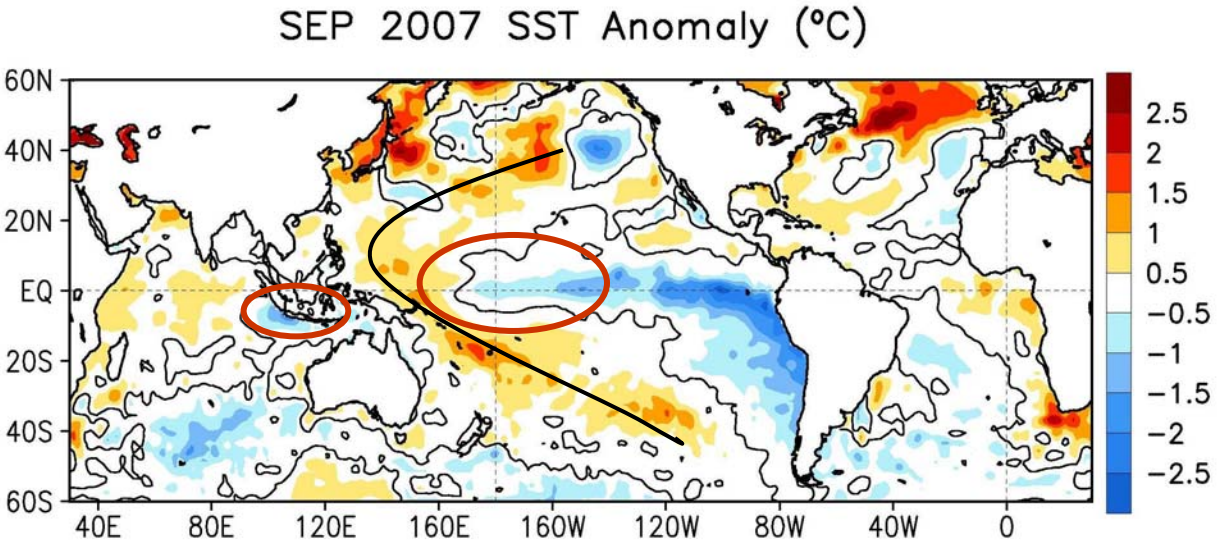
Outline

- Overview
- Recent highlights
  - Pacific Ocean
  - Indian Ocean
  - Atlantic Ocean
- GODAS and CFS SST Predictions

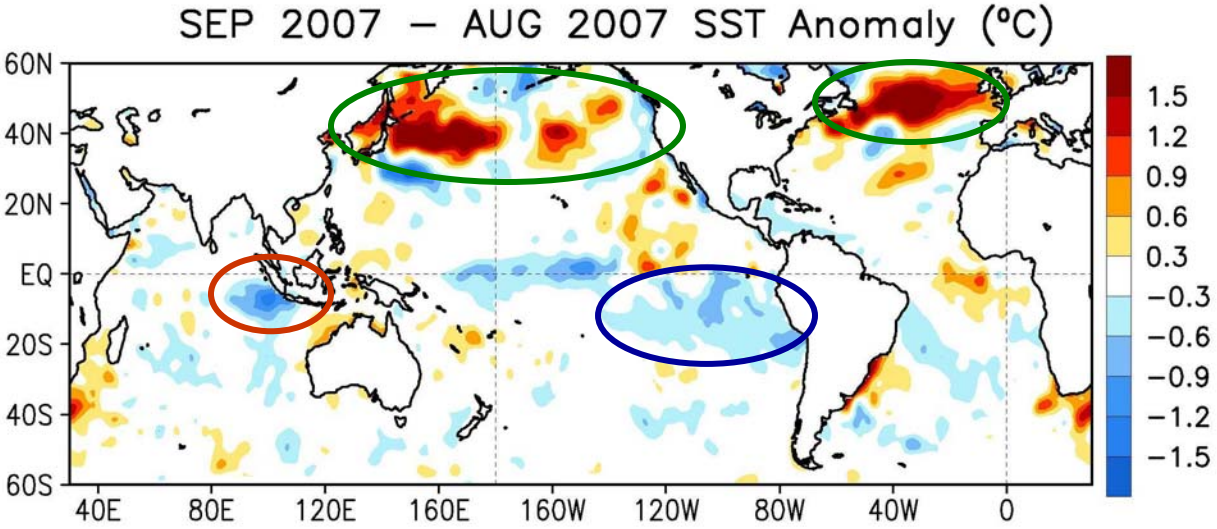
Overview

- **Pacific Ocean**
  - Cold SST anomalies intensified near the dateline
  - CPC's prognostic assessment: La Niña will continue and may strengthen during the next several months
  - Further development of negative SST anomalies near the west coast of South America
  - Large SST changes in the North Pacific
- **Indian Ocean**
  - Near normal SST conditions prevailed
  - IOD index increased to about 1^{o}C above normal
- **Atlantic Ocean**
  - Near normal SST conditions prevailed in equatorial Atlantic.
  - SST anomalies are smaller than for the last year
  - Large SST changes in the North Atlantic

Global SST Anomaly (ºC) and Anomaly Tendency

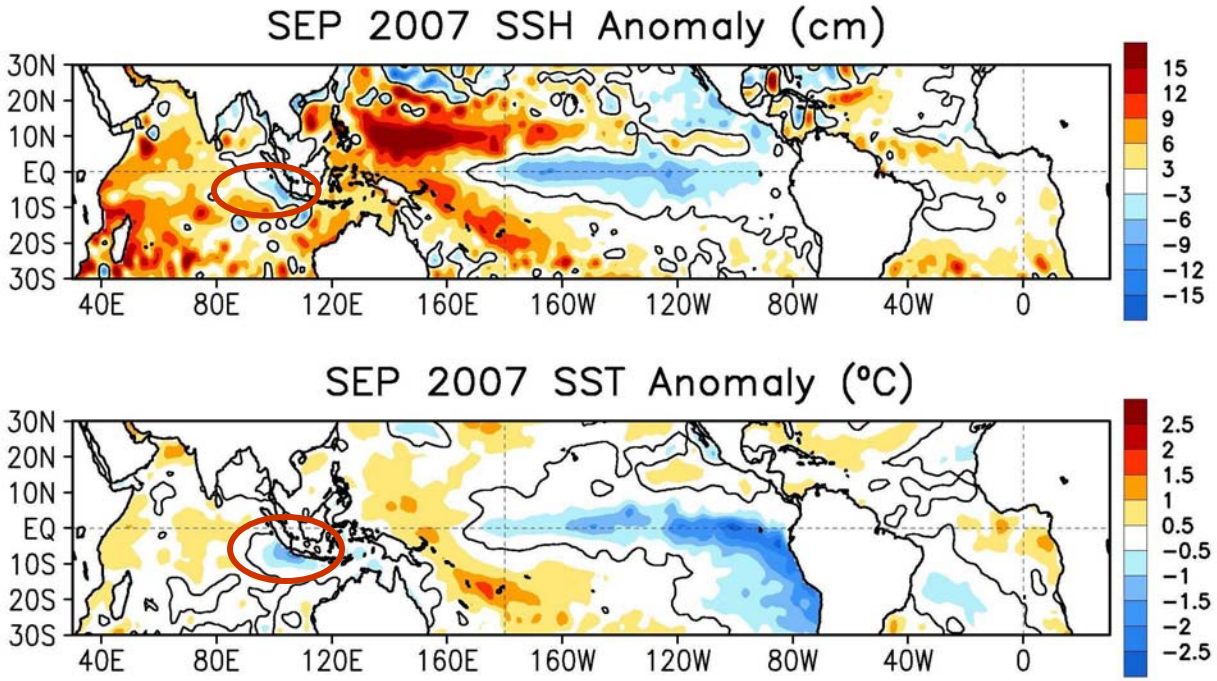


- **Cold SST anomalies intensified near the date line… a canonical horseshoe pattern in the Pacific**
- **Weak positive SST anomalies in the Indian and Atlantic Ocean**
- **Negative SST anomalies near the the maritime continent**



- **SSTs in the Eq. Pacific cooled**
- **Large changes in the NH extratropics (shallower mixed layer at this time of the year)**
- **Further cooling near the maritime continent**

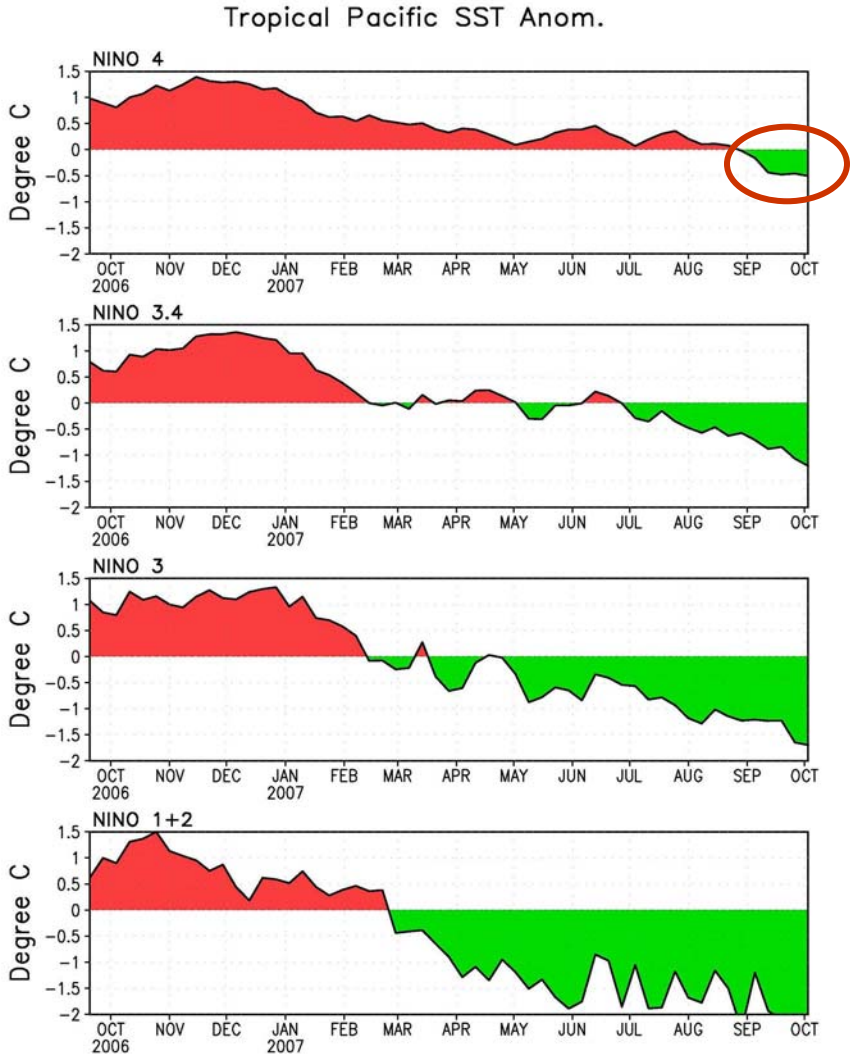
SSH Anomaly (cm) v.s. SST Anomaly (ºC)

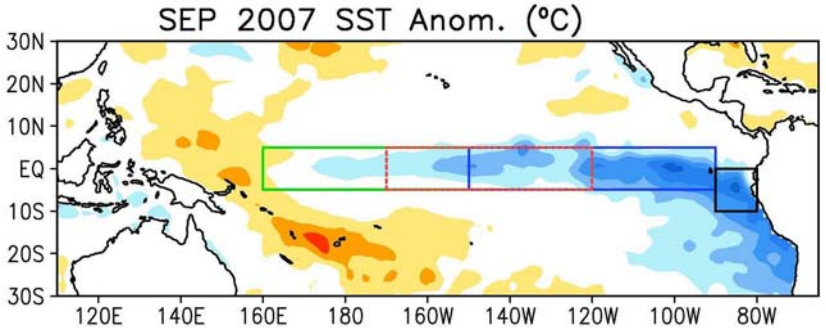


- **Good consistency between SSH and SST in the equatorial latitudes**
- **Changes in the SH extratropical latitudes in the SSH may reflect warming trends in the deeper oceans**

Pacific Ocean

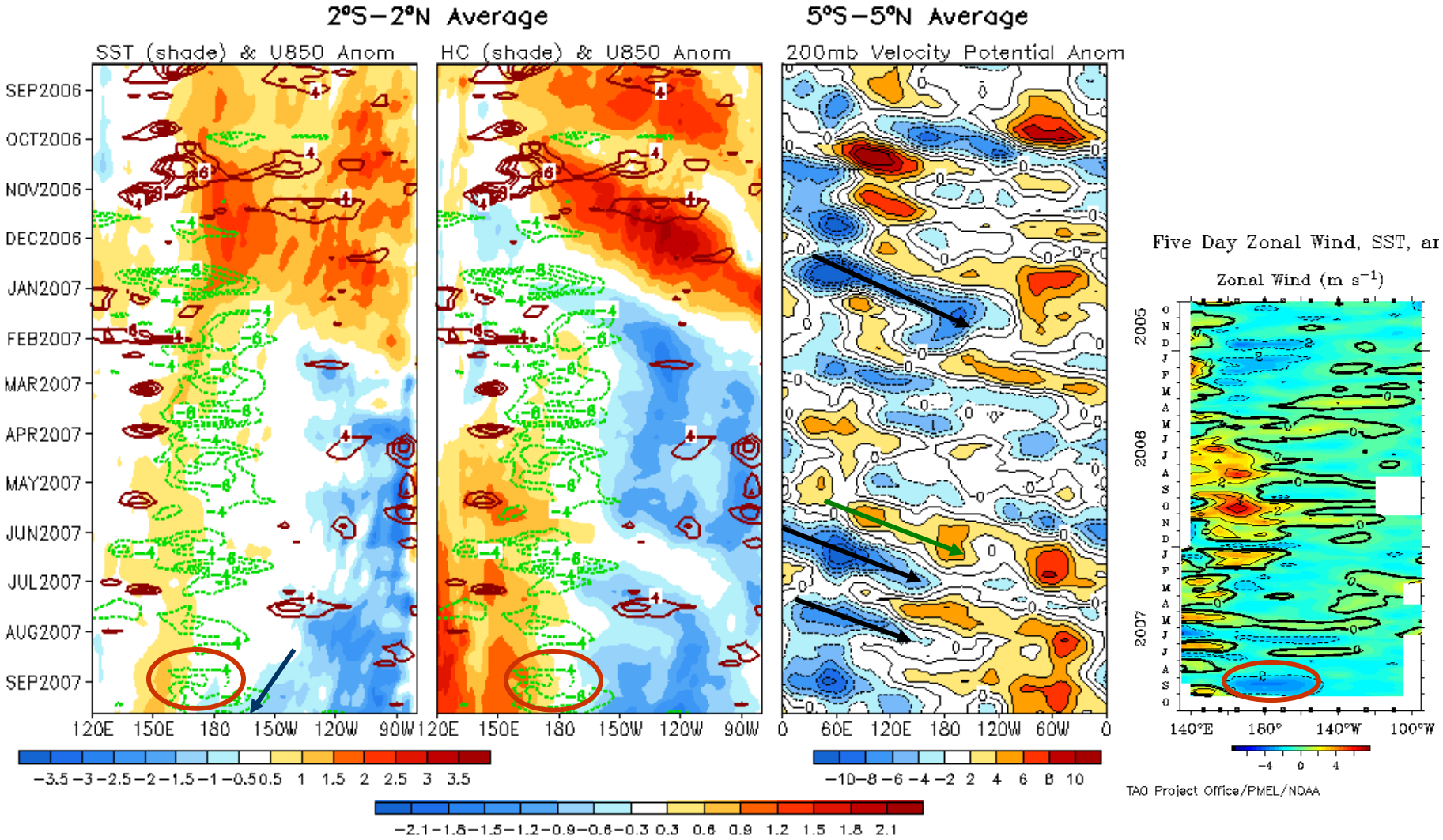
Recent Evolution of Pacific NINO SST Indices





- **All Niño SST indices had a cooling trend**
- **Cooler SST anomalies reached Niño 4 region (westward propagation)**
- **CPC's ENSO Prognostic Statement: JAS ONI -0.6C, meeting NOAA La Nina definitions which likely enhance in next 3 months**

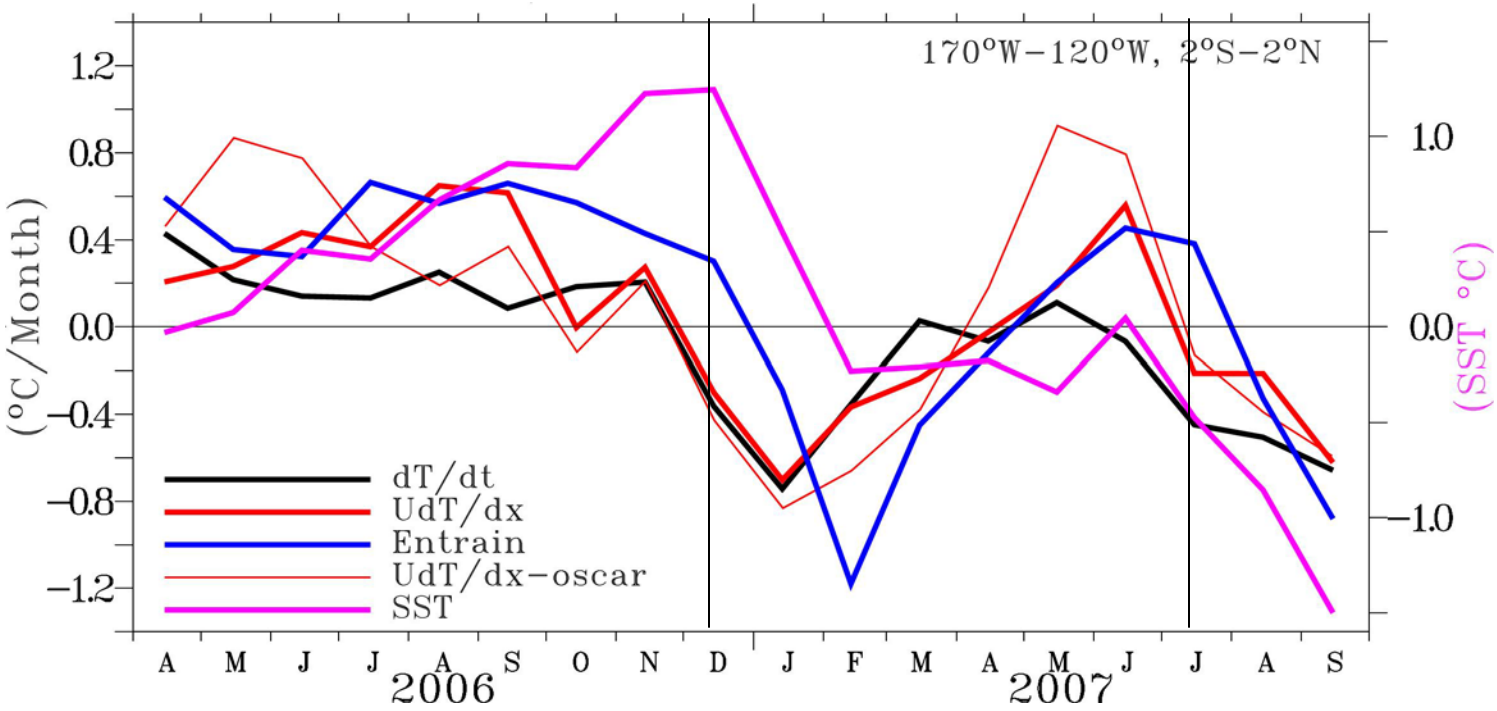
Evolution of Equatorial Pacific SST (°C), 850-mb Zonal Wind (m/s), 0-300m Heat Content (°C) and MJO Activity



- **Intensification of easterlies near the date line in September (TAO data)**
- **Related to enhanced convection in Philippe Sea**
- **Western edge of the negative SST anomalies moved further westward due to enhanced westward zonal current**

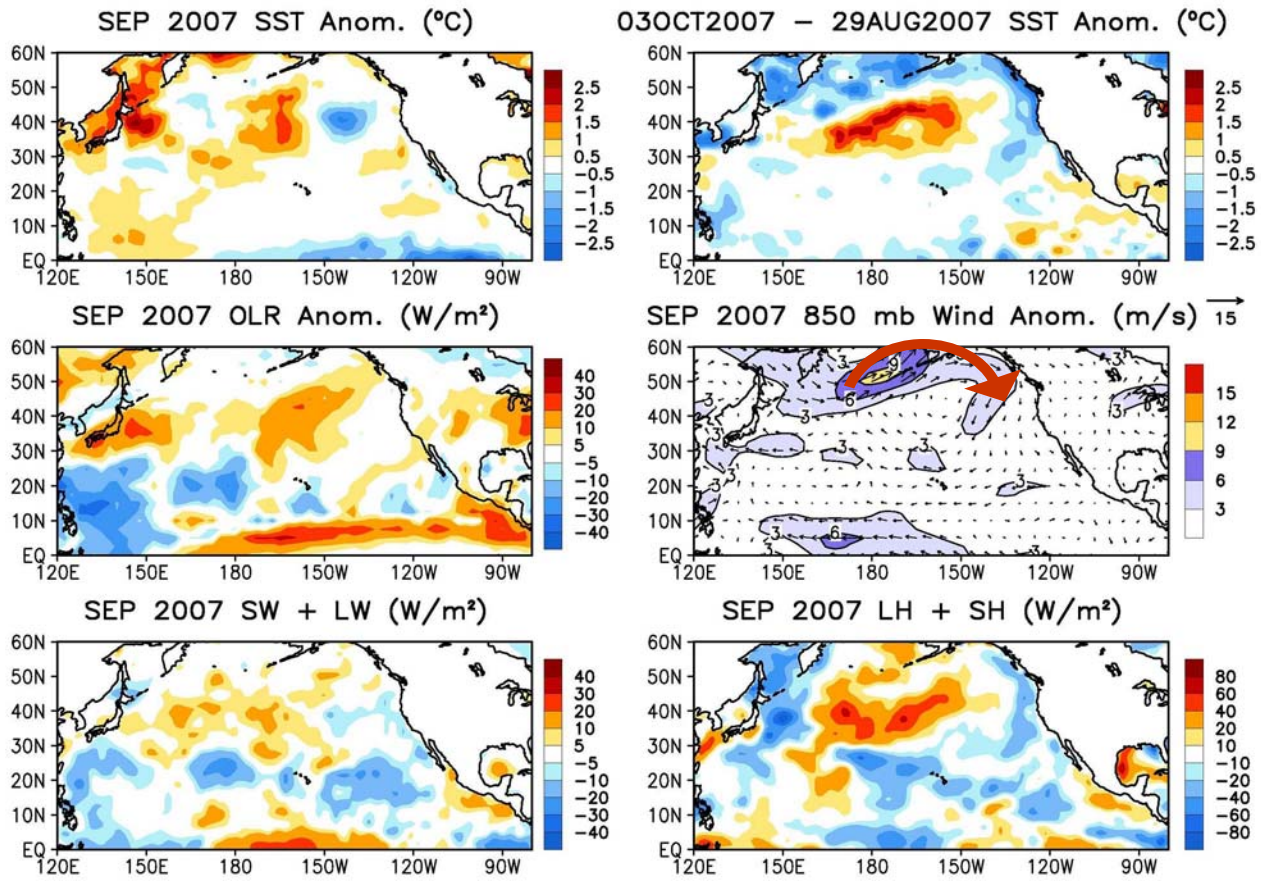
Recent Evolution of Heat Budget in NINO3.4 SST Anomaly

Courtesy of Dr. Dongxiao Zhang



- advective cooling in Dec. 2006 (MJO) followed by entrainment cooling in Jan. 2007
- advective and entrainment warming in May-Jul 2007 (MJO) delayed La Nina development
- advective cooling in Jul. 2007 (MJO) followed by entrainment cooling in Aug-Sep 2007 led to La Nina development

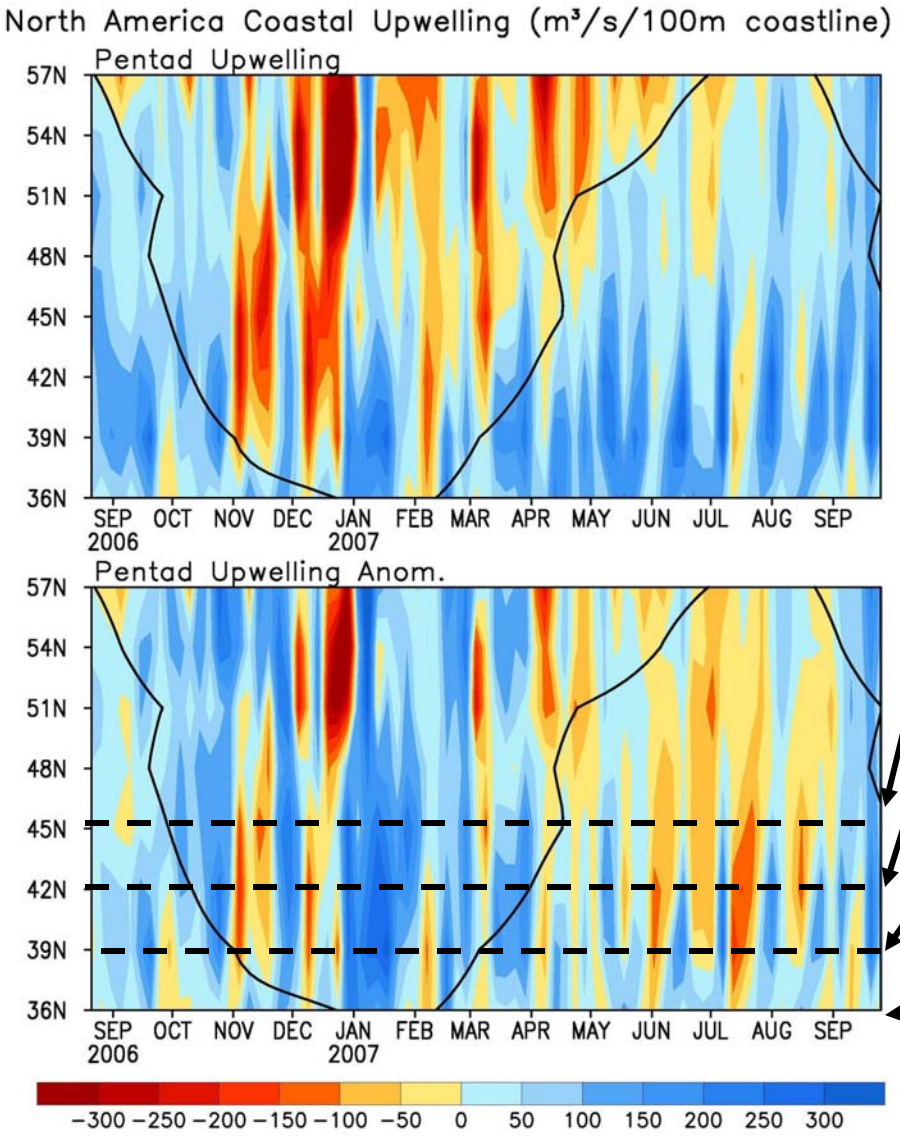
North Pacific: SST Anom., SST Anom. Tend., OLR, 850-mb Winds, Sfc Rad, Sfc Flx



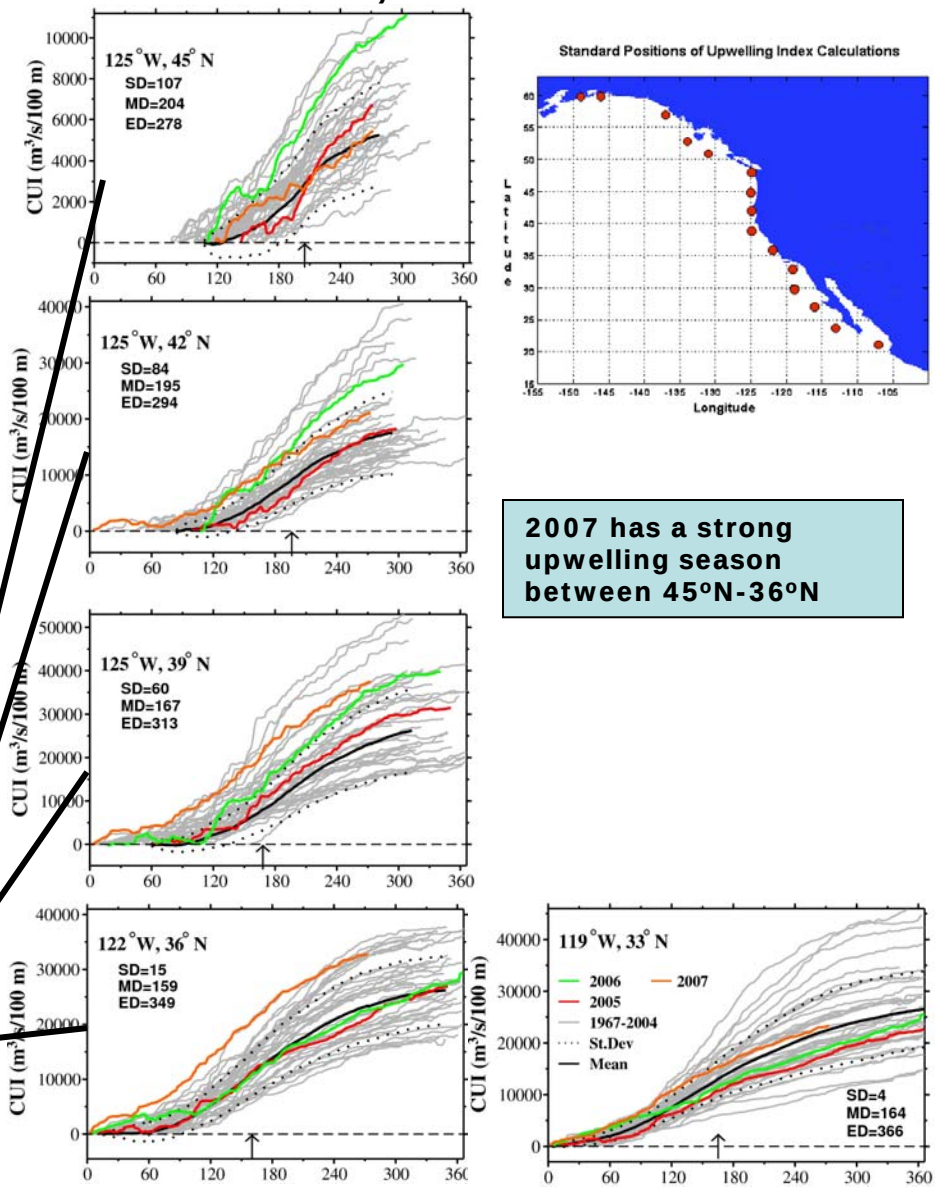
- **Western coast of North America and Gulf of Alaska cooled down … weaken Aleutian Low**
- **Ekman transport / pumping and Sfc. heat fluxes were likely the main external forcing**

North America Western Coastal Upwelling

CPC, NCEP



SWFSC, NOAA Fisheries

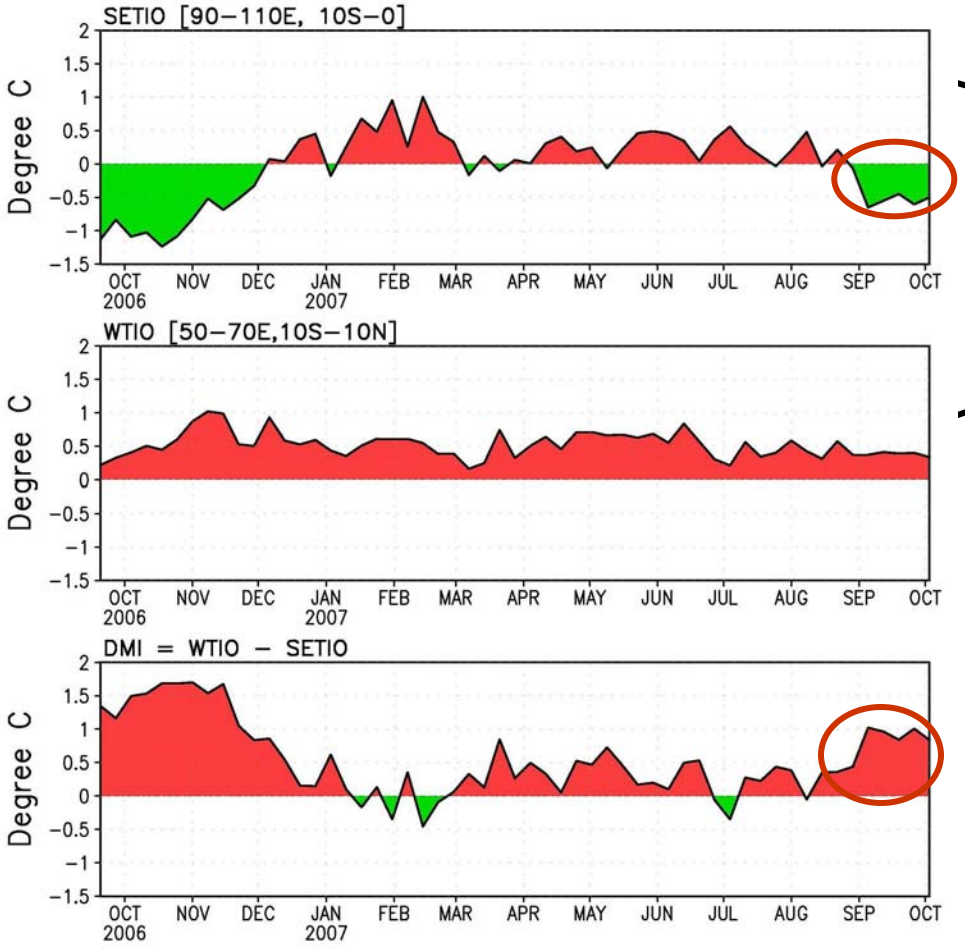


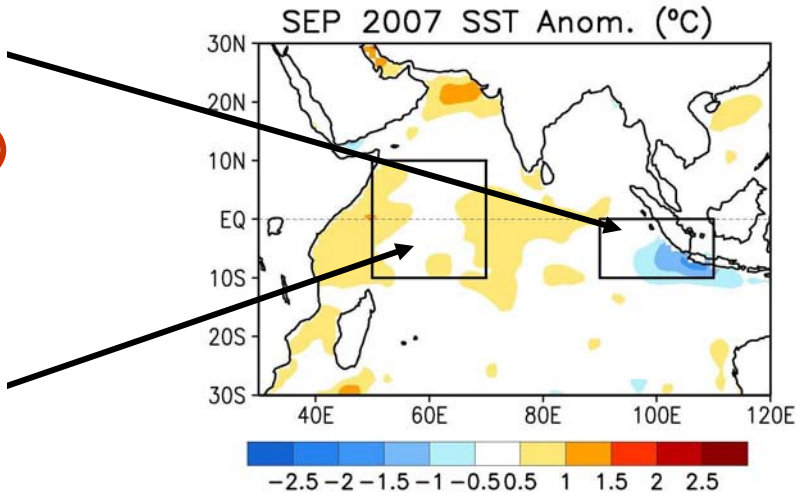
2007 has a strong upwelling season between 45ºN-36ºN

•Climatologically upwelling season progresses from March to July along the west coast of North America from 36°N to 57°N.

Indian Ocean

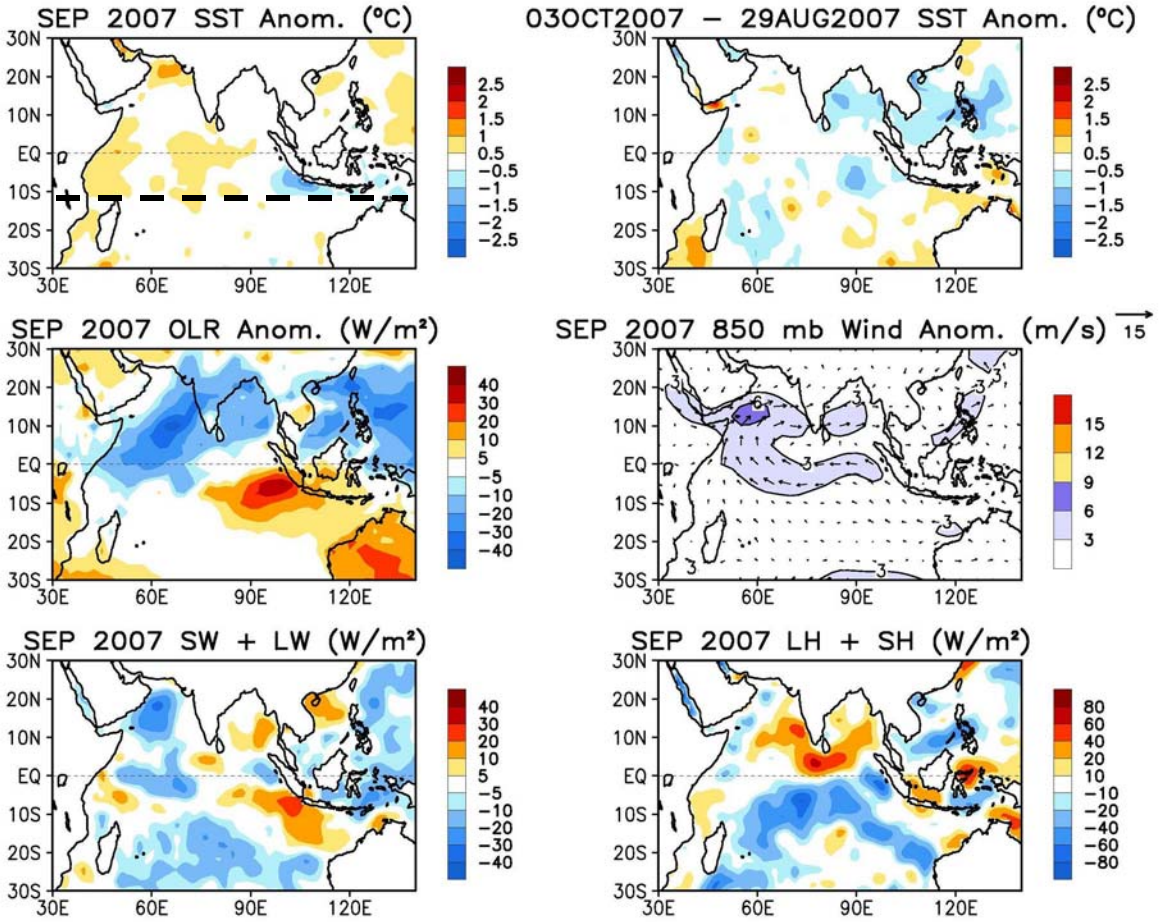
Recent Evolution of Indian Ocean SST Indices





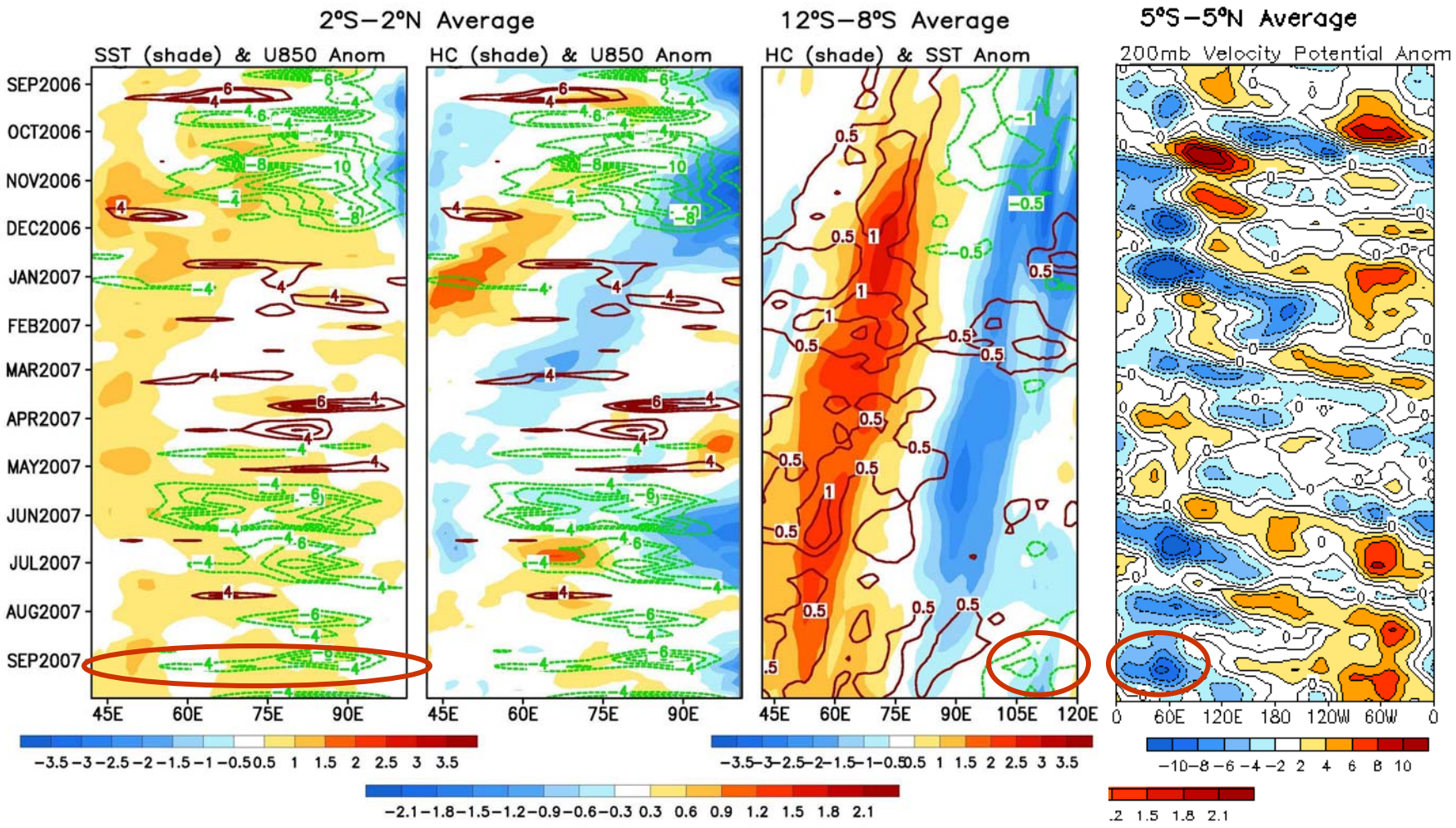
- **Cooling in the south-eastern Indian Ocean**
- **IO Dipole Mode Index (DMI) is about 1ºC above normal**

Tropical Indian Ocean: SST Anom., SST Anom. Tend., OLR, 850-mb Winds



- **Stronger x-equatorial flow…Above normal monsoon rainfall**
- **Stronger Somali jet**

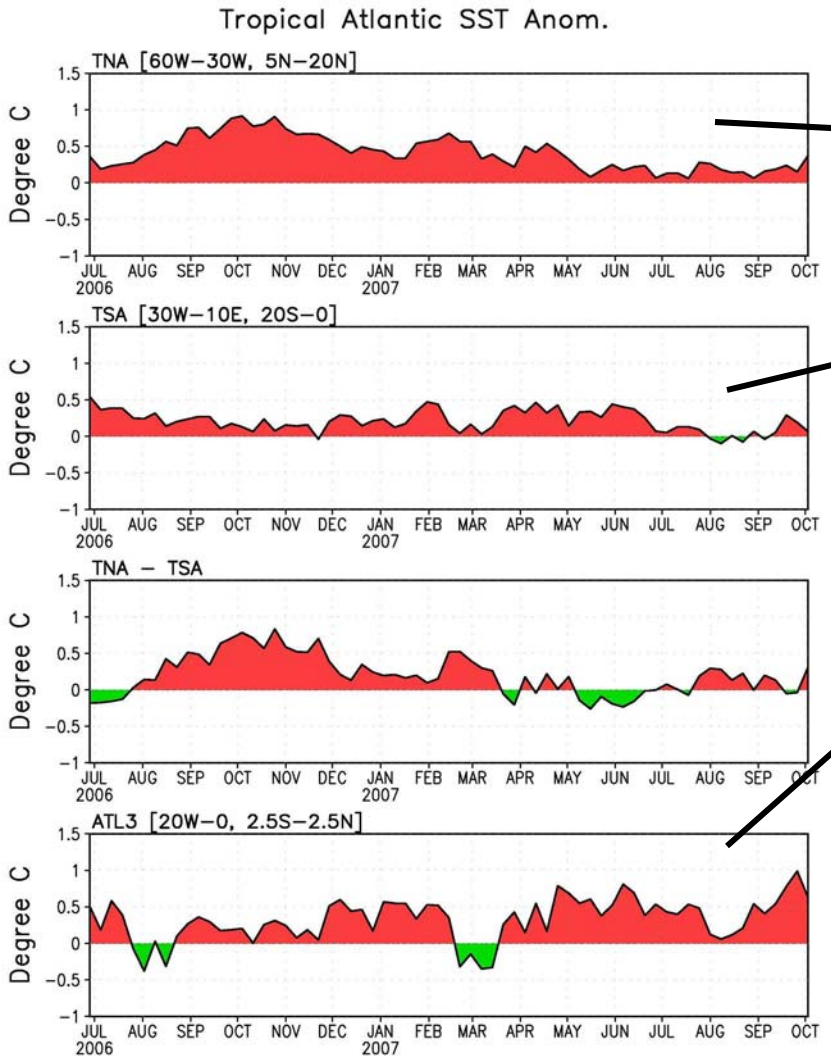
Evolution of Equatorial/10°S Indian SST (°C), 850-mb Zonal Wind (m/s), 0-300m Heat Content (°C)

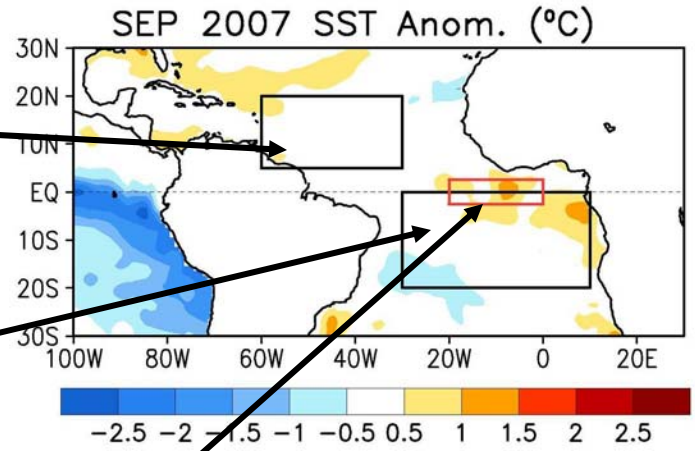


- **Cooling near the Java coast is associated with easterly anomalies and negative heat content**
- **Easterly anomalies were associated with stronger monsoon circulations**

Atlantic Ocean

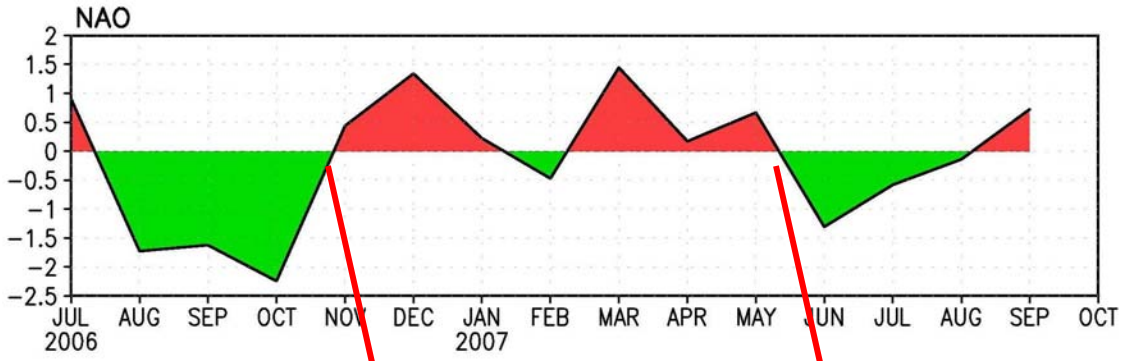
Recent Evolution of Tropical Atlantic SST Indices

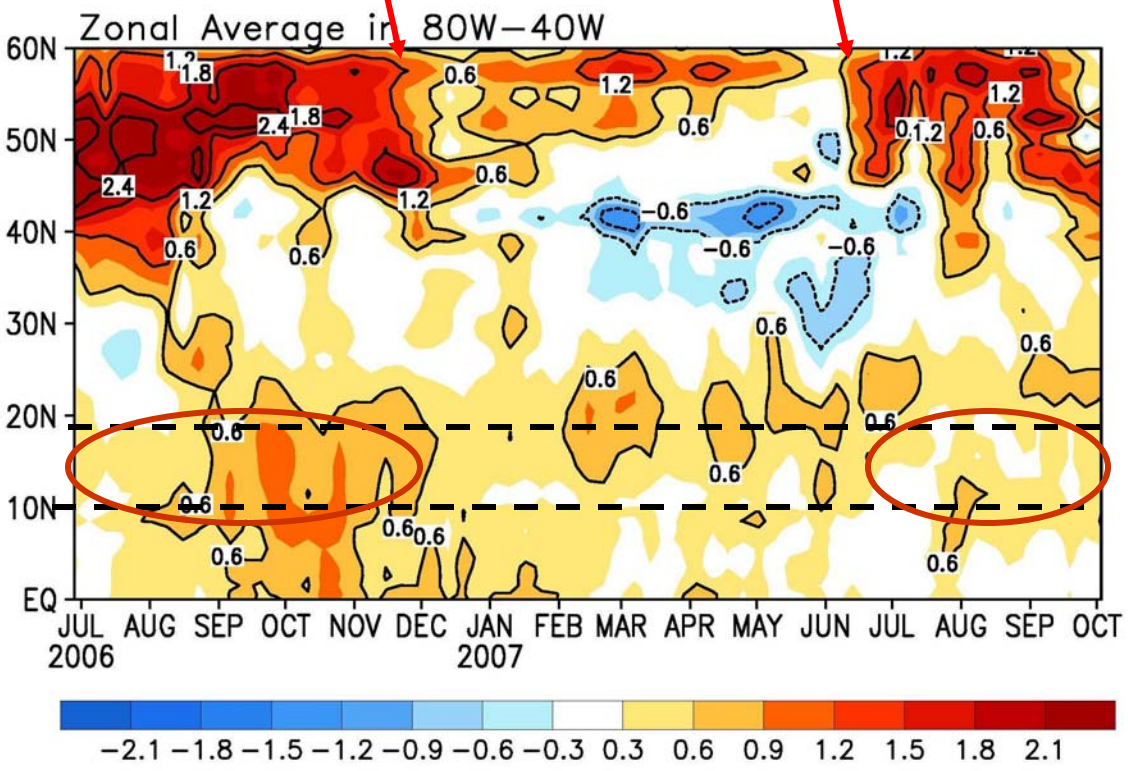


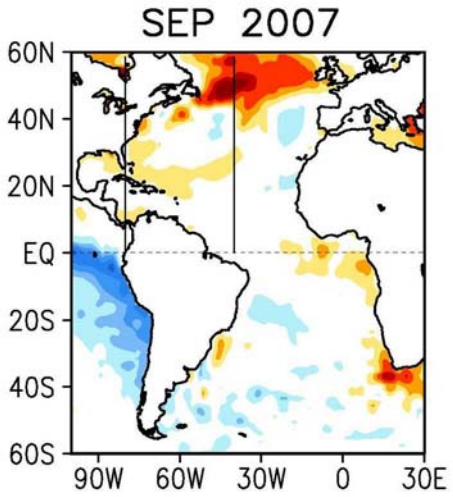


- **TNA SSTs are near normal**
- **TSA SSTs are near normal**
- **Warm TNA SST anomalies weaker than they were last year**

Attribution of SST Anomaly in Northwest Atlantic



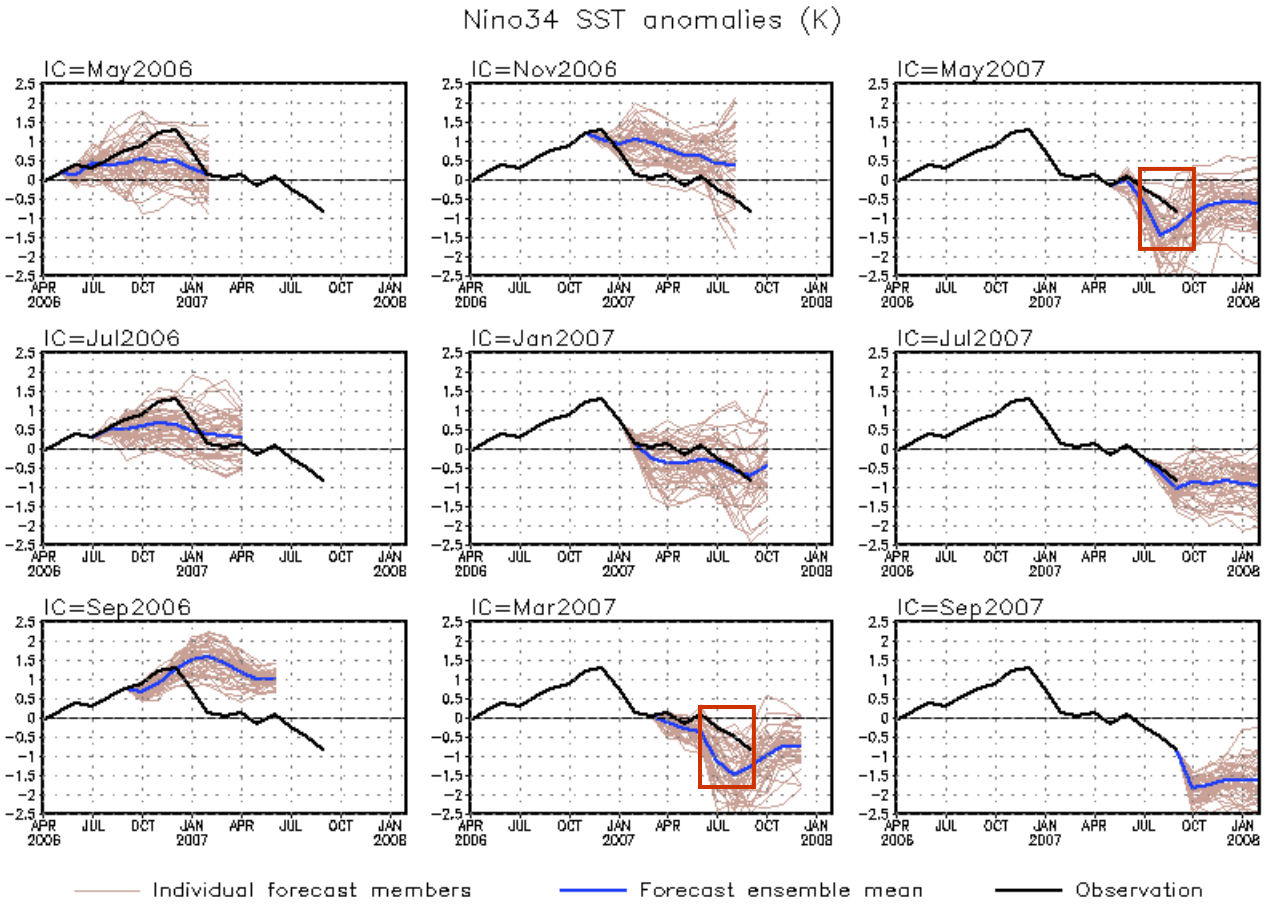




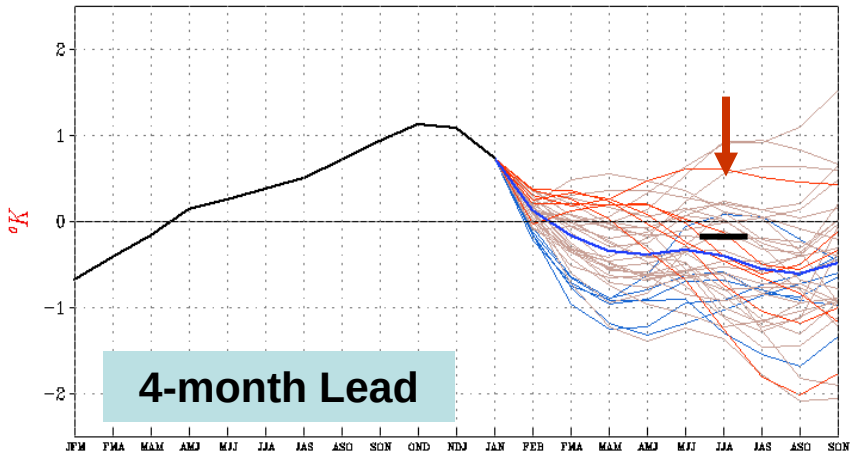
Hurricane season warm SST anomalies weaker than they were last year

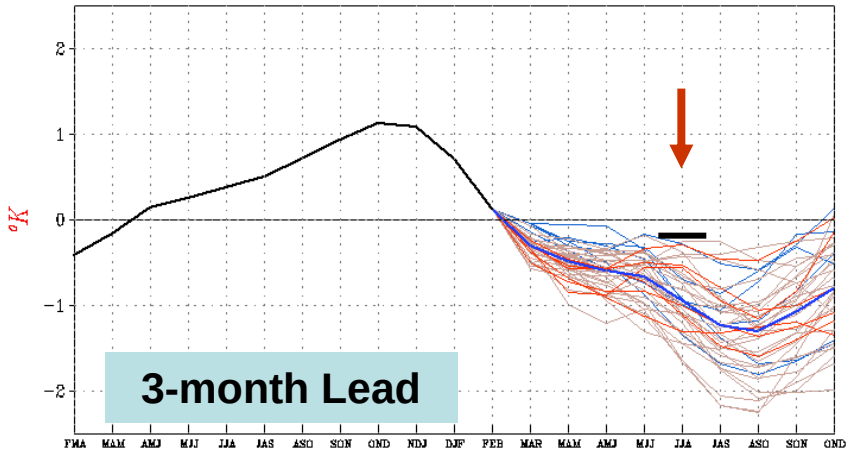
CFS SST Predictions and Ocean Initial Conditions

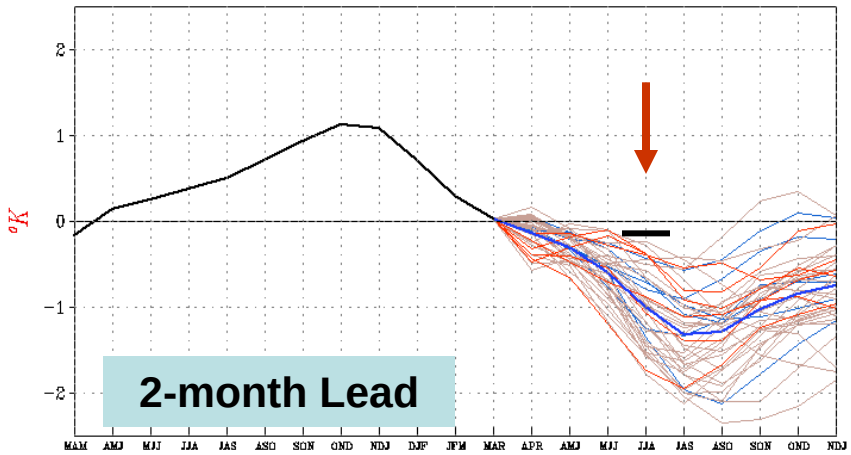
CFS Niño 3.4 SST Predictions from Different Lead Times

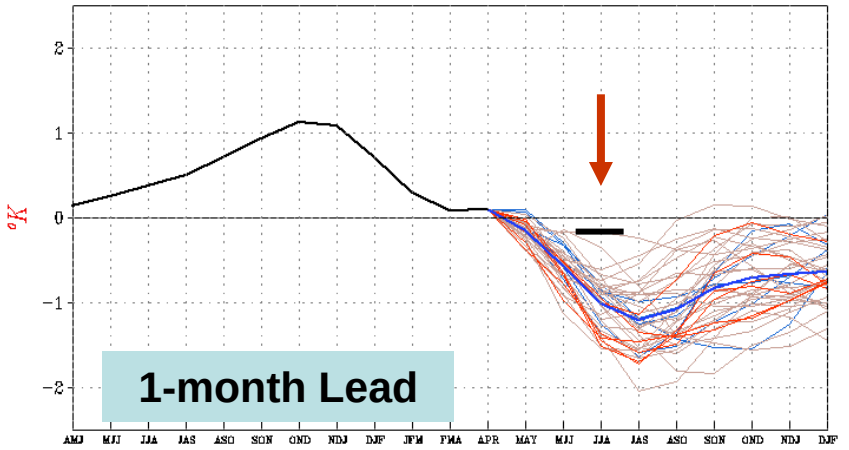


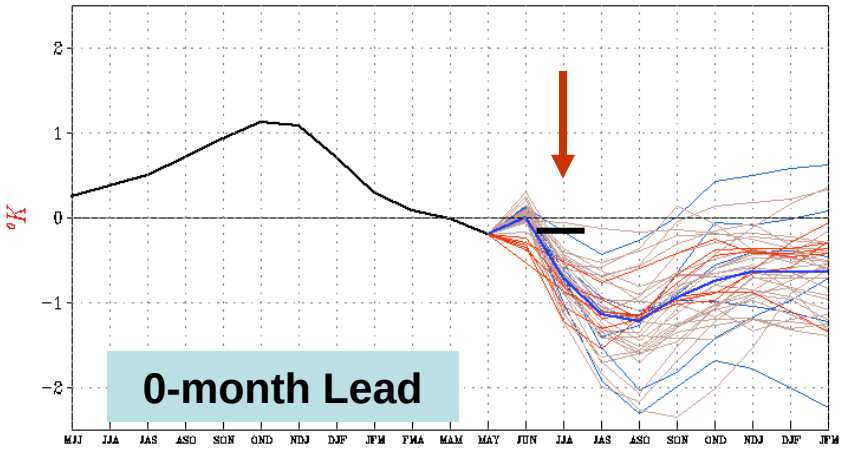
- **Earlier onset of cold SST anomalies (e.g., March ICs)**
- **Much colder SST forecast in Sept. ICs**







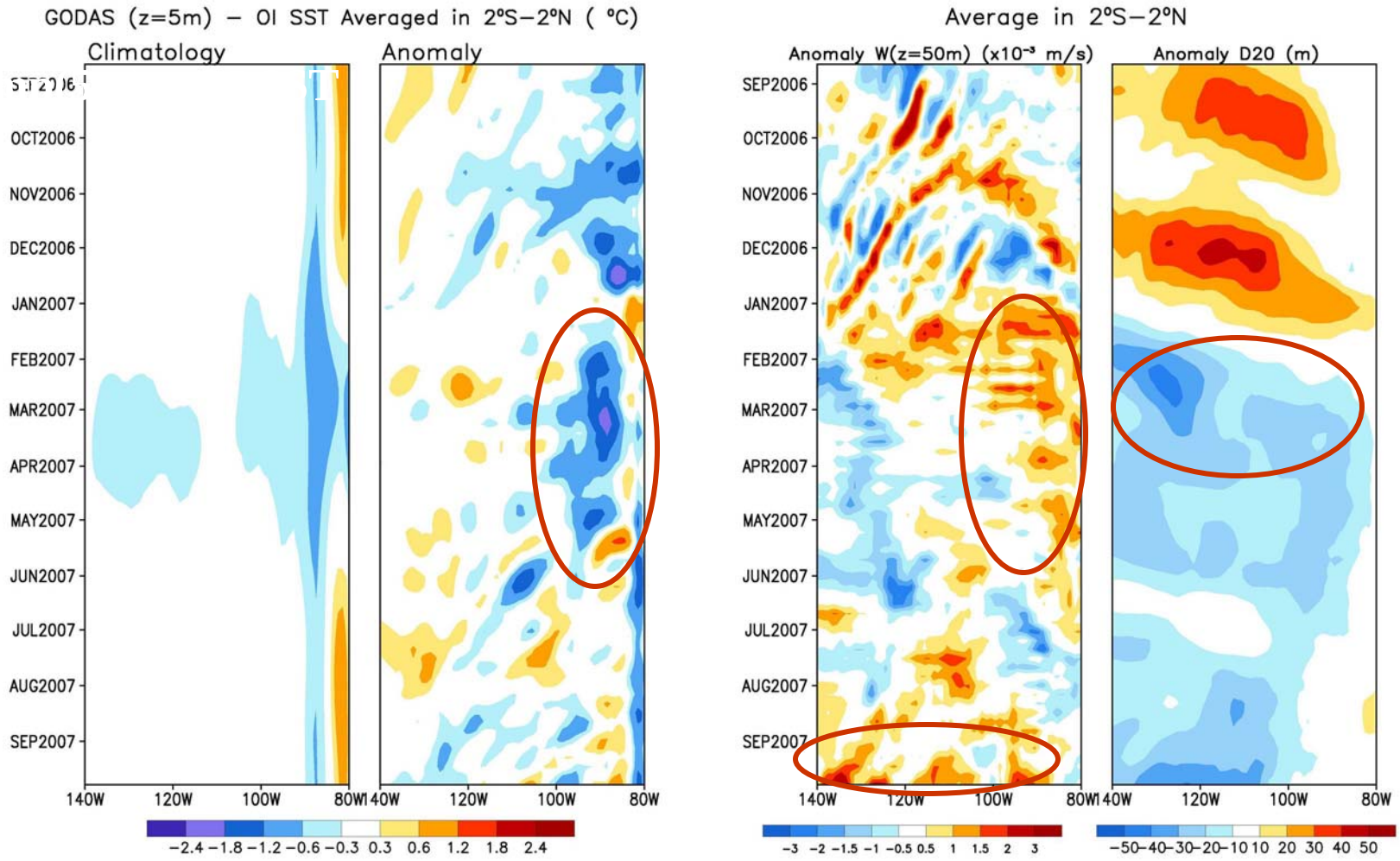




For JJA 2007 as the Target; Forecasts From Different Leads

The low skill in JJA is attributed to both model errors (cold biases) and low predictability related to active MJO activities

Recent Evolution of Equatorial Far Eastern Pacific SST Biases, Vertical Velocity and D20 Anomaly



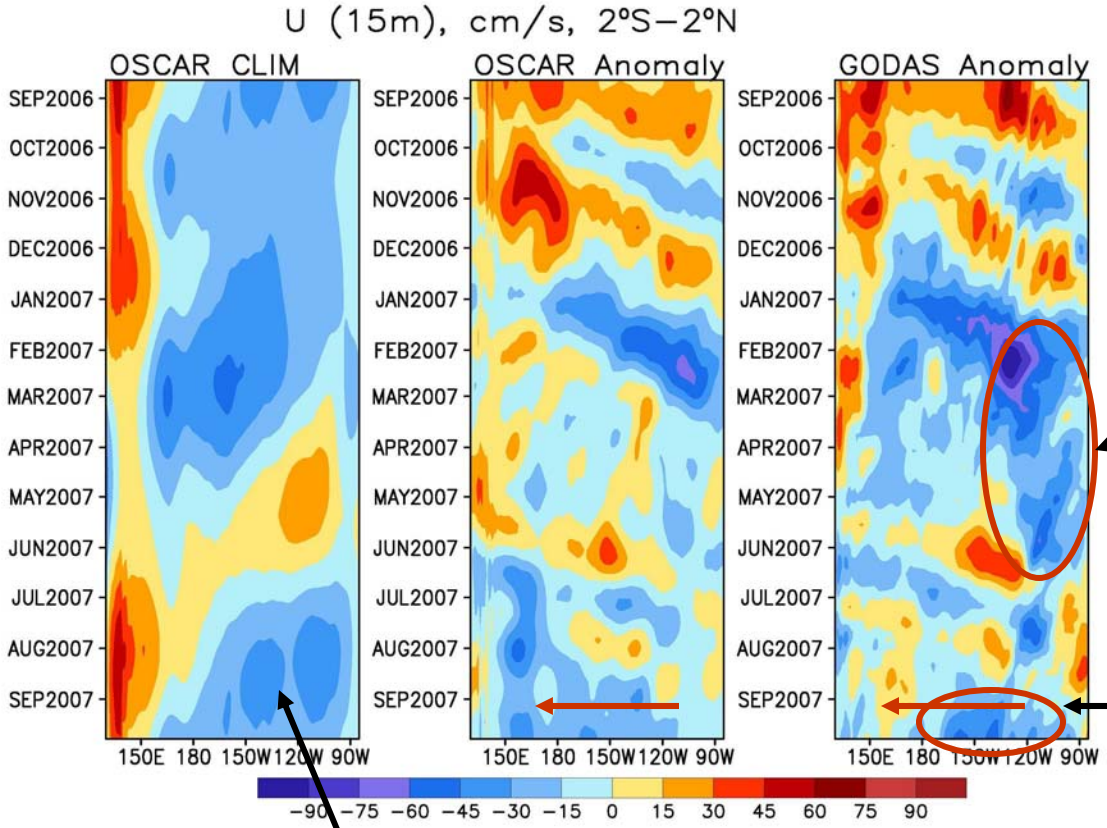
Large negative SST biases in spring of 2007

Related to anomalously strong upwelling at 50-meter depth

Related to anomalously shallow thermocline in the analysis

Upwelling is abnormally strong in Sept. 2007

Recent Evolution of GODAS Biases: Equatorial Surface (15 m) Zonal Current

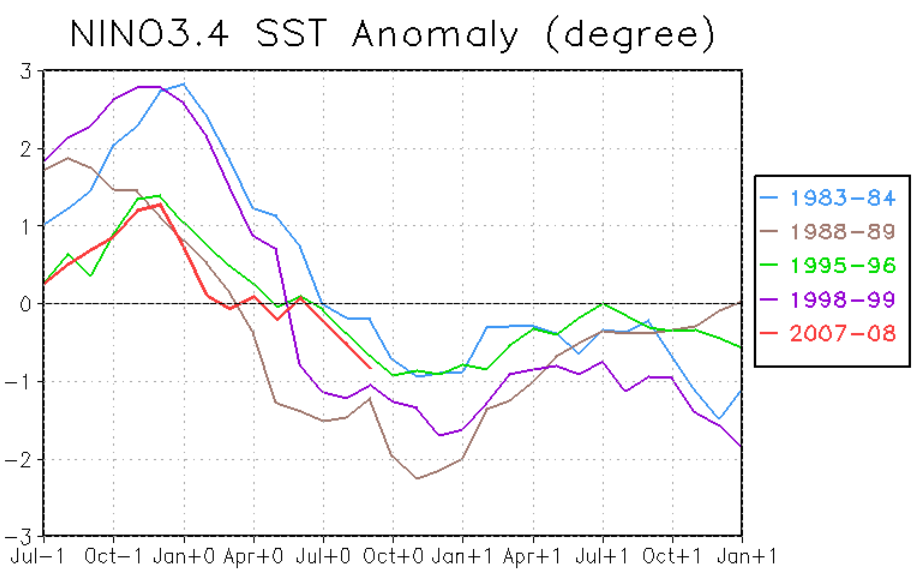


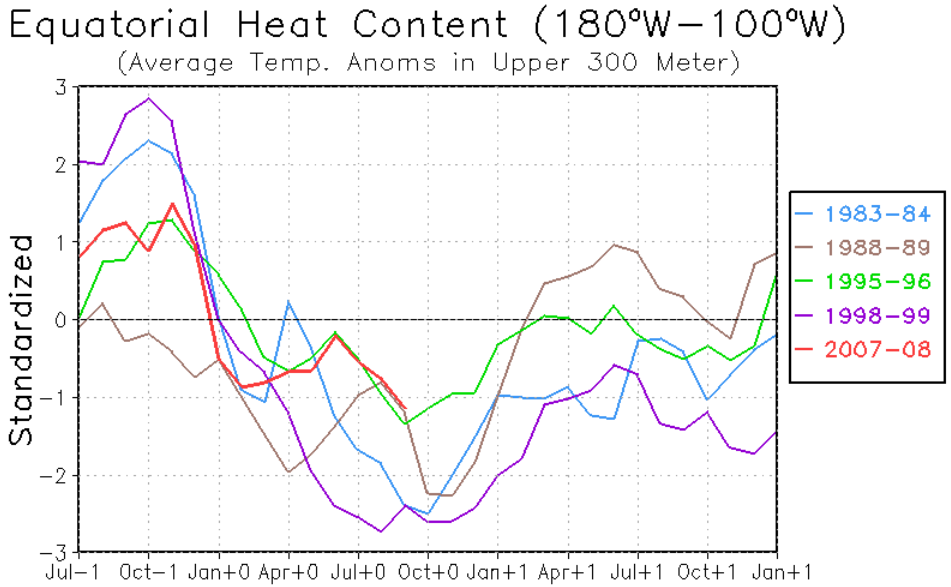
Too strong westward currents

Anomalous westward currents since Sept. 2007

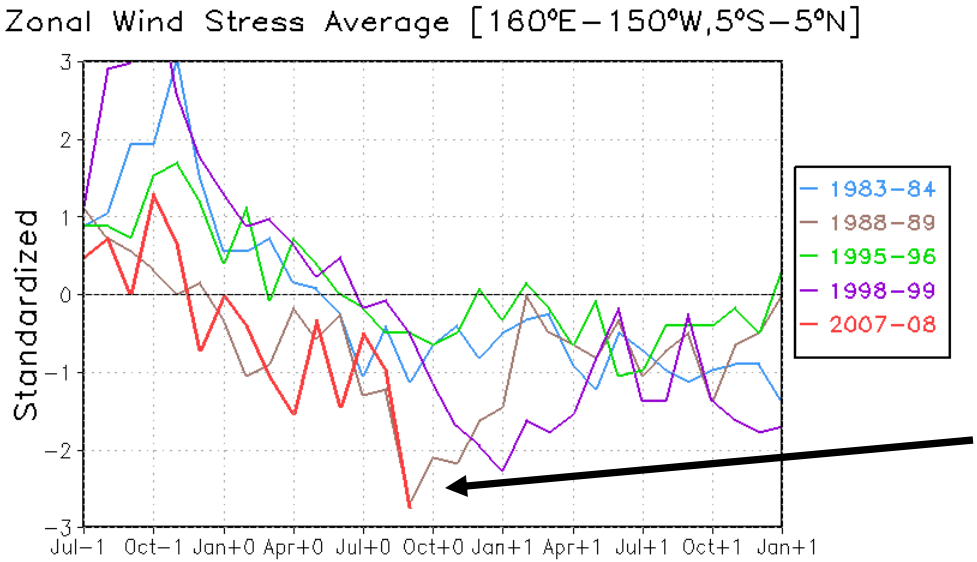
Climatological surface currents are westward since July 2007

Cold SST biases and too strong westward currents contributed to earlier onset of cold SST forecast in spring 2007





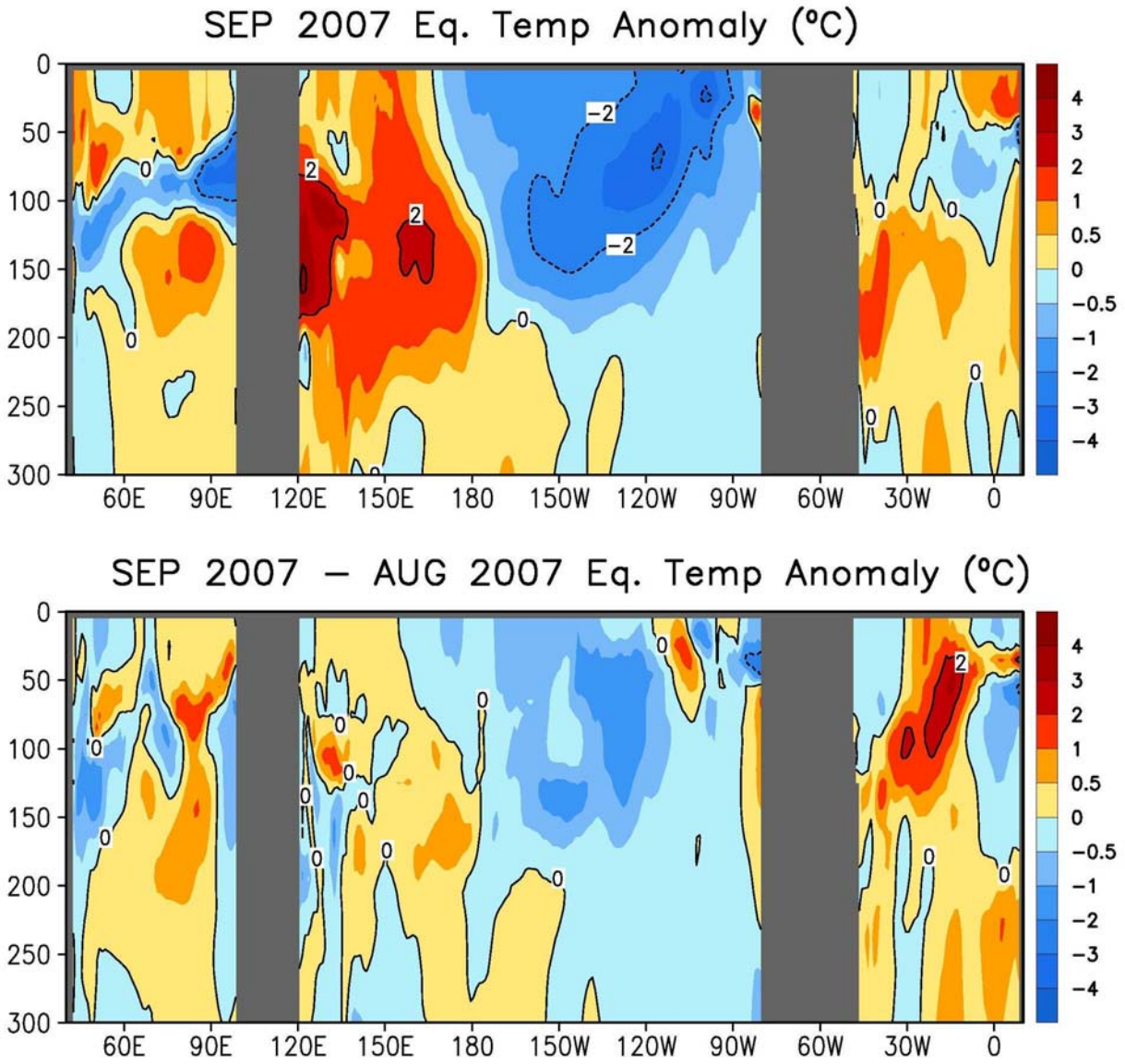
R2 wind stress



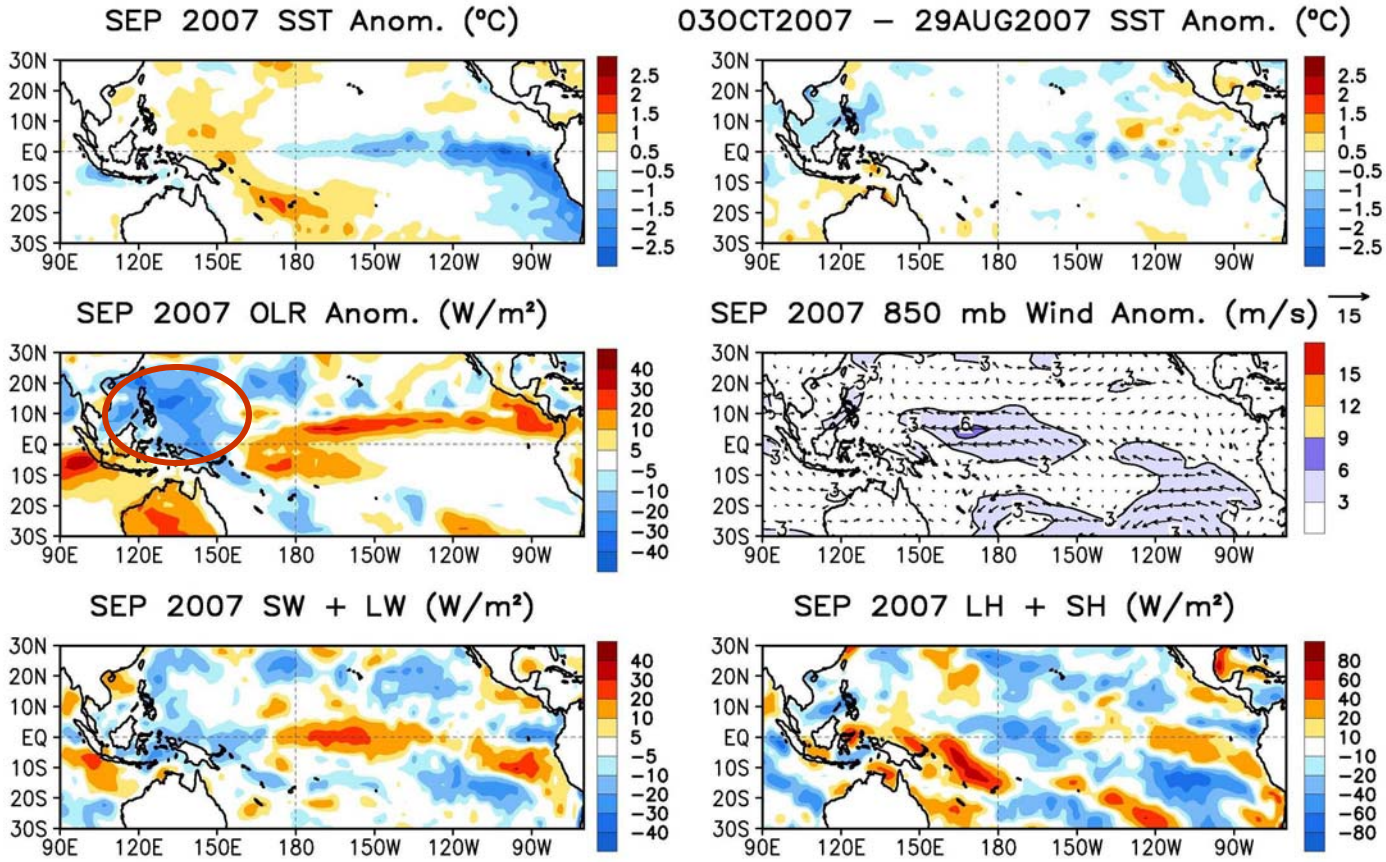
Compared to the past La Nina events since 1979 transitioning from positive to negative phase during spirng, the current year so far is very similar to the 1995 cold. However, the easterly zonal wind stress anomalies in the central Pacific increased dramatically in September, **indicating the 2007-08 La Nina may surpasses the weak 1995-96 event and become a moderate cold event.**

Backup Slides

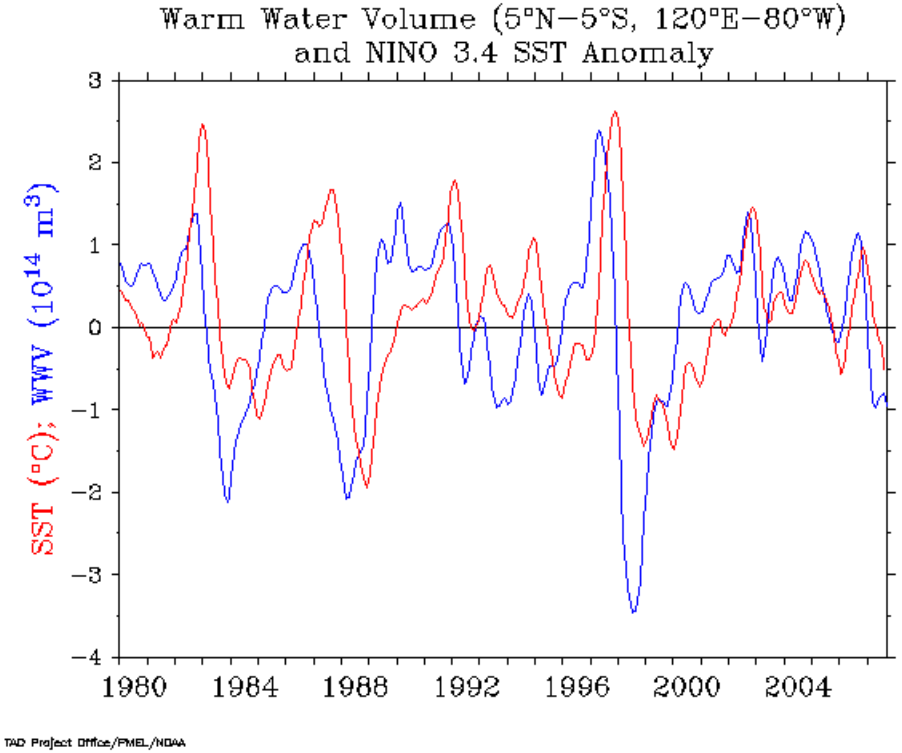
GODAS Equatorial X-Z Temperature



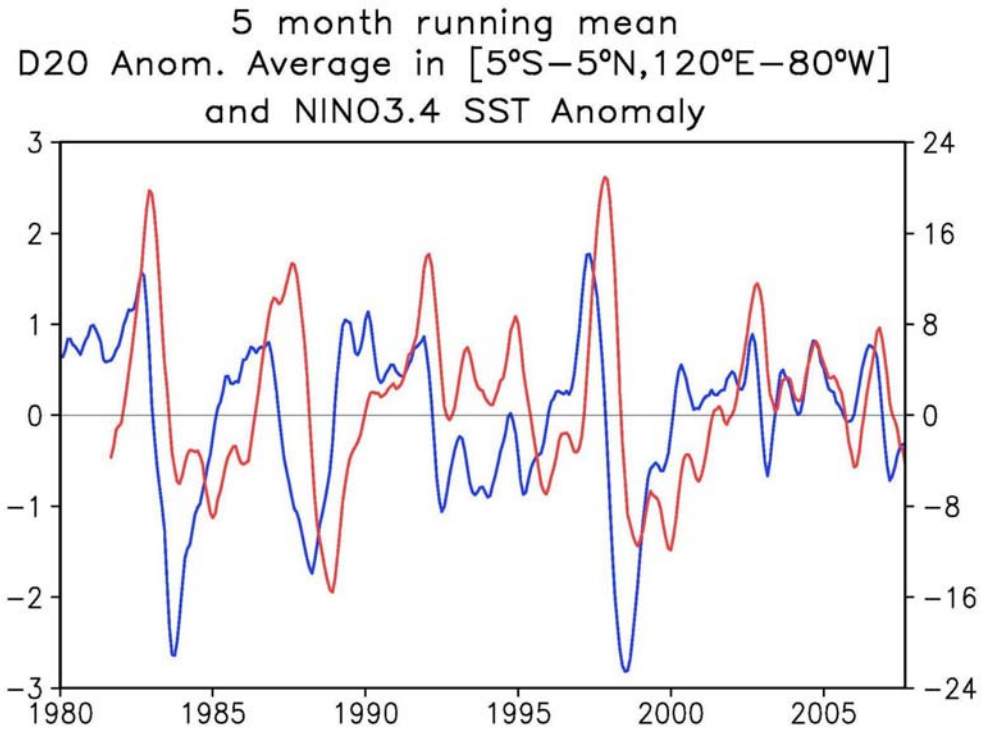
Tropical Pacific: SST Anom., SST Anom. Tend., OLR, 850-mb Winds, Sfc Rad, Sfc Flx



Pacific Warm Water Volume

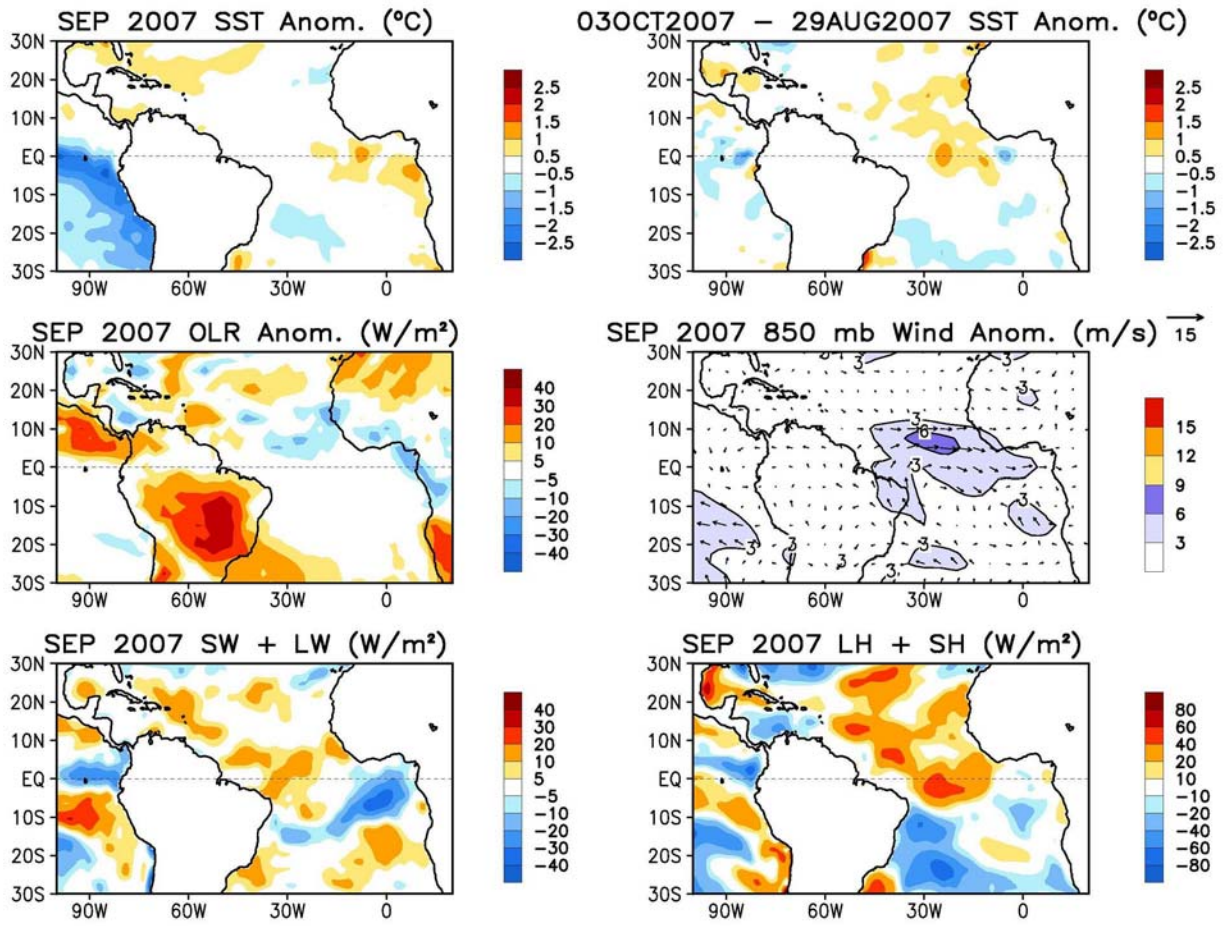


PMEL

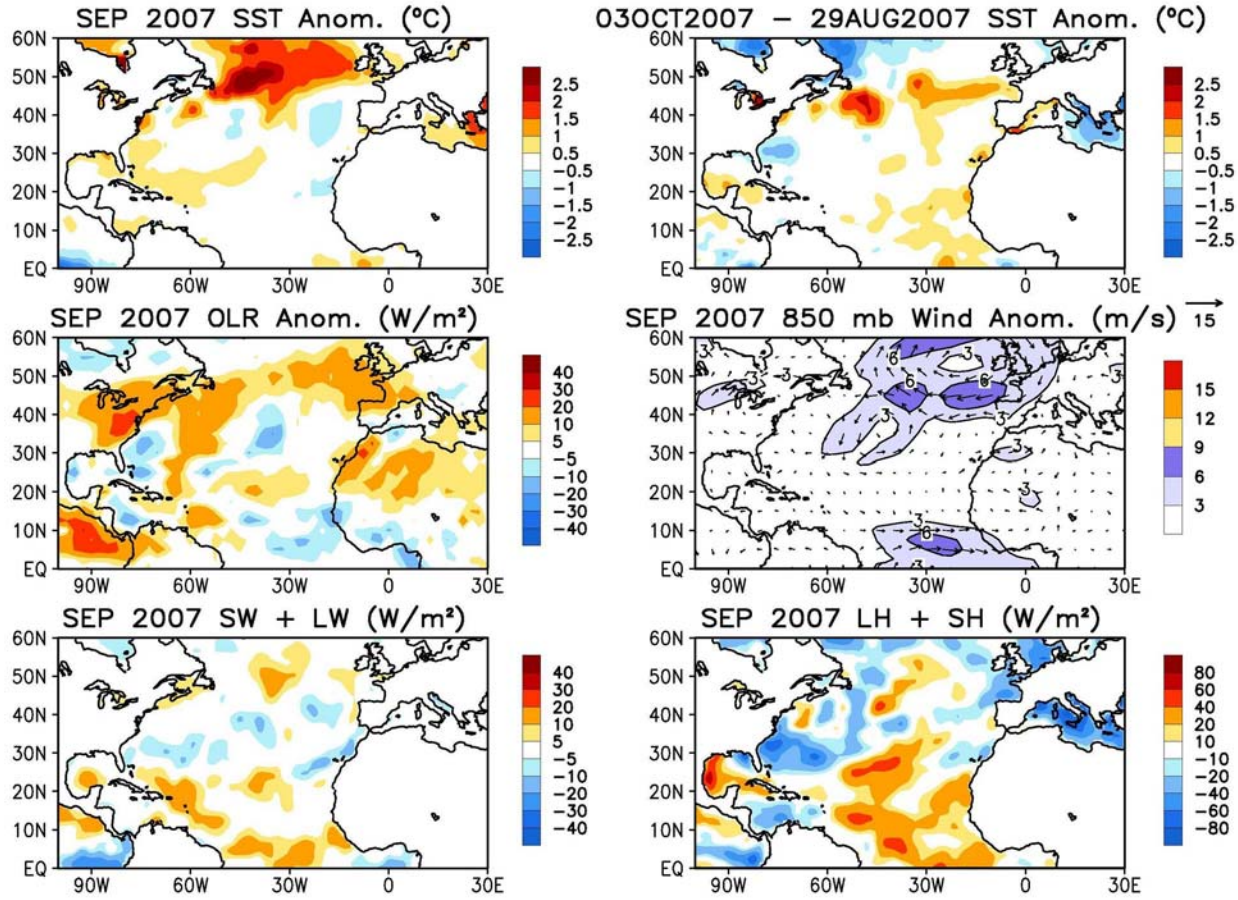


GODAS

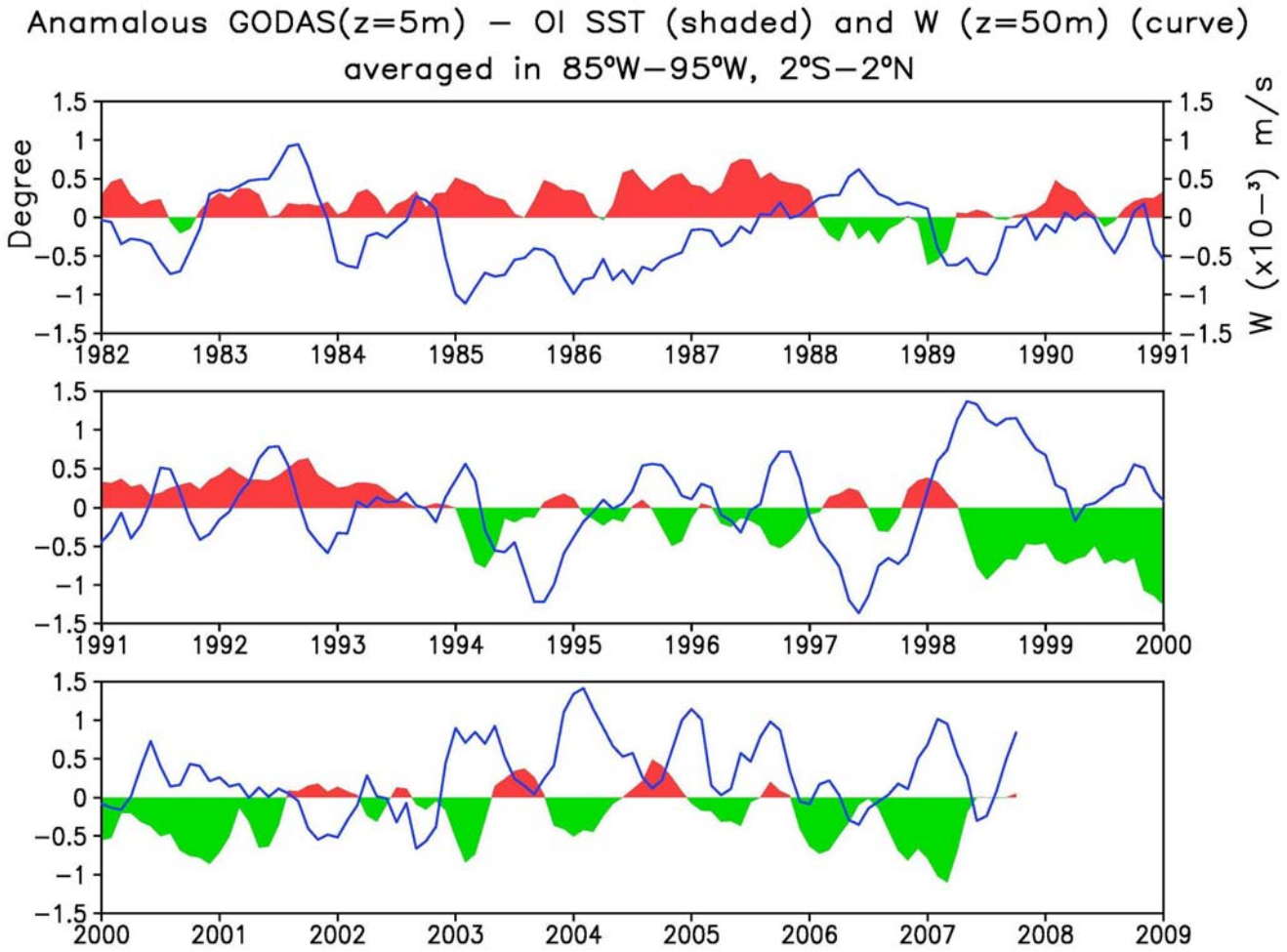
Tropical Atlantic: SST Anom., SST Anom. Tend, OLR, 850-mb Winds, Sfc Rad, Sfc Flx



North Atlantic: SST Anom., SST ANom. Tend., OLR, 850-mb Winds, Sfc Rad, Sfc Flx



Historical Evolution of Equatorial Far Eastern Pacific SST Biases and Vertical Velocity

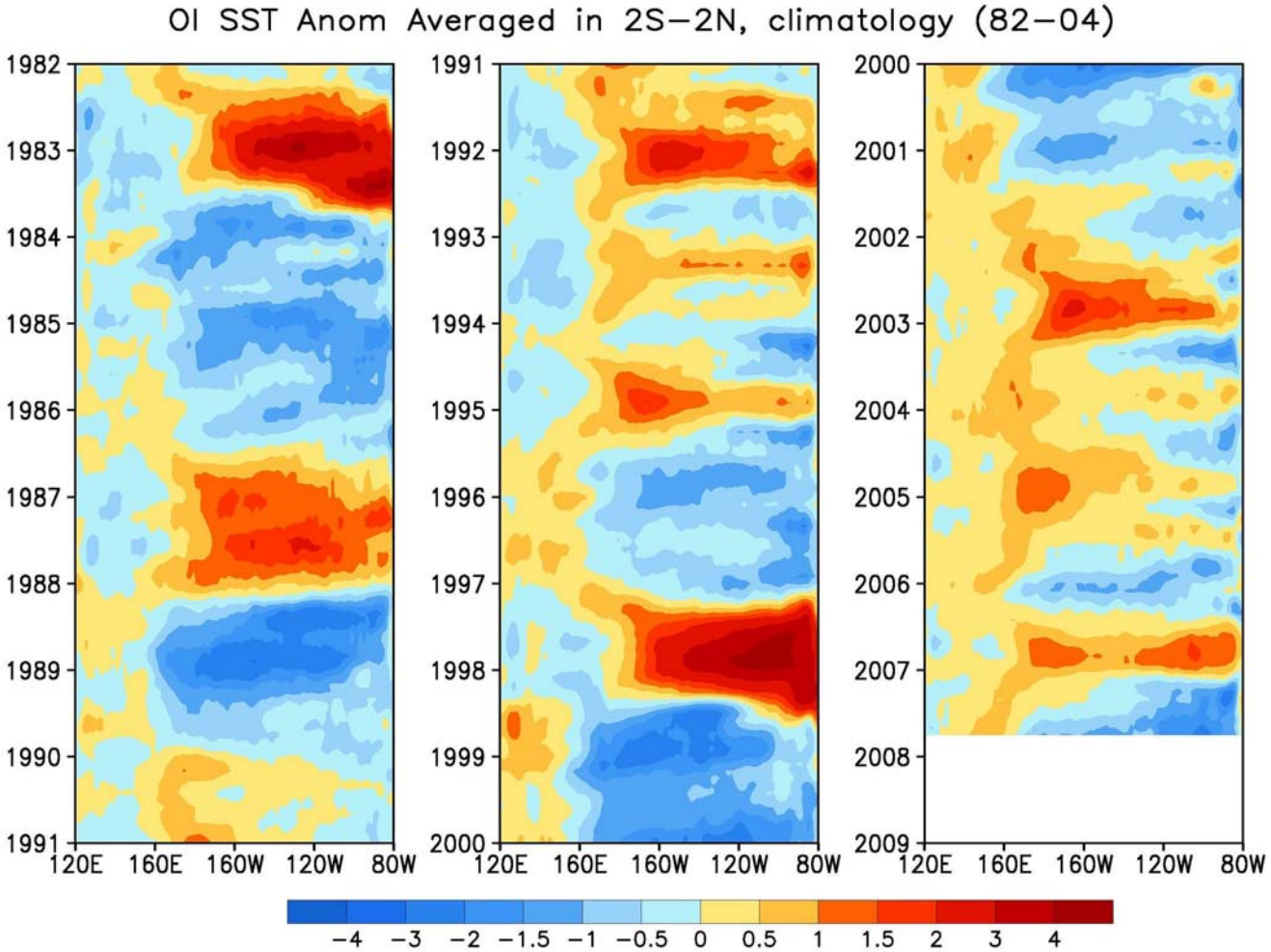


Negative anomalous SST biases since 1998

Related to anomalously strong upwelling

Anomalous upwelling - annual cycle – early spring surge since 2003

Decadal Variability of Equatorial Pacific SST

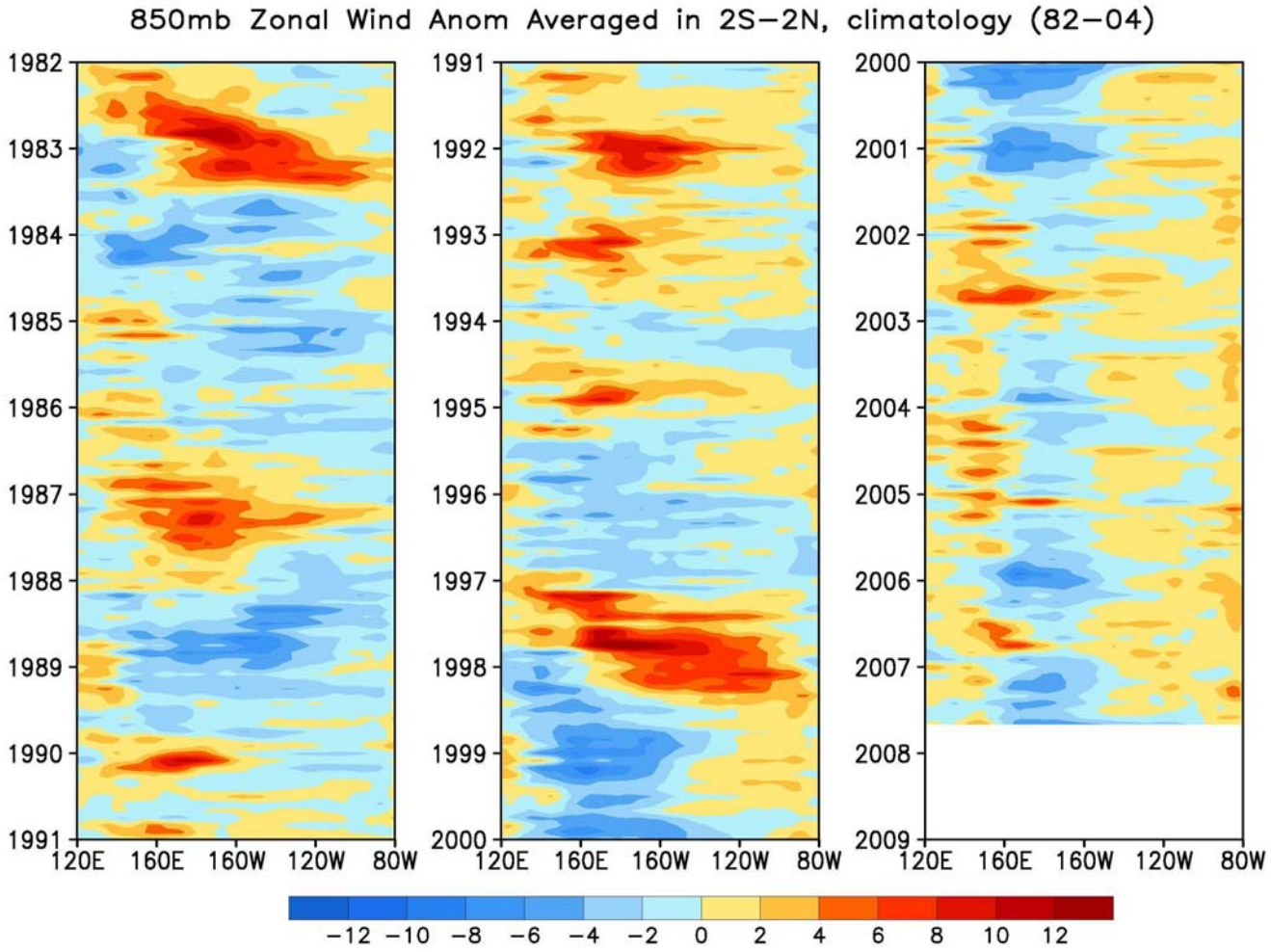


Persistent western Pacific warming since 2001

Weak SST variability since 2001

High frequency (annual) eastern Pacific SST variability – annual cooling in spring

Decadal Variability of Equatorial Pacific Zonal Winds



Easterly anomalies persistent near the dateline since 2001

Westerly wind events abundant west of 160E since 2001

Westerly anomalies persistent in the far eastern Pacific since 2001