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

Prepared by

Climate Prediction Center, NCEP

January 8, 2008

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

Outline

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

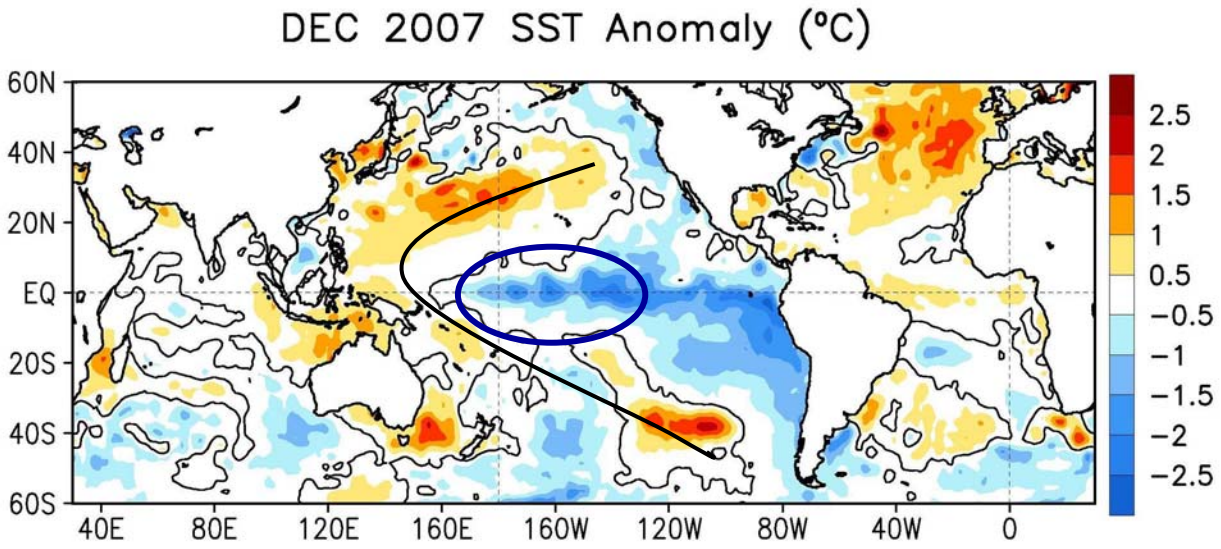
Overview

- **Pacific Ocean**
  - Moderate-strength La Niña (ONI SST < -1C) persisted from SON to OND
  - CPC's prognostic assessment: La Niña will continue into the Spring of 2008
  - Easterly wind anomaly and suppressed convection extended to the far western Pacific
  - Large intraseasonal variability in the extra-tropical North Pacific

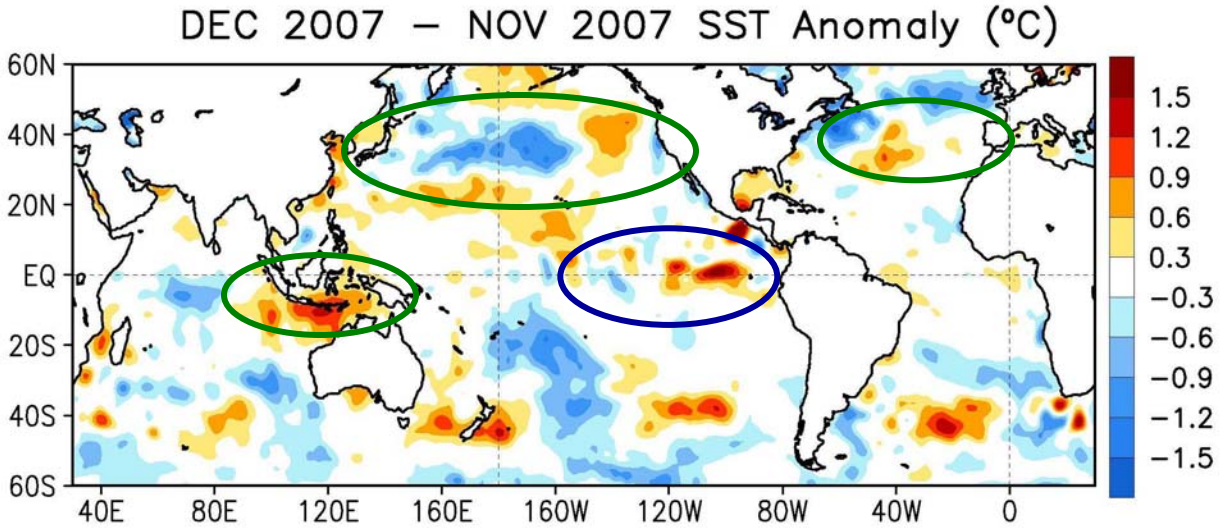
- **Indian Ocean**
  - Near normal SST presented in the tropical Indian Ocean
  - IOD index near normal
  - Moderate-strength MJO progressed from Africa to Maritime Continent
  - Above normal convection related to MJO activities

- **Atlantic Ocean**
  - Near normal SST presented in the tropical Atlantic Ocean
  - Negative SST anomalies in south-western Atlantic persisted – forced by La Nina?
  - SST anomalies in the extra-tropical North Atlantic weakened

Global SST Anomaly (ºC) and Anomaly Tendency



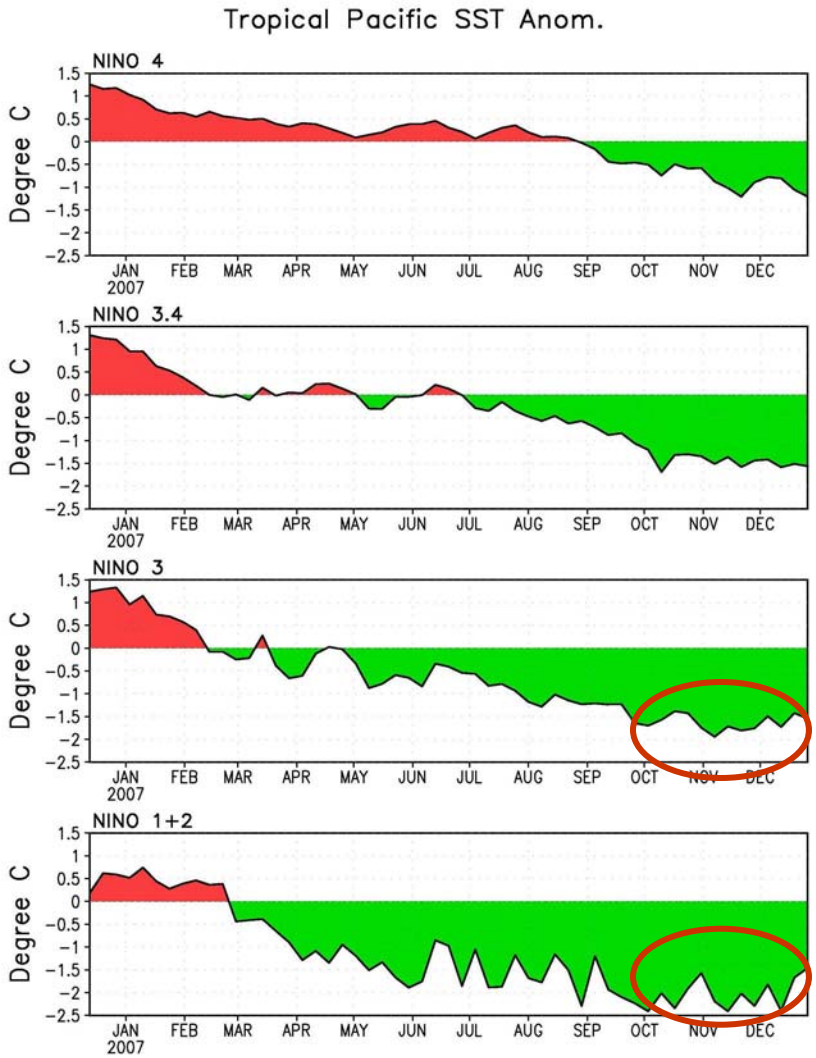
- **Negative SSTA east of 160E-- a canonical horseshoe pattern in the Pacific**
- **Near normal SST in Indian Ocean**
- **Near Normal SST in tropical Atlantic**

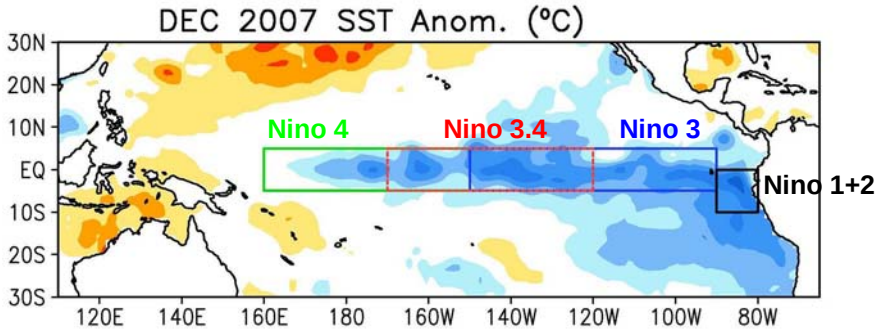


- **Negative SSTA weakened near 100W**
- **SSTA in NH extra-tropics weakened**
- **Positive SSTA near Java coast intensified**

Pacific Ocean

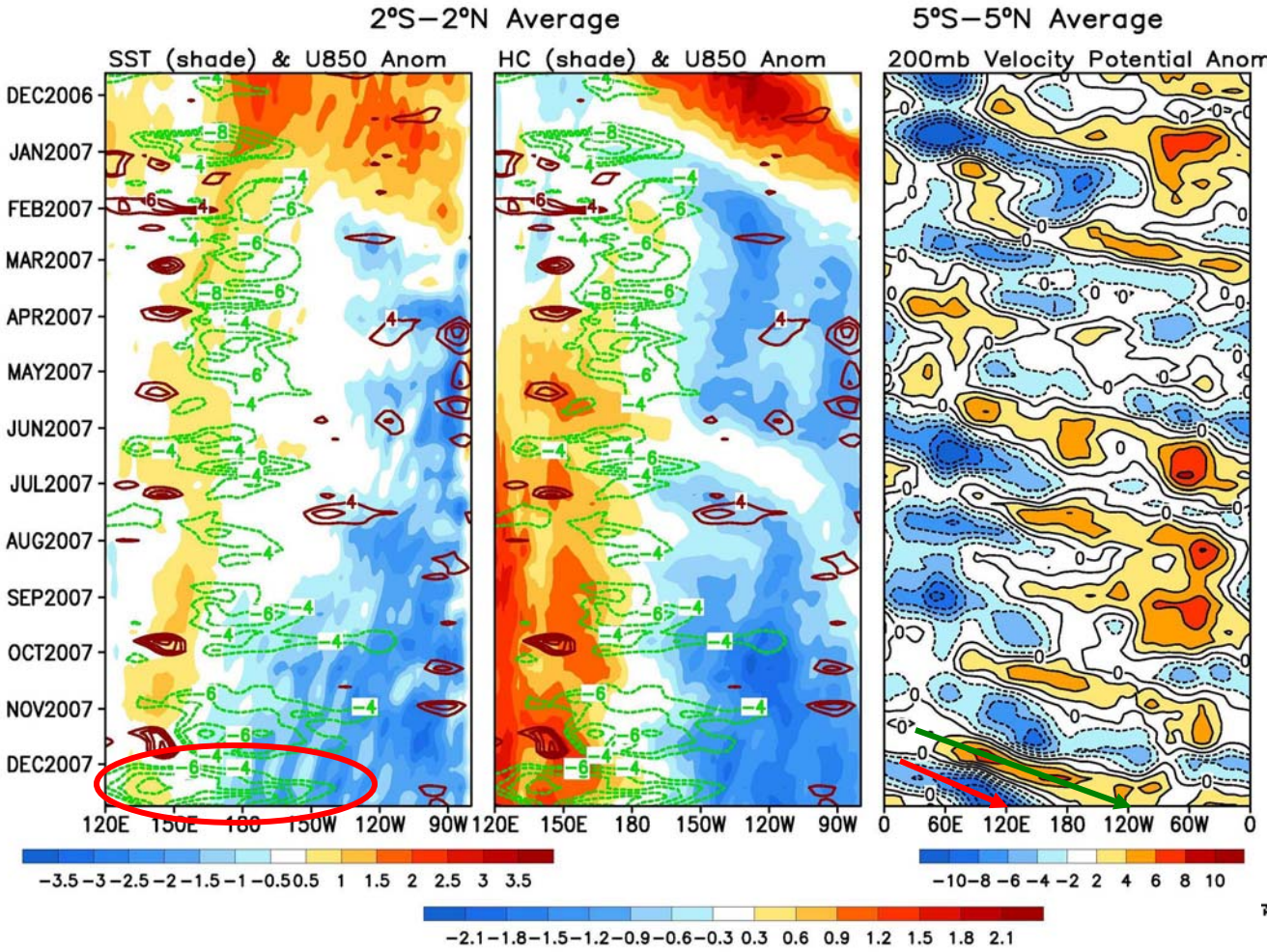
Recent Evolution of Pacific NINO SST Indices



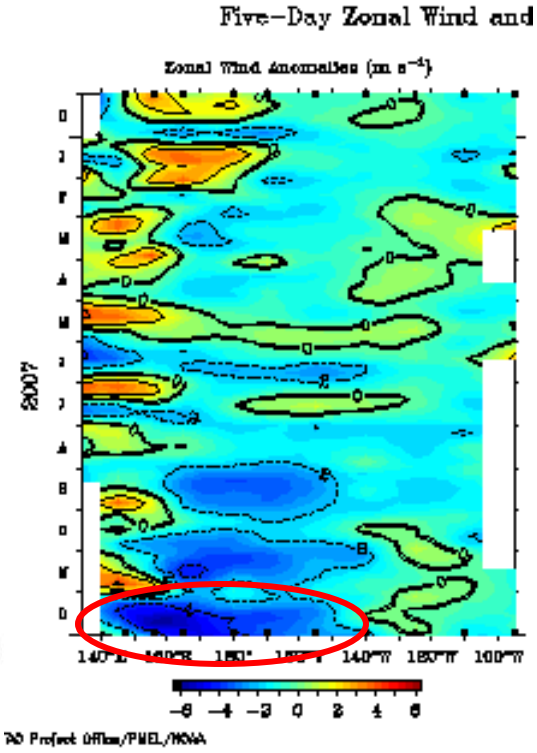


- **All NINO indices persisted**
- **CPC's ENSO Prognostic Statement: OND ONI -1.2C, a moderate-strength La Nina persisted. The La Nina will continue into the spring of 2008.**

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



TAO winds

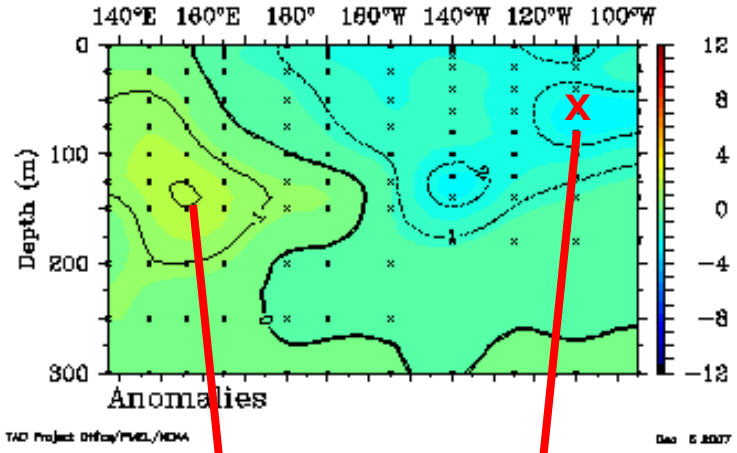


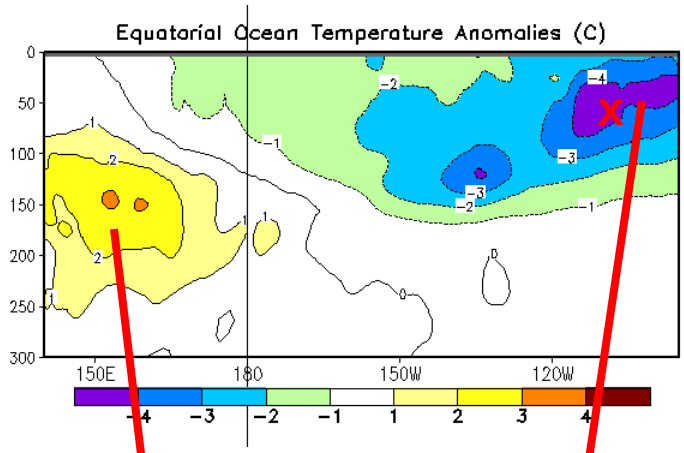
- **CPC's MJO prognostic statement: Moderate MJO activity presented since late October**
- **In December, MJO progressed from Africa to the maritime continent**
- **Associated with the MJO, easterly wind anomalies intensified in the far western Pacific**

Depth-Longitude Section of Temperature Anomaly

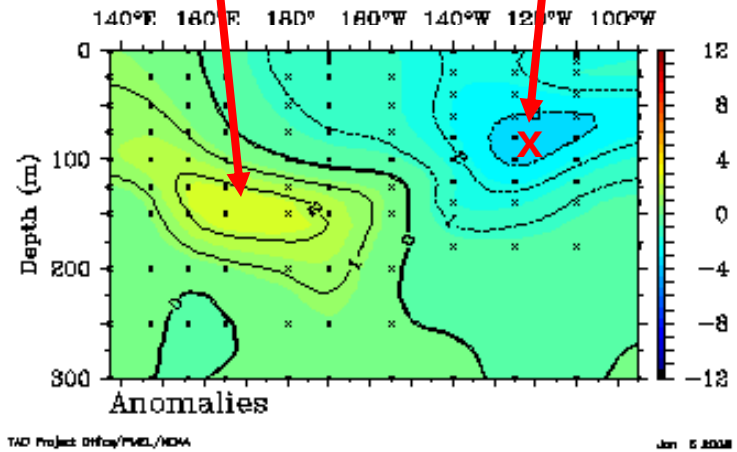
TAO | **GODAS**

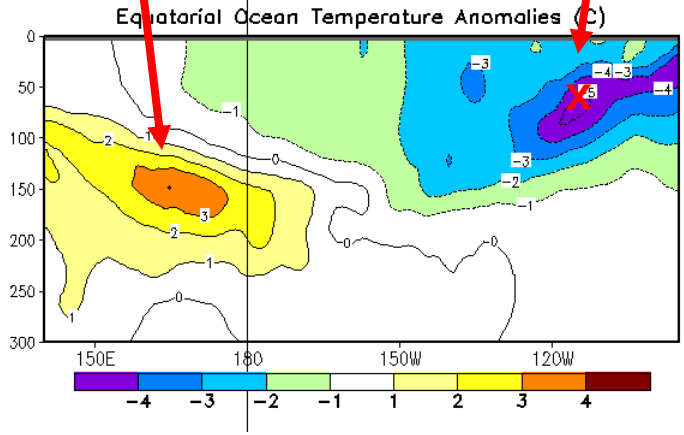
November





December

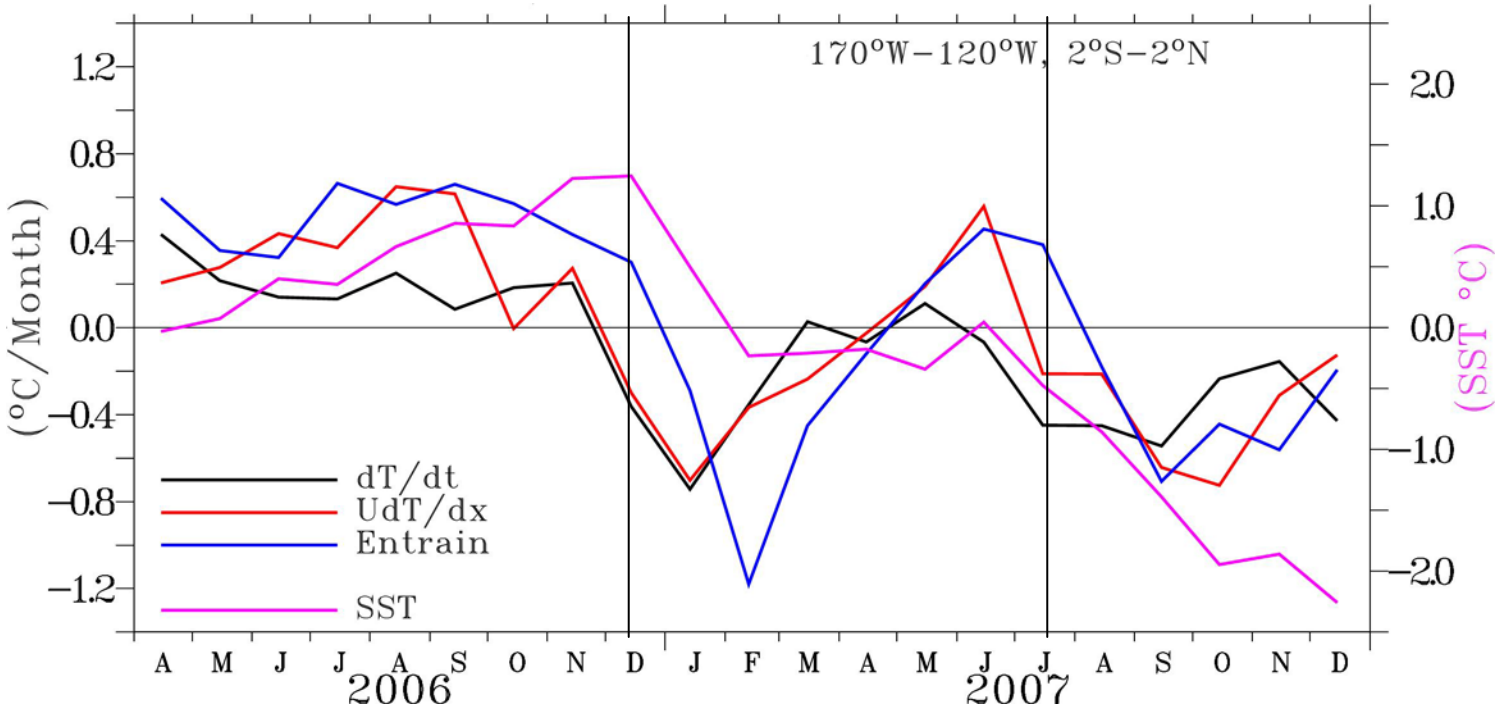




- East-west dipole pattern of temperature anomalies featuring La Nina conditions
- Temperature anomalies in GODAS are stronger than those of TAO, partially caused by diff. climatology base period
- Negative (positive) temperature anomalies moved westward (eastward) and became stronger than those in November

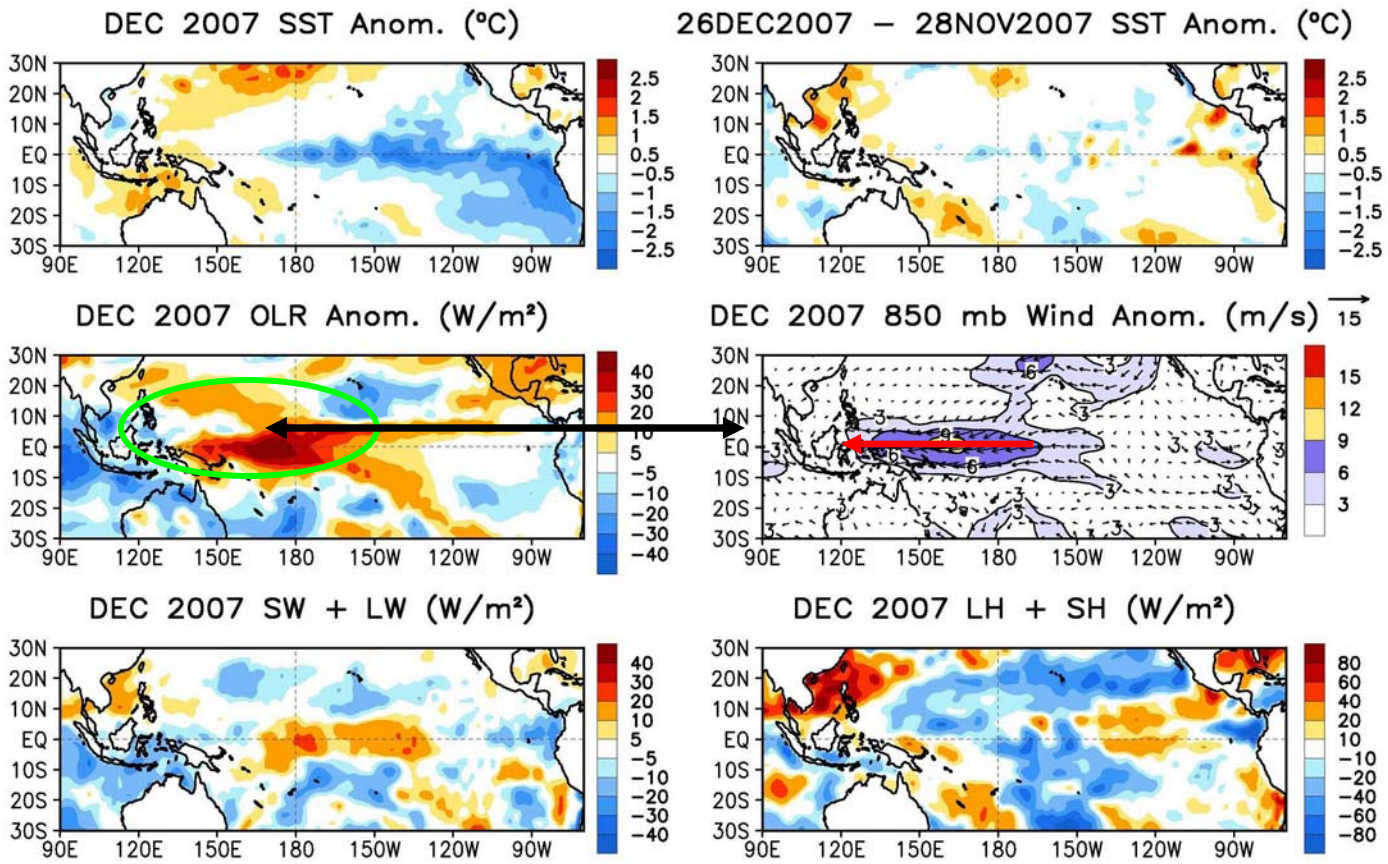
Recent Evolution of Heat Budget in NINO3.4 SST Anomaly

Courtesy of Dr. Dongxiao Zhang



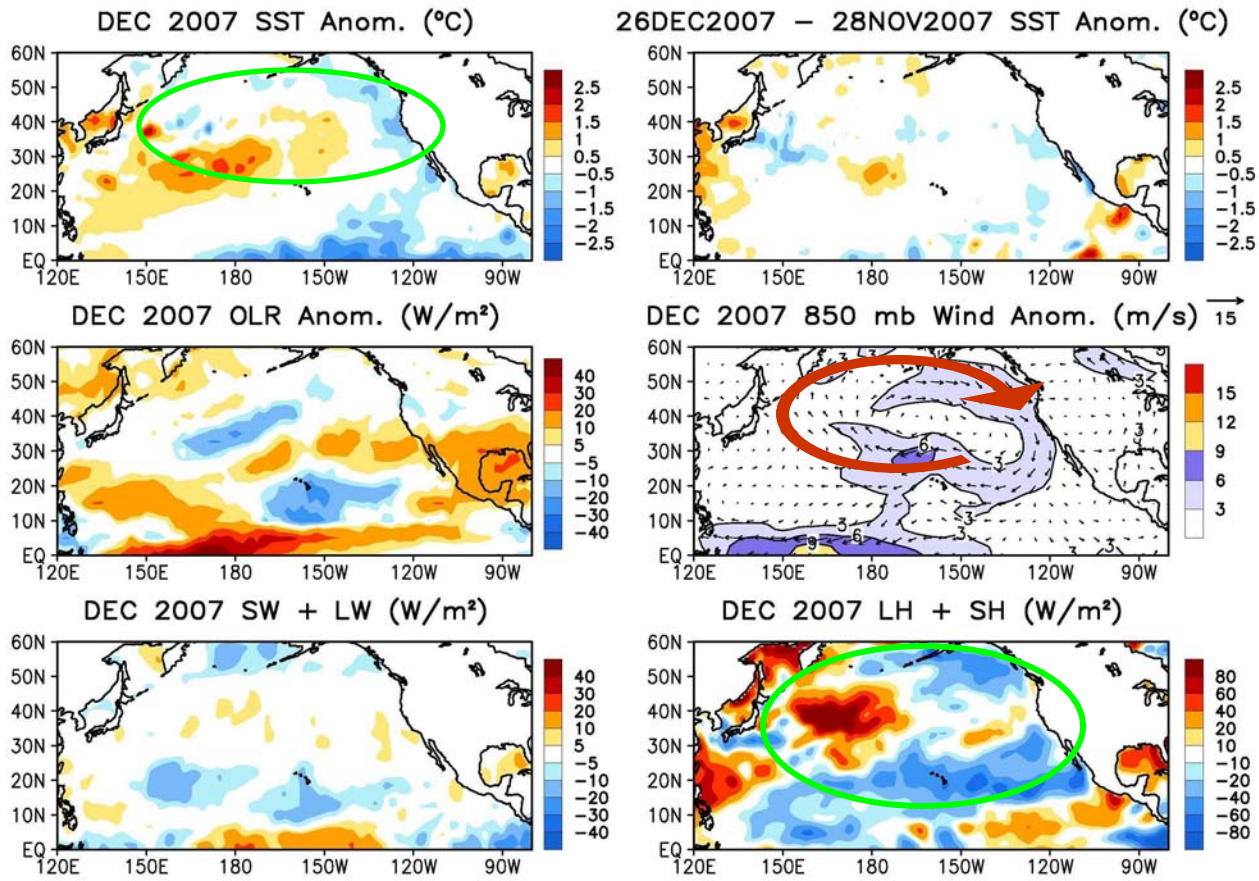
- **Advective cooling in Dec. 2006 (MJO) followed by entrainment cooling in Jan. 2007**
- **Advective and entrainment warming in May-Jul 2007 (MJO) delayed La Nina development**
- **Advective cooling in Jul 2007 (MJO) followed by entrainment cooling in Aug-Oct 2007 led to La Nina development**
- **Both advective and entrainment cooling weakened in December**

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



- **Reduced convection in the central and western Pacific**
- **Easterly wind anomalies intensified, and extended westward to 120E**

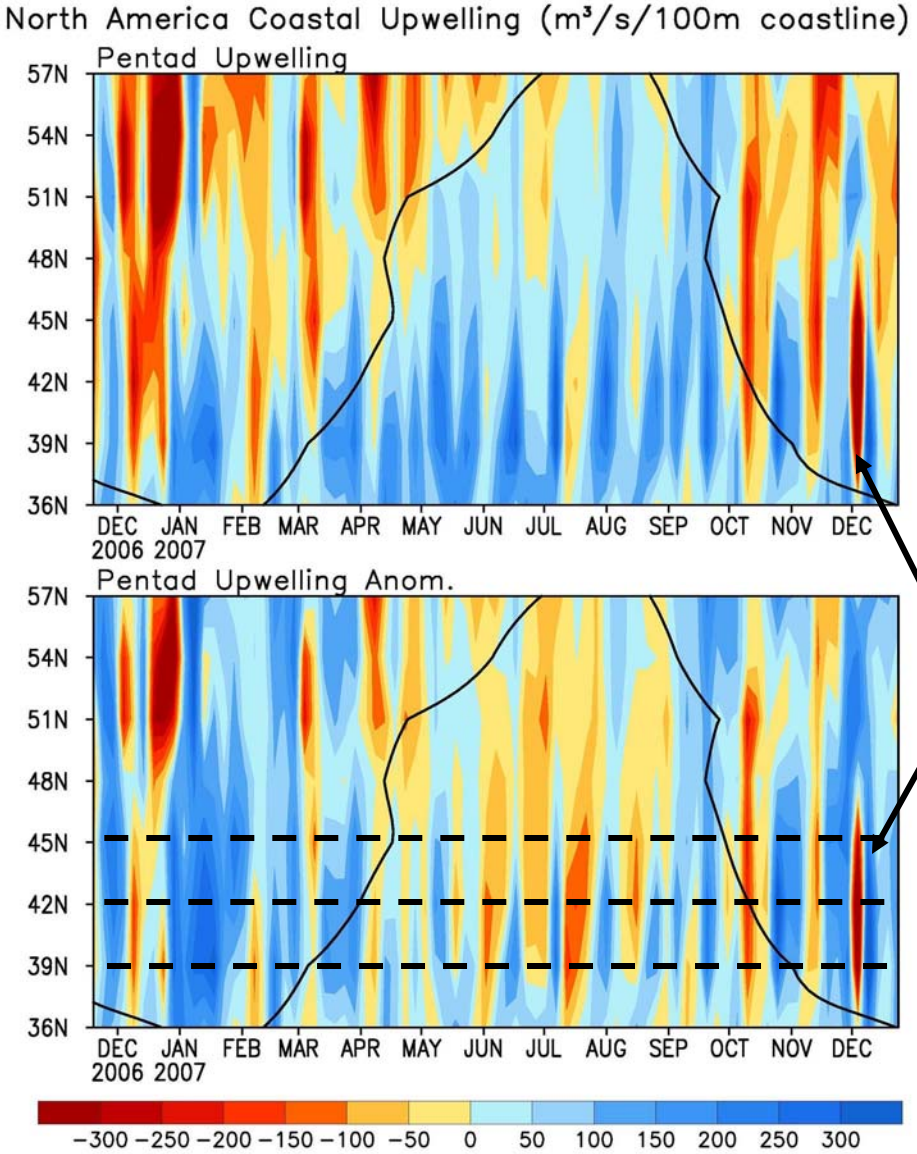
North Pacific: SST Anom., SST Anom. Tend., OLR, 850-mb Winds, Sfc Rad, Sfc Flx

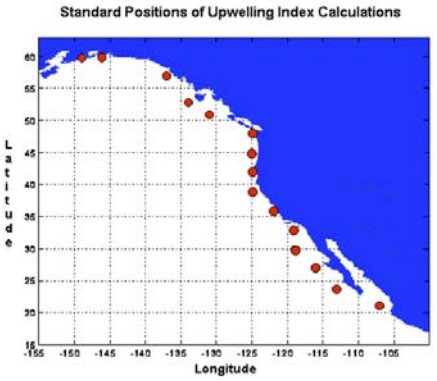


- **Cooling near western coast of North America and warming in central North Pacific weaker than those in November.**
- **Ekman transport / pumping and surface heat fluxes were likely the main external forcing**

North America Western Coastal Upwelling

CPC, NCEP



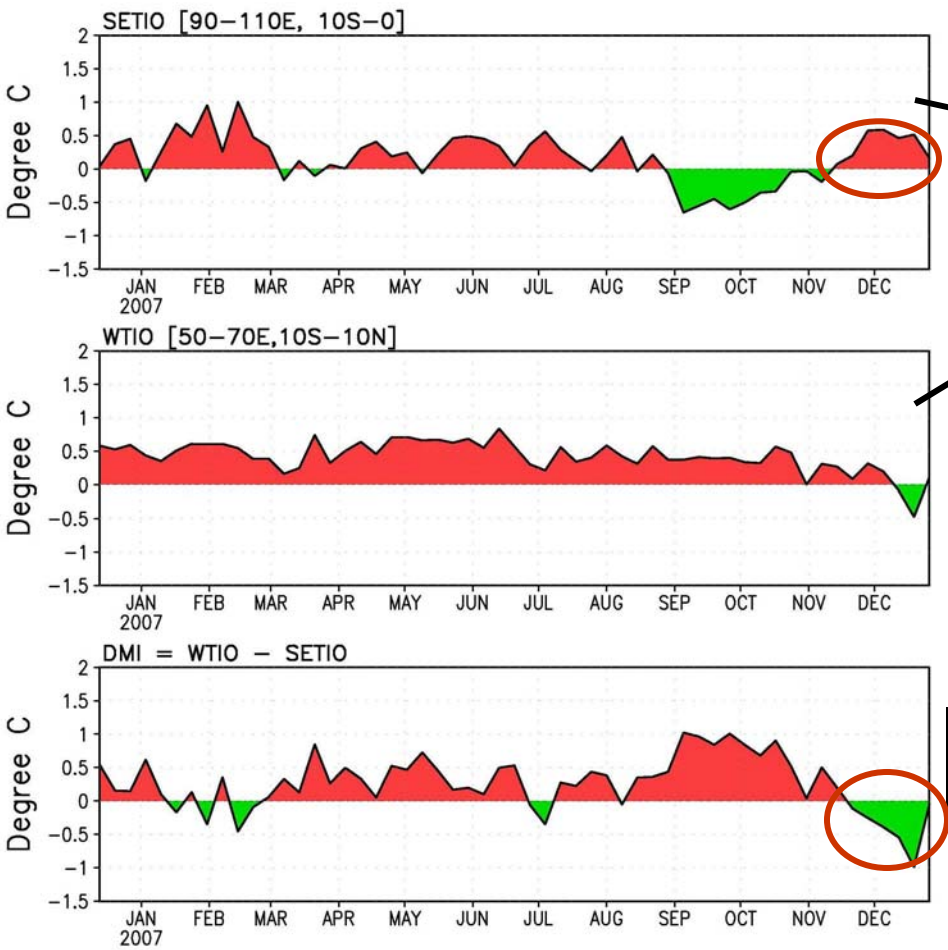


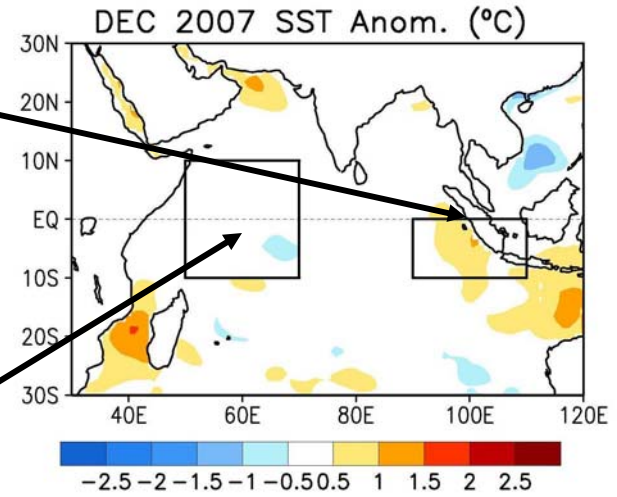
- **Climatological downwelling prevails along the coast in December**
- **Large intraseasonal variability since October**

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

Indian Ocean

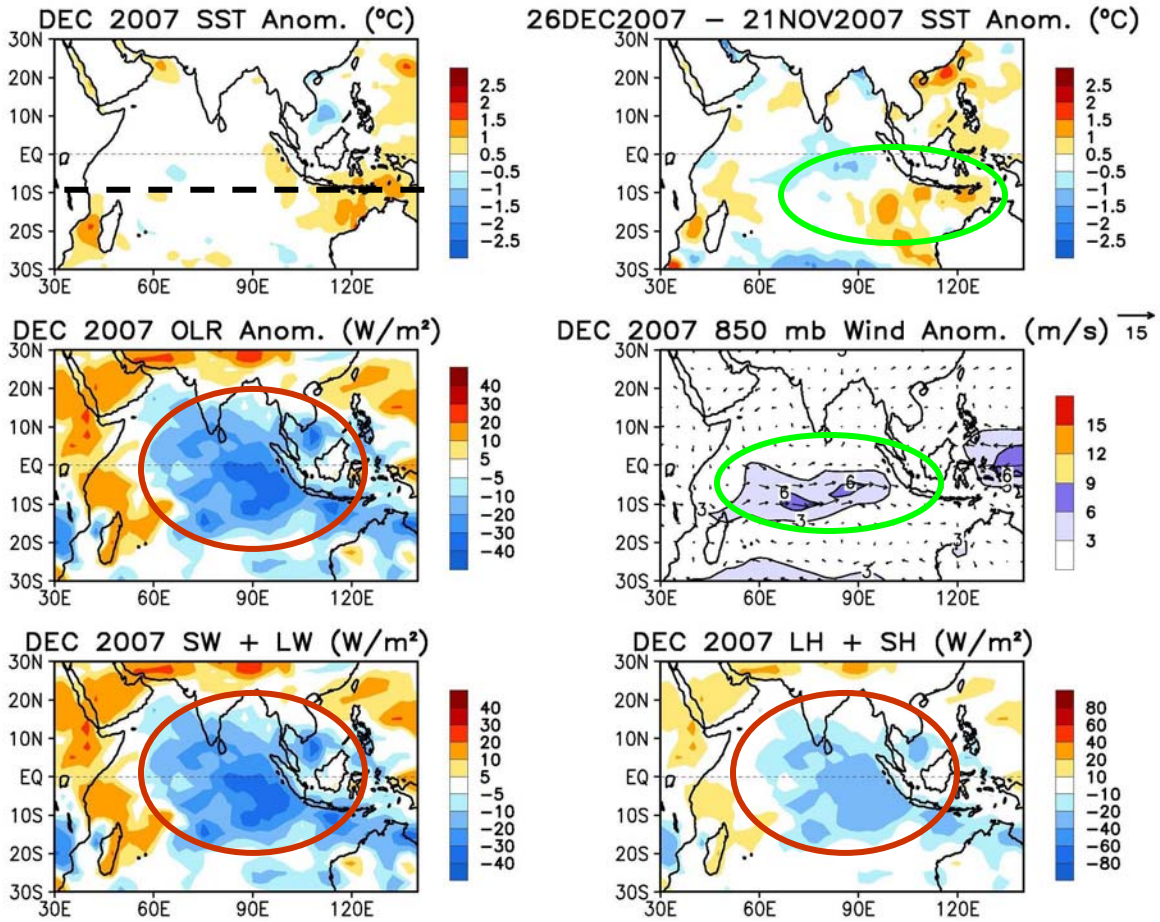
Recent Evolution of Indian Ocean SST Indices





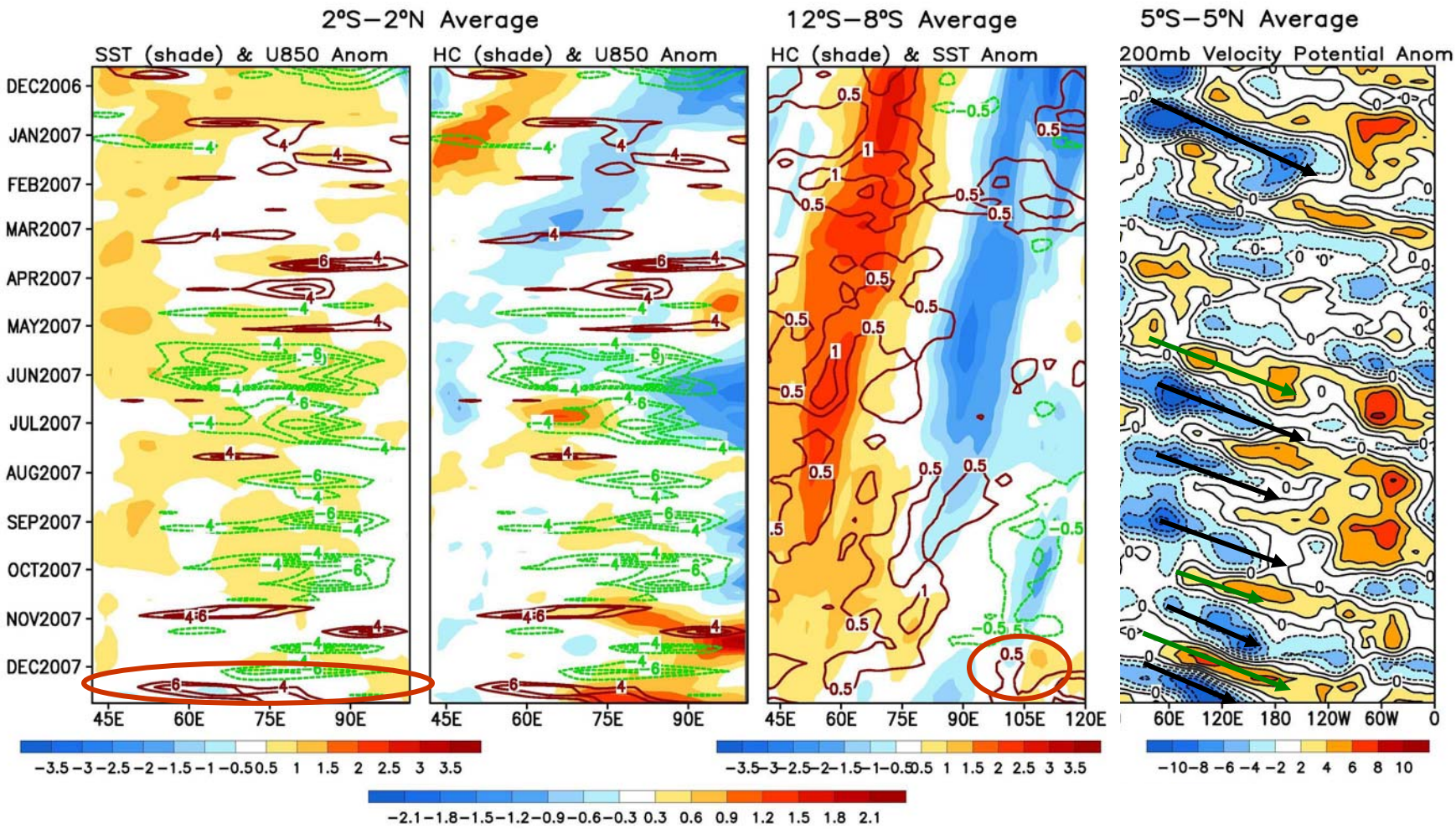
- **SST are near normal in Indian Ocean**
- **IO Dipole Mode Index (DMI) is near normal**

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



- Above normal rainfall over most of Indian ocean due to MJO activities
- Above normal SST near Java coast and Indonesian Passages
- Below normarl surface heat flux, cooling the ocean
- Westerly wind anomalies

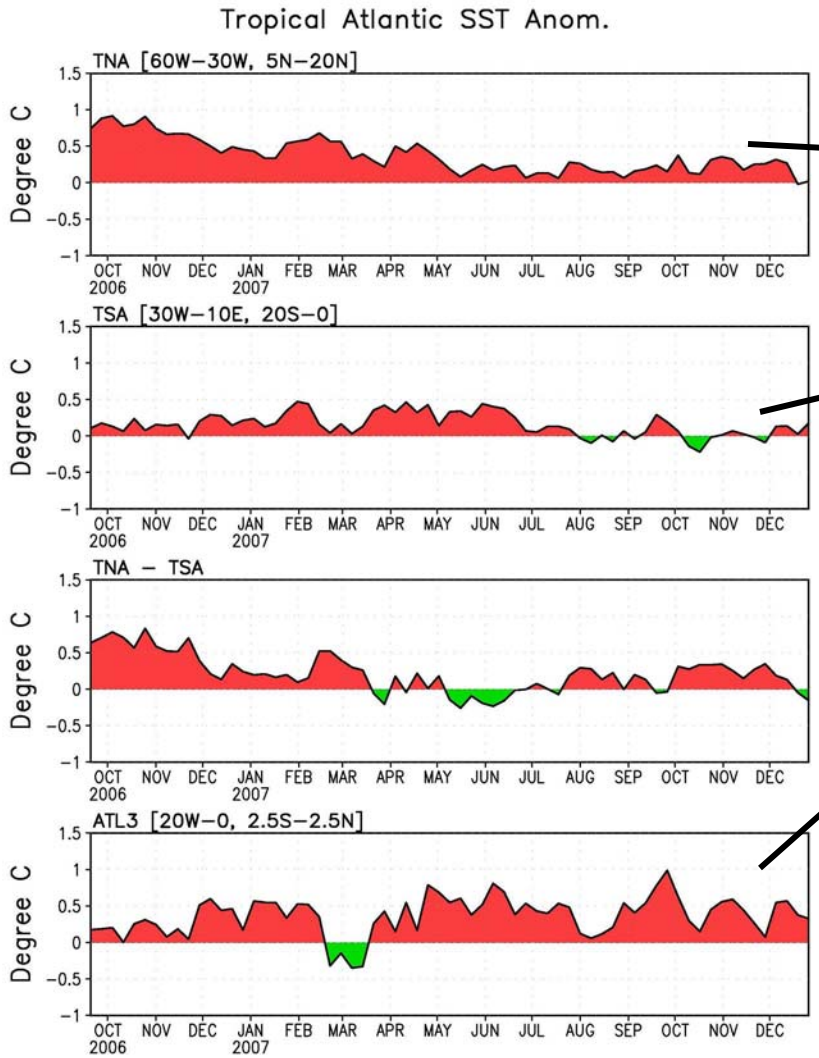
Evolution of Equatorial/10°S Indian SST (°C), 850-mb Zonal Wind (m/s), 0-300m Heat Content (°C)

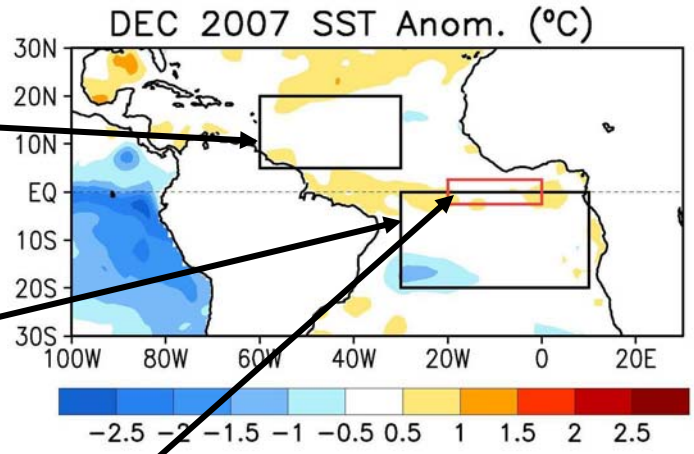


- **Moderate MJO activities**
- **Westerly wind anomaly**
- **Positive SST and HC anomalies near Java Coast**

Atlantic Ocean

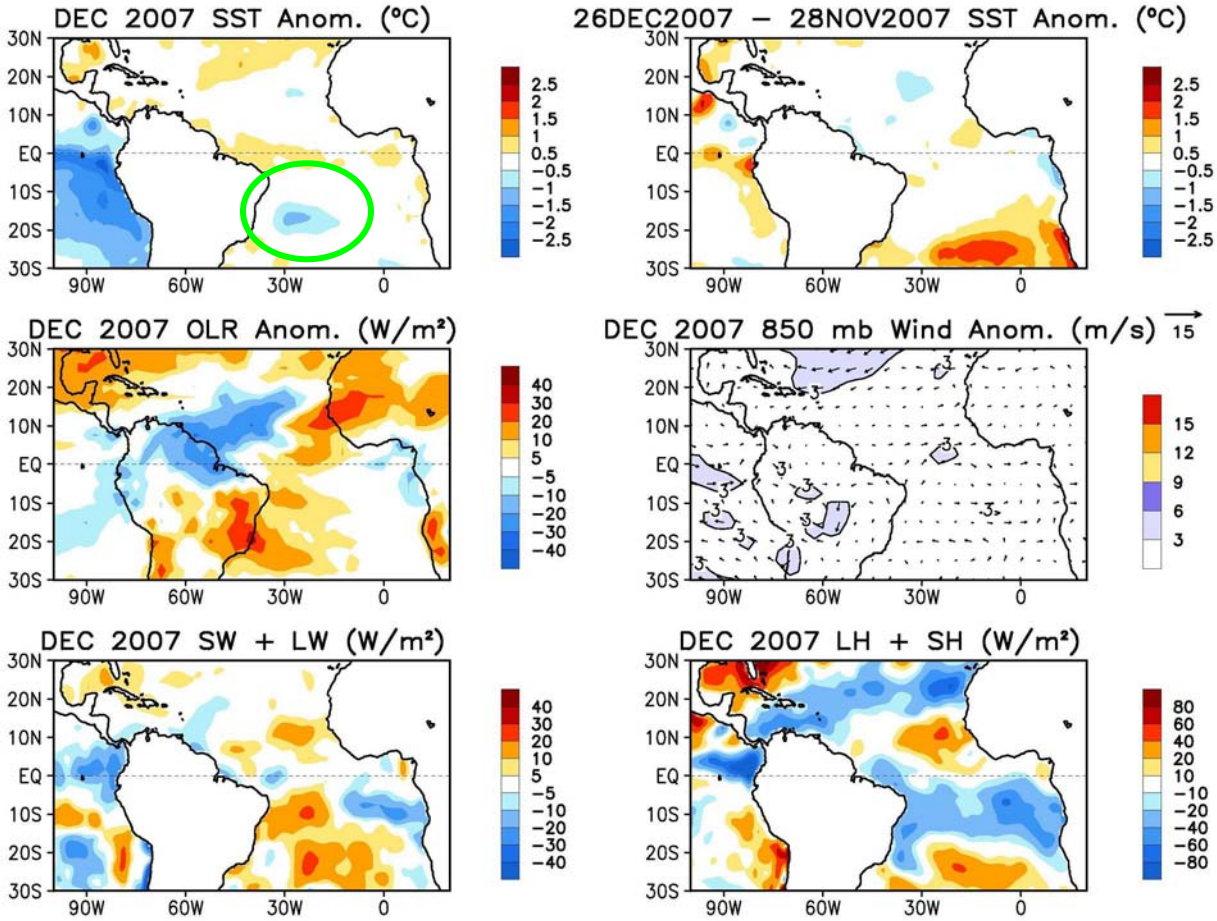
Recent Evolution of Tropical Atlantic SST Indices





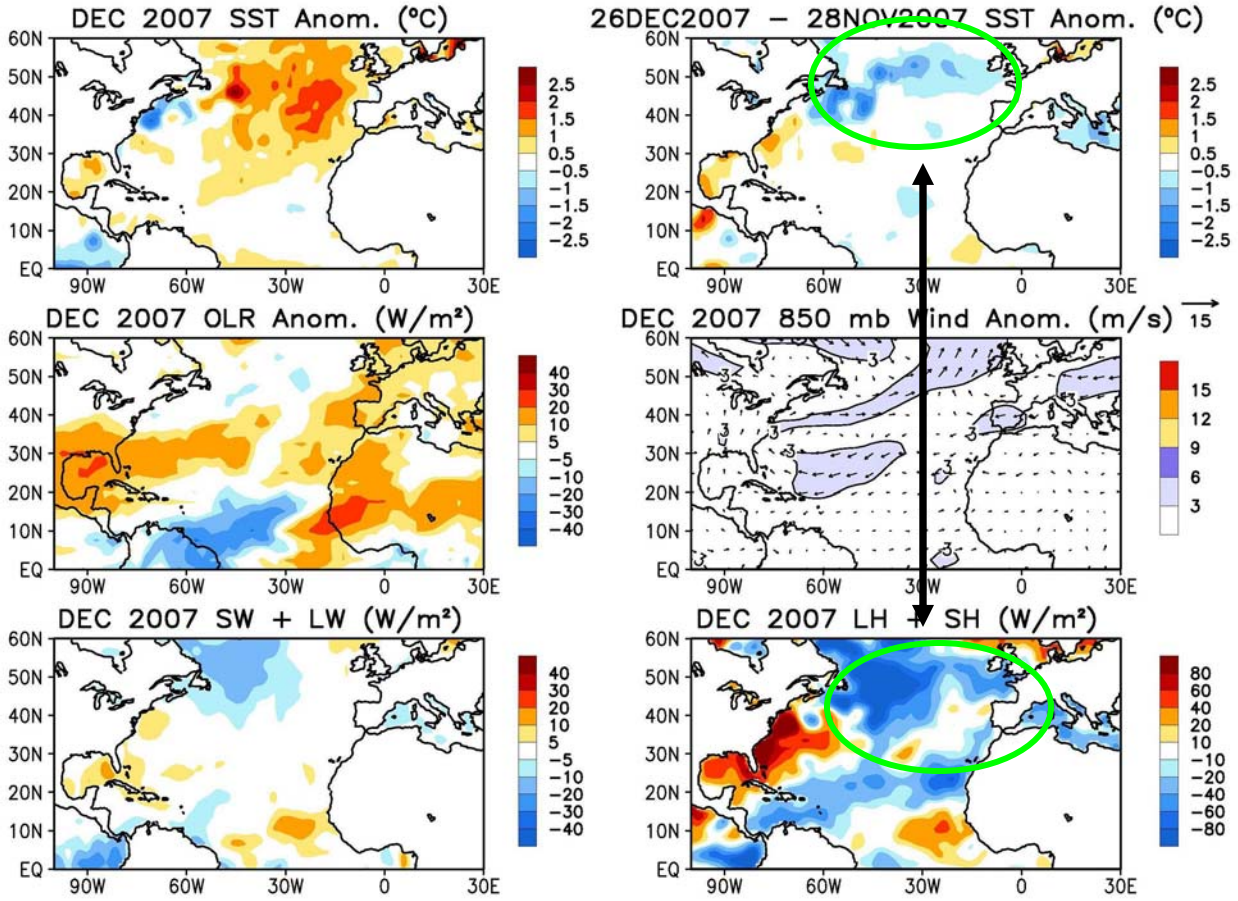
All indices are near normal in December 2007

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



- **SST near normal in tropical Atlantic**
- **Negative SSTA between 10S and 20S persisted**

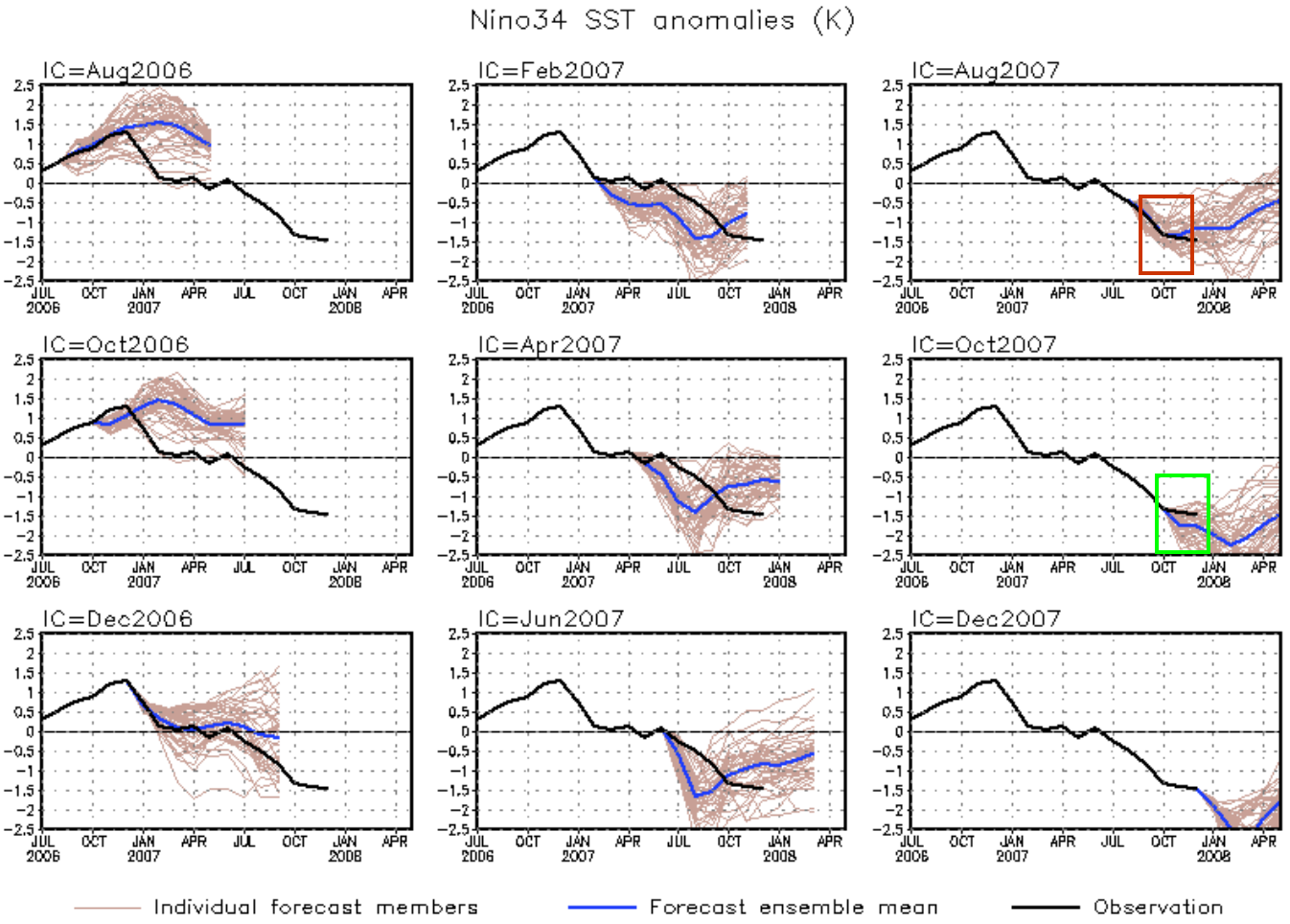
North Atlantic: SST Anom., SST Anom. Tend., OLR, 850-mb Winds, Sfc Rad, Sfc Flx



- **Large positive SST anomalies near 40N**
- **Negative surface heat flux anomalies contributed to SST cooling**

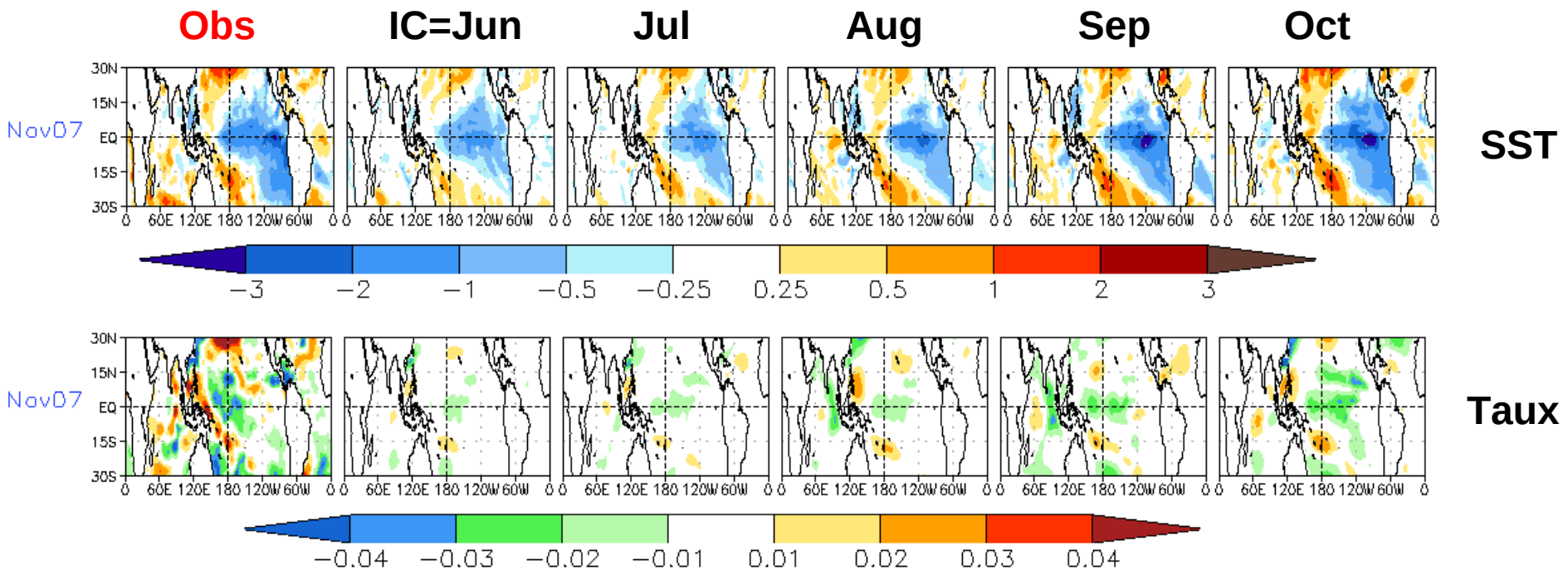
CFS SST Predictions and Ocean Initial Conditions

CFS Niño 3.4 SST Predictions from Different Lead Times



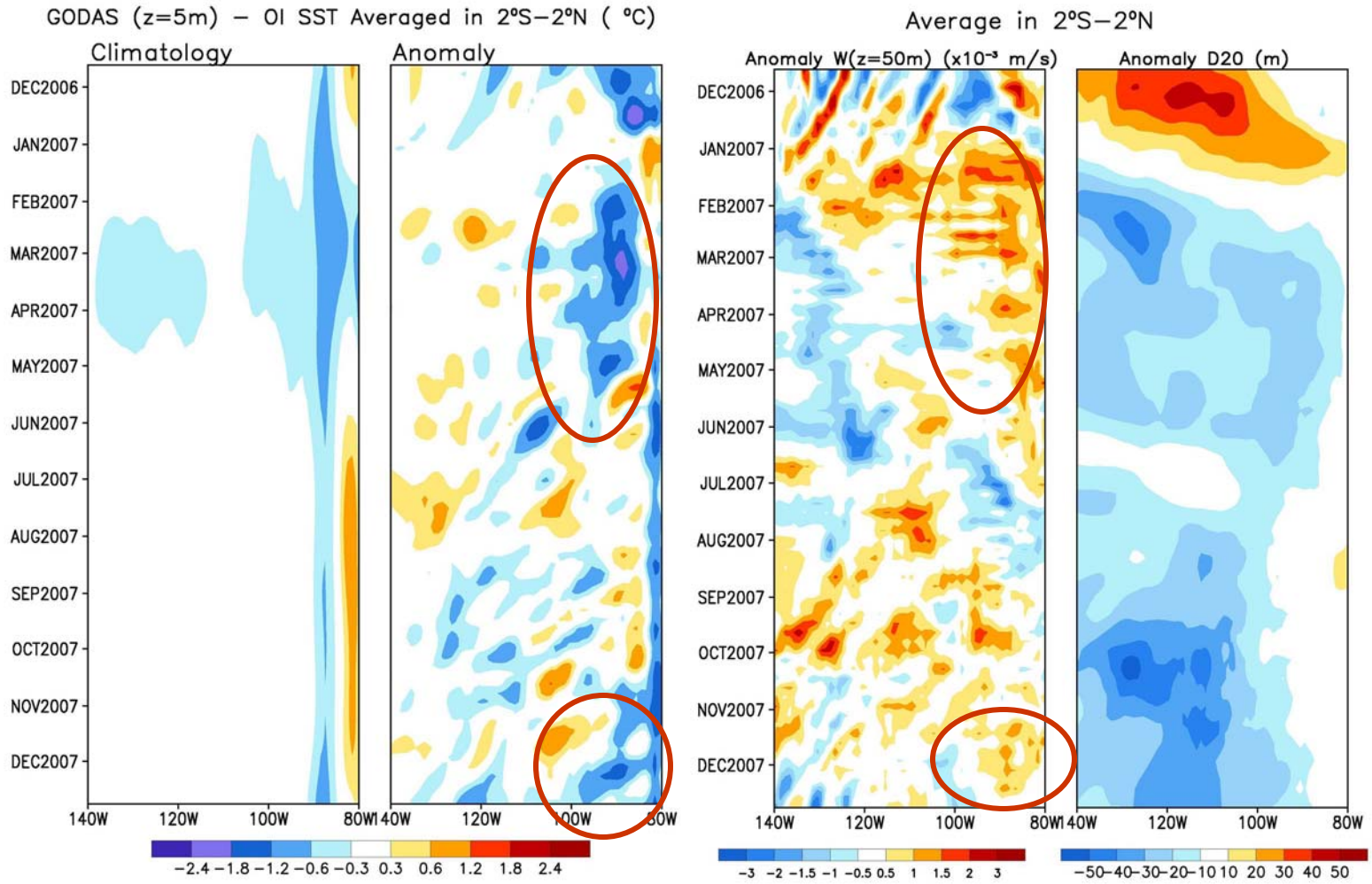
- **Earlier onset of cold SST anomalies in spring**
- **Reasonable SST forecast in August**
- **SST forecast biased towards cold since September**
- **What cause the CFS cold bias?**

CFS biases in SST and wind



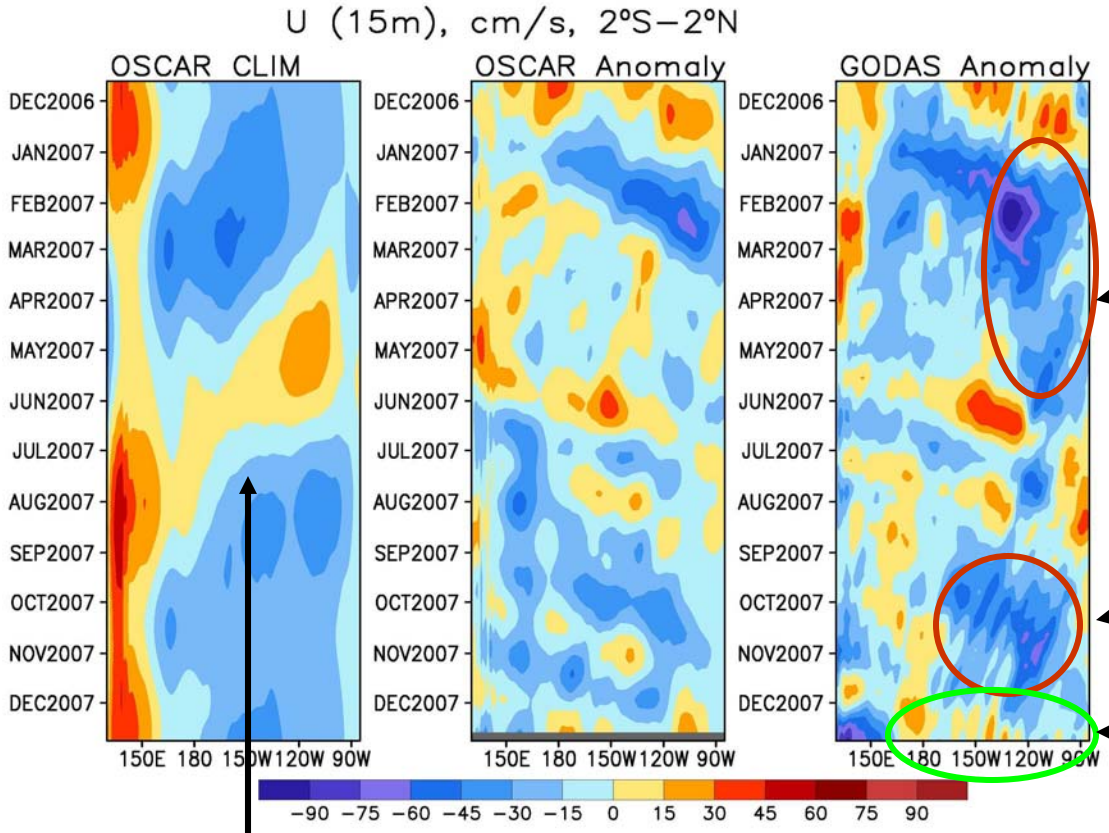
- CFS forecasts from different I.C. are validated in November
- SST forecasts from Sept and Oct I.C. biased cold in eastern Pacific
- Consistent with cold SST biases, easterly wind anomalies extended too far east

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



- **Large negative SST biases east of 100W in spring of 2007, and Nov-Dec 2007**
- **Likely related to anomalously strong upwelling at 50-meter depth**

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



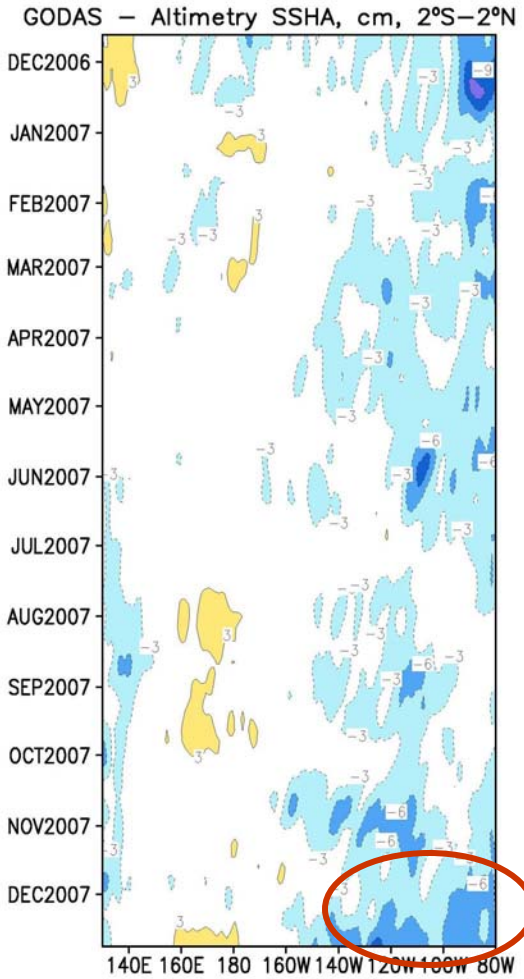
Too strong westward currents

Too strong westward currents

Eastward currents

Climatological surface currents are westward since July

Easterward current and westward wind anomaly may be caused by different climatological periods.



- **GODAS SSH anomalies have been consistently too low in the eastern Pacific since December 2006**

- **GODAS SSH anomalies are about 6cm lower than those Altimetry SSH in December 2007 east of 140W**

- **Negative subsurface temperature anomalies (-4C) in GODAS are probably too large, consistent with the differences between TAO and GODAS shown in slide 9.**

Summary

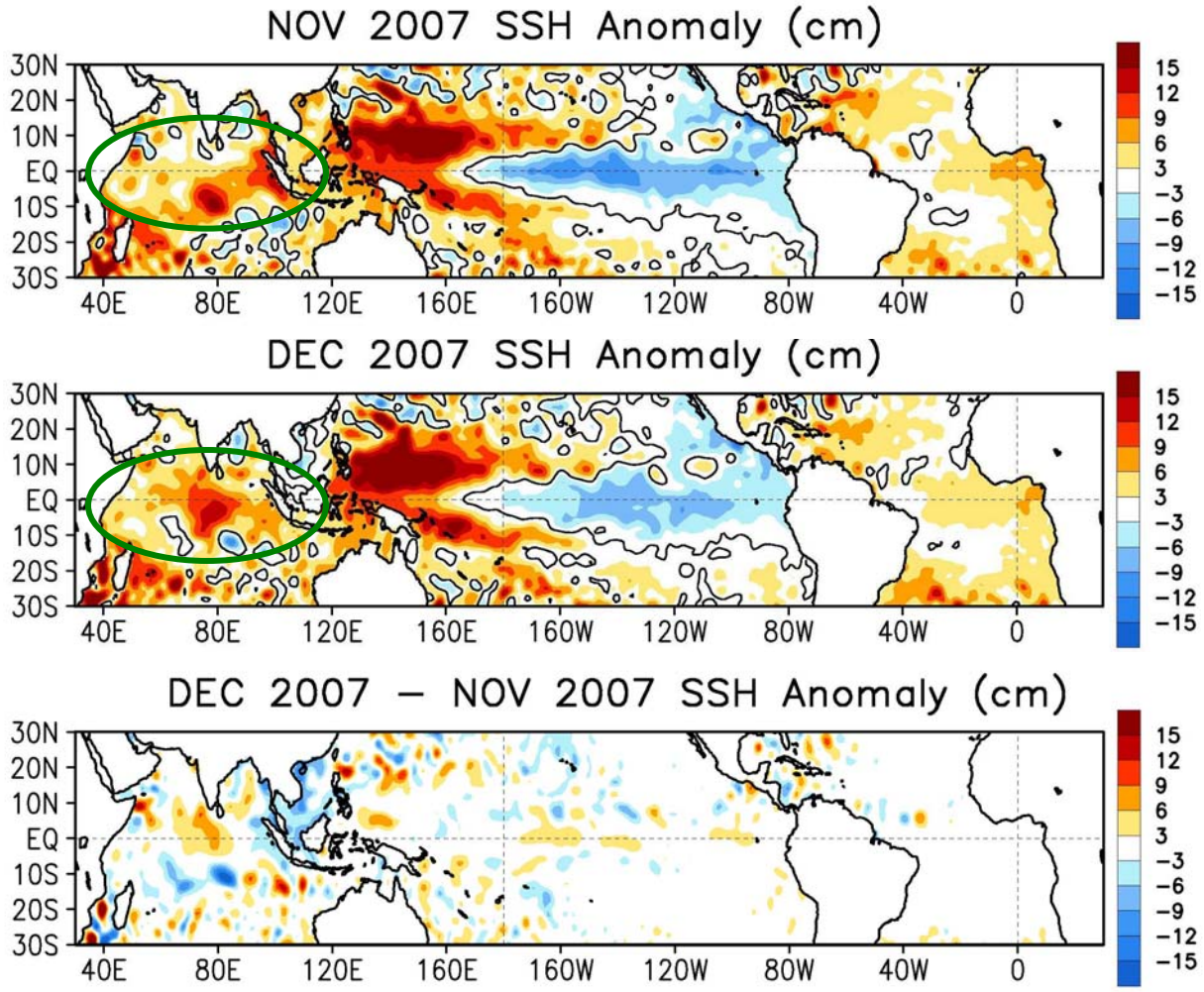
- **Pacific Ocean**
  - Moderate-strength La Niña (ONI SST < -1C) persisted from SON to OND
  - CPC's prognostic assessment: La Niña will continue into the Spring of 2008
  - Easterly wind anomaly and suppressed convection extended to the far western Pacific
  - Large intraseasonal variability in the extra-tropical North Pacific

- **Indian Ocean**
  - Near normal SST presented in the tropical Indian Ocean
  - IOD index near normal
  - Moderate-strength MJO progressed from Africa to Maritime Continent
  - Above normal convection related to MJO activities

- **Atlantic Ocean**
  - Near normal SST presented in the tropical Atlantic Ocean
  - Negative SST anomalies in south-western Atlantic persisted – forced by La Nina?
  - SST anomalies in the extra-tropical North Atlantic weakened

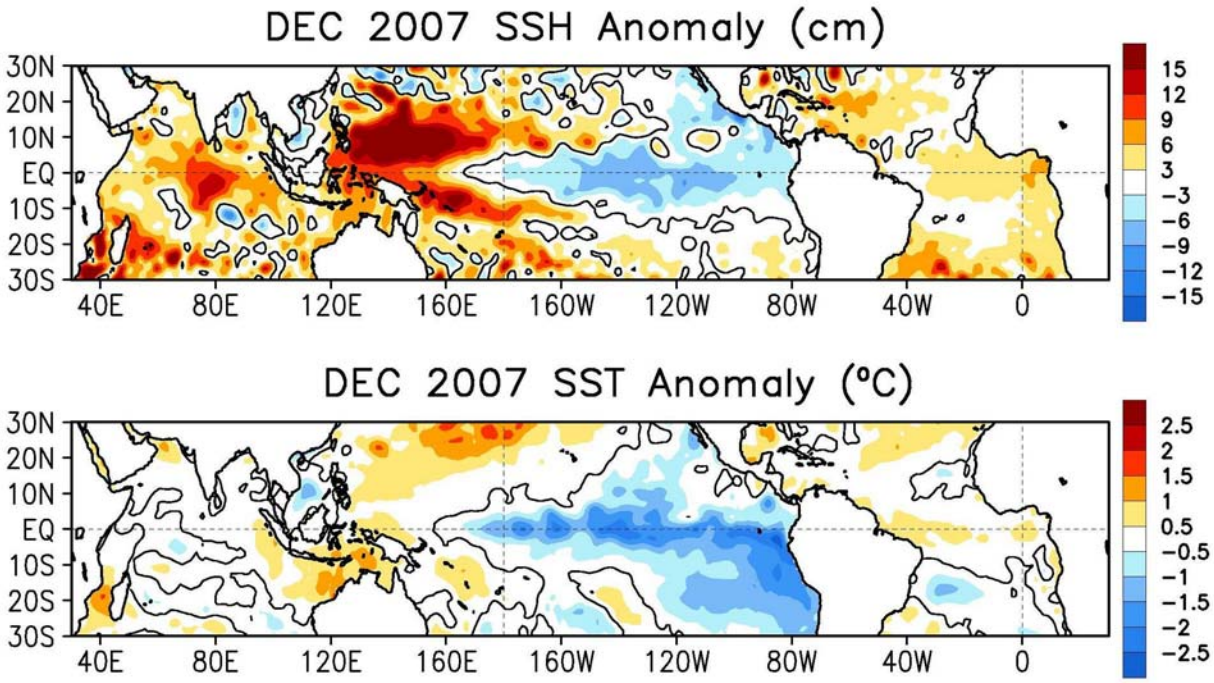
Backup Slides

Global SSH Anomaly and Anomaly Tendency



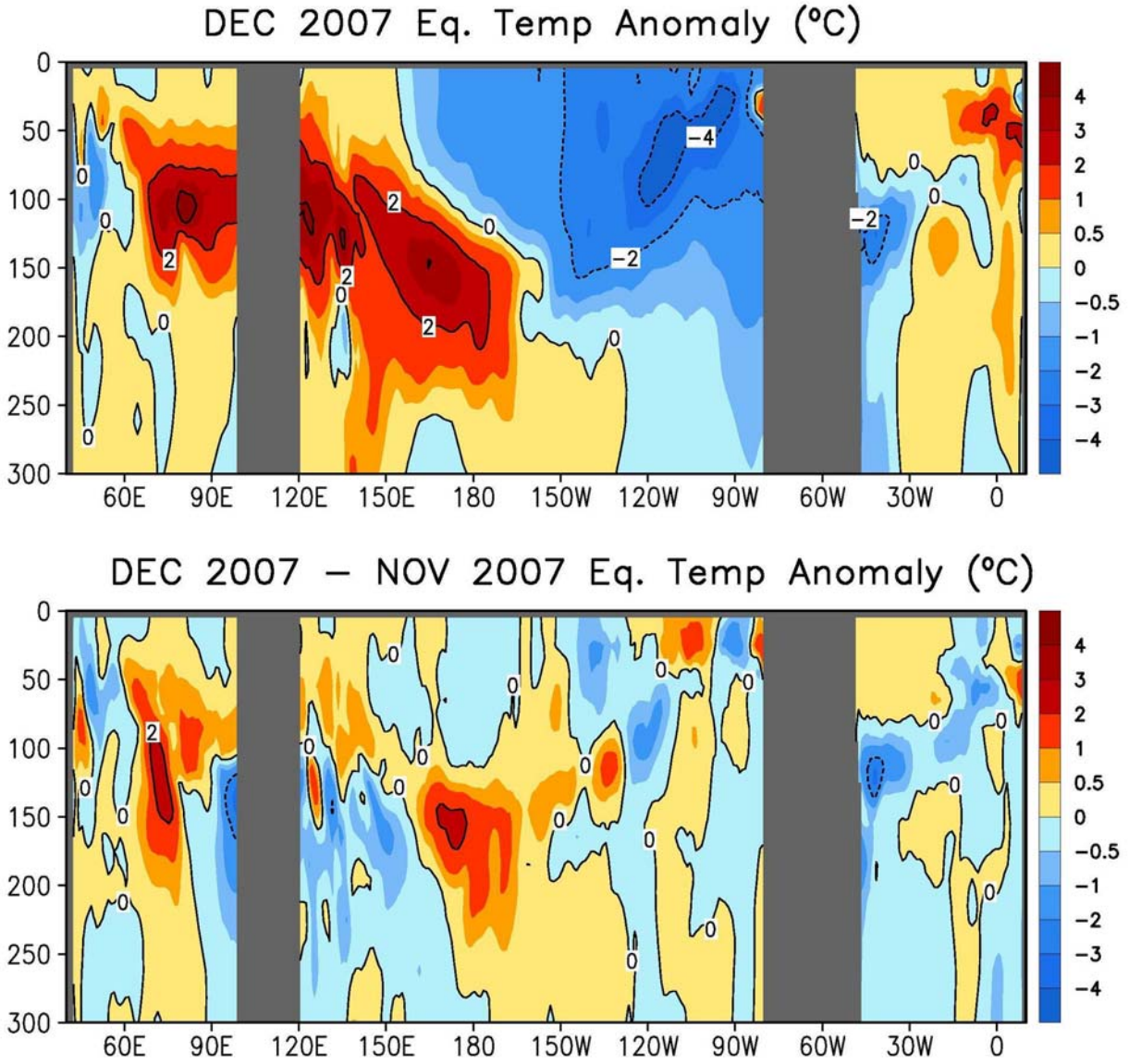
- **SSHA weakened in the far eastern tropical Indian Ocean in December due to MJO-related westerly wind anomalies**

SSH Anomaly (cm) v.s. SST Anomaly (^{0}C)

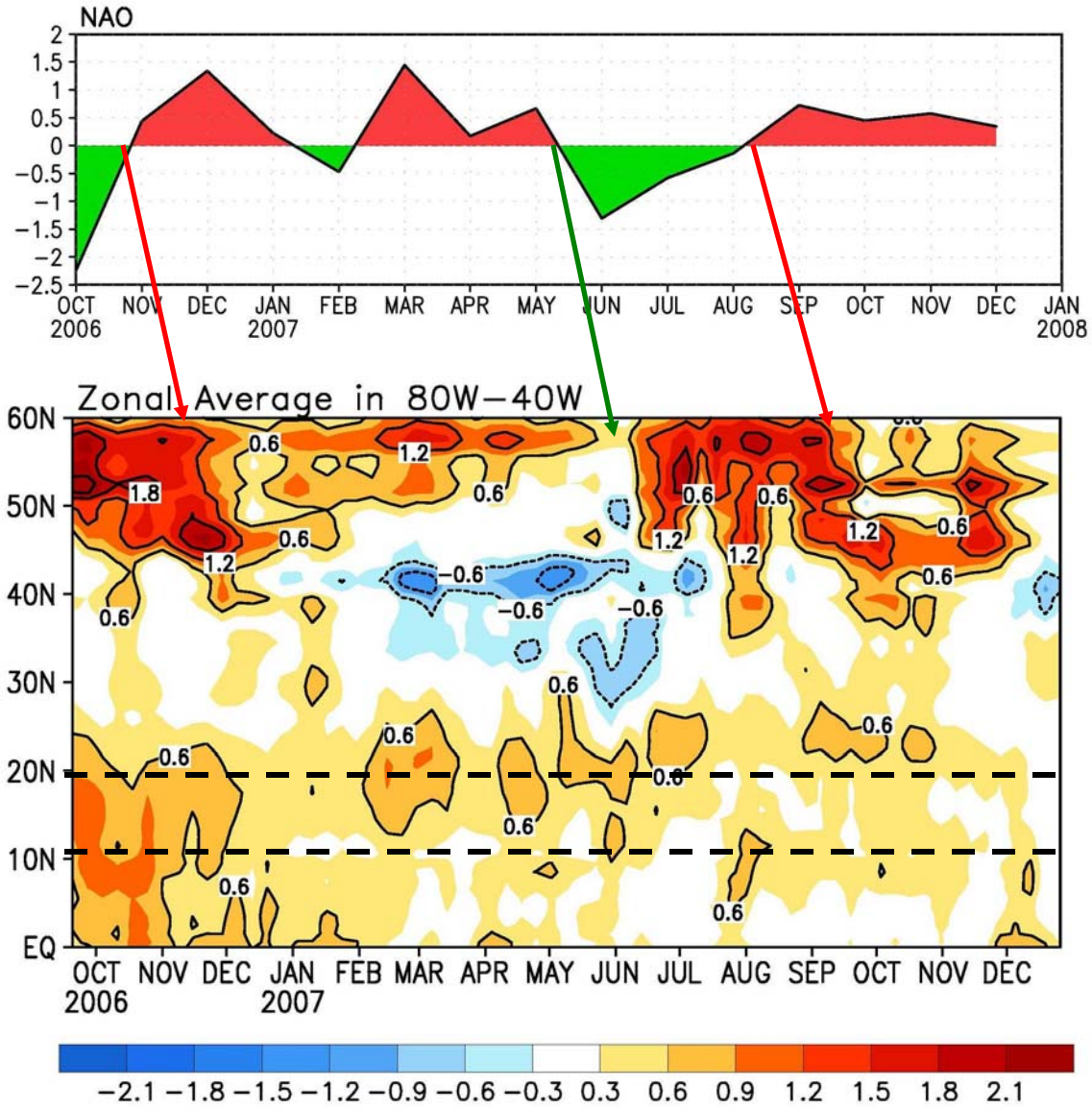


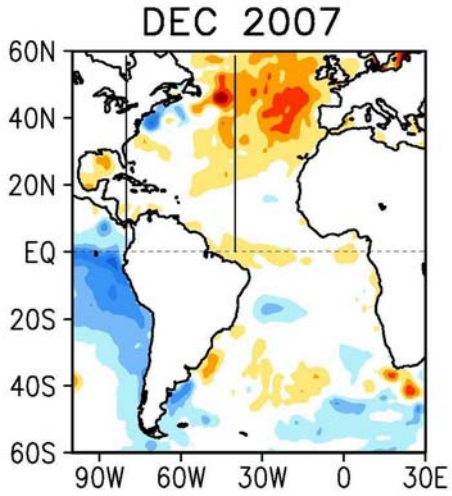
- **Good consistency between SSH and SST in the equatorial latitudes**

GODAS Equatorial X-Z Temperature



Attribution of SST Anomaly in Northwest Atlantic





- NAO index has been positive since August