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

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Climate Prediction Center, NCEP

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

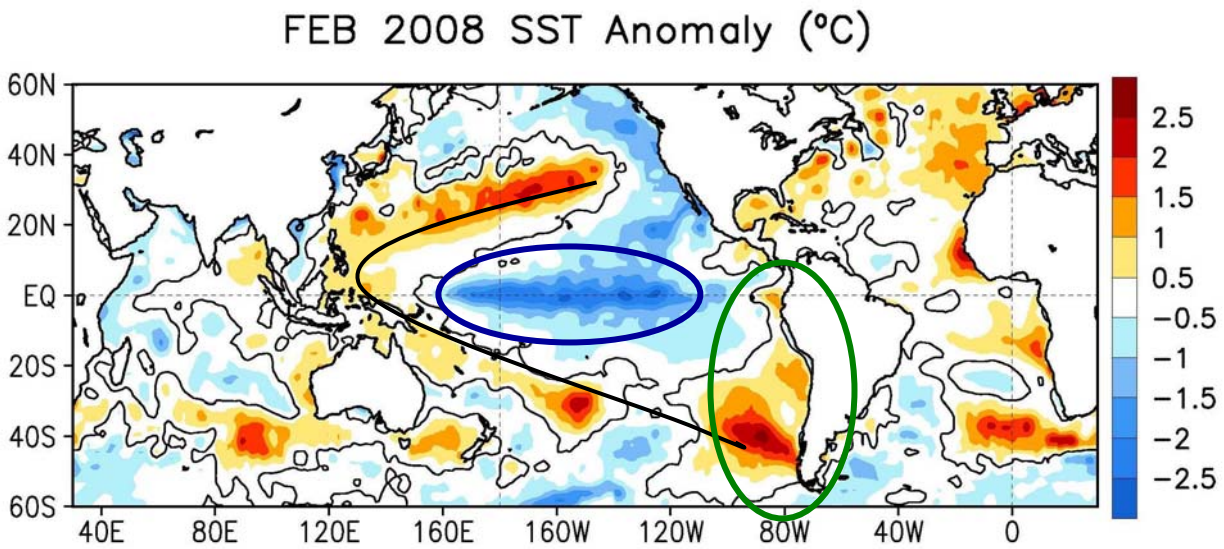
Outline

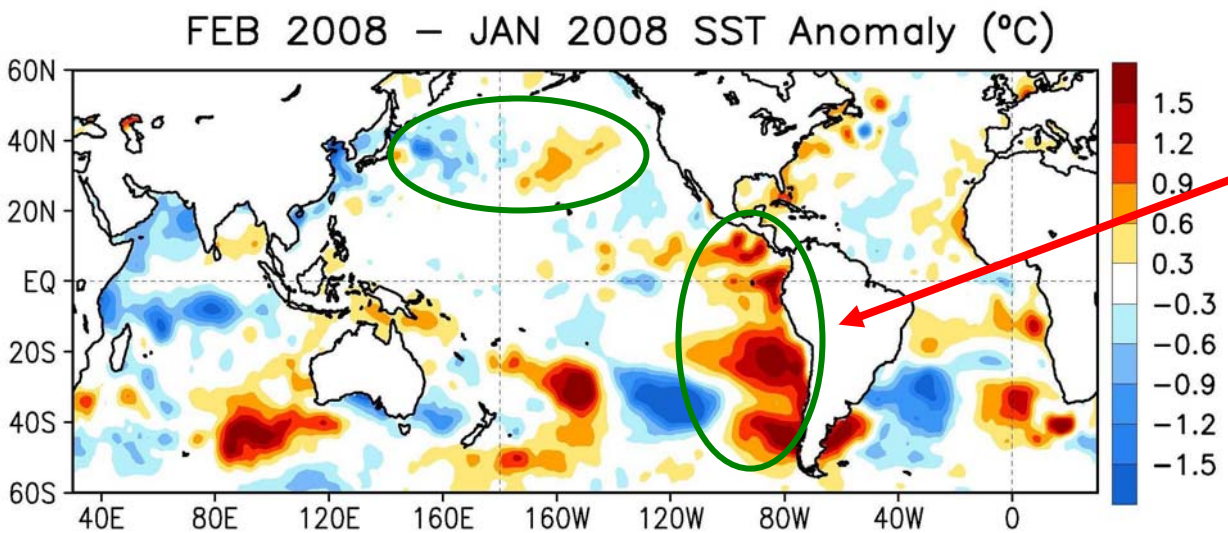
- Overview
- Recent highlights
  - Pacific Ocean
  - Indian Ocean
  - Atlantic Ocean
- GODAS and CFS SST Predictions

Overview

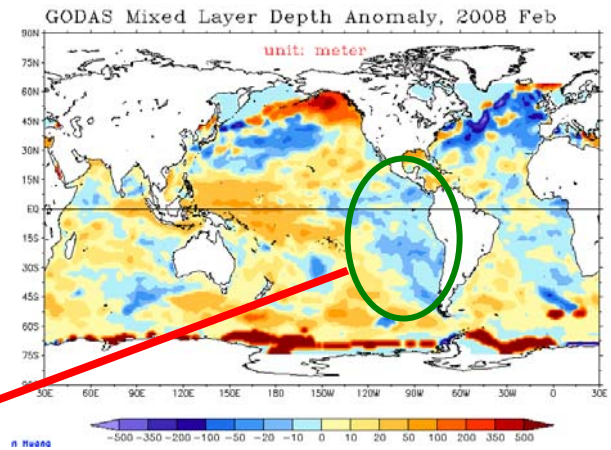
- **Pacific Ocean**
  - Moderate La Niña persisted from SON, and enhanced in DJF (ONI SST < -1.5C)
  - CPC's prognostic assessment: La Niña will continue into the Spring of 2008
  - Easterly wind anomaly and suppressed convection in central and western Pacific
  - Westerly wind anomaly in eastern Pacific and NINO 1.2 index changed into positive
  - SST and wind anomalies persisted in the extra-tropical North Pacific
- **Indian Ocean**
  - Near normal SST in the tropical Indian Ocean
  - Above normal convection related to MJO activities
- **Atlantic Ocean**
  - Positive SSTA along cost of African near 10N and 15S
  - SST anomalies persisted in the extra-tropical North Atlantic

Global SST Anomaly (ºC) and Anomaly Tendency





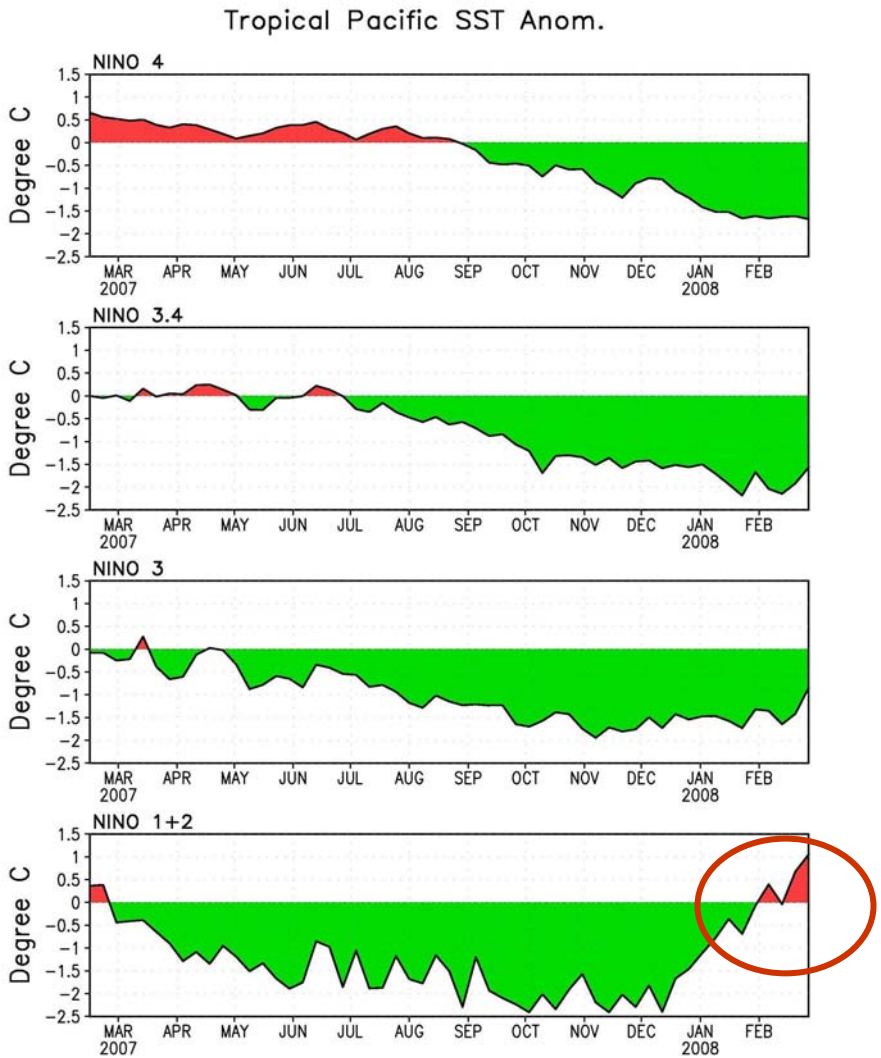
- **Negative SSTA east of 160E-- a canonical horseshoe pattern in the Pacific**
- **Positive SSTA in Pacific and Atlantic near the western coasts of South America and Africa.**
- **Near normal SST in Indian Ocean**
- **Strong positive SSTA in Southern Oceans.**

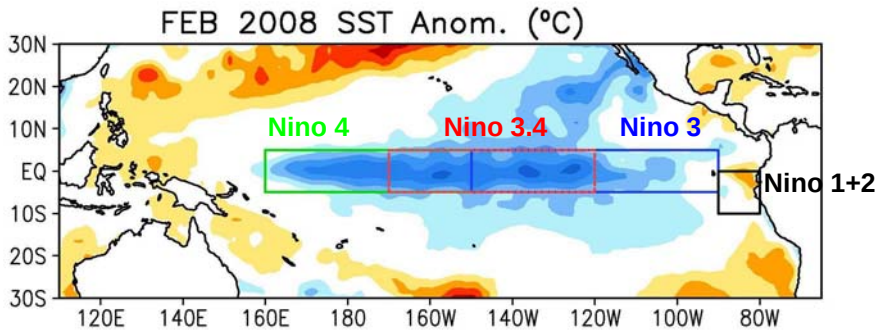


- **Negative SSTA weakened east of 120W and along the coast of South America**
- **SSTA in NH extra-tropics weakened in Pacific and maintained in Atlantic**
- **SST in Indian Ocean cooled**

Pacific Ocean

Recent Evolution of Pacific NINO SST Indices





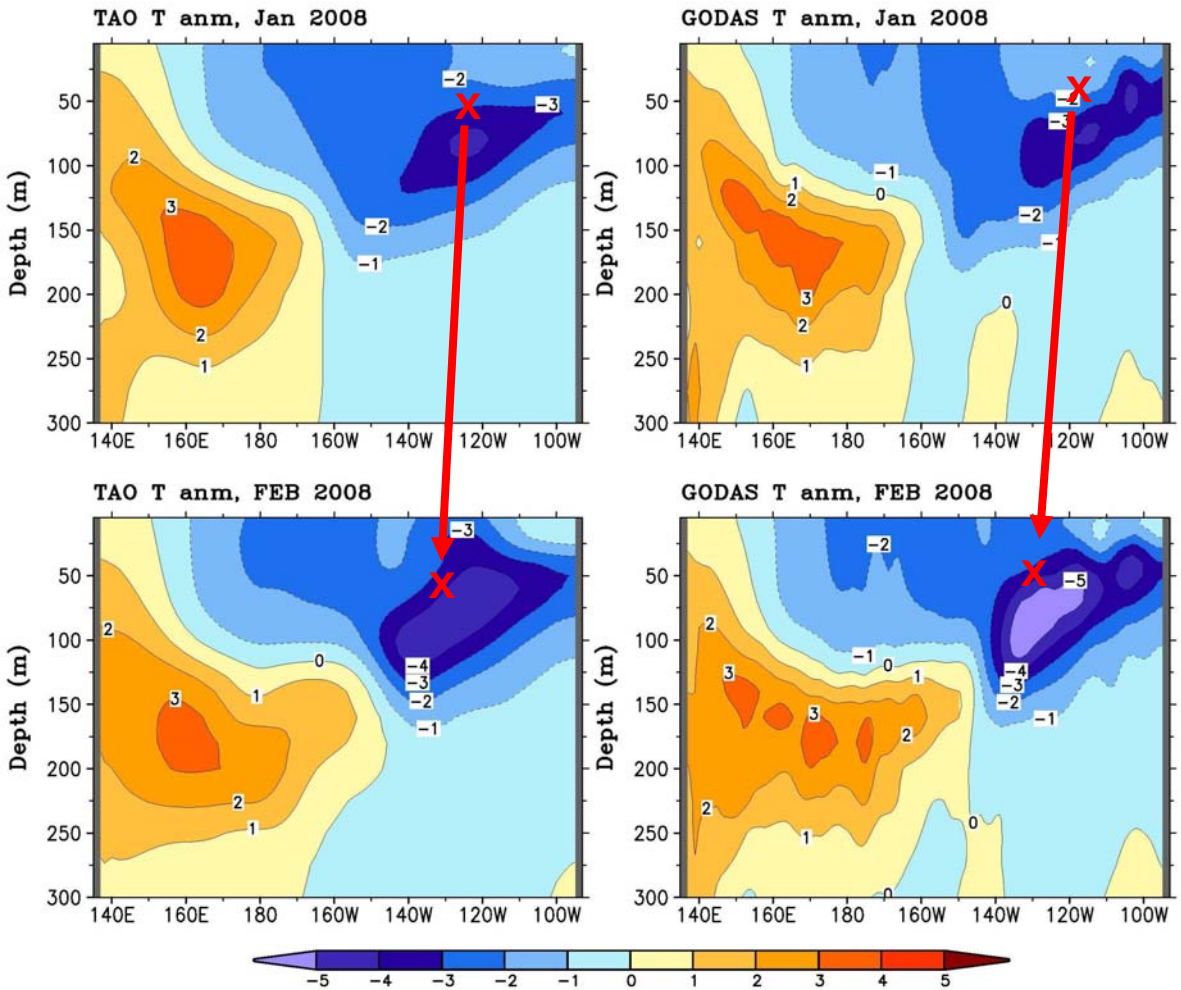
- **NINO 4 and 3.4 persisted.**
- **NINO 3 weakened.**
- **NINON 1+2 changed sign.**
- **CPC's ENSO Prognostic Statement: DJF ONI enhanced to -1.5C, and La Nina will continue into the spring of 2008.**

Depth-Longitude Section of Temperature Anomaly

TAO (2S-2N) GODAS (2S-2N)

January

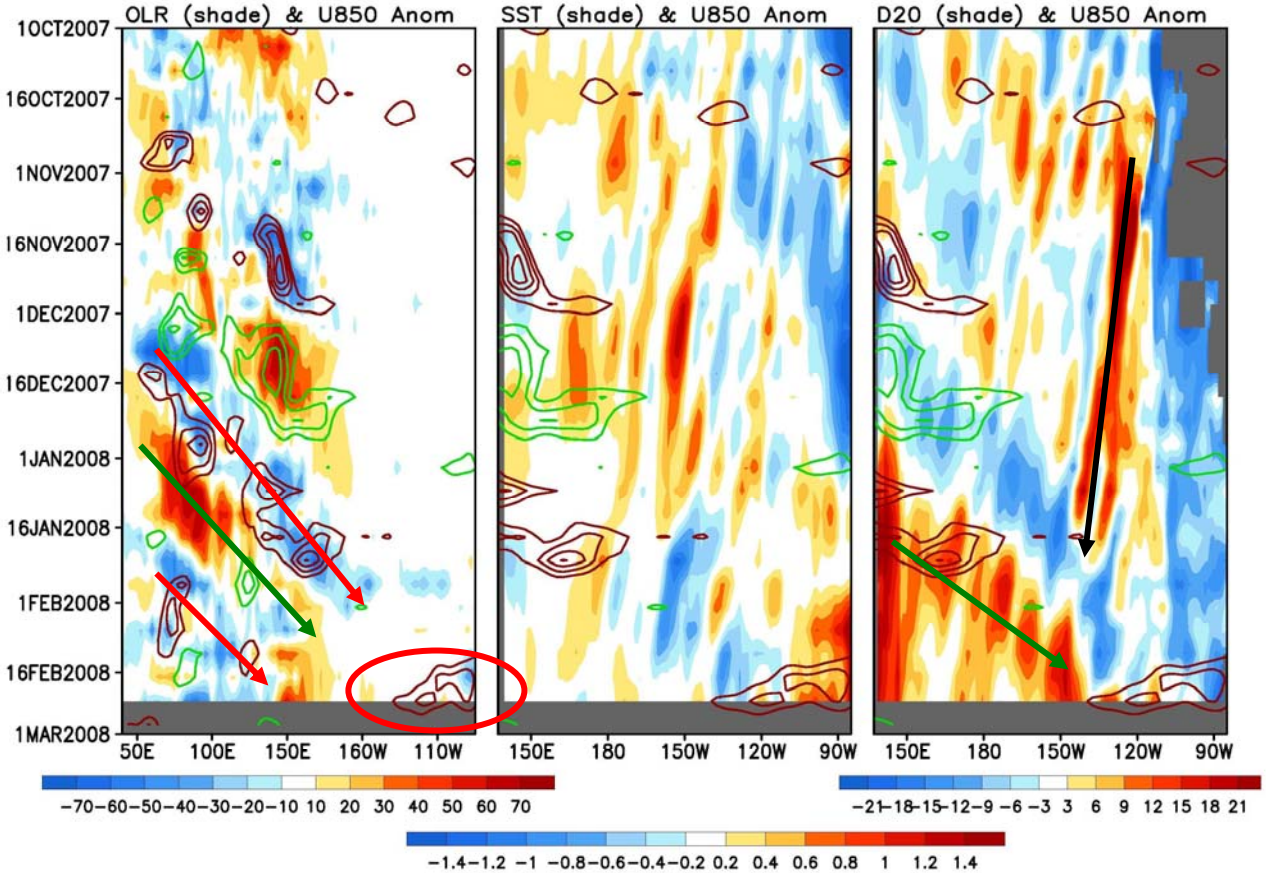
February



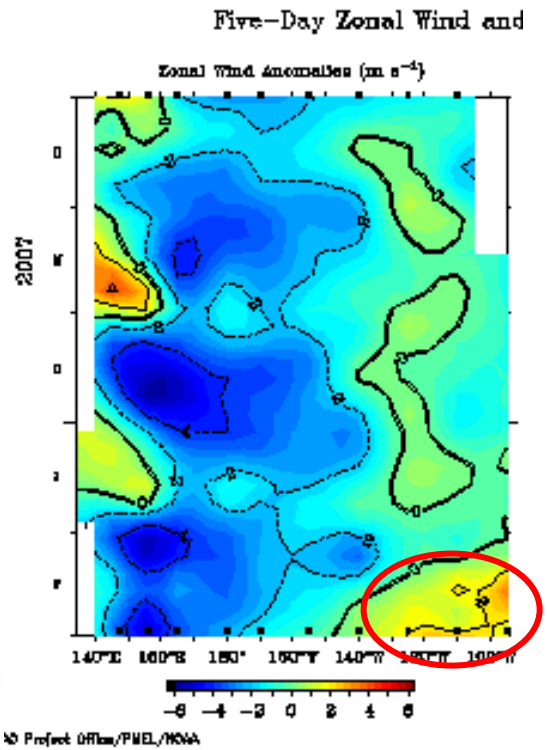
- East-west dipole pattern of temperature anomalies featuring La Nina conditions maintained
- Positively temperature anomaly in thermocline moved eastward, and stronger in GODAS than in TAO
- Negative temperature anomalies in thermocline moved westward, and stronger in GODAS than in TAO

Evolution of Equatorial Pacific OLR, SST (°C), 850-mb Zonal Wind (m/s), and depth of 20C

2S-2N, 25 pentad running mean removed



TAO winds



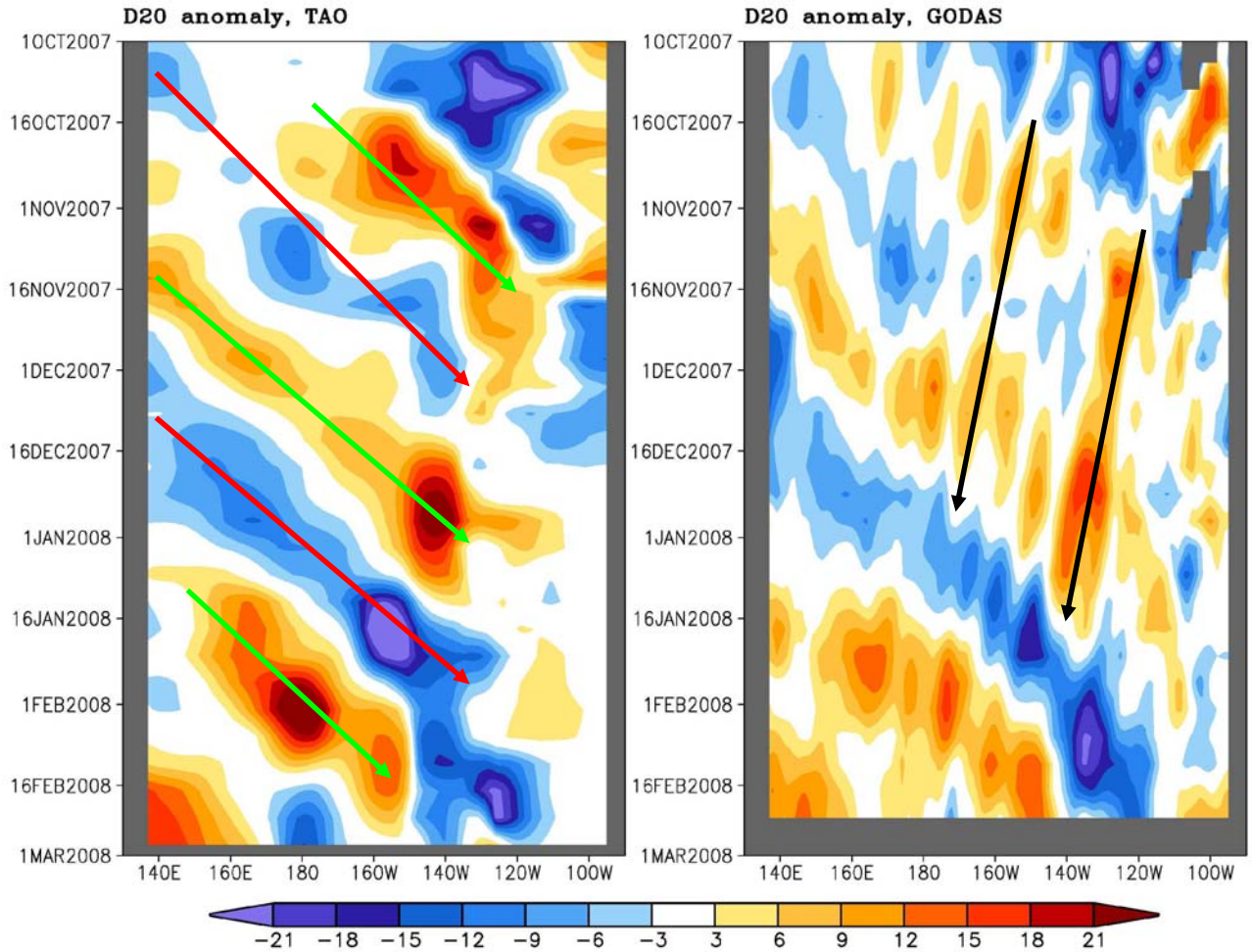
- CPC's MJO prognostic statement: Moderate MJO activity presented since late October
- In February, MJO weakened and confined in the Indian Ocean and maritime continent
- Westerly wind anomaly east of 150W, consistent with positive NINO 1.2 index

Recent Evolution of 20C Isotherm

(25 pentad running mean removed)

TAO (2S-2N)

GODAS (2S-2N)

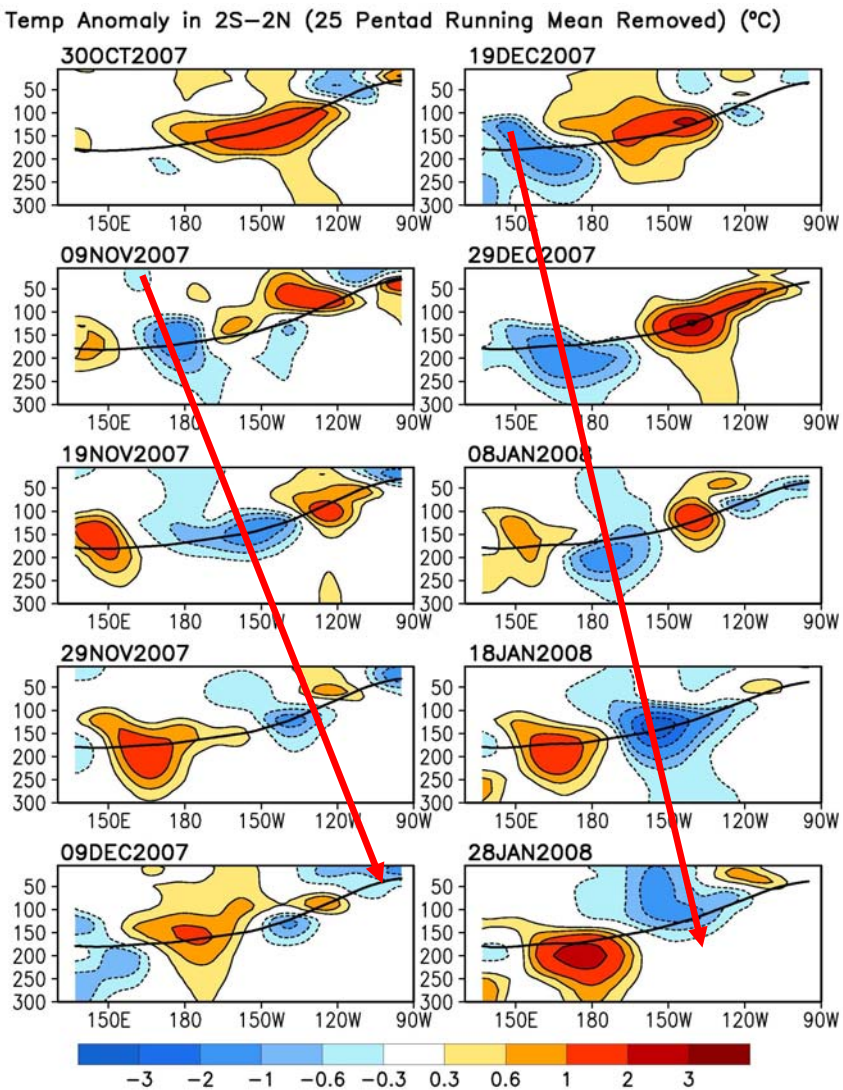


- Kelvin wave activities were stronger in TAO than in GODAS
- Tropical instability wave (TIW) activities were clear in GODAS but less clear in TAO

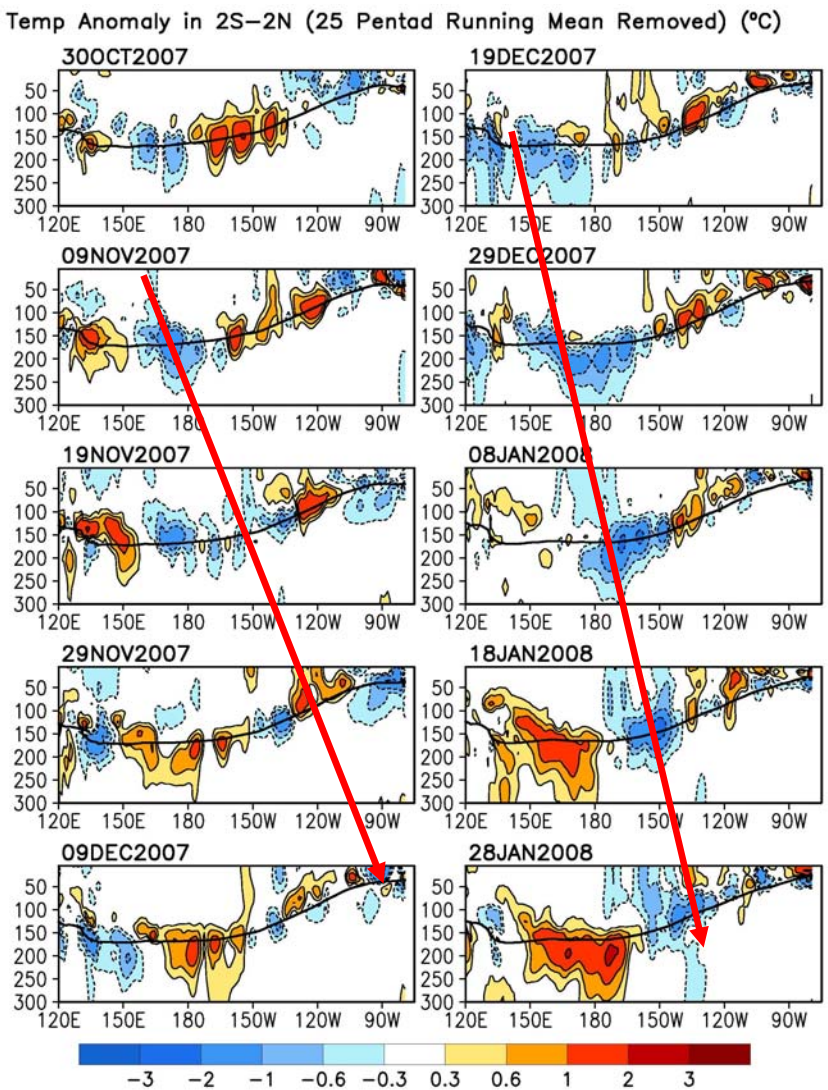
Recent Evolution of Tropical Temperature

(2S-2N, 25 pentad running mean removed)

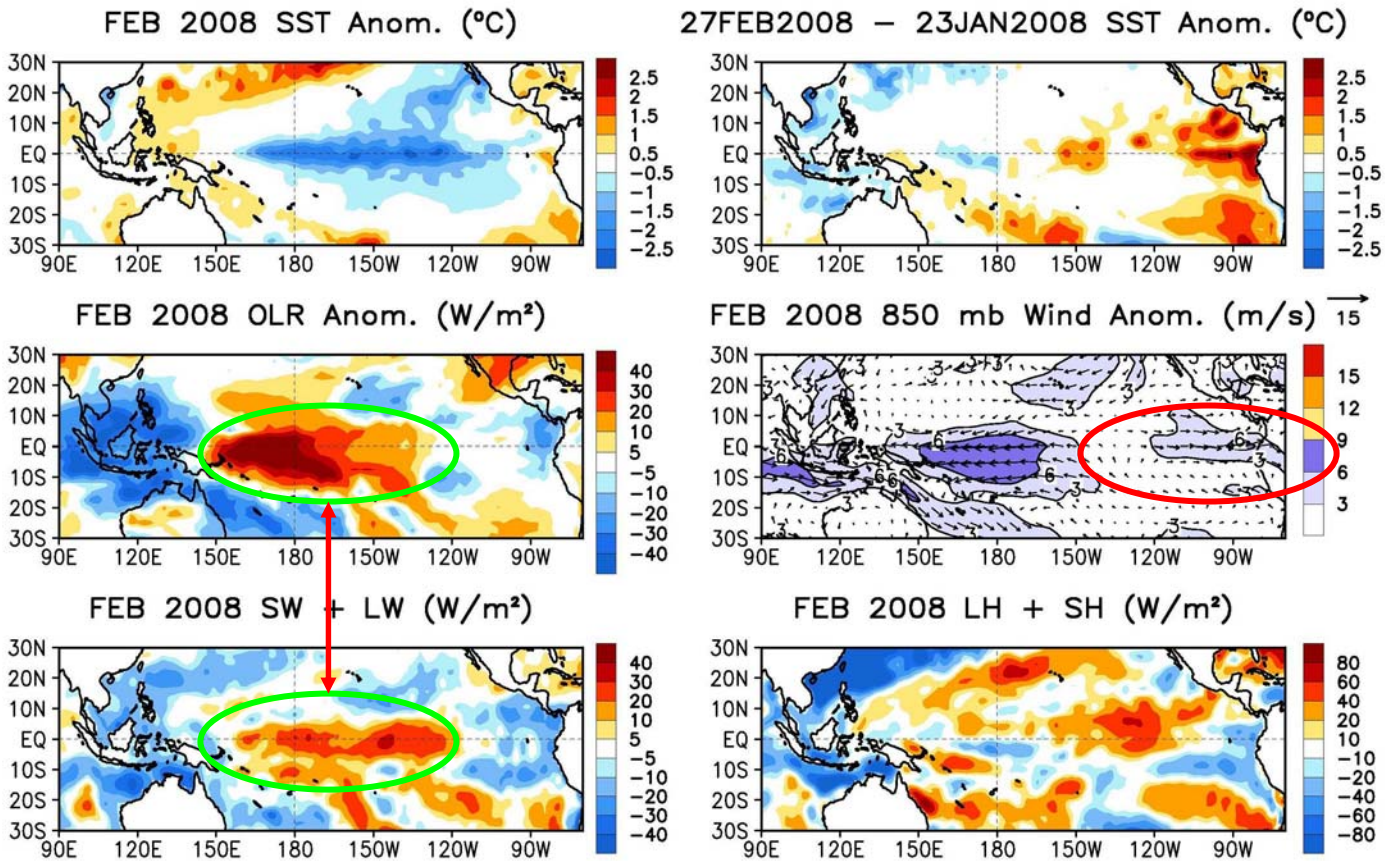
TAO



GODAS

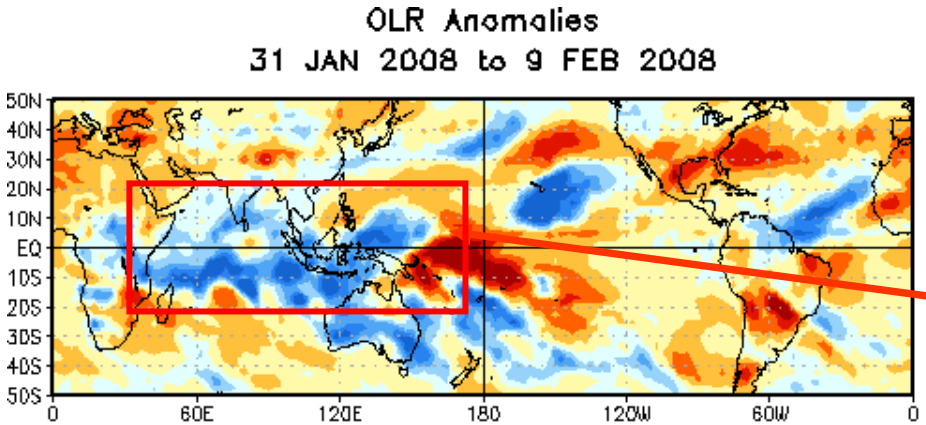


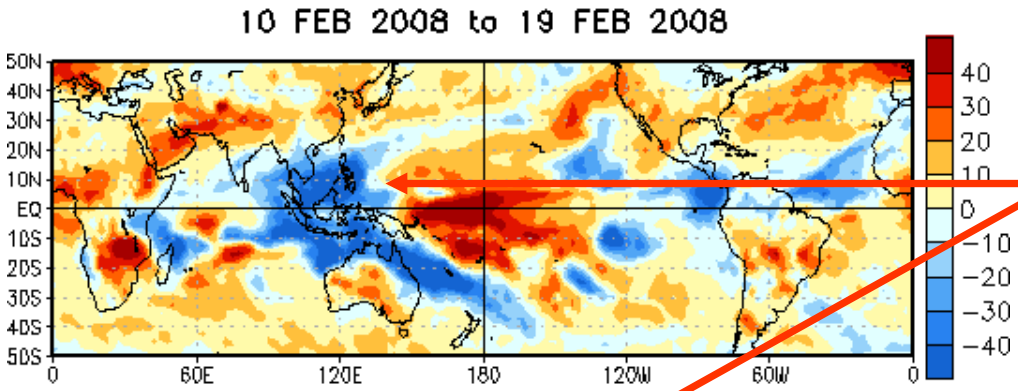
Tropical Pacific: SST Anom., SST Anom. Tend., OLR, 850-mb Winds, Sfc Rad, Sfc Flx

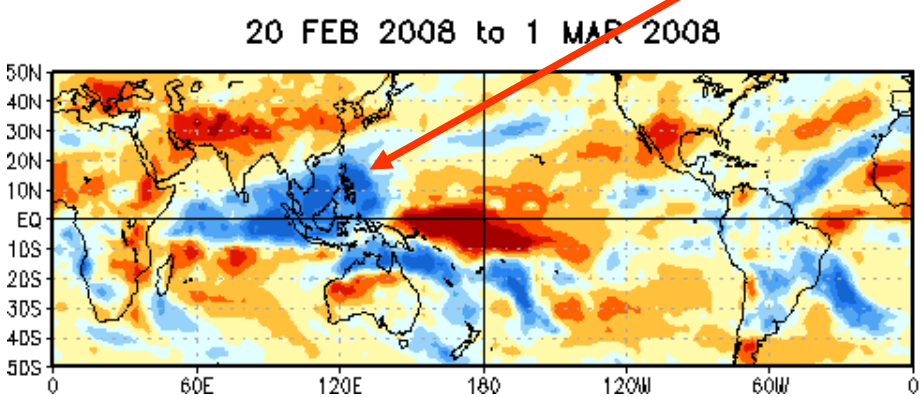


- **Enhanced convection in the Maritime Continent, weakened convection in western and central Pacific**
- **Easterly wind anomalies maintained in the western Pacific**
- **Westerly wind anomaly enhanced east of 140W**

OLR Anomalies: Last 30 days







Drier-than-normal conditions, positive OLR anomalies (red shading)

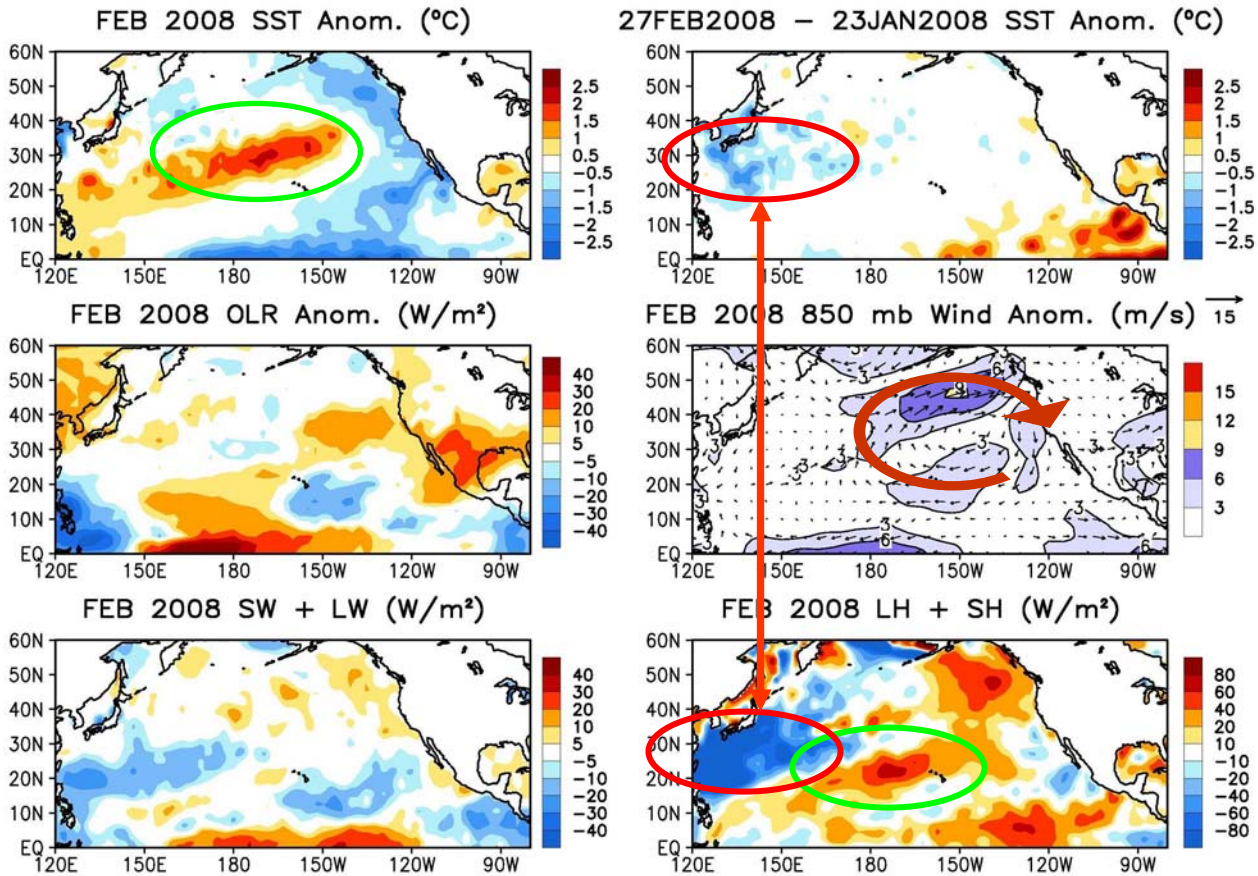
Wetter-than-normal conditions, negative OLR anomalies (blue shading)

Wet conditions were observed across the Indian Ocean and Indonesia.

As the MJO propagated eastwards, enhanced rainfall once again developed across Indonesia and northern Australia by mid-February. Dry conditions persisted across the central Pacific.

From CPC ENSO webpage

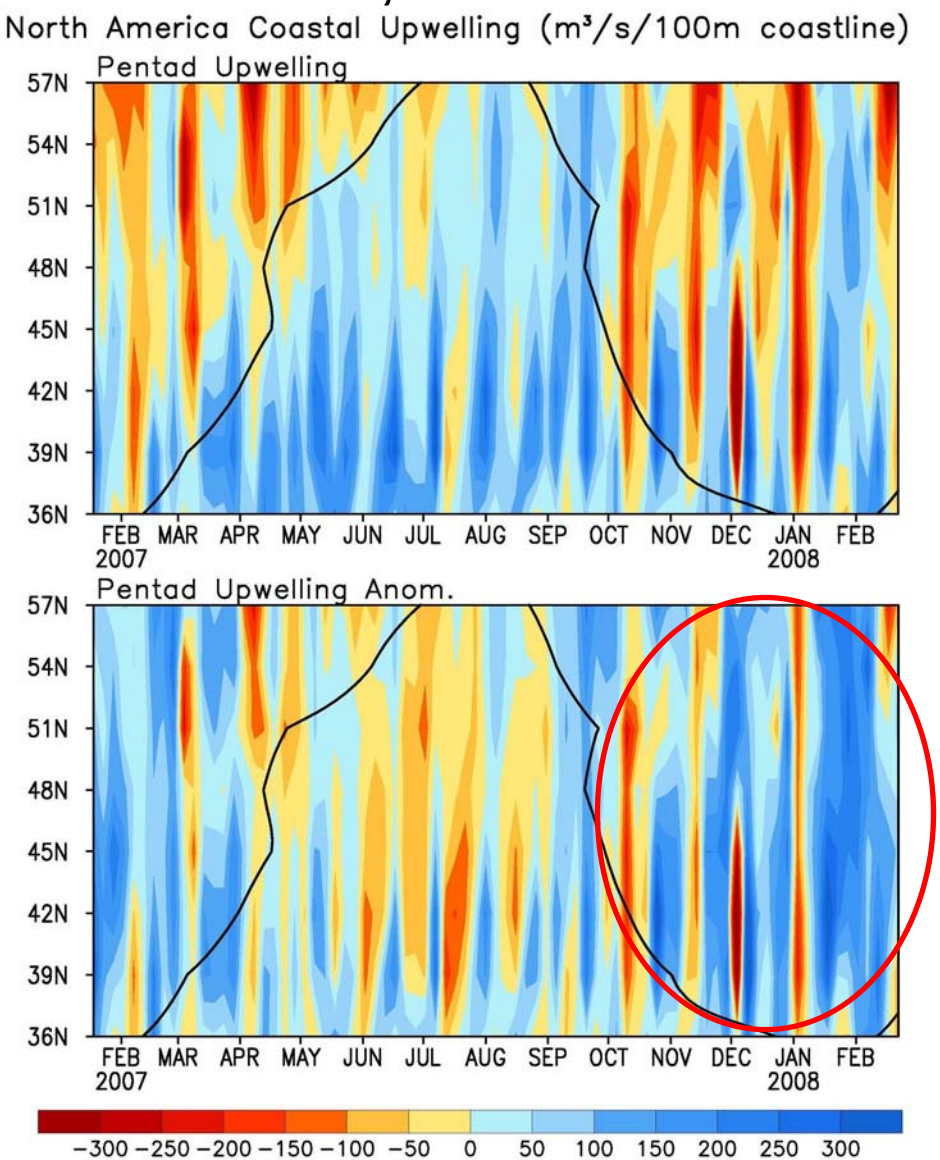
North Pacific: SST Anom., SST Anom. Tend., OLR, 850-mb Winds, Sfc Rad, Sfc Flx

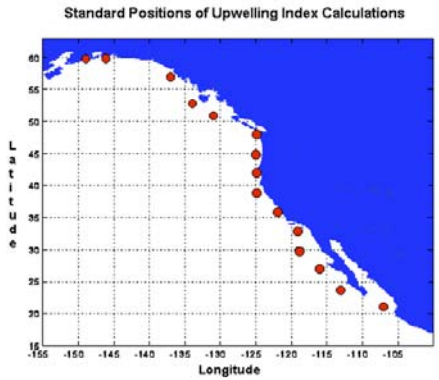


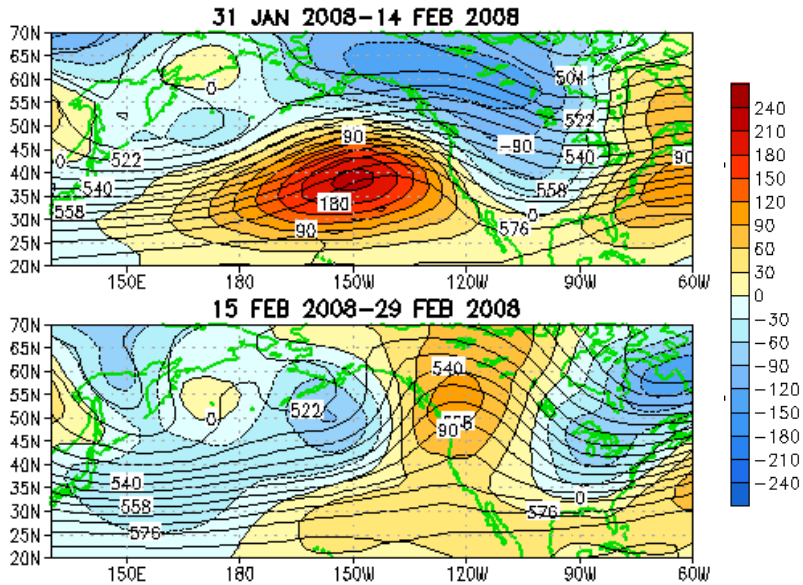
- **Cooling near western coast of North America and warming in central North Pacific weaker than those in January.**
- **Ekman transport / pumping and surface latent heat flux were likely the main external forcing**

North America Western Coastal Upwelling

CPC, NCEP





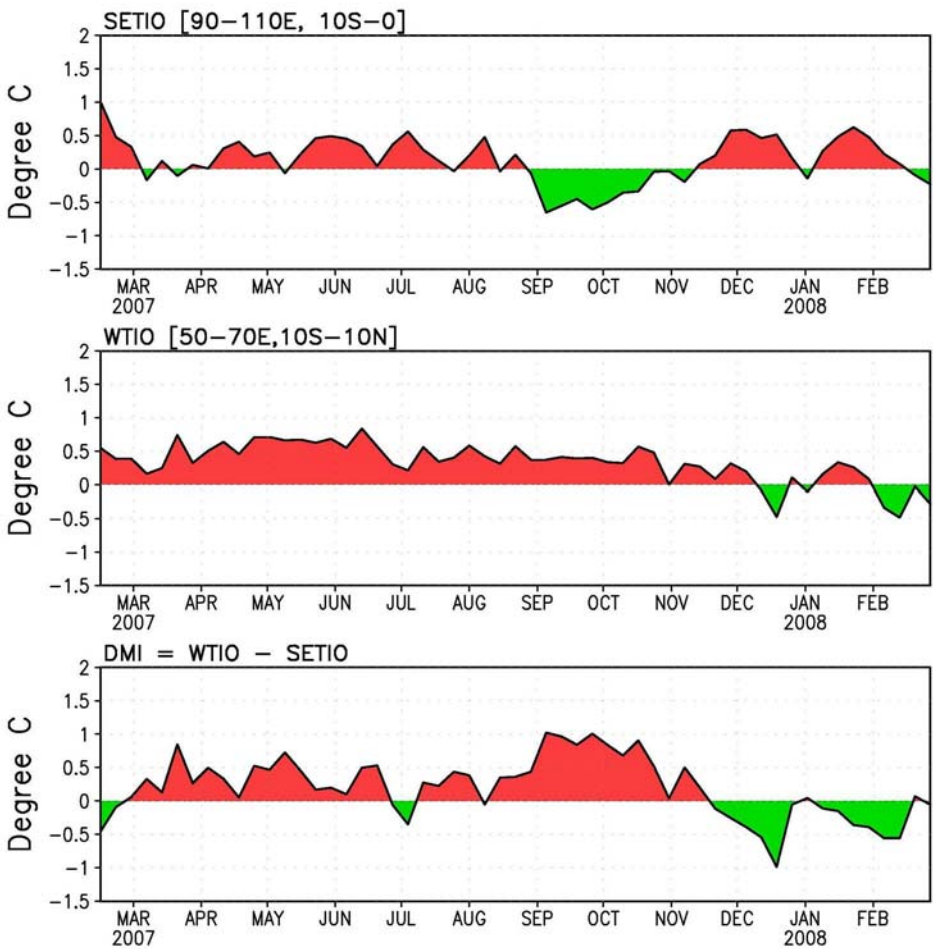


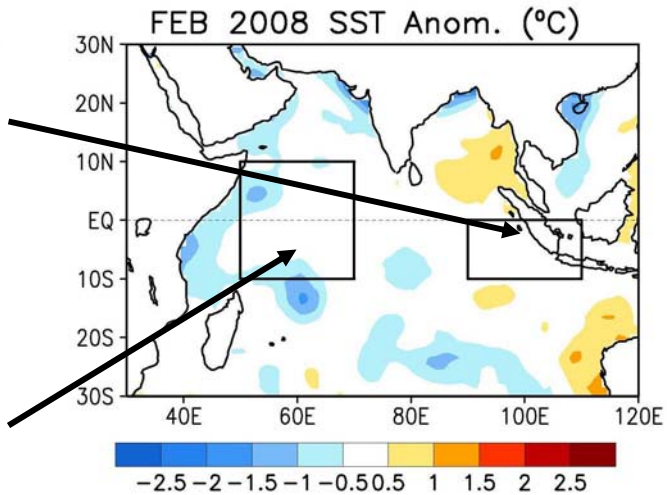
- **Downwelling prevails since October, but with intermittent upwelling**
- **Upwelling is abnormally strong since September with large intraseasonal variability**
- **Strong blocking in earlier February consistent with above normal upwelling**

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

Indian Ocean

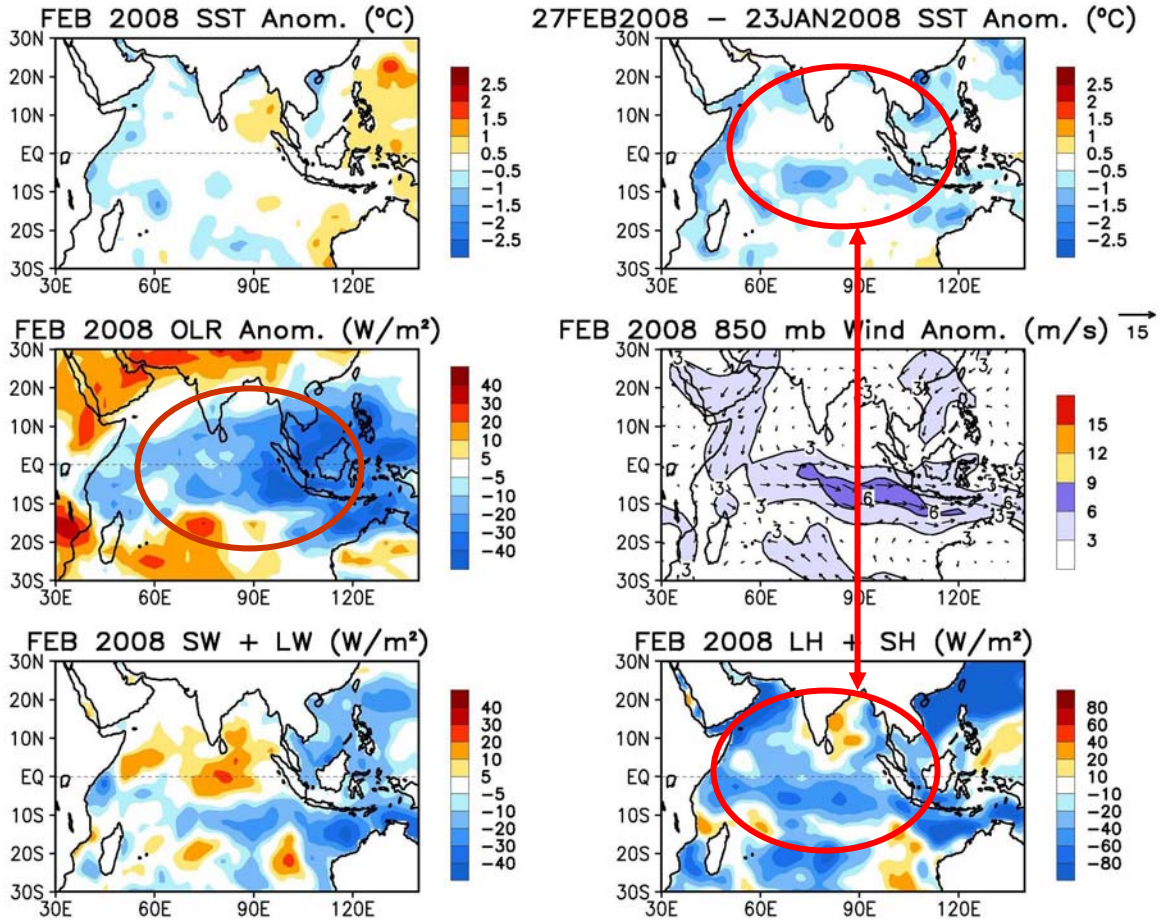
Recent Evolution of Indian Ocean SST Indices





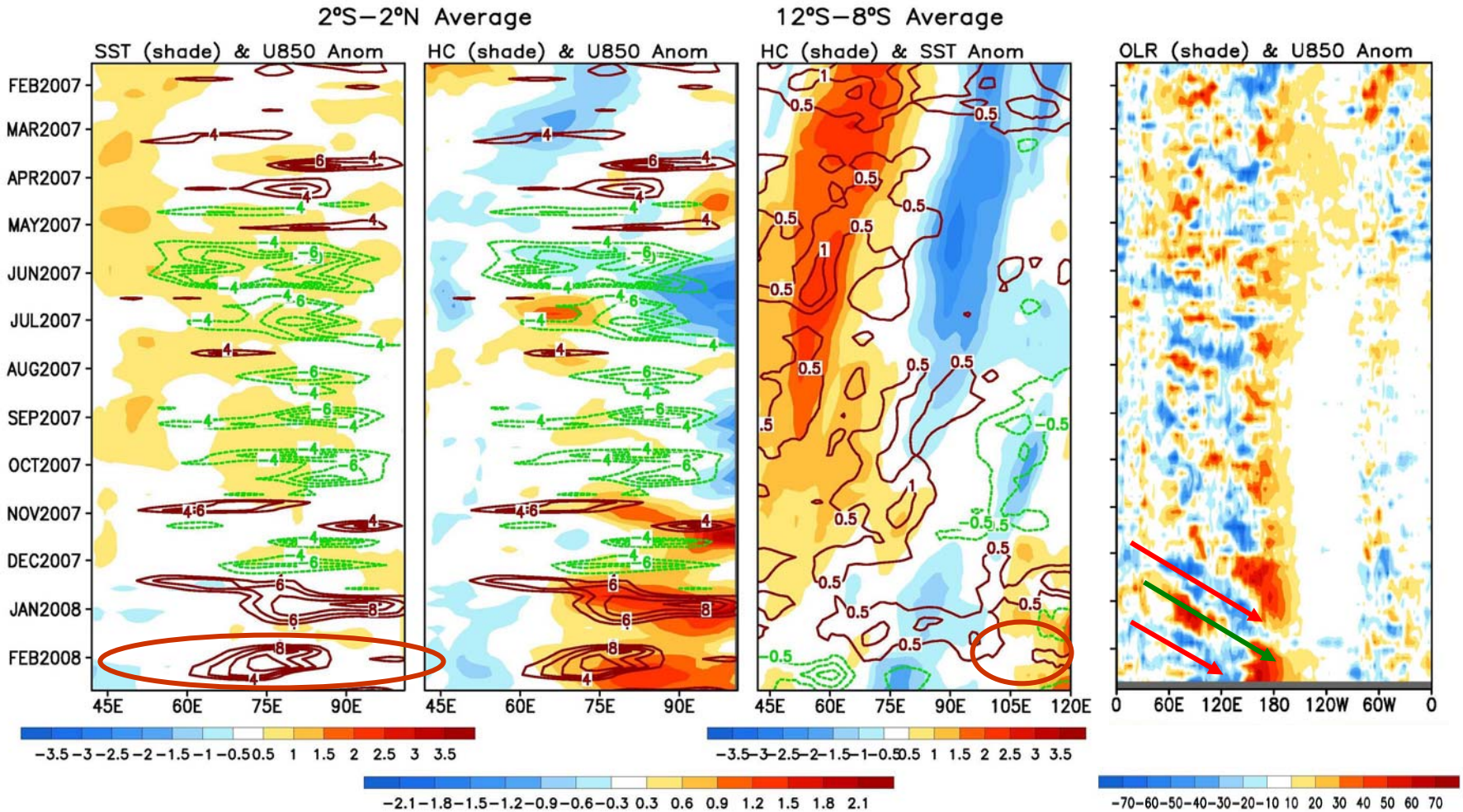
- **SST are near normal in Indian Ocean**
- **IO Dipole Mode Index (DMI) is near normal**

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**
- **Below normal surface heat flux cooled the Indian Ocean**

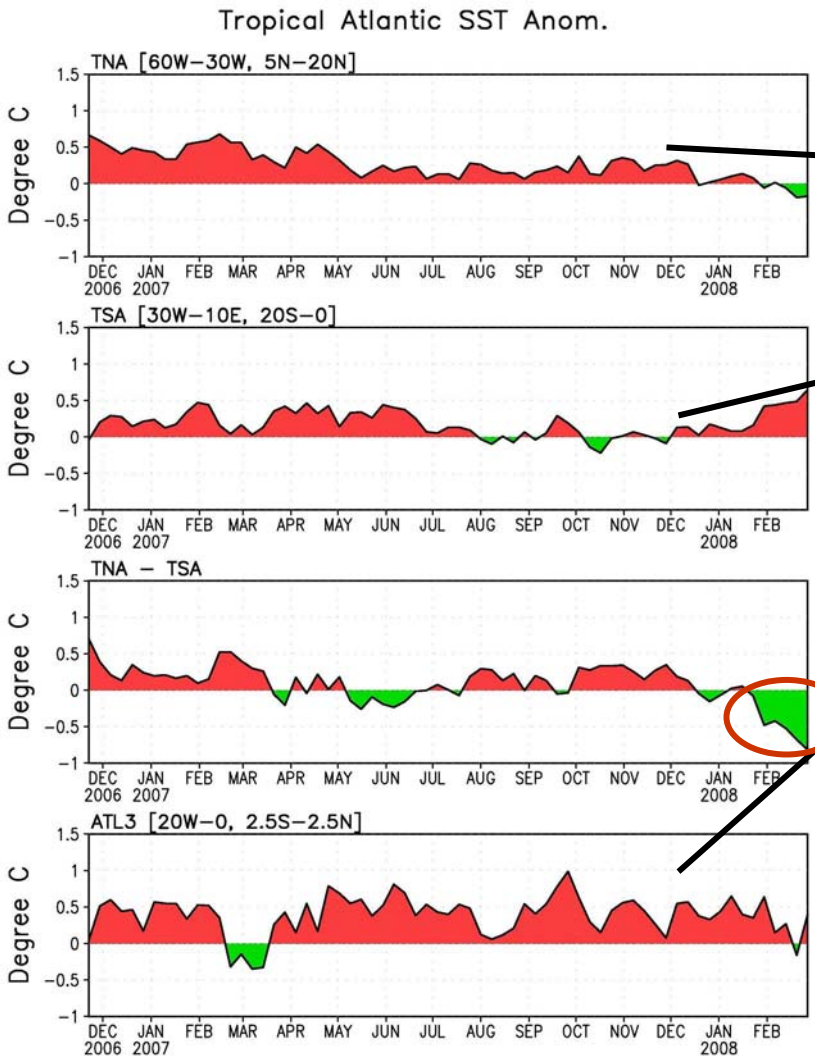
Evolution of Equatorial/10°S Indian SST (°C), 850-mb Zonal Wind (m/s), 0-300m Heat Content (°C)

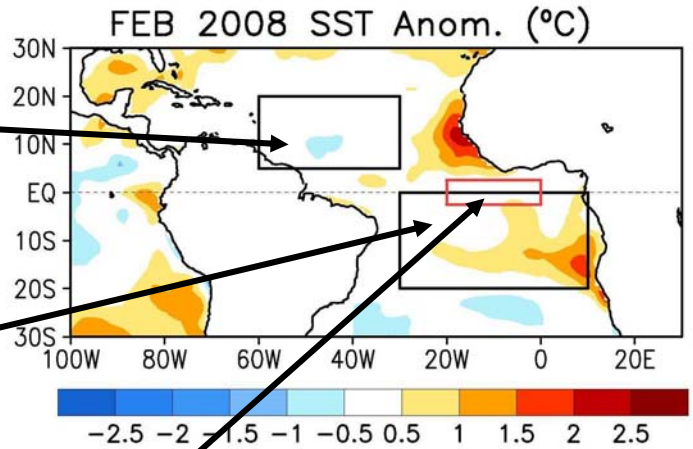


- **Weaker MJO activities**
- **Westerly wind anomaly**
- **Positive HC anomalies in the eastern equatorial Indian Ocean**

Atlantic Ocean

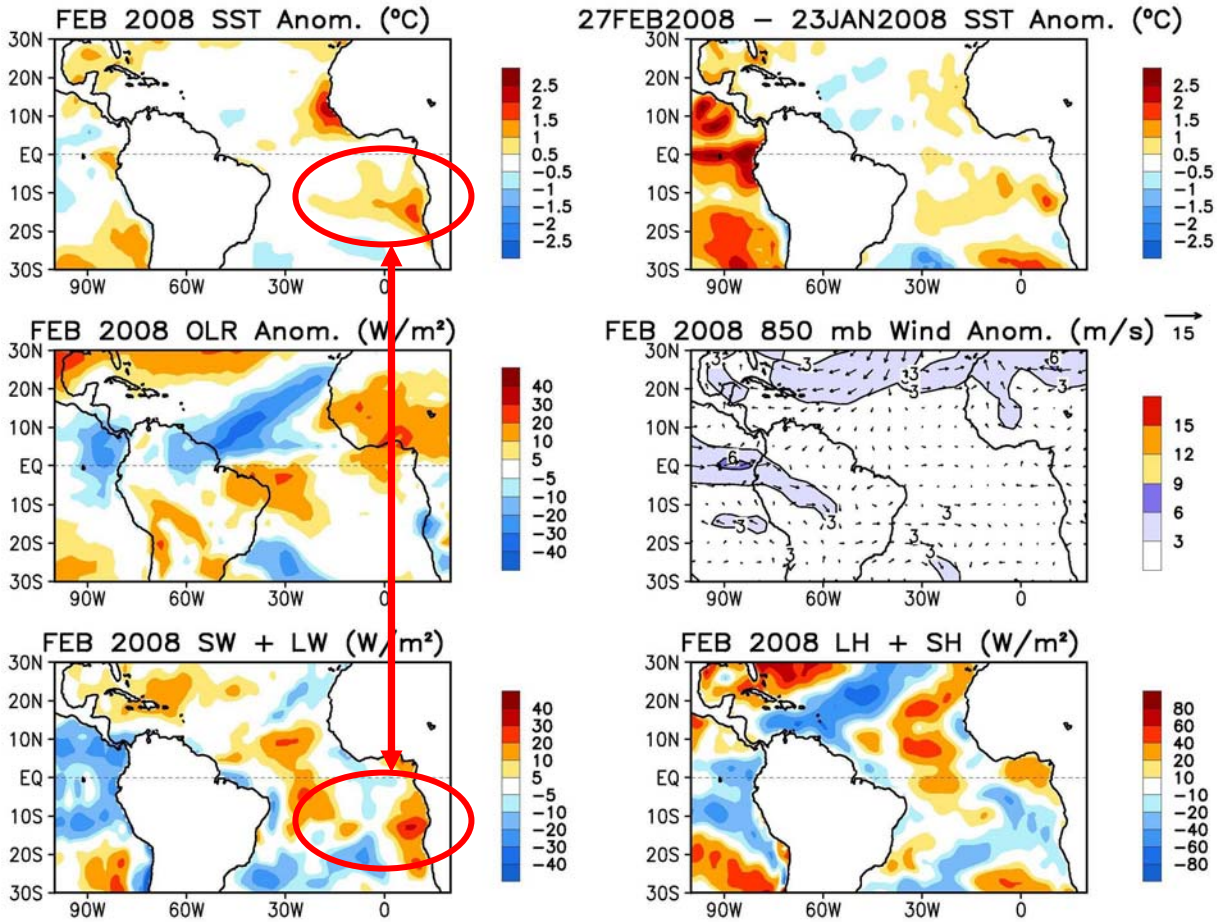
Recent Evolution of Tropical Atlantic SST Indices





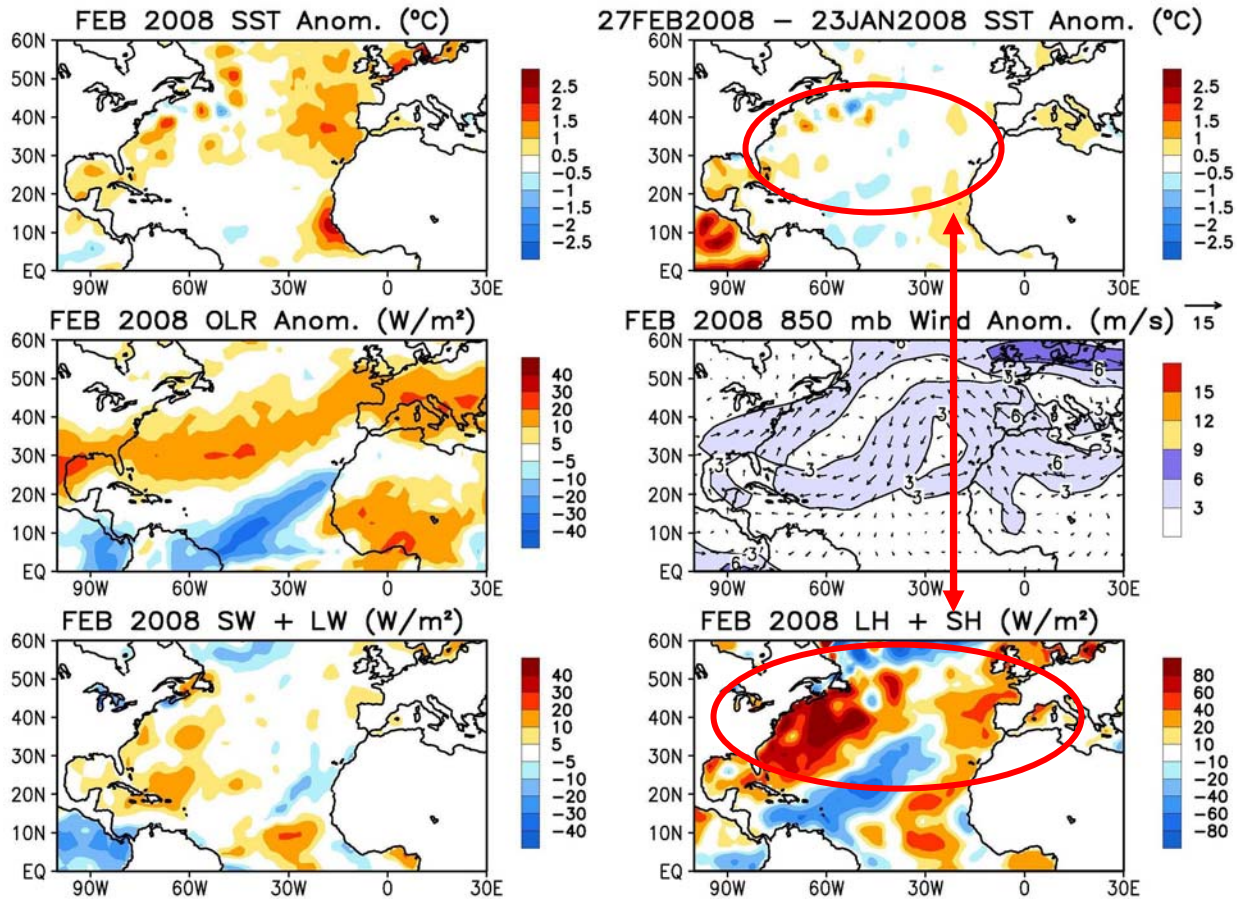
Positive TSA and Negative TNA-TSA in February

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



- Positive SSTA near 15S consistent with radiative heating

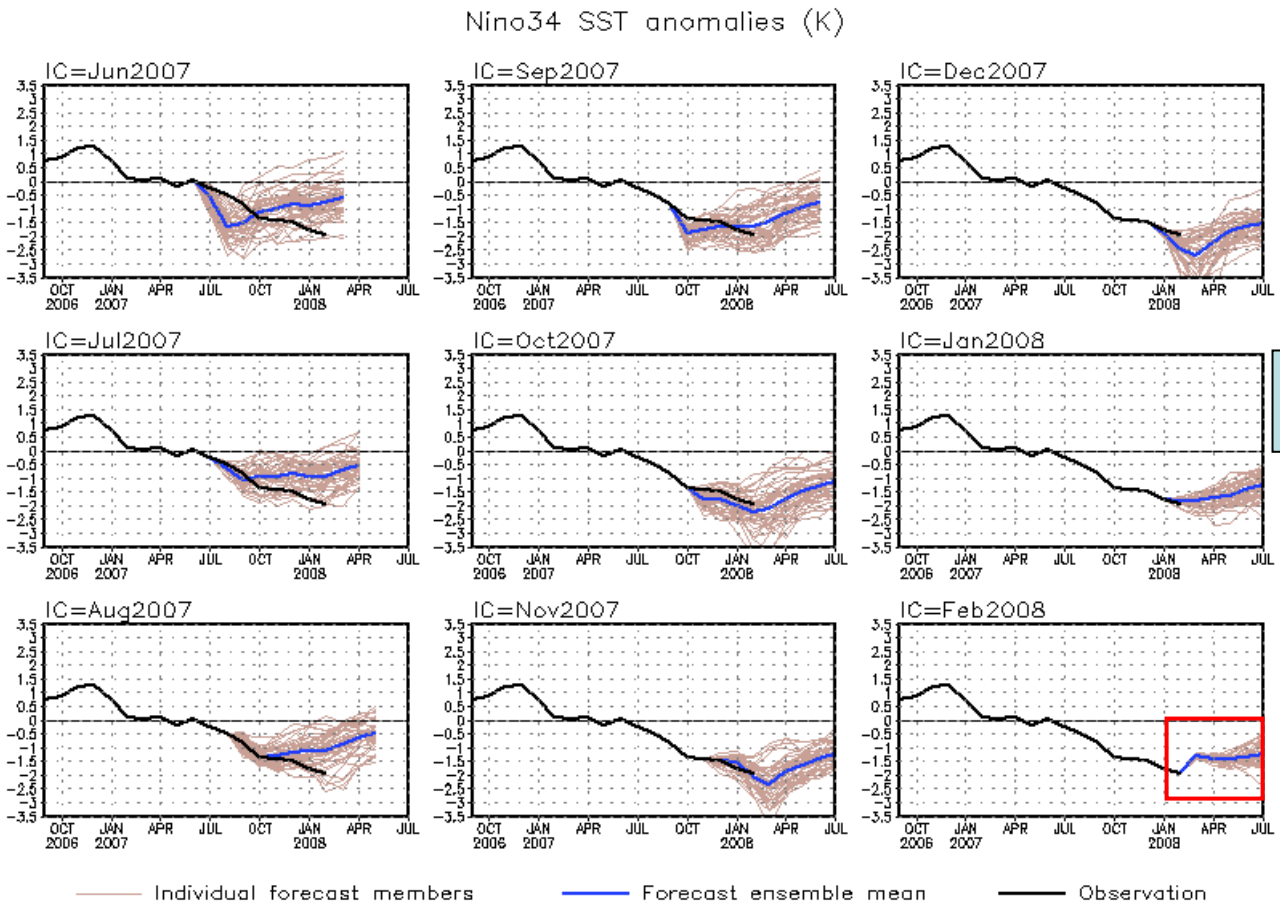
North Atlantic: SST Anom., SST Anom. Tend., OLR, 850-mb Winds, Sfc Rad, Sfc Flx



- **Large positive SST anomalies between 30N and 60N**
- **Positive surface heat flux anomalies contributed to SST warming**

CFS SST Predictions and Ocean Initial Conditions

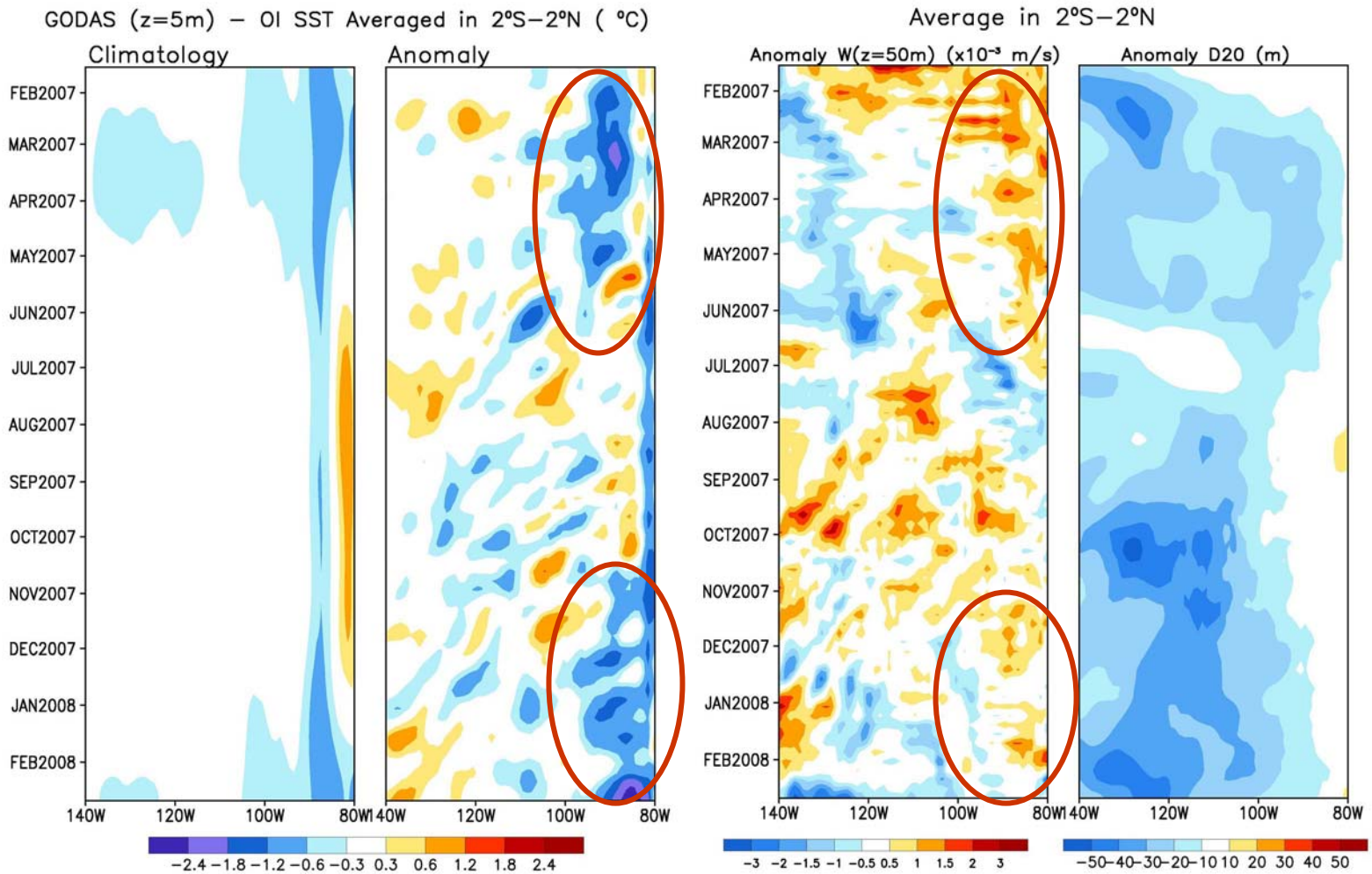
CFS Niño 3.4 SST Predictions from Different Lead Times



New CFS system starting Jan 2008

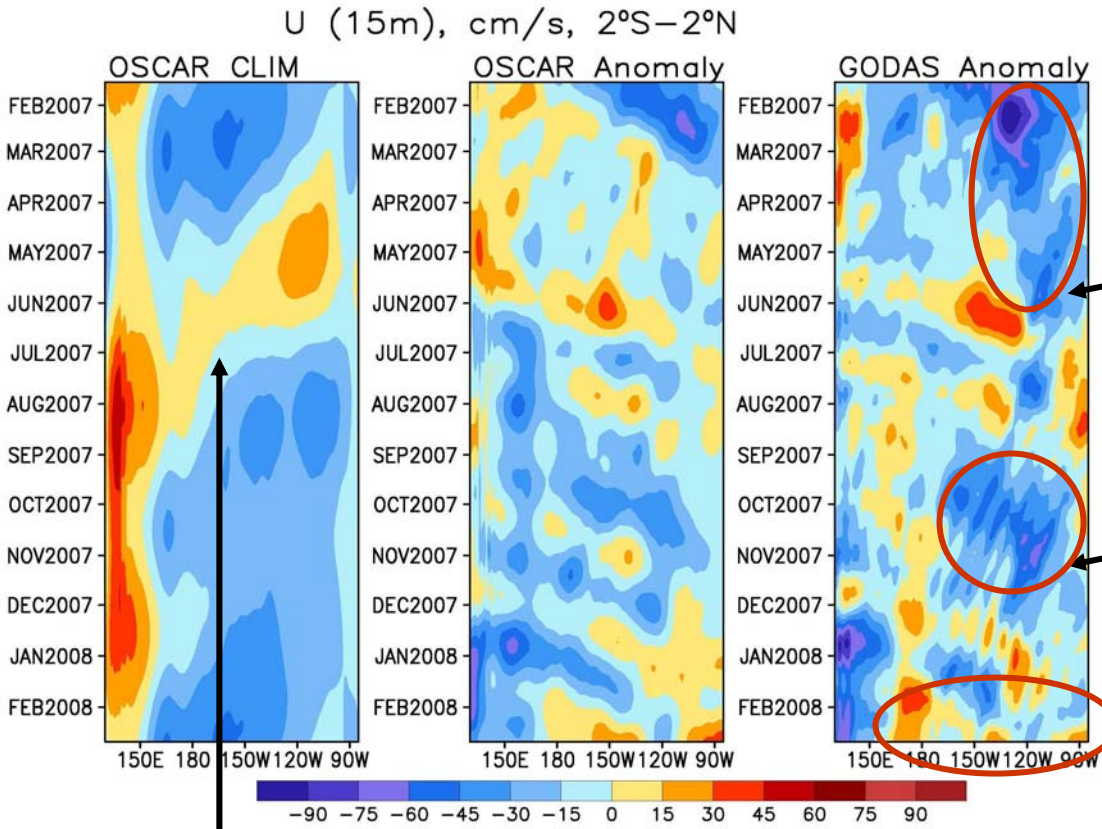
- **SST forecast biased towards warm in June-August**
- **Reasonable SST forecast in September-November**
- **SST forecast biased towards cold in December**

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 since November 2007**
- **Likely related to anomalously strong upwelling at 50-meter depth**

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

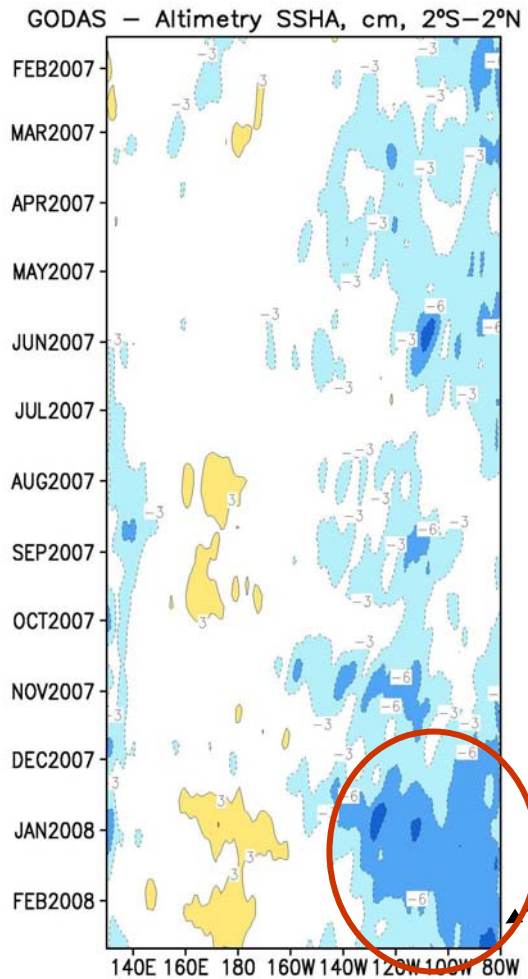


Too strong westward currents

Too strong westward currents

Eastward currents

Climatological surface currents are westward since July



- **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 since December 2007 east of 140W**
- **What causes the biases?**

Summary

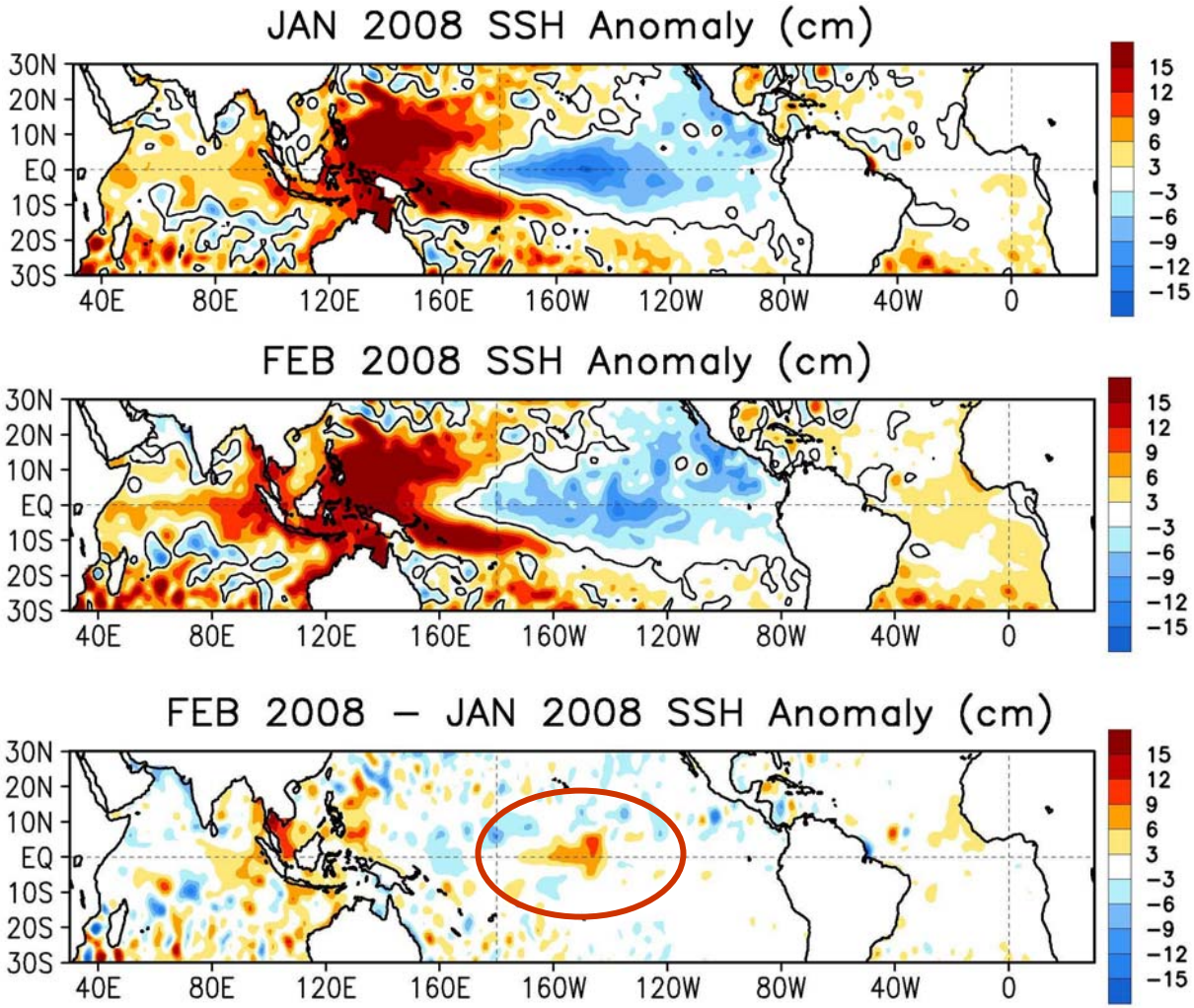
- **Pacific Ocean**
  - Moderate La Niña persisted from SON, and enhanced in DJF (ONI SST < -1.5C)
  - CPC's prognostic assessment: La Niña will continue into the Spring of 2008
  - Easterly wind anomaly and suppressed convection in central and western Pacific
  - Westerly wind anomaly in eastern Pacific and NINO 1.2 index changed into positive
  - SST and wind anomalies persisted in the extra-tropical North Pacific

- **Indian Ocean**
  - Near normal SST in the tropical Indian Ocean
  - Above normal convection related to MJO activities

- **Atlantic Ocean**
  - Positive SSTA along African coast near 10N and 15S
  - SST anomalies persisted in the extra-tropical North Atlantic

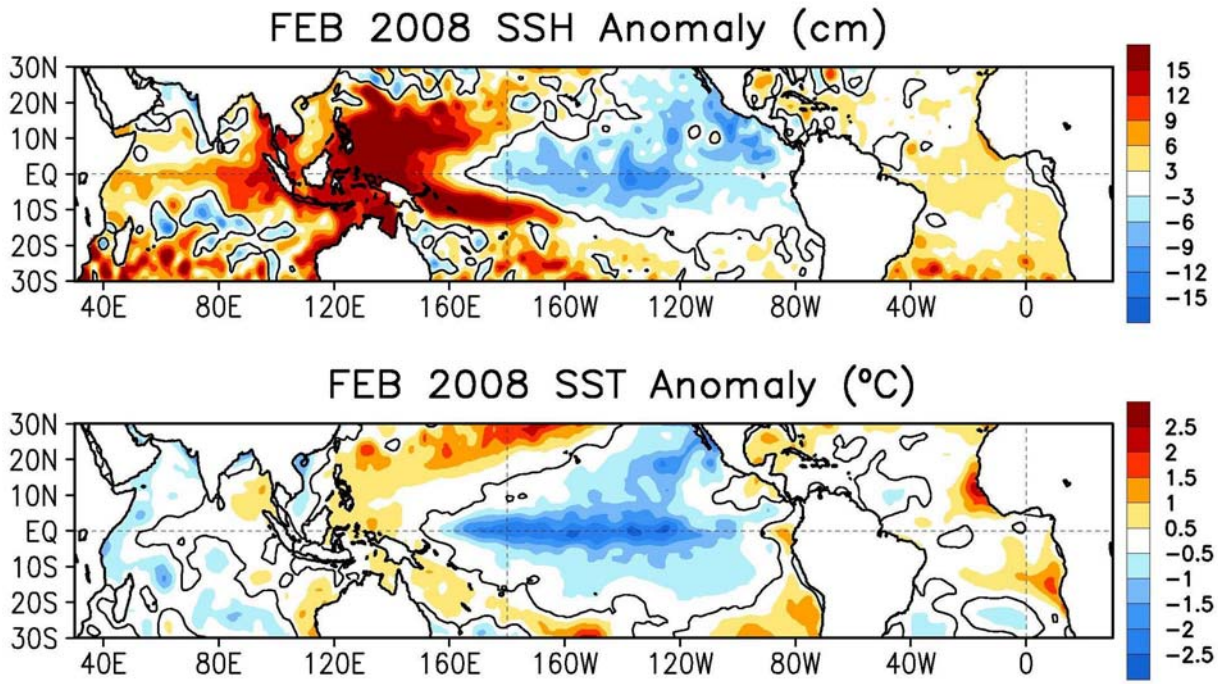
Backup Slides

Global SSH Anomaly and Anomaly Tendency



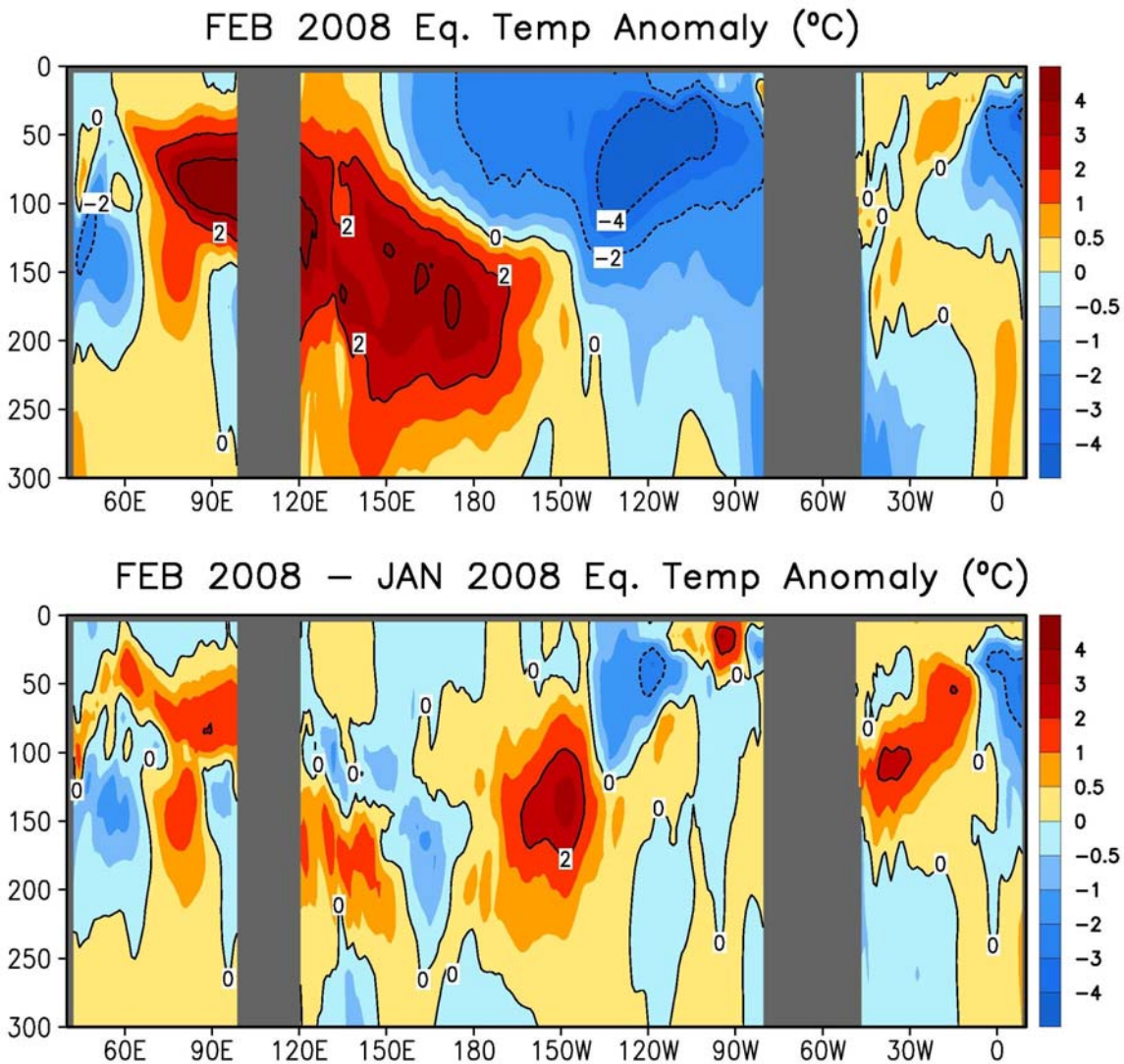
- **SSHA weakened near 150W**

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

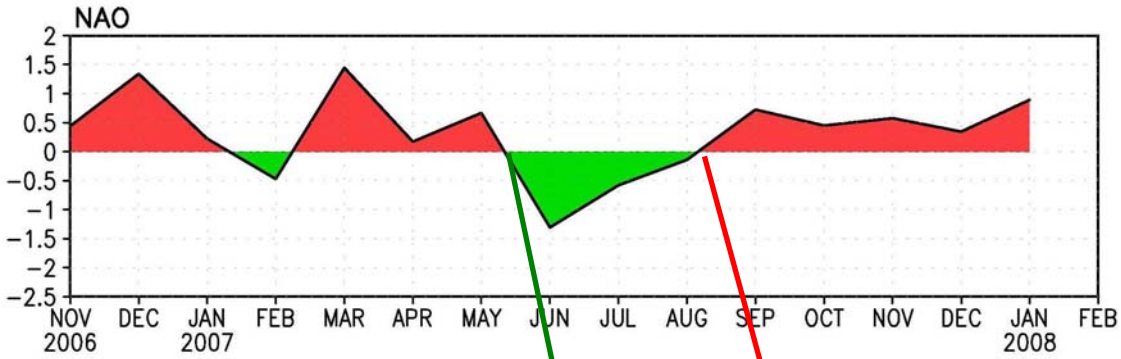


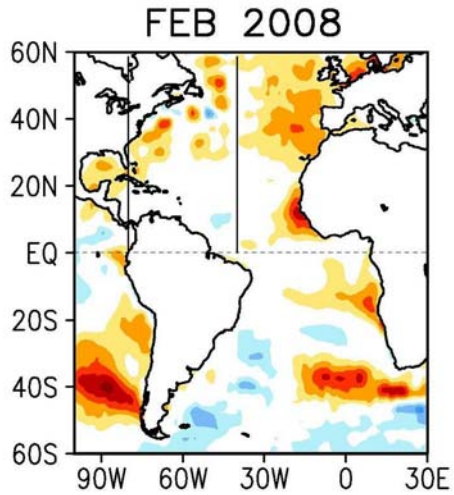
- **Good consistency between SSH and SST in the equatorial latitudes**

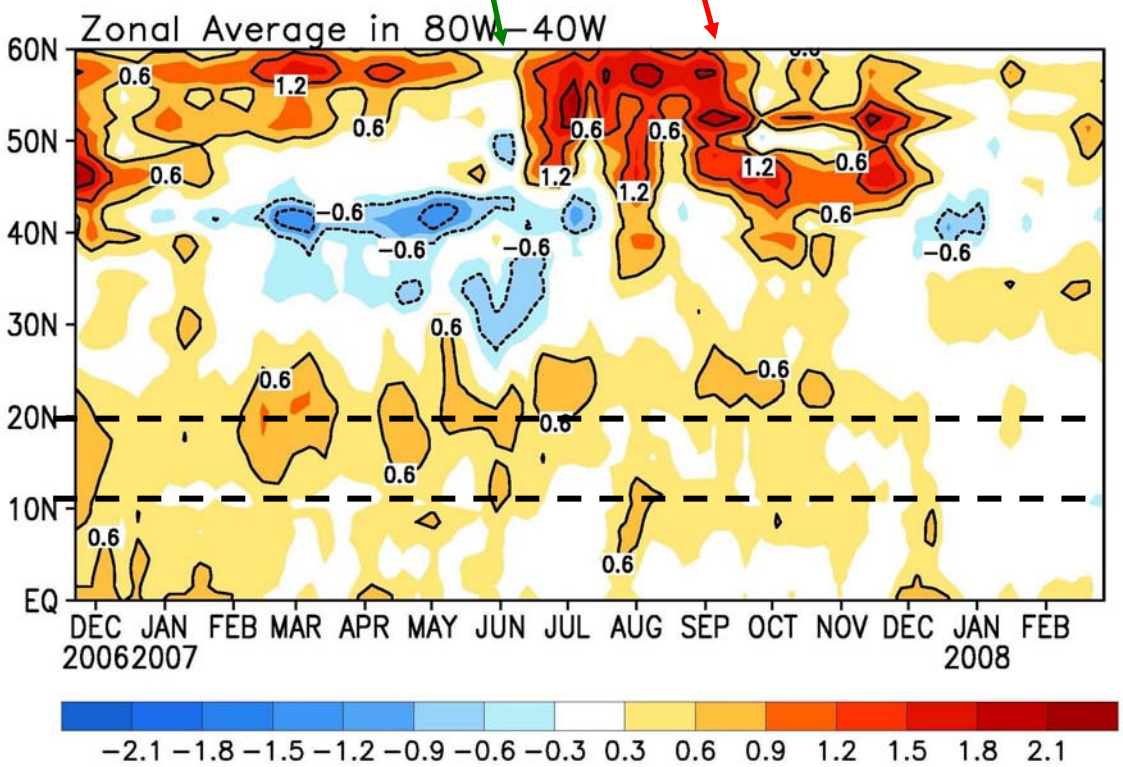
GODAS Equatorial X-Z Temperature



Attribution of SST Anomaly in Northwest Atlantic





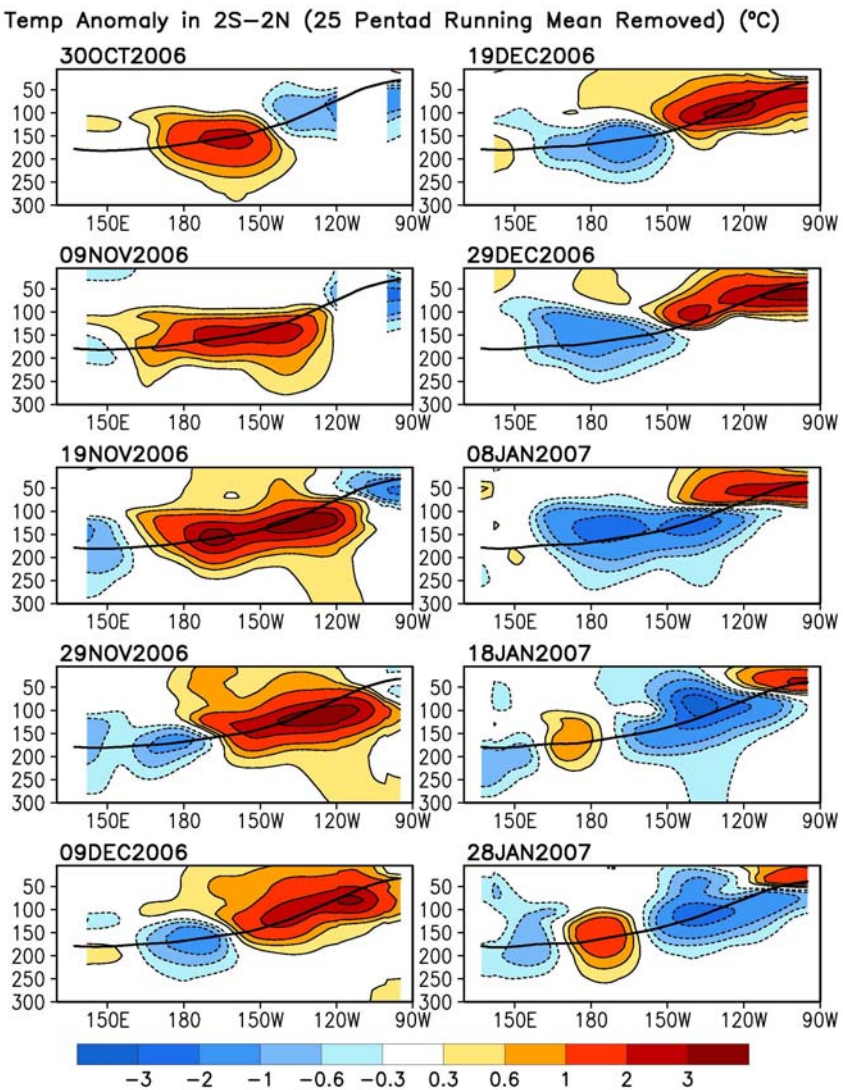


- NAO index has been positive since August

Recent Evolution of Tropical Temperature

(25 pentad running mean removed)

TAO



GODAS