Global Ocean in 2006-2007

Prepared by

Climate Prediction Center, NCEP

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

Overview

- **Global**
  - Above normal global mean SSTs anomalies continued their long term trend
  - However, global mean SST anomalies decreased from their 2006 level
  - The decline occurred in almost all the ocean basins (except the Indian Ocean)
  - Global mean sea surface height anomaly increased 68% from 2006 to 2007

- **Pacific Ocean**
  - El Niño conditions decayed rapidly at the beginning of the year and gave way to moderate-strength La Niña (ONI SST < -1C) SSTs by the fall of 2007
  - MJO-related winds had substantial impacts on ocean heat content, and appear contributed significantly to the demise of 2006 El Nino
  - North Pacific SST near Gulf of Alaska decreased to below-normal in 2007 from near-normal in 2006

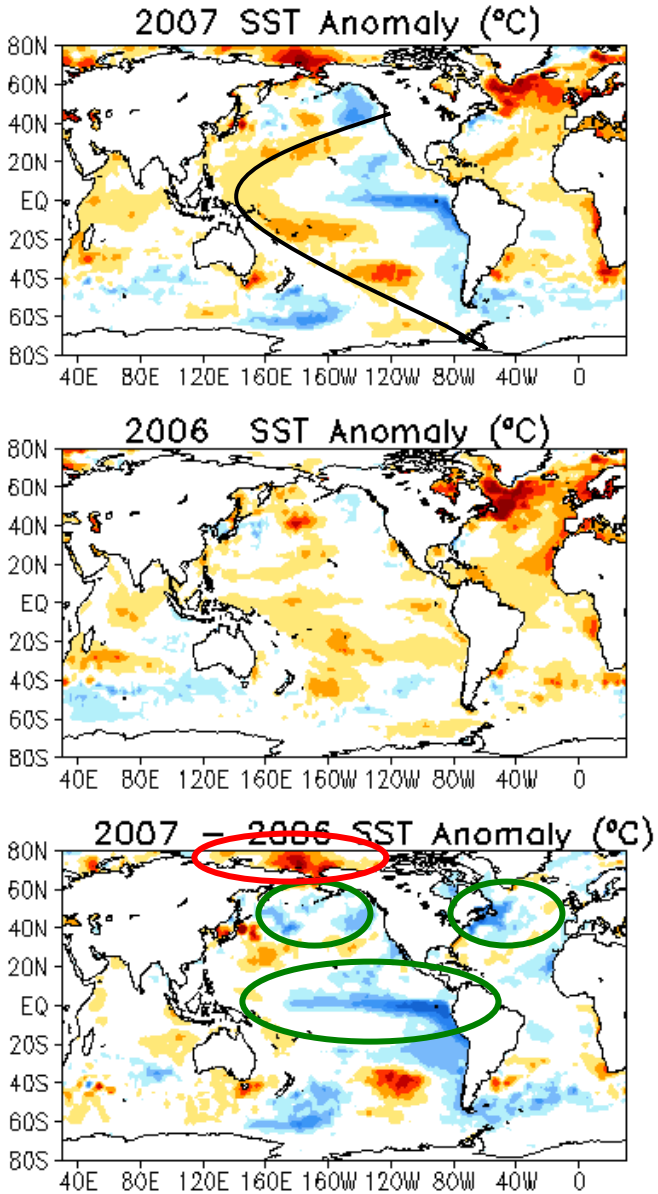
- **Indian Ocean**
  - Above normal SST anomalies continued in the Indian Ocean
  - A brief IOD episode during SON 2007 (unexpected during a La Niña episode)

- **Atlantic Ocean**
  - Above normal, but weaker, SST anomalies
  - SST anomalies in the Main Development Region continued their decline from 2005
  - North Atlantic continued to be above normal (but weaker than in 2006)

Data Sources

- Optimal Interpolation SST (OI SST) version 2
- Reconstructed SST (ERSST) version 3
- NCEP/NCAR Reanalysis-1 850 mb winds, 200mb velocity potential, heat fluxes
- NOAA's Outgoing Long Wave Radiation
- CPC's CAMS-OPI precipitation
- NCEP's Global Ocean Data Assimilation System (GODAS) subsurface temperature, heat content, tropical cyclone heat potential
- Aviso Altimetry Sea Surface Height
- Ocean Surface Current Analyses – Realtime (OSCAR)

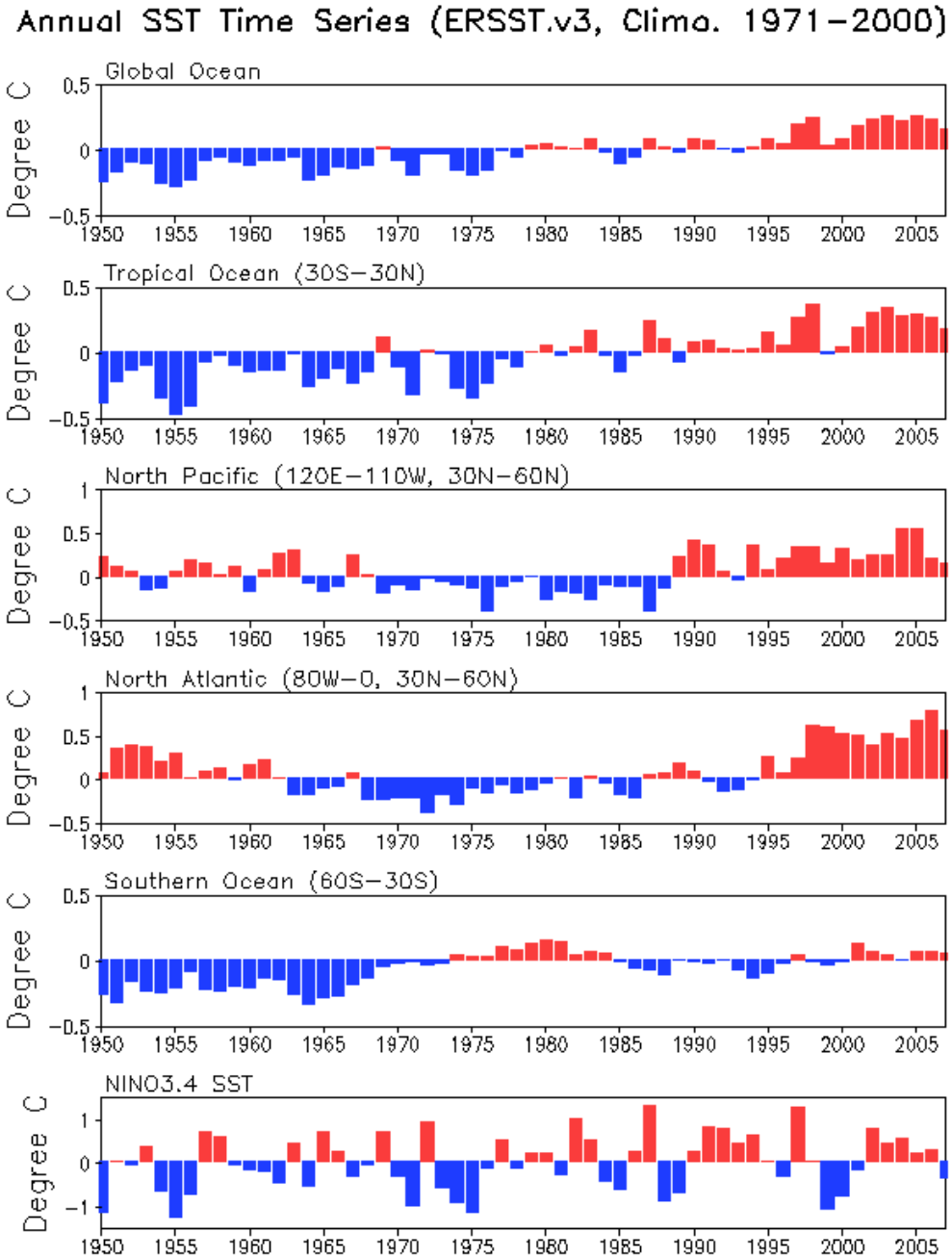
Global SST Anomaly (ºC) and Anomaly Tendency



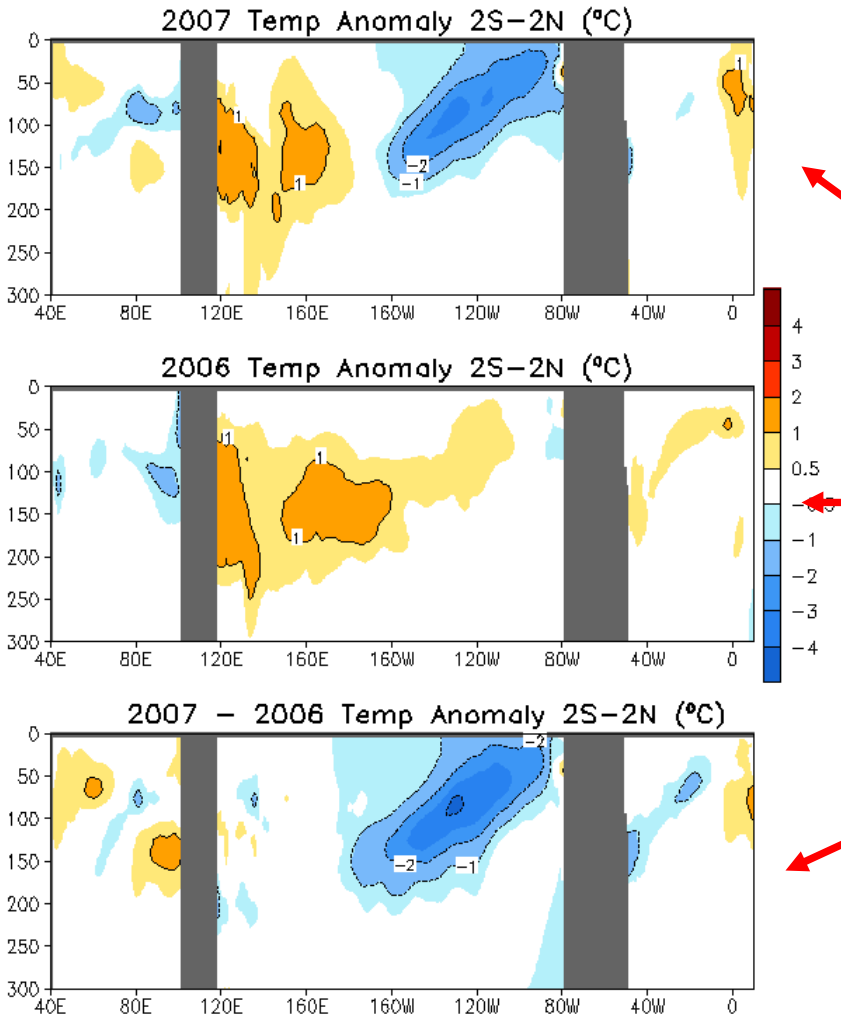
- Horseshoe SST in tropical Pacific dominated by 2007 La Nina
- Weak above-normal SST in tropical Indian and Atlantic
- Strong above-normal SST north of Bering Strait and high-latitude North Atlantic
- Strong below-normal SST in Gulf of Alaska
- Global mean SSTA is 0.13C, 0.1C lower than that of 2006

- Weak above-normal SST in tropical Pacific dominated by 2006 El Nino
- Weak above-normal SST in tropical Indian and Atlantic
- Strong above-normal SST in high-latitude North Atlantic
- Global mean SSTA 0.21C

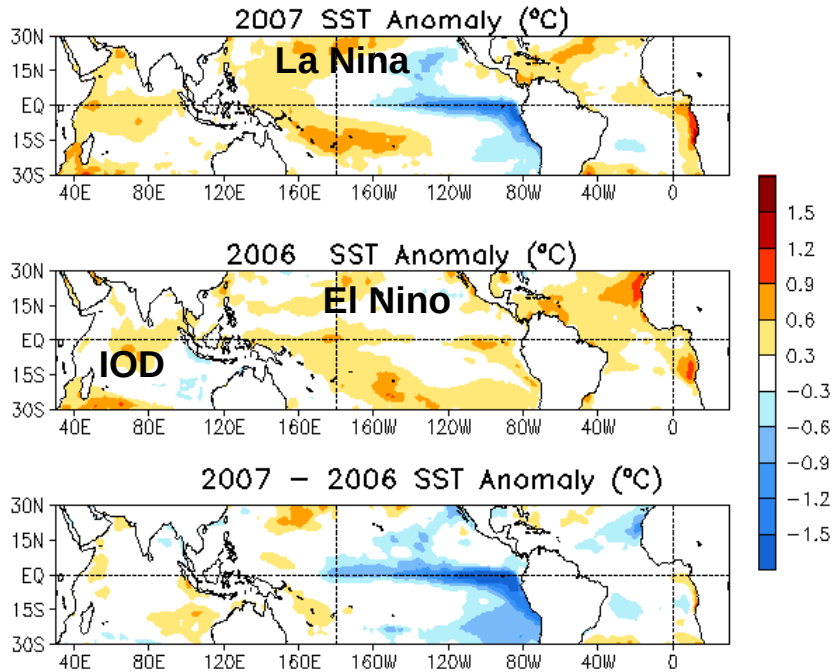
- SST decreased in tropical Pacific, Southeast Pacific, North Pacific and North Atlantic
- SST increased substantially north of Bering Strait


Annual SST Time Series (ERSST.v3, Clima. 1971-2000)
Global Ocean
Tropical Ocean (30S-30N)
North Pacific (120E-110W, 30N-60N)
North Atlantic (80W-0, 30N-60N)
Southern Ocean (60S-30S)
NINO3.4 SST
Degree C
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005

Equatorial Temperature Anomaly

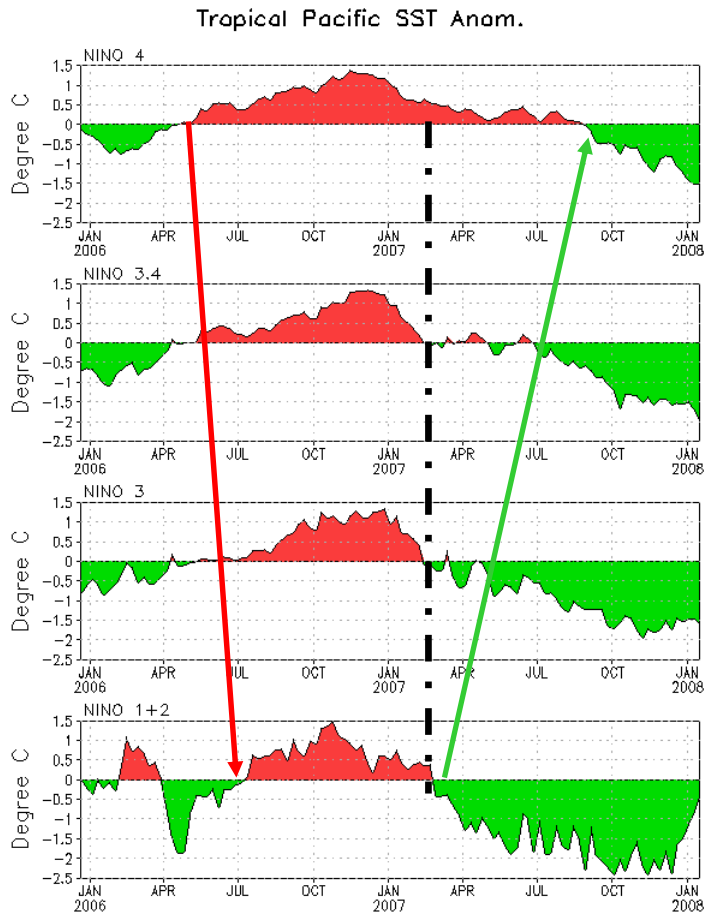


Tropical SST Anomaly

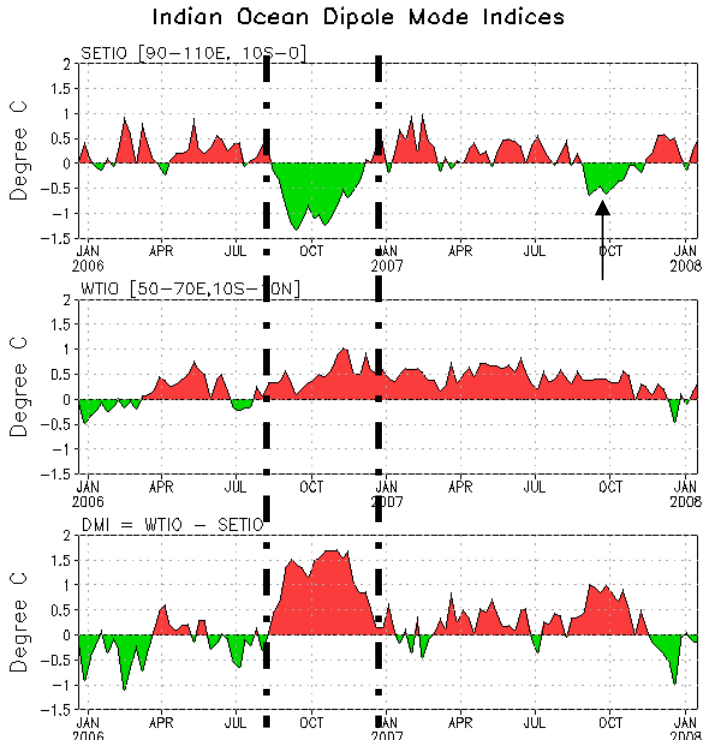


- **East-west dipoles in SSHA and SSTA dominated by 2007 La Nina**
- **No east-west dipoles in SSHA and SSTA due to atypical evolution of 2006 El Nino**

NINO Indices



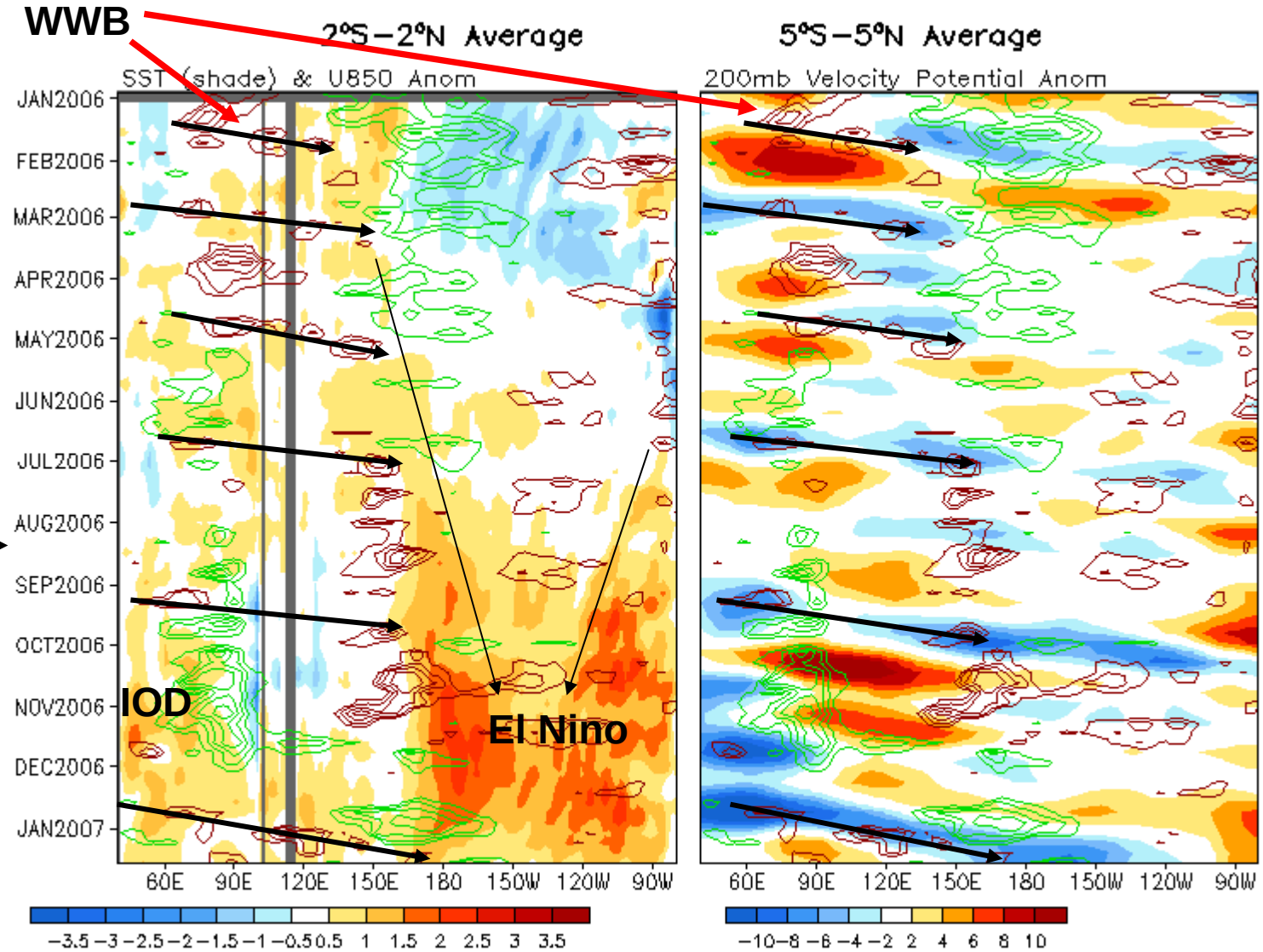
IOD Indices



- **Positive SSTA progressed from west to east during 2006 El Nino**
- **2006 El Nino ended abruptly in February 2007**
- **Negative SSTA progressed from east to west during 2007 La Nina**

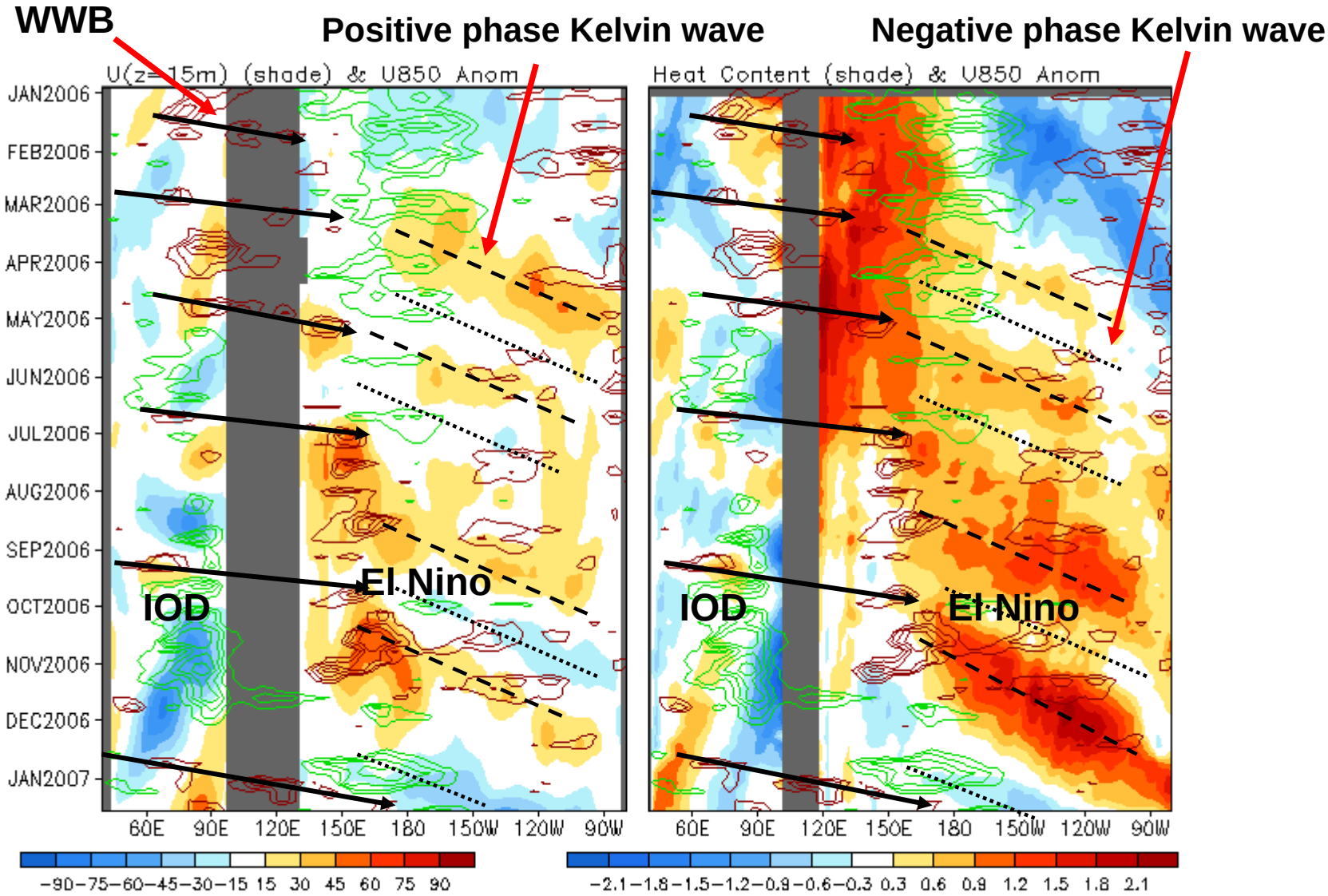
- **SETIO transitioned from positive to negative in August 2006, leading to a 2006 IOD event**
- **2006 IOD event decayed in December 2006**
- **Mini IOD in 2007**

2006 MJO Evolution



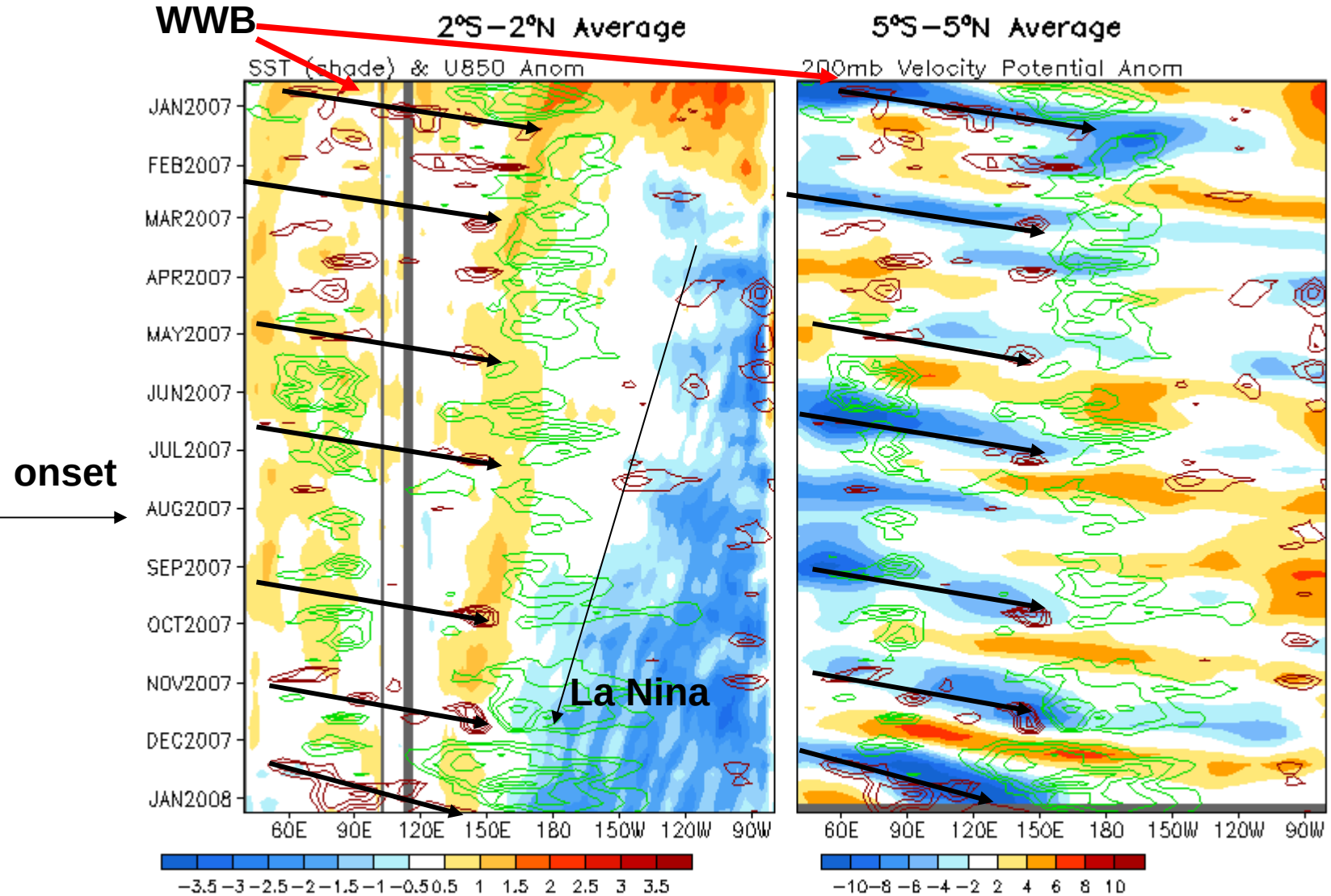
- **Westerly Wind Burst (WWB) associated with MJO were active in Spring 2006, contributing to demise of "2005 La Nina" and onset of 2006 El Nino**
- **WWB moved progressively eastward along with positive SSTA in western-central Pacific**
- **MJO initiated in Indian Ocean in mid-December 2006 contributed to demise of 2006 El Nino**

2006 MJO's Impacts on Ocean



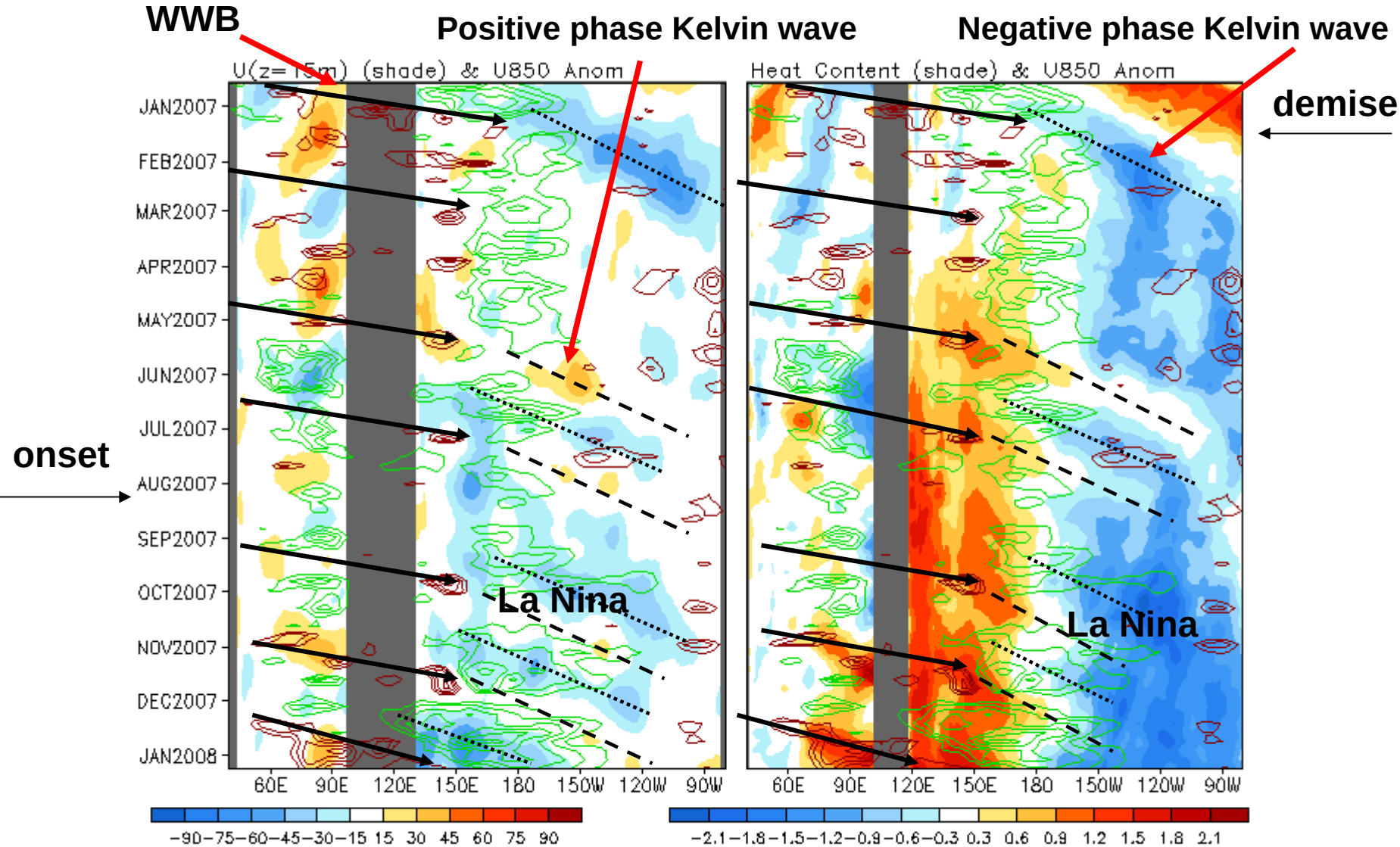
- **MJO initiated in late-February 2006 produced downwelling Kelvin waves**
- **MJO initiated in April, June and September 2006 increased heat content in central-eastern Pacific**
- **MJO initiated in mid-December 2006 generated strong easterly wind burst, leading to depletion of heat content and demise of 2006 El Nino**

2007 MJO Evolution



- **WWB progressed westward while warm SSTA in western Pacific moved westward**
- **MJO in November-December was the strongest in the past four years according to CPC's MJO monitoring team**

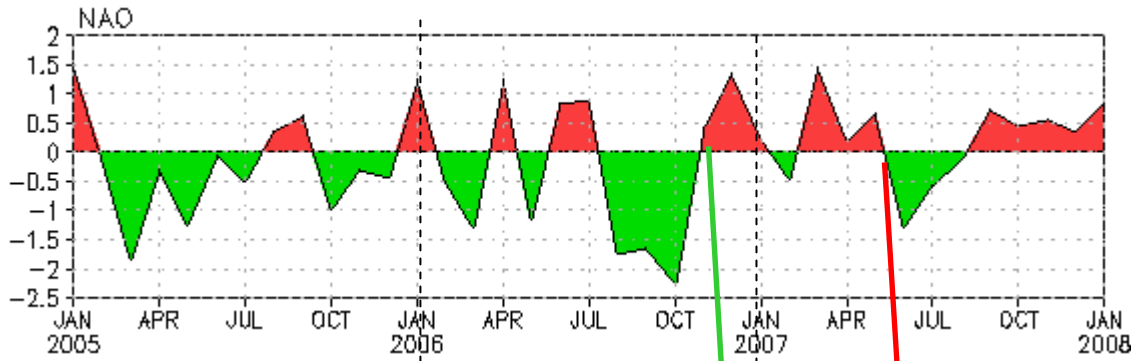
2007 MJO's Impacts on Ocean

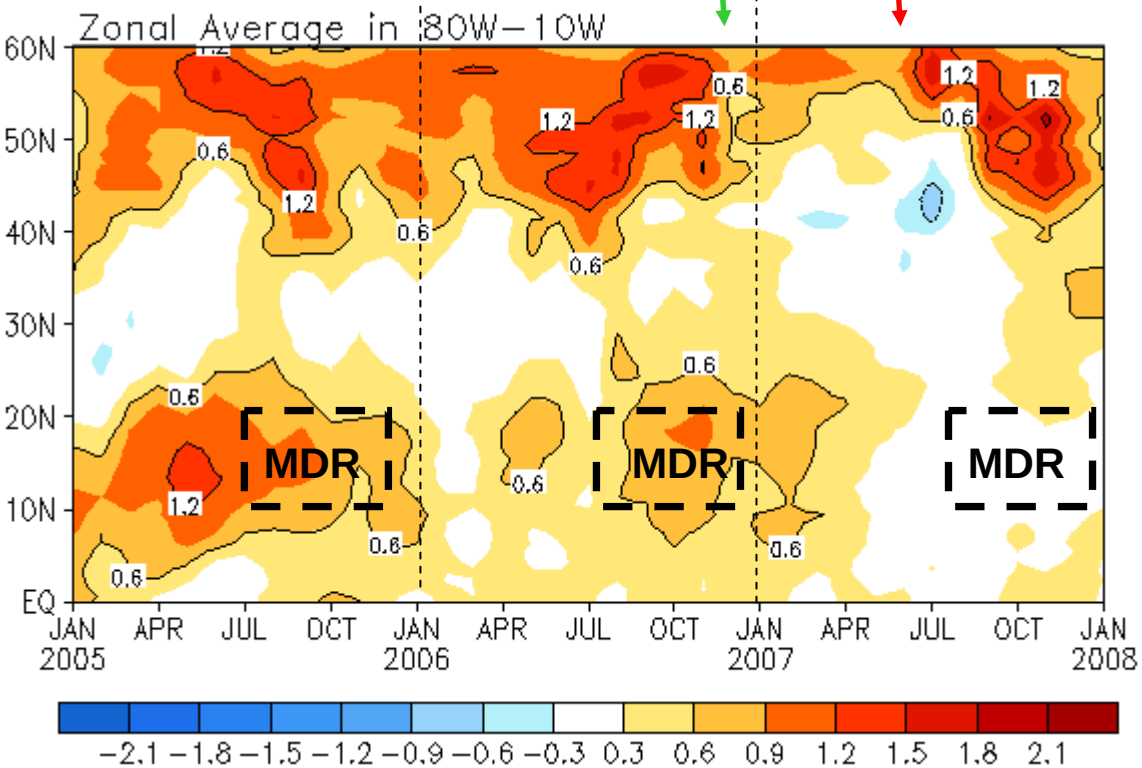


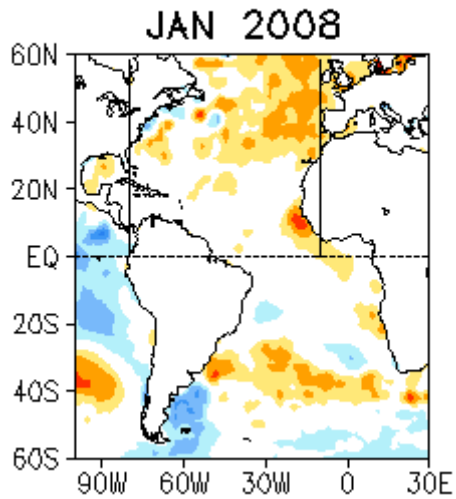
- **MJO in December 2006 produced strong westward surface currents and negative heat content anomalies, leading to abrupt demise of 2006 El Nino**

- **Stronger easterly anomalies associated with MJO in December 2007 produced upwelling Kelvin wave, leading to strengthening of current La Nina**

SST Anomaly in North Atlantic

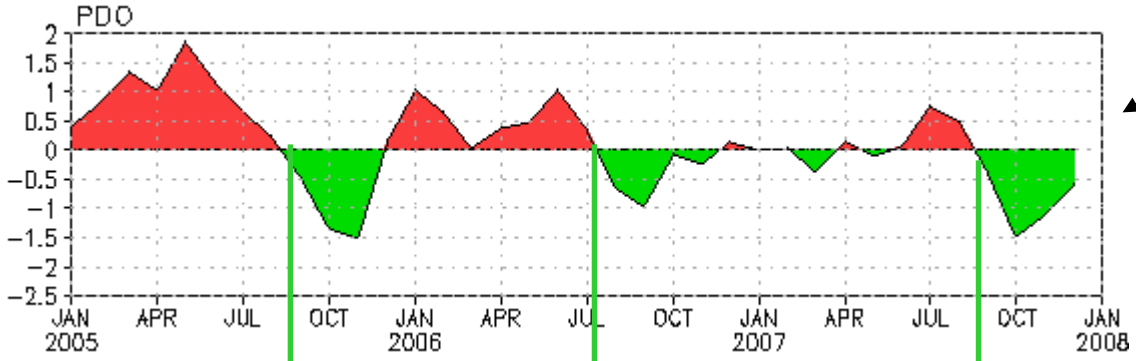




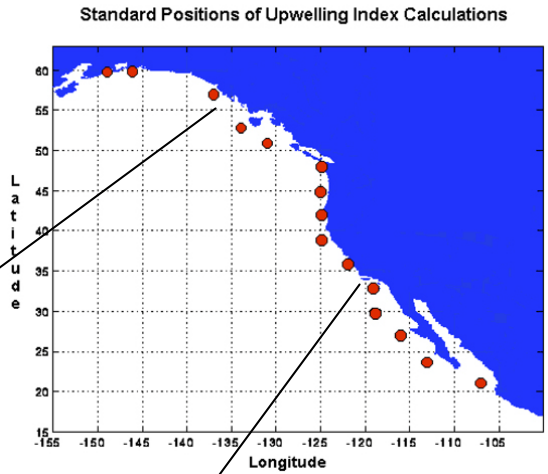


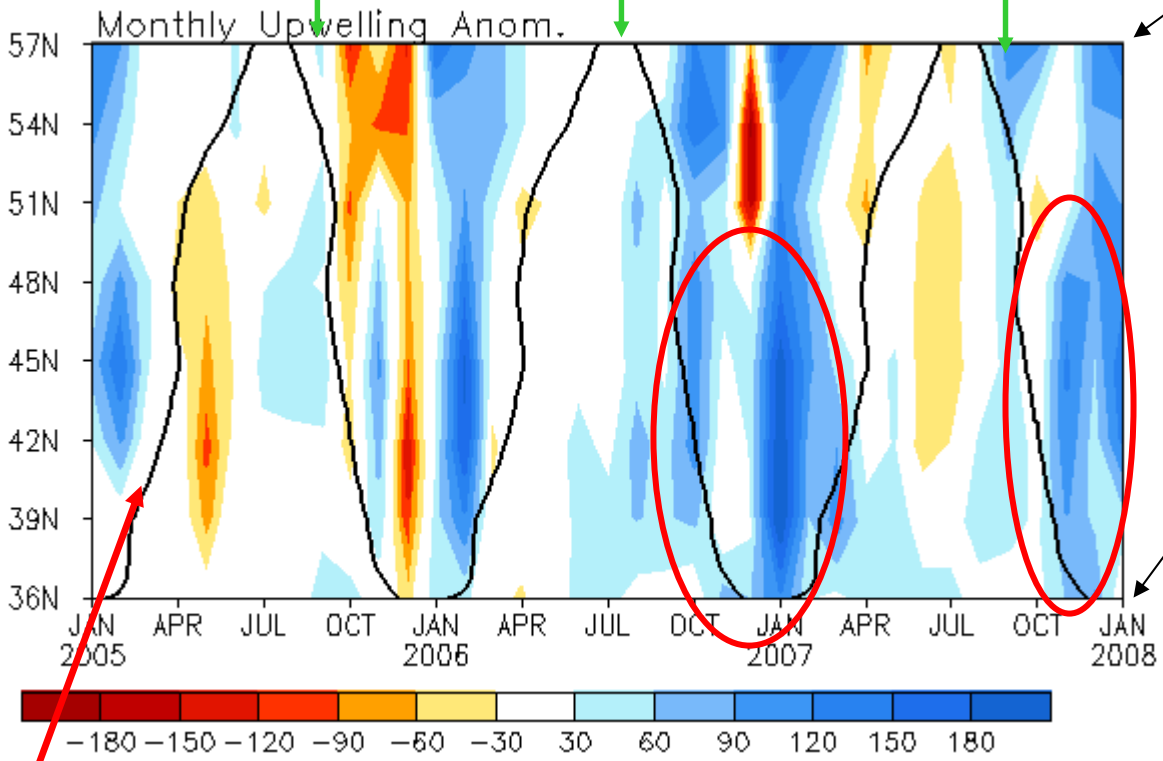
- **SSTA in hurricane Main Development Region was near normal in JASON 2007, much cooler than that of 2006**
- **High-latitude North Atlantic SSTA in 2007 were above-normal, but not as warm as those in 2006**
- **North Atlantic SSTA were closely related to NAO index**

North America Western Coastal Upwelling



UW/NOAA JISAO PDO page

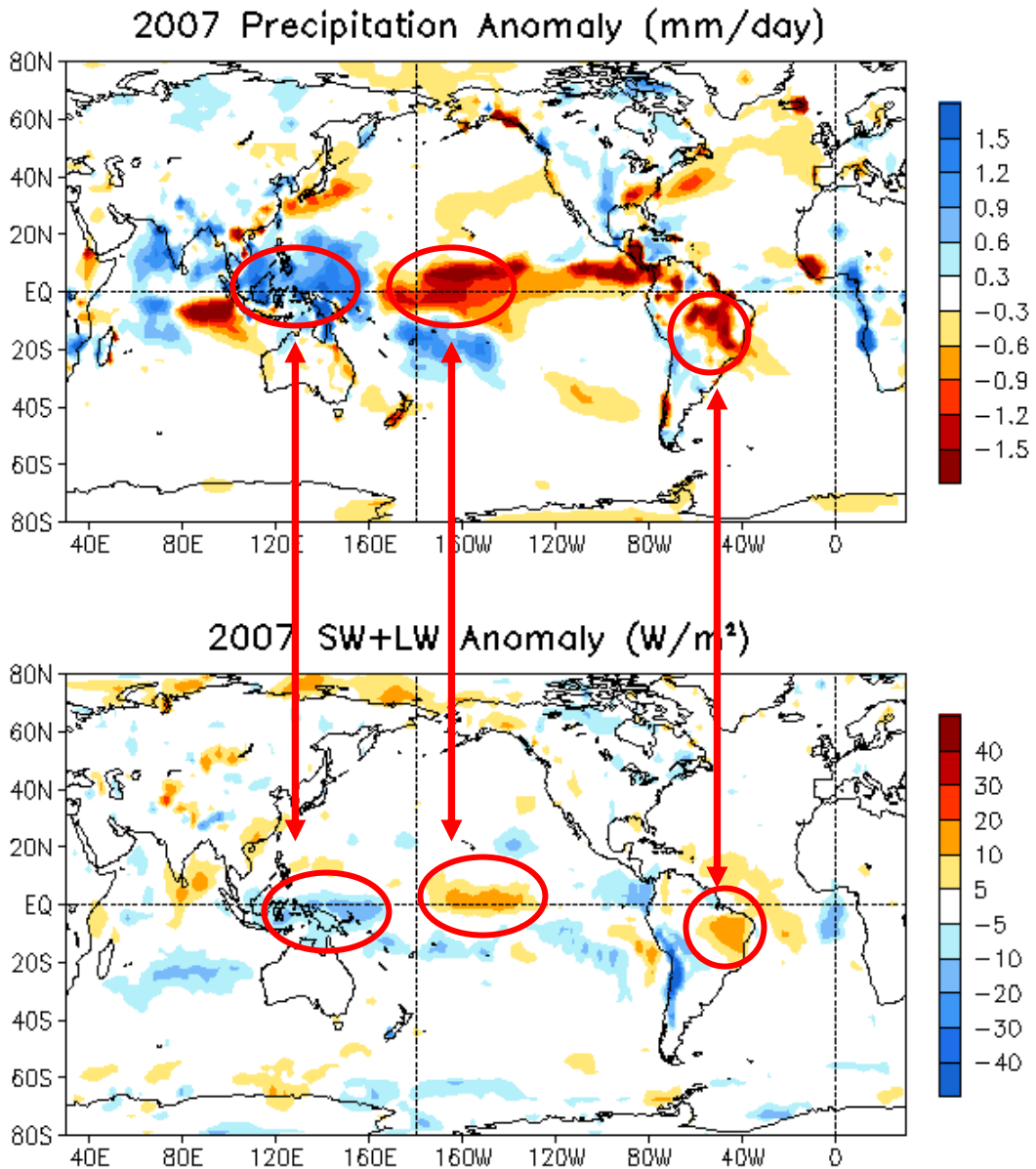




- **2007 upwelling season is close to normal**
- **Negative PDO is associated with above-normal upwelling**

- **Area below (above) black line indicates climatological upwelling (downwelling) season**
- **Climatologically upwelling season progresses from March to July along the west coast of North America from 36°N to 57°N.**

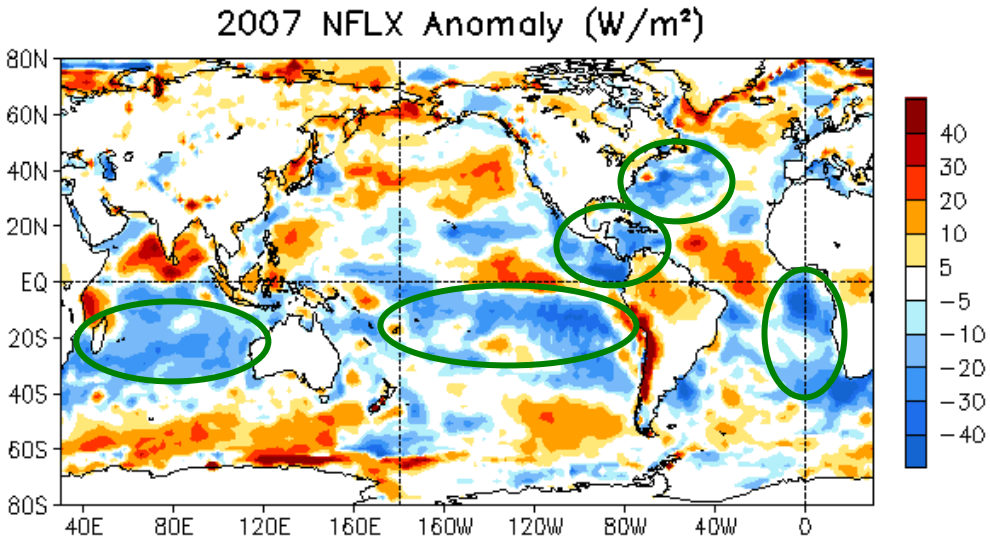
Global Prec. Anomaly and Anomaly Tendency



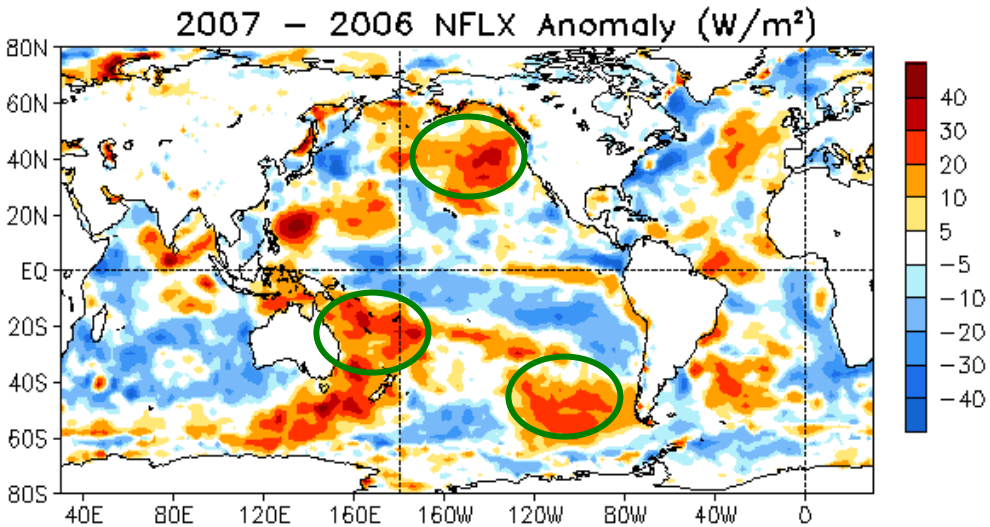
- **Convection suppressed in central tropical Pacific, ITCZ, Brazil, Southeast Indian Ocean**
- **Convection enhanced in western tropical Pacific, SPCZ, Northern Indian and western coast of Africa**

- **Enhanced convection reduced SW at surface**
- **Suppressed convection increased SW at surface**

Global Net Heat Flux Anomaly and Anomaly Tendency

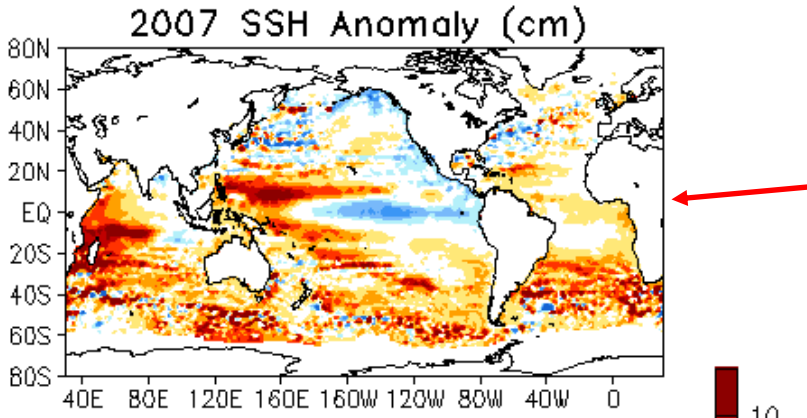


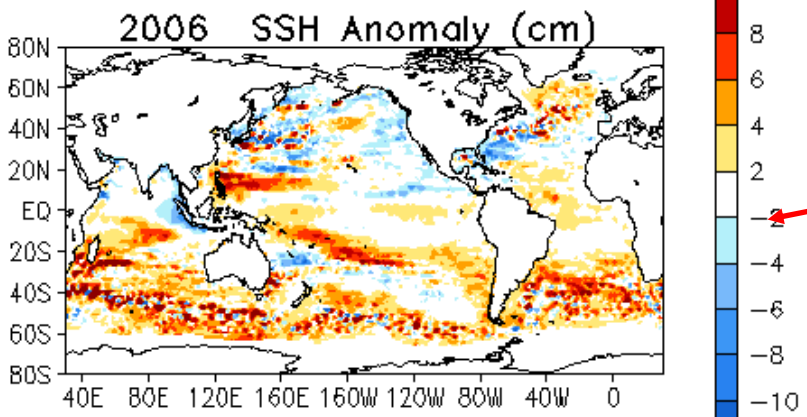
- Net heat flux anomalies were dominated by LH+SH
- Net heat flux anomalies cooled Western Hemisphere Warm Pool, Northwest Atlantic and Southern subtropical Ocean
- Net heat flux anomalies warmed North Indian, North Pacific and high-latitude Southern Ocean
- Global mean NFLX is 3.15 W/m²
- Global mean NFLX anomaly is 0.1 W/m²

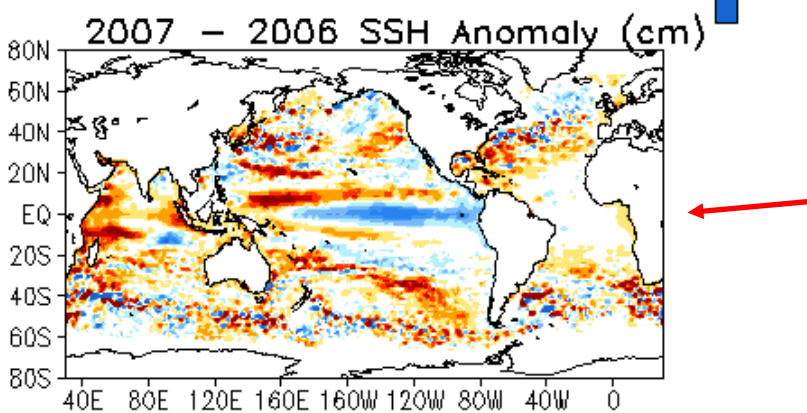


- Net heat flux changes warmed SST in Gulf of Alaska, SPCZ and high-latitude Southern Ocean
- Net heat flux changes cooled South Indian, central tropical Pacific

Global SSH Anomaly and Anomaly Tendency





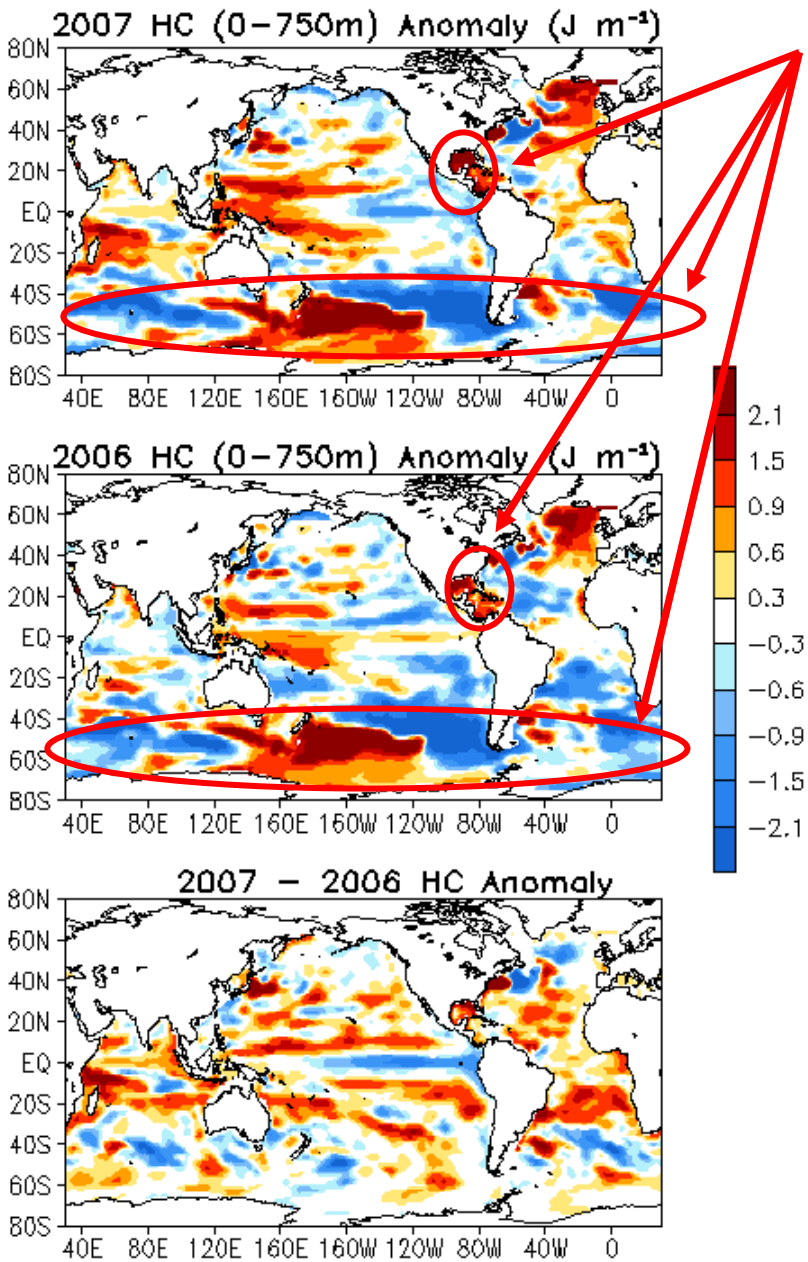


- East-west SSH dipole in tropical Pacific dominated by 2007 La Nina
- Strong above-normal SSH in western Indian Ocean
- Above-normal SSH in Southern Oceans
- Below-normal SSH in Gulf of Alaska
- Global mean SSHA is 1.9cm, increased by 68% from that of 2006

- East-west SSH dipole in tropical Indian dominated by 2006 IOD
- Above-normal SSH in western subtropical Pacific
- Above-normal SSH in Southern Oceans
- Below-normal SSH along eastern coast of North America
- Global mean SSHA is 1.1cm

- SSH increased in subtropical Pacific, but decreased in tropical Pacific – heat discharge
- SSH increased in tropical Indian
- SSH increased in Southern Ocean
- SSH increased in subtropical North Atlantic

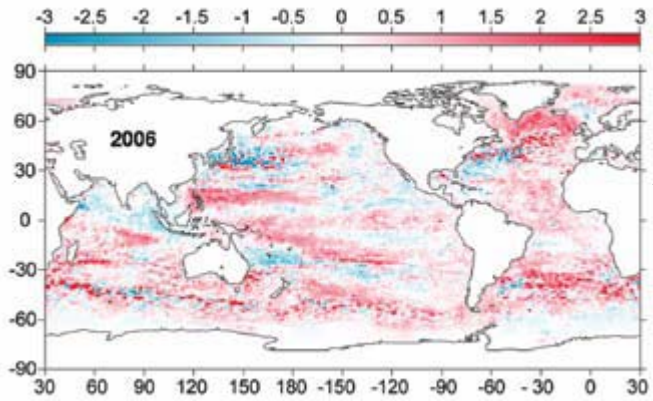
Global Heat Content (0-750m) Anomaly and Anomaly Tendency



Likely problematic due to lack of observations

- East-west HC dipole in tropical Pacific dominated by 2007 La Nina
- Above-normal HC in southwestern Indian Ocean
- Below-normal HC in Gulf of Alaska
- Global mean HCA 8.6×10^7 J/m^2

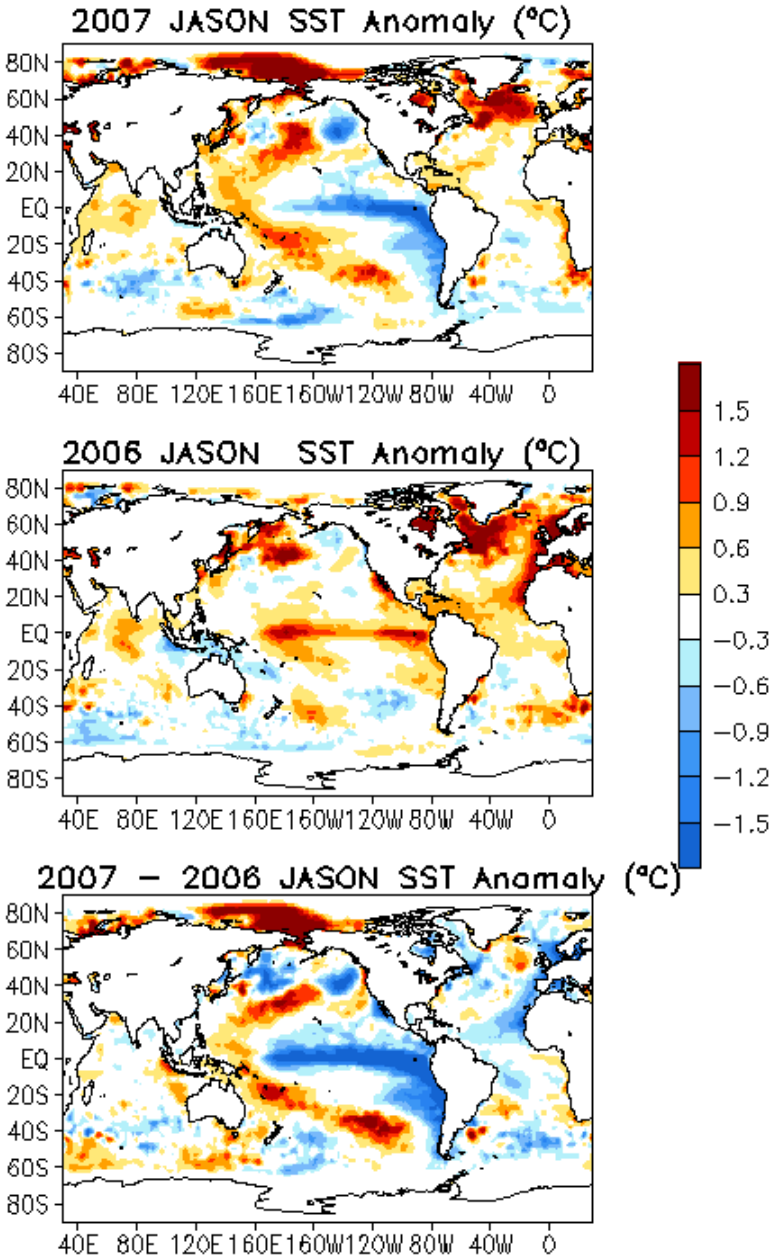
- Major features consistent with "State of the Climate in 2006", BAMS 2007
- Global mean HCA -12×10^7 J/m^2



Johnson, Lyman, Willis, BAMS 2007

- HC increased in subtropical Pacific, but decreased in tropical Pacific – heat discharge
- HC increased in tropical Indian
- HC increased in Southern Ocean
- HC increased in subtropical North Atlantic

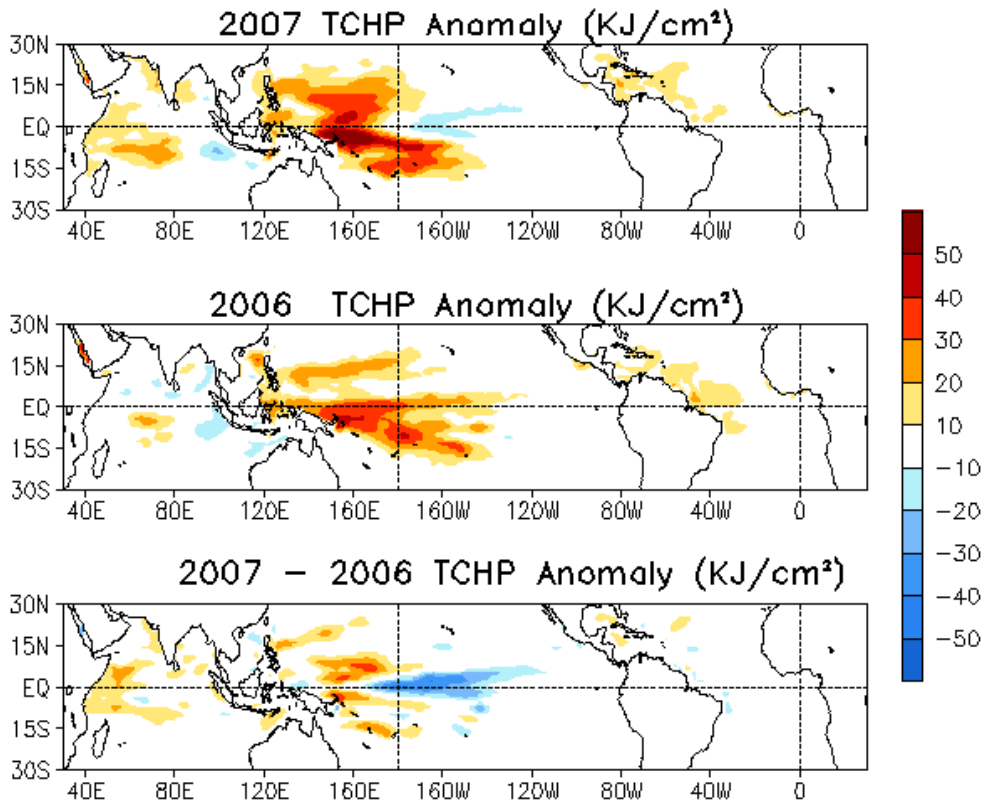
SST Anomaly for Atlantic Hurricane in Jul-Nov 2007



-**Tropical North Atlantic was cooler in 2007 than in 2006**

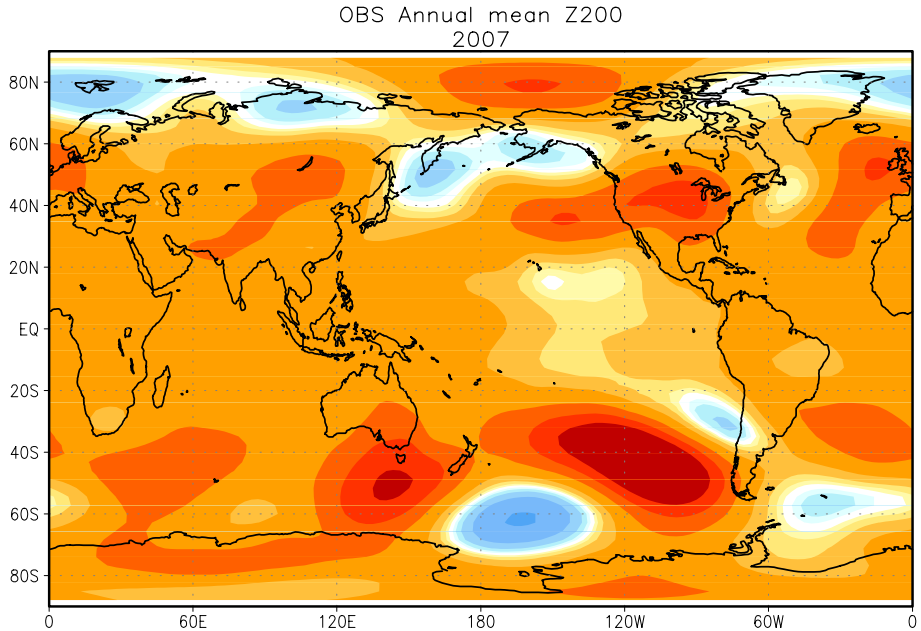
- **Strong positive SSTA north of Bering Sea corresponds to 2007 Arctic sea ice minimum**

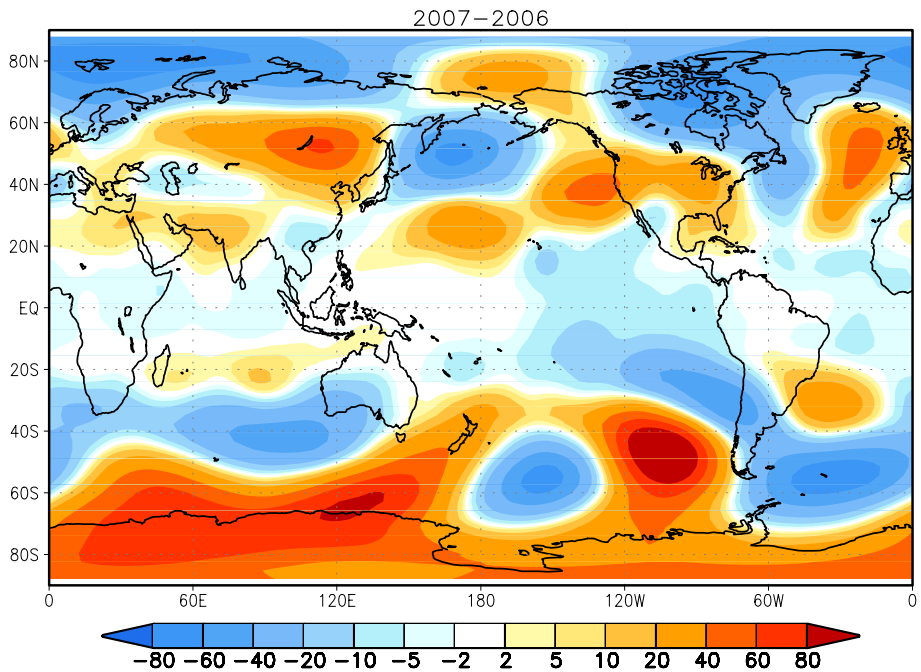
Tropical Cyclone Heat Potential (TCHP) Anomaly for Atlantic Hurricane in Jul-Nov 2007



- **TCHP in Atlantic Main Development Region was similar in 2007 and 2006, slightly above-normal.**

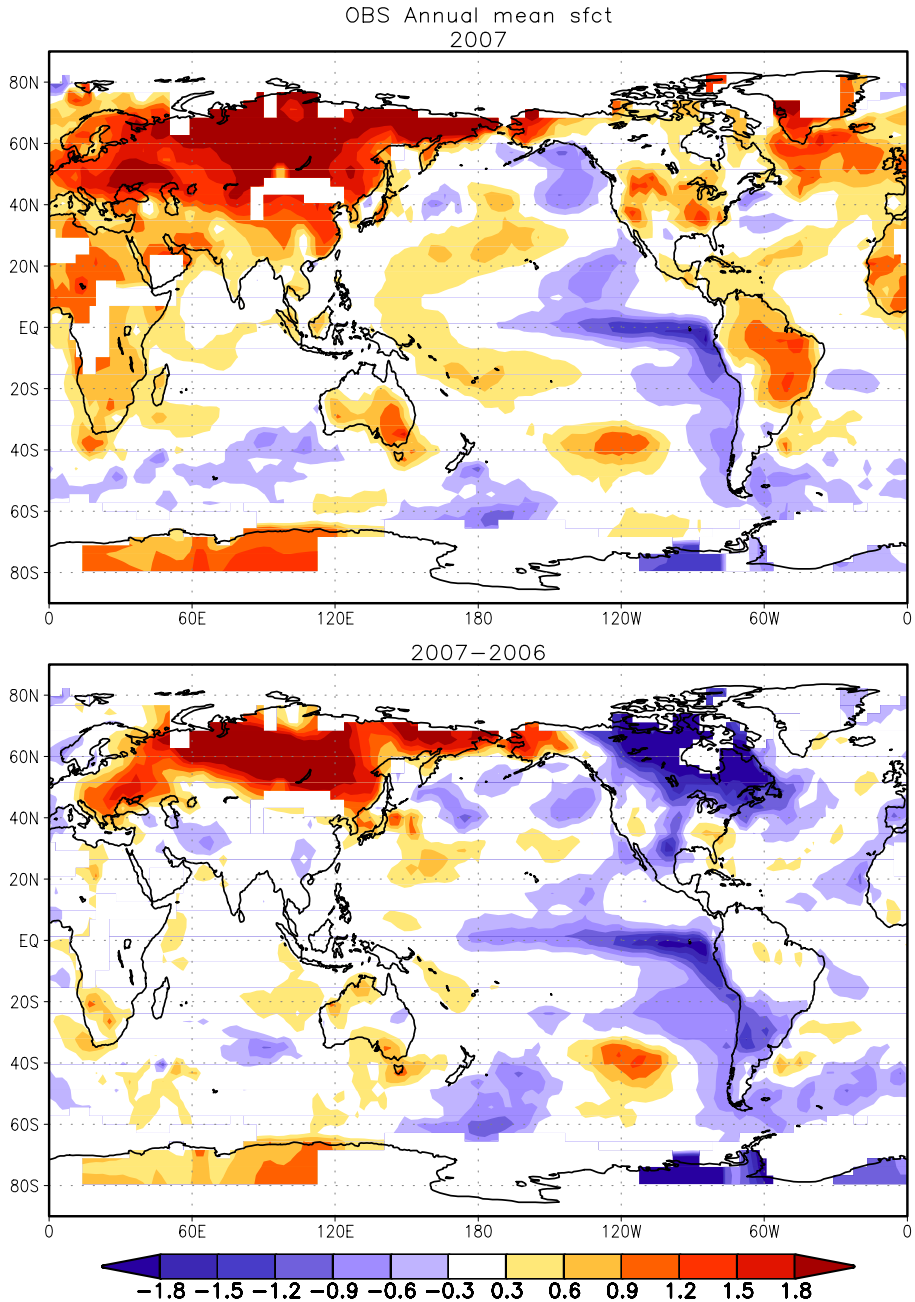
200-Mb Annual Mean Height Anomaly





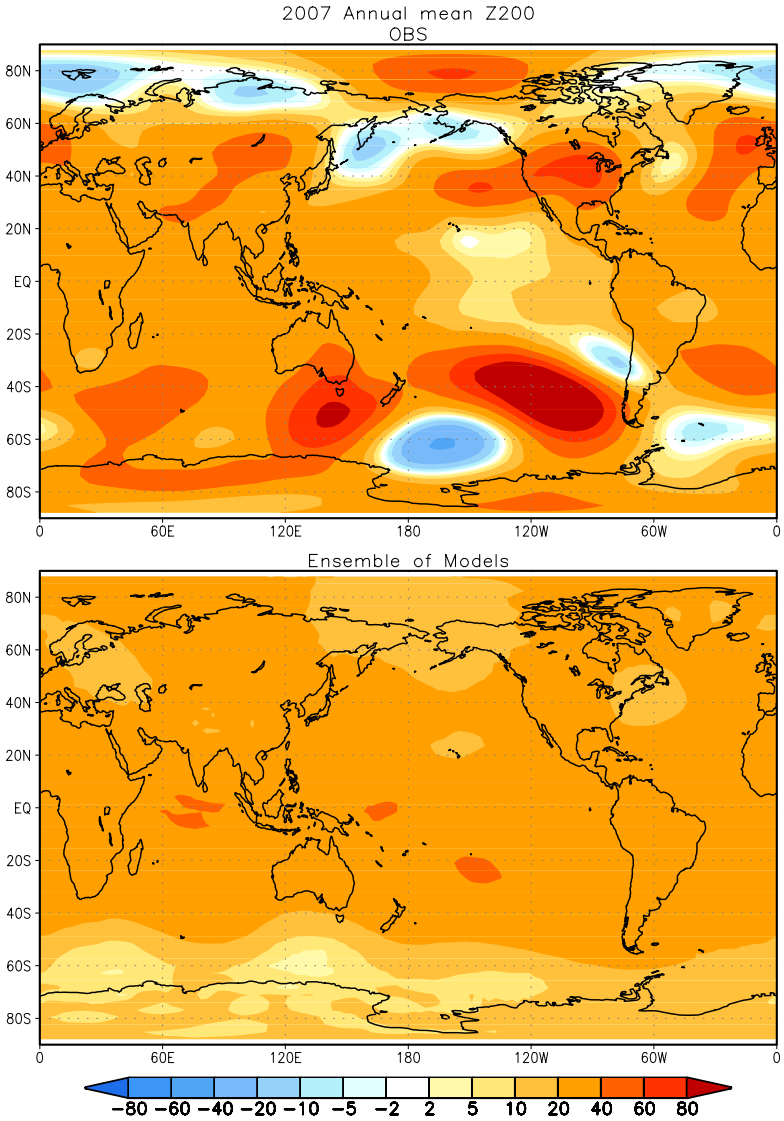
- **Positive height anomalies consistent with the above normal global mean SSTs**
- **However, tropical heights were lower than for 2006 possibly because of La Nina conditions in the tropical eastern Pacific**
- **Role of SSTs?**

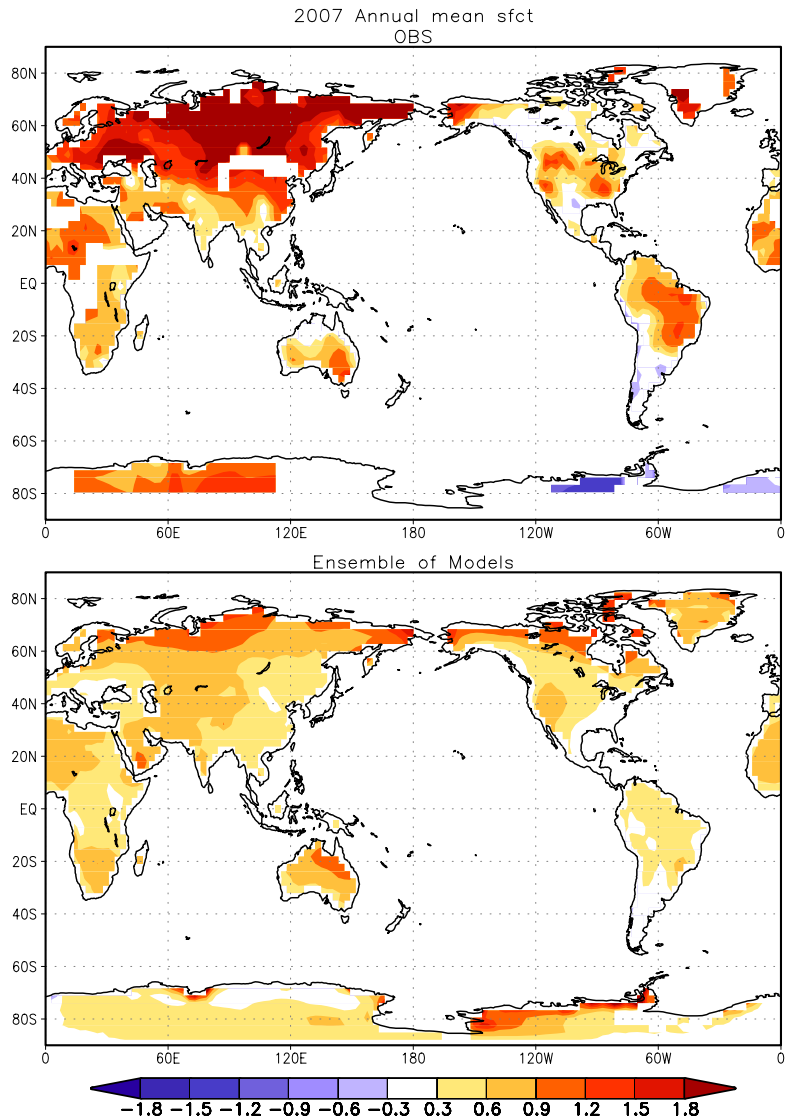
Annual Mean Surface Temperature



- Land average ~1.02 (warmest since 100; Ocean average~0.38 (9th warmest since 1900) …Source—NCDC)
- Land 1.02ºC (2007) vs. 0.77ºC (2006)
- Ocean 0.37ºC (2007) vs. 0.45ºC (2006)

Comparison of Obs and Model Simulations Forced with SSTs





- **For the annual mean, AGCMs were successful in simulating above normal heights and above normal land temperatures**