Global Ocean in 2006-2007

Prepared by
Climate Prediction Center, NCEP
February 8, 2008

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 < -1°C) 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 (°C) 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 0.13°C, 0.1°C 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 0.21°C

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

- 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

IOD Indices

- 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
- 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
- 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.
- 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
The 2007 upwelling season is close to normal. Negative PDO is associated with above-normal upwelling. The 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 the Western Hemisphere Warm Pool, Northwest Atlantic, and Southern subtropical Ocean. Net heat flux anomalies warmed the 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 the Gulf of Alaska, SPCZ, and high-latitude Southern Ocean. Net heat flux changes cooled the South Indian and 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

- 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 $8.6 \times 10^7$ J/m$^2$
- Major features consistent with "State of the Climate in 2006", BAMS 2007
- Global mean HCA $-12 \times 10^7$ J/m$^2$

- 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

Likely problematic due to lack of observations

Johnson, Lyman, Willis, BAMS 2007
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

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