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

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

• Overview

• Recent highlights
  – Pacific Ocean
  – Indian Ocean
  – Atlantic Ocean

• CFS SST Predictions
Overview

- **Global Ocean**
  - Global mean SST anomalies went to below-zero during the past winter due to the 07/08 La Nina cooling, and have been steadily increasing since then.

- **Pacific Ocean**
  - ENSO-neutral conditions: NIN03.4 for last week was +0.2°C.
  - CPC’s prognostic assessment: ENSO-neutral conditions will continue through fall.
  - Equatorial tropical Pacific heat content has recharged from Feb to May during the decay phase of the 07/08 La Nina, but discharged from May to July.
  - Easterly wind anomalies and suppressed convection in C. Pacific persisted.
  - Positive SST anomalies in the equatorial eastern Pacific continues to expand westward.

- **Indian Ocean**
  - Dipole Mode Index was above 0.5°C during June-July.
  - Easterly wind anomalies in the tropical Indian Ocean persisted during May-June switched to westerly wind anomalies in mid-July, probably due to the eastward progression of the MJO (see CPC MJO Diagnostic Assessment).

- **Atlantic Ocean**
  - In the hurricane Main Development Region, SST and Tropical Cyclone Heat Potential were above-average, vertical wind shears were below-average due to westerly (easterly) wind anomalies at 850 mb (200 mb) in July → favourable for hurricane development.
Global SST Anomaly (°C) and Anomaly Tendency

- Large positive SST anomalies presented in the western North Pacific and North Atlantic.
- Large positive SST anomalies presented in the Arctic Ocean.
- Weak negative (positive) SST anomalies presented in the central (eastern) equatorial Pacific.
- Weak-to-moderate negative SST anomalies presented in the south-eastern Indian Ocean.

- Weak warming in all nino-regions.
- Strong warming in the North Pacific.
- Strong warming (cooling) in the western (eastern) North Atlantic.
- Strong warming in the Arctic Ocean.
Sea Surface Height Anomaly (cm)

- Sea level anomalies increased (decreased) in the eastern (central) Indian Ocean.

- GODAS SSH agrees with Altimetry SSH well except in the Southern Oceans.
Positive temperature anomalies now extended across the entire equatorial Pacific near the thermocline.

Negative anomalies were confined to the upper 75 meters in the central and western Pacific.

Temperature increased at 50-150 m depth in the equatorial Indian Ocean.

Temperature decreased near the thermocline in the western and far eastern tropical Pacific.
- Tropical land temperature tracks the tropical ocean temperature well.
- Land temperature variability is larger than SST variability.
- GODAS heat content agrees poorly with that of the Coriolis ocean analysis based on the Argo data except in the tropical Pacific.
- Because GODAS SSH is a diagnostic variable, its global mean stays near 0, thus we cannot use GODAS to assess trends in seal level height.
Pacific Ocean
Evolution of Pacific NINO SST Indices

- ENSO-neutral conditions presented in July.
- NINO3 is slightly positive.
- Positive anomalies in Nino1+2 has persisted from February to July.
Warm Water Volume (WWV) is defined as average of depth of 20°C in [120°E-80°W, 5°S-5°N] (http://www.pmel.noaa.gov/tao/elnino/wwv/) and calculated with GODAS data.

- Warm Water Volume (WWV) has increased rapidly from February to May, but has decreased since then.
- SST increased east of the Dateline and in the far western Pacific.
- Suppressed convection and easterly (westerly) wind anomalies at 925mb (200 mb) presented in the western-central Pacific.
- Positive SST and westerly wind anomalies in the eastern Pacific continue to expand westward.
- Positive heat content anomalies in the central Pacific have switched to negative anomalies.
- Suppressed convection near the Dateline and enhanced convection in the western Indian Ocean persisted, but enhanced convection in the tropical Atlantic diminished.
Total Upwelling was weak south of 33N in July due to negative upwelling anomalies there. Upwelling was suppressed along most of the coast near the end of July.

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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.
Monthly Chlorophyll Anomaly
http://coastwatch.pfel.noaa.gov/FAST

Negative Chlorophyll anomalies south of 43N were largely consistent with suppressed upwelling there.
Indian Ocean
Recent Evolution of Indian Ocean SST Indices

- Tropical Indian Ocean SST is cooler than that last year.
- Dipole Mode Index (DMI) was above 0.5°C in June-July.
Enhanced convection over the western Indian Ocean, and suppressed convection in the south-eastern Indian Ocean, are consistent with positive (negative) SST anomalies in the central (south-eastern) Indian Ocean.
Recent Evolution of Equatorial Indian SST (°C), 0-300m Heat Content (°C), 850-mb Zonal Wind (m/s) and OLR (W/m²) Anomalies

Easterly wind anomalies persisted in May-June switched to westerly wind anomalies in mid-July in the western-central Indian Ocean, probably due to the eastward progression of the MJO (see CPC MJO Diagnostic Assessment).

- Negative heat content anomalies in the eastern Indian Ocean weakened substantially.
- Enhanced convection in the western Indian Ocean has persisted for two months, and reduced the SST in that region.
Atlantic Ocean
Evolution of Tropical Atlantic SST Indices

- Tropical North Atlantic SST has been steadily increasing since April.
- Meridional Gradient SST (TNA-TSA) is approaching zero in July.
- SSTs increased in the hurricane Main Development Region (MDR).
- Westerly (easterly) wind anomalies at 850 mb (200mb) resulted in below-average wind shear in MDR.
- Tropical Cyclone Heat Potential was above-average in MDR, favourable for hurricane development.
SST Anomaly in North Atlantic

- High-latitude North Atlantic SSTAnomaly (°C) are closely related to NAO index – negative NAO leads to SST warming and positive NAO leads to SST cooling.

- Negative NAO persisted over last 3 months has caused large warming in the North Atlantic.
CFS SST Predictions and Ocean Initial Conditions
CFS Niño 3.4 SST Predictions from Different Initial Months

Latest forecasts are calling for ENSO-neutral conditions.
CFS Indian Ocean Dipole (DMI) SST Predictions from Different Initial Months

Starting from May I.C., CFS has been predicting a positive Indian Ocean Dipole. For Jan-Apr 08 I.C., CFS called for a strong negative IOD event to be developed in fall 08.
CFS Atlantic Main Development region (85W-20W,10N-20N) SST Predictions from Different Initial Months

CFS forecasts missed the warming over the past 2 months. The forecast continues to damp to climatology.
Summary

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

Heat Content in Eastern Indian Ocean has decreased.
- Cooling near the west coast of North America and Gulf of Alaska persisted
- Anti-cyclonic wind anomalies near the coast of California, favorable for coastal upwelling
- Large amount of warming is radiative
CFS  E10 SST anomalies (K)

IC=Nov2007  IC=Feb2008  IC=May2008
IC=Dec2007  IC=Mar2008  IC=Jun2008
IC=Jan2008  IC=Apr2008  IC=Jul2008

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Individual forecast members  Forecast ensemble mean  Observations
Eastern Pole Forecasts from FRCGC....
Monthly Time Series

CAMS
3-Month running mean Temperature (Climo. 1982–2004)

CDAS
3-Month running mean Temperature (Climo. 1982–2004)
Monthly Time Series

CDAS-2
3–Month running mean Temperature (Climo. 1982–2004)

Global Land

North America (180°–360°, 30°N–80°N)

Eurasia (OE–180W, 30°N–80°N)

Africa/Australia (OE–180W, 30°N–90°S)

South America (180°–360°, 30°N–90°S)

JRA-25
3–Month running mean Temperature (Climo. 1982–2004)

Global Land

North America (180°–360°, 30°N–80°N)

Eurasia (OE–180W, 30°N–80°N)

Africa/Australia (OE–180W, 30°N–90°S)

South America (180°–360°, 30°N–90°S)
**Data Sources**

- Optimal Interpolation SST (OI SST) version 2
- Reconstructed SST (ERSST) version 3
- NCEP/NCAR Reanalysis-1 wind, velocity potential and heat fluxes
- NOAA’s Outgoing Long Wave Radiation
- PMEL TAO equatorial temperature analysis
- NCEP’s Global Ocean Data Assimilation System (GODAS) temperature, heat content, currents
- Aviso Altimetry Sea Surface Height
- Ocean Surface Current Analyses – Realtime (OSCAR)