PIRATA: Some Operational Oceanography highlights

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PIRATA areas of interest also key issues for ocean forecasting systems

- Cyclogenesis
- North Equatorial Current

- Oxygen Minimum Zone
- NECC evolution

- North Brazil Current retroflexion into the North Equatorial Counter Current:
- Amazone River influence

- North Brazil Current
- SEC bifurcation

**Gulf of Guinea:**
- Cold tongue
- Equatorial upwelling
- Congo River influence
- Coastal upwellings

**Benguela-Angola Front Zone:**
- SST bias,
- SST front migration
- Coastal upwellings
PIRATA and Operational Oceanography

Real time daily averages

GDAC Coriolis

Forecast Centres

Forecast Centres
PIRATA and Operational Oceanography

Real time in-situ data collection at Mercator Océan: pre-processing by type of data

Other kind of data from PIRATA cruises also used when available (TSG, XBT, CTD..)

Few daily data in the Tropical Atlantic
Temperature innovation: misfits between observation and model guess (or forecast)
Assimilation impact of in situ data in the Tropical Atlantic
Comparison between Mercator global 1/12° hindcast and PIRATA
Quarterly systematic operational validation: OND 2014 misfits statistics among Mercator forecasting systems
Forecasting skill monitoring by comparison to in-situ data

PIRATA and Operational Oceanography

RMS error (Obs - Mod) FCST3D TEMP TAT OND 2014

RMS error (Obs - Mod) TEMP TAT PSY4V2R2 OND 2014

Legend:
- WOA09
- BEST
- F1
- PSY2
- F3
- PSY3
- F5
- PSY4
• GDAC (Coriolis…) database are regularly qualified to propose dedicated dataset for assimilation on ocean reanalysis: EN3, CORA3.4 ….

• The ocean reanalysis community (mostly ocean and climate/seasonal forecast centres) is regularly providing improved ocean reanalysis: most are eddy-permitting over the altimetric era.

• In the framework of CLIVAR/GSOP and GODAE OceanView an Intercomparison exercice has been carried out recently: ORA-IP results under publication in Clim. Dyn.

• In operational mode, ocean estimation is carried on, and synthetized at NCEP.
PIRATA tropical moorings and impact on reanalyses and ocean estimation

<table>
<thead>
<tr>
<th>Product</th>
<th>Institution</th>
<th>Configuration</th>
<th>Control method</th>
<th>Reference</th>
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<tr>
<td>CFSR</td>
<td>NOAA NCEP</td>
<td>1/2° MOM4 coupled</td>
<td>3DVAR (T)</td>
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<td>GloSea5</td>
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<td>Fuji et al (2009)</td>
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<td>OI (SLA)</td>
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Tropical Atlantic Sea Level

- Sea level trend assessment
- Definition of averaging boxes with consistent signals (SL index)
- Analysis of the seasonal and interannual variability
- Assessment against SL observed products / Tide Gauges
- Assessment of the ensemble average

Sea Level Trend (mm/year) from ARMOR3D (AVISO)
Contribution of steric signals to SL

Variability of interannual signals: 0-100m steric vs sea level
Climate Observation Division
Historical TAO reporting + ship resourcing

TAO Array Data Return
January 2003 - July 2013

ship days

Total Data Return (%)

Number of Buoys Reporting Data
The ensemble mean (ensemble spread) can be used to measure signal (noise).

The signal-to-noise (SN) ratio is relatively low in the western (central-eastern) Pacific where negative (positive) anomalies presented.

The low signal-to-noise ratio may be partially attributed to the sparse observations in those regions.

Courtesy of Yan Xue
Influences of ocean observations on spread among ocean reanalyses

Courtesy of Yan Xue
Real-Time Multiple Ocean Reanalyses Intercomparison

Jul 1982

Anomalous Temperature (°C) Averaged in 5S-5N: JUL 1982

NCEP

JMA

ECMWF

CFDL

NASA

BOM

ENS. Mean

SN Ratio

Jul 2015

Anomalous Temperature (°C) Averaged in 5S-5N: JUL 2015

NCEP

JMA

ECMWF

CFDL

NASA

BOM

ENS. Mean

SN Ratio

Courtesy of Yan Xue

(http://origin.cpc.ncep.noaa.gov/products/GODAS/multiora_body.html)
Tropical Atlantic:
SST Anom., SST Anom. Tend., TCHP OLR, Sfc Flx, 925-mb/200-mb Winds and RH

- Negative SSTA and TCHP continued in the hurricane Main Development Region (MDR).
- Above-normal vertical wind shear was observed in MDR in July 2015.

Courtesy of Yan Xue
July 2015 Ocean synthesis overview at NCEP

➢ Pacific Ocean
- El Niño conditions strengthened in July 2015 and the Nino34 index (+1.6°C) exceeded the threshold for a strong El Niño (>=1.5°C).
- Most model predictions called for a strong El Niño through the Northern Hemisphere fall-winter 2015.
- Upper ocean warming associated with the "Blob" has persisted since winter 2013/2014.
- Positive PDO phase strengthened, with the PDO index increased from +0.7 to +1.5 in July.

➢ Indian Ocean
- Positive SSTAs dominated the whole Indian Ocean.

➢ Atlantic Ocean
- NAO switched to negative phase with NAOI = -3.1 in July.
- NOAA’s updated hurricane outlook called for 90% chance of below-normal Atlantic hurricane season.
Concluding remarks

• PIRATA mooring data are used in real time by most ocean and seasonal forecast centres
• Tropical Atlantic is not correctly covered (Argo) and PIRATA offers the main source of T/S information at depth
• PIRATA data are key data to assess ocean forecast skill on daily basis

• At depth, ocean reanalyses T/S reliability depends strongly on PIRATA data: a lack of ship servicing like in the Tropical Pacific would impact more ocean estimates in the Atlantic (less Argo profiles)

• Ocean estimation monitoring are now in place in several operational centres, and international collaboration is now in place