Recent enhanced observations in the equatorial Pacific with Argo floats

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IMPROVEMENTS OF THE EQUATORIAL COVERAGE

Before 2014 - reasonably good resolution of long zonal-scale seasonal and longer variability (Roemmich and Gilson, 2009) - Recommendations (OceanObs’09, endorsed by Argo ST) have been made to enhance float coverage near the equator for improved estimation of intraseasonal variability.

March 2014

deployments of 41 floats (Jan-Mar 2014)

S/V Investigator

(Pictures from Graham Wragg)
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March 2014

March 1998

March 2012

XBT, TAO, CTD, profilers (WOA13)

~objective of 3°x3°

the 41 floats deployed

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NEW FLOAT GENERATION (SOLOII)

- Profile 0-2000 dbar anywhere in the world ocean (increased buoyancy control).
- Have increased battery life for > 300 cycles (6 years at 7-day cycles).
- Use Iridium 2-way communication for:
  - Short surface time (15 mins) to greatly reduce equatorial divergence, grounding, bio-fouling, and other hazards.
  - High vertical resolution (2 dbar full profile).
  - Improved surface layer sampling (1 dbar resolution, with pump cutoff at 1 dbar).
- Are lightweight (18 kg) for easier shipping and deployment, and increasingly robust.

Effects on the equatorial divergence

Note strong (10 cm/s) annual velocities at 1000 m, Annual Rossby reverse currents
COVARIANCE FUNCTION

==> Normalised covariance of Steric Height anomalies (0/2000) from the climatological cycle

**Using 5 years of data**
(Roemmich and Gilson 2009)

**Using 10 years of data**

- In the tropics, thermosteric component dominates, except in the western Pacific due to salinity stratification.
  → East/West differences

- More accurate covariance function than Roemmich and Gilson (2009)

→ More data are needed to have more accurate covariance function
The ESTIMATED ERROR (mean square error) in any optimal average is:

- proportional to the signal variance,

- dependent on the individual data points only in terms of the data spacing, not the individual data values themselves,

- the chosen spatial/time scales and signal-to-noise.

**ASSESSMENT OF THE ESTIMATED ERRORS IN TEMPERATURE**

100-m temperature Argo/TAO and errors at 140°W, 0°N, 100m

*RMS T° Argo = 2.6°C*
*RMS T° TAO = 2.6°C*
*RMS diff = 0.8°C*
*RMS error = 0.9°C*
EVOLUTION OF ERRORS FOR THERMOCLINE TEMPERATURE

→ Effect of the 41 floats deployed in 2014 on temperature errors

- Very low error along the equator
- Increasing of the accuracy thanks to the 2014 deployments
- Stronger errors for latitudes > 2-3°

→ Decrease of around 0.2°C thanks to the 41 deployed floats
SALINITY IN THE WESTERN PACIFIC

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SALINITY IN THE WESTERN PACIFIC

Representation of the SSS front

Impacts of errors on density

Effect of TAO/Argo error when Argo_subsampled close to Argo
Effect of sampling when TAO_subsampled close to TAO

Effect of TAO/Argo error when Argo_subsampled close to Argo
Effect of sampling when TAO_subsampled close to TAO

Impacts of errors on density
NEAR REAL TIME CAPACITY

Time longitude diagrams along the equator

average from 1.5°S to 1.5°N.
3. Representation of equatorial variability

**ANNUAL CYCLE - ALTIMETRIC SSH / ARGO SH anomalies**

**What is the climatological cycle at the equator in the upper ocean?**
- Quasi annual Rossby waves
- Negative anomalies first half
- Positive anomalies second half
- Downwelling Kelvin waves amplify positive anomalies in the 2nd half.
3. Representation of equatorial variability

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  - Inversion of the zonal gradient
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- **What did happen in 2014?**
  - Strong downwelling Kelvin waves at the beginning of the year
  - Similar situation in the first half than the 2nd half for El Niño

average from 1.5°S to 1.5°N.
SUMMARY

• More than 10 years of Argo data
• Strong improvements since 2006,
• 41 floats have been deployed along the equator from 100°W to 160°E, which is an enhancement, not a substitution

Technical impacts:
• Obvious decreasing temperature errors
• Salinity impacts in the western Pacific
• Errors off-equatorial regions (>2-3°)

Scientific impacts:
• Well-resolved intraseasonal variability (20-100 days)
• SSS front resolved at monthly time scales
• Off-equatorial representation seems to be insufficient

PERSPECTIVES

• Maintenance of the actual array
• Deployment of many floats in the eastern Pacific
• Divergence experiments
• Western Pacific