Recent enhanced observations in the equatorial Pacific with Argo floats

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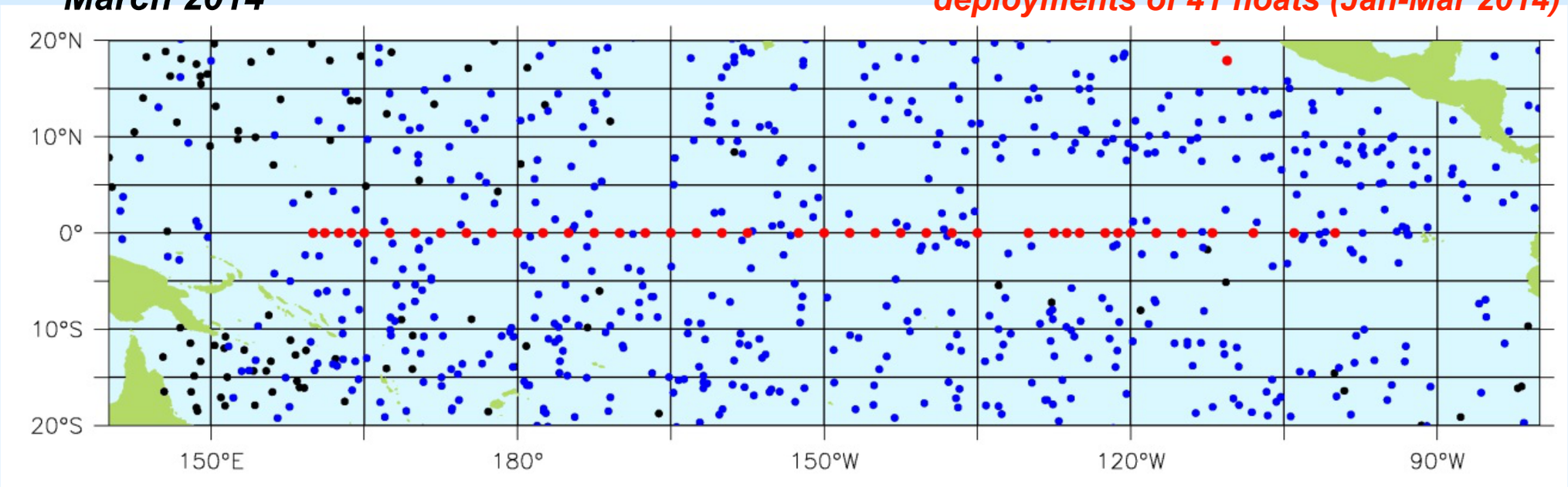
AST-15
Brest, March 2015

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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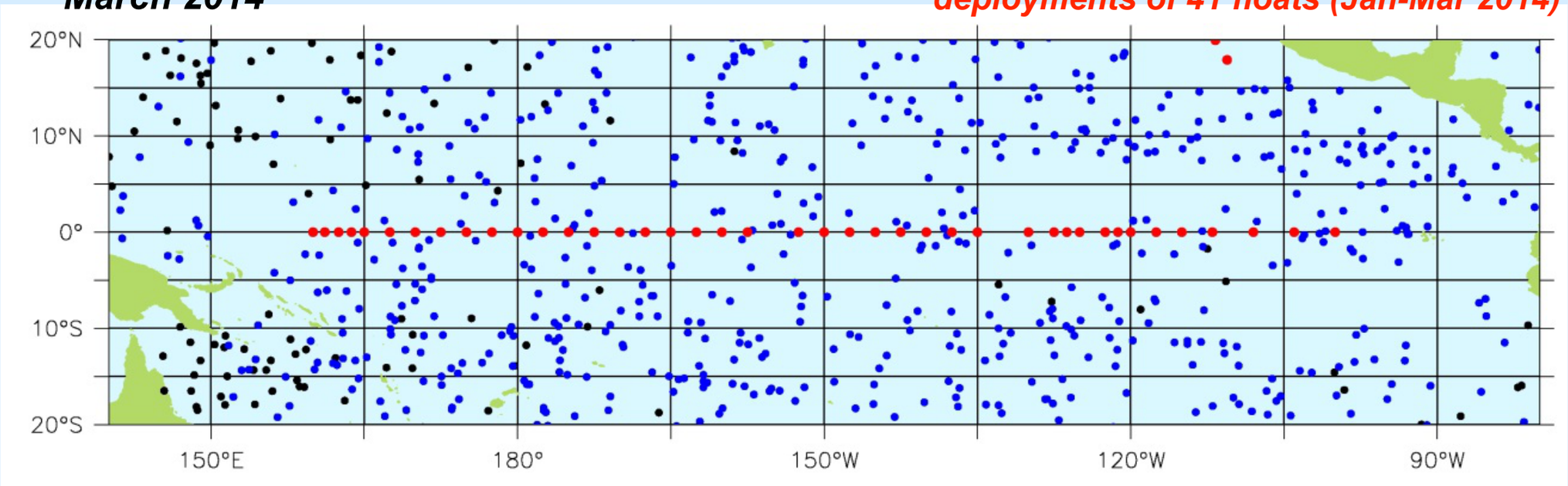
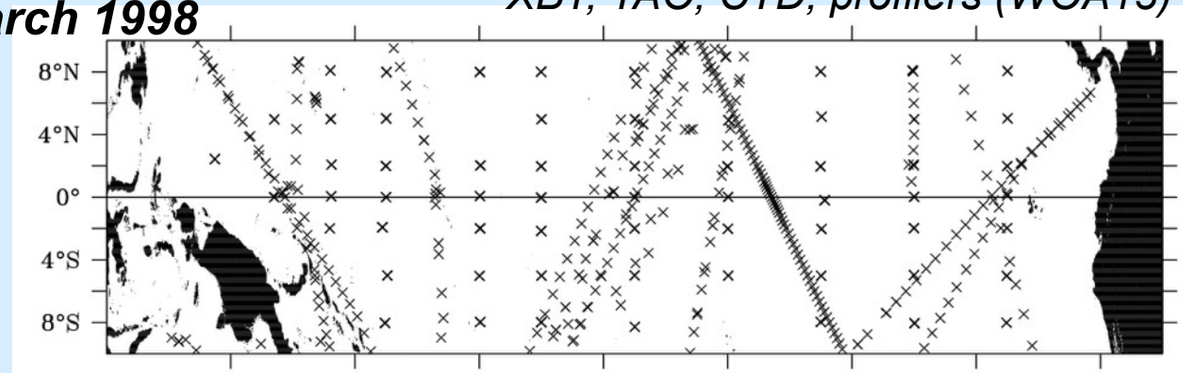
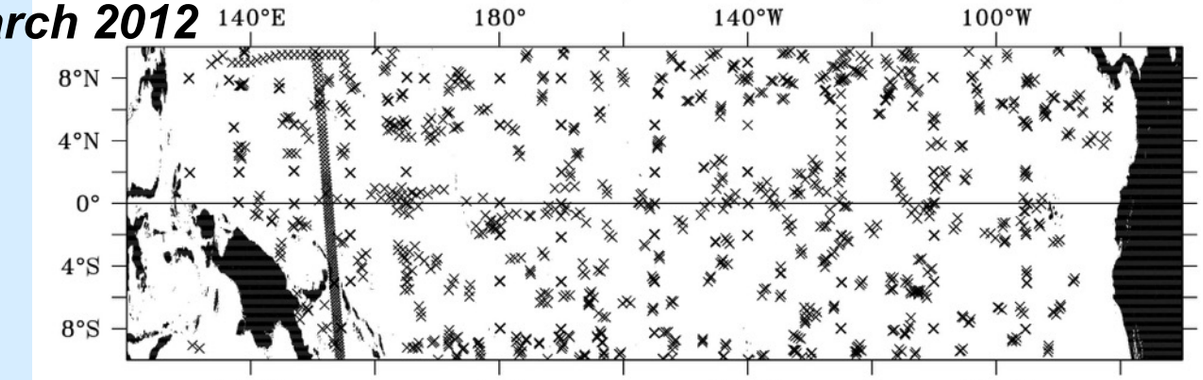


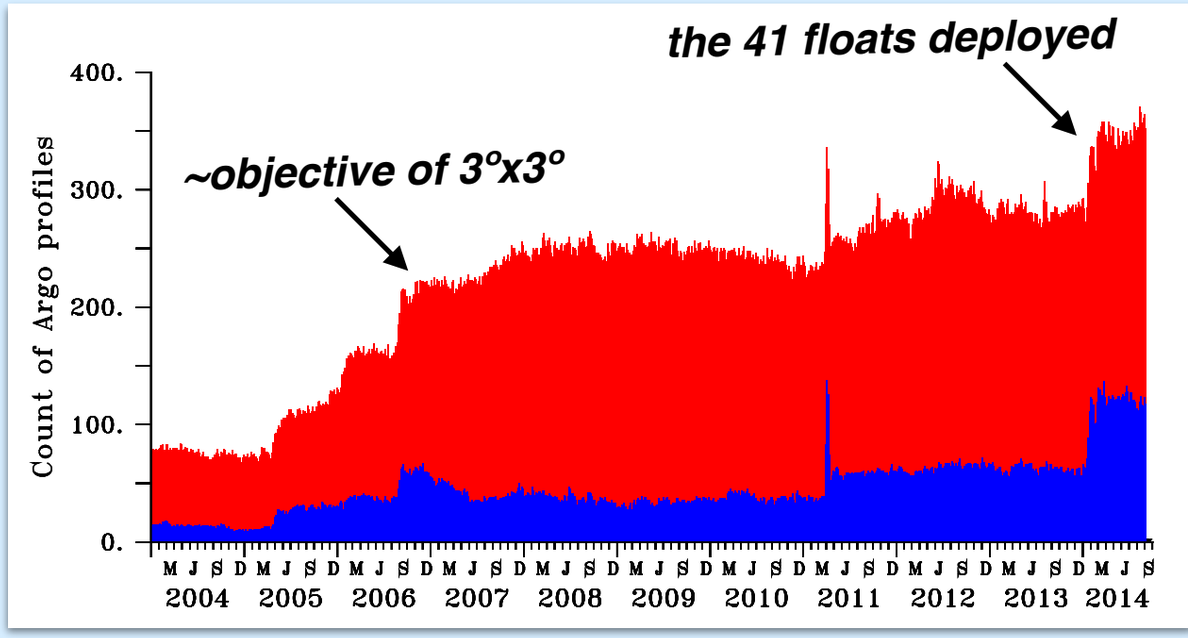
XBT, TAO, CTD, profilers (WOA13)

March 1998



March 2012



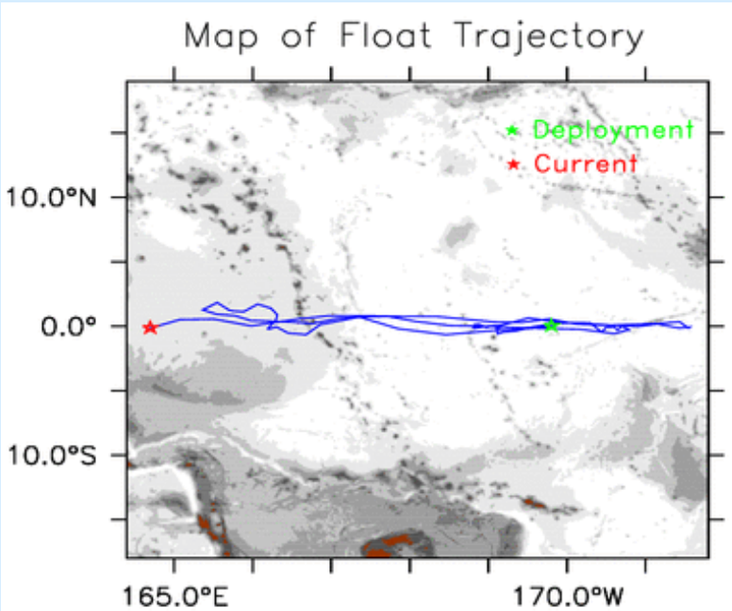


NEW FLOAT GENERATION (SOLOII)

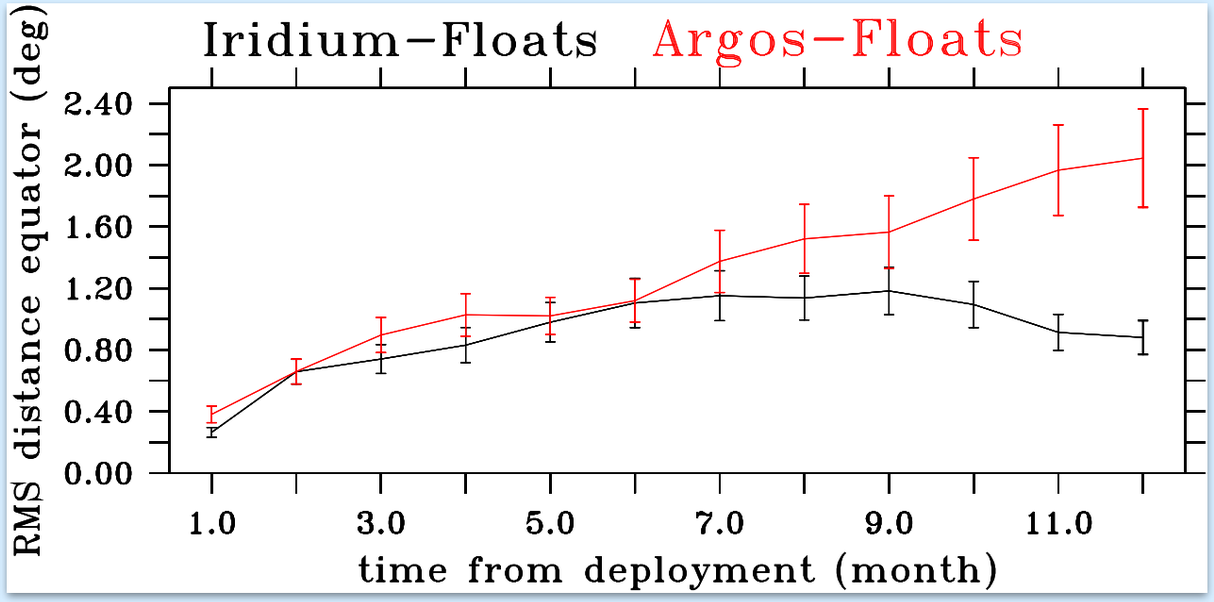
- Profile 0-2000 dbar anywhere in the world ocean (increased buoyancy control).
- Have increased battery life for > 300 cycles (6 years at 7-day cycles).
- Use Iridium 2-way communication for:
  - Short surface time (15 mins) to greatly reduce equatorial divergence, grounding, bio-fouling, and other 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.

SOLO-II (Iridium float) ***SOLO-I (Argos float)***

Effects on the equatorial divergence



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

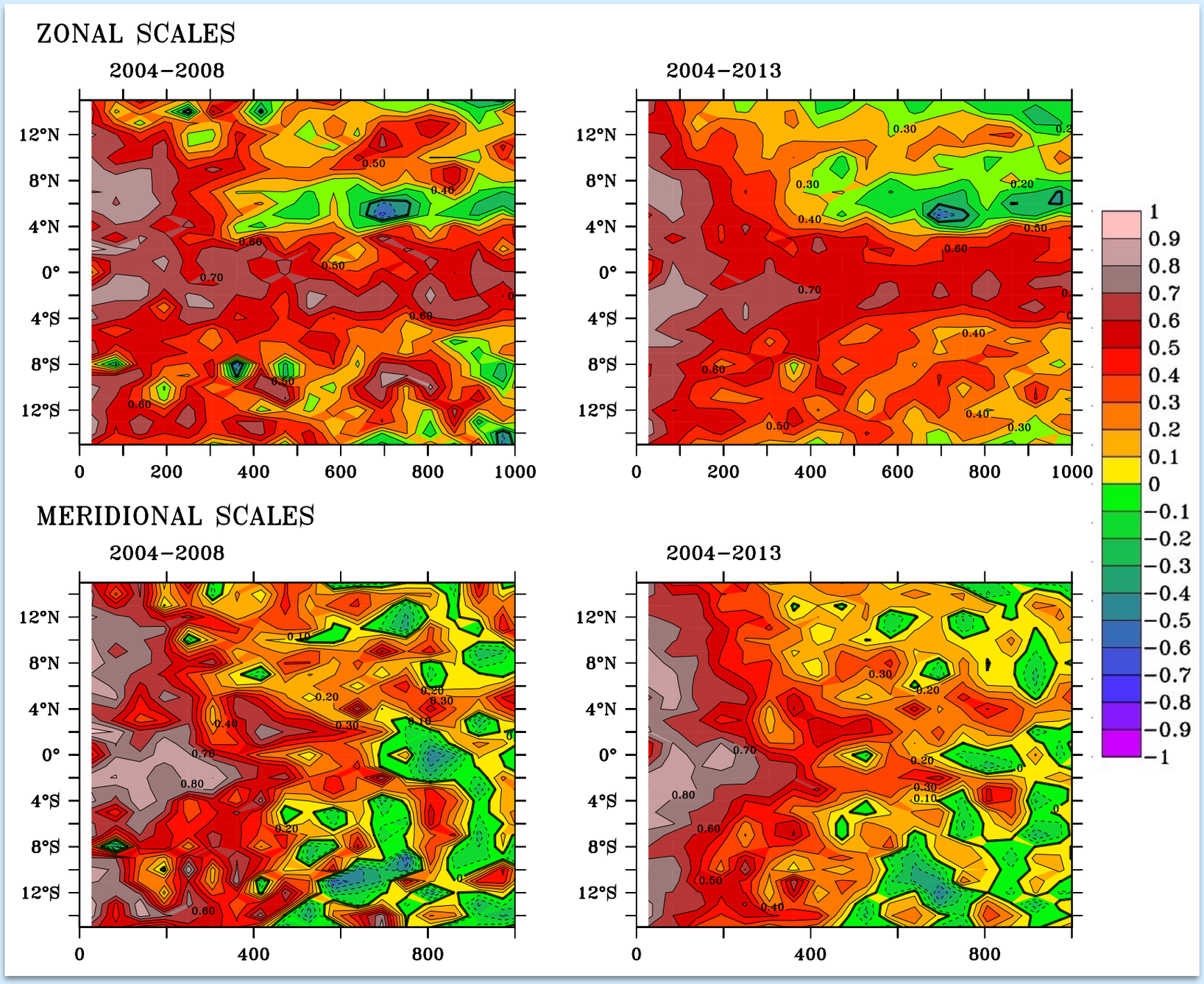


COVARIANCE FUNCTION

==> 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

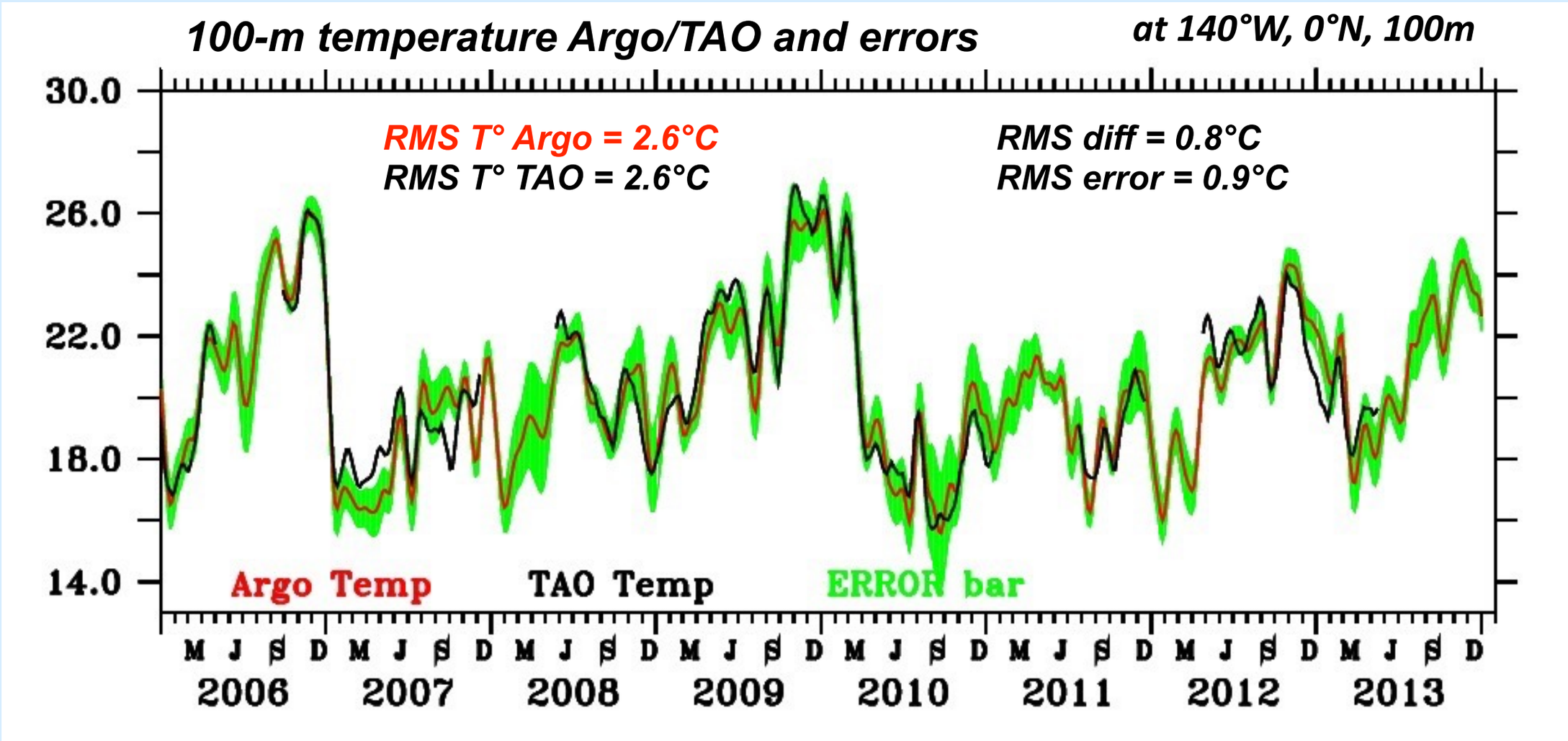
ASSESSMENT OF THE ESTIMATED ERRORS IN TEMPERATURE

The ESTIMATED *ERROR* (**mean square error**) in any optimal average is:

- proportional to the **signal variance,**

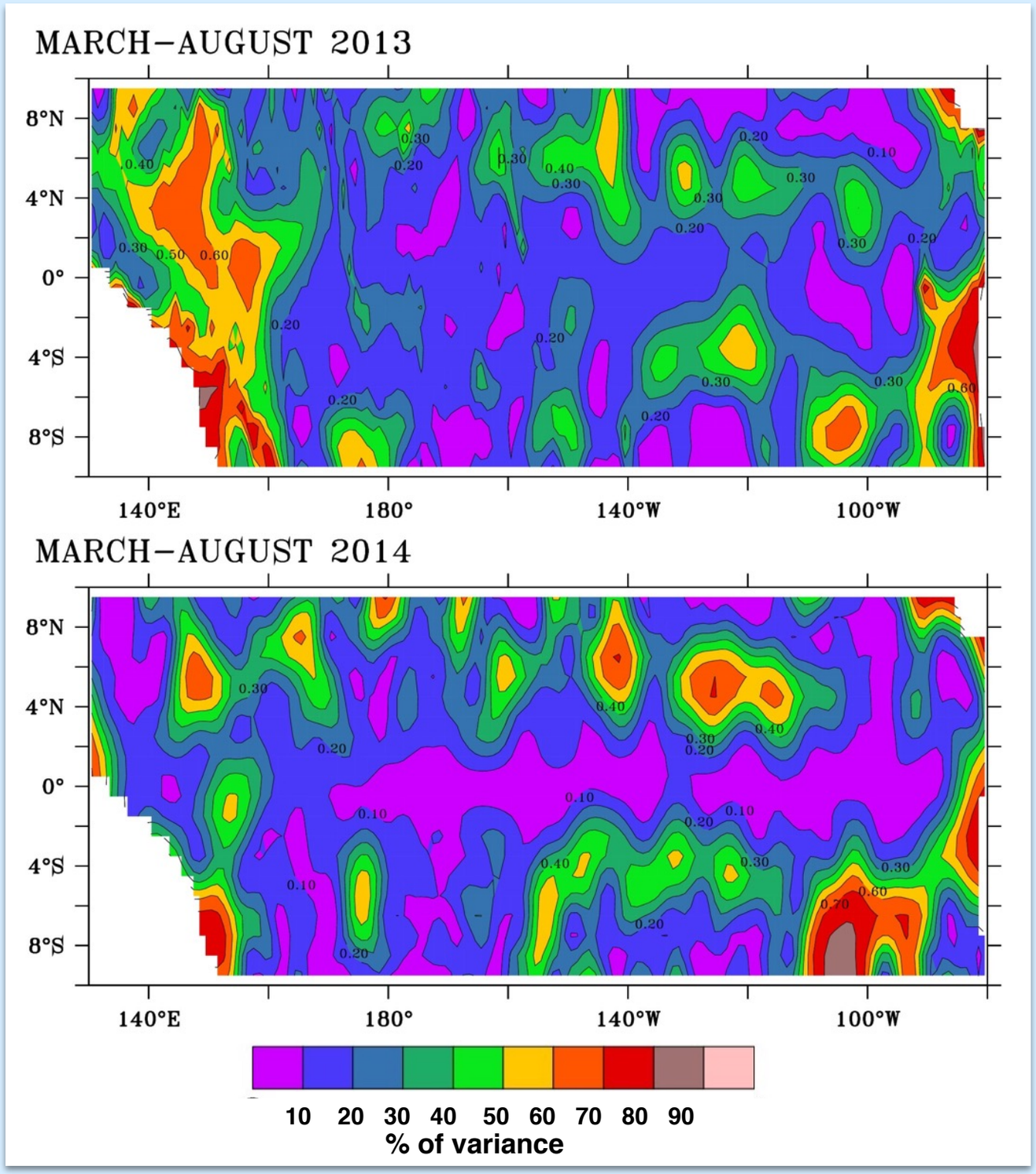
- dependent on the individual data points only in terms of the **data spacing,** not the individual data values themselves,

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



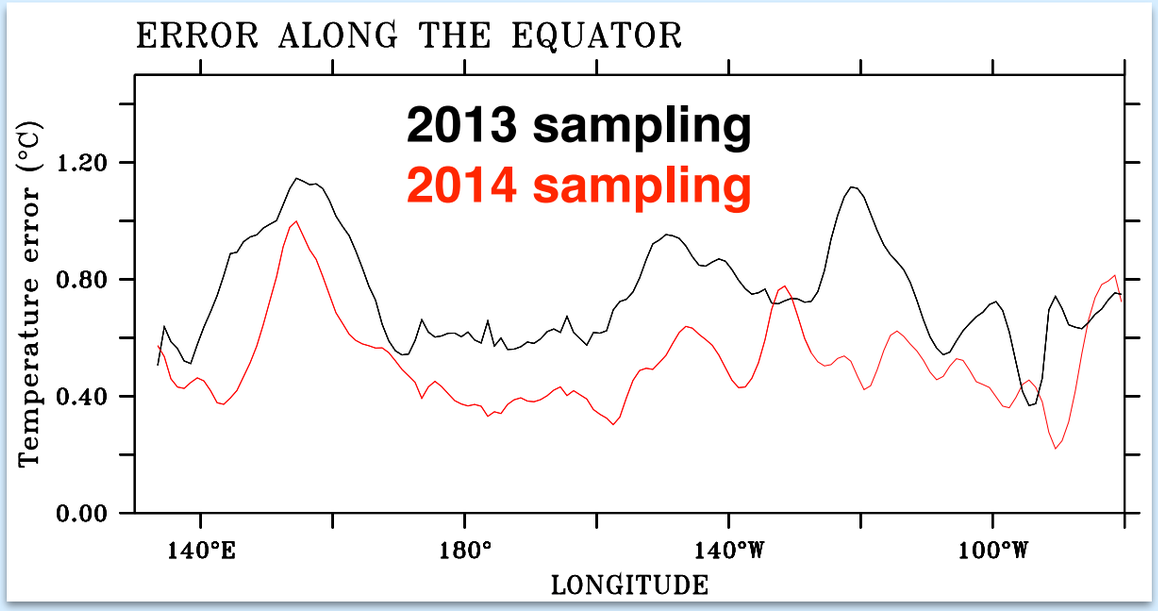
EVOLUTION OF ERRORS FOR THERMOCLINE TEMPERATURE

→ 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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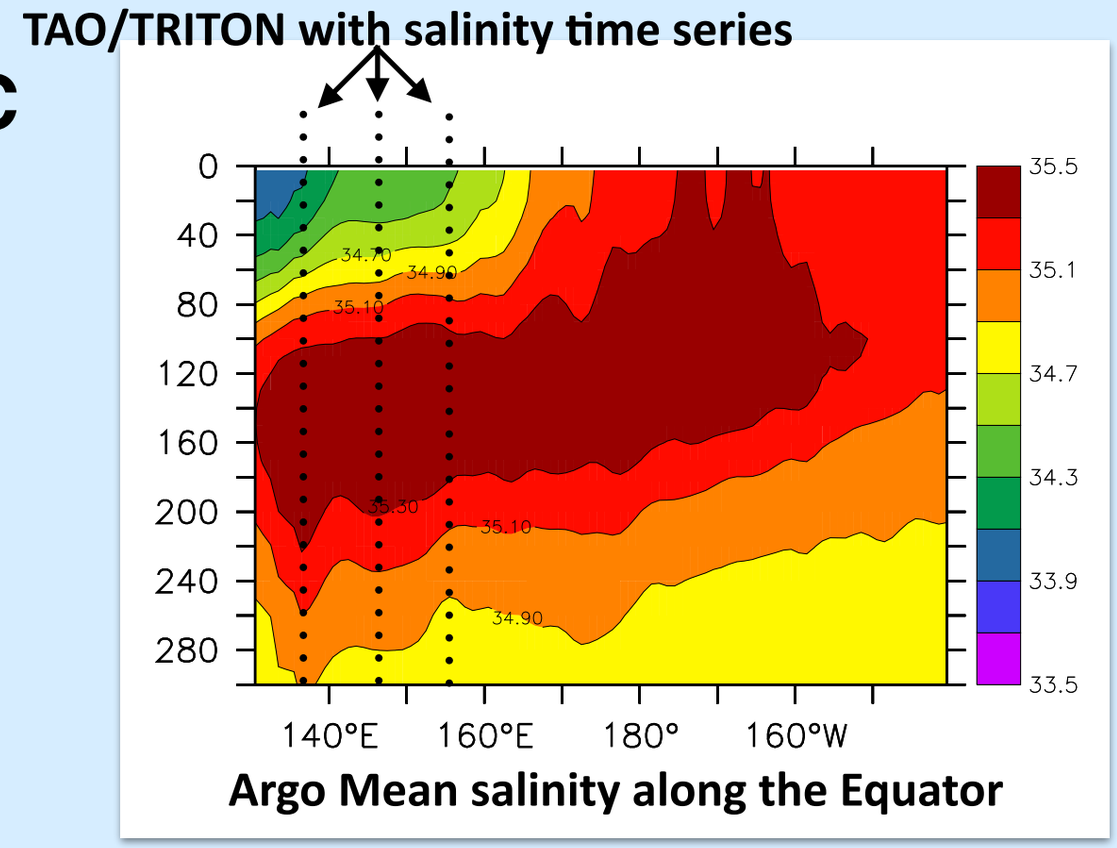

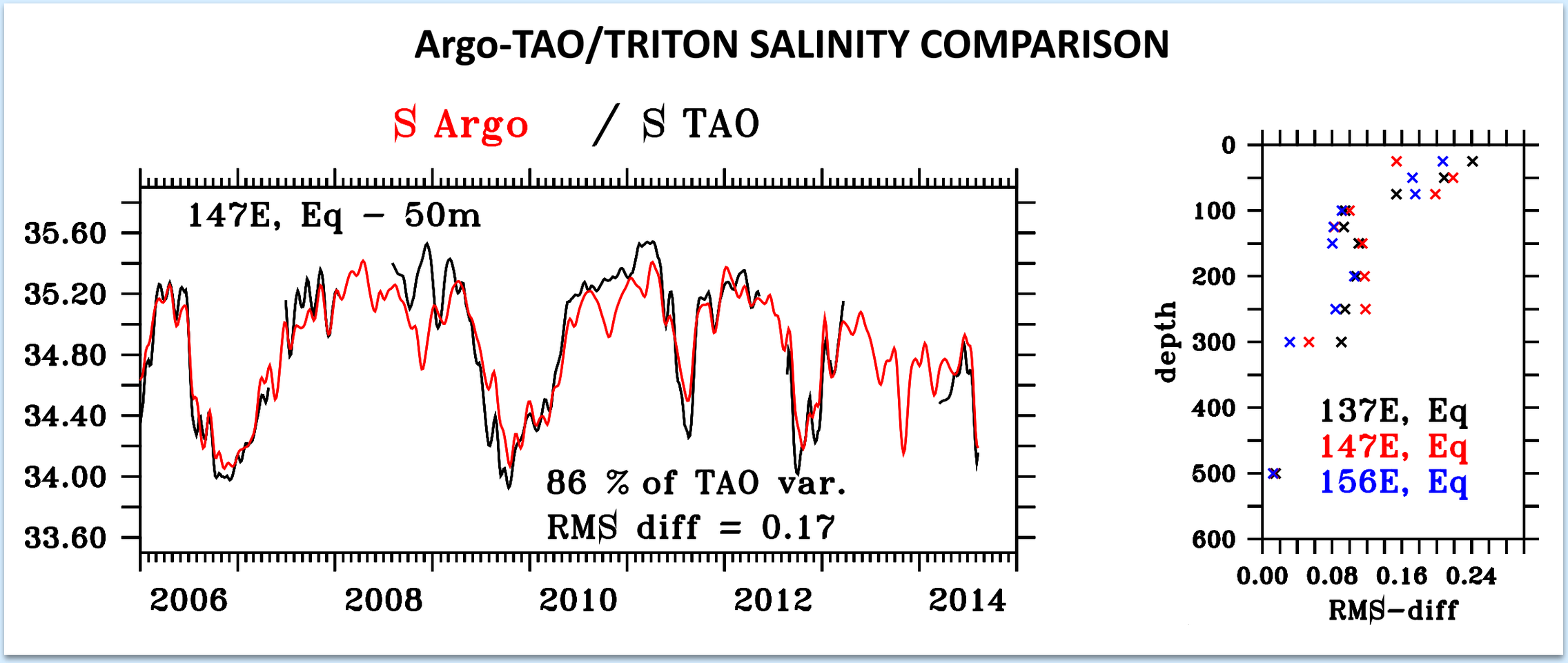

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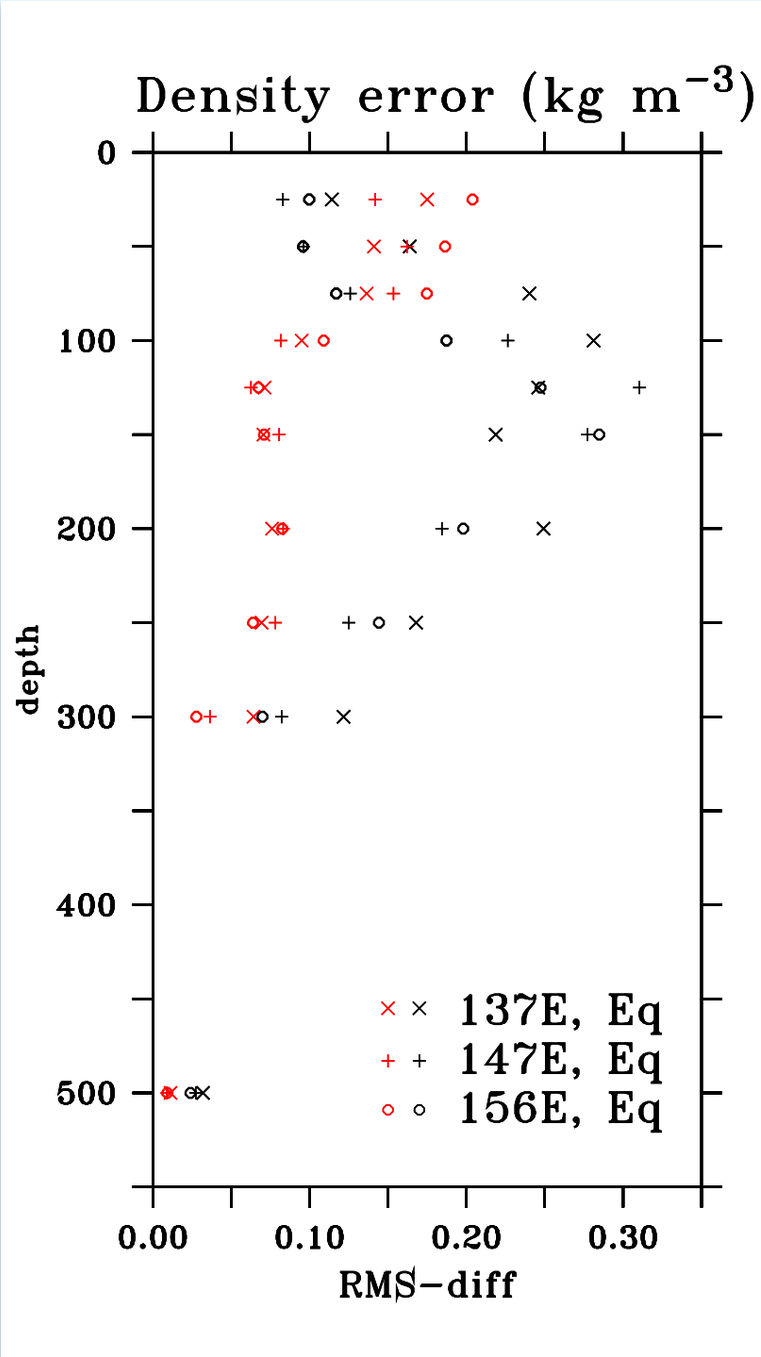
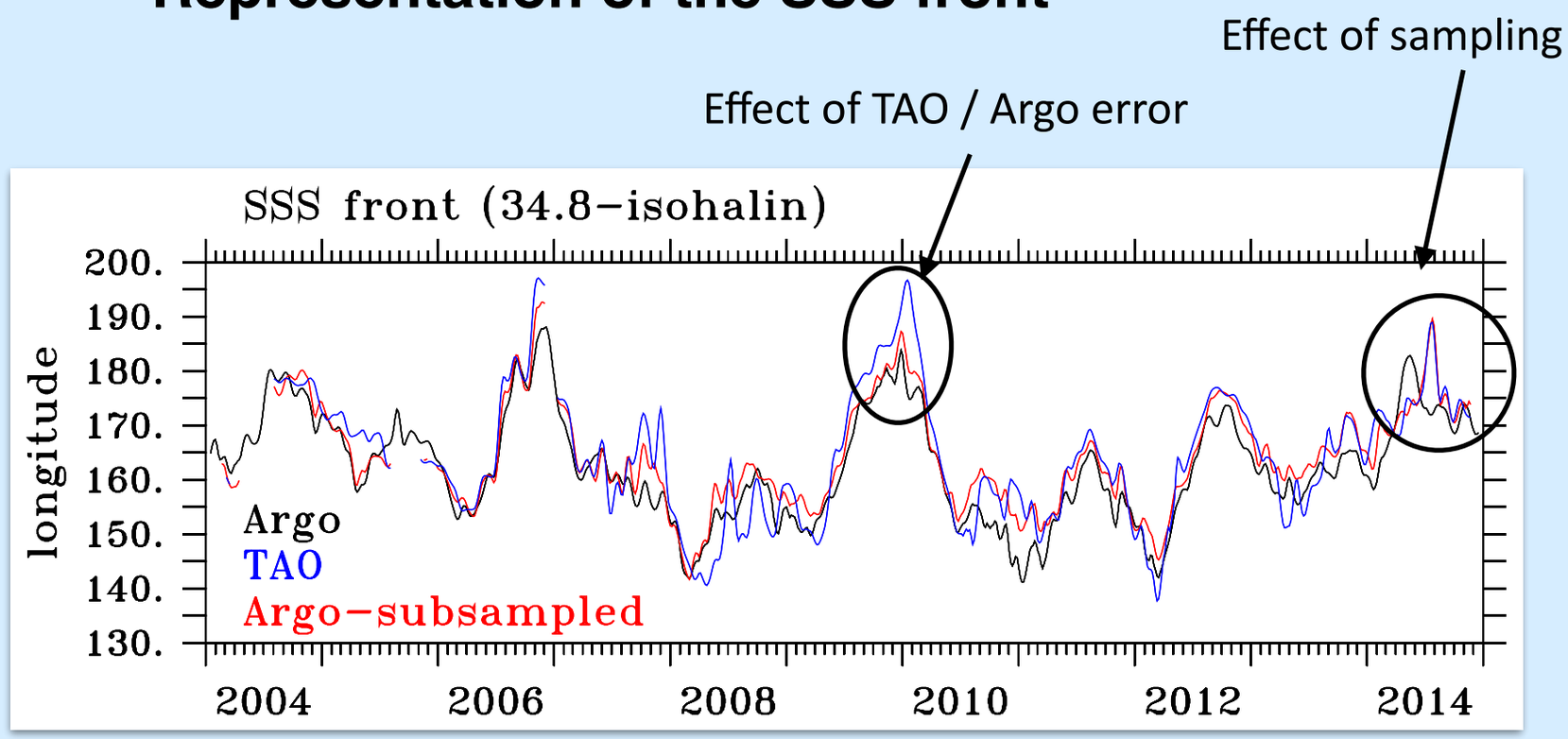


Representation of the SSS front



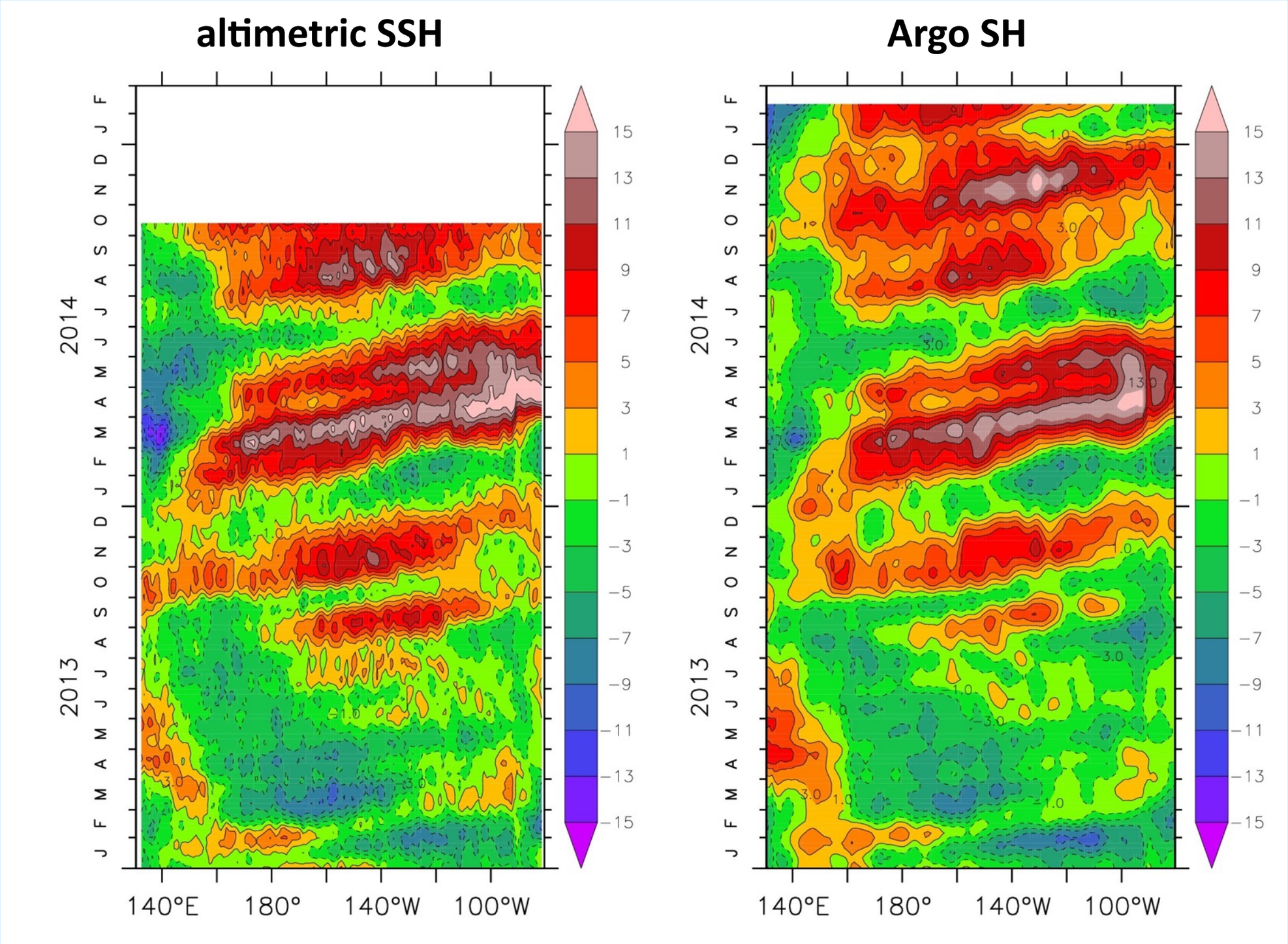
Effect of TAO/Argo error when Argo_subsampled close to Argo
Effect of sampling when TAO_subsampled close to TAO

Impacts of errors on density

NEAR REAL TIME CAPACITY

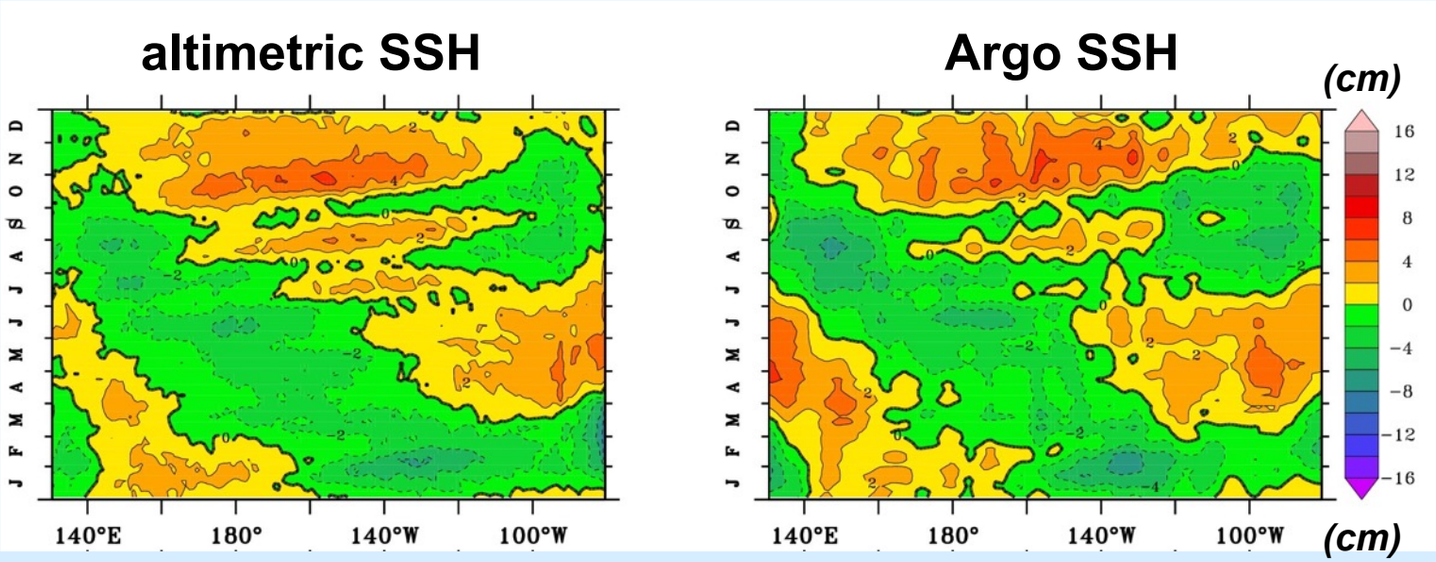
average from 1.5°S to 1.5°N.

Time longitude diagrams along the equator



ANNUAL CYCLE - ALTIMETRIC SSH / ARGO SH anomalies

2004-2013 cycle



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.

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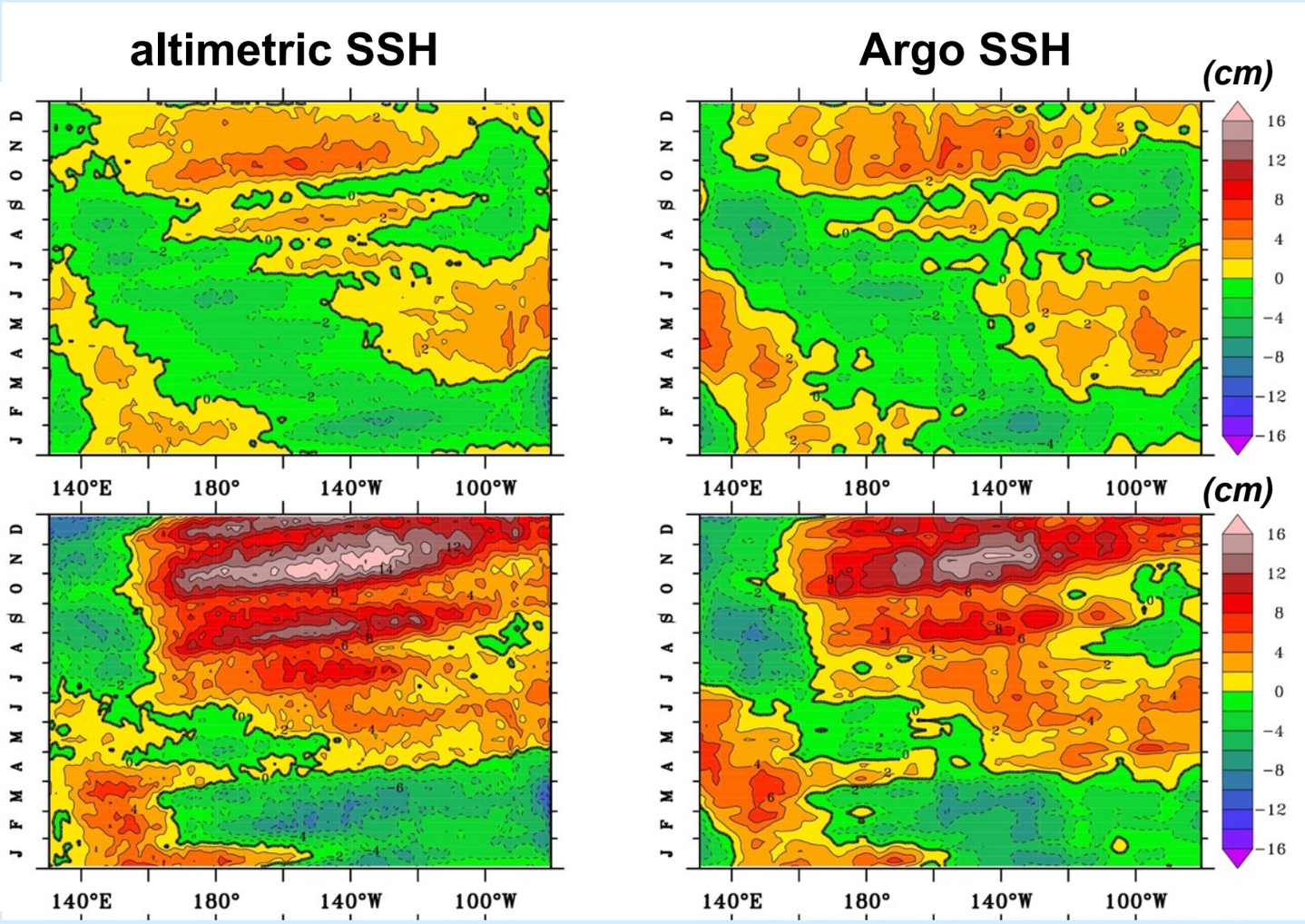

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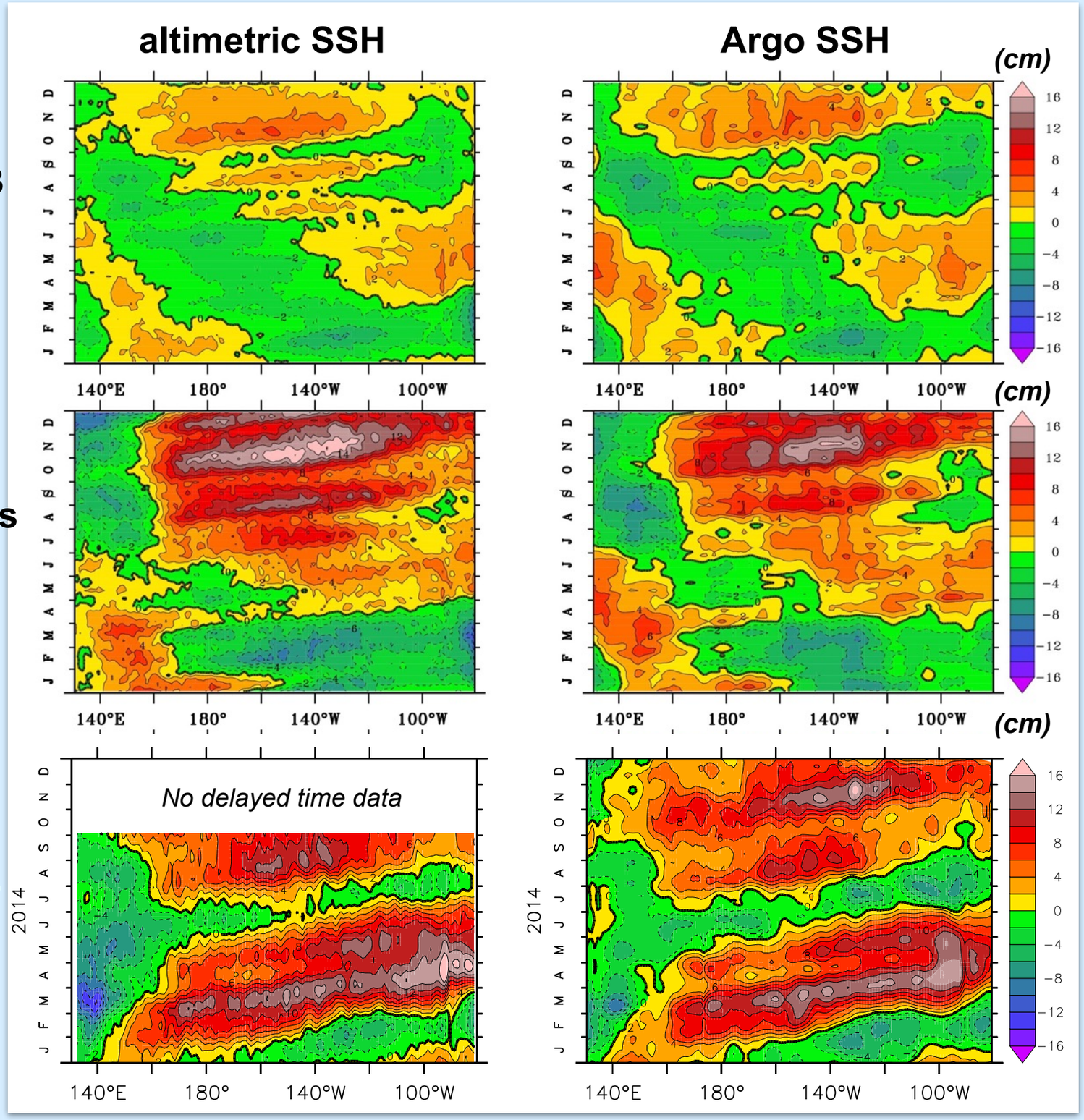
year 2014



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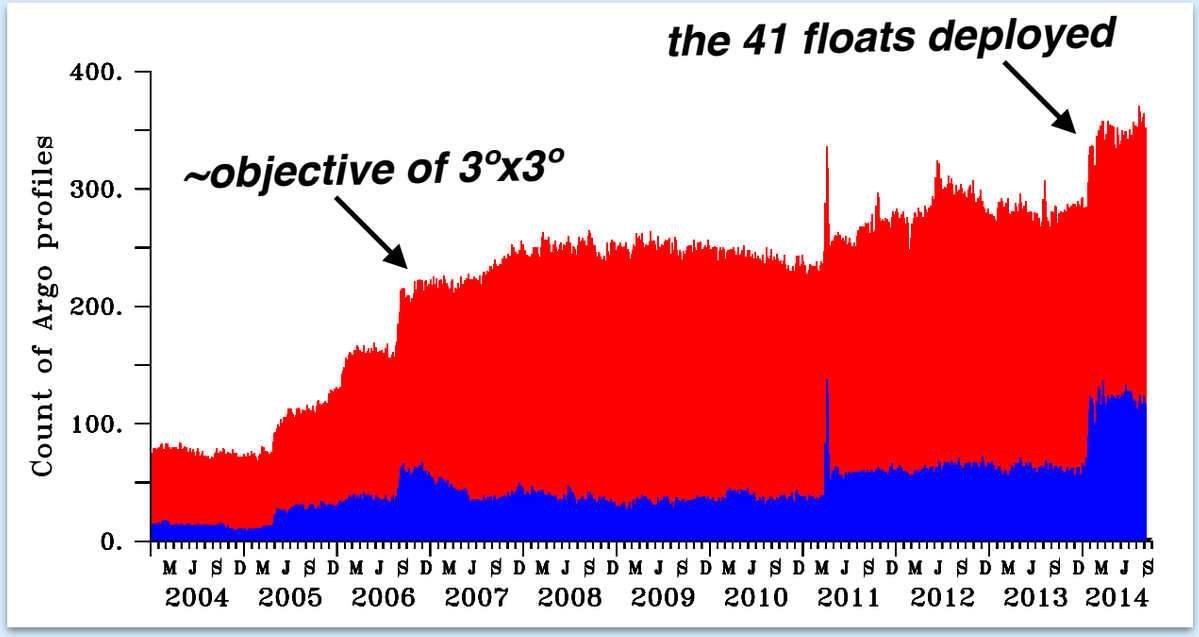
What did happen in 2014 ?

- 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

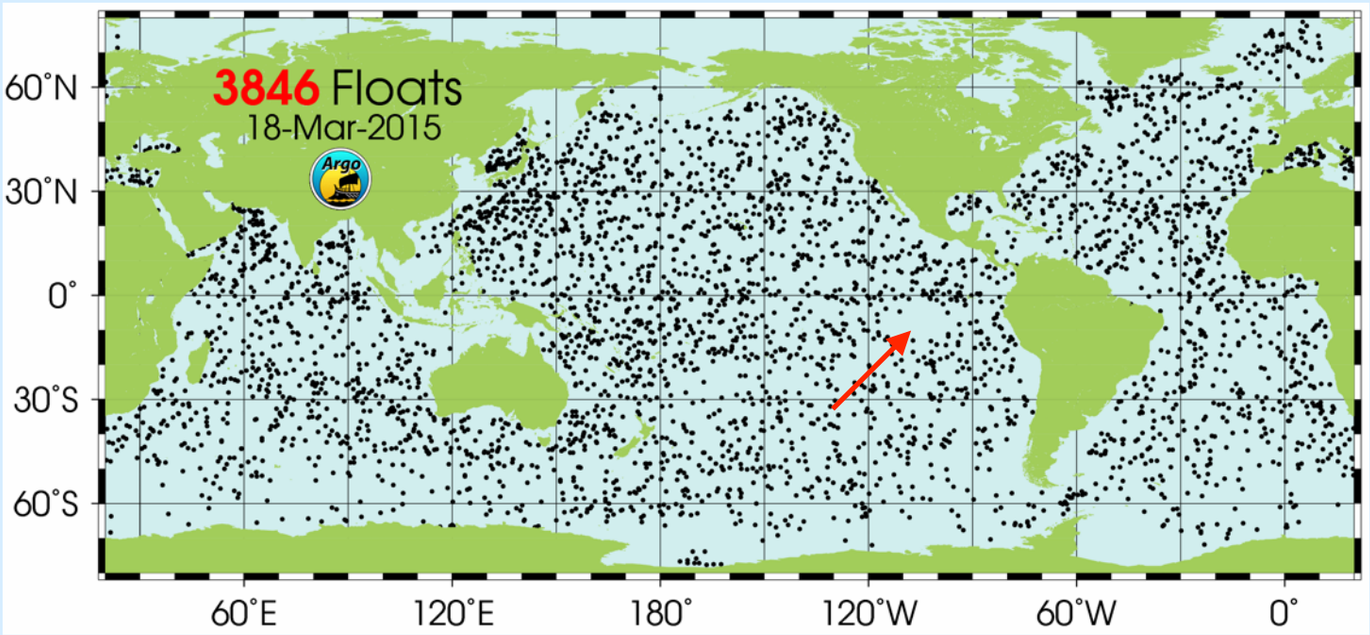


Technical impacts :

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

Scientific impacts :

- Well-resolved intraseasonal variability (20-100days)
- 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