Euro-Argo
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Assessment of the subsurface observing system in the Equatorial Pacific: The role of Argo in resolving intraseasonal to interannual variability

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TROPICAL PACIFIC OBSERVING SYSTEM (TPOS 2020)

TPOS 2020
Tropical Pacific Observing System

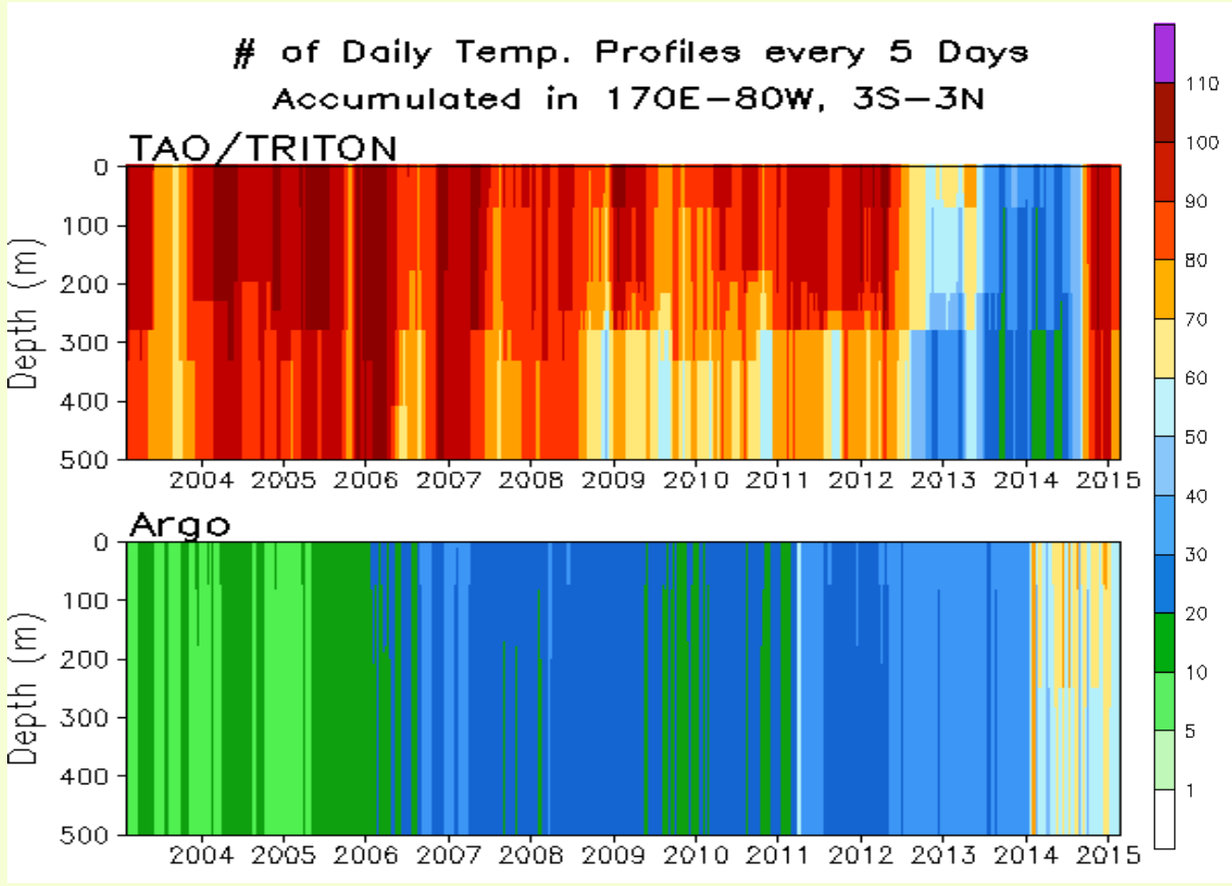
This would oversee the transition to a more resilient and integrated observing system.

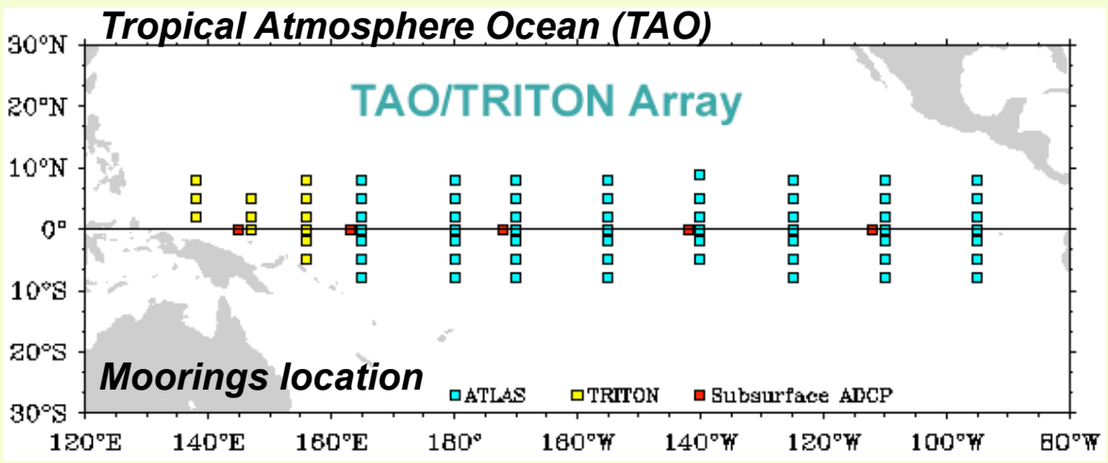
- for ***monitored, observed and predicted*** *the state of ENSO,*

- for ***sustained observations*** *to* ***support prediction systems****,*

- for advanced and refined ***the knowledge of the predictability horizon****.*

- for determined ***interannual to multidecadal variability*** *impacts.*





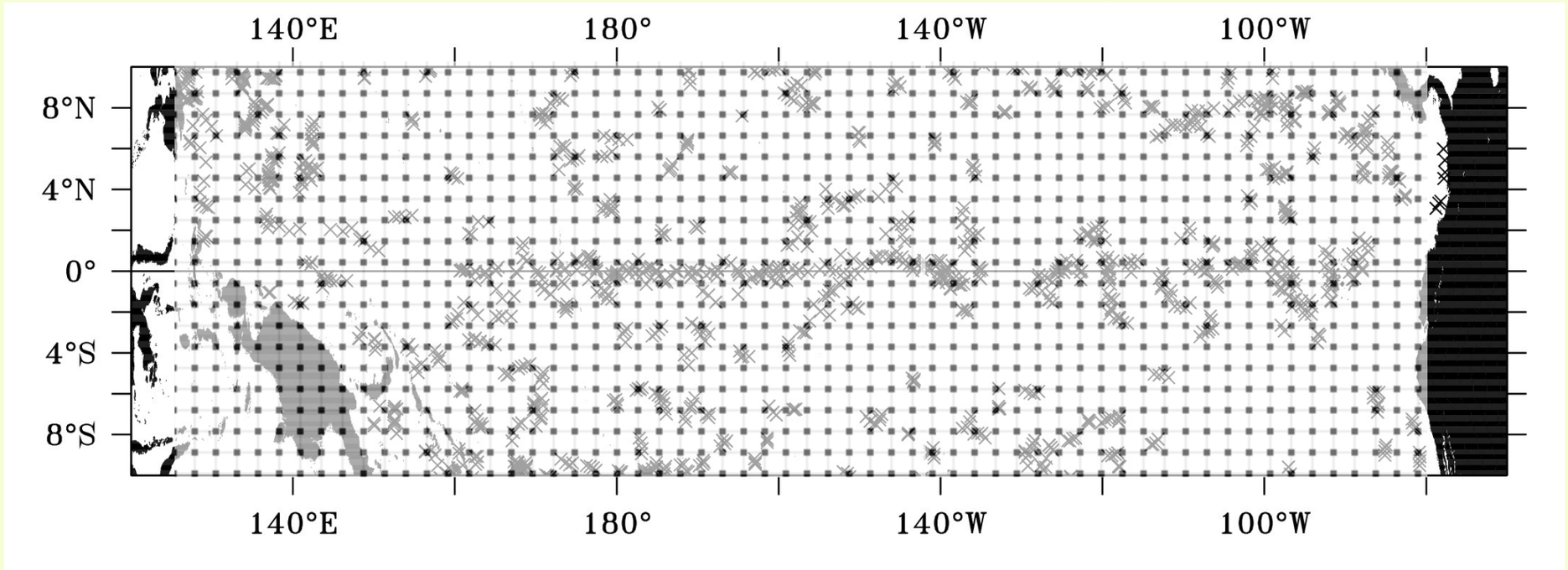
Milburn et al., 1996

TAO

Argo

OPTIMAL INTERPOLATION (Roemmich and Gilson, 2009)

T/S profiles at different location and time, and different pressure levels → ***T/S estimation every 1°lat x 1°lon, every 5 days, at 58 pressure levels (0-2000m)***



<u>First step</u>

- Climatological annual cycle, least square fit at each pressure level with the 300 “nearest” points.

  (100 from the present pressure level plus 100 from each adjacent pressure level above and below, for each of the 12 months).

- Data weighted in inverse proportion to their horizontal distance from the grid point

<u>Second step</u>

- Then, anomalies from this first estimate, for each of 5-day bins of the time-series, were calculated by objective analysis.

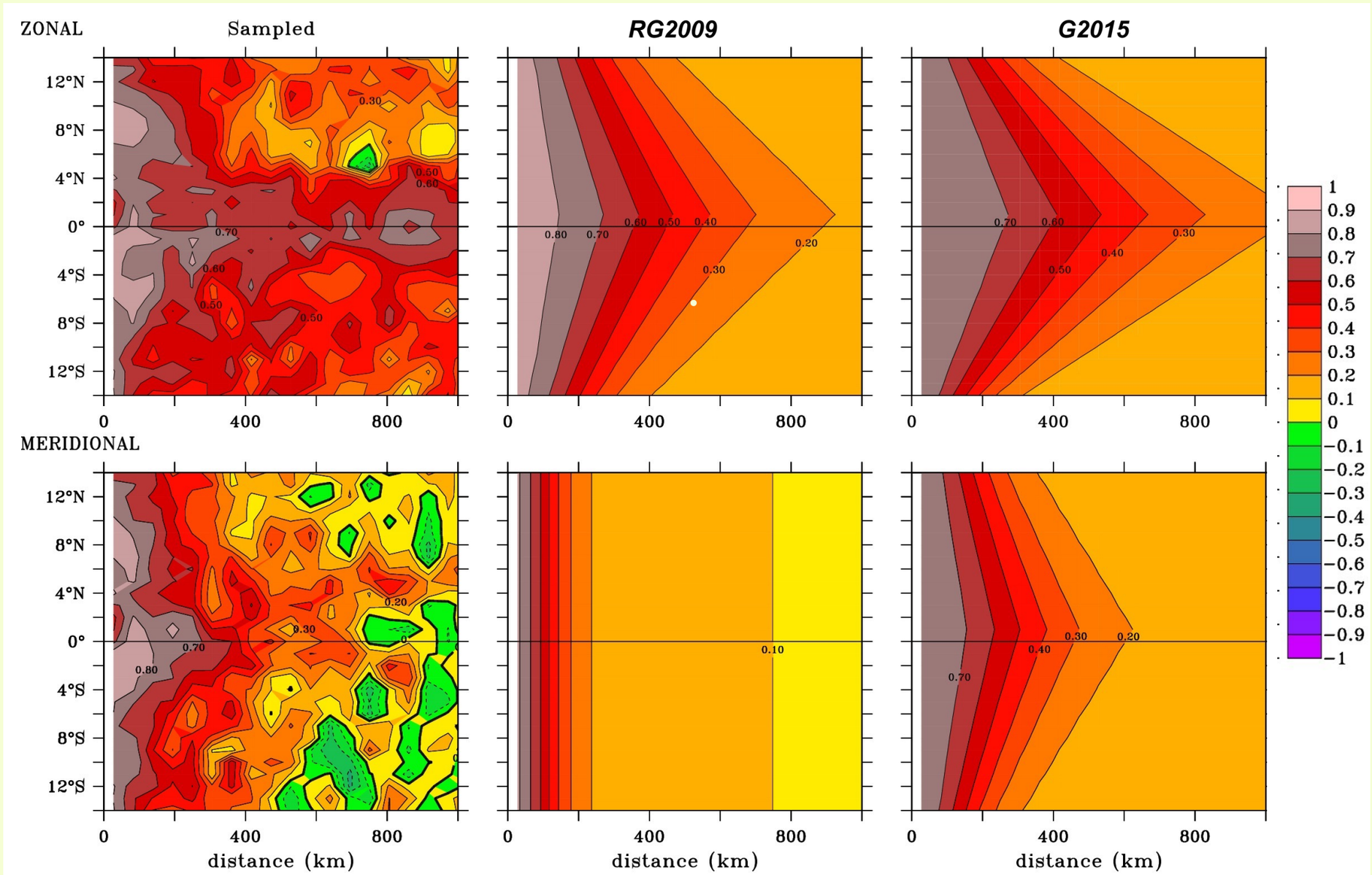
- Data weighted depending on spatial and temporal scales

1. Sampling improvements

SPATIAL SCALES

Main differences between RG2009/G2015 : Using more than 10 years of data
Focusing on the Equatorial Pacific

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



Roemmich and Gilson, 2009 (RG2009)
Gasparin et al., 2015 (G2015)

Sampled covariances
(pairs separated by less than 1 day)
Modelled covariances
(sum of exponential and gaussian)

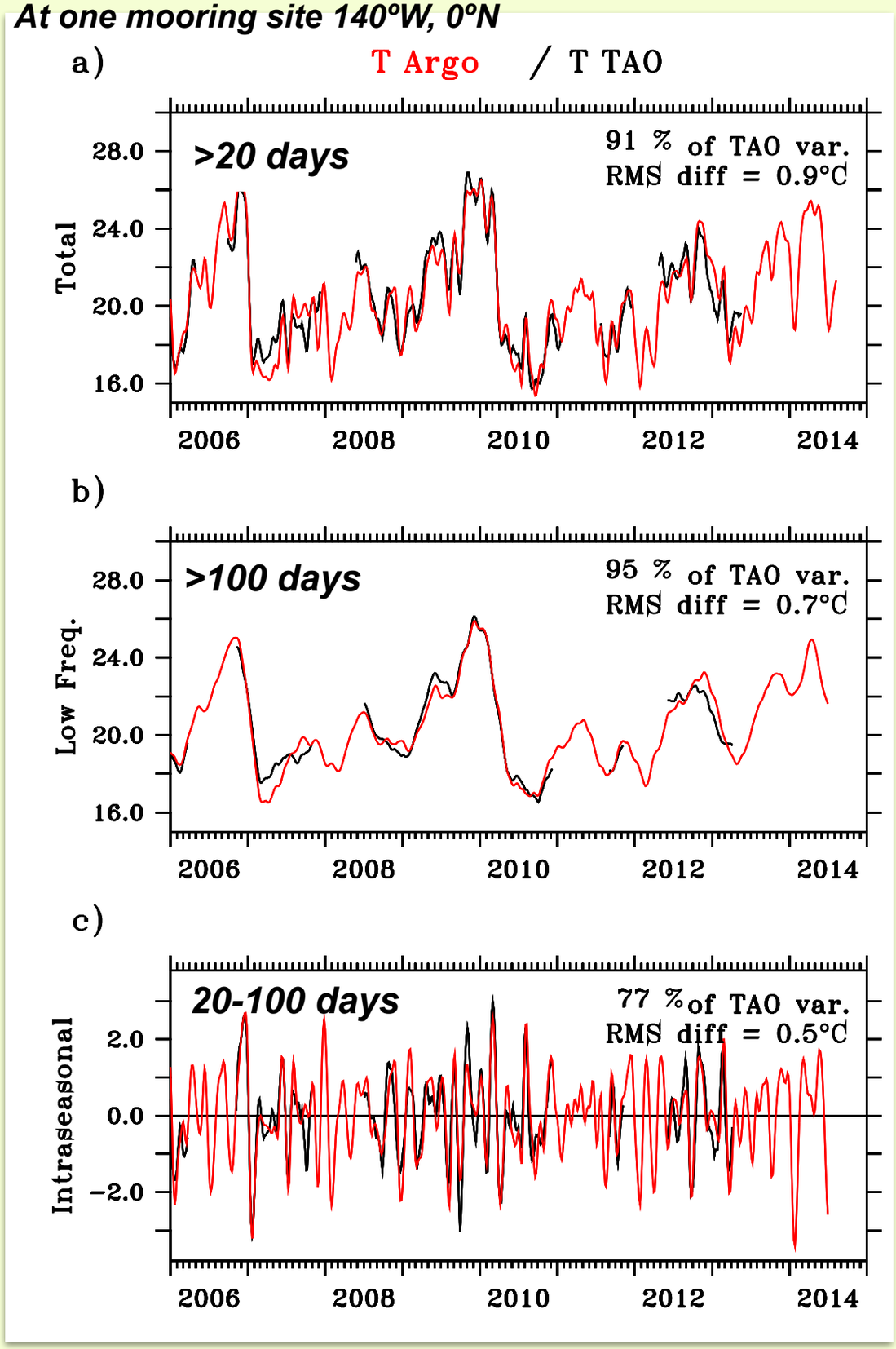
- Underestimation of covariance near the Equator
- Small increase of zonal scales between RG2009 and G2015

- Longer meridional scales at the Equator
(not taken into account in RG2009)

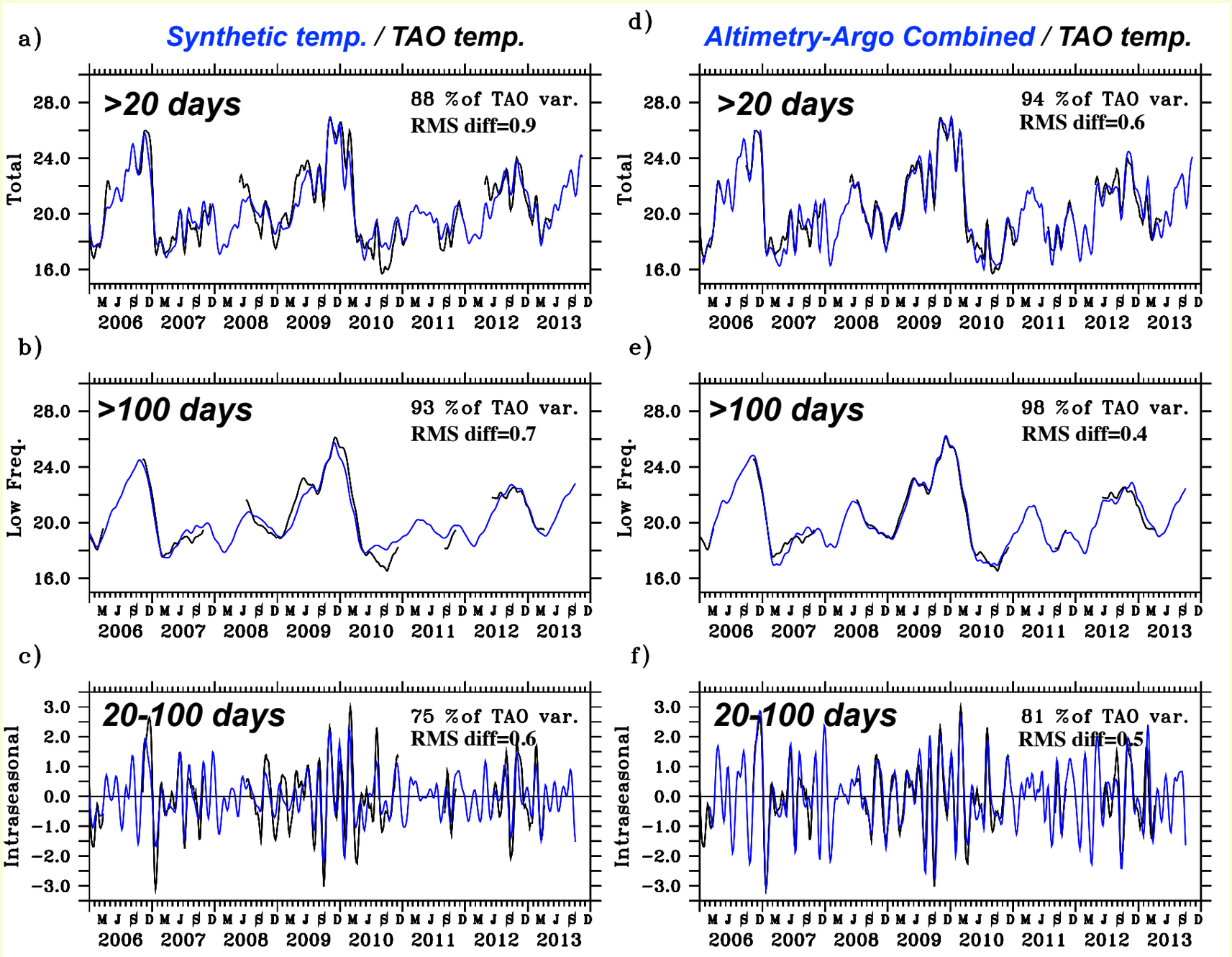
COMPARING INDEPENDENT DATA : TEMPERATURE at 100m from TAO moorings

- *Argo is not able to represent upper ocean properties <u>at timescales lower than 20 days.</u>*
- *The 20-day signal represents around 70-80% of the total signal (TAO estimate).*
- ***How intraseasonal and longer term variability can be represented by Argo ?***

At one mooring site 140ºW, 0ºN



COMBINING ALTIMETRY & ARGO : TEMPERATURE at 100m from TAO moorings



100m temperature at 140°W, 0°N

Synthetic Temp: ***Linear regression on altimetry and 100-m Argo temperature***

Altimetry-Argo combined:
- First guess is synthetic temp.
- Optimal interpolation with Argo

==> Altimetry-Argo combined is better than Argo-alone and Altimetry-alone.

Significant improvements

ASSESSMENT OF THE ESTIMATED ERRORS IN TEMPERATURE

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

- proportional to the **signal variance,**

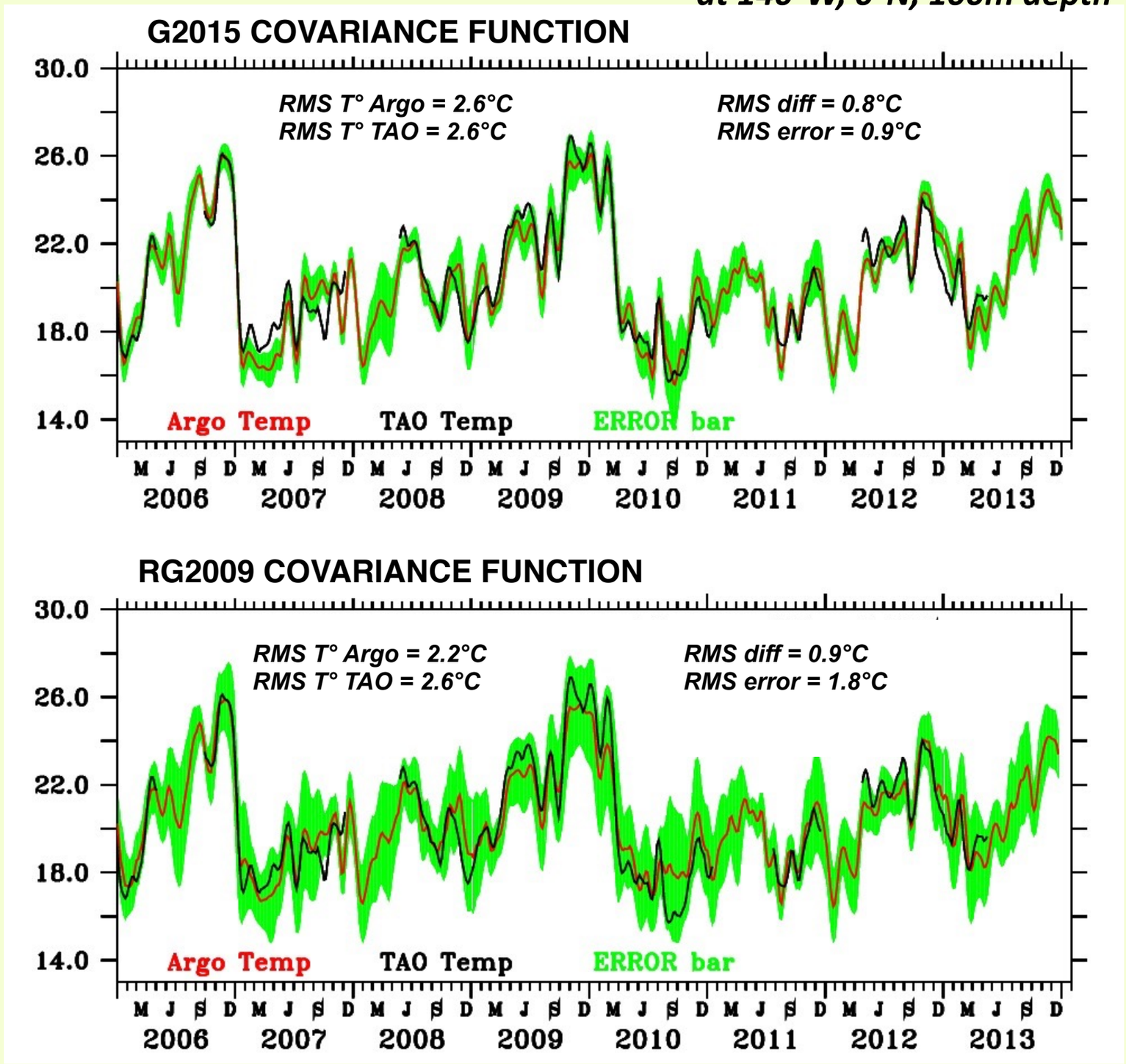
- dependent on the individual data points only in terms of the **data spacing,** not the individual data values themselves,

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

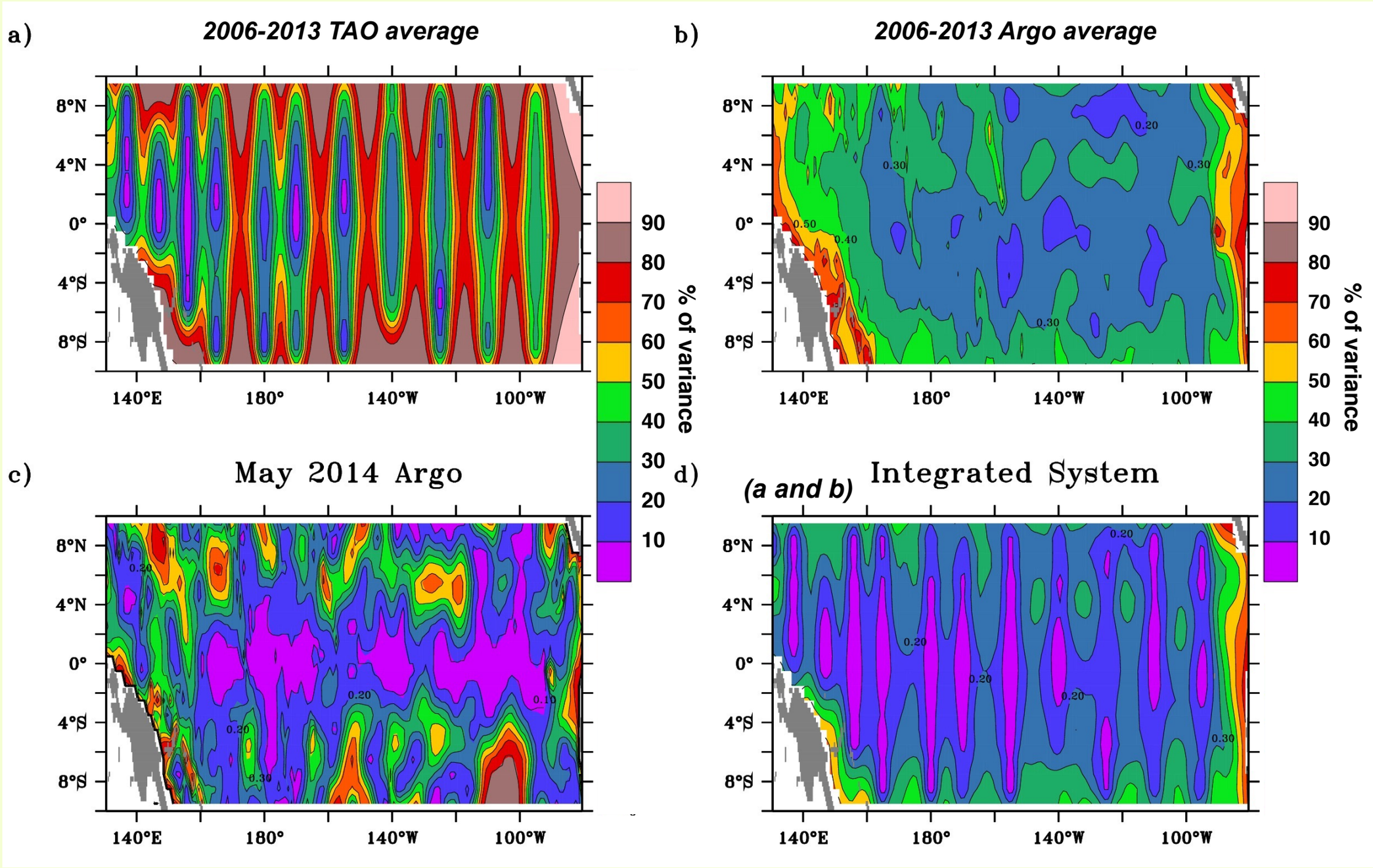
In general, G2015 lower than RG2009 and more consistent with OI minus independent observations.

==> important feature for assessing sampling strategies in the following

at 140°W, 0°N, 100m depth



DIFFERENT ERRORS FOR DIFFERENT DESIGNS FOR THERMOCLINE TEMPERATURE



2006-2013 TAO average : Low errors at the mooring sites, high errors between

May 2014 Argo : Lower error along the equator

2006-2013 Argo average : More uniform

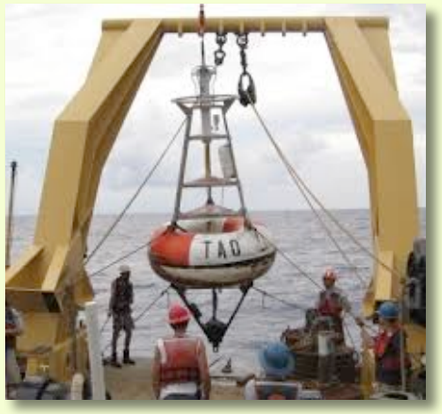
Integrated system : Advantage of both datasets

PRELIMINARY CONCLUSION ON THE OCEAN OBSERVING SYSTEM

Argo skills

- *Homogeneous coverage*
- *High vertical resolution*
- *Salinity measurements down to 2000 m*
- *Cost per profile*

<u>weaknesses:</u> temporal resolution, 10-year dataset



TAO array skills

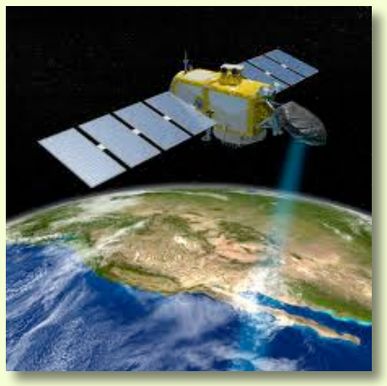
- *High frequency time-series data at the moorings sites.*
- *Atmospheric, and interface measurements*
- *Current velocity measurements*
- *The longest time series in the tropical Pacific (more than 30 years)*

<u>weaknesses:</u> spatial resolution, maintenance cost

Satellites

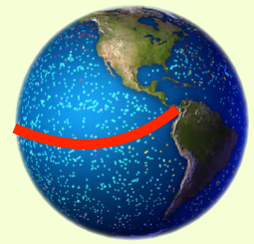
- *Relatively high spatial and temporal resolution at the ocean surface.*
- *Salinity measurements at the surface*
- *20-year dataset*

<u>weaknesses:</u> no subsurface measurements



- **Measurement overlaps** are essential in an observing system due to the crucial need of intercomparisons which enable to assess the reliability of each component.
- Differences in the temporal and spatial resolution in the measurements enable to take advantage of **the skills of each component** of an observing system.

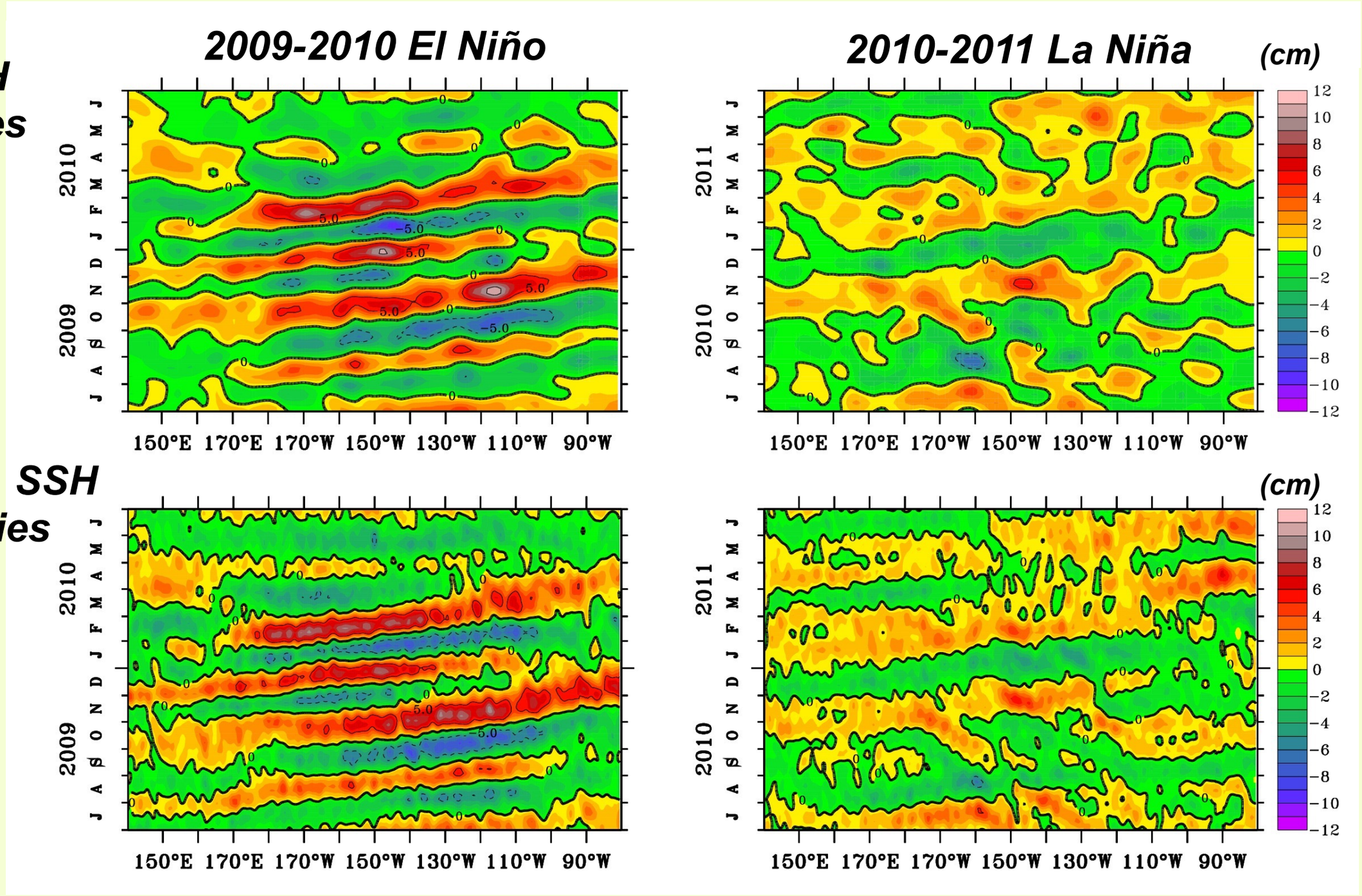
INTRASEASONAL VARIABILITY - Altimetric SSH & Argo SH anomalies



average from 1.5°S to 1.5°N.

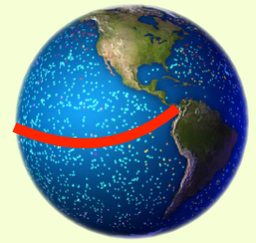
Argo SH anomalies

Altimetric SSH anomalies

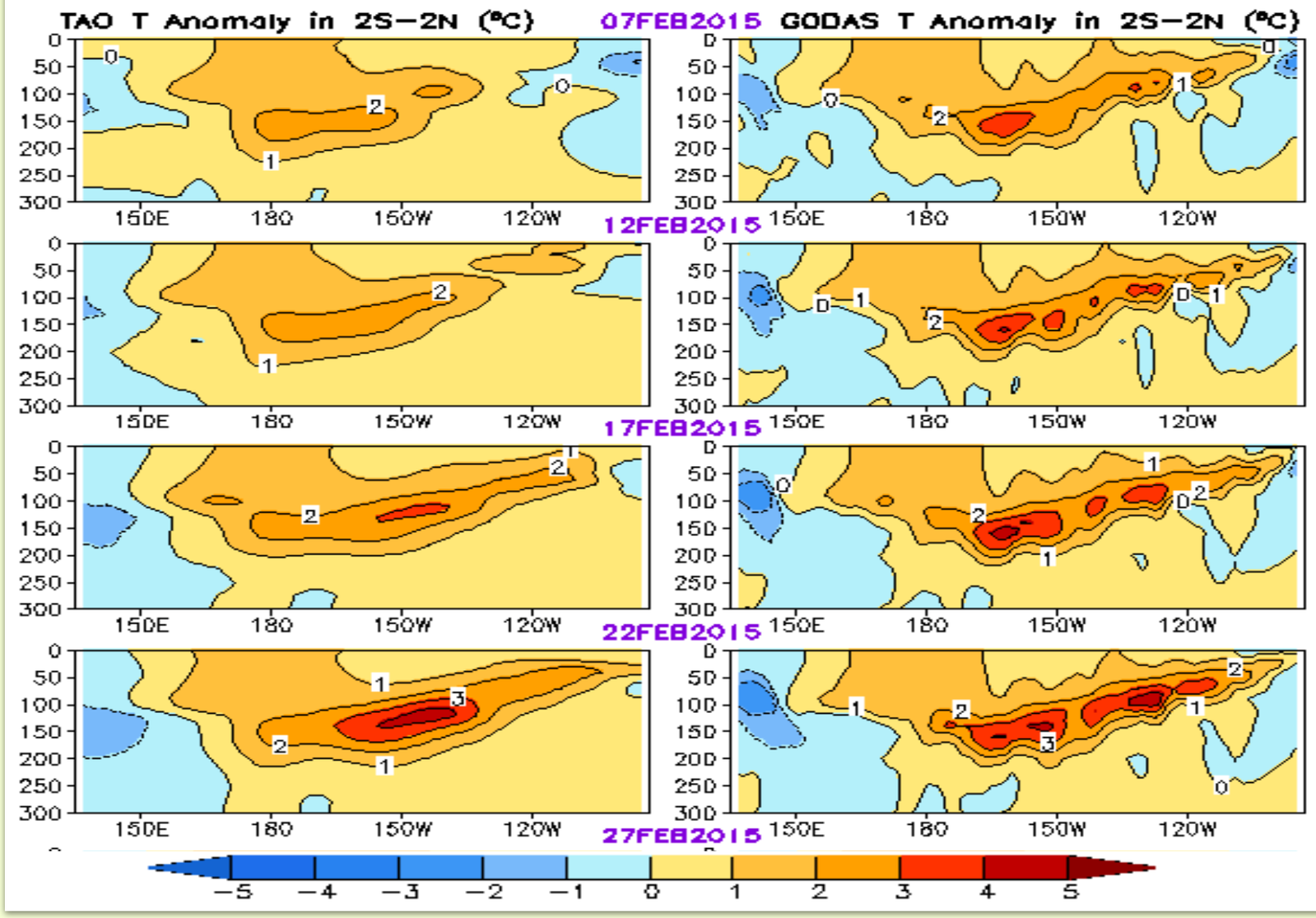


Upper thermal layer in 2015 - Is El Niño coming ?

average from 1.5°S to 1.5°N.



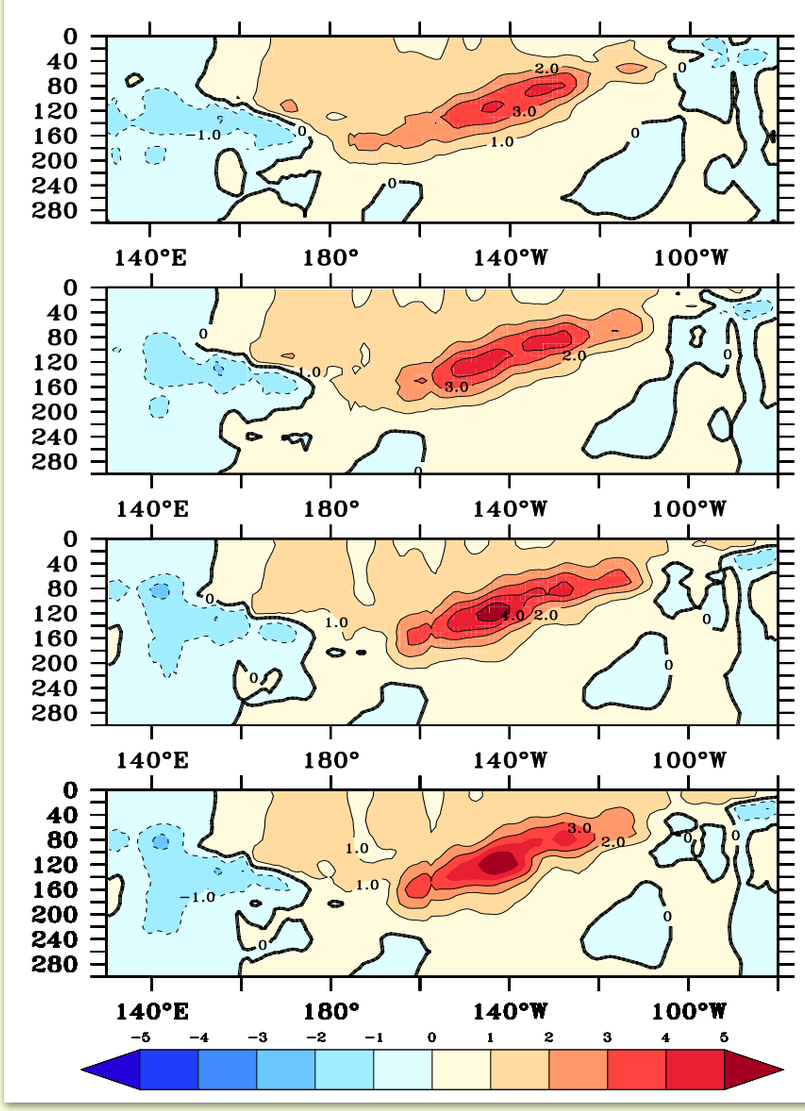
TAO



GODAS

Monthly Ocean Briefing
(NOAA Center for Weather and Climate Prediction)

Argo



SCRIPPS Argo-product

SUMMARY

Assessment of the subsurface ocean observing system in the Equatorial Pacific: The role of Argo in resolving intraseasonnal to interannual variability

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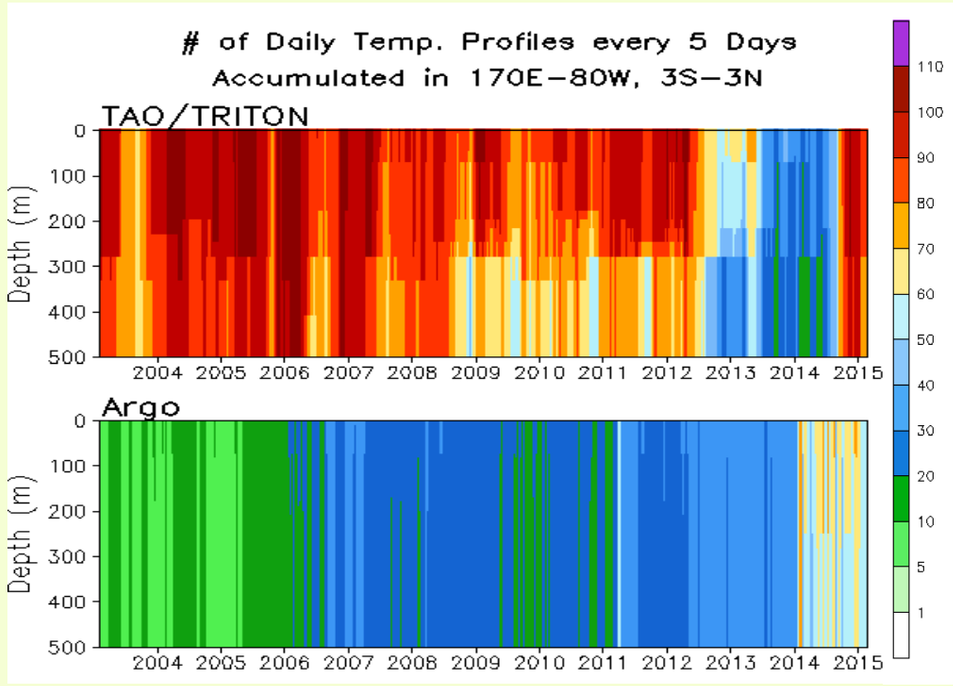
1. *Re-mapping the upper-ocean properties with* ***a more accurate equatorial characteristics.***

2. ***Comparing estimation*** *to TAO temperature and altimetry sea surface height.*

3. ***Assessing different components*** *of the oceanic observing system.*

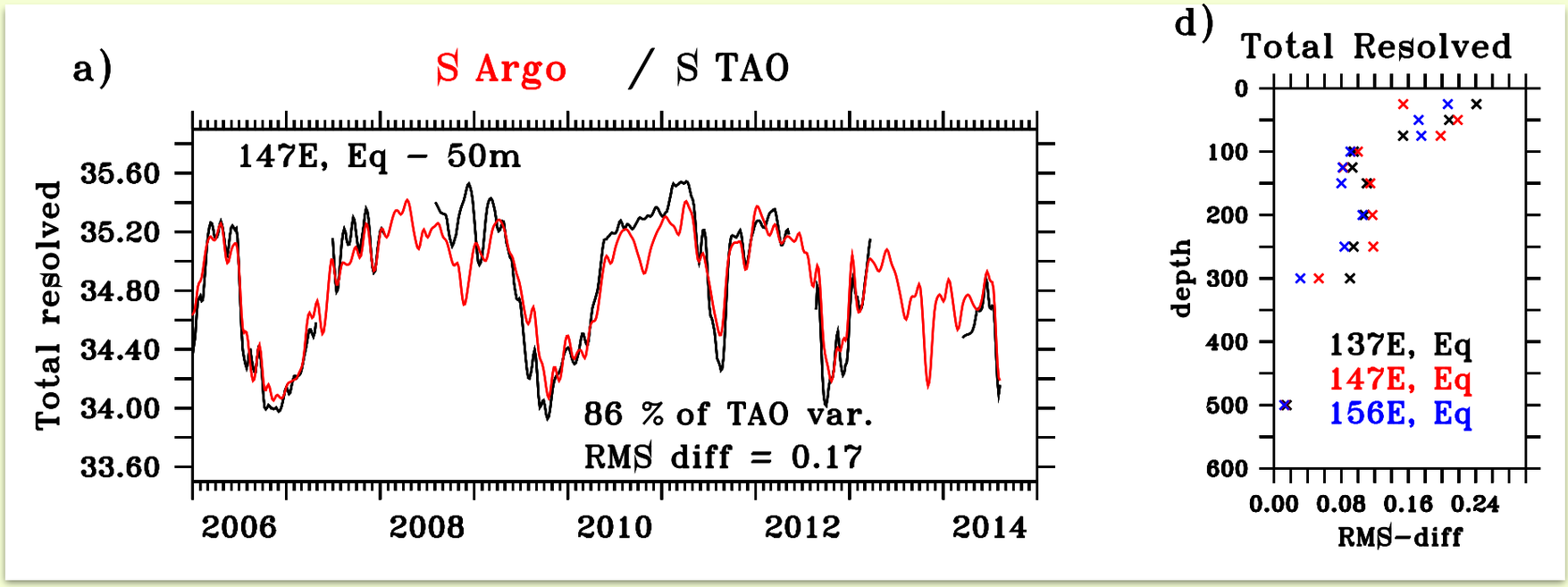
4. *Showing how* ***vertical, zonal and meridional resolution*** *has improved the representation of equatorial dynamic at intraseasonal and longer-term variability*

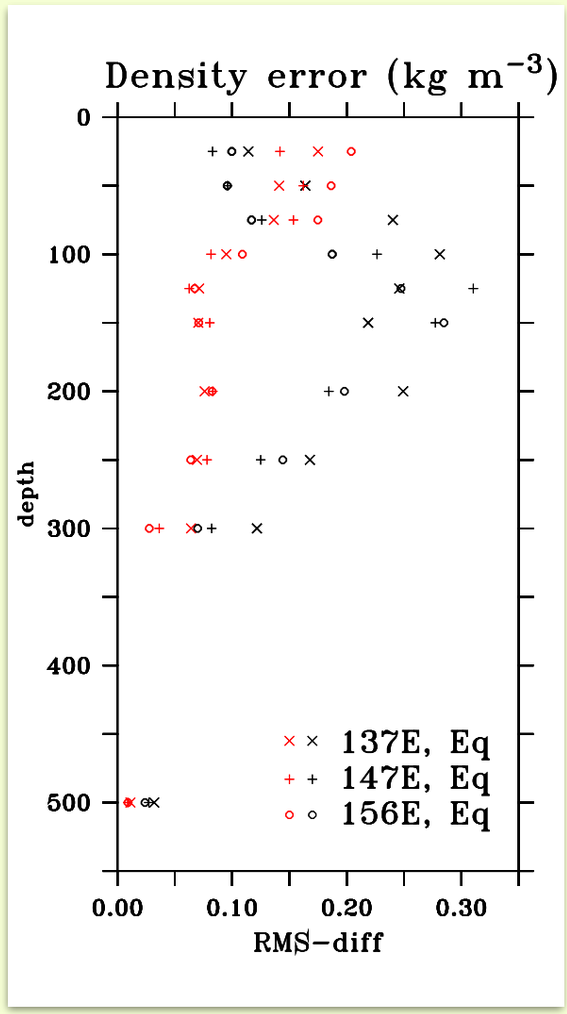


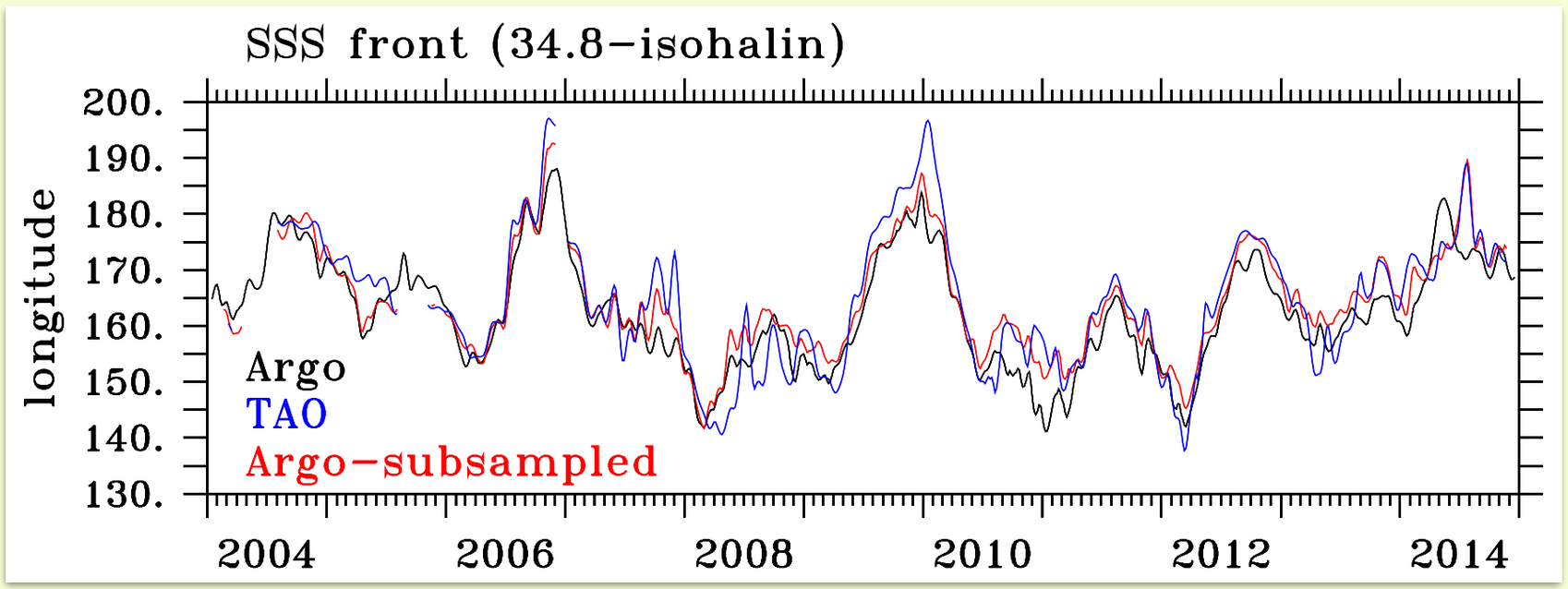
Gasparin et al., 2015, Assessment of the ocean observing system in the Equatorial Pacific: The role of Argo in resolving intraseasonal to interannual variability, Journal of Atmospheric and Oceanic Technology, (in review).

Extra

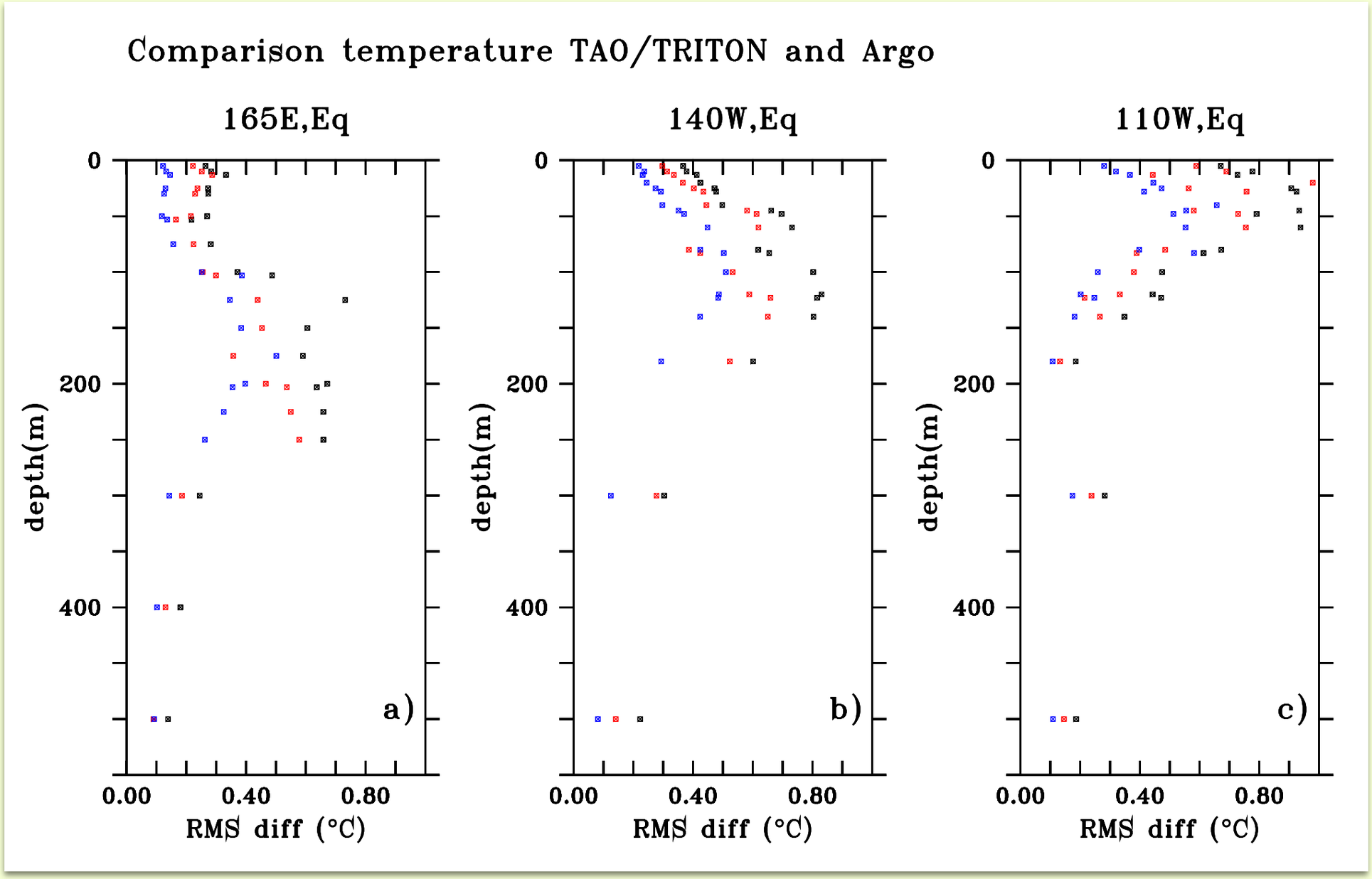
SALINITY IN THE WESTERN PACIFIC







VERTICAL STRUCTURE



error on the vertical

RMS / altimetry - combined

PDF conversion