Tropical Atlantic Dynamics from Argo and Jason altimetry missions: first results

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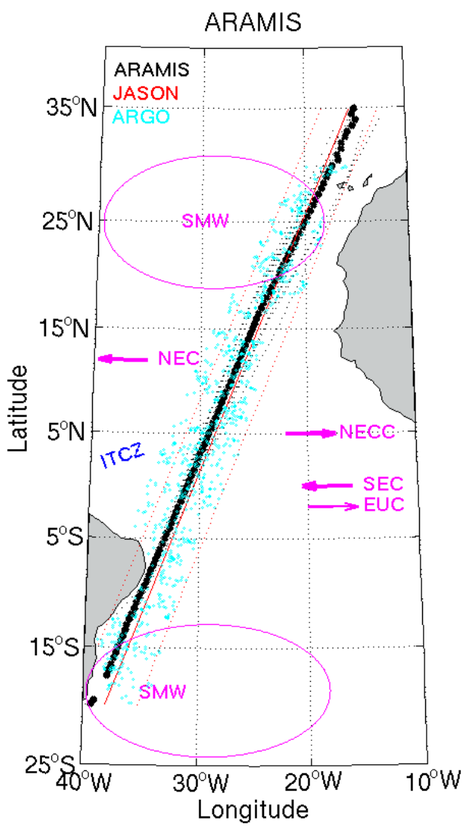
1. The ARAMIS Experiment

The ARAMIS project, funded by the french CNES (Centre National d'Etudes Spatiales) and IRD (Institut de Recherche pour le Développement) organizations, implemented a long term survey (2002-2008) of T-S structures in the tropical Atlantic.

The ship line crosses the major tropical Atlantic oceanographic and meteorological features. The line is also superimposed to a JASON track.

Twice a year, in boreal spring then fall, when the oceanic circulation reaches its minimum/maximum intensity in the surface layers, expendable probes (XBTs and XCTDs) have been launched alternatively along the ship route.

ARGO floats have been also deployed during each cruise (*collab. NOAA, National Oceanographic and Atmospheric Administration, USA*). These floats together with the other ones located in the area constitute the second T-S data set used during the ARAMIS experiment.



ARAMIS project: The shiplines are in blue with the mean route in black; Argo floats in cyan; Jason tracks in red. Westward North Equatorial Current –NEC- and South Equatorial Current -SEC-, eastward North Equatorial CounterCurrent -NECC- and Equatorial Undercurrent -EUC-), the InterTropical Convergence Zone (ITCZ) and the Atlantic regions of Salinity Maximum Water (MSW) are also indicated.

2. Barrier Layer (Bls) Analysis

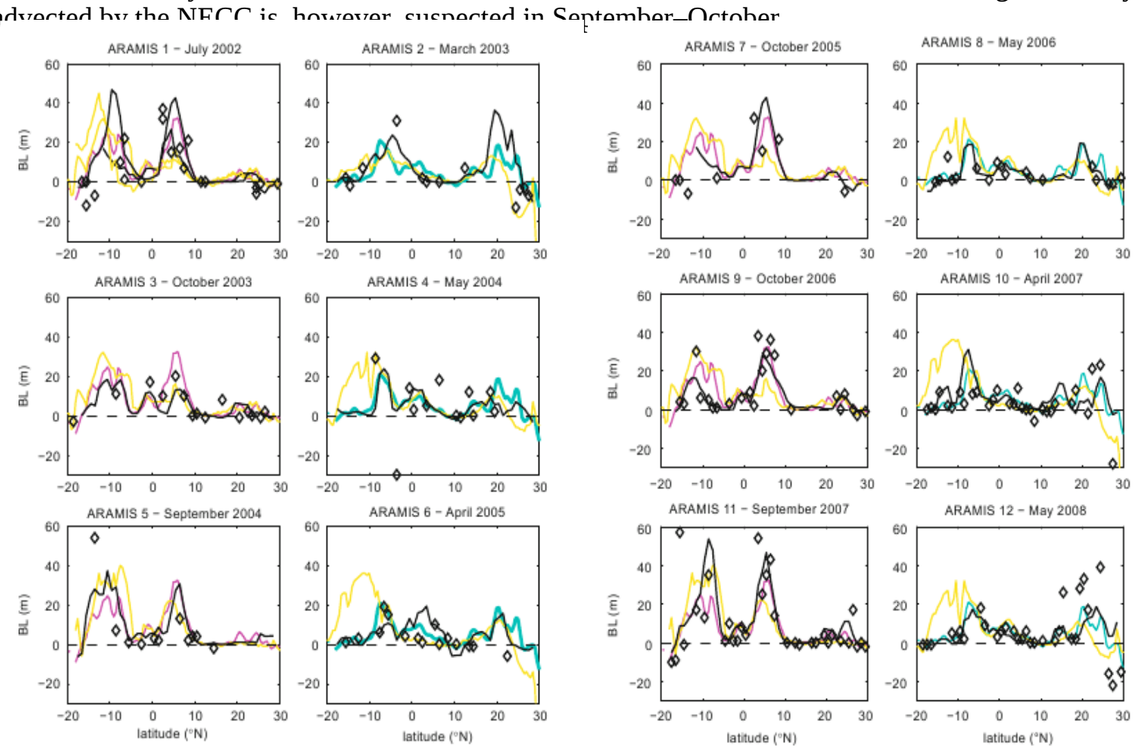
(Tanguy, Y., et al., Isothermal, mixed, and barrier layers in the subtropical and tropical Atlantic Ocean during the ARAMIS experiment. Deep-Sea Research I (2010), doi:10.1016/j.dsr.2009.12.012)

A first analysis dedicated to BL processes has been conducted from ARAMIS and Argo data sets.

Both Argo and ARAMIS observed BLs present the following patterns :
- almost permanent BLs in the South, more extended in September–October than in April–May;
- BLs with an important seasonal variability (larger in boreal autumn) and a position following ITCZ latitudinal displacement between 1 and 10°N;
- BLs from 13 to 25°N that are stronger in spring;
- compensated layers (‘‘reverse’’ BL) north of 25°N.

The two BLs near the subtropical northern and southern gyres are linked to surface advection of fresh water above the SMW during local winter. However, we also find BLs during local summer, especially in the southern area, which are apparently mainly linked to small-scale processes near the salinity front.

Below the ITCZ, the BL mainly arises from rain effects. In March–April–May, the advection of sub-surface salty waters by the EUC core moving northward together with the rain effect of the ITCZ moving southward modify the latitudinal structure of the BL. The role of the Amazon discharge and salty SAW advected by the NECC is, however, suspected in September–October.

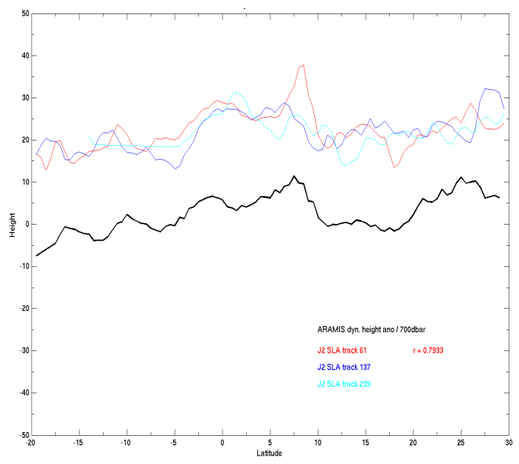


Variability of BL thickness from in-situ data: ARAMIS (black curve), and Argo (black diamond) for the different campaigns. Also indicated is the ARAMIS seasonalaverage (light blue for MAM and magenta for SO). Levitus 1998 climatology is indicated in yellow. All values were computed using a ‘‘0.5 1C’’ criterion. A 21 running mean was determined to reduce latitudinal variability on the smaller scale than for the equatorial Rossby radius for ARAMIS data.

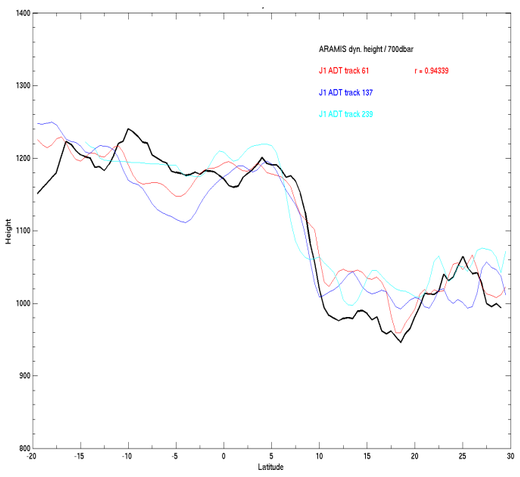
3. In situ and Jason1&2 Comparisons

We compare the ARAMIS/Argo dynamic heights to different altimetry products downloaded from the french AVISO website (*http://www.aviso.oceanobs.com*). The results are usually good especially during the September-October campaigns, either for TOPEX/Poséïdon or Jason missions.

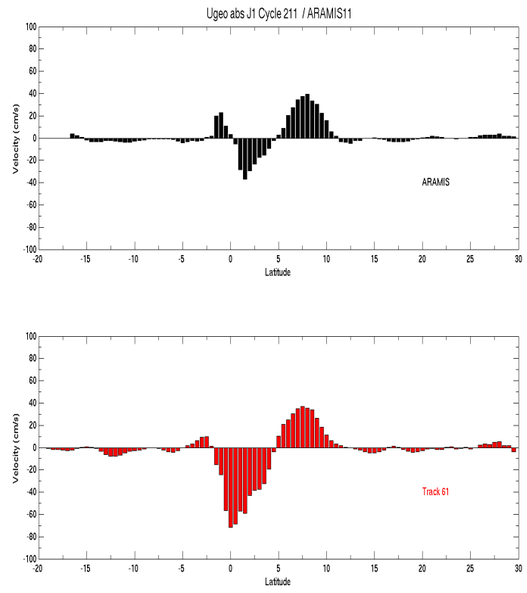
Sea Level Anomaly (SLA) correlations range between 0.5-0.8.



More interesting are the comparisons with the recently obtained "absolute" topography (ADT) by using a Mean Sea Surface.



The agreement between ADTs also stands for absolute geostrophic currents even in the equatorial domain..



4. Conclusions

The ARAMIS experiment was an excellent candidate to check in the tropical Atlantic the complementarity of various sources of data: in situ T and S profiles from expendable probes or Argo floats and altimetric data. The results are promising either in terms of "absolute" or "anomaly", and either in terms of dynamic topography or geostrophic current. It offers opportunity for long term variability investigations thanks to the decades of altimetric missions.

Acknowledgements

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