Inter-comparison of surface current *in situ* measurements in the Tropical Atlantic Ocean

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The objective of this study was to compare the surface current measurements made by various sensors in the Tropical Atlantic. The spatial-temporal distribution of data available in the area was analyzed to specify the most appropriate study periods. The average seasonal cycle, spatial and temporal variability of currents, as well as seasonal variability were highlighted. Finally, these data were qualified through intercomparisons to show the complementarity of datasets and their shortcomings.

DATA

Sensors	Database	Time series	Depth range
PIRATA cruises S-ADCP	SISMER	2001-2017	15-300m
ARGO floats	Andro database (Ollitrault and Rannou, 2013)	08/1997 – 10/2016	Surface
Drifters	GlobCurrent (Rio and Etienne, 2017)	1985 - 2016	15m
PIRATA ADCP mooring 23°W 0°N	IRD	2001-2016	15-300m
PIRATA buoy current meter 23°W 0°N	PMEL	2005-2017	10;12;20m

Table 1. Sensors, database, time series and depth range used for the study

PIRATA cruises tracks and moorings location

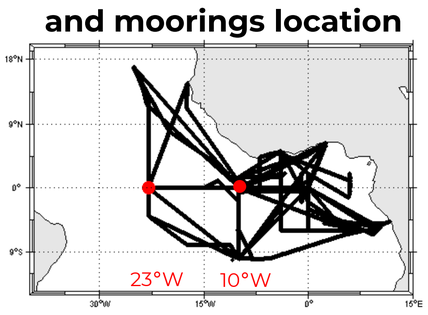


Fig. 1. Tracks of PIRATA cruises (black lines) and ADCP moorings position (red circle)

Mooring ADCP data at 23°W-0°N

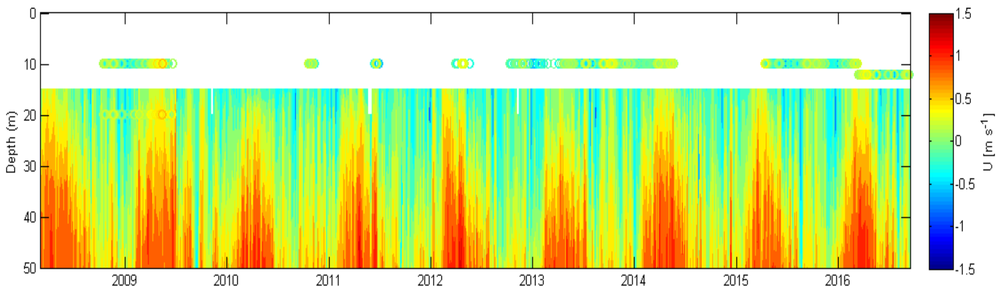
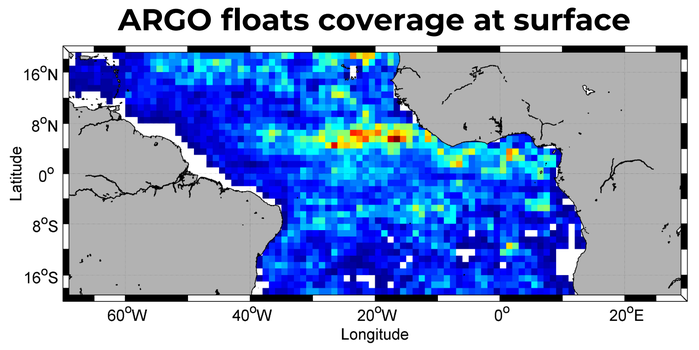


Fig. 2. Zonal current data from ADCP mooring (between 16m and 50m) and from the PIRATA buoy current meter at 10m.

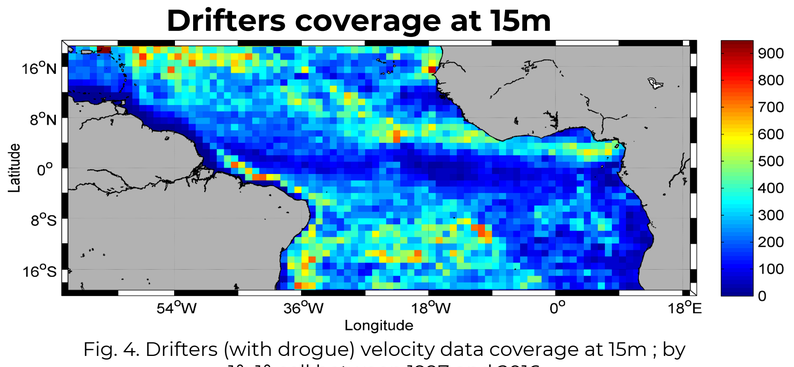
ARGO floats coverage at surface



- Large number of ARGO floats between 6°-7°N
- Very few in the South and Southeastern parts of the basin

Fig. 3. ARGO floats velocity data coverage at surface ; by 1°x1° cell between July 1997 and October 2016.

Drifters coverage at 15m



- Very few drifters trajectories in the equatorial band and in the southeastern part of the area.

Fig. 4. Drifters (with drogue) velocity data coverage at 15m ; by 1°x1° cell between 1997 and 2016

RESULTS

Seasonal cycle

From ADCP mooring, ARGO floats, drifters, and buoy currentmeter, at 23°W- 0°N

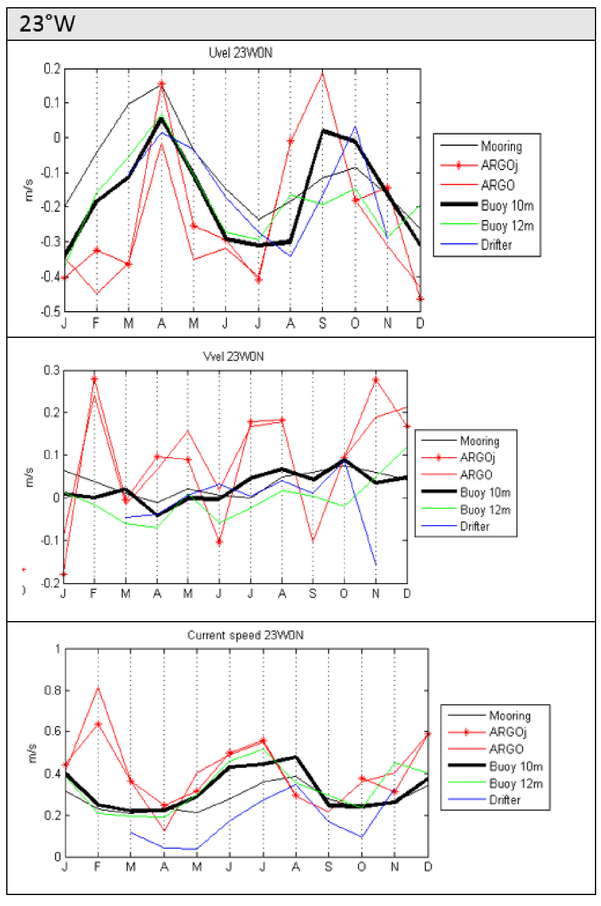


Fig. 5. Current values were obtained after a regridding of data over a 1°x1° box and then monthly averaged and over the period i) from 08/1997 to 09/2016 for « ARGOj » (DAC Coriolis + AOML ; choice of the closest point to the mooring after regridding); ii) from 08/1997 to 10/2016 for « ARGO» (DAC Coriolis only, so less data from 2010); ii) from 01/1997 to 01/2016 from « Drifter ». The current values for the mooring and the buoy currentmeters are monthly means over the period i) from 12/2001 to 09/2016 for the ADCP mooring; ii) from 05/2005 to 11/2017 for the buoy currentmeter at 10m and 12m.

From ARGO floats over 1°S-1°N equatorial band

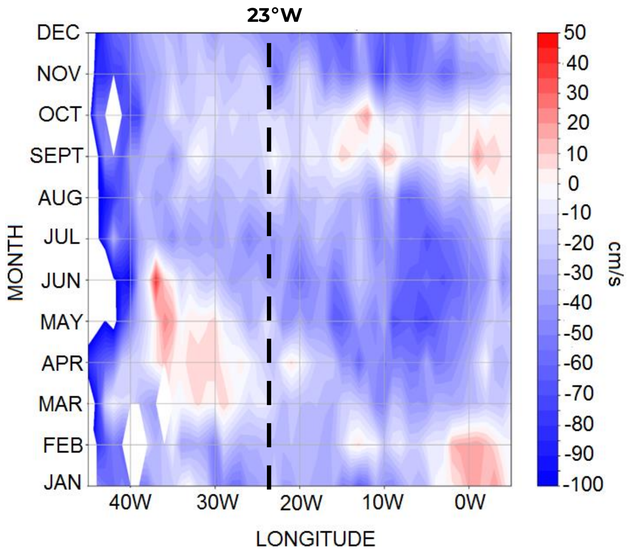


Fig. 6. Longitude-Time diagram of mean monthly zonal surface current (cm/s) estimated from ARGO floats over 1°S-1°N equatorial band.

- Relatively good agreement between current measurements from ARGO (surface), ADCP mooring (15m) and buoy currentmeter (10m), with greater gap (up to 0.25m/s between ARGO and buoy currentmeter at 10m) from January to March (Fig.5)
- Westward current maximum in boreal summer and December – January
- Eastward current in April and September-October (Fig.6)

S-ADCP vs ARGO

SADCP data bring important information about the instantaneous circulation along the cruise tracks but the comparison with ARGO floats data is not relevant due to the time variability of the current and the ARGO data sampling.

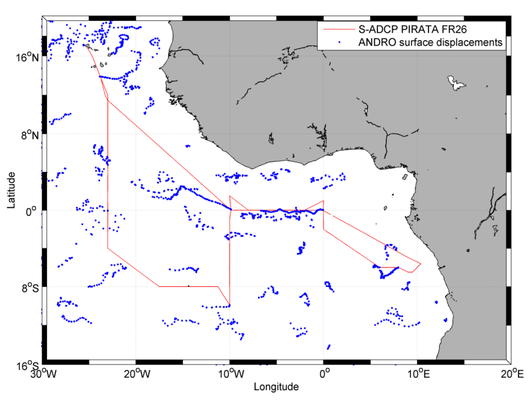


Fig. 7. PIRATA FR26 S-ADCP track and ARGO surface displacements

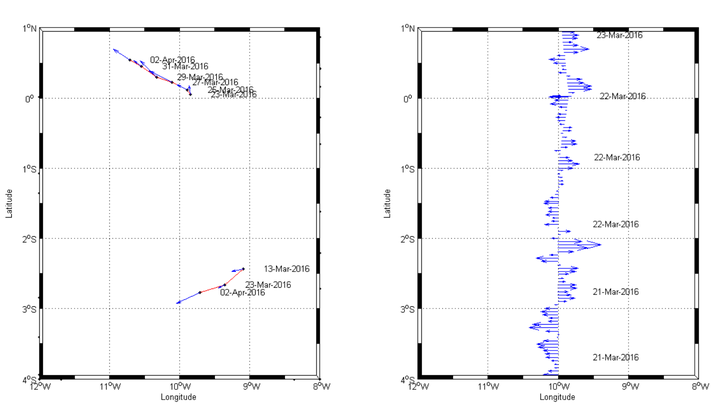


Fig. 8. PIRATA FR26 10°W section. Left: mean zonal current (cm/s) estimated by ARGO drifters at the surface. Right: mean zonal current measured by S-ADCP 150 kHz at 15m.

Surface current correlation

Good correlation (>=0.7) between current measurement from ADCP mooring at 15m and from current meter at 10m from April to December. Minimum found in Jan.-Mar.

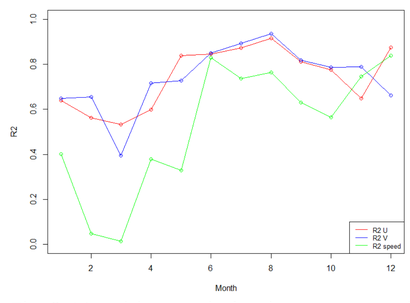


Fig. 9. Monthly correlation between zonal, meridional current and speed measured by ADCP mooring at 15m and current meter at 10m,

- At seasonal time scale, the drifter and ARGO data allow to describe the vertical current shear between the surface and 15m depth.

Surface current shear

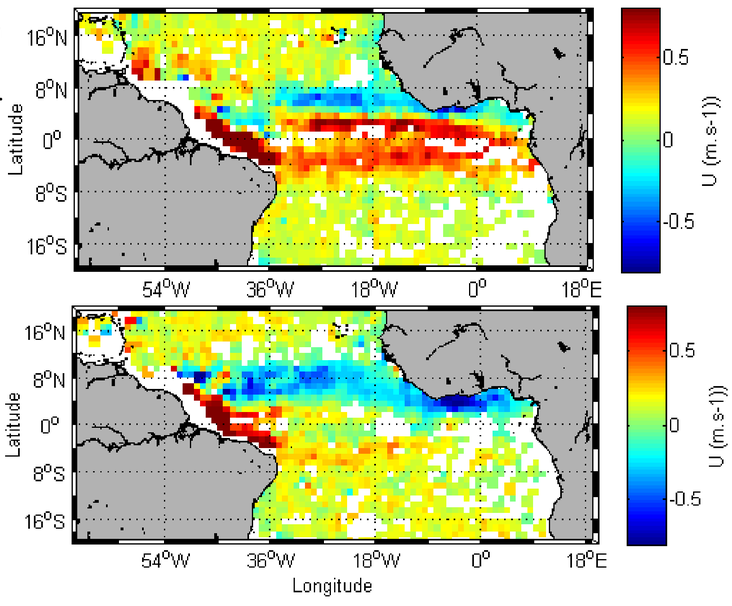


Fig. 10. Mean zonal current difference by 1°*1° cell between current estimated by drifting buoys at 15m and ARGO profilers at the surface, for June (up) and September (bottom)

CONCLUSIONS

The spatial distribution of Argo and drifters data reveals a crucial lack of data in the south-eastern region. Drifters data are also missing in the equatorial region. Due to different spatial and temporal coverages according to data sets, biases appear when comparing the different types of data owing to the high temporal and spatial variability of currents. The complementarity between S-ADCP and ARGO data is more difficult to evaluate as the S-ADCP measurements are instantaneous. However, the existing observations allow a good description of the mean seasonal cycle of the zonal surface currents with a relatively good agreement between the different datasets except in January-March, when minimum correlations are found. ARGO and drifters data also allow to describe surface current shear in the basin.

LITERATURE CITED

- Habasque J,, Herbert G, (2018). Inter-comparaison des mesures de courant dans l'Atlantique Tropical. Rapport Coriolis. http://archimer.ifremer.fr/doc/00440/55134/
- Ollitrault, M., and Rannou, J.P. (2013). ANDRO: An Argo-Based Deep Displacement Dataset. Journal of Atmospheric and Oceanic Technology *30*, 759–788.
- Rio M-H, Etienne H., 2017. Global Ocean delayed mode in-situ observations of ocean surface currents. SEANOE: http://doi.ord/10.17882/41334

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