THE SOLOMON SEA OBSERVED BY GLIDER AND ALTIMETRY

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1. ABSTRACT
The Solomon Sea with intense Low Latitude Western Boundary Currents (LLWBCs) is a key region for the tropical/subtropical connexion and for the feeding of the Equatorial Under current with possible effect on ENSO modulation. An experimental glider monitoring of the LLWBCs within the Solomon Sea is currently tested to understand how the inflow distributes within the Solomon Sea. Five glider missions have been operated from August 2007 to January 2009 showing the huge variability of the transports in relation with ENSO conditions and eddy activities. The Solomon Sea exhibits the highest levels of sea level variability of the whole South Equatorial Pacific Ocean. Therefore altimetry is another valuable source of information. Both datasets are shown to be highly complementary. The satellite data are useful to replace the along track glider data in a synoptic context whereas the glider data are useful to test how the surface information from altimetry is representative of the dynamics at depth.

2. INTRODUCTION
The Solomon Sea with intense western boundary currents like the New Guinea Coastal Current is a key region for the tropical/subtropical connexion and for the feeding of the Equatorial Under current with possible effect on ENSO modulation. The sharp Papua-New Guinea coastline and the Solomon Sea with its narrow straits to the north impose strong topographic constraints on the flow that is little documented so far. Long-term observations in the region are sparse, and so far the Argo floats array does not sample this enclosed area well. Climatologies are hampered by the sparse data coverage. Gliders are autonomous underwater platforms that are moved over the water column by modifying their buoyancy and "glide" using wings that confer a horizontal velocity associated with their vertical displacements. Gliders are expected to be an important contribution to monitor boundary current, especially in regions of difficult accessibility. An experimental glider monitoring of the LLWBC within the Solomon Sea is currently tested to understand how the inflow distributes within the Solomon Sea. Five glider missions have been operated from August 2007 to January 2009 showing the huge variability of the transports in relation with ENSO conditions and eddy activities.
Satellite altimetry has the advantage to continuously provide synoptic pictures of Sea Level Anomaly in an area where the Solomon Sea exhibits the highest levels of sea level variability of the whole South Tropical Pacific Ocean. The 1/3° x 1/3° gridded AVISO data product provided every 7 days is used. It combines data from the different altimetric missions. Depending on time, up to four altimetry satellites are available (Jason-1, Envisat or ERS-2, Topex/Poseidon and GFO). Combining data from different missions significantly improves the estimation of mesoscale signals. At a given time, SLA provides some insights on the circulation of the Solomon Sea such as the eddy anomaly activity, and the anomalies of geostrophic surface current.
Glider, and satellite date provide information on current that are highly complementary. A glider mission takes 4 months to sample at high resolution (5 km) a specific trajectory whereas satellite provide a synoptic view of the Solomon Sea circulation at a given time. To really interpret the glider data requires placing them in a larger view as given by altimetry. But it it is first necessary to test if the glider and satellite information are compatible. This is the motivation of this short written.

3. ESTIMATION OF CURRENT
Two complementary types of data are produced by the glider: profiles of temperature and salinity comparable to ARGO float data, and an estimate of absolute depth-averaged velocity derived from the difference between vehicle motion as measured by GPS fixes and the distance travelled through the water. Therefore the glider provides an estimate of the 0-600 m vertically averaged velocity, and the cross-track geostrophic velocity relative to 600 m. The difference between the vertical average of cross-track geostrophic velocity and of glider-measured absolute velocity gives the reference level cross-track velocity and thus the absolute geostrophic cross-track velocity over the upper 600 m.
Anomalies available from altimetry are referenced to the 1993-1999 period and limit their use of our purpose. Therefore it is necessary to add a Mean

Sea Surface Height to get absolute sea level. No one based on in situ data has the required accuracy therefore the MSSH used comes from a model simulation at 1/12° resolution of the Solomon Sea [1]. The absolute sea level is interpolated in space and time on the glider track, and provides an estimation of cross-track geostrophic current at the surface.

4. THE SOLOMON 7 MISSION

The Solomon 7 mission was held during November, 10 2008 to February, 1 2009. The deployment and the recovery were from Gizo, a small island in the Western province in Solomon Islands. The glider crossed twice the Solomon Sea. It reached to the west the Louisades archipelago at the southern east extremity of Papua New Guinea where it sampled twice the New Guinea Coastal Current and Undercurrent (NGCC/NGCU), the western boundary currents entering the Solomon Sea (Fig.1). More than 500 profiles of temperature and salinity have been recorded for a distance of 1900 km. The variability of SLA during the 3 months of the mission shows that the glider trajectory went through a patch of high variability in its eastern part (Fig. 1). The intrinsic variability during the time of the mission is at the origin of inaccuracy in the estimation of transport entering the Solomon Sea from the glider.

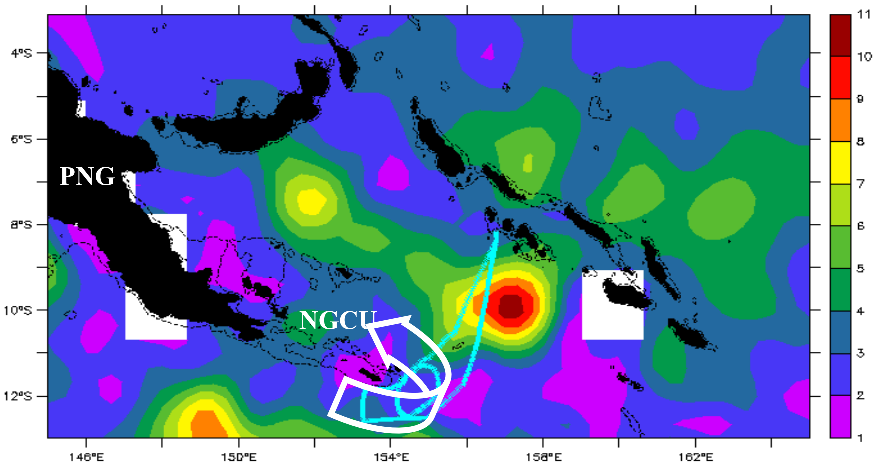

Figure 1: Map of SLA variability in the Solomon Sea during the 3 months of the glider mission7 (in cm). The trajectory of the glider for Mission 7 is shown by the blue line.

The absolute geostrophic cross-track current estimated for the surface layers in the upper thermocline by the glider is shown on Fig.2a. It is notable that the velocities are rather different during the round trip. The southern section presents relatively high velocities (0.2 m/s) exiting the Solomon Sea in its eastern part and entering the Solomon in its western part whereas the northern section shows lower velocity with opposite direction. Also the different sections through the NGCC in the west show zonal velocity in opposite direction: westward for the western section and eastward for the eastern section. Despite a supposed high variability of the surface currents, it is very encouraging that the estimation of absolute geostrophic cross-track current at the surface from altimetry shows similar structures that those from the glider (Fig.2b) even if some discrepancies exist between their magnitudes.

5. CONCLUSION

Despite a supposed high variability of the surface currents, the estimation of absolute geostrophic cross-track current at the surface from altimetry shows similar structures that those from the glider even if some discrepancies exist between their magnitudes. The good similarity between the estimation of currents averaged over the upper thermocline and the surface currents from altimetry tell us that the surface information from altimetry can be extended in depth until the upper thermocline (around 200 m depth). Therefore altimetry will be useful to follow the time evolution of the structures during the glider mission and might help to interpret the observations from the glider. The intrinsic variability during the time of the mission is at the origin of inaccuracy in the estimation of transport entering the Solomon Sea from the glider, and altimetry could be useful to estimate such inaccuracy.

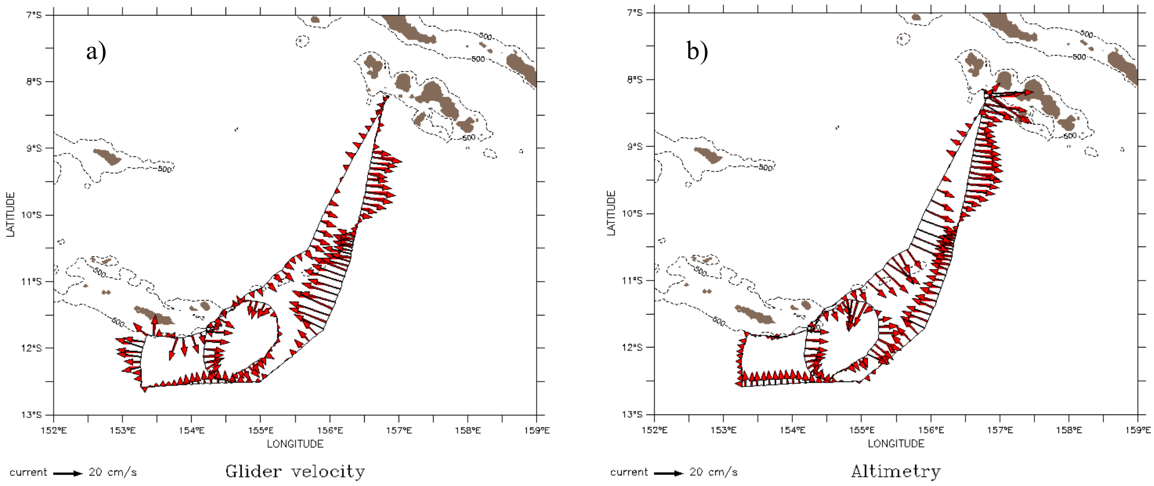

Figure 2: Absolute geostrophic cross-track current estimated by a) the glider for the surface layers (0-200 m depth), and b) altimetry at the surface

6. REFERENCES

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