Surface Circulation Observed by Altimetry along the Tunisian Coast (Central Mediterranean Sea)

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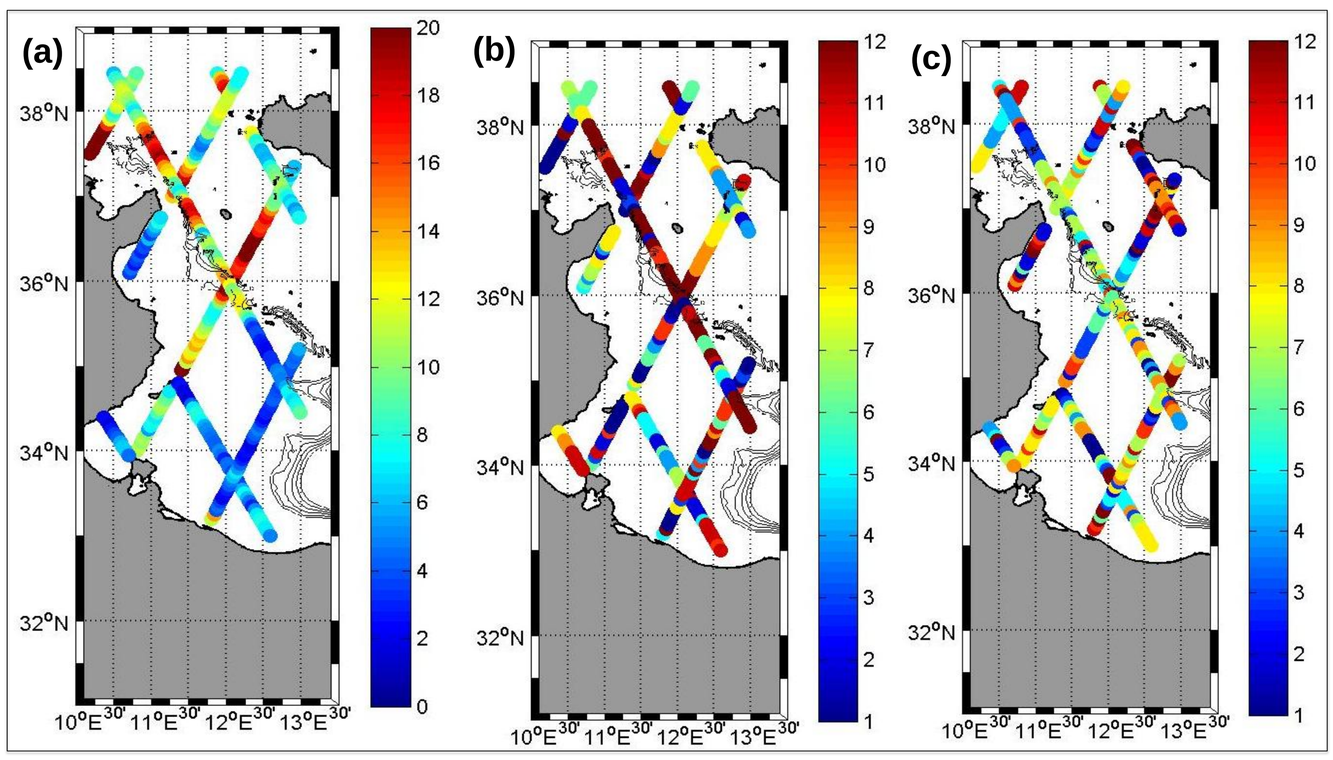
The Atlantic Tunisian Current (ATC) is a slope current flowing around the Tunisian coast close to the 200 m isobath until the Lampedusa Island. Because of its position, the ATC and the surrounding mesoscale activity should play a key role in the exchanges between the coastal and offshore waters. However, despite significant advances, the circulation scheme on the Tunisian-Libyan shelf remains poorly informed and the state of knowledge on ATC variability patterns is still fragmented. Coastal altimetry is expected therefore to provide a synoptic view on current position and intensity.

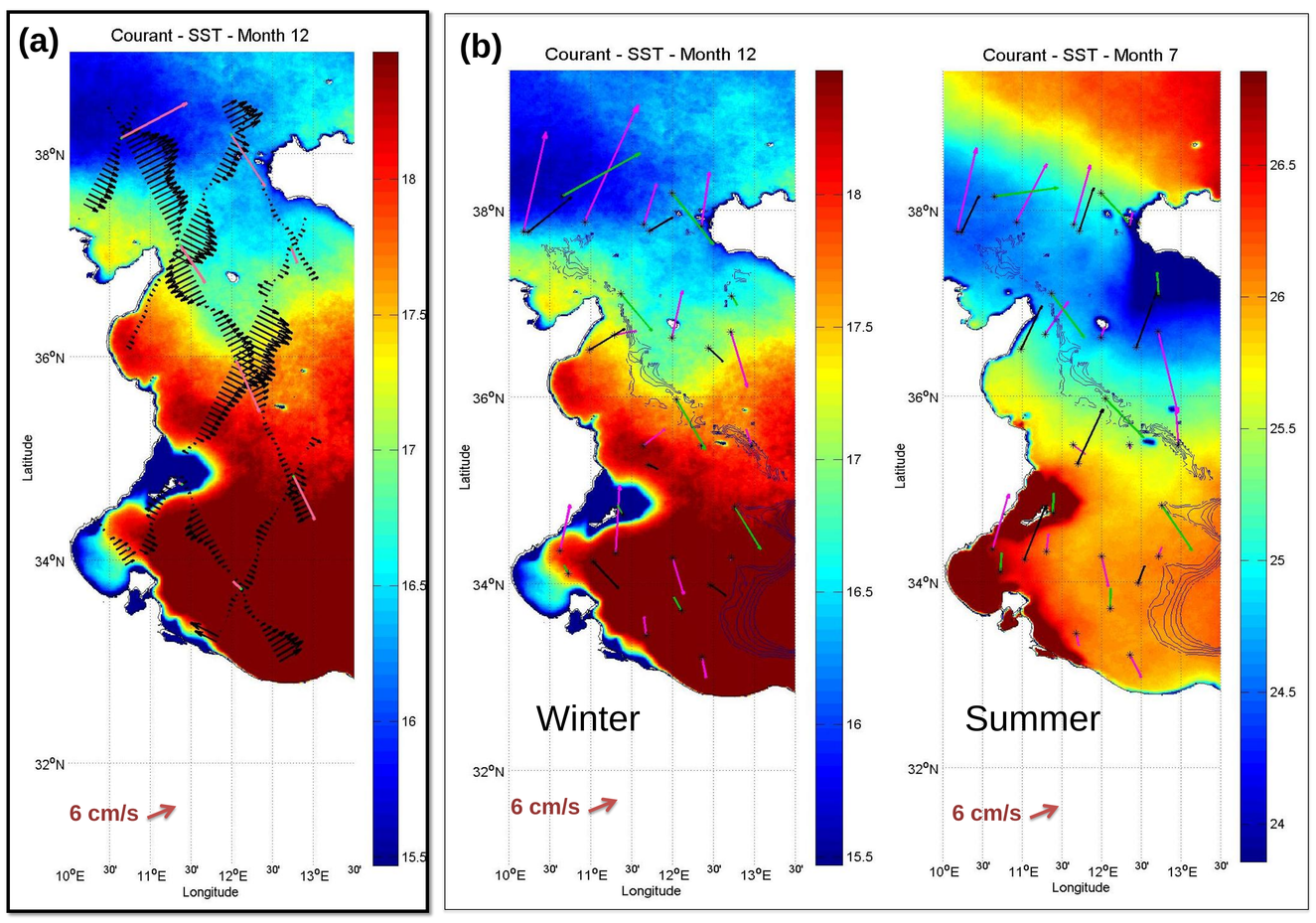
1. Seasonal circulation

❖ Surface current anomaly climatology are used to examine the seasonal variability of the highly fluctuating coastal circulation estimated from satellite altimetry over Tunisian coasts. Temporal and intensity characteristics from the Geostrophic Velocity Anomaly (GVA) climatology have been extracted (Fig 1.1). In Panel a, larger values of absolute amplitude, A, (15–20 cm/s) are observed where the ATC location is expected. The maximum values of A are obtained near cap Bon and off the gulf of Hammamet. The maximum amplitude of the coastal current anomaly (Panel b) is reached in December and in January. The corresponding minimum (Panel c) generally appears around July but also displays larger dispersion over the region (ranging from May to October) than the phase of the maximum. The internal consistency of the results can also be considered as validation of the altimetric derived currents.



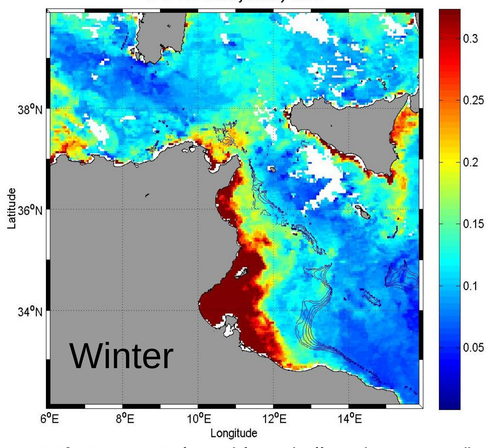
1.1) (a) Maximum amplitude (in cm/s) observed in the seasonal cycle of the surface current field deduced from altimetry. This value is the difference between the maximum and minimum values observed. Time, given in month number, during which the maximum (b) and minimum (c) values are observed. The 200-m isobaths is superimposed.

❖ 11 years (2002-2012) of along track altimeter SLA data, derived from multi-missions (TOPEX/Poseidon, Jason (1/2), GFO and Envisat), are used to compute GVA at mono-satellite crossover locations This provide a directional measure of the current variability. The orientation of Jason GVA (green arrows in Fig (1.2)) parallel to the 200m isobaths near cap Bon and off the Gulf of Gabes in both winter (represented by December) and summer (represented by July) seasons confirm the predominant direction of the ATC, which is moving southward and flows off the Gulf of Gabes



1,2) **(a)** Monthly climatology maps of cross-track geostrophic current anomalies and of SST (DLR obtained from the DLR EOWEB – Earth Observation Information Service) for December. The satellite altimeter data are derived from Jason missions (TPn / J1n / J1 / J2). The pink arrows show the GVA at monosatellite crossovers. **(b)** GVA computed at each satellite crossover during the 7-year multi-mission time period. Bathymetry (m) is indicated by contour lines. A velocity scale is in the bottom left corner. The green (resp. black, pink) arrows indicate Jason (resp. Gfo, Envisat) GVA.

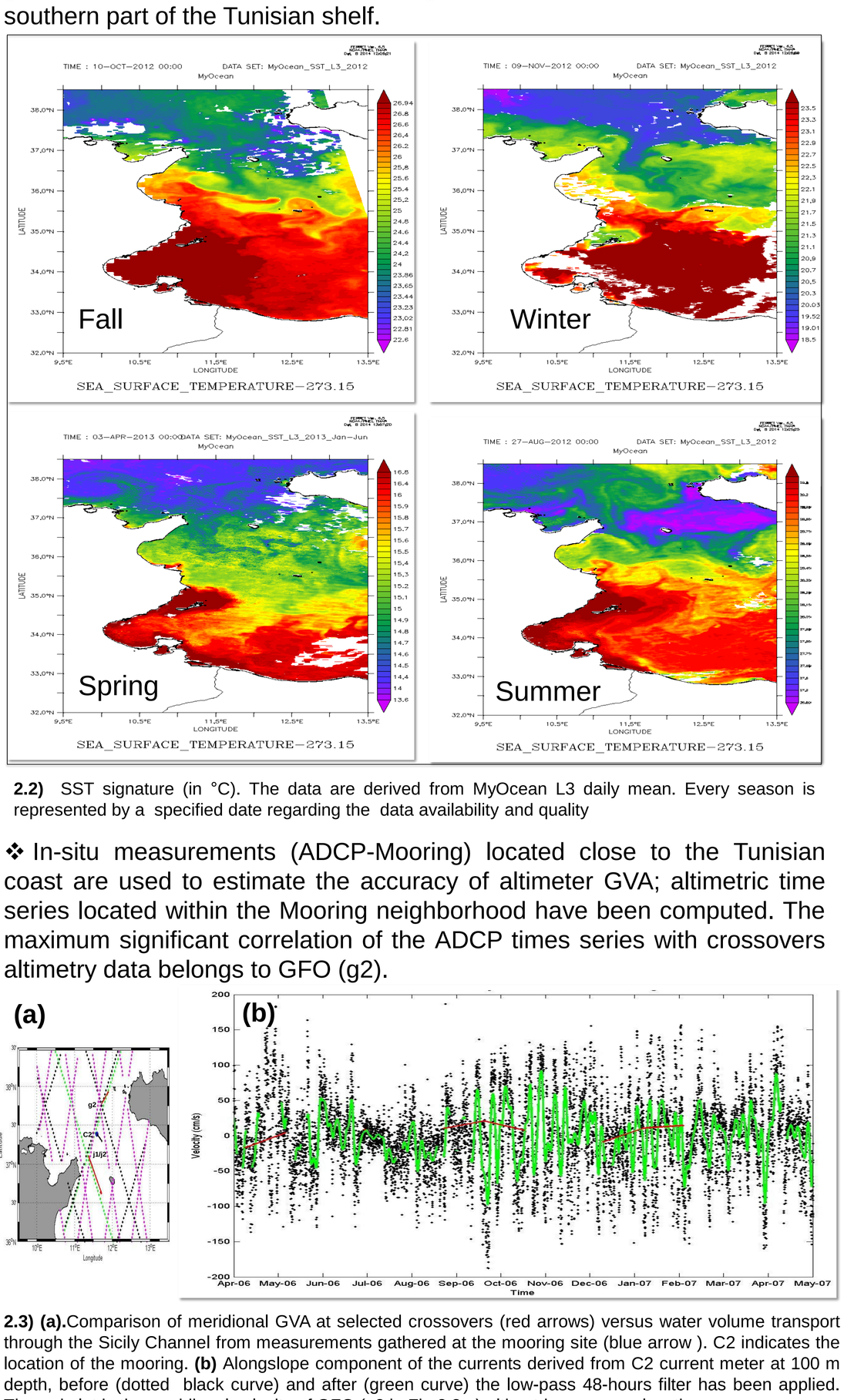
2. Multi-sensor comparison and validation



2.1) Ocean Color Chlorophyll-a signature (in mg/m^3). Those concentrations were calculated for the first week of January 2012

❖ SST and Chlorophyll-a imagery are used to further analyze the major features highlighted by the GVA climatology. According to altimetry, the ATC trace is more intense in winter and flowing over the slope of the Tunisian shelf (200m isobath). The pathway of this cold and rich Atlantic water which intrudes Tunisian coasts (Sicily Channel and gulf of Hammamet) is visible in both chlorophyll (Fig 2.1) and SST (Fig 2.2) patterns. The highest Chlorophyll concentrations along the coasts are due to the remote sensors overestimation.

❖ Some dynamical structure are observed in SST images (Fig 2.2), mainly the presence of growing meanders and fine-scale eddies starting to take place in Fall, intensifying in winter with a marked frontal dynamic and vanishing in spring. This is in accordance with the altimetry current maps (Fig 1.2) confirming the intrusion of the ATC current near the coast in the gulf of Hammamet as well as its flowing with the 200m isobath and over the southern part of the Tunisian shelf.



2.2) SST signature (in °C). The data are derived from MyOcean L3 daily mean. Every season is represented by a specified date regarding the data availability and quality

❖ In-situ measurements (ADCP-Mooring) located close to the Tunisian coast are used to estimate the accuracy of altimeter GVA; altimetric time series located within the Mooring neighborhood have been computed. The maximum significant correlation of the ADCP times series with crossovers altimetry data belongs to GFO (g2).

2.3) (a). Comparison of meridional GVA at selected crossovers (red arrows) versus water volume transport through the Sicily Channel from measurements gathered at the mooring site (blue arrow). C2 indicates the location of the mooring. **(b)** Alongslope component of the currents derived from C2 current meter at 100 m depth, before (dotted black curve) and after (green curve) the low-pass 48-hours filter has been applied. The red plot is the meridional velocity of GFO (g2 in Fig.2.3.a) altimetric crossover location.

Conclusion & perspectives

➢ The use of altimetry to study the surface circulation in the study region has increased the quantity of available observations near the coastline

➢ We have assessed the ability of the altimeter-derived currents (at the crossover locations) to capture the main surface circulation features and the associated mesoscale variability along the Tunisian coast.

➢ For more accurate comparison between altimetry and in-situ data, it is planned to make in-situ radial parallel and close to altimetric tracks or at least radials with certain points located close to altimetric crossovers.

➢ The chosen examples for Multi-sensor comparison (SST-Chl-a) were for a particular data during a relatively intense episode of slope currents with marked frontal dynamics. We wish to make a more systematic analysis of these fronts, over a longer period.