New study on the detection of cold-core rings in the Gulf Stream area using remote sensing platforms

The Gulf Stream plays a major role in the meridional transport of heat and salt across the North Atlantic Ocean. The Gulf Stream acts as a barrier between the cold (10-18 °C) and relatively fresh (salinity around 30-32 in the practical salinity scale) waters of the Labrador Current and the warm (23 °C), salty (36), clear, and unproductive waters of the Sargasso Sea. After leaving Cape Hatteras, the Gulf Stream forms large-amplitude meanders that may loop back onto themselves and break off the stream forming detached rings. Warm-core anti-cyclonic rings bring significant amounts of warm tropical water to the continental slope and shelf seas north of the Gulf Stream. Similarly, cold-core cyclonic rings bring cold, nutrient-rich shelf water, to the biologically barren Sargasso Sea waters. Detection of cold-core rings from satellite data has been quite elusive so far as the surface temperature signature rapidly disappears.

Sea Surface salinity on August 23, 2015 according to various SSS products with superimposed OSCAR velocities. The plot on (a) correspond to the one-degree binned Aquarius L3 map. The other three maps show the fusion of the map shown in (s) with: AVISO SSH (b); SMOS SSS (c); and AVHRR SST (d).

In a recent study by Umbert et al. (2015), the bivariate data fusion technique developped by (Umbert et al. 2014), which exploits the hypothesis that the singularity exponents of sea surface temperature must correspond to the ones of sea surface salinity, is used to both improve the quality of binned maps of remotely sensed SSS and to assess whether the salinity

signature of the mesoscale rings associated with the Gulf Stream can be represented.

For that purpose, binned maps (one degree bin size) of Aquarius SSS maps are interpolated to a quarter-degree grid by fusing the salinity data with different geophysical templates: sea surface height (SSH) from AVISO, and sea surface temperature (SST) from AVHRR and SSS from SMOS.

Daily maps of fused SSS have been produced for year 2012. Analysis of the results indicate that the data fusion product that better represents the presence and dynamics of the cold core rings is the one that fuses Aquarius SSS with AVISO SSH. Indeed, it provides a series of negative salinity anomalies that better collocate with the position of the cyclonic eddies tracked from sea level anomaly maps. Such a result is consistent with the hypothesis that this cyclonic eddies in this area are indeed cold-core rings shed off the Gulf Stream.

References:

Umbert, M., N. Hoareau, A. Turiel, and J. Ballabrera-Poy (2014), New blending algorithm to synergize ocean variables: The case of SMOS sea surface salinity maps, Remote Sens. Environ., 146, 172–187, doi:10.1016/j.rse.2013.09.018.

Umbert, M., S. Guimbard, G. Lagerloef, L. Thompson, M. Portabella, J. Ballabrera-Poy, and A. Turiel (2015), Detecting the surface salinity signature of Gulf Stream cold-core rings in Aquarius Synergistic producsm J. Geophys. Res. Oceans, 120, 859-874, doi:10.1002/2014/JC010466.