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Combination of in-situ and satellite observations to monitor the Ocean State: Application to the North Atlantic Ocean

Sandrine Mulet, Stéphanie Guinehut, Marie-Hélène Rio, Anne-Lise Dhomps, Laurent Bessieres, Gaël Nicolas, and Gilles Larnicol

CLS, Space Oceanography Division, Ramonville Saint-Agne, France (sandrine.mulet@cls.fr)

Producing comprehensive information about the ocean has become a top priority to monitor and predict the ocean and climate change. Complementary to modeling/assimilation approaches, an observation based approach is proposed here. It relies on the combination of in-situ (temperature and salinity profiles) and remote-sensing (altimetry and sea surface temperature) observations and statistical methods. Global temperature, salinity and current fields are provided weekly from the surface down to 1500-meter depth over the 1993-2009 period.
The method uses first, a multiple linear regression method to derive synthetic T/S profiles from the satellite measurements. These synthetic profiles are then combined with all available in-situ T/S profiles using an optimal interpolation method to create the ARMOR3D fields. The thermal wind equation with a reference level at the surface is finally used to combine current fields from satellite altimetry with the ARMOR3D field and thus to generate the global 3D current fields called SURCOUF3D.
ARMOR3D and SURCOUF3D fields are used to study the variability of the North Atlantic Ocean and are compared with independent data from in-situ sections and numerical model reanalyses. We mainly focus on the section at 26.5°N. First, we look at the western boundary current off the Bahamas: in the first 1000 m high correlation (up to 0.9) are found with in-situ velocities measured by the RAPID-MOCHA current meter array. Then a 1993-2009 long time series of the maximum Atlantic Meridional Overturning Circulation strength is computed. It is in good agreement with results from RAPID-MOCHA monitoring project and GLORYS Mercator-Ocean reanalysis and describes a very high variability across this section without showing any significant trend.