Meso and Submeso-scale Vertical Velocity Estimations in Different Dynamical Regimes in Preparation for the High Resolution Observations of the SWOT Altimetry Mission

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Upper ocean vertical transport associated with meso and submesoscale processes plays an essential role in ocean dynamics and physical-biological coupling through the upwelling of nutrient in the photic zone and the subduction of water masses modified by surface fluxes. However, it is very difficult to measures vertical velocities (w) because of their small intensity compared to horizontal motions and their important variability in space and time. Estimations are thus usually inferred using a generalized approach based on frontogenesis theories. The choice of the method used to calculate w generally depends on the data available and on the dominant processes in the region of study. A widely used approach is to solve the Q-vector version of the omega equation.

We will present a comparison of the results obtained by solving different expressions of the omega equation from the simple quasi geostrophic formulation to the generalized one. We aim to provide a statistically robust evaluation of the scales at which the vertical velocity can be resolved with confidence in a variety of flow and data availability conditions. The spatial and temporal resolution of the data as well as its synoptic character will constrain the formulation of the equation that can be used and the uncertainty on estimated w. To simulate the possible data sets a high resolution simulation (dx=1-1.5 km) of the North Atlantic was used. We compare the different reconstruction of w to the modelled vertical velocity. The simulation encompasses regions with different regimes of atmospheric forcing, mesoscale turbulence intensity, seasonality and thermohaline structure, allowing us to explore and contrast several different dynamical contexts.

In a few years the SWOT mission will provide bi-dimensional images of sea level elevation at a significantly higher resolution than available today. The wide-swath altimeter should capture wavelength down to 10 to 20 km, which in combination with high-resolution satellite imagery and in situ data could provide very valuable information on the vertical circulation. This work helps assess the possible contribution of the SWOT data to the understanding of the submesoscale circulation and the associated vertical fluxes in the upper ocean.