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Survey of submesoscale structures at the margin of the Northern Current in the North Western Mediterranean Sea using Gliders: observations and diagnostics

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From 2008 on, repeated sections crossing the Northern Current (NC) were operated by gliders as part of a global observing system (MOOSE project) of the North Western Mediterranean Sea.
This work is dedicated to the analysis of the submesoscale thermohaline variability at the margin of this current observed by gliders. The mean circulation of the basin is characterized by a cyclonic gyre (whose Northern part is the so-called NC) associated with a doming of the isopycnals preconditionning the whole interior basin to great vertical mixing. The thermal and haline differences between the Atlantic Water (AW) transported by the NC and older and modified AW off the coast leads to a frontal structure. Especially in winter, when the mixed layer depth used to reach several hundreds of meters offshore, isopycnal outcropping and the role of frontal processes are enhanced leading to intense variability at scales smaller than the deformation radius.
Based on diagnostics using the Potential Vorticity (PV) computed from the glider data assuming quasi-geostrophic conditions and no variation in the alongshore direction, we discuss the dynamical processes at work, with a focus on 2 typical examples:
(1) the first example takes place in winter during a strong vertical mixing event. While the glider crossed the frontal region, the temperature and salinity fields exhibit vertical motions at depths about 0-400m. Frontogenesis might be at play through mesoscale strain since the glider shows an intense mesoscale activity but a weak stratification and enhanced horizontal buoyancy gradient actually make the Ertel PV reach negative values and symmetric instability is likely to be a prominent mechanism explaining the observed variability.
(2) the second example takes place in spring. We identify an episode of down-front wind blowing during the glider deployment which could have extracted PV from the surface layer. However, the geostrophic turbulence is in that case likely to play a key role in the formation of the observed variability of the temperature and salinity since it is organized along slopes characterized by an aspect ratio of an order of f/N.