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3D Reconstruction of oceanic mesoscale currents from a single snapshot of sea surface temperatures

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A key problem in oceanography is the synoptic estimation of the three-dimensional (3D) velocity field of the ocean. In this work we focus on the ability to reconstruct the 3D dynamics of the ocean from a single snapshot of Sea Surface Temperature (SST) by an effective version of Surface Quasi-Geostrophy (eSQG). The eSQG method is based on Quasi-Geostrophic Potential Vorticity principle and on the fact that surface density plays an analogous role as interior PV. With the extra assumption that SST anomalies fully represent surface density anomalies, one obtains a direct relation between the 3D velocity field and the SST field. The implementation for this methodology is simple and robust and only requires the set-up of two parameters: the mean Brunt-Väisälä frequency and a parameter that determines the energy level at the ocean surface. The validity of this approach is tested using an OGCM simulation representing the North Atlantic in winter. It is shown that the method is quite successful in reconstructing the velocity field at the ocean surface for mesoscales (between 30 km and 300 km). The eSQG framework can also be applied to reconstruct subsurface fields using surface information (SST as well as altimetric measurements). Results have shown that the reconstruction of velocities and vorticity from surface fields are reasonably good for the upper 500 meters and that the success of the method mainly depends on the quality of the SST as a proxy of the density anomaly at the base of the Mixed Layer (ML). This situations happens after a ML deepening period. Therefore, the ideal situation for the application of this method would be after strong wind events. This methodology has

been also applied to real SST images such as infra-red MODIS data and microwave AMSR-E measurements.