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Lagrangian reconstructions of tracer fields at ocean surface

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In recent years the role of submesoscales, i.e. small scale structures of size $O(1-50)$ km created by the stirring of mesoscale eddies, has been shown to be more and more important. Indeed, it has been theoretically and numerically put in evidence that they are associated with large vertical fluxes and that their energetic content is much higher than previously thought. Improving the characterization of such small scales reveals to be crucial to grasp their impact on the global ocean properties. Direct measurement of submesoscale features on a global scale, nevertheless, is at present severely limited by the spatial resolution of available satellite products. As a consequence, the development of techniques for the reconstruction of small scale features from low resolution data is needed.

In this work we numerically study a method for the reconstruction of tracer fields in a two-dimensional turbulent flow (in the Surface-Quasi-Geostrophic regime) that bears good resemblance with surface flows at meso and sub-mesoscales. Tracers are reconstructed using a Lagrangian technique based on the property of chaotic advection to generate small scale structures. We discuss the capabilities of the present method by a qualitative as well as quantitative comparison between the original (high resolution) fields and their reconstructions, performed using only low resolution data. Good agreement is found between the original and the reconstructed fields in a range of advective timescales, with an optimal reconstruction time. Our results indicate that the method properly allows to reproduce statistical features of the original field as, e.g., the spectrum of tracer fluctuations. We also consider the statistics of tracer gradients, which are relevant for assessing the potential of the method for the detection of fronts.