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Mesoscale turbulence properties in the North-East Atlantic from altimetry and ADCP observations

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The North-East Atlantic ocean is characterized by a mesoscale turbulence which properties, in terms of eddy kinetic redistribution and impact on the large-scale circulation, are not well known. We have analysed these properties by using four years of ADCP measurements taken as part of the Ovide project during the summer time. The ADCP transects (about 1000 km) are close and quasi-parallel to three altimeter tracks.

We show that the spectral characteristics of the Sea Surface Height (SSH) deduced from the along-track altimetry observations are very close to those of the stream function (SF) deduced from the ADCP data: SSH and SF spectral slopes are close to k^{-4} with k the wavenumber. Such slopes are shallower than expected from the quasi-geostrophy (QG) turbulence theory (k^{-5} - k^{-6}) but similar to those predicted by Surface Quasi-Geostrophic (SQG) theory ($k^{-11/3}$), which highlights the impact of small scales.

These spectral characteristics from two independent datasets are consistent with recent theoretical and DNS results. As such, they strongly suggest that the mesoscale and submesoscale surface frontal dynamics impacts the mesoscale turbulence during the summer time, with the consequence of a significant inverse kinetic energy cascade over a large scale range.

This good agreement between SSH and SF spectral characteristics has to be contrasted with recent results in the North-West Atlantic that reported a SSH spectral slope in k^{-4} and a SF spectral slope slightly steeper than k^{-5}. Some explanations for this discrepancy, in terms of eddy turbulence, are proposed.