Supporting Information for
"Structure of the bottom boundary current South of Iceland and spreading of deep waters by submesoscale processes"

Charly de Marez[1], Angel Ruiz-Angulo[1], and Mathieu Le Corre [2,3]

[1]University of Iceland, Reykjavik, Iceland

[2]Service Hydrographique et Océanographique de la Marine (SHOM), Brest, France

[3]Laboratoire d'Océanographie Physique et Spatiale (LOPS), University of Brest, CNRS, IRD, Ifremer, IUEM, France

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Corresponding author: Charly de Marez, `charly@hi.is`

1 Backward particule advection simulation

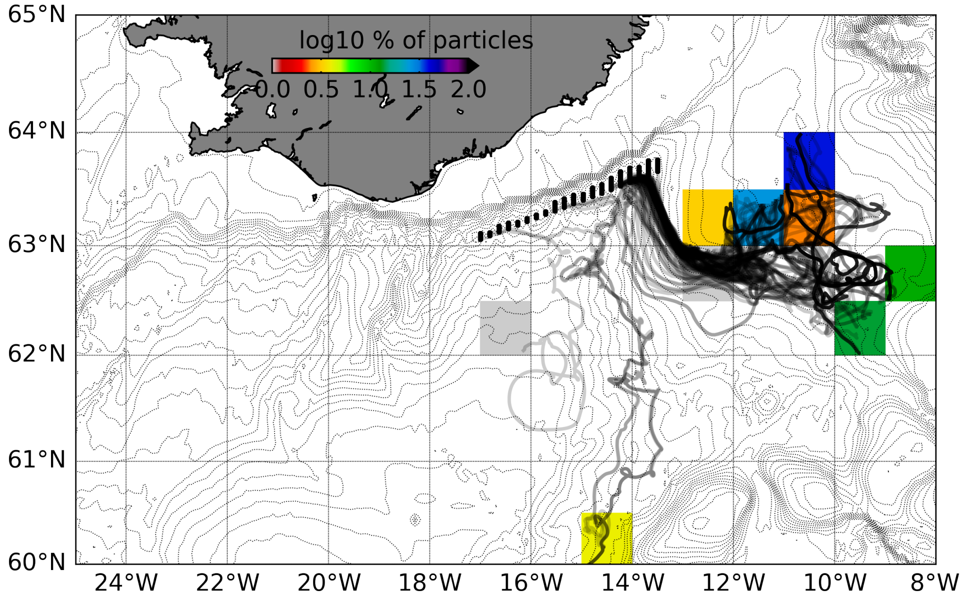

Figure S1. Distribution of the particle origin position from backward Lagrangian simulation (only the 3,342 particles that have traveled more than 300 km are considered); the release position of particles is shown by the black dots.

We performed a backward advection simulation. We released 75 particles along the Suðurland slope every days of year 2005 on the 1027.75 $\text{kg}\,\text{m}^{-3}$ isopycnal, and advect them backward to locate their origin. We only considered particles that have traveled more than 200 km (a large number of particles are discarded as they got trapped on the edge of the isopycnal and stopped moving). Most of the remaining particles originate from the mouth of the Faroe Bank Channel and the Iceland-Faroe Ridge, as suggested by the average velocity norm from simulations, and the 2 forward particle advection simulation discussed in the main manuscript. We can roughly estimate that $\mathcal{O}(10)$ % particles come from the FBC mouth, and that $\mathcal{O}(50)$ % particles come from the IFR. These are only estimates. An accurate estimation could be done using a 3D particle advection using the full (3D) velocity field, but it is not the topic of the current study.

This simulations also highlights the fact that a few particles ($< 5\%$) may end up along the slope in the bottom boundary current while traveling from the interior (or the

East) of the Iceland Basin. This is mostly due to the intense deep-reaching mesoscale turbulent flow in the Iceland Basin that stir the deep water masses, and thus contributes in bringing waters in the bottom boundary current.

2 Vorticity of advected particules

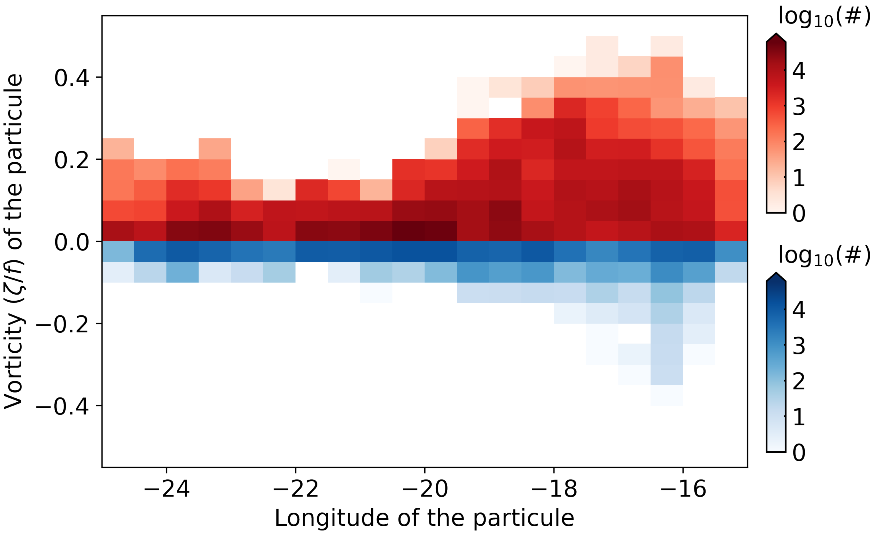

Figure S2. Vorticity histogram of particles released along the Suðurland slope as a function of the longitude of the particle. Red (resp. blue) bins show the number of particles with cyclonic (resp. anticyclonic) vorticity. To compute the histogram, all timesteps are considered.

3 Cross-slope condition for geophysical instability

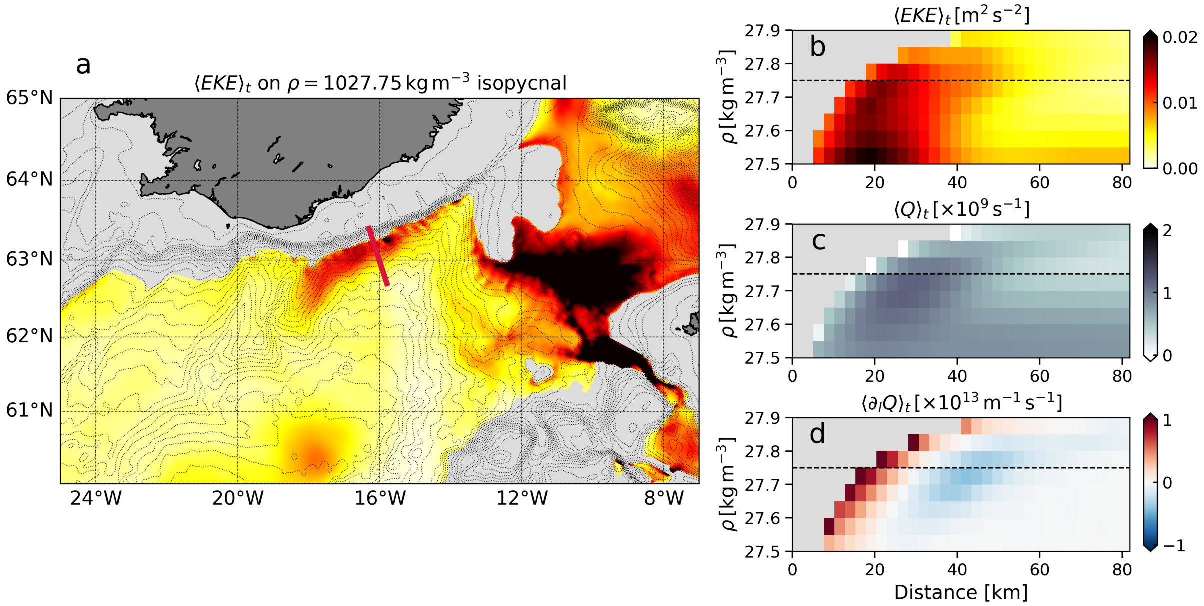

Figure S3. a. Mean EKE on the 1027.75 kg m^{-3} isopycnal. b,c,d, sections of mean EKE, PV, and cross-slope gradient of PV along the line shown in a; sections are shown in isopycnal coordinates.

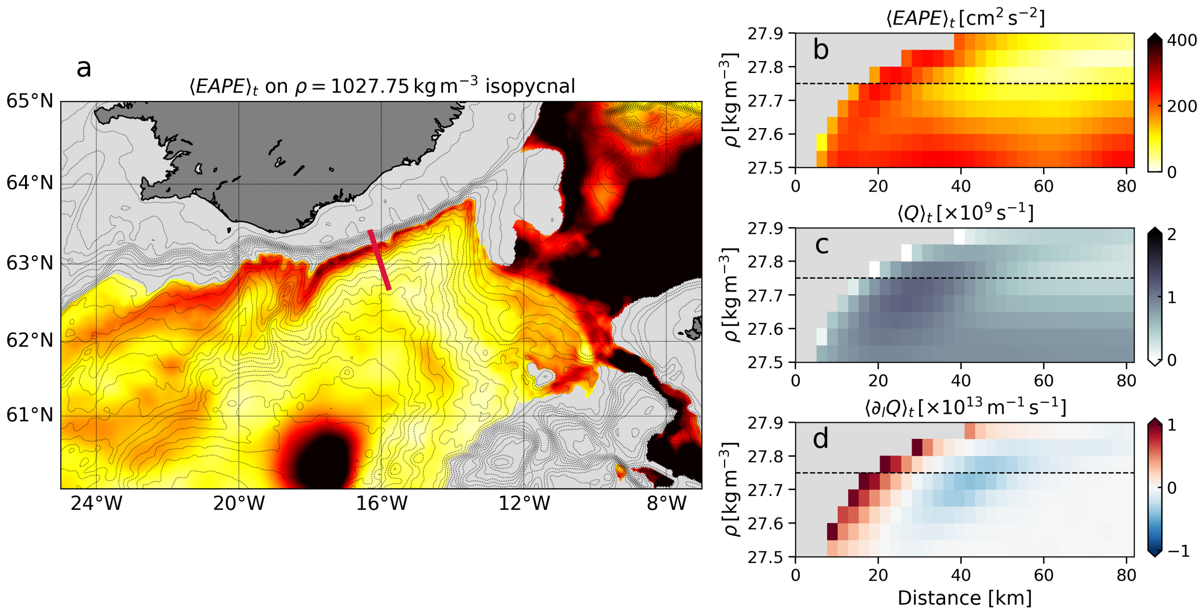

Figure S4. Same as Fig. S3, but with panels a,b showing the EAPE.