Notes on seamounts and mixing

May 22, 2020

1 Sampling velocities

How to sample typical velocities for seamounts? Preliminary tests are shown below.

We compare velocities evaluated at mid-depth, bottom velocities ($\sqrt{u_b^2 + v_b^2}$) and velocities 50 m above bottom ($\sqrt{u_{b+50}^2 + v_{b+50}^2}$) for a 3-km run in Fig 1 and for the 500-m nest in Fig. 4. Corresponding vertical sections are shown in Fig. 3 and 5.

One issue , as noted by Lois, is that mid-depth according to seamount dataset is quite different than the one in the model (which is about 800 m deeper).

There are differences between the croco simulation and LLC4320 for this specific example. We don't know yet if this is variability (only on week of LLC4320) or differences between models.

Sampling one-day every month (or better every 2-weeks) should give a much better idea of the mesoscale variability.

2 Diffusivity

How to diagnose diffusivity in the model?

So far only the vertical tracer mixing coefficient from the model parameterization is used. For the 500=m run we use a $k - \epsilon$ parameterization.

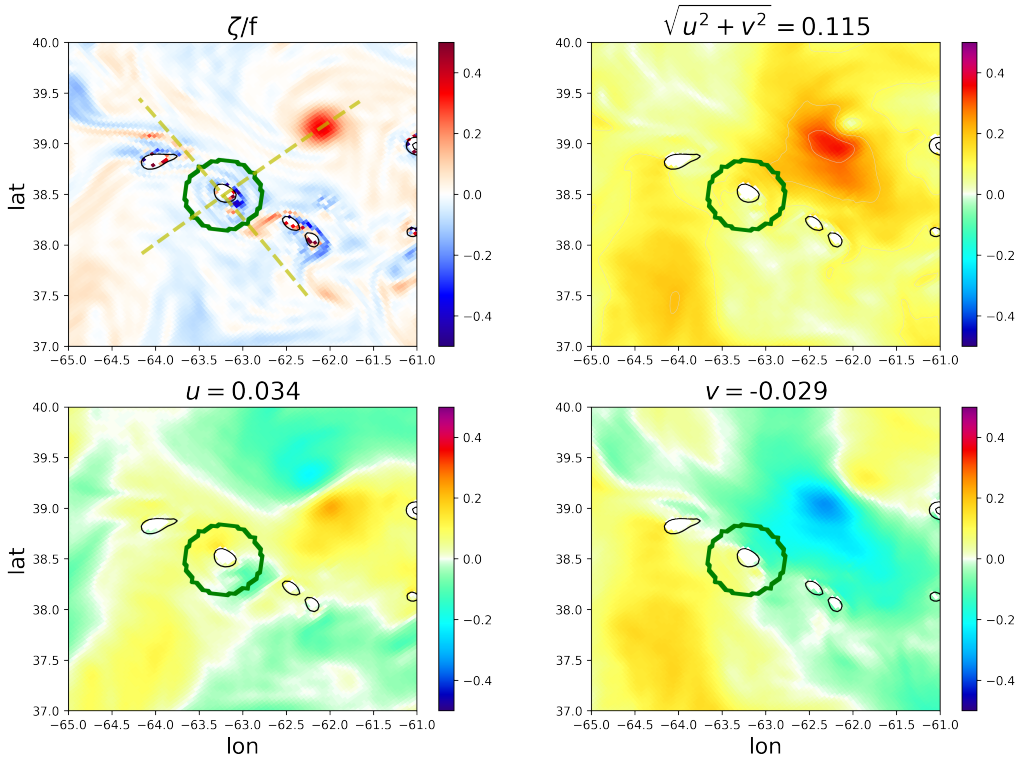

Figure 1: Example snapshot for one NE seamount of (a) vorticity and (b) velocity amplitude at 2757 m depth (mid-depth according to seamount dataset). (c) Bottom velocity ($\sqrt{u_b^2+v_b^2}$), and (d) Velocity 50 m above the bottom ($\sqrt{u_{b+50}^2+v_{b+50}^2}$) for a 3-km Atlantic simulation.

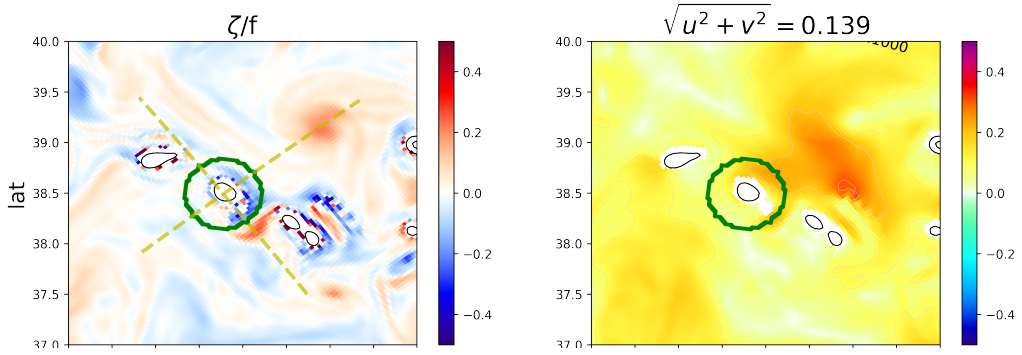

Figure 2: Same than Fig. 1 at 3500 m depth

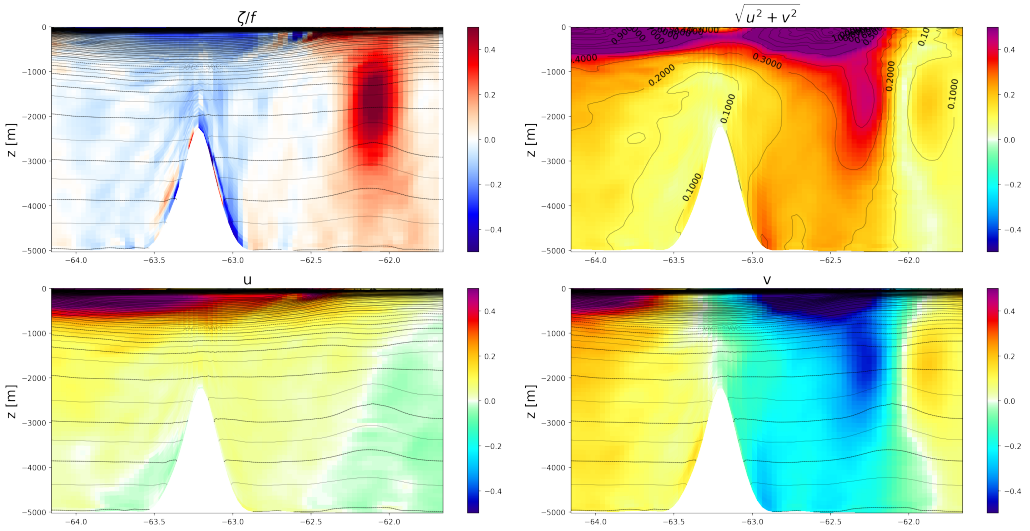

Figure 3: Example snapshot for one NE seamount of (a) vorticity, (b) velocity amplitude, (c) u, and (d) v for the same 3-km Atlantic simulation.

3-month time-mean vertical and horizontal sections as well as area averaged vertical profiles are shown in Fig. 10, 11, and 12.

3 Seamount parameters

Rossby and Froude numbers for 2 (randomly chosen) snapshots both simulations are shown in Fig. 13 and 14.

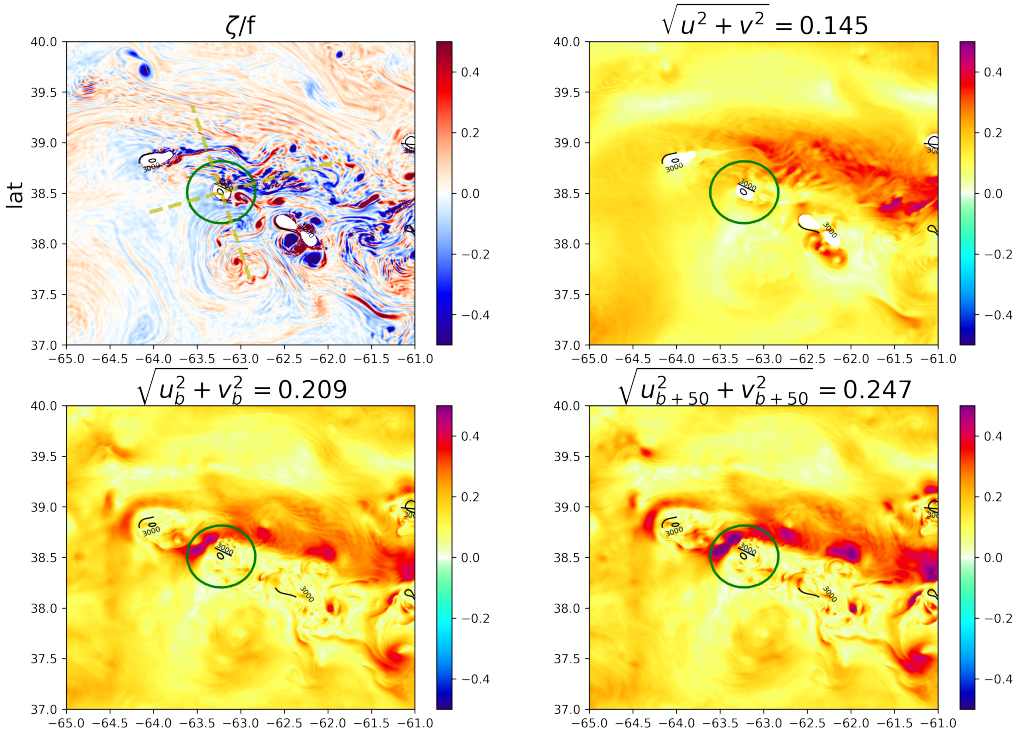

Figure 4: Example snapshot for one NE seamount of (a) vorticity and (b) velocity amplitude at 2757 m depth (mid-depth according to seamount dataset). (c) Bottom velocity ($\sqrt{u_b^2+v_b^2}$), and (d) Velocity 50 m above the bottom ($\sqrt{u_{b+50}^2+v_{b+50}^2}$) for a 500 m nest.

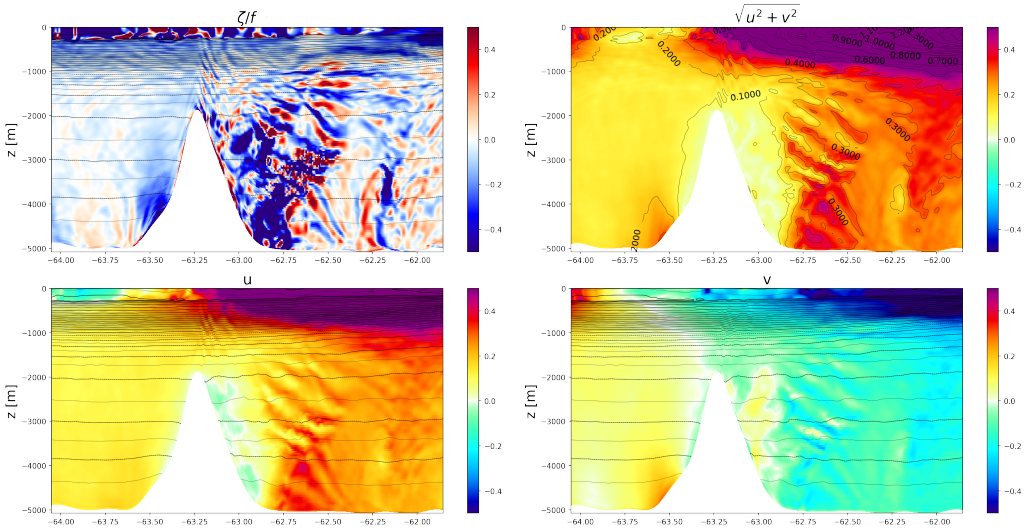

Figure 5: Example snapshot for one NE seamount of (a) vorticity, (b) velocity amplitude, (c) u, and (d) v for a 500-m simulation.

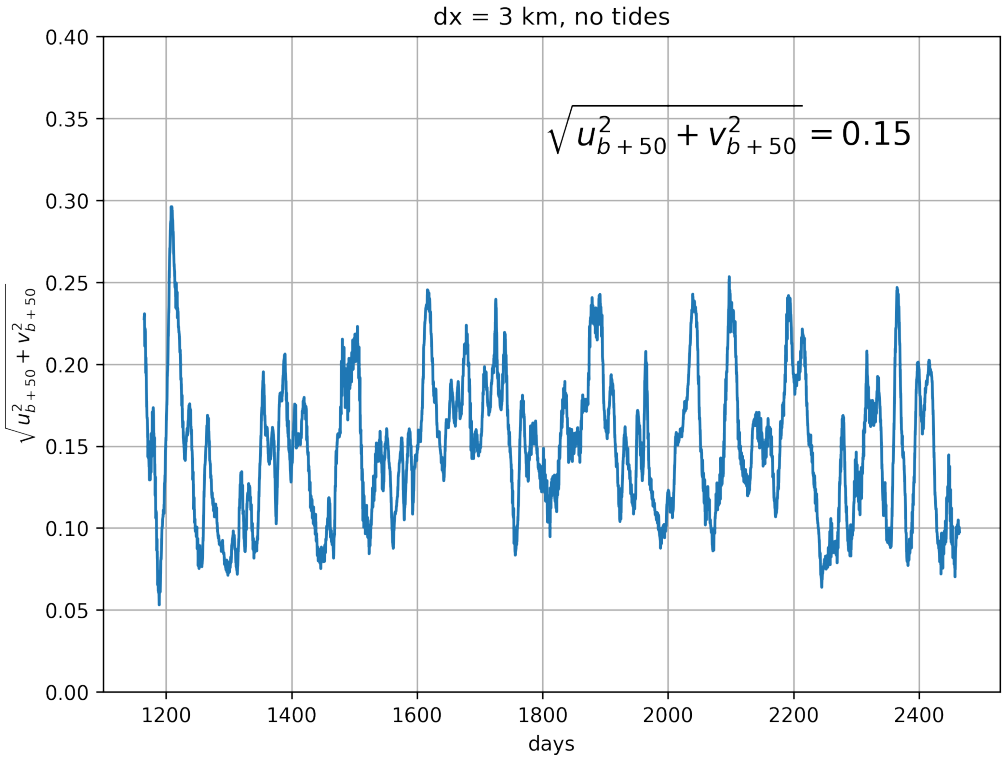

Figure 6: Time-series of $\sqrt{u_{b+50}^2 + v_{b+50}^2}$ integrated over the area around the seamount (circle in Fig. 1) for a 3-km Atlantic simulation.

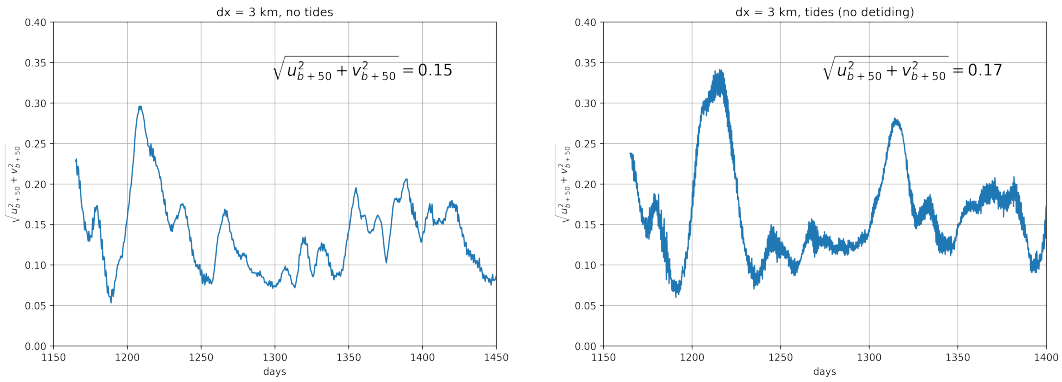

Figure 7: Same than Fig. 6 without (left) or with tides (right) for a 3-km Atlantic simulation

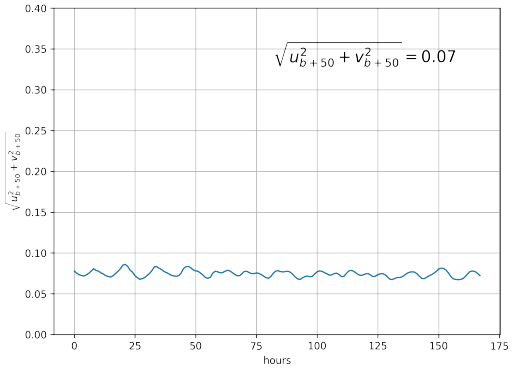

Figure 8: One-week of $\sqrt{u^2 + v^2}$ extracted from LLC4320 at 2757 m depth over (approximately) the same area.).

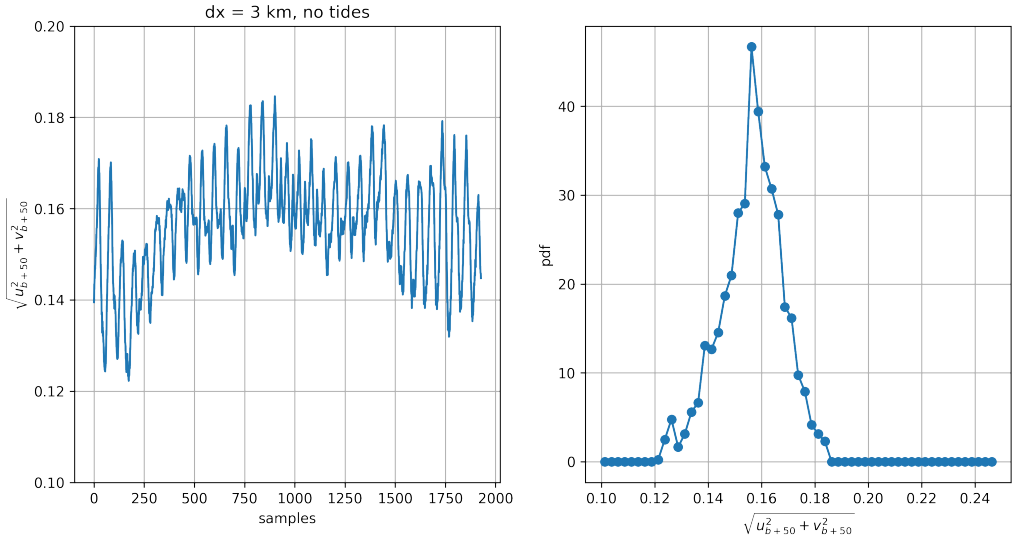

Figure 9: Effect of sub-sampling (one day per month) the signal in Fig 6 on the computation of the typical velocity

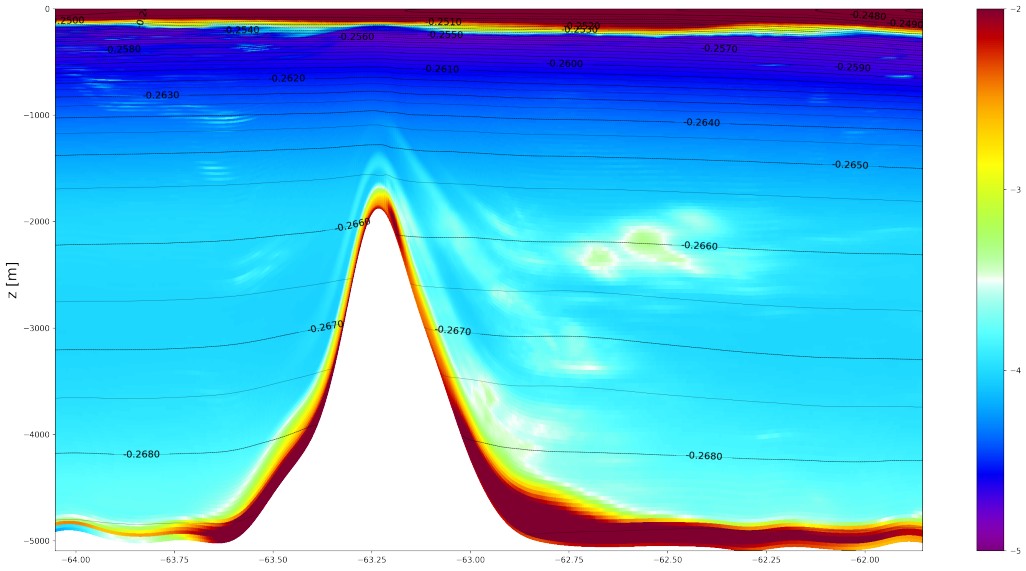

Figure 10: Time-mean (3-month) vertical section of vertical mixing coefficient from the 500 m nest

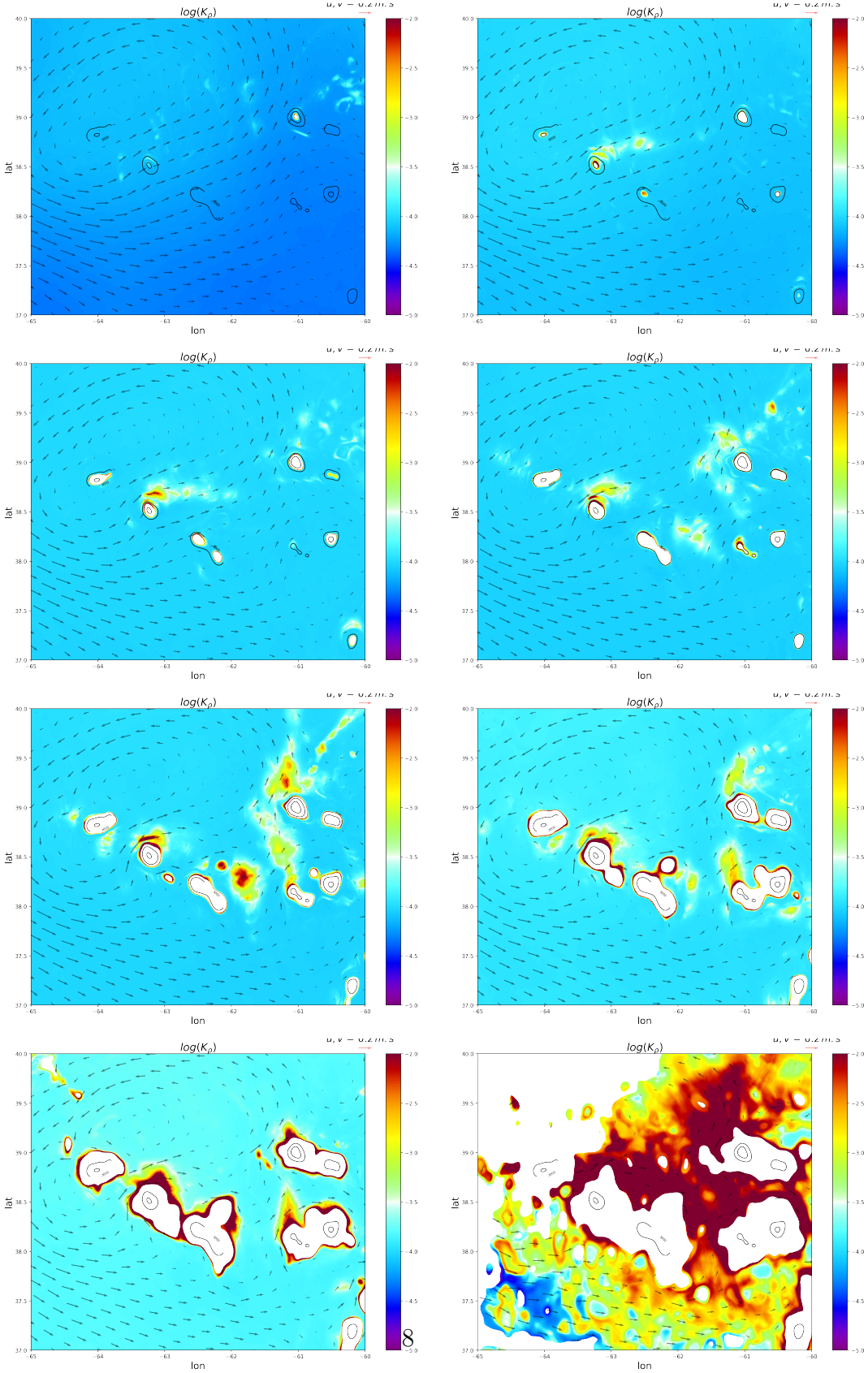

Figure 11: Time-mean (3-month) vertical mixing coefficient from the 500 m nest at (a) 1500 m, (b) 2000 m, (c) 2500 m, (d) 3000m, (e) 3500 m, (f) 4000 m, (g) 4500 m, and (h) 5000 m

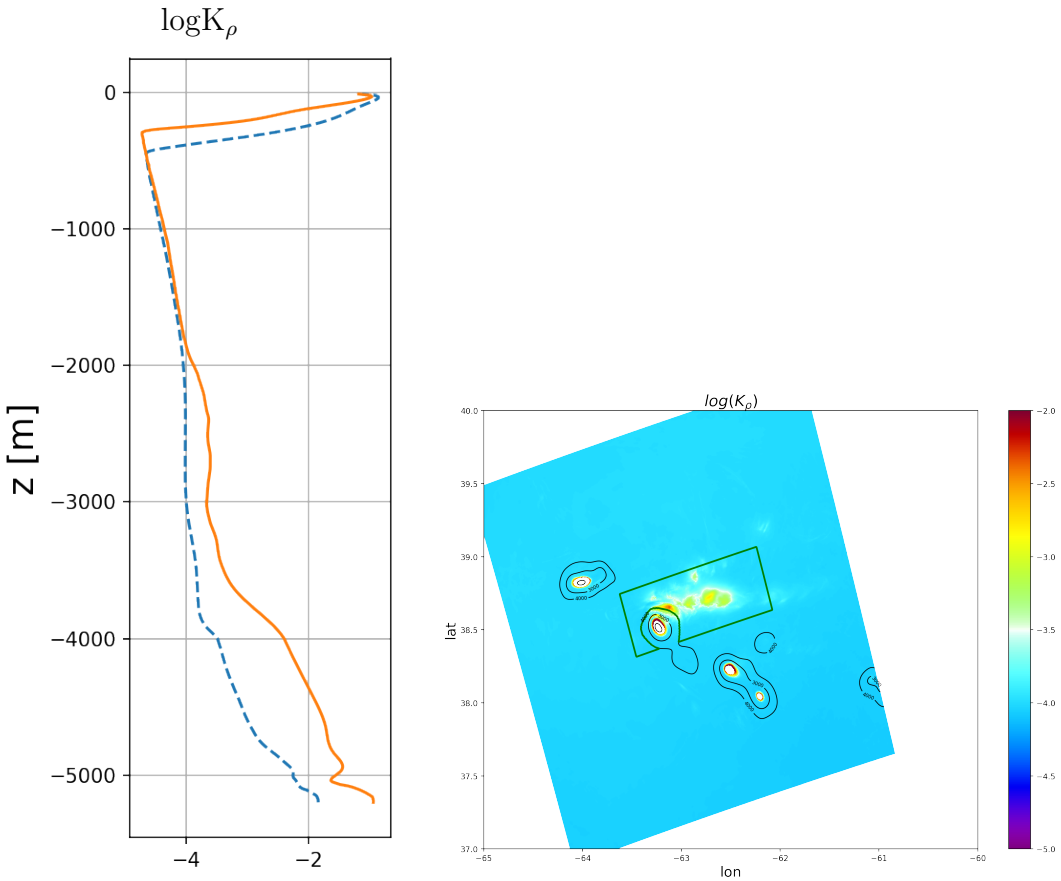

Figure 12: Time-mean (3-month) vertical section of vertical mixing coefficient from the 500 m nest averages over the region plotted on the right (dashed line) and over the wake of the seamount only (plain line). Only regions deeper than 4000 m are included.

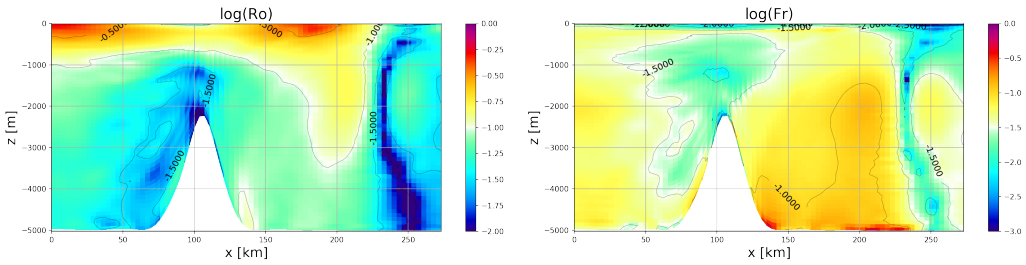

Figure 13:

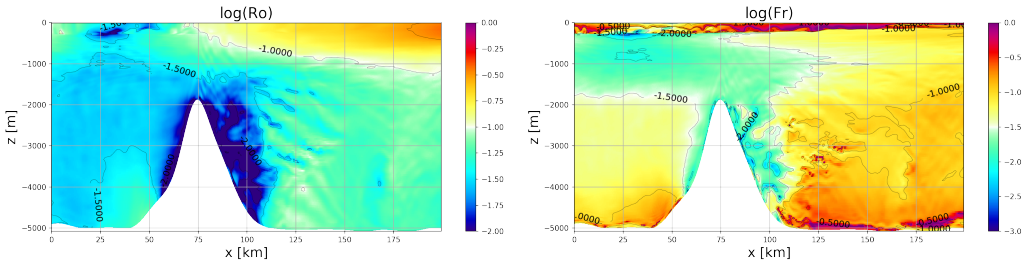

Figure 14: