

Interactive comment on “The INALT family – a set of high-resolution nests for the Agulhas Current system within global NEMO ocean/sea-ice configurations” by Franziska U. Schwarzkopf et al.

Anonymous Referee #1

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This long manuscript presents a family of region ocean model configurations centered around the Agulhas Current System. These configurations are all based on the NEMO3.6-LIM2 ocean circulation and ice model. They are all nested into global models (based on ORCA05 or ORCA025 from the Drakkar project), use ETOPO1 or ETOPO2 as bottom topography and are forced by the COREv2 product by a bulk formula.

The configuration parameters are detailed. The $1/10^\circ$, $1/20^\circ$, $1/60^\circ$ resolution configurations are called INALT10, INALT20 and INALT60.

Several measures of model behaviour are provided: SSH variance, Transport of the ACC, Transport through the Mozambique Channel, Malvinas and North Brazil Current,

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Meridional Overturning Circulation, The Agulhas Current and Undercurrent, Agulhas Leakage. A comparison with observations is given when possible showing the abilities of these configurations.

Tests are made on grid resolution, lateral conditions of z-coordinate models on topography (free slip or non slip) and on the effect of ocean currents on wind stress.

In addition to a general assessment of these configurations the main message is that the dynamics of the Agulhas Current system depend on the representation of mesoscale processes with the Agulhas Current and the Agulhas Undercurrent transports increase with increasing resolution.

General Comments

This article is clear and well written (although a bit tedious). Figure quality is satisfactory.

Although the scientific message is relatively limited, this presentation in great lengths of these configurations is valuable.

The approach is conservative, using a model designed originally for large scale ocean circulation (NEMO), based on second order numerics, using coarse surface forcing (CORE) and Laplacian diffusion; but increasing the horizontal resolution.

It is notorious that modelling the Agulhas Current is a difficult exercise. The solution found here to harness the beast was to increase the resolution while keeping relatively large values of Laplacian diffusion and biharmonic viscosity (see Table 2). Combinations of biharmonic and Laplacian operators have been used in the past to stabilise the Gulf Stream (Chassignet and Garrafo, 2001), the Laplacian operator bringing a dissipation acting at all scales (Soufflet et al., 2016). Here, the value of Laplacian diffusion used for INALT10 (120 to 400 $\text{m}^2 \text{s}^{-1}$) is comparable to the Laplacian viscosity used by Chassignet and Boudra (1988): 330 $\text{m}^2 \text{s}^{-1}$ for a 40 km resolution experiment made in 1988.

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The comparison of the large scale and regional circulation with observations is interesting, although long term trends such as in the Mozambique Channel Transport (Fig8 a) are a bit surprising.

There was a couple errors with the literature: Rouault et al. (2009) did not report a long term decline in AC transport. Loveday et al. (2014) did not report a decrease of the AC transport in reponse to decreasing trade winds.

In regard of these comments I recommend publication after minor corrections.

Specific Comments

Figure 2: It would be clearer if the names of the configurations could be seen directly on the zooms

Table 2: It got confused with the units of $ahm0$ [$m^2 s^{-1}$] while the values were typical of biharmonic viscosities. and $ahtm$ [$m^4 s^{-1}$] while values were typical of Laplacian diffusions. I got also confused with $|ahmm| > |ahm0|$ for ORCA05 while $|ahmm| < |ahm0|$ for all the other runs. Why ? Please clarify.

Figure 9: I had doubts of the interest of the comparison of these meridional velocities so close to a current separation. We get here opposite currents while differences between the run could be small.

Page 29: Improper reference to Rouault et al. (2009)

Page 30: Improper reference to Loveday et al. (2014)

References

Chassignet, E. P., and Z. D. Garraffo (2001), Viscosity parameterization and the Gulf Stream separation, in From Stirring to Mixing in a Stratified Ocean: Proceedings of Aha Huliko, a Hawaiian Winter Workshop, Honolulu, Hawaii, pp. 37-41, Univ. of Hawaii at Manoa, Honolulu.

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Soufflet, Y., P. Marchesiello, F. Lemarie, J. Jouanno, X. Capet, L. Debreu, R. Benshila,
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