Project: **939**

Project title: **Global eddy permitting ocean modeling with focus on the Agulhas system**

Project lead: **Dmitry Sein**

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The simulations with two global ocean setups of FESOM were carried out and compared (Sein et al., 2016). The first one employs a coarse mesh with nominal resolution of about 1° in the global ocean, about 25~km north of 50°N, about 1/3º in the equatorial band, and moderate refinement along the coasts. This setup is further referred to as FESOM-LR (low resolution).

The second setup uses a locally eddy-resolving mesh. Its design relies on the AVISO satellite altimetry product. The coarsest resolution on this mesh is set to 60~km, and the finest resolution is 10~km. The refinement was determined by a low-pass filtered SSH variance (SSHV) pattern derived from the AVISO data. Fine resolution is obtained in regions with high SSHV, including the pass ways of main currents -- the Gulf Stream, Kuroshio, Antarctic Circumpolar Current (ACC) and Agulhas Current. This setup is referred to as FESOM-HR (high resolution). The mesh contains about $1.3 \cdot 10^6$ surface grid nodes, which is close to the number of nodes on a Mercator 1/4°mesh (only wet nodes are dealt with on unstructured meshes). This mesh size was also selected to ensure reasonably fast simulations with available computational resources.

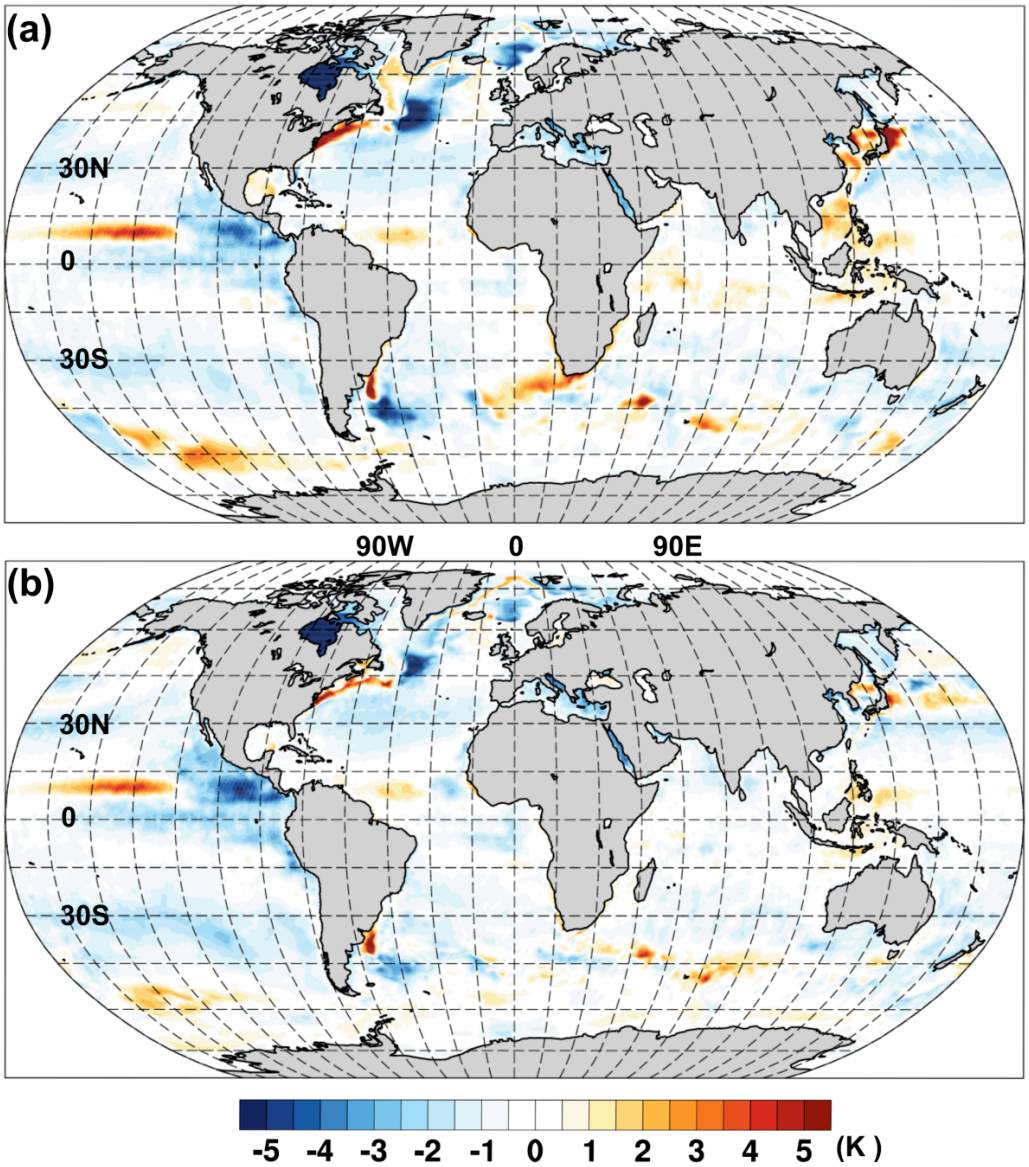

Fig.1. The bias in temperature averaged over the upper 100 m with respect to the GDEM climatology for FESOM-LR (top) and FESOM-HR (bottom).

While the simulated SSHV is a direct indicator of the success of the concept, in the case of

realistic ocean one is more interested in the simulated ocean state. We present there examples showing the improvements brought about by the increased resolution. Figure 1 compares the model bias in temperature averaged over the upper 100~m, referenced to the GDEM climatology. The results are averaged over the last 10 years. The top panel shows the LR case, which has biases common to models of comparable resolution in regions with high SSHV (the north-west corner, Agulhas Current, Southern Ocean). The biases are generally reduced on mesh HR (bottom panel). The bias in the eastern equatorial Pacific is, however, not visibly different on the two meshes. Presumably it reflects some transient variability which is not fully eliminated by averaging. High resolution helps to reduce model biases through explicit representation of dynamical processes mediated by eddies. The refined resolution does not only imply the presence of eddies, but also lower dissipation. The improved representation of the path way of the North Atlantic Current on mesh HR is seemingly related to this. On mesh HR the current follows a more northern path way than on LR, which reduces the cold bias in the north west corner.

References

Sein, D. V., S. Danilov, A. Biastoch, J. V. Durgadoo, D. Sidorenko, S. Harig, *and* Q. Wang *(*2016*),* Designing variable ocean model resolution based on the observed ocean variability, J. Adv. Model. Earth Syst., 8, 904–916, *doi:*10.1002/2016MS000650.