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Analyzing the Kinetic Energy budget of submesoscale-permitting ensemble simulations

Quentin Jamet[1], William K. Dewar[1,2], Thierry Penduff[1], Julien Le Sommer[1], Stephanie Leroux[3], Jean-Marc Molines[1], and Jonathan Gula[4]

[1]Univ. Grenoble Alpes, CNRS, IRD, Grenoble INP, IGE, Grenoble, France
[2]Department of Earth, Ocean, and Atmospheric Science, Florida State University, Tallahassee, Florida
[3]Ocean Next, Grenoble, France
[4]Laboratoire d'Océanographie Physique et Spatiale, Univ. de Bretagne Occidentale, Brest, France

Ensemble simulations are becoming more and more popular in oceanography. Among other advantages, this modeling strategy elevates the number of dimensions available to apply statistics, and then offer new opportunities to disentangle small scale ocean turbulence from the larger scale (ensemble mean) flow, as well as their interactions. In such a framework, ocean turbulence is usually defined as the ensemble spread, reflecting the intrinsic variability that spontaneously emerges from the ocean, while the larger scale flow is defined as the ensemble mean, and whose variability is controlled by the forcing. Here, we aim at leveraging results of recently produced, submesoscale-permitting (1/60^{o}) ensemble simulations of a forced ocean model configuration of the western Mediterranean Sea (MEDWEST60, 20 members) to diagnose the role played by ocean turbulence in the Kinetic Energy (KE) budget of these simulations. We develop for this purpose offline tools to compute such budget based on the NEMO modeling platform, which we aim at presenting.

These offline tools are part of the CDFTOOLS, a FORTRAN based package developed to export the NEMO code into an offline version of it for post-processing. Our contributions have been to include the momentum budget of the code into this package, on which kinetic energy builds upon. We first evaluate the accuracy of these offline computations against online estimates over a short period of time. At the model time step, this accuracy reaches up to 10^{-3} -10^{-4} for time rate of change, advection and pressure work, and 10^{-1} for vertical dissipation. The surface pressure correction associated with the time-splitting scheme has proven difficult to implement offline, due to 1/ sub-domain boundaries instabilities in the computation of the barotropic mode, and 2/ replication of the interpolation scheme used in NEMO for atmospheric forcing fields (atmospheric surface pressure, evaporation, precipitations, runoff). The use of one hour model outputs is found to degrade the accuracy of the offline estimates by up to one order of magnitude locally. We then present and discuss preliminary applications of these diagnostics to the MEDWEST60 ensemble simulation model outputs (hourly averages).