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Technical and physical challenges to achieve a regional simulation at multi-decadal scales: Application to the Bay of Biscay.

Sébastien Theetten, Frédéric Vandermeirsch, and Guillaume Charria
IFREMER ; DYNECO/PHYSED, Technopôle de Brest-Iroise, BP 70, F-29280 Plouzané, France

With the aim to study the regional impact of the climate change on the ocean dynamics and its impact on ecosystem, we implemented the first 53-year long numerical hydrodynamical regional experiment of the Bay of Biscay with a spatial high resolution of 4 km with the MARS3D code. This configuration is a first step included in an on-going implementation process toward higher resolution configurations ($\sim$2 km).
MARS3D is a sigma-coordinate code based on primitive equations that uses an ADI (Alternating Direction Implicit) scheme on the barotropic part and an efficient time scheme. Technical (parallelization and input/output management) and physical (open boundary conditions and atmospheric forcing) aspects had to be investigated to optimize the numerical experiment and to realize this 53-year long experiment with MARS3D on a dedicated supercomputer.
The parallelization is based on a classical domain decomposition method that allows the use of high performance computing resources needed for such long simulations. This parallelization involves the use of MPI and OPENMP technology suitable for the scalar supercomputers. We present some performances of our configuration with respect to the chosen parallelization method and the domain decomposition. We demonstrate that using 768 processors is feasible with MARS3D and that it leads to a good balance between cpu time and elapsed time. Concerning the input/output management, the large amount of output files generated by different processors on a long integration period requires that the calculation task and the input/output management task are evenly distributed. Several strategies, including an innovative strategy that dedicates a set of processors for the calculation and another set of processors for the writing of outputs, have been evaluated for MARS3D and are presented.
The numerical experiment requires external forcing fields adapted to open ocean boundaries and ocean-atmosphere interface. The z-coordinate global simulation at 1/4 degree from the DRAKKAR project (ORCA025-GRD100 configuration) is used to force the limits of the regional model during the 1958-2010 period. Challenges and solutions to interpolate DRAKKAR data on the sigma grid of MARS3D are presented. The atmospheric reanalysis of ECMWF allow to recalculate the solar and turbulent fluxes using bulk formulation. The preparation of these boundary conditions on the grid of the ocean model is very sensitive to the choice of temporal and spatial interpolations.