Understanding the role of the ocean and sea ice small scale features in the Arctic.

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In the global ocean, mesoscale eddies are ubiquitous. They account for most of the turbulent kinetic energy and are key to the long-term equilibrium of the large-scale circulation, ocean ventilation of tracers, upper-ocean biology and pollutant dispersion. In the Arctic Basin, however, observations taken under sea ice have pointed out that the energy at mesoscale in the Arctic interior is relatively low when compared to characteristic midlatitude open ocean dynamics. At first order, the mesoscale activity could be fundamentally different between ice-covered and ice-free regions.

Owing to the challenge of modelling at such small deformation radius (less than 10 km in the Arctic), there is currently no existing eddy resolving models of the Arctic Basin, preventing us from fully apprehending the specificity of the mesoscale features in the Arctic, and their importance for the Arctic dynamics. This is particularly important as interactions between mesoscale eddies and sea ice could potentially represent an important, yet currently ignored, mechanism, via which the ocean might contribute to the on-going and future sea ice retreat.

In this context, the overarching goal of our project is to improve the quantification and our fundamental understanding of the mesoscale dynamics in the presence of sea ice. To that aim, we are making use of the newly developed ocean-sea ice configuration SEDNA (Sea ice - EDdy resolving ocean paN-Arctic configuration), based on the NEMO modelling platform and with a horizontal resolution of less than a kilometre in the Arctic Basin.

The SEDNA configuration has more than 6 billion grid points with about 6500 points in each horizontal direction, 150 vertical levels and a 40 seconds model time step. It relies on a fully MPI horizontal domain decomposition and requires more than 16 000 cores to achieve the targeted simulations, allowing to simulate one year in about 12 days elapsed time. Given the extremely high cost in term of computing resources of SEDNA, our PRACE allocation has allowed us to produce simulations spanning a few years corresponding to about 400 TB of data.

We are currently running and analyzing a simulation spanning the period 2009-2016. This pioneer simulation will allow to characterise all processes important for the interplay between the sea ice and the mesoscale eddy in the Arctic, to test theory related to these processes and quantify their effects on the large scales. We will be able to determine for the first time if the mesoscale dynamics is fundamentally different in the ice-cover regions and in open ocean and explore ways of parameterizing them for climate-scale ocean models that are unlikely to resolve mesoscale features in the polar regions in the near future.