Master 2

INTERNSHIP PROPOSAL

Laboratory name: Laboratoire de Météorologie Dynamique
Internship director: Guillaume Lapeyre and Stefano Berti
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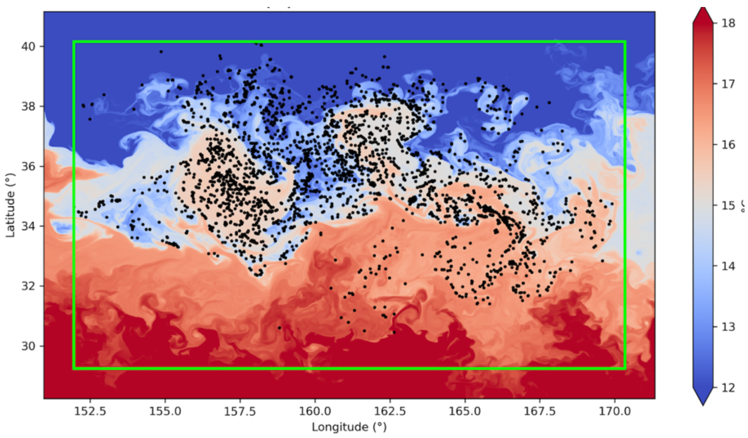
Internship location: Laboratoire de Météorologie Dynamique, Ecole Normale Supérieure, Paris.
Collaboration with : S. Berti Unité de Mécanique de Lille; A. Ponte, Laboratoire d'Océanographie Physique et Spatiale, IFREMER
Thesis possibility after internship: YES

Tracer dispersion at fine scales in the global ocean

Ocean eddies on the mesoscale (O(100) km) contain most of the kinetic energy and play an essential role in ocean dynamics on climatic scales. The submesoscales (below O(10) km) are associated with smaller, faster eddies, as well as filaments and temperature fronts, and are crucial both because of the intense vertical transport (of heat and nutrients) they induce and because of their role in energy transfers.
It is possible to understand the horizontal dispersion of Lagrangian drifters observed at mesoscales using predictions from turbulence theory. At submesoscales, deviations from these predictions can provide information on the interaction between fast processes (frontal dynamics, tidal waves) and slower (geostrophic) processes, in order to better understand energy transport and transfer properties at these fine scales.
The aim of the internship is to explore the statistical properties of Lagrangian particle transport at the ocean surface using state-of-the-art realistic numerical simulations. Particular attention will be paid to the phenomenon of particle clustering induced by submesoscales, whose mechanisms are not yet fully understood. The methodology will rely on the analysis of statistical indicators of aggregation (e.g. velocity gradients) and other tools from the turbulence theory (e.g. structure functions). This will help to propose modifications of existing theory to include fast dynamical processes. The study will be based on a global numerical simulation of the ocean with its associated dataset of Lagrangian trajectories, constituting a unique database, due to the kilometric resolution in space, hourly resolution in time, and global coverage.



Sea surface temperature field from numerical simulations in the Kuroshio Extension, off the coast of Japan. The black dots indicate the final positions of Lagrangian tracer particles starting in a smaller subregion and advected for a month.

Specialities: macroscopic physics and complexity, numerical modeling