INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire de Météorologie Dynamique
CNRS identification code: UMR 8539
Internship director'surname: Guillaume Lapeyre and Stefano Berti
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Internship location: Laboratoire de Météorologie Dynamique, Ecole Normale Supérieure, Paris.

Thesis possibility after internship: YES
Funding: YES   If YES, which type of funding: CNES

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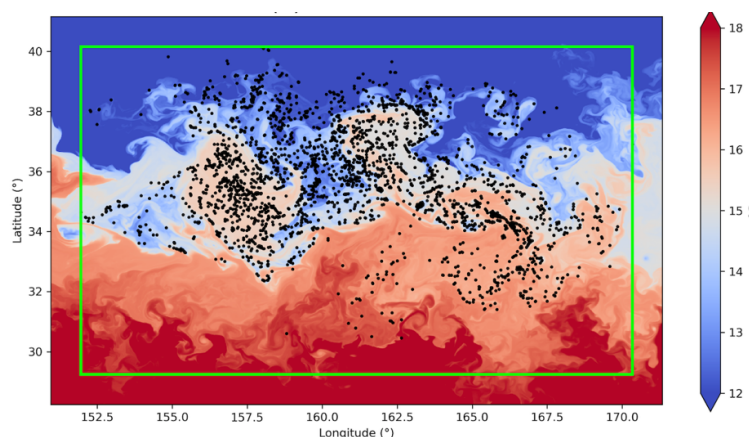
Sea surface temperature field from numerical simulations in the Kuroshio Extension, off the coast of Japan. The black dots indicate the final positions of Lagrangian tracer particles starting in a smaller subregion and advected for a month.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES   Soft Matter and Biological Physics: YES
Quantum Physics: NO   Theoretical Physics: YES