Inertial, elongated and motile particles in turbulence

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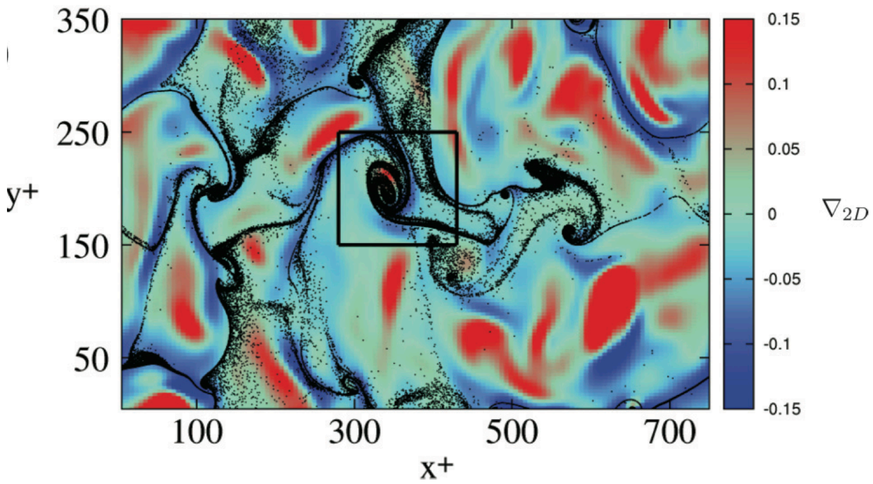
Particle transport and mixing in turbulent flows are fundamental to science as well as to technology. Examples of open scientific issues include emissions reduction in combustion, rheological characterization of fibrous particle suspension, plankton population dynamics, convection of pollutants in the atmosphere, to name a few.
The simplest numerical framework to study the dynamical and statistical features of turbulent particle dispersion is based on the assumption that particles can be modeled as point-like spheres brought about by the flow. In spite of its simplicity, this framework has led to significant advancements in the study of particles-turbulence interactions, allowing the precise identification of the coherent structures responsible for particle sedimentation and re-entrainment in turbulent boundary layers [1].
In this talk we examine two possible sources for bias in particle dispersion that may arise when particles are non-spherical (elongated) and may actively move within the fluid (motile). In particular, we show how elongation and motility may add to particle inertia to modulate particle motion, preferential concentration and accumulation in turbulent boundary layer [2,3]. Results relevant for particles suspended in environmental and wall-bounded turbulence are presented to give insights into important topics such as oceanic carbon cycling and industrial process optimization.



Instantaneous distribution of floater clusters at the free-surface of turbulent channel flow: floaters segregate in downwellings (corresponding to regions of negative surface divergence, in blue) avoiding upwellings (corresponding to regions of negative surface divergence, in red).

References:
[1] C. Marchioli, A. Soldati, *J. Fluid Mech.*, **468** (2002), 283-315.
[2] C. Marchioli, L. Zhao, H.I. Andersson, *Phys. Fluids*, **28** (2016), 013301.
[3] M. Mashayekpour, E. Nematy Lay, S. Lovecchio, C. Marchioli, A. Soldati, *Adv. Water Res.* (2018), In press.