STATISTICAL PHYSICS SEMINAR

June 14th, 2017.
Wednesday, 11.00
ELTE TTK Northern Building 2.54

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Non-inertial mechanisms for clustering of settling particles

The density of settling particles accumulated on the bottom surface of an incompressible fluid often exhibits inhomogeneities (i.e., clustering), which is usually supposed to be related with inertial effects. Earlier work [1] has shown, however, that inertial effects are negligible in the parameter range of settling biogenic particles in relevant ocean flows, and that clustering nevertheless occurs for such particles. Here we describe the two different non-inertial mechanisms leading to clustering. One mechanism is dynamical: the density varies within sheets of dimension lower than that of the embedding fluid during the time evolution of these sheets, since incompressibility holds only for the full-dimension volume element. The other mechanism is a simple projection of the densities within such moving sheets onto the bottom surface. Clustering occurs when these sheets are inhomogeneously tilted with respect to the bottom surface, and their non-vertical velocity also needs to be taken into account during the projection. Foldings of the sheets and corresponding caustics play a special role. We systematically explore the importance of the two mechanisms in numerical examples between limiting cases of the relevant parameters, and point out several nontrivialities.

[1] P. Monroy, E. Hernández-García, V. Rossi, and C. López, Modeling the dynamical sinking of biogenic particles in oceanic flow. Nonlinear Processes in Geophysics Discussions, dx.doi.org/10.5194/npg-2016-78 (2016).

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