Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Clustering of vertically constrained passive particles in homogeneous and isotropic turbulence[1] MICHEL VAN HINSBERG, Eindhoven University of Technology, MASSIMO DE PIETRO, LUCA BIFERALE, University of Rome Tor Vergata, HERMAN CLERCX, FEDERICO TOSCHI, Eindhoven University of Technology — We analyze the dynamics of small particles confined within a horizontal fluid slab in a three-dimensional (3D) homogenous isotropic turbulent velocity field. Particles can freely move horizontally as fluid tracers but are vertically confined around a given horizontal plane via a simple linear restoring force. The present model may be considered as the simplest description for the dynamics of small aquatic organisms that, due to swimming, active regulation of their buoyancy or other mechanisms, are capable to maintain themselves in a shallow horizontal layer somewhere below the free surface of oceans or lakes. In the model varying the strength of the restoring force can control the thickness of the fluid slab in which the particles can move. Whenever some confinement is present, particle trajectories deviate from fluid tracers and experience an effectively compressible velocity field. We report a quantification of this effective compressibility as well as a quantification of preferential concentration of tracer particles in terms of the correlation dimension. We found that there exists a particular value of the force constant, corresponding to a mean slab depth approximately equal to a few times the Kolmogorov length scale, that maximizes the clustering of the particles.

[1]This work is part of the research programmes 11PR2841 and FP112 of the Foundation for Fundamental Research on Matter (FOM), which is part of the Netherlands Organisation for Scientific Research (NWO). The work was partially funded by ERC Grant No 339032.

Michel van Hinsberg
Eindhoven University of Technology

Date submitted: 25 Jul 2014 Electronic form version 1.4