Inverse energy cascade in confined three-dimensional turbulence

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Experimental and numerical studies have demonstrated that it is possible to produce an inverse turbulent cascade of energy in a thin layer of fluid with a quasi-two-dimensional geometry. When the flow is forced at a scale comparable or larger than the thikness, a fraction of the energy injected is observed to flow to larger scales producing the inverse cascade with a Kolmogorov scaling[1]. In the absence of a large-scale dissipative mechanism, this energy evenutally accumulates at the largest scale producing the *condensate*.

In this talk we discuss the role of the bottom friction on the development of the inverse cascade on the basis of realistic numerical simulations of a free-surface turbulent flow. We show that, in the range of parameters investigated, the flow is unable to sustain an inverse energy cascade. We observe a transient inverse cascade, of duration which depends on the thickness S, but the 3D motion in the bottom boundary layer eventually propagates from the no-slip bottom to the full layer and the flow becomes fully three dimensional with the inverse cascade being suppressed[2].

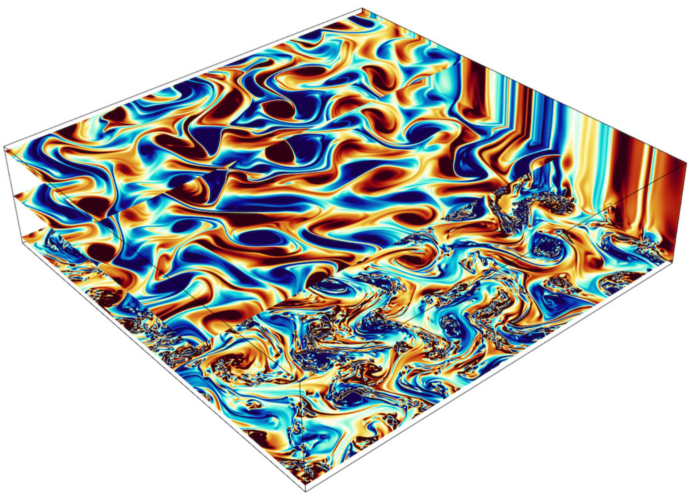

Figure 1: Snapshot of the vorticity field from a surface-flow turbulent simulation.

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[1]S. Musacchio, G. Boffetta, *Phys. Rev. Fluids* **4**, 022602 (2019).

[2]G. Boffetta, S. Musaccchio, A. Mazzino, M.E. Rosti, *Phys. Rev. Fluids* **8**, 034601 (2023).