Chaotic advection by vortices and filaments in flatulence

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Two dimensional turbulence or 'flatulence' consist of a combination of large scale coherent vortices and small scale vortex filaments (see figure 1 for an example). Although the large coherent vortices carry a major fraction of the total energy of the flow, the vortex filaments play a key role in controlling the dynamics at smaller scales (Kevlahan and Farge 1997, Chertkov et al. 2007). Consequently, the stirring of a tracer field will be influenced by the dynamics of these vortex filaments.

We propose a project that will investigate the evolution of a passive tracer field by vortex filaments. The goal will be to examine the chaotic advection by vortex filaments, extending much of the existing work related to point vortices (Aref 1984, Aref et al. 2017). Dynamics associated with a single filament and an ensemble of filaments will be analyzed in detail as part of this work.

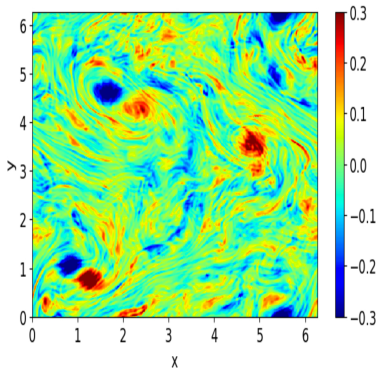

Figure 1: A two dimensional turbulent vorticity field, taken from a numerical simulation. Notice the large scale vortices and the small scale filaments of vorticity.

References

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