LUKE BLACKBOURN, University of St Andrews

Number of degrees of freedom and energy spectrum of SQG turbulence.

A simple dynamical systems approach is used as an analytic alternative to the traditional phenomenological method, recovering a number of classical predictions for surface quasi-geostrophic turbulence dissipated by the usual molecular viscosity. It is shown that the system's number of degrees of freedom, which is defined in terms of local Lyapunov exponents, scales as $\Re^{3/2}$. Here, $\Re$ is the Reynolds number, defined in terms of the energy dissipation rate, the viscosity, and the domain length scale. This result implies the Kolmogorov $k^{-5/3}$ scaling of the energy inertial range and determines the dissipation wavenumber, which marks the high-wavenumber end of this range.

Support for these analytical results, as well as for the classical idea of a dissipation anomaly, where inviscid singularities lead to nonzero energy dissipation in the inviscid limit, is provided through a series of direct numerical simulations.