Fractional dissipations in fluid dynamics: the surface quasigeostrophic equation

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The surface quasigeostrophic equation (SGQ) is a 2d physical model equation which emerges in meteorology and shares many of the essential difficulties of 3d fluid dynamics. In the supercritical regime for instance, where dissipation is modelled by a fractional Laplacian of order less than 1/2, it is not known whether or not smooth solutions blow-up in finite time.

The goal of the talk is to show that every L^2 initial datum admits an a.e. smooth solution of the dissipative surface quasigeostrophic equation (SGQ); more precisely, we prove that those solutions are smooth outside a compact set (away from t=0) of quantifiable Hausdorff dimension. We draw analogies between SQG and other PDEs in fluid dynamics in several aspects, including the partial regularity results, and underline some extra structure that SQG enjoys.

This is a joint work with Silja Haffter (EPFL).