Geophysical Fluids and Convex Integration

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Geophysical Fluids

- 3D quasi-geostrophic system (QG) - A model for atmospheric and oceanic circulation
- (N., Vasseur '18) - For any smooth initial value, there exists a unique global-in-time classical solution to the 3D quasi-geostrophic system (with viscosity)
- 2D critically dissipative SQG (surface quasi-geostrophic) - a special case of 3D QG in the absence of interior vorticity

Convex Integration

- (Buckmaster, Masmoudi, N., Vicol '21) - For any $\beta \in \left(0, \frac{1}{2}\right)$, the 3D Euler equations admit non-conservative weak solutions in the regularity class $C\left([0,T]; H^{\beta}(\mathbb{T}^3)\right)$.
- $H^{\frac{1}{3}}$ (or equivalently the $\frac{5}{3}$ scaling law for the energy spectrum) corresponds to the predictions of Kolmogorov's 1941 phenomenological theory of turbulence
- Deviations from the predictions of K41 characterize *intermittency*