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Title: Well/Ill-Posedness Results for the Magneto-Geostrophic Equations

Abstract: We consider a nonlinear active scalar equation with singular drift velocity that is motivated by a model for the geodynamo. We show that the non-diffusive equation is ill-posed in the sense of Hadamard in Sobolev spaces. In contrast, the critically diffusive equation is globally well-posed.

In the case of fractional diffusion there is a striking loss of regularity when the power of the Laplacian drops below $1/2$. The main reason for this phenomenon is that the constitutive law used to obtain the velocity from the active scalar is given by an unbounded Fourier multiplier that is both even and anisotropic.

This work is joint with Vlad Vicol.