Abstract Submitted
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On the validity of Kraichnan scalings for forced two-dimensional turbulence[1] JEROME FONTANE, Universite de Toulouse, ISAE, DAEP, DAVID DRITSCHEL, RICHARD SCOTT, School of Mathematics and Statistics, University of St Andrews — We examine the validity of the scaling laws derived by Kraichnan (1967) for forced two-dimensional turbulence. We use a new numerical technique (Dritschel & Fontane 2010) to reach higher Reynolds number than previously accessible with classical pseudo-spectral methods. No large scale friction or hypo-diffusion is used in order to avoid any distortion of the inverse cascade and to be in agreement with the theoretical framework of Kraichnan. Both spectral and spatial forcing are considered and statistical convergence is obtained through large simulation ensembles. A steeper energy spectrum proportional to k^{-2} is observed for the inverse cascade in place of the classical $k^{-5/3}$ prediction. This steepening is shown to be associated with a faster growth of energy at large scales, scaling like t^{-1} rather than Kraichnan's prediction of $t^{-3/2}$. The deviation from Kraichnan's theory is related to the emergence of a vortex population dominating the distribution of energy across scales, and whose number density and vorticity distribution with respect to vortex area are related to the shape of the enstrophy spectrum.

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