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Vortex scaling ranges in two-dimensional turbulence HELEN BURGESS, RICHARD SCOTT, DAVID DRITSCHEL, University of St Andrews — We introduce a scaling theory for vortices in the forced inverse energy cascade of 2D turbulence. Far-from-equilibrium systems generically exhibit multiple scaling regimes associated with transport of conserved quantities. Motivated by this observation, we model a three-part time-evolving vortex number density distribution, $n(A) \sim t^{\alpha_i} A^{-r_i},\ i \in 1, 2, 3$, conserving the first three moments of $\overline{\omega_v^2} n(A)$ in three distinct scaling ranges. Here $\overline{\omega_v^2}$ is the 'vortex intensity', or mean square vorticity evaluated over vortices, and areas A are intense regions of vorticity bounded by vorticity isolines. We predict α_i and r_i by enforcing conservation in 'comoving intervals', whose endpoints evolve at the vortex growth rate; this amounts to assuming invariance under the dilatation of flow features associated with the inverse cascade, and that vortex area growth is the appropriate measure of dilatation in all scaling ranges. High resolution numerical simulations verify the predictions, which are insensitive to the vorticity threshold used to isolate the areas. Similar concepts can be applied to model vortices in decaying 2D turbulence, pointing toward a unified description of vortices in both systems.

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