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Mean flow and anisotropic cascades in decaying 2D turbulence CHIEN-CHIA LIU, RORY CERBUS, GUSTAVO GIOIA, PINAKI CHAKRABORTY, Okinawa Institute of Science and Technology — Many large-scale atmospheric and oceanic flows are decaying 2D turbulent flows embedded in a non-uniform mean flow. Despite its importance for large-scale weather systems, the affect of non-uniform mean flows on decaying 2D turbulence remains unknown. In the absence of mean flow it is well known that decaying 2D turbulent flows exhibit the enstrophy cascade. More generally, for any 2D turbulent flow, all computational, experimental and field data amassed to date indicate that the spectrum of longitudinal and transverse velocity fluctuations correspond to the same cascade, signifying isotropy of cascades. Here we report experiments on decaying 2D turbulence in soap films with a non-uniform mean flow. We find that the flow transitions from the usual isotropic enstrophy cascade to a series of unusual and, to our knowledge, never before observed or predicted, anisotropic cascades where the longitudinal and transverse spectra are mutually independent. We discuss implications of our results for decaying geophysical turbulence.

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