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Influence of Initial Conditions on Decaying Two-Dimensional Turbulence RUBEN TRIELING, LAURENS VAN BOKHOVEN, HERMAN CLERCX, GERTJAN VAN HEIJST, Eindhoven University of Technology — A numerical study of freely decaying two-dimensional turbulence is presented to show how the time evolution of characteristic flow quantities is influenced by the initial conditions. The numerical method adopted is a standard two-dimensional (2D) Fourier pseudo-spectral algorithm with Newtonian viscosity. Vortex statistics have been extracted using a vortex census method. Several characteristic initial vorticity distributions analogous to those employed in previous laboratory experiments are considered. All initial vorticity distributions have in common a dominant subset of vortices. Reliable statistics have been obtained for each characteristic distribution by ensemble averaging. The evolutions of the average wavenumber and the number density related to a dominant subset are found to collapse confirming the self-similarity of 2D turbulence, one of the starting points for the scaling theory proposed by Carnevale et al. [Phys. Rev. Lett. 66, 2735 (1991)]. The mutual ratios of the relevant scaling exponents as predicted by the scaling theory are not confirmed, however, and thus seem questionable within the considered parameter range. Furthermore, power-law exponents for both the number density and the average wavenumber are found to be affected by the initial number density. This suggests that for experiments in shallow fluid layers any agreement with a universal scaling exponent seems coincidental.

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