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How to compute and model two-dimensional turbulent flows using wavelets?

To compute fully-developed turbulent flows we combine deterministic integration and statistical model. We achieve a decoupling between active modes, which are out of equilibrium, and passive modes, which have reached equilibrium, by performing a segmentation in wavelet coefficient phase-space. We have shown that the strong wavelet coefficients correspond to the coherent vortices and present non-Gaussian statistics, while the weak wavelet coefficients correspond to the incoherent background flow and present Gaussian statistics. We propose a new method, so-called Coherent Vortex Simulation, to compute the dynamics of coherent vortices using a limited number of wavelet modes, keeping only the strongest ones and re-mapping the wavelet basis at each time step, while modelling the incoherent background flow as a Gaussian stochastic process.