Structure Functions as a Tool for Measuring the Mesoscale

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Structure functions (SFs) depend on spatial differences between variables in turbulent flows, and they can be used to diagnose turbulent regimes, inertial cascades, and spectral fluxes of energy, enstrophy, and other variances. Structure functions can be particularly useful for analyzing observations of the ocean mesoscale, because they can be easily calculated from irregularly-spaced or Lagrangian data. Structure functions have long been used to study idealized turbulent flows, but their applications to geophysical flows are typically based upon assuming isotropy. We shall (1) discuss existing theories of SFs in isotropic flows; (2) present new SF diagnostics for spectral fluxes in anisotropic QG and 2D turbulence; and (3) demonstrate the utility of SF diagnostics by applying them to QG models, mesoscale observations, and mesoscale-resolving global-ocean models.