Model Spectra for Turbulence Below and Above the Ozmidov Wavenumber

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A model spectrum is constructed to describe both anisotropic stratified turbulence below and isotropic turbulence above the Ozmidov wavenumber using dimensional and dynamical scaling in terms of a cascade (or dissipation) rate ε, Coriolis frequency f, buoyancy frequency N and horizontal wavenumber k. The Ozmidov wavenumber $(N^3/\varepsilon)^{1/2}$ is the lowest wavenumber for which turbulence can overcome stratification to produce density overturns. The model reproduces observed spectral shapes and behavior in ocean and atmosphere measurements, specifically the −1 vertical wavenumber spectral slope in the invariant saturated spectrum band and +1/3 horizontal wavenumber spectral slope in the several decades immediately below the Ozmidov wavenumber. Aspect ratios become increasingly anisotropic below the Ozmidov wavenumber until reaching ~O(f/N). It is argued that geophysical turbulence can arise from anisotropic instability of the internal-wave field at wavenumbers well below the Ozmidov then cascade energy forward into isotropic turbulence, in contrast to the conventional wisdom that isotropic turbulence arises directly from vertical instability injecting energy at or above the Ozmidov wavenumber. Thus, anisotropic and isotropic turbulence are manifestations of the same forward energy cascade to dissipation.

Keywords: turbulence, dissipation , cascade

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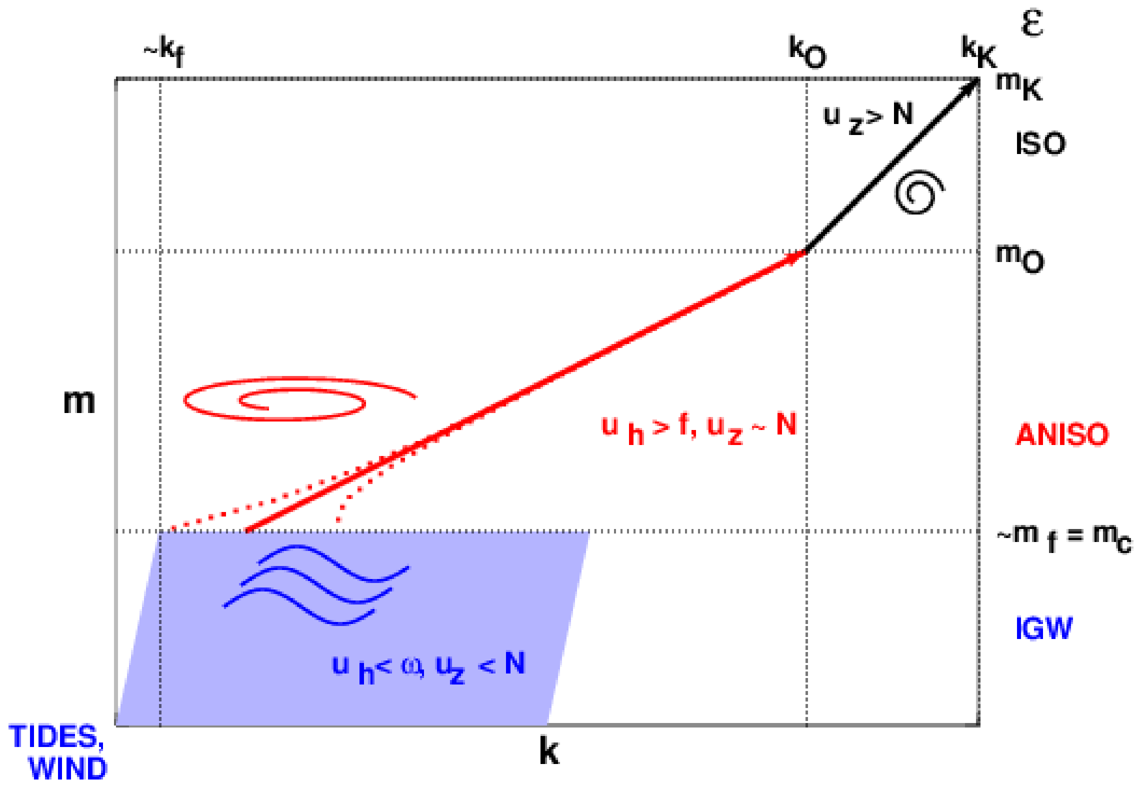

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