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### **Remote Sensing of Turbulence in Natural Fluids<sup>1</sup>**

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It is generally agreed that natural fluids including the atmosphere, ocean, and astrophysical objects are mixed by turbulence against the forces of gravity. However, the basic mechanisms, definition, and even the direction of the turbulence kinetic energy cascade remain controversial. Broadband remote sensing gives strong evidence to resolve such questions. Turbulence is found to be an eddy-like state of fluid motion where the inertial-vortex forces of the eddies are larger than any other forces that tend to damp the eddies out. Irrotational flows are non-turbulent by definition. Because turbulent vorticity is always produced at the Kolmogorov scale, the direction of the turbulent energy cascade is always from small scales to large. Fossilization of the turbulence occurs at its largest scales. Fossil turbulence is any perturbation of a hydrophysical field produced by turbulence that is no longer turbulent at the scale of the perturbation. In the ocean, fossil vorticity turbulence internal waves carry bottom turbulence energy to the sea surface by means of beamed zombie turbulence maser action mixing chimneys, a generic process of natural fluids. Spectral analysis of the sea surface brightness from space satellites combined with simultaneous ocean microstructure sea truth reveals the generic mechanism, also supported by recent astrophysical observations <http://arxiv.org/abs/1005.2772v4>.

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