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Upscale and downscale energy transfer in turbulent open channel flow SALVATORE LOVECCHIO, Dipartimento di Ingegneria Elettrica, Gestionale e Meccanica, University of Udine, ALFREDO SOLDATI, Centro Interdipartimentale di Fluidodinamica e Idraulica and Dipartimento di Energetica e Macchine, University of Udine — Heat and mass transfer phenomena in free-surface turbulence are of great importance in a wide range of geophysical/environmental situations. Examples include CO_2 transfer across the ocean surface or the transport of organic species. These phenomena are controlled by the dynamics of free-surface turbulent structures, which are known to give rise to transport of energy among the flow scales. In this study we use Direct Numerical Simulation to analyze such energy transfer in turbulent channel flow with a free surface. Our results suggest that the inhomogeneity, inherently present in near-wall and free-surface turbulence, generates energy fluxes that correspond to a spatial redistribution of turbulent kinetic energy within the flow. We show that the energy transfer near the boundaries is significantly different from that in the bulk flow, where the behaviour is more homogeneous and isotropic. This is due to an increased energy backscatter from small to large flow scales. We also show that regions of direct (downscale) and inverse (upscale) energy transfer can be associated to the coherent structures of the flow.

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