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Wind and Temperature Oscillations Generated by Wave-Turbulence Interactions in the Stably Stratified Boundary Layer

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We investigate atmospheric internal gravity waves (IGWs): their generation and induction of global intermittent turbulence in the nocturnal stable atmospheric boundary layer based on the new concept of turbulence generation discussed in Sun et al. (2012). The IGWs are generated by air lifted by convergence forced by the colliding background flow and cold currents near the ground. The buoyancy-forced IGWs enhance wind speed at the wind-speed wave crests such that the bulk shear instability generates large coherent eddies, which augment local turbulent mixing and vertically redistribute momentum and heat. The periodically enhanced turbulent mixing, in turn, modifies the air temperature and flow oscillations of the original IGWs. These turbulence-forced oscillations (TFOs) resemble waves and coherently transport momentum and sensible heat. The observed momentum and sensible heat fluxes at the IGW frequency, which are either due to the buoyancy-forced IGWs themselves or by the TFOs, are larger than turbulent fluxes near the surface. The IGWs enhance not only the bulk shear at the wave crests, but also local shear over the wind speed troughs of the surface IGWs. Temporal and spatial variations of turbulent mixing as a result of this wave-induced turbulent mixing change the mean air flow and the shape of the IGWs.