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Semi-Empirical Models of Surface Pressure in the Planetary Boundary Layer in terms of Second-Order Structure of Atmospheric Turbulence GREGORY LYONS, U.S. Army Engineer Research And Development Center, Construction Engineering Research Laboratory, CARL HART, U.S. Army Engineer Research And Development Center, Cold Regions Research and Engineering Laboratory — The fluctuations in surface pressure beneath turbulent boundary layers have long been of interest due to the aerodynamic noise and structural vibrations they induce. In the planetary boundary layer, analogous fluctuations at the ground surface contribute to instrument noise directly as static pressure, recorded by microbarometers and microphones, and indirectly as ground motion, detected by seismographs and geophones. It is hypothesized that the fast (i.e. linear) term of the pressure Poisson equation makes the principal contribution to surface fluctuations, so that only second-order structure of the inhomogeneous velocity field is necessary for modeling of second-order pressure statistics. The mirror flow model due to Kraichnan and rapid-distortion theory models proposed by Mann, which both derive inhomogeneous turbulence from initially homogeneous fields, are used to produce semi-empirical models of the surface pressure wavenumber spectrum. With an effective convection velocity, frequency pressure spectra are derived and contrasted. Using meteorological observations from a recent experiment, model parameters are estimated from velocity spectra, and the resultant pressure spectral models are compared with measurements from flush-mounted pressure sensors.

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