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Relationship of electric field and charged particle density fluctuations to air turbulence in the mesosphere SCOTT ROBERTSON — A theoretical model is developed for the electric field fluctuations that arise in the polar summer mesosphere as a result of the coupling of the charged species to the neutral air turbulence. The motions of electrons, ions, and charged aerosol particles are described as harmonic oscillators both driven and damped by the drag force exerted by the neutral air. The relative fluctuations in the ion density are found to be nearly the same as those in the neutral air as a consequence of the ions' high momentum-transfer relaxation frequency. The aerosol particle (dust) density fluctuations follow those of the neutral air at frequencies below their relaxation frequency, which is in the acoustic range. The electrons move primarily in response to the electric force to partially cancel the net charge density of ions and aerosol particles except at wavelengths shorter than the Debye length. Electric field and charge-density fluctuations are calculated for several sets of conditions. In bite-out regions in which the electron density is reduced as a consequence of attachment to the aerosol particles, the electric field fluctuations are found to be enhanced, which is consistent with observations.

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