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Mass Influx of Cosmic Dust Estimated From Vertical Transport of Meteoric Metals

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The mesospheric metal layers are formed by the vaporization of high-speed cosmic dust particles in the lower thermosphere and upper mesosphere. The vaporized atoms and ions are transported downward by waves and turbulence to chemical sinks below 85 km, where they form stable compounds. These compounds condense onto meteoric smoke particles and are then transported to the winter pole where they eventually settle onto the surface. The downward fluxes of the metal atoms are directly related to their meteoric influxes and chemical loss rates. In this paper we use Doppler lidar measurements of Na and Fe fluxes made by the University of Illinois and University of Colorado groups, and a chemical ablation model (CABMOD) developed at the University of Leeds, to constrain the velocity/mass distribution of the meteoroids entering the atmosphere and to derive an improved estimate for the global influx of cosmic dust. We find that the particles responsible for injecting a large fraction of the ablated material into the Earth's upper atmosphere, enter at relatively slow speeds and originate primarily from the Jupiter Family of Comets. The global mean Na influx is 21,500$\pm$1,100 atoms/cm^2/s, which equals 372$\pm$18 kg/d for the global input of Na vapor and 186$\pm$24 t/d for the global influx of cosmic dust. The global mean Fe influx is 131,000$\pm$36,000 atoms/cm^2/s, which equals 5.5$\pm$1.5 t/d for the global input of Na vapor.