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The cosmic dust input to the earth's atmosphere

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This paper will address a fundamental problem – the size of the cosmic dust input to the earth's atmosphere. Zodiacal cloud observations and spaceborne dust detectors indicate a daily input of 100 – 300 tonnes, in agreement with the accumulation rates of cosmic elements (Ir, Pt, Os and super-paramagnetic Fe) in polar ice cores and deep-sea sediments. In contrast, measurements in the middle and upper atmosphere – by radars, lidars, high-flying aircraft and satellite remote sensing – indicate that the input is only 2 - 30 tonnes. There are two major reasons why this huge discrepancy matters. First, if the upper range of estimates is correct, then vertical transport in the middle atmosphere must be considerably faster than generally believed; whereas if the lower range is correct, then our understanding of dust production and evolution in the solar system, and transport from the middle atmosphere to the surface, will need substantial revision. Second, cosmic dust particles enter the atmosphere at high speeds and in most cases completely ablate. The resulting metals injected into the atmosphere are involved in a diverse range of phenomena, including: formation of layers of metal atoms and ions; nucleation of noctilucent clouds; impacts on stratospheric aerosols and O_3 chemistry; and fertilization of the ocean with bio-available Fe, which has potential climate feedbacks.