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Heterogeneous chemistry on nano dust in the terrestrial and planetary atmospheres (including Titan)

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Cosmic dust particles are produced in the solar system from the sublimation of comets as they orbit close to the sun, and also from asteroidal collisions between Mars and Jupiter. Recent advances in interplanetary dust modelling provide much improved estimates of the fluxes of cosmic dust particles into planetary (and lunar) atmospheres throughout the solar system (Plane *et al.* 2018). Combining the dust particle size and velocity distributions with a new chemical ablation model enables the injection rates of individual elements to be predicted as a function of location and time (Carrillo-Sánchez *et al.* 2016). This information is essential for understanding a variety of atmospheric impacts, including the formation of layers of metal atoms and ions, the subsequent production of meteoric smoke particles, and the role of these particles in ice cloud nucleation and heterogeneous chemistry (Plane *et al.*, 2015). Specific examples that will be discussed are: in the terrestrial atmosphere, the formation of mesospheric and stratospheric ice clouds, and polar vortex chemistry (James *et al.* 2018); for Venus, the oxidation of CO and removal of O_2 on meteoric smoke particles in the hot troposphere (Frankland *et al.* 2017); for Mars, production of an Mg^+ layer which has recently been observed by the MAVEN spacecraft (Crismani *et al.* 2017), and the formation of metal carbonate-rich ice particles which nucleate CO_2 clouds in the Martian mesosphere (Plane *et al.* 2018); and for Titan, the production of benzene in the troposphere by the cyclo-trimerization of acetylene on dust particles (Frankland *et al.* 2016).

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