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Interstellar Dust in the Solar System: Model versus In-Situ Spacecraft Data

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In the early 1990s, contemporary interstellar dust penetrating deep into the heliosphere was identified with the in-situ dust detector on board the Ulysses spacecraft. Later on, interstellar dust was also identified in the data sets measured with dust instruments on board Galileo, Cassini and Helios. While Ulysses in-situ monitored the interstellar dust stream at high ecliptic latitudes between 3 AU and 5 AU for about 16 years, the three other spacecraft data sets cover much shorter time intervals and a heliocentric distance range between 0.3 AU and 3 AU and at 9.5 AU, both in the ecliptic plane, respectively. We compare in-situ interstellar dust measurements obtained with these four spacecraft, published in the literature, with predictions of a state-of-the-art model for the dynamics of interstellar dust in the inner solar system (Interplanetary Meteoroid environment for EXploration, IMEX) in order to test the reliability of the model predictions. The dust fluxes predicted by the model were calibrated with the Ulysses interstellar dust measurements. Micrometer and sub-micrometer sized dust particles are subject to solar gravity and radiation pressure as well as to the Lorentz force on a charged dust particle moving through the Interplanetary Magnetic Field (IMF), leading to a complex size dependent flow pattern of interstellar dust in the planetary system. The model covers these relevant forces and we study the time-resolved flux and mass distribution of interstellar dust in the solar system. The IMEX model agrees with the spacecraft measurements within a factor of 2 to 3, also for time intervals and spatial regions not covered by the original model calibration with the Ulysses data. The IMEX model is a very useful tool to study interstellar dust detection conditions with past and future space missions.