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Comparison of measurements and simulations of Mercury's exosphere

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In this study we compare the sodium exosphere observations during Mercury's transit made by Schleicher et al. (2004) and the recent MESSENGER calcium and sodium with the result of a detailed numerical simulation. The observations, made during the transit of Mercury across the solar disk on 7 May 2003, show a maximum of sodium emission near the polar regions, with north prevalence, and the presence of a dawn-dusk asymmetry. The MESSENGER observations show extended tails both for the calcium and the sodium measurement, however with different morphology. We model these exospheric distributions as the resulting effect of the solar wind proton precipitation on Mercury's surface, sputtering, photon-stimulated and thermal desorption. Alteration of the surface as well as photon pressure are included in the calculation of exospheric densities. In addition, the shape of the magnetosphere is calculated from the solar wind plasma parameters, yielding the area and the flux of precipitating solar wind ions. The observed and simulated distributions agree very well with this hypothesis and indicate that the employed processes at the surface, and their combination, are able to explain the observed exospheric features. Moreover, the model reproduces also the velocity distribution of exospheric sodium for the transit measurement.