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Na exosphere, comparison with model and MESSENGER data

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In this work we use an updated version of the Monte-Carlo (MC) exosphere model developed by Wurz et al.(2010) to explain the contribution of the release processes behind the presence of sodium in the exosphere of Mercury. We do this by comparing the tangential column density profile of the sodium exosphere derived from MESSENGER MASC/UVVS measurements by Cassidy et al.(2015), to the results of our MC model and Chamberlain theory (1963). We simulate the trajectories of sodium atoms ejected from Mercury's surface using thermal desorption, photon-stimulated desorption, solar wind sputtering, and micro-meteorite impact vaporization as the main release mechanisms. We found that two main processes explain the derived tangential column density profile as follows: close to the surface thermal desorption dominates driven by a surface temperature of 594 K, whereas at higher altitudes micro-meteorite impact vaporization prevails with a characteristic energy of 0.21 eV. Close to the surface and up to 500 km the MC model results agree the Chamberlain model, and the observations agree as well. At higher altitudes the MC model using release via micro-meteorite impact vaporization explains the observations well, however by adjusting the amplitude of the impacting micro-meteorite flux by a factor of 8 upward. Using a thermal component instead, e.g. a Chamberlain model, a second thermal component with 2500 K has to be assumed to explain the observations.