Models of gas emission from regolith provide improved parameterization for models of surface-boundary exospheres. M. Sarantos[1] , S. Tsavachidis[2], D. Kuruppuaratchi[1,3] and E.Mierkiewicz[4], [1]NASA Goddard Space Flight Center, [2]Self, [3]University of Maryland College Park, [4]Embry-Riddle Aeronautical University.

Accounting for the effect of regolith on models of surface-boundary exospheres is important because gases in such environments experience no collisions after leaving the surface. Previous work has demonstrated a variety of regolith effects on outgassing, such as decreased rates of gas release due to diffusion deeper into the epiregolith, and trapping in microshadows. In this work, we present new insights that help further update the boundary assumptions of global exosphere models.

We constructed models of the sub-mm fraction of lunar regolith using random sphere packings. The packings were representative of three grain size distributions consistent with mature, sub-mature, and immature lunar regolith samples. They also differed in porosity, with the fluffiest samples having 60% average porosity, and even higher porosity at the extreme surface. In total, nine packings were used for simulations. Using these computer-generated substrates we quantified the angular distribution of gas for thermal and photon-stimulated desorption. For the latter physical process we found that gas emission angles depend upon the local time and latitude of a surface patch. We validated this prediction by comparing a global simulation to measured line widths of sodium in the lunar exosphere. We also studied how the illuminated fraction of a rough surface varies as a function of solar incidence angle, a result that affects photodesorption rates. Finally, we quantified the mean free path distribution and Knudsen diffusion coefficients for volatiles as a function of sample grain size.

These new findings help improve the setup of simulations of exospheric and surface reservoir at the Moon and Mercury.