CARBON-BEARING VOLATILES: SURFACE ABUNDANCE ESTIMATES FROM EXOSPHERIC CONTENT CONSIDERATIONS.
M. Sarantos[1,2], R. M. Killen[2] and J. McLain[3,2]
[1]University of Maryland Baltimore County, Baltimore, MD; [2]NASA Goddard Space Flight Center, Greenbelt, MD; [3]University of Maryland College Park, College Park, MD.

Introduction: We evaluate the present-day rates of transport of carbon monoxide, carbon dioxide, and methane to the polar regions of the Moon as a function of the relatively poorly known parameters of gas-surface interaction. Constraints to these calculations are provided by existing upper limits on exospheric abundances of these species.

Methods: The abundances of such exospheric gases are estimated with a Monte Carlo transport model using rates that are consistent with fluxes brought in by the solar wind and micrometeoroids. This model considers photodissociation and ionization gas reactions as well as reactions taking place on the surface of grains such as dissociative adsoprtion. Along with computing three-dimensional properties of the exosphere, the model solves for the surface abundance of adsorbed particles of each species on grain surfaces that achieve flux balance with the exosphere. The neutral-surface interactions are modeled in 0.5°x0.5° surface resolution using Diviner surface temperature maps that capture topographic effects on this scale.

Results: The lifetime of a given constituent on a grain is uncertain but may be constrained by exospheric observations as different binding site distributions result in varying amounts of exospheric gases. An example is shown in Figure 1, which demonstrates that decreasing abundances of CO in the exosphere can be estimated by assuming that CO binds more strongly with the lunar soil. Additionally, the local time dependence of the exosphere changes as nightside frost is assumed to desorb further from dawn. From limits on CO obtained near dawn by the Apollo LACE experiment, we may surmise that the activation energy for CO desorption from lunar soils is 0.8 eV or greater. As longer residence times on the surface are assumed, losses of adsorbed particles to sinks other than sequestration at polar cold traps are increased, thus reducing the expected amounts of continuous deposition of lunar volatiles at the poles.

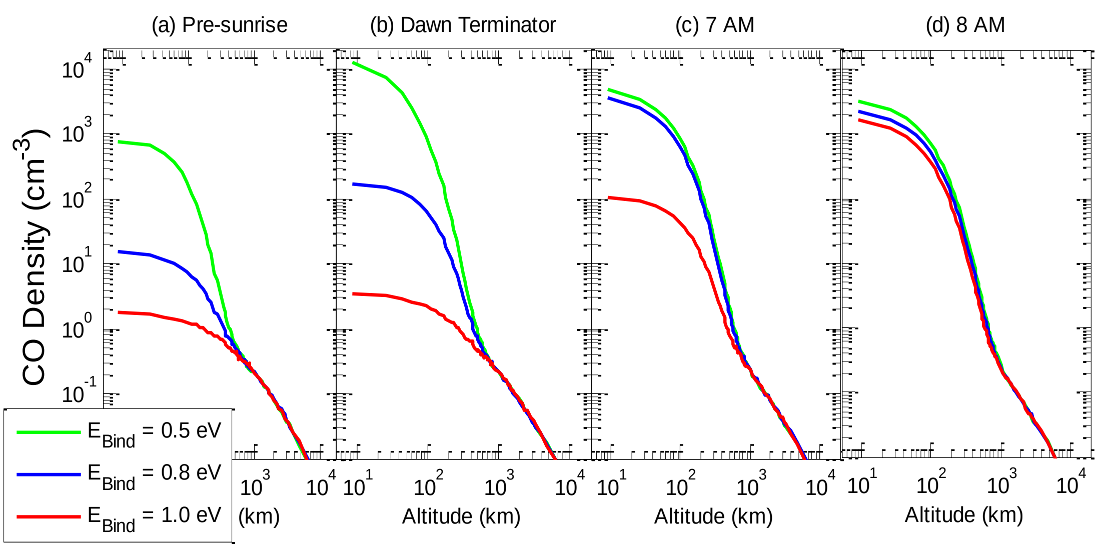

Figure 1. Equatorial density for exospheric CO parameterized by binding energy. The production rate of $4x10^4$ CO mol $cm^{-2}s^{-1}$ is assumed in all cases, but as the particle residence time on the surface is increased, the expected exospheric density goes down. Further, the peak density of the exosphere moves away from dawn towards the subsolar point.