PUSHING THE BOUNDARIES OF LUNAR ICE: VERTICAL VOLATILE TRANSPORT IN SEASONALLY SHADOWED REGIONS. K. M. Luchsinger[1] and N. J. Chanover[1], [1]New Mexico State University (kluchsin@nmsu.edu).

Introduction: The recent discovery of a possible active water cycle due to the chemical interactions between solar wind protons and oxygen within lunar rocks reinforced the idea of the lunar poles, where permanently shadowed regions can trap water over geologic time scales, as a priority target for study and exploration. However, in order to truly understand this process, we need to understand both the actively forming and migrating water and the reservoirs of water that have been sequestered at the poles. In order to better understand the water in both states, actively migrating and captured, I am exploring locations on the lunar surface where water regularly transitions between these two states: seasonally shadowed regions.

Methods: Seasonally shadowed regions are locations on the lunar surface that have at least one full day of shadow and at least one day where the sun rises above the local horizon. The regions that fulfill that description represent a broad range of illumination conditions. I am modeling the vertical transport and deposition of H_2O over one lunar year. Volatiles are deposited on the surface and allowed to migrate and escape, with residence times given by local thermal conditions. For each region, I explore whether the volatiles have time to migrate far enough below the surface to be stable; how much ice mass might be present within that possible stable volatile reservoir below the surface; and if there is a temporal lag in escaping volatiles. In Figure 1, I show the ice mass in kg within the uppermost 20 centimeters at a seasonally shadowed location in Cabeus crater over the course of one year. This location was chosen as the first test case due to the low flux received over the course of the year, with only six sunrises and low incident flux angles.

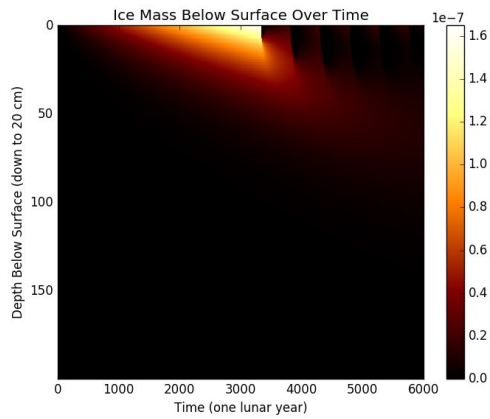

Figure 1: The mass of ice within the uppermost 20 centimeters of lunar sediment in a seasonally shadowed portion of Cabeus crater over the course of one year. This location sees six sunrises over the course of the year, and we see six corresponding signatures of volatile escape. However, some ice is able to persist. We include a constant influx of ice at the surface, and allow the ice at all depths to escape with a residence time dependent on the temperature at that depth.

Expected Results: I will model the transport and loss of water ice over the course of a year for several additional seasonally shadowed regions. My primary goal is to identify the regions where ice may or may not be present at depth, depending on the diffusion rate, as these would be exciting test cases. Additionally, I will predict the vertical distribution of water ice and the temporal variations in water ice escape out of seasonally shadowed regions over the course of a year. A detection or non-detection of ice in these regions would improve our understanding of the diffusion process, as well as our predictions of the distribution of water ice available for use by human exploration.