Gas and Dust Dynamic Model of the LCROSS Impacts. D. Summy[1], D. B. Goldstein[1], A. Colaprete[2], P. L. Varghese[1], L. M. Trafton[1], [1]University of Texas at Austin, [2]NASA Ames Research Center, Moffett Field, CA.

Introduction: The Lunar CRater Observation and Sensing Satellite (LCROSS) followed the upper stage of its launch vehicle as it crashed into the Moon's Cabeus crater. As described below, we model the mass and temperature distributions of lofted regolith grains and the vapor (including water, OH, molecular and atomic Hydrogen) evolved from those grains as seen from Earth and from LCROSS after impact. A detailed summary of the previous state of the model can be found in our poster submission to LPSC from a year ago [1].

Our model of the LCROSS impact has incorporated improvements in the physical representation over the past year. The goal of this work is to match the observations and estimate the conditions and properties of the regolith in a permanently shadowed region (PSR).

Plume Model: The lead vehicle is assumed to displace $3x10^5$ kg of material, which is divided into three modes of dispersion:

1. A low-angle component produces an "inverted-lampshade" of debris at an angle of 60^0 to the surface normal. This consists of cold particles (no impact heating assumed) travelling at velocities up to 800 m/s.
2. A high-angle component produces a central, narrow jet of fast debris that rises vertically. This component may be impact-heated to several hundred Kelvin, and may be pulverized, resulting in smaller particles. These may account for around 0.1% of the mass of the first component.
3. The crater is heated by the impact to temperatures that cause sublimation of local volatiles, some of which will reach the altitude required for observation.

Molecular Motion. The molecular motion model is nearly the same as that described in [1] (see Figure 1), but with the following changes and additions:

Grain model. Dust initial temperature is nominally the 40K of the crater floor. The high-angle component may have an initial temperature of hundreds of Kelvins, and the exact value is a target of ongoing work.

Additionally, there is some interest in adjusting the thermal properties of the dust based on observations. The current models predict a peak in visible water somewhat earlier than the observations suggest, and slowing the heating of the grains could be part of the solution. Methods to model this include using pure ice crystals instead of ice frozen to dust grains, as well as altering the thermal properties of the dust grain based on the amount of ice attached (frost).

Molecule Sources and Sinks. Volatile species added to the simulation include atomic Hydrogen (from photo-dissociation of water and OH molecules) and molecular Hydrogen. The molecular Hydrogen's source is unknown. It is not believed that the amount of H_2 recorded could have come from photo-dissociation of water in the minutes following the impact due to the long time-scale of the involved processes [2]. A variety of sources will be investigated.

Results: While much of the model is still in transition, some of the instrument simulations are already working under simplified conditions. Figure 2 shows the integrated particle counts in a one degree field of view from the LCROSS spacecraft. The "camera" slews to point directly at the initial impact point during the simulation.

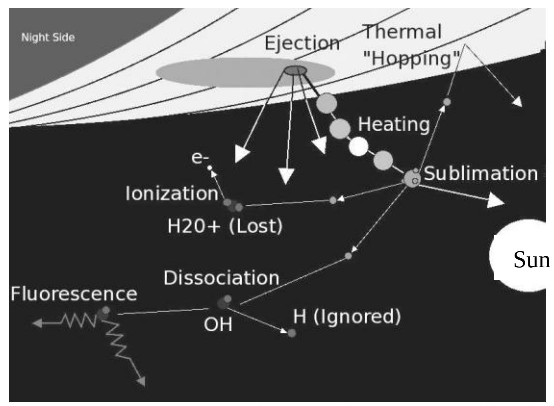

Figure 1: Molecular processes.

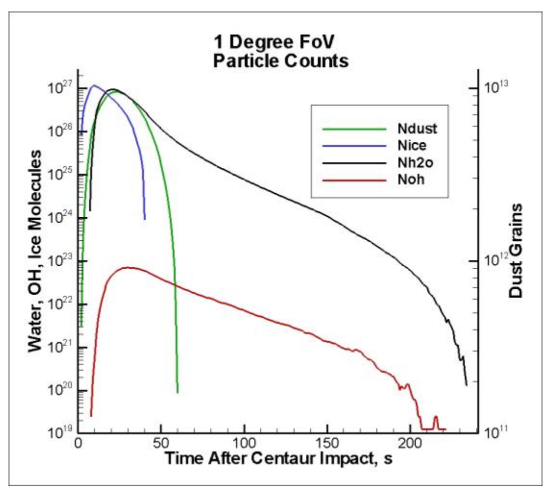

Figure 2: Simulated instrument output from LCROSS chase spacecraft.

References: [1] Summy D, Goldstein D. B, Colaprete A, Varghese P. L, Trafton L. M. (2009) *LPS XL*, Abstract #2267. [2] Huebner *et al.* 1992, pp. 47, 102.