Possibilities for an Atmosphere of Ganymede

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Measurements taken by the Galileo plasma instrument when the spacecraft passed Ganymede at an altitude of only 261 km indicated the presence of a supersonic outflow of gas composed solely of H+ (Frank, et al., 1997). The source of this gas is probably water vapor and other molecules sputtered from or subli mated from the surface. The preliminary model presented here is a look at processes near the surface, leading to the formation of the atmosphere, for a particular subset of Ganymede longitudes. The mode] is an integration of a 1-D heat conduction equation, subject to a surface boundary condition, over the selected area for a diurnal cycle. In this initial model, ice was assumed to be present only in the brightest regions of the surface. Surface brightness temperatures from the Galileo PPR experiment were used to estimate the extent of varying terrain types in the area. Voyager albedo measurements on a 10 x 10 scale were folded into the surface temperature calculation. With this model the temperat ure dist ribut ion of the sat cl lite surface was calculated. Using these temperatures, the magnitude of volatile sublimation and sputtering was inferred, with an assumed temperature-dependent function of volati le production from sputtering after Shi et al. [1995]. Results from the model were used to construct a Knudsen number map of the near surface vapor on a 10° x 10° scale.

Preliminary results from this model show a maximum (noon) subsolar surface temperature of 153 K, very spotty regions of vigorous sublimation, a total global water production from (upward) sublimation of 8.1 x 10A21 molecules/s. The atmosphere resulting solely from the sublimation process shows a nearly collisionless environment with a collisional region near local noon. Crude estimates of the (diurnally varying) sputtered flux do not change this environment, ie the near surface region is a collisionless environment except in the subsolar region, where it becomes collisional. These results in large part arc contingent upon the assumed near surface regolith conditions and the ice/silicate volume fraction. In this paper, surface brightness temperatures from the Galileo PPR experiment will be used to constrain the modeled thermal inertia, and 4.0 micron vs 1.48 micron data from NIMS will be used to better characterize the icy vs silicate terrain types and estimate the extent of these units to better resolution than performed in the earlier study. Results for diurnal variations will be shown .