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Surface physical properties from HP^3 radiometer measurements on the Mars mission InSight

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The Heat Flow and Physical Properties Package (HP^3) includes an infrared radiometer (RAD) attached to the deck of the InSight lander. The main objective of RAD is to constrain the surface thermal boundary condition of the heat flow measurement by the instrumented tether deployed into the subsurface. The heat flow in the subsurface can be affected by seasonal and diurnal temperature variations, by radiation from the lander, its shadow and the change in surface albedo caused by the landing. Fitting of diurnal temperature curves provides an estimate of albedo and other thermophysical properties of the near surface.
The instrument observes two spots on the surface with 3 sensors each. The three sensors have different spectral bandpasses: 8-14, 8-10 and 16-19 micrometers. The two spots observed by the radiometer are in approximately 1.5 and 3 m distance N-N-W from the lander center. The closer spot could not be imaged by the arm camera. The stereo images of the farther spot shows a flat surface with no rocks larger than cobbles. The closer spot likely also observes such a flat surface at a similar elevation below the lander deck as can be inferred from the timing of the effect of the solar panel shadow passing through that spot in the afternoon.
We will present results of the calibration and RAD measurement uncertainties. In addition, we will begin analysis on several topics based on the data HP^3 RAD will have gathered over approximately 100 sols, spanning an Ls of 295° to 358°. These diurnal curves represent the surface response to variation in insolation, and can be fitted with diurnal curves derived from mathematical thermal models. The 24 measurements per sol might allow us to constrain more complex models such as one representing a duricrust as vertical variation of thermal conductivity. The depth to which the surface response can constrain subsurface properties depends on the period of the external forcing. The radiometer will observe the same two small spots for at least one full seasonal cycle. Unlike orbital or rover measurements, this provides complete seasonal coverage at high temporal sampling, and thus depth resolution, without any significant subpixel heterogeneity. The shadow of the solar panel passing through the closer spot presents an opportunity to probe somewhat shallower depth than the diurnal cycle. Even shallower depths would be probed when the sun is eclipsed by the moons Phobos and Deimos for tens of seconds. The first eclipse is expected on the 18th of March.
Another parameter constrained by the diurnal curves is surface albedo. From HIRISE images of the InSight landing site it is obvious that the albedo in the vicinity of the lander has changed. This is expected to have an impact on the measured subsurface heat flow. The lander itself will also change surface temperatures in the vicinity via its shadow and thermal radiation.