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Initial Results from the MSL REMS Ground Temperature Sensor at Rocknest

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The Rover Environmental Monitoring Station (REMS) on the Mars Science Laboratory (MSL) Curiosity rover consists of a suite of meteorological instruments that measure pressure, temperature (air and ground), wind (speed and direction), relative humidity, and the UV flux. Here we focus on interpreting measurements from the ground temperature sensor (GTS) at Rocknest. The GTS field of view (~100 m̂2) included the Rocknest sand shadow as well as rocks >10 cm in diameter just beyond the aeolian feature. GTS brightness temperatures (integrated over ~8 -14 microns) were collected at 1 Hz for a minimum of 5 minutes at the beginning of every hour and we examine 5 min averages from the top of each hour. We use the KRC surface thermal model to estimate the thermal inertia of materials in the GTS field of view by matching modeled to measured temperatures. Here we discuss data from sol 100 as an example.

The diurnal temperature variations measured by the GTS at Rocknest on sol 100 are not well matched by a model temperature curve representing a material having a single thermal inertia (or a homogeneous mixture of materials thicker than the upper diurnal skin depth). The GTS nighttime temperatures compare reasonably well with predicted nighttime temperatures for a material with an inertia of ~250 J·m̂-2·K̂-1·ŝ-1/2 (units assumed hereafter). During the day, however, the GTS temperatures are best matched by a temperature curve that is characteristic of a higher inertia material, reaching a midday maximum temperature similar to that of a material having an inertia of 550. GTS data on sol 100 also show a brief decrease in evening cooling rate before resuming predicted rates. Similar cooling behavior is observed on other sols at this location. During this period, there was regional dust storm activity leading to increased dust loading in the atmosphere; this and local winds also may play a role in the observed diurnal trends. Thermal infrared emissivity is high at this location in Gale crater, and is not expected to reduce the observed brightness temperatures by more than 1-2 K at local noon.

At ~16:00 hr on sol 100, the Thermal Emission Imaging System (THEMIS) instrument onboard Mars Odyssey orbiter measured surface brightness temperatures in Gale crater; these orbital measurements differ from the GTS measurements by ~20 K, which may be due in part to the difference in the spatial scales of the observations and thus the materials within each area of observation (100 m̂2 for GTS vs. 10,000 m̂2 for THEMIS), as well as environmental factors that are not yet incorporated into the models. A concerted effort is underway to acquire extended blocks of REMS data during all THEMIS overflights for the duration of the MSL mission. These observations will allow us to compare GTS-derived temperatures (and predicted thermal inertias) along the rover's traverse in Gale crater to those measured by THEMIS from orbit at the same time. Such comparisons will be useful for improving models of surface properties from thermal inertia.