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Simultaneous MSL REMS and Mars Odyssey THEMIS ground temperature measurements in Gale crater, Mars

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Ground temperature measurements and thermal models have been used extensively to infer physical properties of the Martian surface such as effective mean particle size [1], rock abundance [2], the presence of lateral or vertical heterogeneity [e.g., 3], degree of induration or cementation [4], etc. Knowledge of these physical properties is valuable for interpreting Mars' geologic history at a variety of spatial scales from local to global, as well as providing important insight into the safety and trafficability of landing sites, both prior to [e.g., 5, 6] and during landed mission operations.

The Ground Temperature Sensor (GTS) of the Rover Environmental Monitoring Station (REMS) onboard the Mars Science Laboratory Curiosity provides the first in situ observations of ground temperature throughout the diurnal cycle [7]. We have compared GTS-measured temperatures and derived thermal inertias through sol 414 with simultaneously acquired data obtained from the Thermal Emission Imaging System (THEMIS) onboard the Mars Odyssey orbiter [8]. These measurements enable us to: 1) compare orbital and in situ temperature observations, 2) compare thermal inertias derived from single time-of-day measurements to those derived from a full diurnal temperature cycle, and 3) validate interpretations of thermophysical data with visual observations of local terrain.

Surface temperatures measured by GTS and THEMIS at locations along Curiosity's traverse show a good correlation and deviations from a perfect fit are expected based on the instruments' spatial resolution differences. Local imaging (e.g., Mastcam clast survey images) show that, not surprisingly, the relatively small GTS field of view can be heavily biased by small-scale, local thermophysical features. THEMIS thermal inertias appear to be somewhat higher than their GTS-derived counterparts overall. However, much of this difference can be attributed to the difference in the spatial resolution of the instruments, particularly at locations such as Rocknest sand shadow and Glenelg. Excluding those locations, the correspondence is improved substantially. Clast survey imaging, particularly when paired with local Navcam mosaics, demonstrates what can be dramatic differences in what is included in the two instruments' areas of observation.

The data discussed here are examples of the comparisons that can be made between orbital and in situ observations of the same location at the same time. More data are needed to draw solid conclusions about the similarities and differences between the data sets and other phenomena that may affect such comparisons.

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