EPSC Abstracts
Vol. 13, EPSC-DPS2019-1296-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Thermophysical properties of Mercury surface

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Abstract

BepiColombo [1] is the first European mission to Mercury. The spacecraft will arrive at Mercury on December 2025; it will be then possible to compare measured temperatures with those calculated with a thermophysical code that provides the temperature value as a function of thermal conductivity. Preliminary tests suggest the presence of high thermal contrast between areas with different physical status and thermal conductivity.

1. Introduction

Mercury is the innermost planet of the Solar System; BepiColombo mission will study several aspects of the planet (the magnetosphere and its interaction with the solar wind, the internal structure, the dynamics, the surface geology and composition and the physical properties of the surface). Thermal emission will be used to derive the surface temperature [2]. The surface temperature variations of airless bodies is controlled by thermal inertia, a fundamental parameter whose value is sensitive to the presence of dust, regolith or rock, so this is an indicator of the history and physical characteristics of the surface material.

2. Methods

We use a thermophysical model in order to calculate the surface temperature. Local illumination and observing geometry have been derived from a USGS digital elevation model of Mercury. The surface temperature depends on the thermal conductivity of the uppermost surface layer as thick as few centimeters; the code can simulate different types of material from fine dust to bedrock, in ascending order of thermal conductivity and thermal inertia. We have selected an area characterized by the geological contact between northern smooth plains and intercrater plains materials in the northern hemisphere of Mercury [Fig. 1]. Since intercrater plains are older and more cratered than smooth plains, it is likely that they underwent harsher space weathering processes that caused the formation of a thicker and finer layer of regolith during time. Thus, intercrater plains and smooth plains are here thought to represent the presence of finer (older) or coarser/intact (younger) materials, respectively. Thus, we have calculated the surface temperature by assuming different thermal conductivity values, in order to show the different thermal response at various local solar times. We are also looking for areas at the north polar regions, because their low temperature can allow water ice presence ([3], [4]).

3. Summary and Conclusions

Preliminary results show that night-time temperatures are good indicators of the physical status of the hermean surface: we can see that higher thermal inertia terrains are warmer in the night-time with respect to lower thermal inertia terrains.

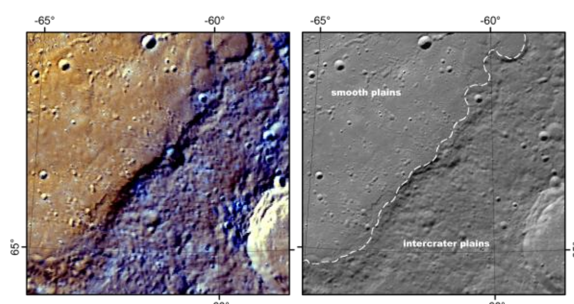

Figure 1. Area used in our simulation showing the contact between the northern smooth plains and the intercrater plains of Mercury.

References

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