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Simulation of thermal surface properties of asteroid 1 Ceres in the light of the Dawn NASA mission

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Abstract

We applied the numerical model described in (Lasue et al. 2008; De Sanctis et al. 2010a; De Sanctis et al. 2010b) to depict the thermal surface properties of asteroid Ceres in the light of the Dawn NASA mission, whose spacecraft is planned to arrive on Ceres in the spring 2015.

1. Introduction

Asteroid 1 Ceres is a very primitive intact asteroid residing in the extensive zone between Mars and Jupiter, and representing the key, together with Vesta, to answer some important questions about the role of size and water in determining the evolution of the planets. It is a rock-ice body 950 km in diameter and it may have active hydrological processes leading to seasonal polar caps of water frost. It also may have a thin, permanent atmosphere distinguishing it from the other minor planets. Ceres comprises about a third of the estimated total mass of the asteroid belt (Pitjeva 2005): its mass is sufficient to give it a nearly spherical shape in hydrostatic equilibrium (Thomas et al. 2005). In literature, we can find several previous works dedicated to the study of this asteroid, e.g., McCord & Sotin (2004); McCord et al. (2011). The current work uses a quasi 3D approach to study the thermal properties of the surface and it will be applied to depict the complete geophysical history of the asteroid.

2. The Model

The model uses a quasi-three-dimensional approach in which diurnal and latitudinal temperature variations are calculated by the insolation onto the asteroid. The numerical code simultaneously solves the heat and vapor transfer equations by a Crank-Nicholson implicit scheme (described in Capria et al. (1996)), with surface conditions defined by a grid with variable shape and illumination conditions. The model assumes Ceres as a spherical body with fixed radius and made of a homogeneous mixture of silicates and icy and allow to depict thermal maps of the surface both in presence and in absence of icy on (and below) the crust. We developed several geophysical and thermal scenarios as theoretical support to data analysis for the Dawn mission (Russell & Raymond 2011).

Acknowledgements

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