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Challenges of Dawn FC data Photometry of Ceres

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Abstract

We discuss non-instrumental systematic deviations from global photometric properties in specific contexts. Besides resolution based influences the high dynamic range of reflectances, local constitutional properties of the surface and superposed semitransparent materials affect the scattering of light. Among others, the complicated case of crater Occator on Ceres requires most careful assessment of the true local photometric model, in contrast to an immediate application of a global model. Problems, methods and limitations of analysis are addressed.

1. Introduction

Proper interpretation of surface details based on images of the Dawn Framing Camera (FC) depends on a reliable photometric model that is used to correct reflectance values. FC images show Ceres resolved on a very wide range of resolutions from 9 to 27000 pixels per diameter which had to be modeled successively to derive Hapke parameters. Also ground-based unresolved photometric data [1] has been included in the determination of a global photometric model. Comparison of photometrically corrected data of specific locations revealed differences, if they were obtained from orbits characterized by different resolution. Also large differences in reflectance led to discrepancies, as well as locations with unusual geologic properties. Thus, the need for local individual correction became obvious.

2. Model approaches for Ceres' crater Occator

Using a global model for photometric correction, contrasts of reflectances reach a factor of 15 [2]. The associated geologic features indicate the presence of quite diverse topographic and macroscopic roughness on different scales. As shown by [3] and [4], there is a variable surplus of scattered light to that of an undisturbed surface, which has been attributed to an optically thin haze. Because of this variability and the constraints from orbital geometry of the spacecraft, the improvement of photometric modeling can only be derived from the target data themselves, not from independent data. As long as the deviations from the model are small compared with the signal, iterative and heuristic approaches can be applied. These are: Investigate relative ratios of reflectances at selected locations inside and outside target, analyse contrasts, and separate phase effects from projection effects and optical depths. A consequence of the enhanced number of influencing variables is the failure of common photometric planetary surface models. Therefore additional appropriate parameters have to be included. Assuming specific layer sizes and distributions of, e.g., optical depths or grain sizes can help to describe a local context consistently. We are going to show examples of these complications and respective improvements of local photometric correction.

References

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