DUST ON MARS FROM NAVCAM AND HAZCAM IMAGES ON MSL

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Introduction: Although not designed for this specific purpose, images taken by the Mars Science Laboratory (MSL) Engineering Cameras can be used for retrieving dust optical depth and aerosols physical properties at Gale Crater [6]. Dust size distribution and particle shapes can be constrained by evaluating the sky brightness as a function of the scattering angle obtained from the MSL cameras [8]. This abstract is a progress report on our analysis of these data.

MSL Engineering Cameras: The MSL Curiosity rover is equiped with 12 cameras whose objective is to support the surface operations of the rover by providing views of the near-field surrounding terrain and to characterize the rover position and orientation.
Navcam. The Navigation cameras consist of four-cameras mounted on the mast of the rover and have a 45-degree square field of view with a broadband response span of 600-850 nm.
Hazcam. The Hazard Avoidance Cameras are chassis-mounted tactical cameras in the front and the rear of the vehicle with a 124-degree square FOV and 600-850 nm response span.
Complete technical specifications of the imagers on MSL can be found in [3, 4].

Sky radiance: The brightness of the sky as a function of the scattering angle provides useful information for constraining the shape and size distribution of aerosols in the atmosphere. Navcam and Hazcam images were used to determine the scattering properties of the dust. The Navcam 'sky 360' surveys cover a wide range of angles from the sun as they were designed to determine scattering properties of the atmosphere. In addition to these images, this work has also evaluated the wide field (120 degrees) images provided by the Hazcams (see Figure 1).

Radiative transfer model: A RT model has been developed in order to model the radiation detected by the MSL Engineering Cameras. This model can also be used with other instruments even on-board orbiters.
We use a discrete ordinate method to solve the RT equation (DISORT) [9] in a plane-parallel Martian atmosphere. The code for setting up the atmosphere and solvin the radiative tranjsfer is based on a Python implementation of CDISORT (PyDISORT) developed by [1]. Absorption data for relevant gases are taken from HITRAN [7] and transformed into correlated-k tables. Local atmospheric profiles and composition have been retrieved from the Mars Climate Database [2, 5].

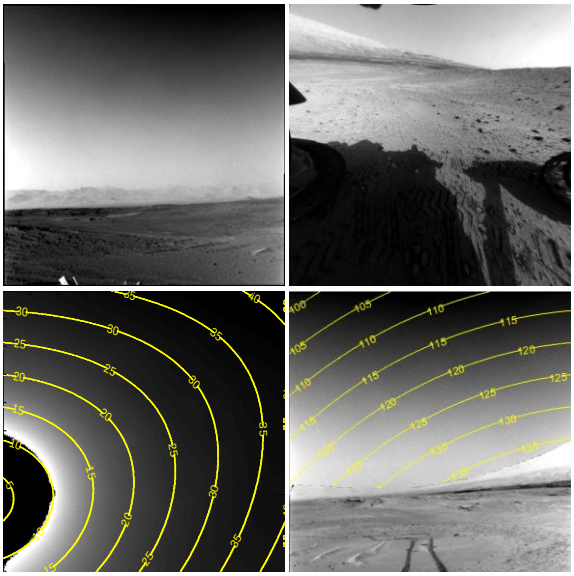

Figure 1. Navcam surveys (left) and Hazcam wide field images (right). Scattering angle contour retrieved for MSL Sol 669 (bottom).

Our implementation allows to use spherical (through Mie approximation) and irregular (T-matrix based) particles. Currently we are working on the retrieval of the internal radiation field in the atmosphere, thus allowing computation of the heating and cooling rates for a given atmospheric model.

References:

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