



The retrieval of atmospheric optical depth and surface albedo of Mars from the brightness of surface shadows in the HRSC images

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We present results for retrieving the optical depth of the Martian atmosphere and the albedo of the underlying surface from Mars Express high-resolution images (HRSC experiment). Since the Martian atmosphere is optically thin out of dust-storms seasons, a core problem in this analysis is to separate the atmosphere and surface contributions to the observed intensity. We have developed a method that within a certain approximation separates these two components by comparing the brightness of shadowed and nearby illuminated surface regions. The required single scattering properties of atmospheric aerosols are assumed to be those derived from the analysis of the sky brightness measurements obtained by the Imager for the Mars Pathfinder. Both the Lambert and non-isotropic reflectance laws are considered for the surface. We find that (1) both the optical thickness and the surface albedo can be estimated with the shadow method; (2) this method applied to stereo channels can also serve for separating the angular functions of the surface reflectance and atmospheric scattering; (3) the shadow method is extremely easy to use for analyzing the long-wavelength images, where the contribution of the Martian atmosphere is relatively low compared to that of the surface. At the same time, the method has the following limitations: (1) the accuracy of the method is sensitive to the spatial resolution of the images and to the optical thickness itself; (2) the method is somewhat “subjective”: the result depends on an accurate choice of the regions to be compared; (3) the difference in elevation between the compared regions must be taken into account.