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Long Term Change Detection on Mars using HRSC images in comparison to other multi-temporal image data sets

Alexa Schöpf[1,2], Daniela Tirsch[1], Ralf Jaumann[1,2], and Klaus-Dieter Matz[1]
[1]German Aerospace Center (DLR), Institute of Planetary Research, Department of Planetary Geology, Berlin, Germany
[2]Institute of Geological Sciences, Freie Universität Berlin, Berlin, Germany

The 2-decade long observation time series of the High Resolution Stereo Camera (HRSC) [1] onboard Mars Express provides the precious opportunity to search for long-term surface changes on Mars in comparison to other multi-temporal image data of even earlier missions. Previous works on the topic of Martian change detection have mostly focused on either different sensor types (e.g., CaSSIS data [2] and MCC data [3]) or on short term and small-scale processes (e.g., gully formation [4] and impact cratering [5]). Surface changes on Mars that are not related to seasonal processes or are often too small-scale to be observed with medium- or low-resolution images occur very slowly. Besides impact cratering, aeolian erosion and deposition are the most important geological processes that cause perceptible surface changes today. As the winds on Mars have a low transport capacity due to the thin atmosphere, slow large-scale changes can best be observed in images with long time intervals. The identification of such long-term surface changes will help gaining a better understanding of Mars' surface-atmosphere interactions and its general surface evolution.

This work starts out by visually comparing Viking orbiter images (from 1975 to 1980) and HRSC images (from 2004 to today) to find changes. We will additionally use image data from other sensors, such as CTX and MOC, to include observation with different spatial resolutions and to narrow down the time of the possible change process. The changes to be expected are wind streak, sand sheet and dust deposition (albedo) changes as well as long-term changes of the polar caps, slope-streak development and larger dune migration. As a start, this work focusses on wind streak changes, which are easy to detect and confirm. We found a significant amount of modified wind streaks around impact craters with changing orientation (azimuth) and/or changes in size. We will present first results from dark and bright (Figure 01) wind streaks in various regions on Mars, which indicate both depositional and erosional wind activity. Additionally, we will use the iron oxide ratio, a remote sensing index that uses the ratio of the red and blue wavelengths to visualize oxidized material on the surface [6], to visualize changes in depositional activity between HRSC images from different acquisition times. In a later step, we try to link the observed changes to specific atmospheric events that caused them (e.g., global dust storms). An overarching objective of our work is to assess the usability of HRSC data for detecting changes on the Martian surface and to provide a dataset of multi-temporal images that can be used for future studies and analysis of specific areas or features of interest.

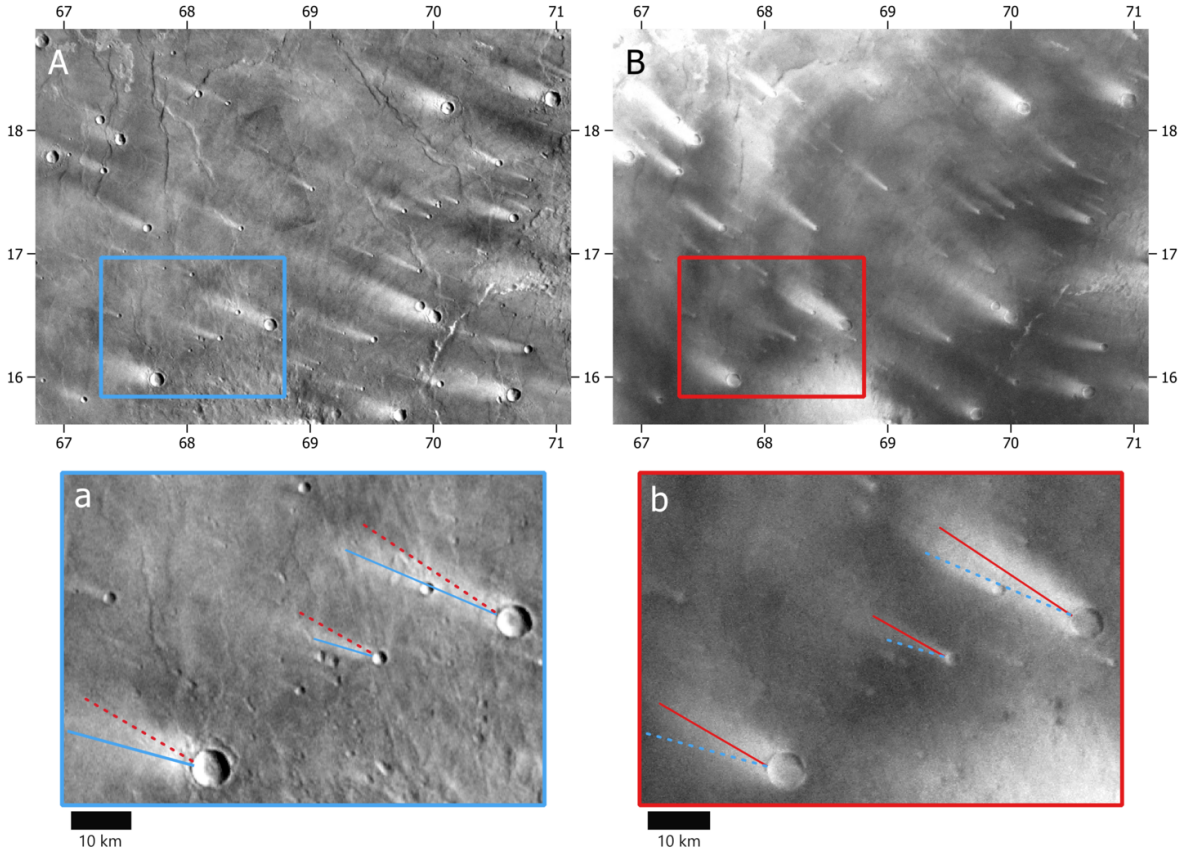

Figure 01: Comparison of bright wind streaks in Syrtis Major, where we already found a significant amount of wind streaks with changing azimuth and/or changing size. Image **A** shows the area in the Viking MDIM2.1 Grayscale Global Mosaic with a resolution of 232 m. Image **B** shows the area in the HRSC image hm612_0000 with a resolution of 200 m. Sub-image **a** and **b** show the corresponding detailed section for a better analysis of the changing azimuth and/or size of the three wind streaks.

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