ANALYSIS OF DARK SLOPE STREAKS IN NOCTIS LABYRINTHUS BASED ON MULTITEMPORAL IMAGERY AND DIGITAL ELEVATION MODEL DERIVED FROM HRSC DATA

B. P. Schreiner[1] (bjoern.schreiner@fu-berlin.de), S. H. G. Walter[1], S. van Gasselt[2], J.-P. Muller[3], P. Sidiropoulos[3]; [1]Planetary Sciences and Remote Sensing Group, Institute of Geological Sciences, Freie Universität Berlin, Germany; [2]University of Seoul, South Korea; [3]Mullard Space Science Laboratory, University College London, United Kingdom.

Abstract: Recurring slope lineae (RSL) on Mars are dark and narrow downhill oriented surface features found in equatorial regions [1] associated with water or hydrated salt flows [2]. On the other hand there are Dark Slope Streaks which seem to be dry avalanches on dust covered slopes [3]. The origin of both ist still under discussion. We found linear features in eastern Noctis Labyrinthus region (6°S, 265°E) with lengths of up to several kilometres and lateral extensions of 20-30 metres. As described by [4], RSL fade and recur in the same location over multiple Mars years. Similarily, Dark Slope Streaks form on at least annual to decade-long timescales [5]. During 10 years of HRSC observation time (2005-2015) several linear features in Noctis Labyrinthus changed in visibility. Slope parameters and seasonal illumination conditions [6] are investigated based on a digital elevation model derived from HRSC data. For large datasets a feature identification is presented which involves spatial filtering in conjunction with elevation data analysis.

Data and Methods: For analysing the time sequence a number of HRSC orbits covering the Labyrinthus Noctis region have been projected to a common centre. Orbits with their corresponding ground resolution are #1955 (12.5m), #1977 (12.5m), #2402 (25m), #a497 (50m) and #e632 (12.5m). Their recording dates span approx. 10 years (July 2005 to July 2015). From these orbits a mosaicked digital terrain model has been calculated to obtain topographic information (Fig. 1). In addition to HRSC data we locally used CTX/HiRISE and MOC image data.

Dark streaks have been identified by the following steps: First the nadir image is highpass-filtered (7x7), from which a two-level image can be derived by thresholding. A sequence of morphological filters are applied (opening, closing, thinning) to produce a skeleton where features are reduced to one-pixel sized chains. These are searched for connectivity with a recursive algorithm that at the same time searches for deviation from the steepest gradient, as dark streaks are known for producing a track downslope. Only chains following the steepest gradient are kept in the record as they are candidates for dark streaks. These chains are then expanded again from their skeleton to the feature seen in the threshold image (Fig. 3).

Results: For 17 dark slope streaks with change (Fig. 2) we found life times that span from less then 1204 days to a maximum of less than 10 years, while recording dates are not equally distributed and image resolution varies from 12.5m to 50m (nominally). This results in uncertainties of detection. Also, in shadowed areas features are difficult to identify as dark streaks can be faint and rendered invisible here.

The detection of dark streaks works satisfying provided that sufficient contrast and resolution is given and a corresponding DTM is available. Still some refinement needs to be done to detect feature change between different orbits for dark slope streaks fully automatic.

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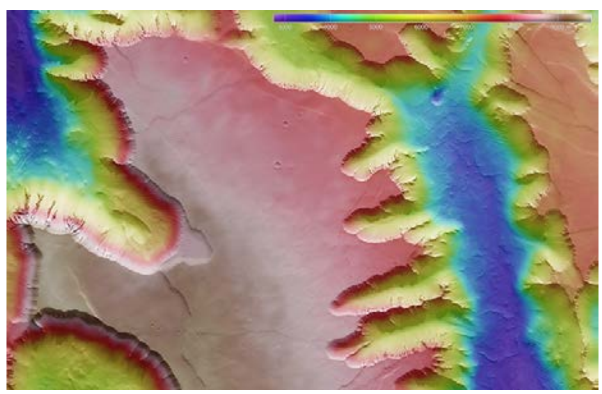

Fig. 1: Colour coded Terrain model of HRSC orbit e632 (Noctis Labyrinthus region), image area is approx. 120x80km with a height range of approx. 5000m, North to the right.

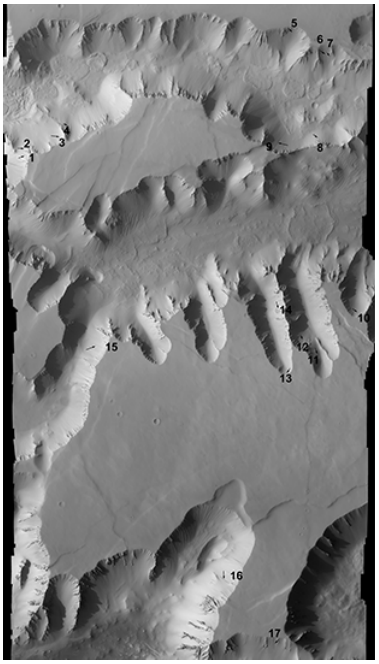

Fig. 2: Locations where dark slope streak changes appear between HRSC orbits. North is up, resolution is 12.5m/pixel.

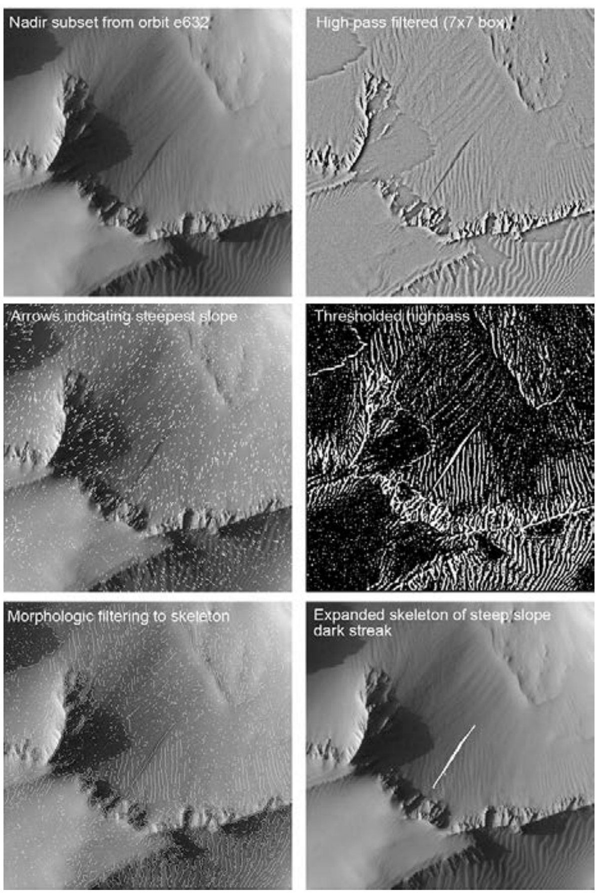

Fig. 3.: Processing steps for dark streak identification.

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