

13 YEARS OF TEMPORAL FADING QUANTIFICATION IN DARK SLOPE STREAKS FROM LYCUS SULCI



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OVERVIEW

▪ Slope streak are typically dark fan-shaped features which are seen on downslope regions. Differently from RSL, their origin remains unknown (wet or dry process). Newly formed streaks are dark, and darker than other streaks in the same region and the streaks tend to fade becoming lighter with time. These streaks provide a more obvious and discernible rate of atmospheric dust fallout and their analysis may provide clues about dust deposition and target material properties.

▪ Our main objective in this paper is to quantify the temporal fading of a set of streaks. For this purpose we developed a tool to measure, in a fully automated manner, the full pixel analyses albedo contrast between slope streaks and their neighborhood regions over 13 years.

IMAGE DATA SET

▪ The dataset is comprised of 20 regions of interest (ROIs) cropped from 14 images (4 MOC and 10 CTX - between the years 2000 and 2013), distributed on regions of Lycus Sulci (Fig. 1.).

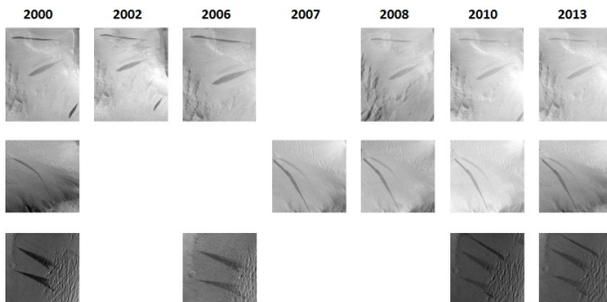
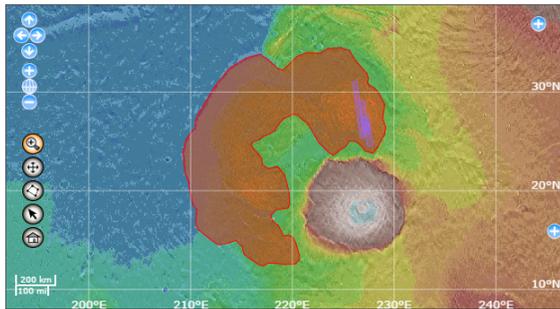


Fig. 1. Location of the images used and regions of interest (ROI) shown in different images

FADING ALGORITHM

▪ The algorithm developed ensures that the same streak is correctly identified in each multi-temporal image (Fig. 2.).

▪ The establishment of the correspondence is achieved through overlapping each element of the primary and older image on the images segmented of the following years. Thus, the inside streak media value (digital number) and the media value of its neighborhood is saved. Since images are acquired by diverse sensors in rather different time periods, it is less prone to errors to evaluate the contrast ratio. Once defined the average values, the DN's is converted into an albedo value.

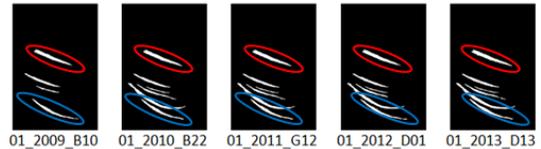
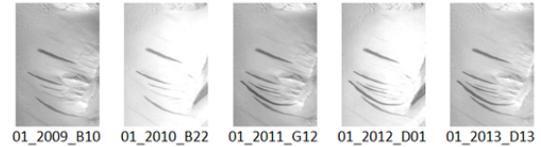


Fig. 2. Sequence developed to compute the slope streaks albedo contrast

TEMPORAL FADING QUANTIFICATION

▪ The contrast ratio of 34 streaks was calculated between the years of 2000 to 2013 (as the contrast ratio tends to 1 the brighter the streak is).

▪ The 34 streaks showed an average change in contrast ratio of 0,009169 per Earth year (Ey⁻¹). Analyzing the streaks fading individually, while the quickest streak fading showed a contrast ratio of 0,755545 in 2000 and 0,941300 in 2013, (red line), the contrast ratio of the slowest streak fading is 0,919339 in 2000 and 0,963043 in 2013 (blue line) (Fig.3.).

▪ In a global evaluation throughout these 13 years of analysis, all the 34 slope streaks faded. However, during some short periods we observed a slight reversal to darkening, and then brightening over again as shown in portions of the curves of the examples presented .

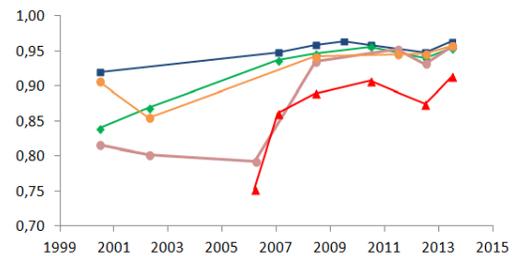


Fig. 3. Variation of contrast ratio of five slope streaks examples analyzed in Lycus Sulci region

CONCLUSIONS

▪ Slope streaks with lower contrast ratio (darker streaks) showed the highest values of change per year. It indicates that the brightening process is not linear. In the current observations, the fading process (or change of contrast ratio per year) is much larger in darker streaks and it is getting light over the years.

▪ The slight darkening observed in all the 34 streaks supports that there are more dynamic aspects involved than a simple streak fading like, for example, a streak reactivation. Additionally, the lack of a relationship between increase and decrease of the change contrast ratio for streaks from the same location may indicate a more dynamic aspect of the process that supposed until now.

▪ The full pixel analyses of the streaks and neighborhoods and the albedo transformation provided by our method ensure a whole set of reliable data. However, we should be cautious and to not state that the fading process at Lycus Sulci is representative of the whole in Mars. For that purpose we need to analyze much more sites that would help establishing a relationship for fading and maybe to validate the idea of reactivation.