SLOPE STREAK FORMATION RATE ON MARS: INVESTIGATION USING OVERLAPPING THEMIS IMAGES. ***S. R. Sherman*** and ***M. A. Kreslavsky***, Earth and Planetary Sciences, University of California - Santa Cruz, 1156 High Str., Santa Cruz, CA, 95064, USA; ssherman@ucsc.edu, mkreslav@ucsc.edu.

Introduction: Slope streaks are prominent surface markings that occur in wide regions in the equatorial zone of Mars [e.g., 1-4]. They have very distinctive morphology. The streaks are mostly interpreted as results of some kind of dry fluidized surficial flow of fine dust, a specific type of dust avalanches [1]. The major difficulty of this mechanism is that the streaks can run over 1 km on slopes as gentle as 10 - 15°. Recently a new "wet" mechanism of slope streak formation was proposed [e.g., 5]. This mechanism involves seasonal formation of concentrated chloride brines in the soil and run-away propagation of percolation front. This mechanism explains some observations better than the traditional "dry" mechanism; however, at the current state of knowledge the "dry" mechanism cannot be discarded.

Formation of slope streaks is an ongoing process. Newly forming streaks are dark, they fade with time and in some locations become a little brighter than undisturbed surface, and then disappear. Fading occurs at time scales of tens to hundreds of years [2], so only a few disappeared streaks have been reported [6]. Fading streaks are actively being joined by newly emerged dark streaks, so the total number of slope streaks on the planet is increasing. In [2] a survey of 181 overlapping MOC image pairs with ~2500 streaks and ~126 new streaks has been performed. This survey gave an estimate of a global streak formation rate of ~7% per existing streak, per Mars year. In [6], a systematic comparison of Viking and MOC images (~140 persisting, ~70 new streaks) led to the overall formation rate of ~3% per streak per Mars year. In that work the authors also have noted some indications that streak formation in some areas or times is more active than in others.

The "wet" mechanism [5] explicitly predicts seasonality of streak formation, with active season timing depending on the latitude and slope orientation. Aiming to test these predictions we are performing another systematic survey of streak formation rates with a focus on slope orientations. Here we present some preliminary results.

Survey: In our survey we use THEMIS daytime VIS images. Although only large slope streaks are unambiguously recognizable in these images, this data set is the most suitable due to a good surface coverage with overlapping image pairs and homogeneous image quality. We record only unambiguously identified old and new streaks within image overlapping areas. Streaks are known to follow topographic gradients, and we record direction of each streak as a good proxy for the orientation of the streak-bearing slope.

The survey is in progress. The presently (January 2008) completed survey area covers 12°S to 29°N and 135° to 198°E. This area covers most of Elysium Planitia and Amazonis Planitia, including an area directly west of Elysium Mons. 219 THEMIS image pairs containing streaks were surveyed with new streaks appearing in 104 of them. 4100 streaks were counted and 306 new streaks were found.

Preliminary Results: **Fig. 1** shows frequency distribution of all streaks with respect to their orientation (shaded rose diagram). The fact that the number of streaks on east-facing slopes is smaller than on west-facing slopes is possible an observational bias. All THEMIS VIS images are taken at local afternoon and solar illumination comes from the west; east-facing slopes are often dark or even shadowed, which make it more difficult to identify streaks. However the significant excess of west- and east-directed streaks over north- and south-directed streaks and approximately equal amount of north and south-directed streaks are robust observational results. Specifically in this area there is no apparent anisotropy in slope directions, and this pattern probably objectively reflects streak occurrence. Our results partly contradict to observations in [3], where, for the same region, along with confirmed scarcity of north-directed streaks, a preferential orientation to south and south-west has been reported.

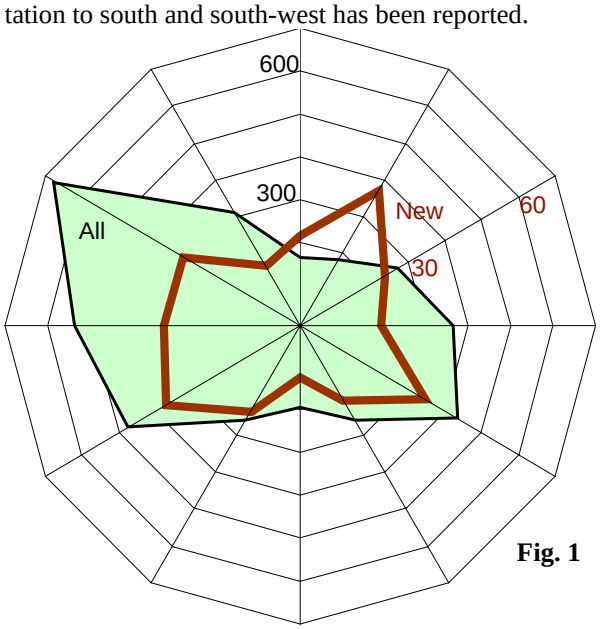

Fig. 1

Fig. 1 also shows directional distribution of new streaks (radial scale multiplied by a factor of 10 in comparison to the total). It is clearly seen that the number of new streaks does not correlate with the total number of streaks. New streaks do not tend to form on the slopes where they are already abundant.

Following [2], we calculated the average relative streak formation rate q as

$$q = \frac{\sum_i \Delta n_i}{\sum_i n_i \Delta t_i},$$

where n_i is the total number of streaks in the i-th image pair, Δn_i is the number of new streaks, and Δt_i is the time interval between images in the i-th pair. With our survey results we obtained an overall average formation rate of q = 10.8% per Martian year. This rate is even higher than the rate reported in [2], however, that survey included streaks in Arabia Terra, where the formation rate seems to be generally lower [6]. **Fig. 2** presents the rate, calculated separately for streaks of different direction. Huge peak for north- and north-east facing slopes is observed. Detailed analysis show that only a few image pairs with large number of new streaks, small number of old streaks and small time interval between images contribute to this rate excess. This clearly indicate that streak formation is not evenly distributed both in space and in time.

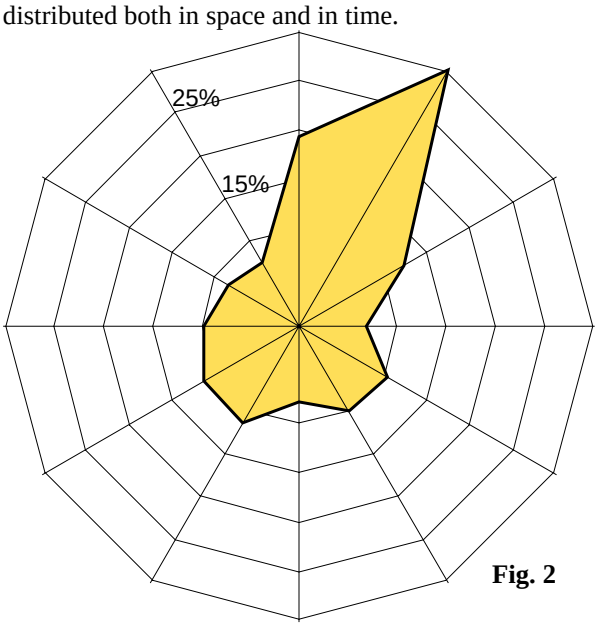

Fig. 2

This observation can be explained by local simultaneous triggering of streaks in some locations, for example, by seismic events. Alternatively, one may speculate that the surface layer "maturates" for runaway streak formation process (by accumulating enough dust in the framework of "dry" mechanism or by segregation of chlorides in the framework of the "wet" mechanism).

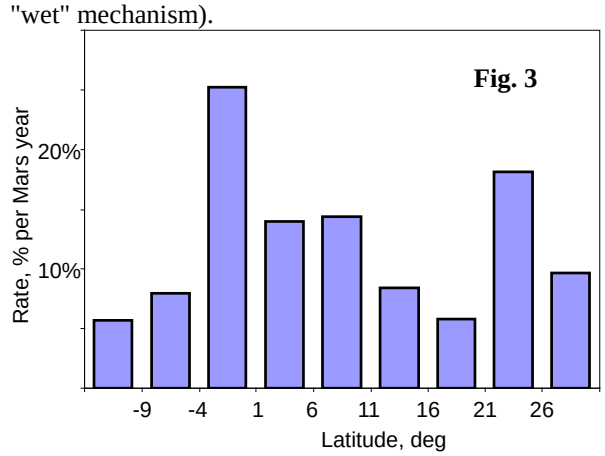

Fig. 3 shows the average relative streak formation rate calculated for a number of latitudinal bins. It is seen that there is not any systematic dependence of the rate on latitude. Our data set is not large enough to assess variations of the rate with respect to latitude and orientation simultaneously.

Among the studied image pairs, 49 pairs have separation time interval Δt less than 1/4 of martian year, 13 of them contain totally 37 new streaks. In principle, such pairs allows testing of seasonality of streak formation. Totally 28 streaks, more than 75% were formed during the northern summer season, for Ls = 90 - 180°. However, the data set is yet insufficient for robust assessment of seasonality.

Conclusions. We found that formation of new streaks is highly inhomogeneous in space and time. Local formation rate is not proportional to the number of existing streaks. Data collected so far are not extensive enough to assess seasonality of streak formation at slopes of different orientation. We continue the survey to address this important problem.

References: [1] Sullivan R et al. (2001) *JGR, 106,* 23607–23633. [2] Aharonson O. et al. (2003) *JGR, 108,* 5138, doi:10.1029/2003JE002123. [3] Baratoux D. et al. (2006) *Icarus, 183,* 30-45. [4] Chuang F. C. et al. (2007) *GRL, 34,* L20204. [5] Kreslavsky M. A. and Head J. W. (2008) *LPS XXXIX* (this conference), #1411. [6] Schorghofer N. (2007) *Icarus, 191* 132–140.