Interactions of Dust Devils and Slope Streaks on Mars. T. Heyer[1], J. Raack[1], H. Hiesinger[1], and R. Jaumann[2], [1]Institut für Planetologie, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany, [2]German Aerospace Center (DLR), Berlin, Germany. (thomas.heyer@uni-muenster.de)

Introduction: Slope streaks are gravity-driven landforms that occur throughout the martian year in dust-rich, low-thermal-inertia equatorial regions on Mars [1-3]. The distinctive features typically originate from point sources on slopes steeper than ~20°, follow the topographic gradient, extend or divert around small obstacles, and propagate up to maximum lengths of a few kilometers [4]. The initially dark-toned streaks brighten with time, sometimes become brighter than their surroundings, and fade away due to settling dust from the atmosphere [5]. In contrast to recurring slope lineae (RSL), which gradually extend over time [e.g., 6], a growth, or reactivation of existing streaks has not been observed. Slope streaks have never been observed in a terrestrial environment although some analogs have been proposed [e.g., 7, 8]. Based on diverse orbital observations, a number of mechanisms including granular [e.g., 1] and aqueous flows [e.g., 8-10] have been proposed to explain their formation.

High-resolution images revealed the lack of identifiable trigger mechanisms for most slope streaks. Rare observations indicate that slope streaks are triggered by various types of disturbances of accumulated dust, including rockfalls [11], impacts [e.g., HiRISE image ESP_054066_1920], and blasts from impacts [11]. In addition, a high-resolution observation showed a single intersection of a dark track with the upper part of a slope streak indicating a dust devil-related triggering of the slope streak [5]. However, the chronological timing of slope streak and dust devil occurrence and thus the triggering mechanism remained unclear.

Observations: Using high-resolution images [12], we identified several regions where dust devil tracks and slope streaks occur on the same slopes, e.g., Tharsis (24.0° N, 260.3° E), Arabia Terra (40.0° E, 8.7° N), or Orcus Patera (178.4° E, 11.9° N). Most of the identified dark tracks indicate that dust devils run on dusty slopes, occasionally intersecting slope streaks without any apparent interaction. However, rare observations suggest a dust devil related triggering of slope streaks (Figs. 1, 2). Fig. 1 shows multiple slope streaks initiating along a single dust devil track. The ~650 m long and ~1.5 m wide dust devil track spans over the top of a steep and dusty crater rim. In the upper part of the slope, multiple streaks with lengths ranging from a few meter up to ~770 m initiate from the dust devil track and move downslope.

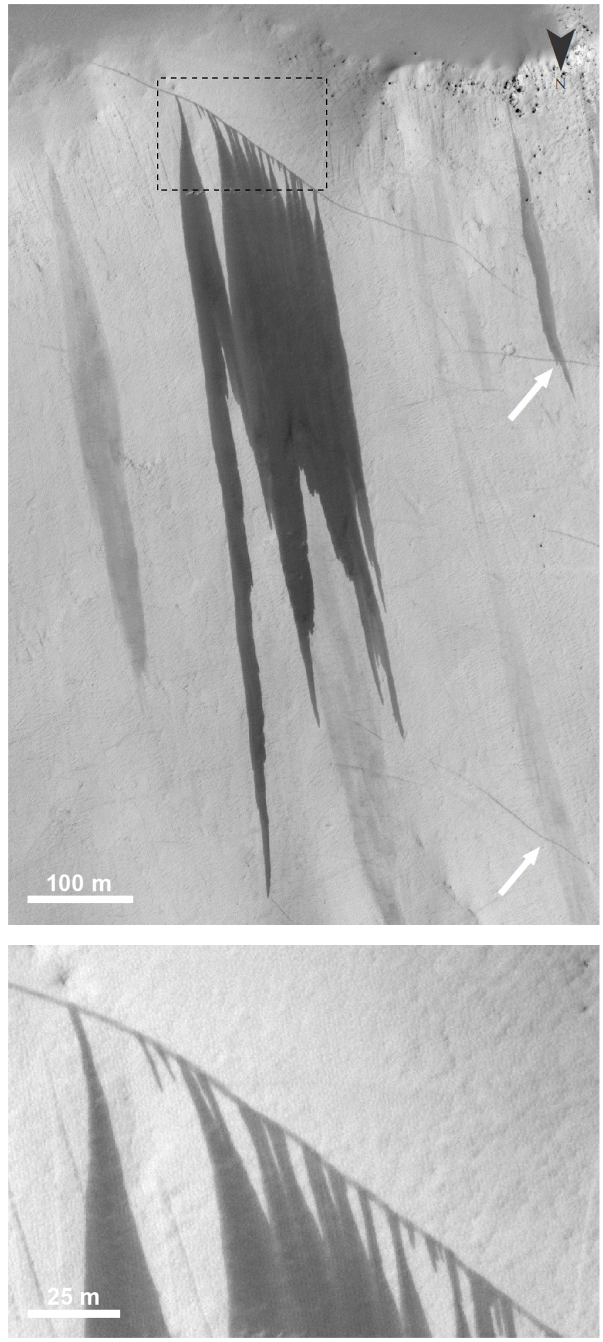

Fig. 1: Multiple slope streaks initiate along a dust devil track (HiRISE image PSP_009192_1890). All figures are stretched to show local albedo differences between dust devil tracks and slope streaks. White arrows indicate intersections of dust devil tracks with faded (older) slope streaks. Downhill is to the bottom.

Fig. 2: Multiple slope streaks initiating along dark tracks (HiRISE image ESP_027244_1890). Streak triggering occurred at the upper part of the slopes. The triggered slope streaks have lengths ranging from a few meter up to ~1375 m. Downhill is to the bottom.

The triggered streaks appear darker in comparison to the dust devil track indicating that slope streaks most likely erode more fine-grained material than dust devils. Equivalent to the strength of dust devils, mainly small particles were lifted/removed, while larger particles were only be locally relocated [13, 14].

Other cases where multiple slope streaks emanate from dark tracks probably formed by dust devils are presented in Fig. 2. In these cases, dark tracks are limited to the area where slope streaks initiate possibly due to the short-lived character of the dust devils or due to the local favorable conditions of the surface.

Discussion/Conclusions: The observed interactions confirm previous observations [5] that slope streaks are triggered by diverse disturbances, including dust devils on Mars. Dust devil-related streak triggering has been observed at the upper parts of the slopes, indicating that favorable conditions, e.g., steep slopes or sufficient deposits of dust are essential for streak formation. Albedo differences between dust devil tracks and consequently triggered slope streaks suggest a more substantial disturbance of the surface by slope streaks. Furthermore, dust devil tracks continuing on faded (older) slope streaks indicate that the fading of the streaks is related to air-fall dust [7].

The observed streak triggering suggests a dry formation process where fine-grained material moves downslope in form of an avalanche-like granular flow [e.g., 1]. However, most slope streaks initiate on point sources and show no evidence for a specific triggering mechanism. Potential unapparent triggering mechanisms, which are consistent with the observed seasonality of slope streaks [3], are strong winds [1] or insolation processes [15, 16].

Alternatively, the triggering of slope streaks might be affected by aqueous processes, which stabilize the accumulated dust. A potential minor cementation of dust due to small amounts of hydrated salt phases during the cold season might reduce the possibility of streak triggering. Thus, a seasonally varying stabilization of dust deposits might also explain the observed seasonal formation of slope streaks.

References: [1] Sullivan R. et al. (2001) *JGR*, 106, 23607–33. [2] Schorghofer N. and King C. M. (2011) *Icarus*, 216, 159–68. [3] Heyer T. et al. (2019) *Icarus*, 323, 76-86. [4] Brusnikin E. S. et al. (2016) *Icarus*, 278, 52–61. [5] Schorghofer N. et al. (2007) *Icarus*, 191, 132-140. [6] McEwen A. S. et al. (2011) *Science,* 333, 740–743. [7] Baratoux D. et al. (2006) *Icarus*, 183, 30–45. [8] Kreslavsky M. A. and Head J. W. (2009) *Icarus*, 201, 517–27. [9] Ferris J. C. et al. (2002) *GRL*, 29. [10] Kreslavsky M. A. and Head J. W. (2019) *9th Mars Conf.* #2089. [11] Chuang F. et al. (2007) *RGL*, 34, L20204. [12] McEwen et al. (2007) *JGR*, 112, E05S02. [13] Reiss D. et al. (2010) *GRL*, 37, L14203. [14] Raack J. et al. (2018) *Astrobiology*, 18, 10. [15] Schmidt F. et al. (2017) *Nat. Geosci.,* 10, 270–3. [16] Kraemer A. et al. (2019) *PSS*, 166, 131-134.