MARTIAN DUST RAISING AND SURFACE ALBEDO CONTROLS: THIN, DARK (AND SOMETIMES BRIGHT) STREAKS AND DUST DEVILS IN MGS MOC HIGH RESOLUTION IMAGES. K. S. Edgett and M. C. Malin, Malin Space Science Systems, P.O. Box 910148, San Diego, CA 92191-0148, USA.

Synopsis: Dust devils have long been considered to be an important mechanism for injecting dust into the martian atmosphere. New observations presented here suggest that dust devils may also be an important factor in controlling local- and regional-scale albedo variations on the northern plains and elsewhere on Mars. Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC) high resolution (1.4–12 m/pixel) images have revealed a plethora of dark, thin (10–200 m wide) streaks that typically show no preferred direction and often are found crossing each other and crossing a range of terrain and surface types. When first noticed in MOC images during the pre-Mapping phases of the MGS mission in 1997–1998, we interpreted these streaks as being the result of surface disruption and disturbance caused by the passage of dust devils. Mapping Phase (1999–Present) images revealed that these streaks are a very common martian surface feature at the meter scale, particularly in low albedo regions and on dune surfaces. A few MOC narrow angle camera images have captured active dust devils and, as of this writing, two of these images show a direct connection between dust devils and the formation of dark streaks.

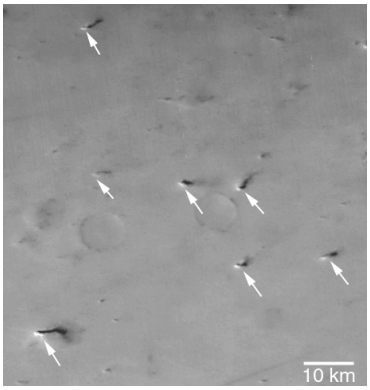

Figure 1. MOC red wide angle camera image M01-01485 showing large dust devils (arrows), some towering up to 6 km, in Amazonis Planitia on May 13, 1999. Illumination is from the lower left, center near 36°N, 159°W.

Dust Devils: Dust devils are the visual apparition of a columnar vortex of rising air mixed with fine granular material. They typically form in afternoons after the ground has heated up and warmed the air immediately above the surface. As pockets of warm air rise and interfere with one another, they create horizontal pressure variations that, combined with other meteorological winds, cause the upward moving air to spin. As the spinning column of air moves across the surface, it may encounter grains of sand, silt, and/or clay that it can set into motion. Silt and clay can become entrained in the columnar vortex, giving rise to a visible "dust devil". Moderate breezes move the vortex across the landscape. Dust devils and vortices have been observed to occur on Mars in Viking orbiter and Mars Pathfinder images and were inferred to have passed over the Viking and Mars Pathfinder landers from air pressure observations. MGS MOC wide angle (250 m/pixel) images have also shown the presence of dust devils (Figure 1).

Streaks: Figures 2a and 2b show typical examples of MOC high resolution views of mid-latitude low albedo plains surfaces in both the northern and southern hemispheres, respectively. These plains appear to owe their low albedo to the presence of abundant, crisscrossing dark streaks. The streaks are usually 10–200 m wide, sometimes individual streaks curve, cross other streaks, cut across different terrain types, and loop back on themselves. Streaks are not confined to mid-latitudes; indeed they are found in nearly every environment on Mars. Figure 2c shows an example from Syria Planum in which the streaks are lighter than their surrounding terrain. Such light streaks are much less common than dark ones. Streaks are not confined to a specific type of surface or landform, though many occur in areas of inferred sand such as dune fields. Figure 2d and 2e show dark streaks running across dune and ripple surfaces. Often the bedforms do not interrupt a streak. Some streaks cross contacts between very different material units, as in 2f where dark streaks cross the boundary between a dark dune (right) and brighter plain (left). The fact that these streaks often cross one another and sometimes form curly loops (Figure 2g) provides prime evidence that they result from the passage of a dust devil rather than by occasional wind gusts.

Martian Devil Sightings: Because Mapping Phase MOC narrow angle images cover, at most, a 3-km wide strip, active dust devil observation are, by necessity, serendipitous. Some have been seen, however, as shown in Figures 2h and 2i. The dust devil in 2h is traveling toward the lower right (southeast) and has formed a faint dark streak nearly as wide as the dust devil itself. A plume of dust near the surface trails behind the dust devil; some of this material may settle and obscure the resulting streak. The dust devil in 2i was caught in the act of forming a prominent dark streak; in this case the streak includes swirls indicating stalling of the forward motion of the vortex. In some regions, particularly the low albedo portions of the northern plains and southern mid-latitudes, production of dark streaks by dust devils may be an important control on surface albedo variation over time.

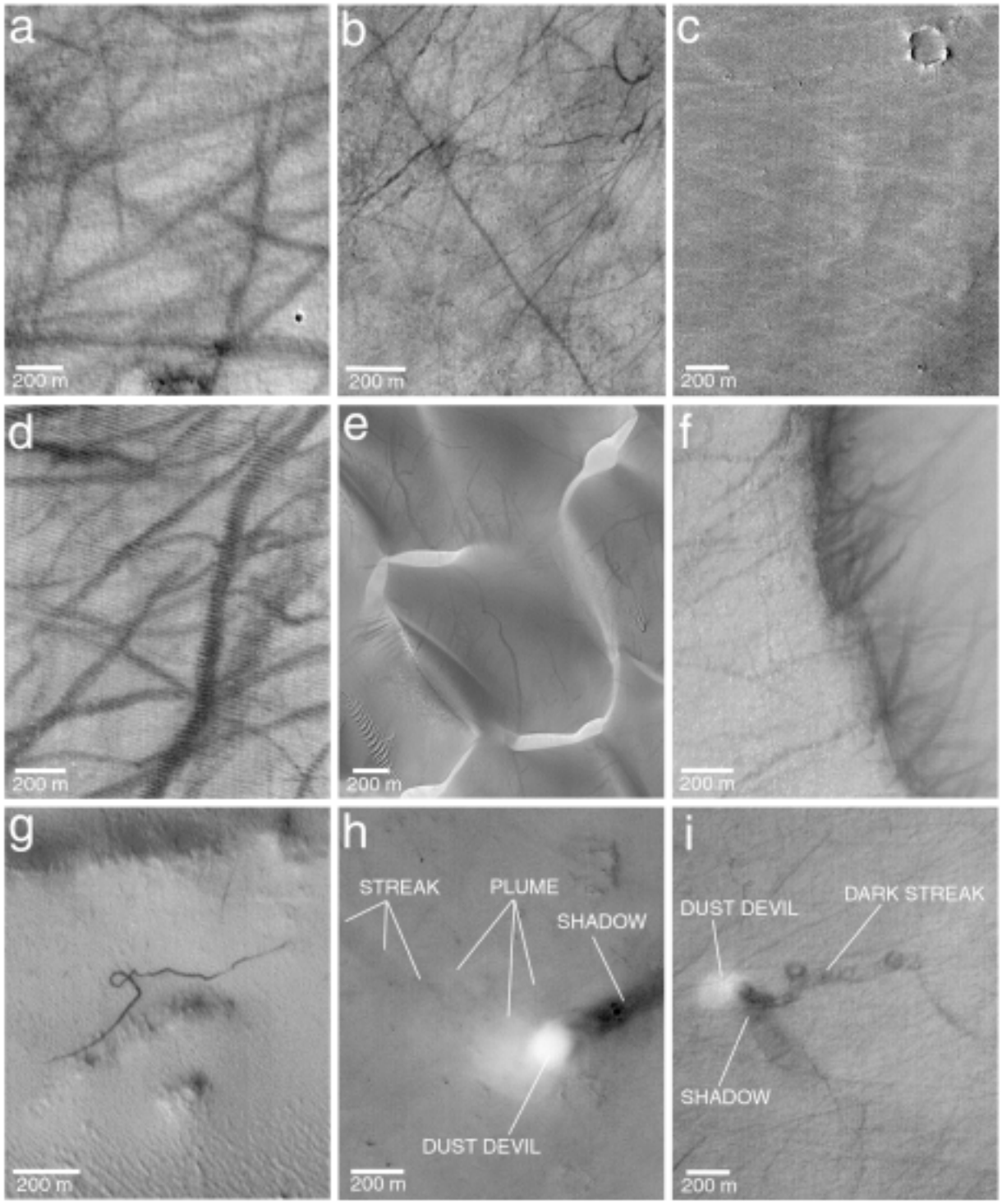

Figure 2. Examples of streaks and dust devils in a variety of locations on Mars. North is toward the upper right in all MOC subframes. **(a)** Utopia Planitia near 53.4°N 274.4°W, M03-04335. **(b)** Noachis Terra near 55.9°S, 324.9°W, M10-00732. **(c)** Syria Planum near 13.0°S, 102.8°W, M10-00638. **(d)** Argyre Planitia near 49.4°S, 41.0°W, M09-06457. **(e)** Rabe Crater dunes near 44.1°S, 325.6°W, FHA-01006. **(f)** Argyre Planitia near 48.8°S, 40.2°W, M10-00592. **(g)** Ulysses Patera near 2.4°N, 121.4°W, M10-00489. **(h)** East Terra Meridiani near 2.6°S, 350.1°W, M09-00193. **(i)** Promethei Terra at 54.1°S, 242.8°W, M10-01267.