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HiRISE Observations of Seasonal Processes on Mars

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Introduction

The High Resolution Imaging Science Experiment (HiRISE) on board NASA's Mars Reconnaissance Orbiter has been returning data for 3 Martian years. These data show that Mars is more dynamic than previously believed. In particular, the high-resolution images (down to 25 cm/px) have given us new insight into seasonal processes. When combined with the observations of the CRISM imagingspectrometer, we begin to obtain a rather detailed picture of how phenomena develop over time.

1. Southern polar processes

Seasonal gas flow is the most effective agent for geomorphic change on Mars today (Piqueux and Christiansen, 2008). The basal sublimation of seasonal ice in south polar regions leads to erosion of the surface over time and transport of dust in a process that may be analogous to geyser-like processes on Triton. This process has been investigated in a number of publications (e.g. Kieffer et al., 2007; Hansen et al., 2010; Portyankina et al., 2010; 2012; Thomas et al., 2010; 2011a,b) suggesting broad agreement with the original ideas of Hugh Kieffer.

2. Gullies on dunes

Modification of gullies on dunes (e.g. in Kaiser crater) seems to be seasonally controlled with activity constrained to late winter (Diniega et al., 2010). The initialization of material transport here may be related to the local accumulation of CO_2 frost.We may be seeing an effect which has analogues on Earth (where water provides the agent) or on Titan's dune fields.

3. North polar avalanches

Russell et al. (2008) have detected avalanches in northern spring on Mars. Multiple avalanches may occur simultaneously along north polar scarps. Analysis of their morphology and structure reveals these events to be similar to terrestrial powder avalanches and falls of loose, dry snow.

4. Northern dune motion

Activity on dune fields in the northern polar regions of Mars is far more prevalent than previously imagined (Hansen et al., 2012). Deposition of seasonal CO_2 ice may, as in southern regions, be an important pre-cursor to this activity. While large jet-like activity is not frequent here, dune crests and the interface to the substrate show darkened material in spring which is probably caused by dust deposition on top of the seasonal deposit as a consequence of activity. The absence of more major deposits may be a consequence of particle size.

5. Spectral changes at the poles

While the NIR spectra of surfaces in polar regions might be expected to change rapidly during the spring, there are clearly subtleties which are caused by water ice sublimation at lower latitudes followed by poleward transport. These too have now been investigated with a qualitative explanation being available (Pommerol et al., 2012).

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