Observation of interannual variability of dust surface/atmosphere exchange on Mars. M. Vincendon[1], [1]Institut d'Astrophysique Spatiale, Université Paris Sud, 91400 Orsay, France (mathieu.vincendon@u-psud.fr)

Introduction: Mars dust is endlessly displaced between surface and atmosphere. These exchanges modify the amount and properties of atmospheric dust with which robotic or human explorers are confronted. Characteristic timescales are connected with the balance between sedimentation and lifting processes. The relative efficiency of these mechanisms is notably linked with dust physical properties, such as grain size. We e.g. observe that dust with larger size settle faster during dust storm decay, which modifies the average grain size of suspended dust as a function of time over the year, as stormy and clear phases alternate (Figure 1, [1]). Triggering factors for mechanisms that result in sedimentation (e.g., dust scavenging by ice clouds), or on the contrary lifting (e.g., dust devil), depend also on changing local conditions impacted by turbulent or random processes, that makes them only partly predictable [2]. As a result, a given year of dust history on Mars is a combination of regular patterns with atypical events [3].

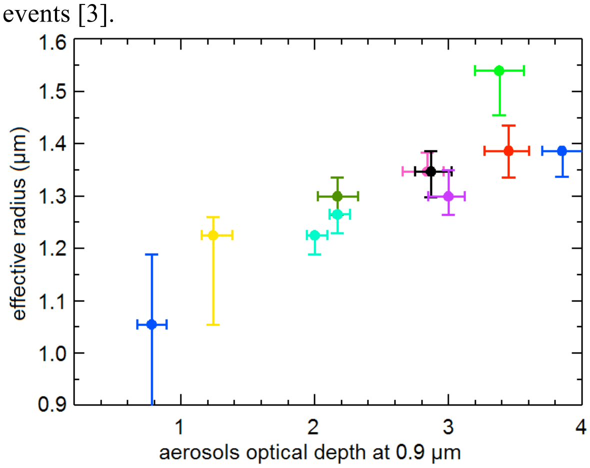

Figure 1: Dust radius versus optical depth during decay of the 2007 global dust storm (MY28). The average particle size decreases with optical depth as large particles settle faster than small ones [1].

Observations: The uninterrupted remote sensing of Mars from orbiters over the last 20 years, coupled with more sporadic former Earth-based or space-based observations, now provide a sufficient dataset to evaluate the variability of surface-atmosphere dust exchanges over various timescales [4]. Observations gathered by the visible and near-IR OMEGA imaging spectrometer, operating since 2004 onboard Mars Express, result in a dataset with various time and spatial samplings that makes it possible to constrain several characteristics of these exchange mechanisms [5]. Dust removal or deposition at the surface is identified from orbit through surface albedo change (Figure 2), which requires accounting for atmospheric and photometric effects through radiative transfer models.

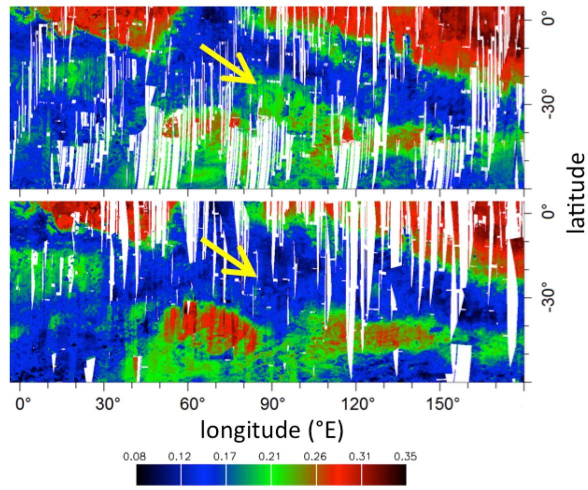

Figure 2: Mars albedo map of the Hellas surroundings before (top) and after (bottom) the MY28 global dust storm (adapted from [5]). The moderately bright area indicated by the arrow becomes dark after the dust storm, as a thin (< 10-100 μm) coating of bright dust was removed from a darker underlying terrain.

Discussion: Changes over several timescales are identified in the OMEGA dataset [5]. The example of Figure 2 illustrates a major modification observed in Hesperia (yellow arrow) over a 1500 x 1000 km wide area. Dust was deposited in that area after the 2001 global dust storm (MY25) [6]. This dust as been preserved over 3 mars years and then injected back in the atmosphere in 2007 (MY28) during the global dust storm (Figure 2). Dust has not returned to that area over the next two years. This illustrates that the dust history of a given local area can be irregular over long timescales and that a similar event (here: a global dust storm) can result in opposite effects. This variability may be difficult to predict and must be accounted for while assessing the local dust conditions that can characterize the environment of future missions to Mars.

References:[1] Vincendon M. et al. (2009) *Icarus, 200,* 395–405. [2] Newman C. E. & Richardson M. I. (2015) *Icarus, 257,* 47–87. [3] Lemmon M. et al. (2015) *Icarus, 251,* 96–111. [4] Geissler P. E. et al. (2016) *Icarus, 278,* 279–300. [5] Vincendon M. et al. (2015) *Icarus, 251,* 145–163. [6] Szwast M.A. et al. (2006), *J. Geophys. Res.*, 111 (E11), E11008.