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Dust Aerosol Particle Size at the Mars Science Laboratory Landing Site

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We have developed a new methodology to retrieve dust aerosol particle size from Mars Science Laboratory (MSL) observations [1]. We use photodiode output currents measured by the Rover Environmental Monitoring Station (REMS) UV sensor (UVS), ancillary data records (ADR) containing the geometry of the rover and the Sun, and values of the atmospheric opacity retrieved from Mastcam measurements. In particular, we analyze REMS UVS measurements when the Sun is blocked by the masthead and the mast of the rover since the behavior of the output currents during these shadow events depends on the dust phase function, which depends on particle size.

The retrieved dust effective radii show a significant seasonal variability, ranging from $\sim$0.6 μm during the low opacity season (Ls = 60º – 140º) to $\sim$2 μm during the high opacity season (Ls = 180º – 360º). The relationship between atmospheric opacity and dust particle size indicates that dust-lifting events originate at various distances from Gale Crater. The external origin of high dust content events is consistent with the strong and persistent northerly and northwesterly winds at Gale Crater during the perihelion season centered around Ls = 270º [2].

From an interannual perspective, the general behavior of the particle size evolution in MY 31-32 is similar to that in MY 32-33, although some differences are noted. During the low opacity season (Ls = 60º – 140º), the retrieved dust effective radii in MY 33 are significantly lower than in MY 32. A larger contribution of water ice clouds to the total atmospheric opacity during the aphelion season of MY 33 can partially explain such a departure. Differences during the perihelion season are caused by interannual variability of enhanced opacity events.

The determination of dust aerosol particle size is important to improve the accuracy of models in simulating the UV environment at the surface [3] and in predicting heating rates, which affect the atmospheric thermal and dynamical fields, and aerosol atmospheric transport, including gravitational settling rates.

References:

[1] Vicente-Retortillo, A. et al., GRL, submitted.
[2] Rafkin, S. et al. (2016), Icarus, 280, 114-138.
[3] Webster, C.R., et al. (2016), AGU Fall Meeting.