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Dust Deposition and Lifting at Gale Crater during the 2018 Global Dust Storm

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A global dust storm caused an abrupt increase in the dust opacity at Gale Crater from values below 1 to values above 8 within 10 sols [1]. These extraordinarily high opacities are more than five times the maximum value measured by Mastcam prior to this storm, which peaked at Ls = 195.5º of Mars Year (MY) 34. Here we use measurements of UV radiation by the Rover Environmental Monitoring Station (REMS) onboard MSL and Mastcam opacities to quantify the amount of dust accumulated on the UV sensor before, during and after the peak of the global dust storm.

The temporal coverage of REMS and Mastcam observations during the storm allows the quantification of dust accumulation on the REMS UV sensor for more than 50 sols between sols 2075 and 2167, allowing analyses of changes in dust accumulation within a small number of sols and potential sol-to-sol variations.

The 2018 global dust storm provides a unique opportunity to study dust deposition and lifting, as well as dust removal mechanisms, under extreme conditions.

In absence of a global dust storm, the amount of dust accumulated on the sensor follows a seasonal cycle, with net dust removal during the perihelion season until Ls $\sim$ 300°, and net dust deposition until the end of the aphelion season (Ls $\sim$ 300°–180°) [2]. During the aphelion season of MY 34, the amount of dust accumulated on the REMS UV sensor shows a slightly increasing trend, as observed in MY 32 and 33. In contrast, dust accumulation increases significantly during the onset of the dust storm. Results indicate that only $\sim$50% of the incoming radiation at the surface reaches the photodiodes after the peak of the dust storm.

Finally, REMS measurements of pressure perturbations within seconds and simulations from the MarsWRF mesoscale model suggest that daytime convective vortices and nighttime winds are likely responsible for the seasonal dust cleaning at Gale Crater in years in which a global dust storm did not occur [2]. Here we will discuss the dust removal mechanisms during the 2018 global dust storm.

References:

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[2] Vicente-Retortillo, Á., et al. (2018), Seasonal Deposition and Lifting of Dust on Mars as Observed by the Curiosity Rover, Sci. Rep., 8, 17576.