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Convective vortices in Gale crater

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43 sudden drops in atmospheric pressure have been detected by the REMS instrument [1] onboard Mars Science Laboratory (MSL) during MSL sols 1 to 100. The Full-Width at Half Maximum durations of these events are less than 30 s, typically $\sim$7 s. Coincident increases in air temperature and variations in wind direction and speed are associated with most events. We conclude that almost all of these events are caused by dust devils or dustless convective vortices. One probable dust devil has also been detected by the Navigation Cameras [2, 3].

Another indication of dust devils in the REMS data are dips in UV radiation flux, possibly caused by dust lifted by vortices and obscuring sunlight [4]. One of these UV obscuration events coincided exactly with a pressure event indicating that a dust-lifting vortex probably passed over MSL. The facts that this happened in only one event and that only a single dust devil was detected by the Navigation Cameras can be explained by assuming that most vortices were not strong enough to lift dust. An alternate explanation is that the area where a vortex lifts dust is small compared to the area where the pressure drop caused by the vortex is observable. These hypotheses could also explain the missing observations of dust devils and their tracks in Gale crater by orbiters such as MRO [5].

All detected pressure events occurred during the daytime, between 9:30 and 15:16 Local Mean Solar Time (LMST). The event intensity peaks around 11 LMST. The maximum intensity of events with magnitude > 0.5 Pa is circa 0.4 events / sol hour, almost the same as that detected by the Pathfinder and Phoenix landers [6, 7]. The magnitude of the pressure drops varies from 0.3 to 2.5 Pa. The distribution of pressure drop magnitudes is similar to that detected by Pathfinder and Phoenix. The observed vortex intensities and magnitudes are surprisingly high taking into account that the daytime boundary layer depth is suppressed in Gale crater [8]. This should suppress vortex activity because it decreases their thermodynamic efficiency [9].

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