CONVECTIVE VORTICES AT THE MSL LANDING SITE

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The REMS instrument [1] onboard Mars Science Laboratory (MSL) has detected numerous sudden drops in atmospheric pressure, interpreted to be caused by passing dust devils or dustless convective vortices, during its first 269 sols on the surface of Mars. The Full-Width at Half Maximum durations of these events are typically ~7 s. Coincident increases in air temperature and variations in wind direction and speed are associated with most events (figure 1).

The magnitude of the pressure drops varies from 0.5 to 2.5 Pa and their frequency of occurrence peaks around noon. The distribution of the frequency of occurrence as a function of local solar time is similar to that detected by the Pathfinder and Phoenix landers [2][3]. The detected magnitude distribution is also similar, except that pressure drops with magnitude higher than 2.5 Pa are missing. An important modeling result related to this observation is the suppression of the daytime boundary layer depth at the landing site on the floor of Gale crater [4]. The efficiency of converting the surface heat flux into the work of driving dust devils is related to the depth of the boundary layer [5].

Only one probable dust devil has been detected by the Navigation Cameras of MSL [6][7]. Dust devils and their tracks have also not been detected by orbiters such as MRO around the landing site [8]. These observations suggest that the convective vortices detected by REMS are relatively dust free. Further, if the vortices were dust lifting, then the dust could obscure sunlight when a vortex passes by and cause variations in the detected UV flux. However, only few pressure drops are associated with coincident variations in UV. Apparently almost all vortices at the MSL landing site are too weak to lift dust which is obviously related to the lack of events with large pressure drops and which must play a role in the overall dust budget of Gale crater.

The long duration of the MSL mission enables studying the seasonal variation in vortex activity. During the first 100 sols after landing vortices occurred almost as frequently than what was detected by Pathfinder and Phoenix [2][3]. As summer has turned into winter on the southern hemisphere of Mars the number of detected vortices has decreased.

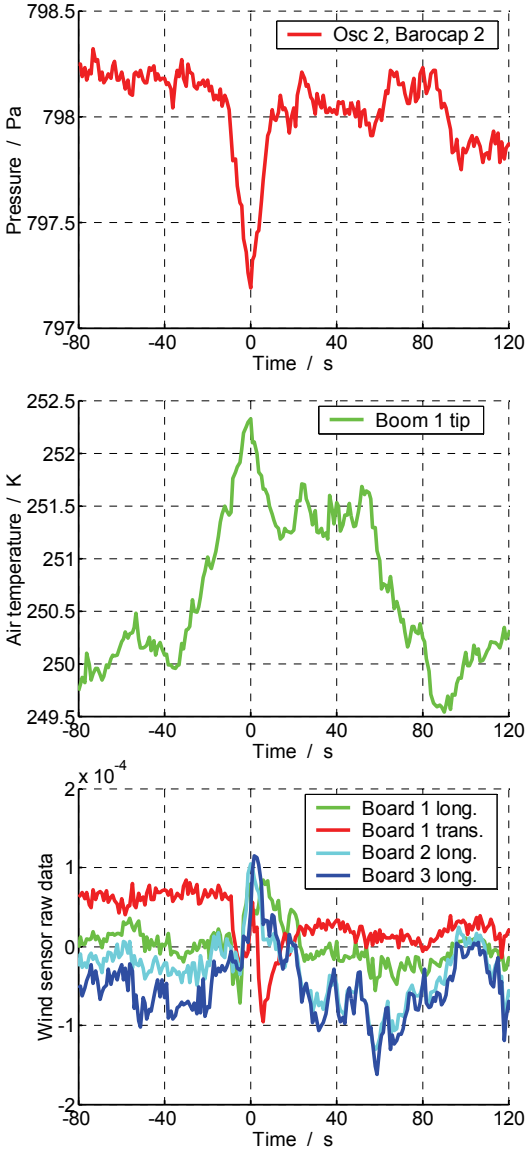

Figure 1. Pressure (top), air temperature (middle) and boom 2 wind sensor raw data (low) measured by REMS during a vortex passing on MSL sol 86. The wind sensor data shows that the wind direction changes back and forth during the pressure event.

References:

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