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Supplementary Materials for

The dynamic atmospheric and aeolian environment of Jezero crater, Mars

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The PDF file includes:

Other Supplementary Material for this manuscript includes the following:

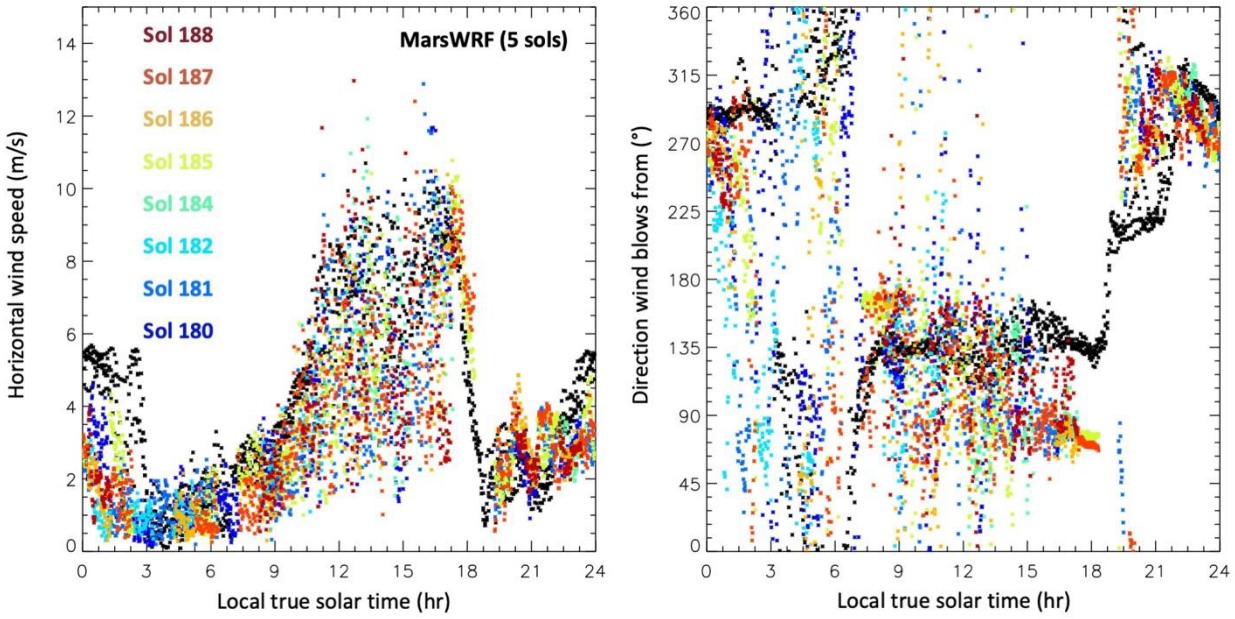

Fig. S1. Comparison between MEDA and modeled wind patterns. Colors show wind speeds (left) and directions (right) measured by MEDA, averaged into 1-minute periods at Ls~90°, as in Fig. 1A in the main text, but now also showing MarsWRF mesoscale model predictions output every 5 minutes over 5 sols (in black).

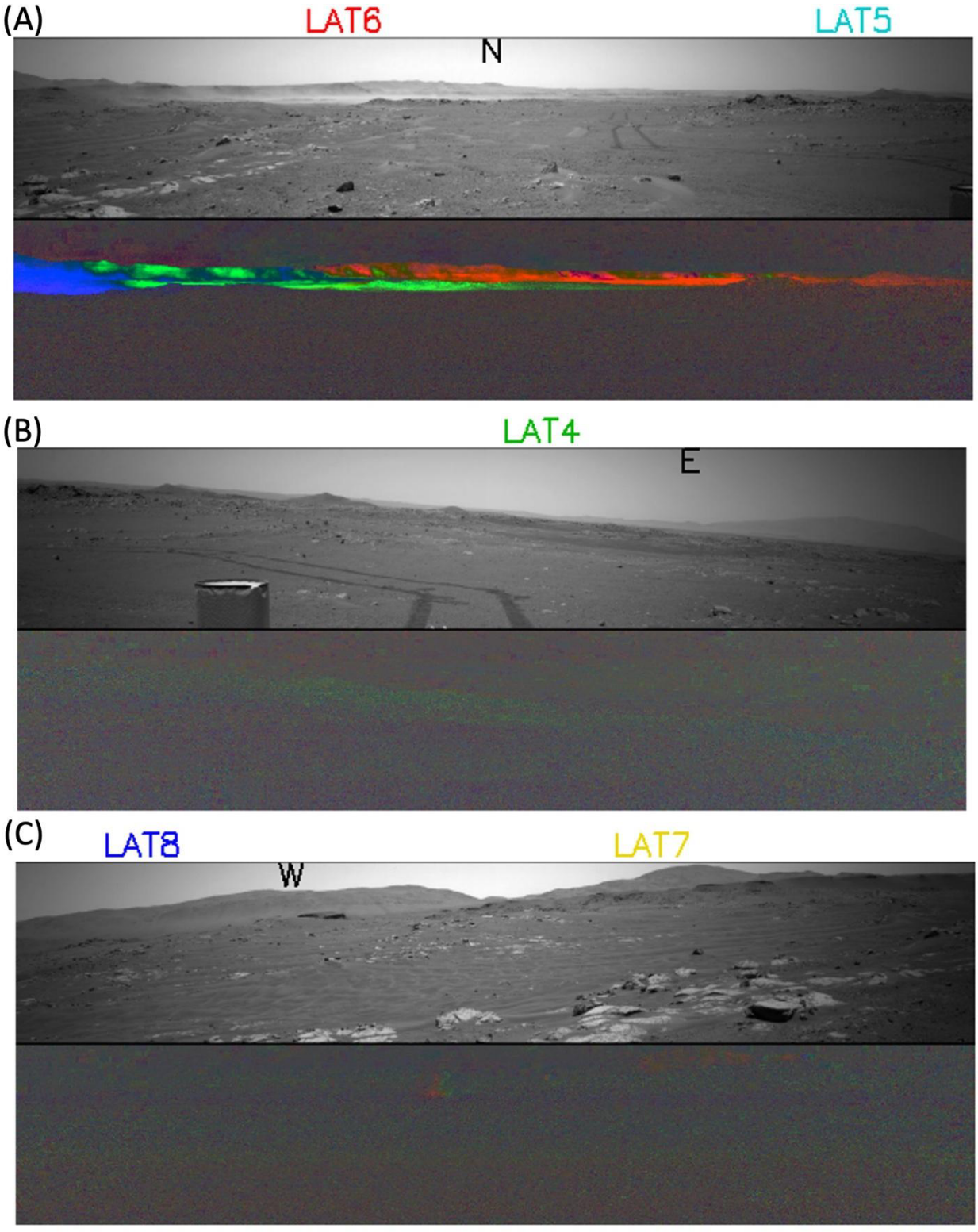

Fig. S2. Dust activity imaged on sol 117. Dust changes in the (A) first, (B) second, and (C) fifth image triplets of the sol 117 Navcam dust devil survey, centered at 0, 72, and 288° azimuth, respectively. For each set, the top shows triplet image three, while the bottom shows differences between the average of the triplet and triplet image one (red), two (green), and three (blue).

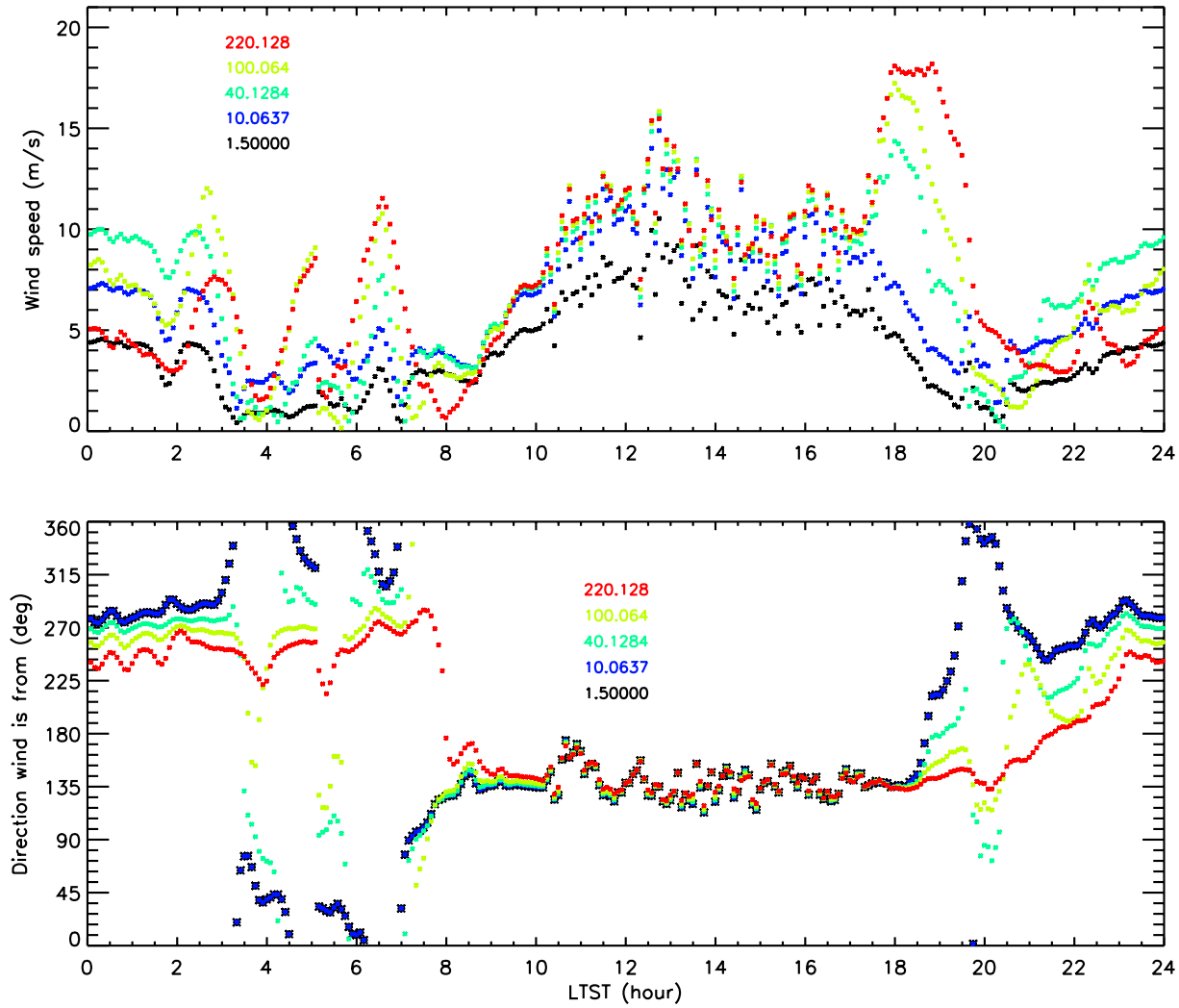

Fig. S3. Predicted wind variation with height at the time of the 'gust lifting' event. MarsWRF mesoscale model (top) wind speeds and (bottom) wind directions at five heights at Ls~60°, shown as a function of LTST over a typical sol at Ls~60°. Color labels indicate heights in m.

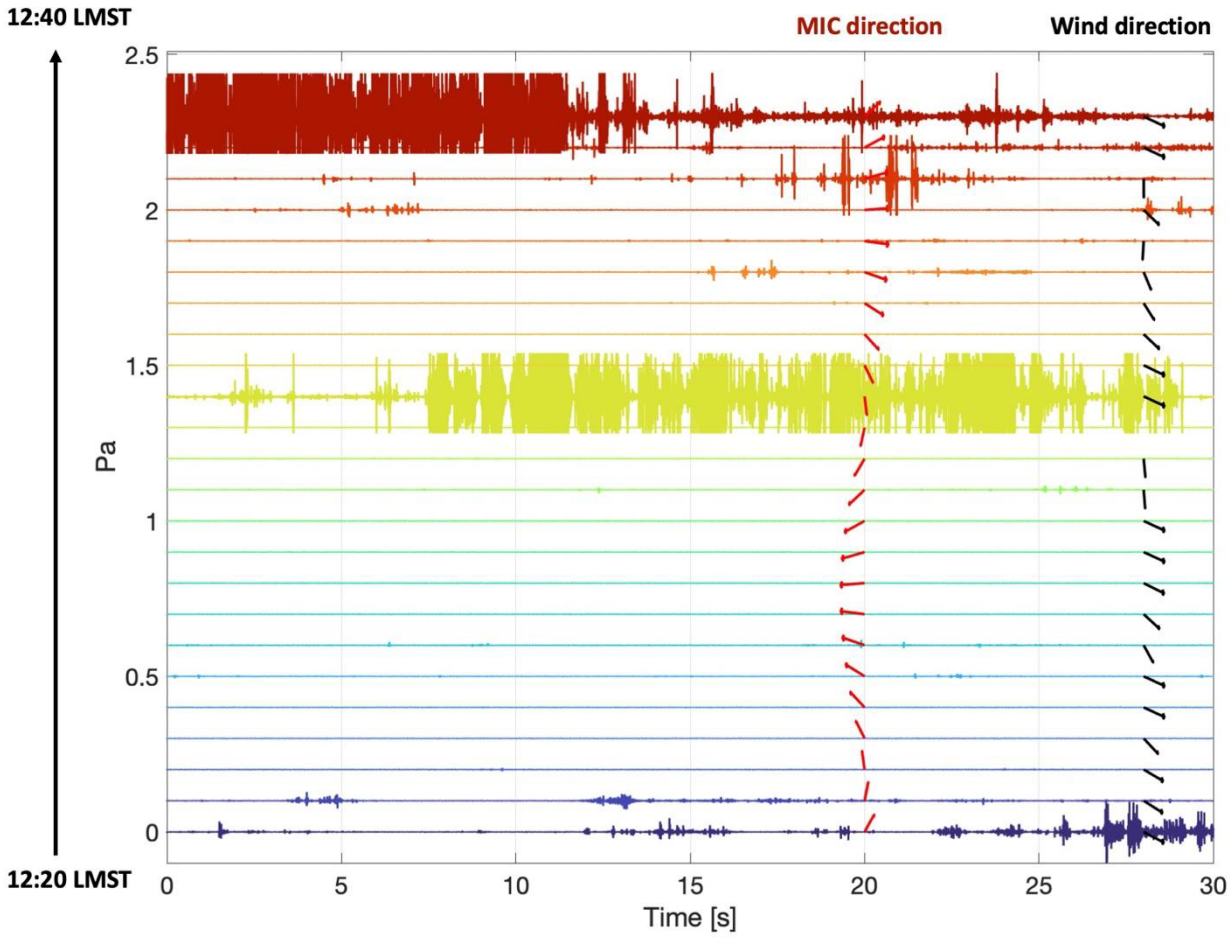

Fig. S4. SuperCam microphone data on sol 117. As part of a wind sensitivity characterization activity, 24 SuperCam microphone recordings lasting 30s each were taken over a 20 minute period on sol 117, ending 2 minutes prior to the sol 117 Navcam dust devil survey. Each line shows the signal for one complete recording, with each recording offset by 0.1 Pa. The first recording was made at ~12:20 LMST while the final recording was made at ~12:40 LMST. The activity was designed to look for any correlations between the direction in which the microphone was pointing (red arrows) and the direction of the incident wind measured by MEDA (black arrows), but results suggest such correlations are minimal and the signal is primarily due to the wind.

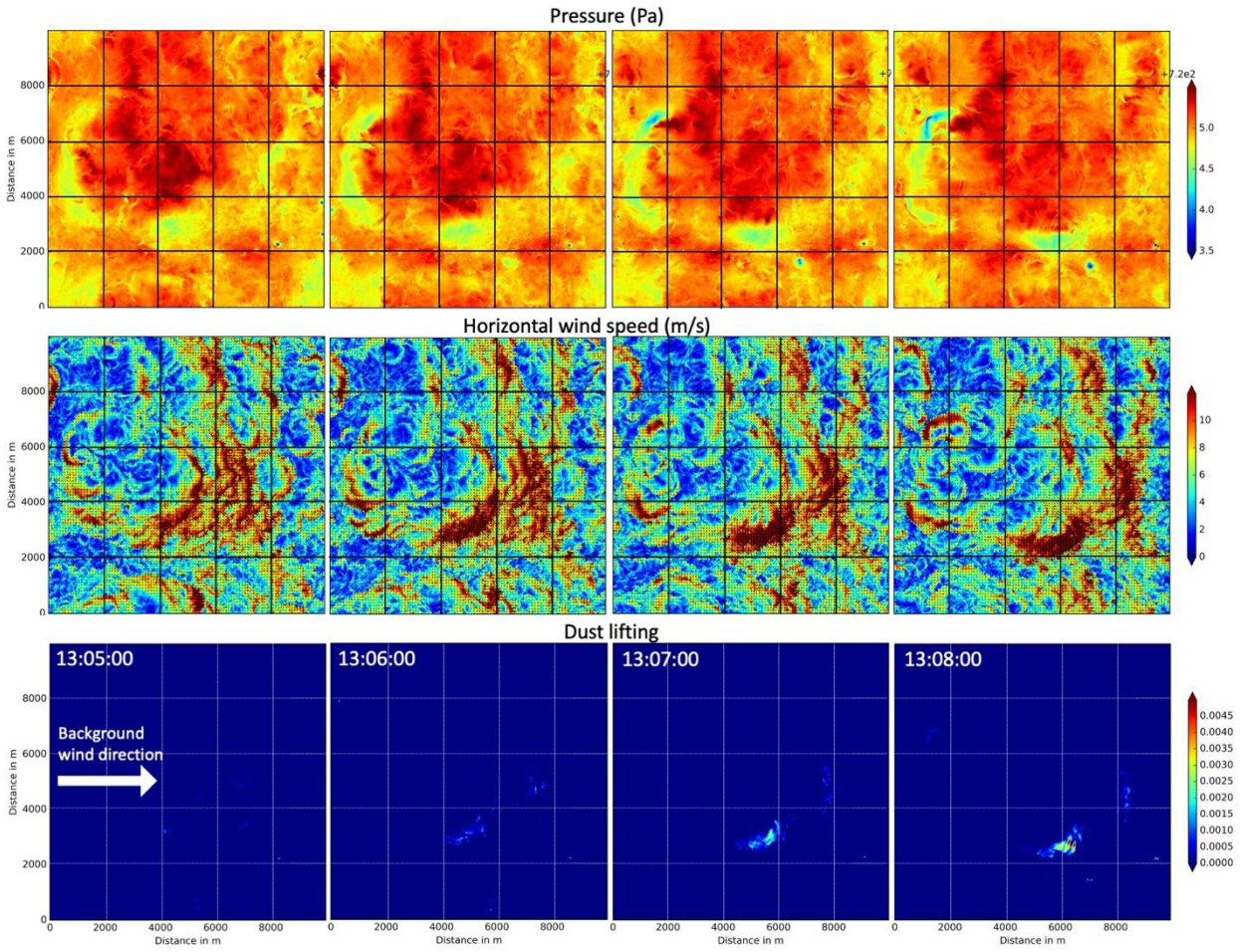

Fig. S5. Largest gust lifting event in a Large Eddy Simulation (LES) of Jezero crater. Surface fields of (top) pressure, (middle) horizontal wind speed and direction at 5m, and (bottom) raised dust flux, in an LES run for Jezero crater's location and surface properties at Ls~60° at 13:05, 13:06, 13:07, and 13:08 LTST (columns 1-4, respectively). The bottom right panel is shown rotated in Fig. 3C such that the imposed background wind direction matches that observed. Dust flux is calculated using a wind stress threshold of 0.008 Pa and the flux formulation of *(71)*.

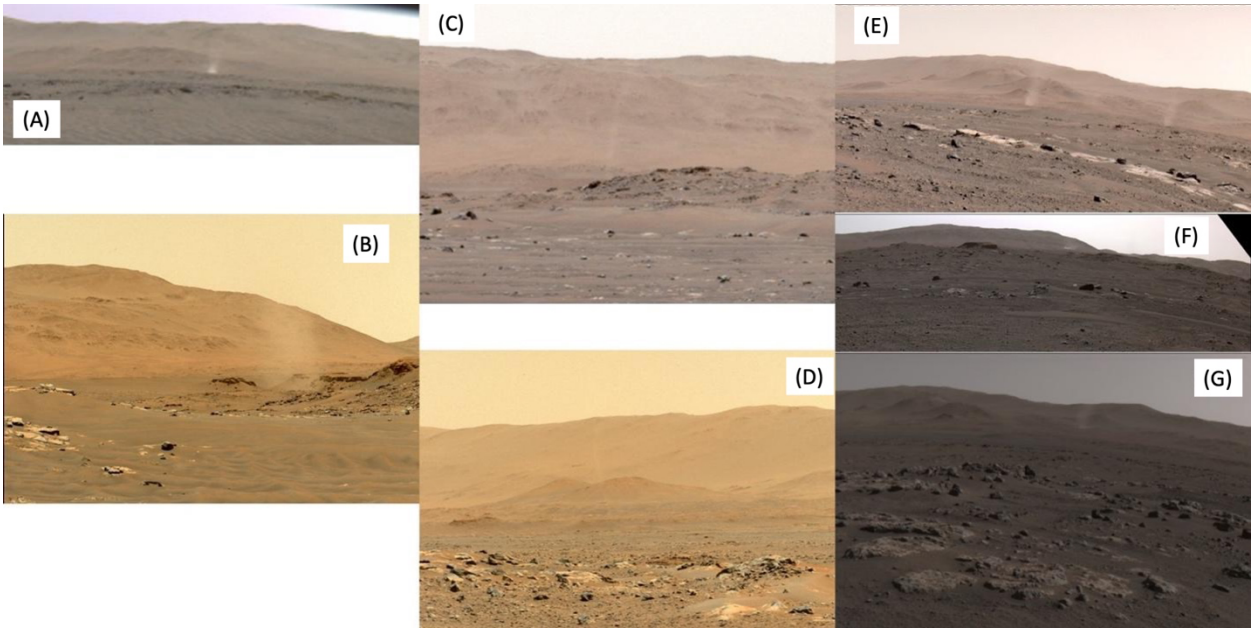

Fig. S6. Crops of dust devils seen in panoramic and drive-direction imaging. (A) Front Hazcam image FLF_0135_0678933320_513CWS_N0051388FHAZ02002_0A0295J04; (B) Mastcam-Z image ZLF_0114_0677061553_832CWS_N0041062ZCAM08094_0630LMJ01; (C) Navcam image NRF_0052_0671559358_448CWS_N0031950NCAM00409_0A00LLJ01; (D) Mastcam-Z image ZLF_0114_0677061420_832CWS_N0041062ZCAM08094_0630LMJ01; (E) Navcam image NRF_0113_0676976848_167CWS_N0041034NCAM00310_0A0195J01; (F) Navcam image NRF_0113_0676982584_199CWS_N0041062NCAM03113_0A0195J01; (G) Navcam image NRF_0129_0678403356_559CWS_N0042222NCAM03129_0A1195J02.

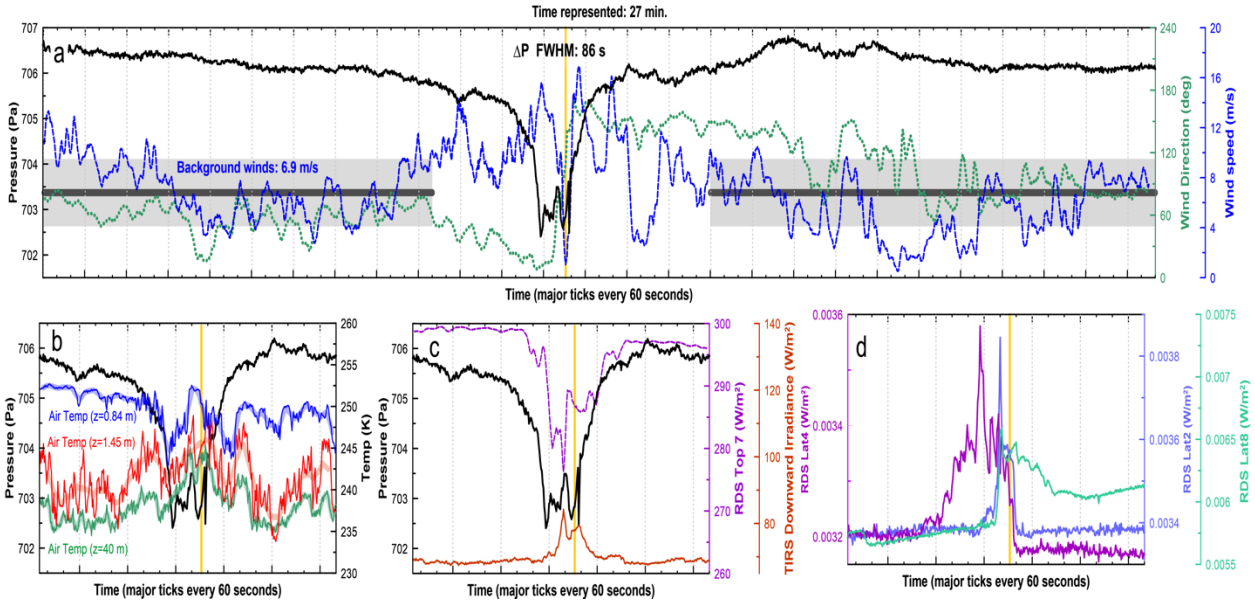

Fig. S7. Sol 184 long duration vortex passage detected in all MEDA sensors. (A) Pressure, wind speed, and wind direction. (B) Pressure and air temperature at different heights. (C) pressure, RDS top, and TIRS downward radiance. (D) RDS lat 4, 2, and 8. The yellow vertical line indicates the moment of closest approach of the vortex core, as indicated by wind speed dropping to almost zero and a rapid change in wind direction. Also shown as an example of how we infer the approximate vortex diameter based on duration of the encounter and ambient MEDA wind speed over the surrounding period. The shaded area shows the time period used to estimate background wind speed, which is ~7 ms^{-1} as shown by the thick black horizontal line. The duration at FWHM is 86 s, hence the estimated diameter is approximately 86 x 7 ~ 600 m.

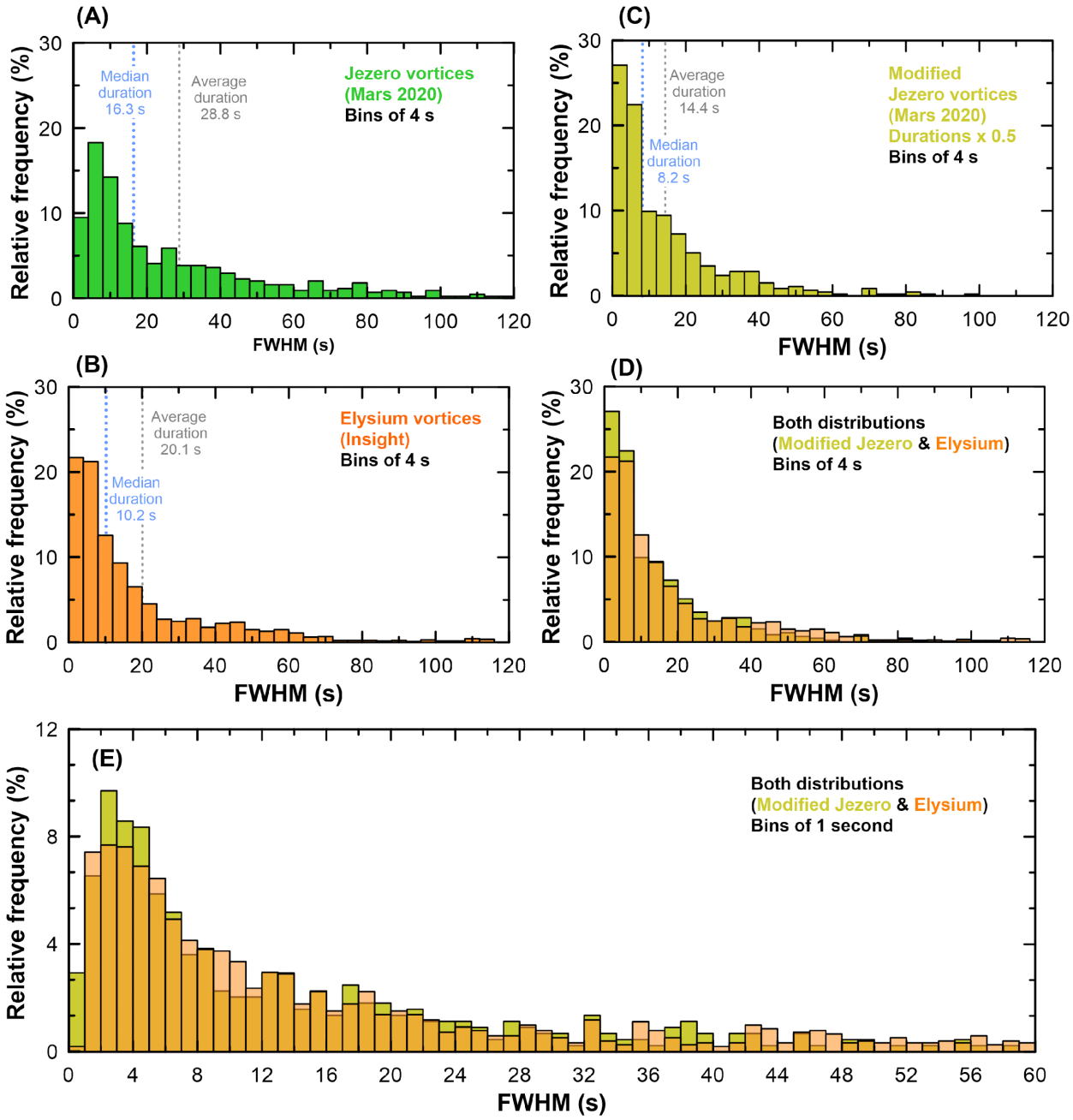

Fig. S8. Comparison of vortex durations at Perseverance and InSight. The duration of daytime vortex pressure drops detected in (A) Mars 2020 MEDA and (B) InSight APSS pressure data, showing the shift to longer durations at Perseverance's location in Jezero crater than at InSight's in Elysium Planitia. (C) shows an effort to compensate for the 'observer effect' (see main text) by multiplying the Jezero crater detections by 0.5, based on a mean daytime background wind speed that is approximately half as large at Mars 2020 as at InSight in this season. (D) and (E) show that the modified distribution of Mars 2020 durations is very similar to those observed by InSight, implying a similar distribution of inferred diameters.

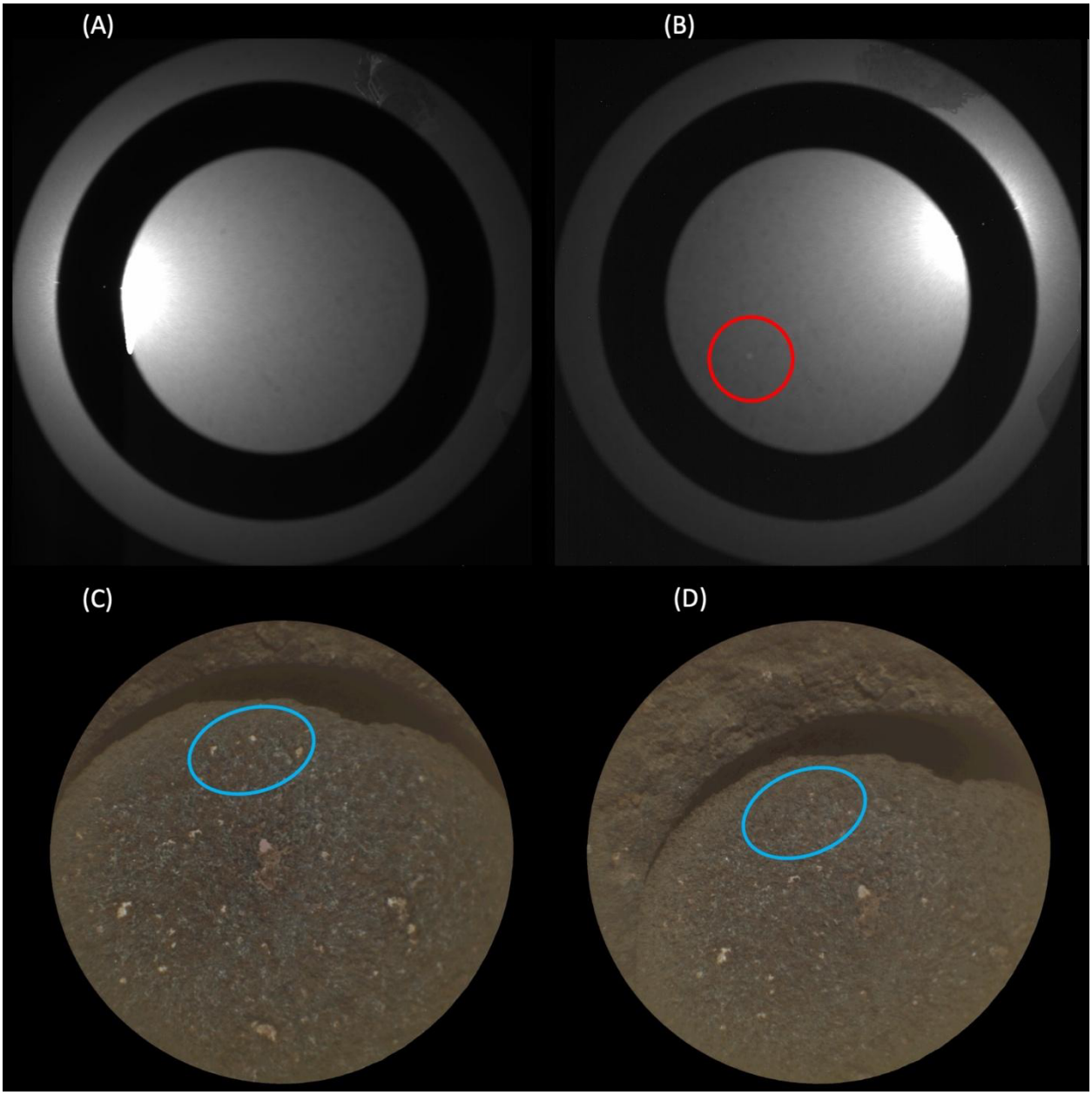

Fig. S9. Rover deck and surface changes on sol 188. (A) and (B): A grain (inside red circle) appears on the lens of the MEDA-Skycam camera, which faces upward on the rover deck, between two Skycam images taken at (A) 08:41 and (B) 14:48 LMST on sol 188. (C) and (D) SuperCam RMI images taken at (C) 12:05 and (D) 12:42 LMST on sol 188, showing the Bellegarde abrasion area. Tailings move between the frames, especially covering some of the top of the abrasion (region inside blue ellipse). Two large vortices with very strong associated winds (Fig. 6C,D) passed over the rover on this sol, one at 12:27 and one at 12:50 LMST, and likely produced these changes.

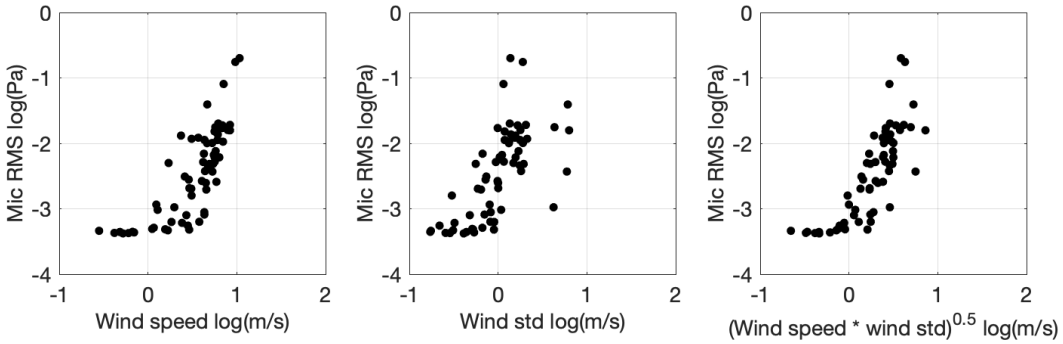

Fig. S10. Correlations between microphone signal and MEDA wind data. Scatter plots of the root mean square (RMS) of the SuperCam microphone signal in the 10-50Hz bandwidth and the wind speed, wind standard deviation and product of the wind speed and standard deviation (left to right). The wind speed data are from MEDA boom 1.

<Movie uploaded separately>

Movie S1. Predicted wind speed (shaded contours) and direction (arrows) over one complete sol at Ls~60° for the Jezero crater region (topography shown as black contours), from the innermost nest of the MarsWRF simulation described in Materials and Methods.

<Movie uploaded separately>

Movie S2. Navcam movie from sol 148 showing dancing dust devils in Jezero crater.

Data S1. (separate file)

Vortex detections in Mars 2020 MEDA pressure data for pressure drops (compared to a linear fit) exceeding 0.5 Pa, up to sol 216 of the mission, which includes data covering the period Ls~13-105°. The file contains event time (in Ls, mission sol, LMST, and LTST), amplitude, duration, percent decrease in RDS top 7 (if >0.5% during the pressure drop), max wind speed (if available), mean and standard deviation of background wind speed and direction. These data are plotted in Fig. 8A-D,F.

Data S2. (separate file)

Vortex detections in InSight APSS pressure data for pressure drops (compared to a linear fit) exceeding 0.5 Pa, for the same Ls range, including event time (in Ls, mission sol, LMST, and LTST), amplitude, duration, max wind speed, mean and standard deviation of background wind speed and direction. These data are plotted in Fig. 8E,F.

Data S3. (separate file)

Mars 2020 MEDA RDS top7 signal decreases exceeding 0.4%, with 3-sigma confidence and lasting at least 4 seconds, in the first 200 mission sols. No lat sensor detections are shown. These data are used to corroborate the RDS top7 signal decreases associated with pressure drops, which are shown in Data S1 and plotted in Fig. 8B,C,D.

Data S4. (separate file)

Data on identification of orientation of wind tails and ventifacts over the first 216 sols of the mission.