

Martian Dust Devils: A Multi-Sensor Analysis

COMPREHENSION • VOCABULARY • DISCUSSION

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Reading Passage

Read the passage carefully. Each paragraph is labelled with a letter for easy reference.

A Dust devils (convective vortices loaded with dust) are common at the surface of Mars, particularly at Jezero crater, the landing site of the Perseverance rover. They are indicators of atmospheric turbulence and are an important lifting mechanism for the Martian dust cycle. Improving our understanding of dust lifting and atmospheric transport is key for accurate simulation of the dust cycle and for the prediction of dust storms, in addition to being important for future space exploration as grain impacts are implicated in the degradation of hardware on the surface of Mars. Here we describe the sound of a Martian dust devil as recorded by the SuperCam instrument on the Perseverance rover. The dust devil encounter was also simultaneously imaged by the Perseverance rover's Navigation Camera and observed by several sensors in the Mars Environmental Dynamics Analyzer instrument. Combining these unique multi-sensorial data with modelling, we show that the dust devil was around 25 m large, at least 118 m tall, and passed directly over the rover travelling at approximately 5 m s^{-1} . Acoustic signals of grain impacts recorded during the vortex encounter provide quantitative information about the number density of particles in the vortex. The sound of a Martian dust devil was inaccessible until SuperCam microphone recordings. This chance dust devil encounter demonstrates the potential of acoustic data for resolving the rapid wind structure of the Martian atmosphere and for directly quantifying wind-blown grain fluxes on Mars.

Vocabulary Glossary

Key words and phrases from the passage. Study them before attempting the exercise below.

WORD / PHRASE	DEFINITION	EXAMPLE SENTENCE
vortices	spinning movements of air or water, like small whirlwinds	<i>The airplane flew into a dangerous zone of strong vortices.</i>
turbulence	irregular and violent movements of air or water	<i>The plane experienced turbulence during the storm.</i>
simulation	a copy or imitation of something real, often using a computer	<i>The flight simulation helped pilots practice flying.</i>
degradation	the process of something becoming worse or less valuable	<i>The old car showed signs of degradation over time.</i>
encounter	an unexpected meeting or experience with something	<i>They had a strange encounter with a wild animal in the forest.</i>
quantitative	related to measuring or counting things numerically	<i>Scientists collected quantitative data on the rainfall over the year.</i>
fluxes	flows or movements of something, often measured over time	<i>The river's fluxes change with the seasons.</i>
acoustic	related to sound or hearing	<i>The acoustic guitar sounded beautiful in the small room.</i>

Vocabulary Exercise — Fill in the Blank

Use one word or phrase from the glossary above to complete each sentence. Each item is used only once. Answers are on the final page.

1. During the storm, the airplane faced strong _____, making the flight bumpy.
2. The engineer ran a _____ to test how the new bridge would hold up.
3. The scientist recorded the _____ of water through the dam to study its effects.
4. The _____ data showed a clear increase in temperature over the decade.
5. We had an unexpected _____ with a famous actor at the cafe.
6. The _____ signals from the microphone helped researchers understand the noise levels in the area.

Comprehension Questions

These questions are different from the online practice test. Choose the best answer (A, B, C, or D). Answers and explanations are on the final page.

Question 1

What main benefit does recording the sound of a Martian dust devil provide?

- A. It helps understand the rapid wind structure on Mars.
- B. It allows for better imagery of the Martian surface.
- C. It improves the performance of the Perseverance rover.
- D. It enables scientists to communicate with Earth better.

Question 2

Why are grain impacts important in the context of Martian dust devils?

- A. They are used to measure the size of dust devils.
- B. They provide information on the number of particles in the vortex.
- C. They protect the rover from damage.
- D. They cause the dust devils to form.

Question 3

How does the passage describe the movement of the dust devil over the rover?

- A. It hovered in place for a while.
- B. It moved erratically in different directions.
- C. It passed directly over the rover at a steady speed.
- D. It circled the rover multiple times.

Question 4

What is one purpose of improving the simulation of the Martian dust cycle?

- A. To enhance the visual quality of Mars images.
- B. To improve the prediction of dust storms.
- C. To make Mars more suitable for human life.
- D. To help the rover travel faster on Mars.

Question 5

What was unique about the data collected from the dust devil encounter?

- A. It was the first time a dust devil was seen on Mars.
- B. It combined multiple sensors and acoustic recordings.
- C. It showed that dust devils do not occur at Jezero crater.
- D. It was the longest recorded dust devil on Mars.

Discussion & Writing Prompts

Each prompt references a specific detail from the passage above. Use for classroom discussion or a short written response (150–200 words).

1. The passage mentions that grain impacts are implicated in the degradation of hardware on Mars. How might this affect future Mars missions and the design of equipment?

2. According to the passage, the dust devil encountered by the Perseverance rover was about 25 meters large. How do you think the size of such phenomena impacts scientific research on Mars?

3. The passage describes the use of acoustic signals to study Martian dust devils. What are some other innovative methods that could be used to study extraterrestrial weather phenomena?

Answer Key

COMPREHENSION QUESTIONS

Q1 A

Q2 B

Q3 C

Q4 B

Q5 B

VOCABULARY EXERCISE

FIB1 turbulence

FIB2 simulation

FIB3 fluxes

FIB4 quantitative

FIB5 encounter

FIB6 acoustic

Comprehension Question Explanations

Why the correct answer is right — and why each wrong option is incorrect.

1. What main benefit does recording the sound of a Martian dust devil provide?

✓ A — It helps understand the rapid wind structure on Mars.

The passage explains how acoustic data helps resolve the rapid wind structure of the Martian atmosphere.

✗ B — It allows for better imagery of the Martian surface.

Imagery is not related to sound recordings.

✗ C — It improves the performance of the Perseverance rover.

The performance of the rover is not discussed in relation to sound.

✗ D — It enables scientists to communicate with Earth better.

Communication with Earth is not mentioned in the context of recording sound.

2. Why are grain impacts important in the context of Martian dust devils?

✓ B — They provide information on the number of particles in the vortex.

The passage states that grain impacts provide quantitative information about the number density of particles in the vortex.

✗ A — They are used to measure the size of dust devils.

Grain impacts are not used to measure the size of dust devils.

✗ C — They protect the rover from damage.

Grain impacts do not protect the rover.

✗ D — They cause the dust devils to form.

Grain impacts do not cause dust devils to form.

3. How does the passage describe the movement of the dust devil over the rover?

✓ C — It passed directly over the rover at a steady speed.

The passage notes that the dust devil passed directly over the rover at approximately 5 m/s.

✗ A — It hovered in place for a while.

The dust devil did not hover in place.

✗ B — It moved erratically in different directions.

There is no mention of erratic movement.

✗ D — It circled the rover multiple times.

It did not circle the rover multiple times.

4. What is one purpose of improving the simulation of the Martian dust cycle?

✓ B — To improve the prediction of dust storms.

The passage states that better simulation helps in the prediction of dust storms.

✗ A — To enhance the visual quality of Mars images.

Improving visual quality is not mentioned.

✗ C — To make Mars more suitable for human life.

Making Mars suitable for human life is not discussed.

✗ D — To help the rover travel faster on Mars.

There is no mention of helping the rover travel faster.

5. What was unique about the data collected from the dust devil encounter?

✓ B — It combined multiple sensors and acoustic recordings.

The passage highlights the combination of multi-sensorial data and acoustic recordings as unique.

✗ A — It was the first time a dust devil was seen on Mars.

Dust devils have been seen on Mars before.

✗ C — It showed that dust devils do not occur at Jezero crater.

The passage confirms dust devils do occur at Jezero crater.

✗ D — It was the longest recorded dust devil on Mars.

There is no mention of it being the longest recorded dust devil.

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