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How Do Martian Dust Devils Vary Throughout the Sol? (abstract)

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How Do Martian Dust Devils Vary Throughout the Sol?

Chapman, R. M., Lewis, S. R. L., Balme, M., Steele, L. J.

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Dust devils are vortices of air made visible by entrained dust particles. Dust devils have been observed on Earth and captured in many Mars lander and orbiter images. Martian dust devils may be important to the global climate and are parameterised within Mars Global Circulation Models (MGCMs). We show that the dust devil parameterisation in use within most MGCMs results in an unexpectedly high level of dust devil activity during morning hours.

In contrast to expectations, based on the observed behaviour of terrestrial dust devils and the diurnal maximum thermal contrast at the surface, we find that large areas of the modelled Martian surface experience dust devil activity during the morning as well as in the afternoon, and that many locations experience a peak in dust devil activity before mid-sol.

Using the UK MGCM, we study the amount of surface dust lifted by dust devils throughout the diurnal cycle as a proxy for the level of dust devil activity occurring. We compare the diurnal variation in dust devil activity with the diurnal variation of the variables included in the dust devil parameterisation. We find that the diurnal variation in dust devil activity is strongly modulated by near-surface wind speeds. Within the range of daylight hours, higher wind speeds tend to produce more dust devil activity, rather than the activity simply being governed by the availability of heat at the planet's surface, which peaks in early afternoon.

We compare our results with observations of Martian dust devil timings and obtain a good match with the majority of surface-based surveys. We do not find such a good match with orbital observations, but these data tend to be biased in their temporal coverage.

We propose that the generally accepted description of dust devil behaviour on Mars is incomplete, and that theories of dust devil formation may need to be modified specifically for the Martian environment. Further dust devil observations are required to support any such modifications.