

A story for major dust storm on Mars

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This is a story for a generic major dust storm on Mars. It is an abstraction of the dust storms observed in Mars Daily Global Maps (MDGMs) during MY 24 –32. Major dust storms both influence and are influenced by atmospheric circulation. This interaction results in a peculiar seasonality for both the global dust distribution and the strength of various circulation components. There are numerous changes and mechanisms involved in this process. This presentation touches upon a few aspects.

A generic major dust storm usually starts from a series of frontal/flushing dust storms near the edge of the north polar cap on a daily basis in early/mid fall or mid/late winter. During this time period, there are strong near-surface baroclinic eddies that are typically dominated by zonal wavenumber $m = 3$ traveling waves. Then, dust advances across the equator to the southern hemisphere through low topography channels of Acidalia, Utopia or Arcadia. Next, dust expands zonally in the southern hemisphere following a few common trajectories. At the same time, the Hadley circulation intensifies, near-surface baroclinic eddies weaken, frontal/flushing events cease, westward traveling waves arise, along with many other changes. In a sense, a westward traveling wave appears to be as good an indicator of the occurrence of a major dust storm as a temperature increase in the middle atmosphere. Consequently, westward traveling wave is among the signature responses of the atmosphere to a major dust storm, though the amplitude of westward traveling wave is not linearly related to the size of dust storm. Eventually, dust dissipates and the atmosphere returns to its climatological condition, completing the sequence of events.

The length and extent of each development stage of a sequence can vary substantially. Some exhibit large deviations from the norm, others fail to complete the whole process. These will be discussed with examples.

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