Appendix

We present here a glossary of the terms used in this manuscript for easy reference.

Dust Storm Instance: We define a "dust storm instance" to be an individual cloud of dust as observed in a single MDGM. The "instance" is the dust cloud as imaged at one moment in time. Since a dust storm instance is defined to be a snapshot of an individual dust storm, it contains no information about the time evolution of the storm. The dust storm instance is the simplest *observational* "atomic" unit of the MDSSD dataset.

Individual Dust Storm: We define an "individual dust storm" to be an individual cloud of dust that has been captured in MDGM images over one or more consecutive sols. As such, an "individual dust storm" is comprised of one or more "dust storm instances" in the MDSSD dataset. If the "individual dust storm" consists of only one "dust storm instance", then the instance has a unique dust storm identification number (Storm ID). If the individual dust storm consists of several instances over consecutive sols, then the collection of dust storm instances corresponding to the individual dust storm are all labeled with the same Storm ID. Since it is most common to conceptualize a "dust storm" as an individual cloud of dust that persists in the atmosphere for a finite interval of time, the "individual dust storm" is the element of the MDSSD that is closest to this intuitive definition of an individual dust storm cloud. Similarly, if an "individual dust storm" is thought of as a movie covering the lifetime of an individual dust cloud, then each "dust storm instance" is a frame in that movie. Note that an individual dust storm keeps its identity (Storm ID) throughout its lifetime. An individual dust storm can be of any size and duration. In the MDSSD, a new Storm ID is assigned on the first sol that a new individual dust storm is identified in a MDGM. If the individual dust storm persists in subsequent MDGMs, the same Storm ID is carried across those subsequent dust storm instances. If the individual dust storm cannot be identified on the next sol, then the Storm ID will not be used again in MDSSD. Thus, a Storm ID is equivalent to a Lagrangian tracer for an individual dust storm. While identification of dust storm instances can be done using a single image, identification of an individual dust storm requires a time series of images. Some individual dust storms may only have been observed in one frame of the time series, while other individual dust storms were observed in multiple frames.

Dust Storm Member: While some individual dust storms exist in isolation, many are observed to form and dissipate in a spatial and/or temporal relationship with other individual dust storms. If we find these relationships within the dataset, we define a "dust storm sequence" (see below). A "dust storm member" is then defined to be an individual dust storm that is part of this larger sequence. Thus, "dust storm members" are a subset of the family of "individual dust storms." Note that this definition of dust storm member is slightly different from that used in Battalio and Wang [2021].

Dust Storm Sequence: We define a dust storm sequence as an organization of dust storm members that occur close enough in time and/or space to each other such that they maintain a coherent spatial trajectory and temporal development history. Observationally, a dust storm sequence can only be identified from the evolution evidenced in a timeseries of images and cannot be determined on the basis of a single image. When a collection of "individual dust storms" are found to collectively constitute a "dust storm sequence", each of the "individual dust storms" becomes a member of the sequence and is given an additional Sequence ID in addition to their Storm ID. The Sequence ID is the same for all members of the same sequence. In the MDSSD, a dust storm

member has both a Storm ID and a Sequence ID, while an isolated individual dust storm only has a Storm ID.

Dust Storm Episode: A "dust storm episode" is the largest superset of emerging storm behavior discussed in this paper. Dust storm episodes are typically identified by the presence of a large peak in the time series of the daily total storm area over the whole planet. In this paper, a dust storm episode is defined as having a peak area larger than $7x10^6$ km^2 (roughly 5% of the total planetary surface area) and a duration of -longer than 5 sols. In the very largest of dust events, the increase in atmospheric dust opacity is often associated with the action of concurrent or consecutive dust storm sequences. These may be sequences that occur in different regions but appear to interact, or they may be other parallel occurrence of sequences that cumulatively elevate the atmospheric dust opacity.

Pseudo-Seasons or "Sextons": Dust storm (and other climate) behavior suggests a division of the Martian year into six variable duration intervals. We coin the term "sexton" for each of these intervals (Unober, Duober, Triober, Quartober, Quintober, Sextober), in a simplistic analogy with the terrestrial month. In practice, seasonal groupings of months (like June-July-August, or JJA) are often used in terrestrial climate science, and the sextons defined here are perhaps most directly analogous with those. However, instead of being based on the Martian orbit, sextons are defined from the outset as intervals within which there are similar patterns of dust storm behavior, and between which the behavior can be quite different. Specifically, the boundaries, though not strict, are defined in terms of distinct behavior of dust storm activity. As dust is a major factor in the Martian climate, sextons can also help categorize and describe the climate system as a whole, including separating intervals of distinct behavior of large-scale water ice cloud features. More details are provided in Table 1 below.

Pseudo-season (Sexton) Name	Ls Interval	Typical Dust Storm and Cloud Events in MDGMs	Related Name
Unober (1^{st})	0°-70°	Individual dust storms near both north and south polar caps, occasional noticeable dust storm sequences from southern high latitudes towards southern low latitudes. South polar hood increases, north polar hood decreases.	-
Duober (2^{nd})	70°-135°	North polar population of individual dust storms, generally quiescent dust activity elsewhere. South polar hood, north polar arc-shaped or spiral clouds, prominent tropical cloud belt.	-
Triober (3^{rd})	135°-185°	Individual dust storms near both north and south polar caps, occasional large dust storm episodes with southern hemisphere origins. North polar hood formation, south polar hood dissipation.	"Z"
Quartober (4^{th})	185°-245°	Large dust storm episodes typically originating from the northern hemisphere, dusty background. North polar hood.	"A"
Quintober (5^{th})	245°-295°	South polar population of individual dust storms, generally quiescent dust activity elsewhere, dusty background.	"B"

		North polar hood.	
Sixtober or Sextober (6th)	295°-360°	Large dust storm episodes typically originating from the northern hemisphere, dusty background. South polar hood formation, north polar hood.	"C"