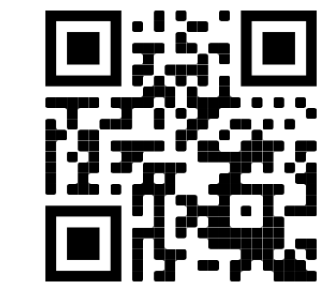


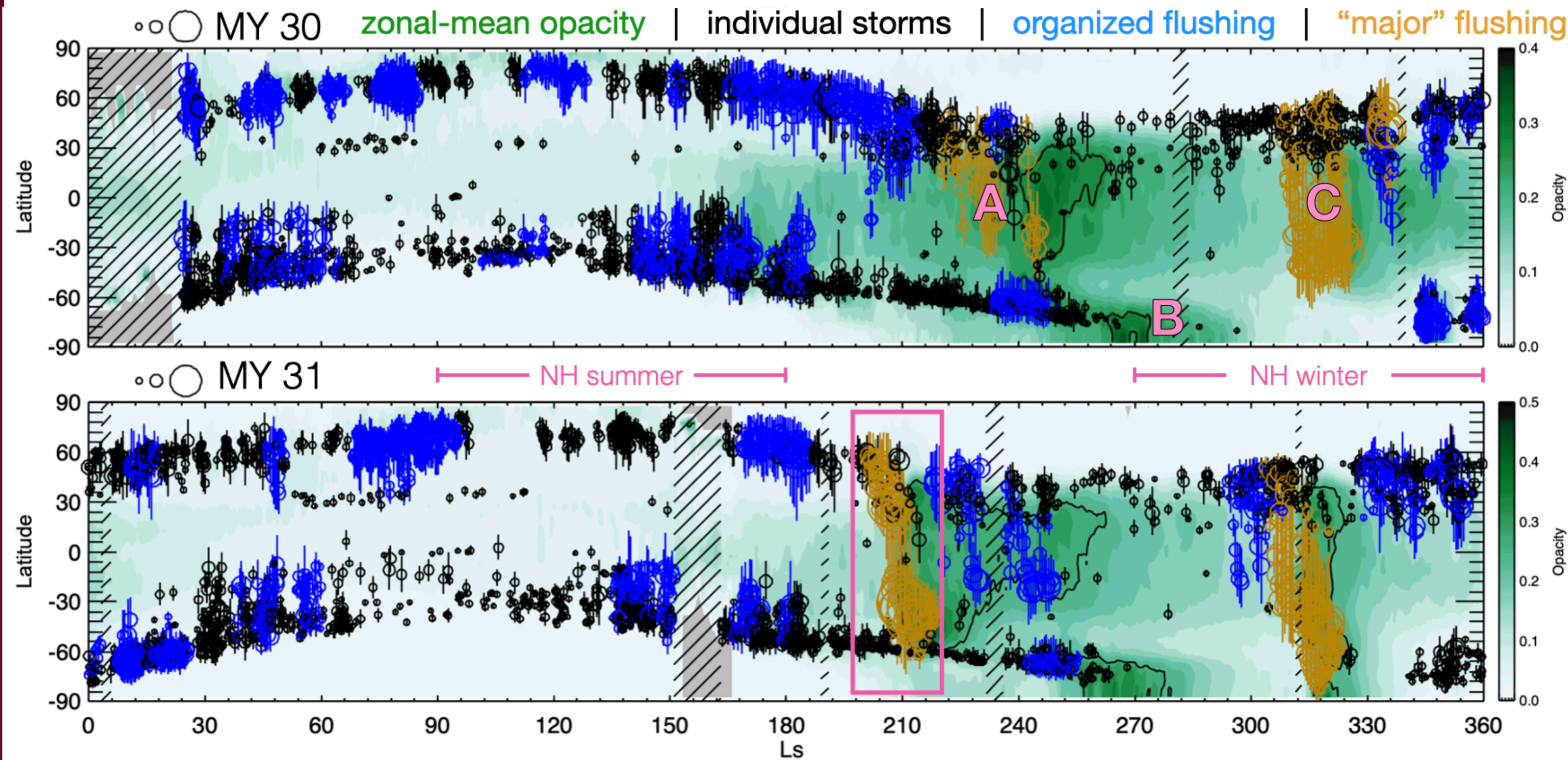
Atmospheric Blocking Precedes Flushing Dust Storms on Mars

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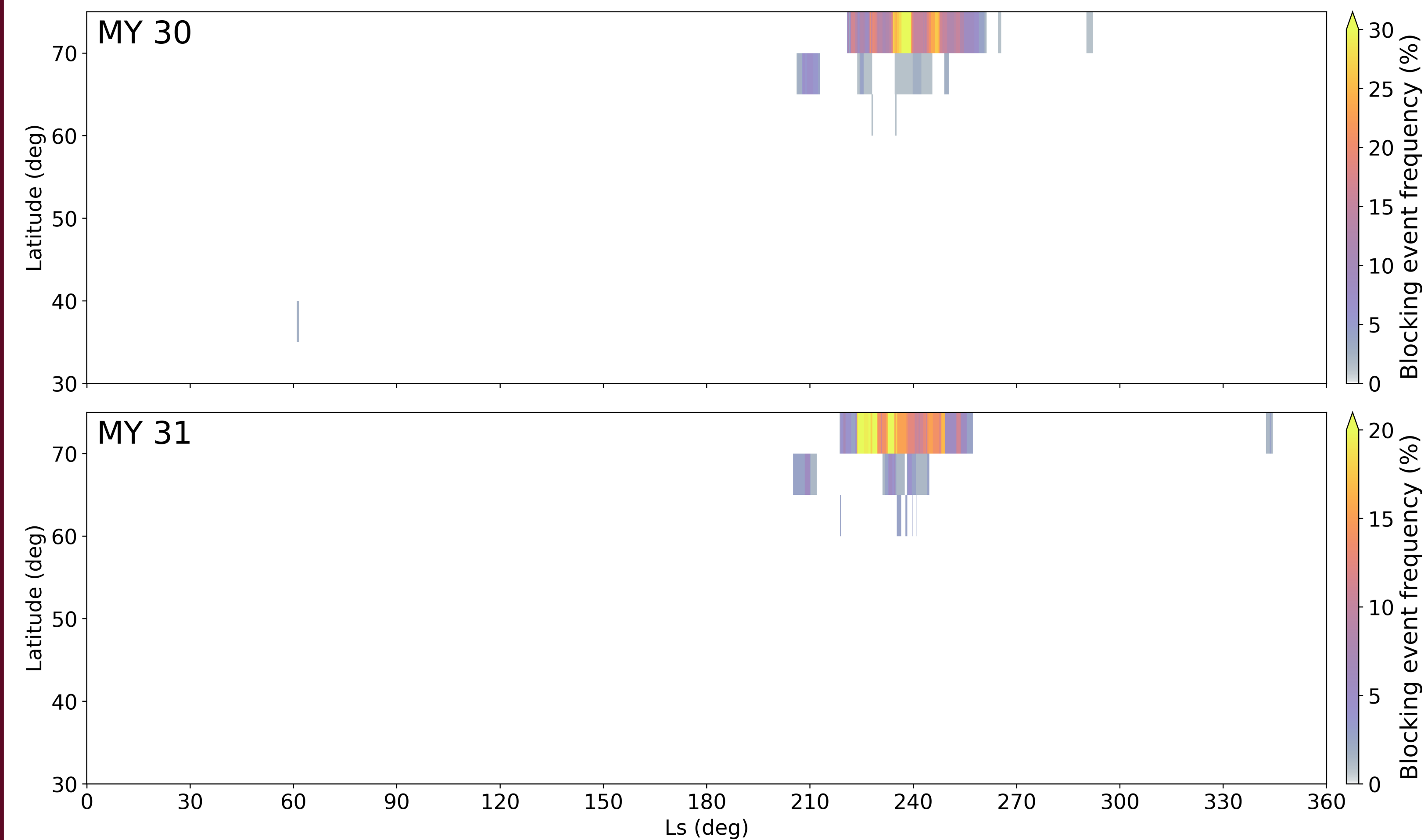
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1 Mars's storm tracks induce widespread dust activity that can "flush" from the North to South Hemisphere.



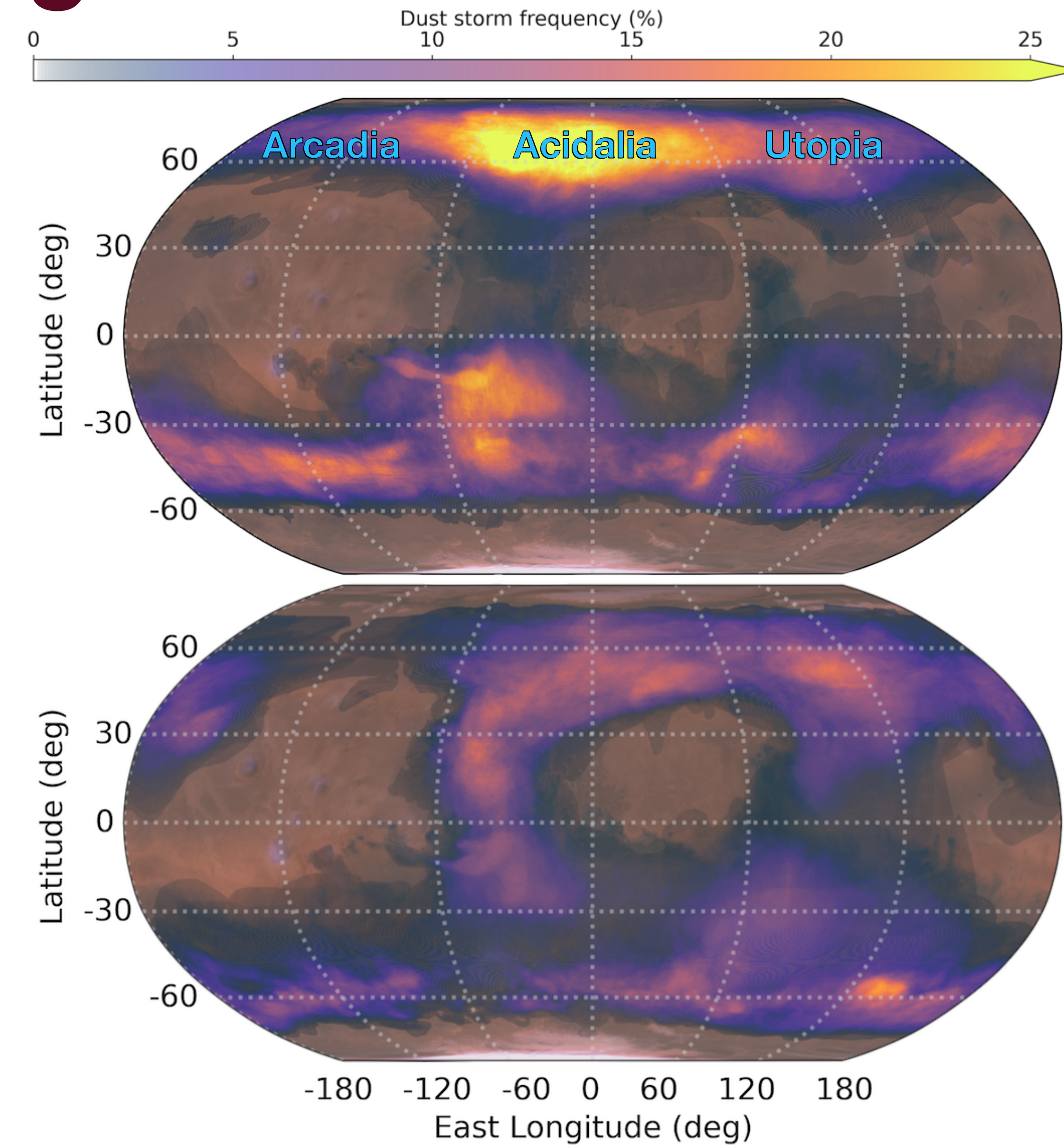
Seasonality of dust storms for two Mars Years (MY). Dust storms initiate along the edge of the polar ice caps and sometimes unpredictably cross the equator, called "flushing." Circles indicate position of individual dust storms, with the legend denoting 1e6, 5e6, and 1e7 km². The three main types of storms, "A," "B," and "C" are labeled in MY 30. The magenta box outlines the period of the case study in poster panels 5 and 6. L_s is areocentric longitude, a measure of time of year; northern summer and winter are noted [Battalio & Wang, 2021].

2 Large-scale Blocking Events occur before "A" storms flush each Mars Year, poleward of the dust storms.



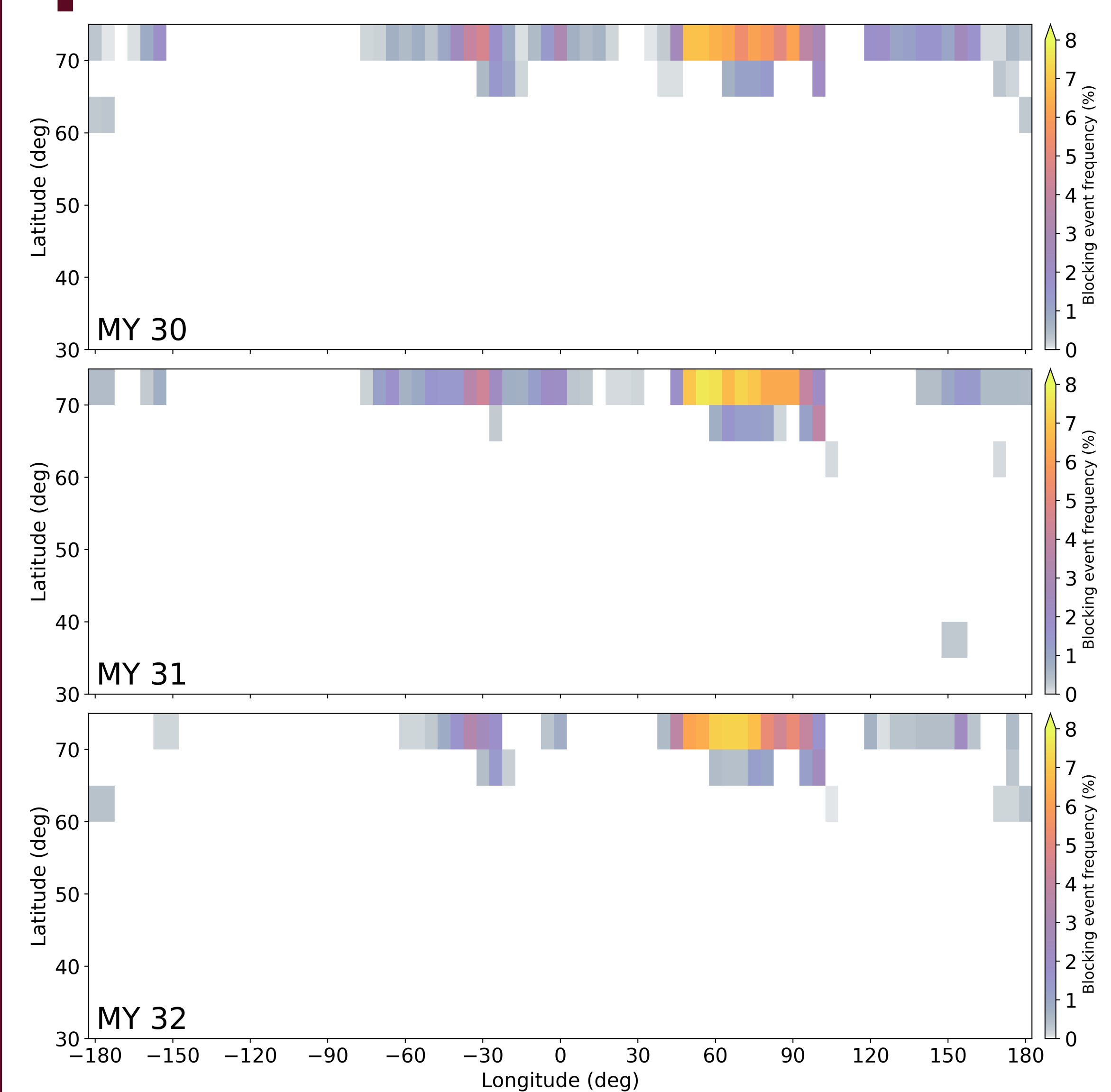
Frequency of large-scale blocking events in Mars Year 30 (top) and 31 (bottom) according to time of year. Blocks are identified using the Ensemble Mars Reanalysis System [Greybush et al., 2019] using the ϕ reversal criteria from Davini et al. [2012] at a pressure level of 200 Pa.

3 Dust storms occur in northern lowlands.



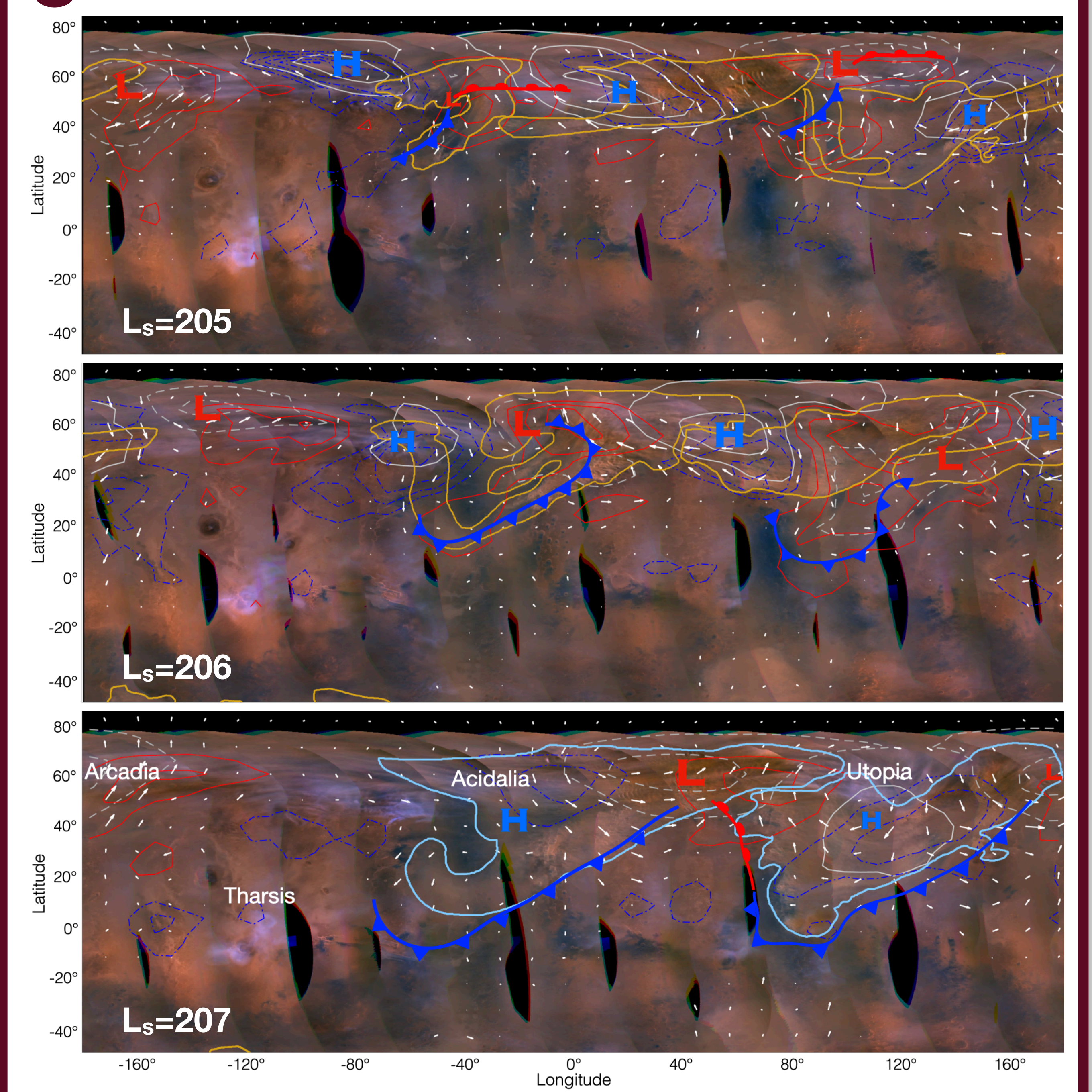
Dust storm frequency in two seasons over 8 years from the Mars Dust Activity Database (MDAD). Frequency during "Triober" ($L_s=135-185^\circ$, top) and "Quartober" ($L_s=185-245^\circ$, bottom). The three main initiation regions are labeled in light blue [Battalio et al. 2023].

4 Blocking spatially aligns with dust.



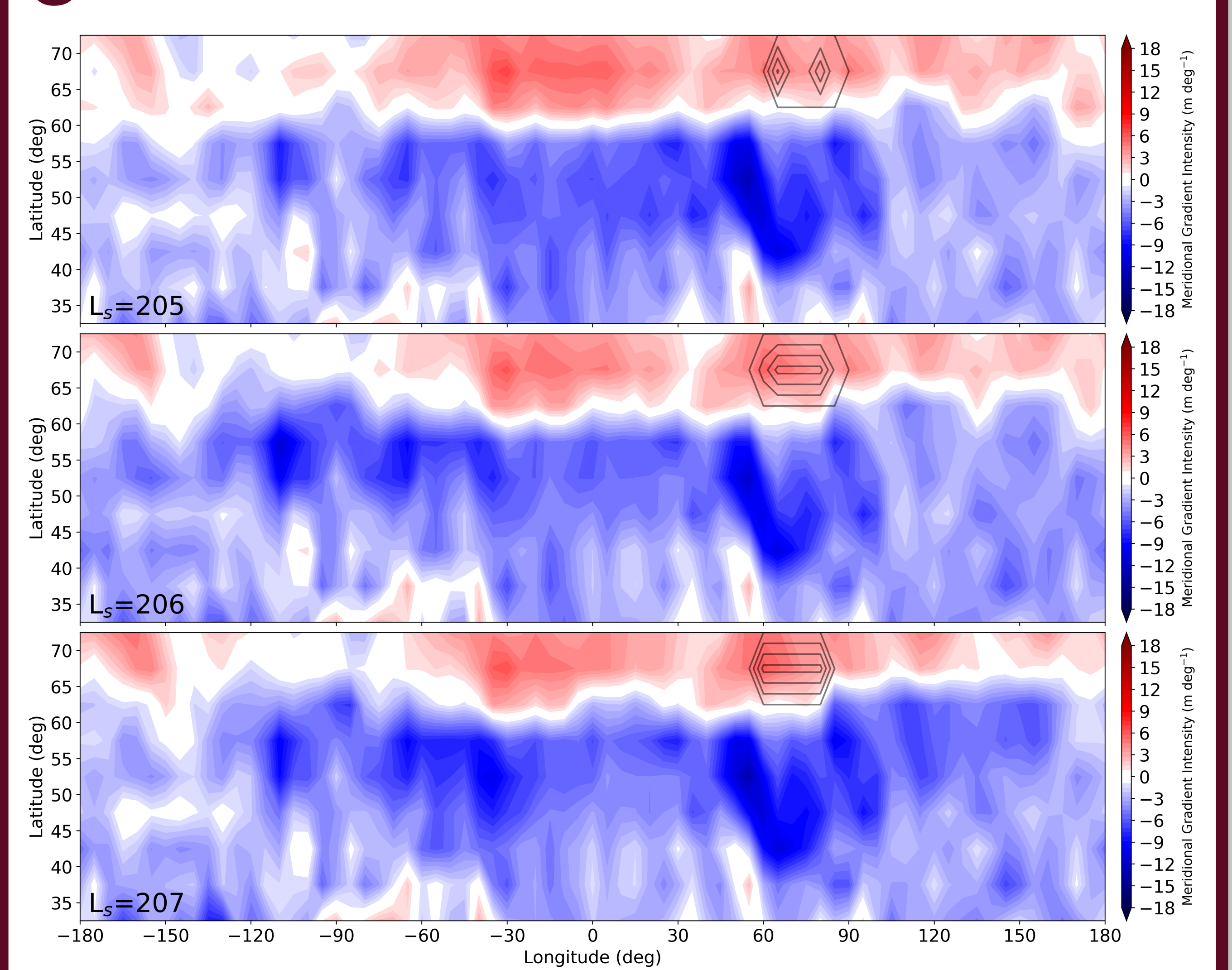
Frequency of blocking in 3 years. Mars Years 30 (top), 31 (middle), and 32 (bottom) all show blocking in the three lowland, high-latitude, northern basins where dust storms originate.

5 Dust storm edges delineated by baroclinic fronts.



Synoptic flushing dust storm case study from MY 31 "A" storm. MDAD storms are outlined in blue. The Utopia and Acidalia storm tracks are activated.

6 Blocking events align in individual cases.



Blocking frequency averaged over times in Panel 5 (black contours every 4%) demonstrates excellent agreement with dust storm flushing. MGI (shading) [Davini et al. 2012] shows ϕ gradient reversals at high latitudes.