# Supporting Information for "The Polarization of Ambient Noise on Mars"

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**Introduction**

**Text S1**

Figure S1 and S2 display the spectrograms of the three seismic components for sol 210 and 310. We observe higher noise amplitude during the day and the lowest amplitude in the evening between 1 and 3 sec of period. In this study we only investigated polarization in the frequency band 0.03-1 Hz and therefore the results are not affected by the resonance modes visible as yellow horizontal lines at higher frequency.

Figure S3 shows the degree of polarization and linearity of the noise particle motion as a function of UTC time and frequency recorded on Earth by the station SSB in France and TAM in Algeria from the GEOSCOPE network on 2020/03/20. As for Mars, we kept only DOP larger than 0.5. The DOP measured with the same parameters is lower on Earth (average dop of 0.62) than on Mars (average dop of 0.7) in the entire frequency band, meaning that the polarization on Mars is more stable over several cycles than on Earth. Figure A3 clearly shows the separation between the primary and secondary microseisms around 0.1 Hz. The linearity (median of 0.6) is lower in the secondary microseism frequency band, between 0.12-0.2 Hz, where Rayleigh waves dominate. Between 0.05 and 0.1 Hz, in the frequency band of the primary microseism, the linearity is more variable due to equipartition between Rayleigh and Love waves. These patterns are not observed on Mars (Figure 5) where there is no ocean and therefore no source of microseims. Considering only detected signals with elliptical polarization (linearity smaller than 0.9), Figure A3 also shows the incident angle of the major vector, the angle between the ellipse and the vertical planes and the azimuth of the major axis. In the entire frequency band, the ellipse is dominantly in the vertical plane. In the frequency range of the secondary microseisms, the histogram of incident angle of the semi-major angle with respect to the vertical is maximum around 20-30$^o$ for SSB and 10-20$^o$ for TAM.

Figures S4 to S7 show the azimuth of the measured signals with elliptical polarization as a function of LMST and frequency for sol 82 to 481. We see the discrepancy between high and low frequency and the progressive changes from one sol to another caused by seasonal changes. Some features such as the horizontal red lines on sol 118 to 121 are due to hammering next to the sensor for HP3 experiment.

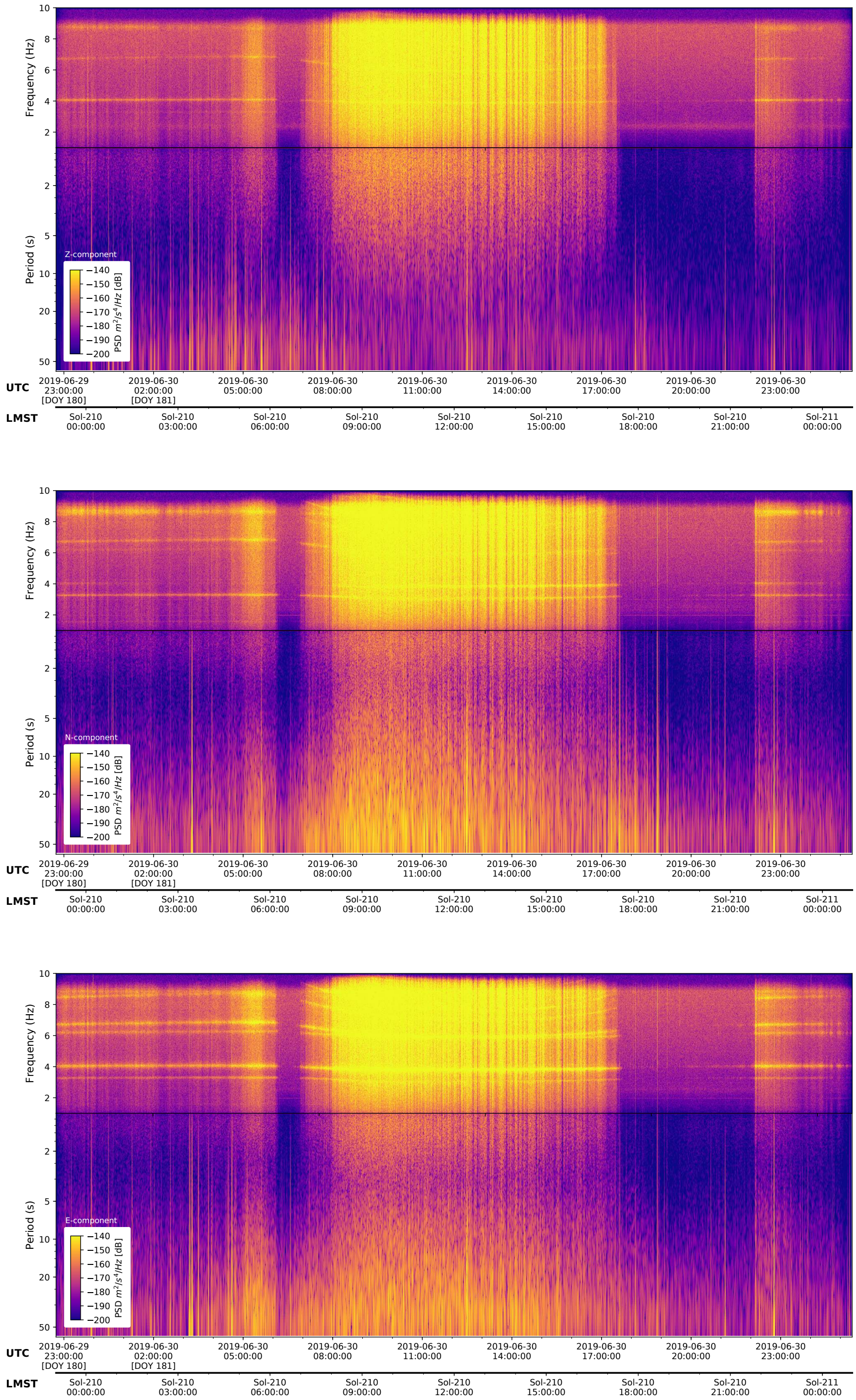




**Figure S1.** Spectrogram of the ELYSE station seismic acceleration for the 3 components on sol 210.

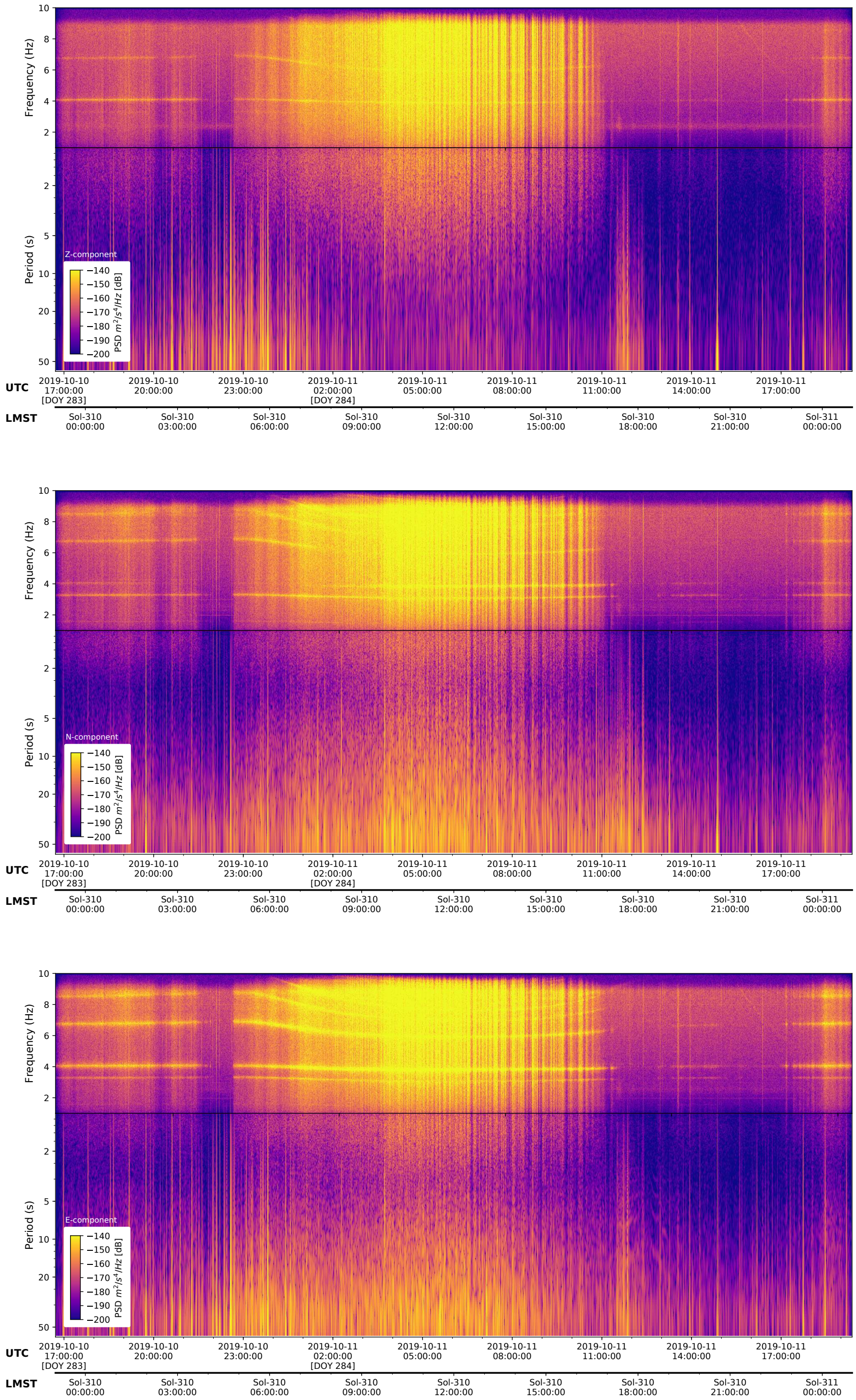


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**Figure S2.** Spectrogram of the ELYSE station seismic acceleration for the 3 components Z, N and E on sol 310.

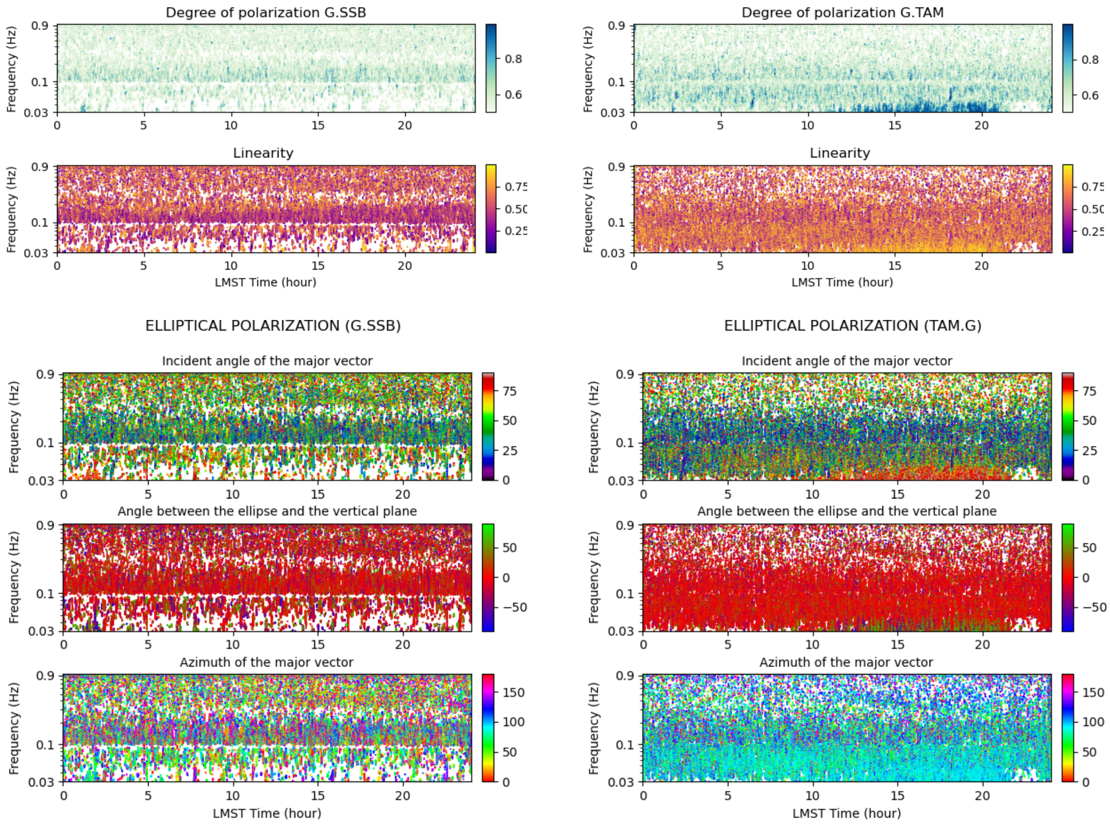


**Figure S3.** Polarization attributes on Earth for stations SSB (left) and TAM (right) of the GEOSCOPE network on 2020/03/20. From top to bottom: Degree of polarization (DOP), linearity, incident angle of the major vector, out-of-vertical plane angle (OVP) and azimuth of the major vector. Both, the DOP and the linearity are lower than on Mars. The minimum number of detected signals around 0.1 Hz corresponds to the separation between the primary and secondary microseisms. Elliptical polarization is in the vertical plane (OVP=0) in almost the entire frequency range and the incident angle of the semi major axis is closer to the vertical than on Mars.

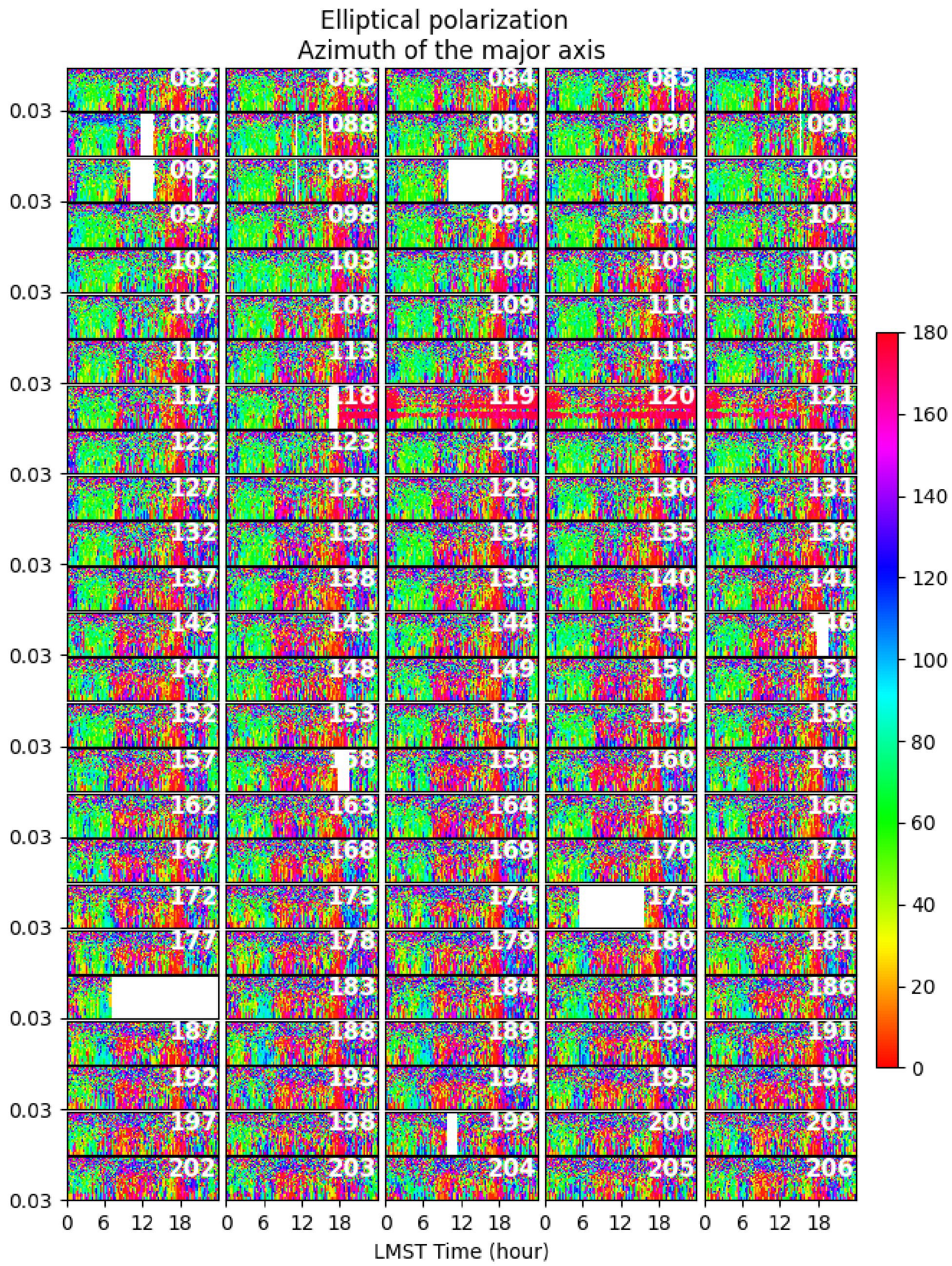


**Figure S4.** For signals with elliptical polarization, azimuth of the particle motion as a function of LMST time and frequency for sols 82 to 206. Azimuth is measured in degrees, clockwise from North.

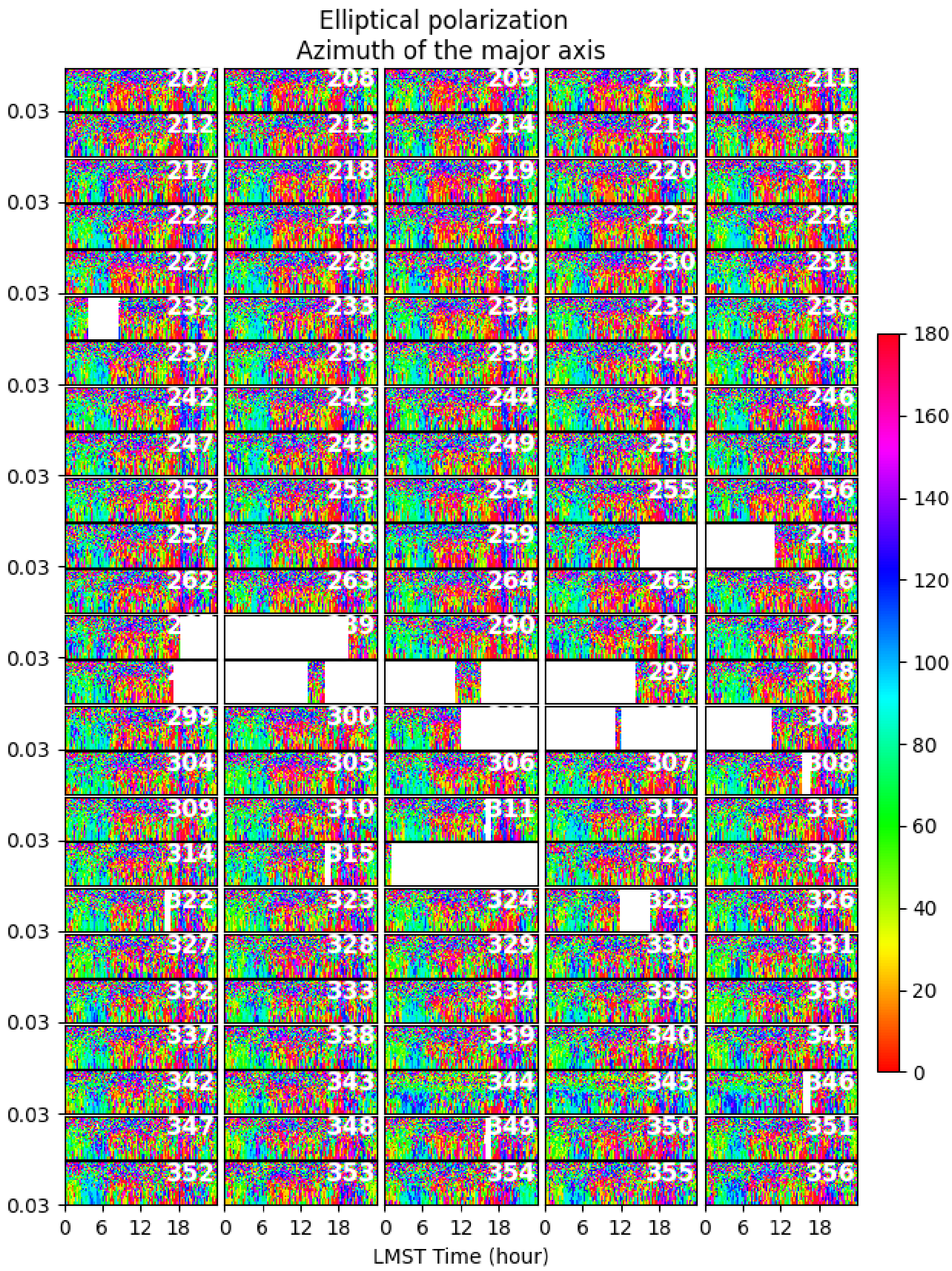


**Figure S5.** For signals with elliptical polarization, azimuth of the particle motion as a function of LMST time and frequency for sols 207 to 356. Azimuth is measured in degrees, clockwise from North.

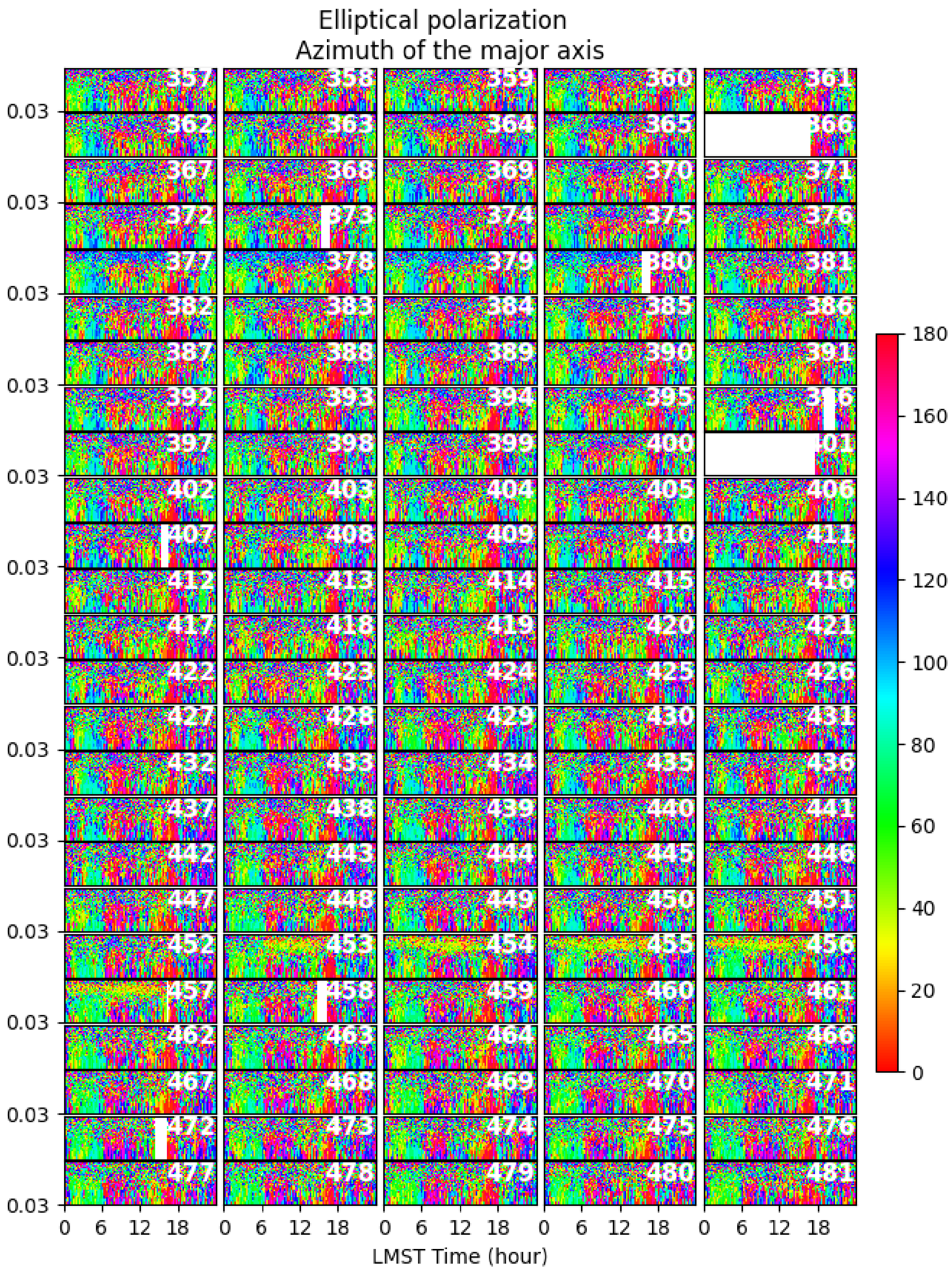


**Figure S6.** For signals with elliptical polarization, azimuth of the particle motion as a function of LMST time and frequency for sols 357 to 481. Azimuth is measured in degree, clockwise from North.

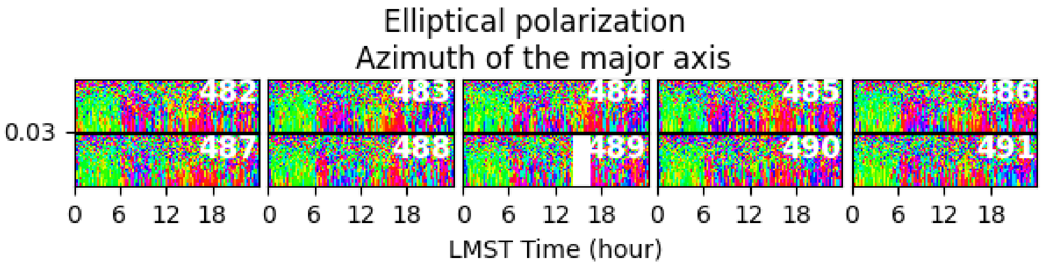


**Figure S7.** For signals with elliptical polarization, azimuth of the particle motion as a function of LMST time and frequency for sols 482 to 491. Azimuth is measured in degree, clockwise from North.