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Supporting Information for "Variability of Upstream Proton Cyclotron Wave Properties and Occurrence at Mars observed by MAVEN"

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Contents of this file

1. Figures S1 to S3

Introduction All of the following figures are generated from MAVEN data which are publicly available through the Planetary Data System (https://pds-ppi.igpp.ucla.edu/index.jsp). Figure S1 shows the probability distribution of PCWs as a function of normalized wave amplitude $\delta B/B$ for upstream data from October 2014 through February 2020, the HR groups, and the LR groups in panels (a), (b), and (c),

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respectively. Figure S2 displays the median amplitude of upstream PCWs for the HR

groups as a function of Y_{MSO} and Z_{MSO} in panels (a) and (b), respectively. Figure S3

shows the median amplitude of PCWs in the upstream region for the HR groups as a

function of IMF cone angle α for waves that satisfy the frequency condition $f_c > 0.07$ Hz.
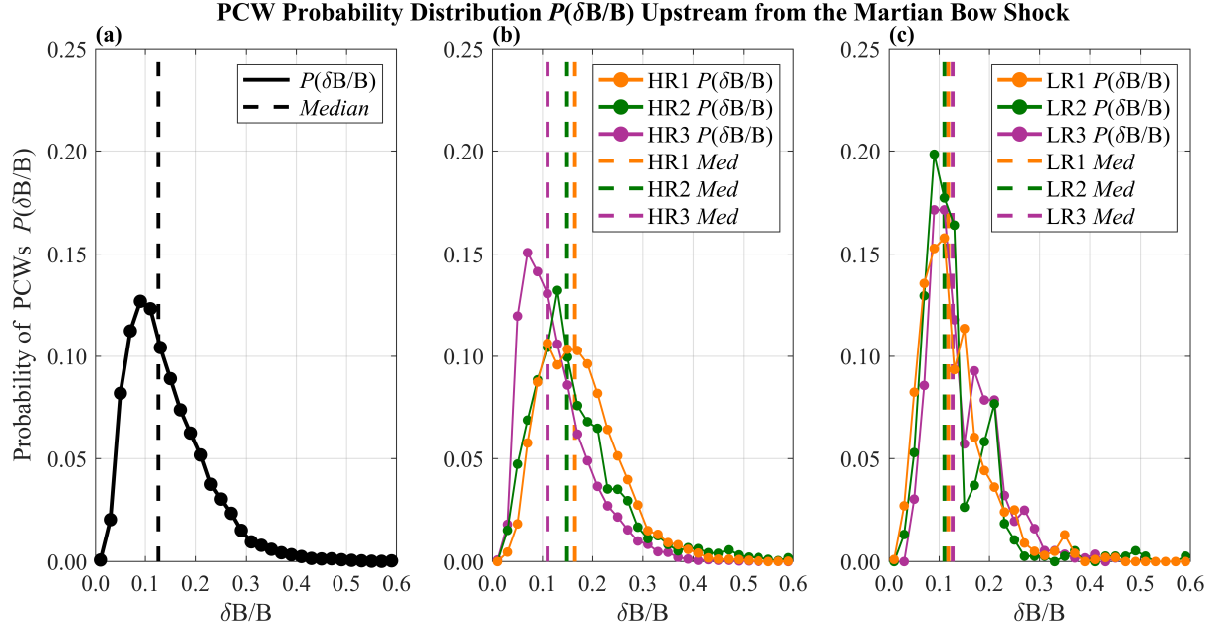
Figure S1. (a) Probability distribution $P(\delta B/B)$ of PCWs as a function of normalized wave amplitude $\delta B/B$ for (a) upstream data from October 2014 through February 2020, (b) the HR1 (orange), HR2 (green), and HR3 (purple) groups, and (c) the LR1 (orange), LR2 (green), and LR3 (purple) groups. The dashed vertical lines represent the median value in each probability distribution.
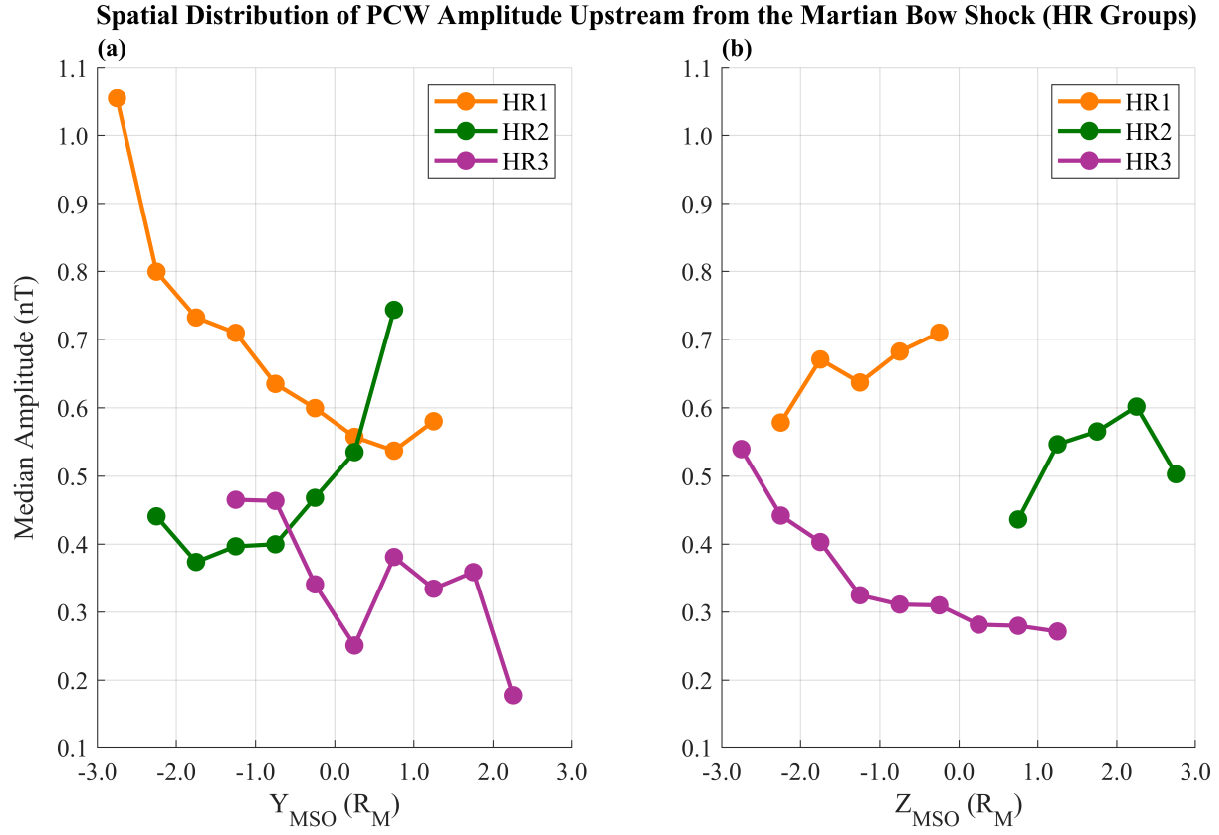
Spatial Distribution of PCW Amplitude Upstream from the Martian Bow Shock (HR Groups)

Figure S2. Median amplitude of upstream PCWs for the HR1 (orange), HR2 (green), and HR3 (purple) groups as a function of (a) Y_{MSO} and (b) Z_{MSO}.
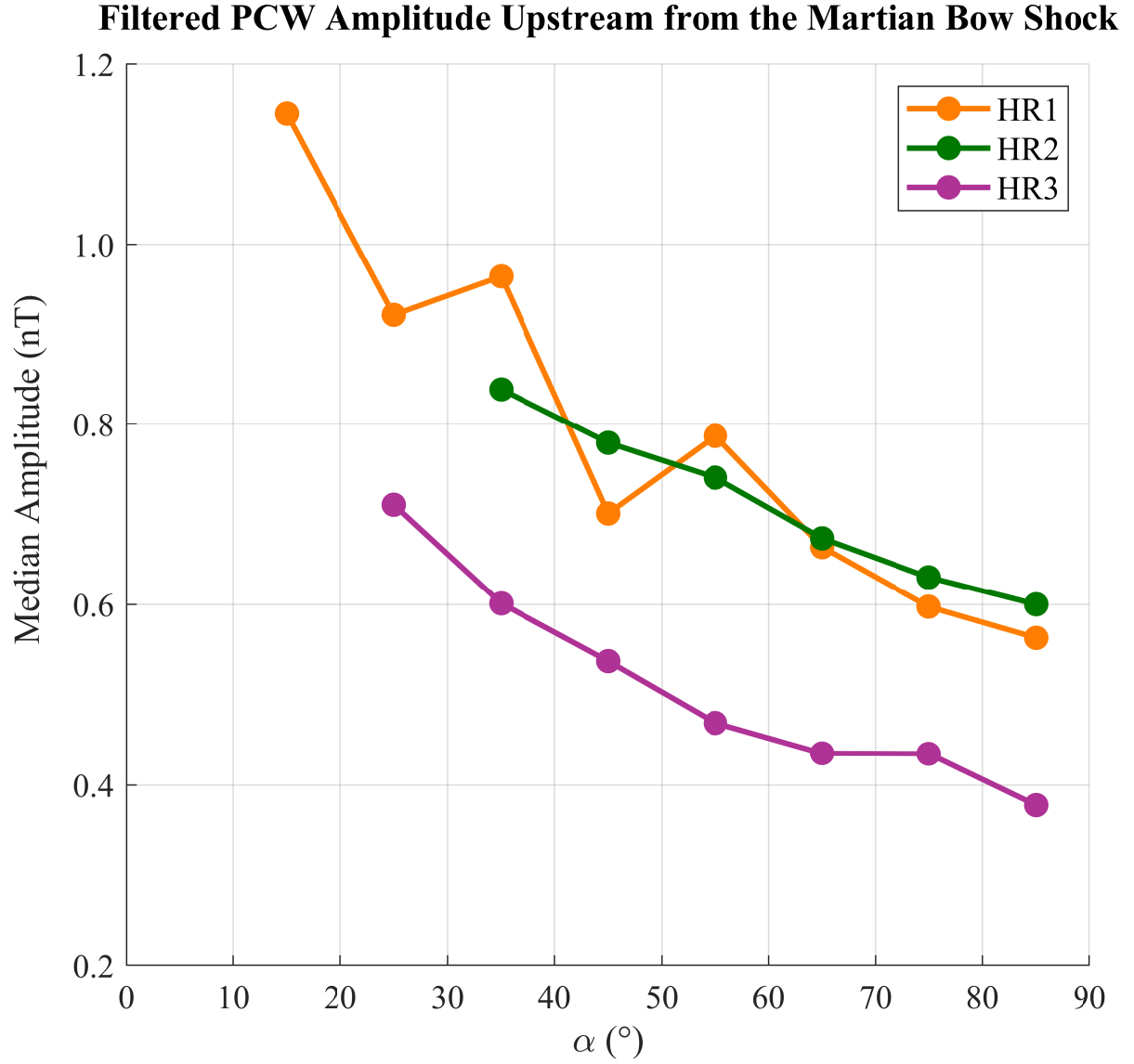
Figure S3. Median amplitude of PCWs for waves satisfying the frequency condition $f_c > 0.07$ Hz in the upstream region for the HR1 (orange), HR2 (green), and HR3 (purple) groups as a function of IMF cone angle α.