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Oral

A fundamental aspect of solar wind formation is where the plasma originates from on the Sun. The solar wind originates from 3 types of coronal magnetic field – the continuously open fields that form coronal holes (CHs), or from either active region (AR) or quiet Sun (QS) at the magnetic open-closed boundary. Relating in situ solar wind measurements to their source at the Sun is a critical step to understanding how the solar wind is formed, because the source determines the plasma temperature, its elemental composition, and the possible mechanisms involved in its release and acceleration. Recent in situ investigations provide more direct measurements of the pristine solar wind closer to its solar origin, and the upcoming PUNCH mission will allow us to observe structures as they propagate from their coronal source out into the solar wind, with uninterrupted remote coronal measurements. However, the use of a model is required to bridge in situ solar wind observations to their precise source region observed remotely. In this presentation, we highlight recent work in which we use the Wang-Sheeley-Arge (WSA) model driven by Air Force Data Assimilative Photospheric Flux Transport (ADAPT) time-dependent photospheric ?eld maps to connect the in situ observed solar wind at L1, with its source region at 1 Rs. We also make use of a new tool we developed to derive the coronal separatrix web (S-web) with the global solution of the WSA-derived coronal field. With the addition of this tool, WSA is now the only model able to quantitatively relate in situ solar wind measurements to the value of the squashing factor (Q) at its coronal source, revealing when the in situ observed solar wind originates from the magnetic open-closed boundary at the Sun. In this work, we classify the L1-observed solar wind based on source (AR, QS, or CH) using the model-derived source region distance from magnetic open-closed boundary and the corresponding photospheric field measurements at the source. We characterize the in situ properties of the solar wind observed at ACE (e.g. speed, proton density, nA/nP, Fe/O, carbon and oxygen charge state ratios) that originate from each source, in order to investigate whether the source region as defined here ultimately determines the plasma properties observed in situ. We use this methodology to investigate two Carrington rotations, one near solar maximum and one near solar minimum. We find a strong relationship between source region and both charge state ratio and FIP observed in situ, with both of these measurements varying widely for solar wind originating from the magnetic open-closed boundary. We discuss these results and other findings in the context of how the source region determines or influences the solar wind properties observed in situ. We conclude with a discussion of synergies between ADAPT-WSA and PUNCH, specifically with our new tool of identifying when the in situ observed solar wind originates from the magnetic open-closed boundary as defined by the S-web.

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