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The heliosphere forms as a result of the interaction of the solar wind blowing from the Sun and the local interstellar medium. The Voyager mission discovered that the heliosphere extends to roughly 120 AU in the direction of the Sun's motion through interstellar space. The solar activity causes various types of time-dependent phenomena in the solar wind from long-lived corotating interaction regions to shorter duration but more extreme events like coronal mass ejections. As these structures propagate outward from the Sun, they evolve and interact with each other and the ambient solar wind. Voyager 1 and 2 provided first unique in-situ measurements of these structures in the outer heliosphere. In particular, Voyager observations in the heliosheath, the outermost region of the heliosphere, showed highly variable plasma flows with different behavior along trajectories of two spacecraft, possibly indicating effects of solar variations extending from the Sun to the heliosphere boundaries. Most surprisingly, Voyager 1 data shows shocks and pressure waves beyond the heliosphere in the interstellar medium. In this presentation I will review simulation efforts towards understanding a role of the solar cycle variations in plasma flows and structures in the outer heliosphere, and variability of locations of the heliosphere boundaries. I will discuss science questions related to the global heliosphere dynamics which require new observations in the outer heliosphere and advanced models. This discussion is most relevant to Working group 4: Solar activity impacts throughout the heliosphere.
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