Neha
Srivastava
University of New Hampshire
Joachim Raeder, University of New Hampshire
David Sibeck, NASA GSFC
Oral
Tangential discontinuities (TDs) are prevalent transient structures in the solar wind and occur more frequently than interplanetary shocks, with typical occurrence rates of more than one per hour. As these structures propagates toward Earth, they repeatedly impinge upon the magnetosphere and play a crucial role in solar wind-magnetosphere coupling.
TDs with strong density jumps are particularly significant as they can cause sudden magnetospheric compressions that may trigger ultra-low frequency (ULF) or Pc waves within the magnetosphere. Notably, such discontinuities must traverse through the bow shock and propagate through the magnetosheath, before interacting with the magnetopause, substantially modifying the dayside dynamics.
In this study, we investigate the interaction of density-enhanced TDs with the dayside magnetosphere using the global MHD model, OpenGGCM. A particular emphasis is placed on the role of the TD inclination angle in the equatorial plane. Our results indicate that, in addition to the density jump, the inclination of TD normal plays a governing role in controlling the deformation of the bow shock and the magnetopause currents. The interaction of TD with the bow shock generates a cascade of waves and secondary discontinuities in the magnetosheath. Moreover, the resulting magnetospheric compression significantly perturbs the magnetopause, producing localized outward protrusions of the boundary bulges whose characteristic depend strongly on the TD orientation. When the TD plane is nearly parallel to the Sun-Earth line, we additionally observe the development of strong sunward flows in subsolar magentosheath. These findings provide new insights into the role of the inclination angle of tangential discontinuities in governing their interaction with the Earth’s magnetosphere and potentially other planetary magnetospheres.
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