Project Details

ROSES ID: NNH22ZDA001N-LWS
Selection Year: 2022
Program Element: Focused Science Topic

Topic: FST #2: Coupling of the Solar Wind Plasma and Energy to the Geospace System

Project Title:
Pressure Pulse Interactions with the Earth's Magnetosphere

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Summary:
Solar wind pressure pulses drive a unique mode of solar wind-magnetosphere interaction. We propose a closely-linked combined observational and hybrid code numerical simulation study of this interaction mode. We begin by determining and distinguishing between the characteristics of pressure pulses intrinsic to the solar wind and those generated by kinetic processes within the Earth's foreshock, with an emphasis on the properties that determine their significance to the overall interaction, namely their extent, amplitude, and occurrence patterns. Observations from L1 monitors and spacecraft immediately upstream from the Earth's bow shock are used for this task. Next we consider how the properties of pressure pulses change as they interact with the bow shock and transit the magnetosheath. Simultaneous observations from spacecraft upstream and downstream from the bow shock are used for this task. Once they reach the magnetopause, pressure pulses drive magnetopause motion and may trigger magnetic reconnection. Observations from spacecraft at and upstream from the magnetopause are used for this task. Finally, both pressure pulses, and the bursty reconnection that they may trigger, launch Alfv n mode waves that propagate down to the ionospheric footprints of magnetic field lines that lead to the magnetopause and fast mode waves that propagate across the magnetic field to locations deeper within the dayside magnetosphere. We survey the corresponding perturbations that occur in high-latitude ground-based magnetograms and in the magnetic field measurements of spacecraft at various locations throughout the dayside magnetosphere to determine the contribution of the pressure pulses to ionospheric convection and diffusion within the radiation belts as a function of solar wind conditions. At each step, we compare hybrid code model predictions with the in situ observations. The significance of the proposed work lies in the fundamental nature of the interaction, its importance to triggering reconnection, and its potential importance to ring current and radiation belt processes. Finally, we propose to lead the focus group team comprising all the proposals selected for this opportunity, establish connections between and beyond the team members selected, and maintain even more regular communication demonstrating progress with NASA HQ staff than the required annual individual and team reports._x000D_
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The proposed research is relevant to the focus science team because it addresses the following AO-stated tasks (1) identifies the parameters controlling the transfer of energy through dayside magnetopause reconnection, (2) investigates the physical processes controlling non-reconnection coupling, and (3) defines the role of solar wind fluctuations in the coupling of the solar wind to the Earth. The proposed study returns (1) a survey of solar wind fluctuation amplitudes and occurrence patterns, (2) specifies how fluctuations are transmitted through the magnetosheath, (3) quantifies their impact on magnetopause motion and reconnection, and (4) defines the properties of the transient ionospheric convection and ring current and radiation belt diffusion that they drive. Finally, the proposal provides experienced leadership to the proposal team.

Publication References:

no references