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:
Role of Solar Wind Fluctuations on Solar Wind- Magnetosphere - Ionosphere Coupling Processes and Magnetotail Energetics

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Summary:
Title: Role of solar wind fluctuations on solar wind -magnetosphere-ionosphere coupling processes and magnetotail energetics. _x000D_
_x000D_
Science Goals and Objectives:_x000D_
The overarching science goal of the project is to address the role of solar wind fluctuations driven by solar wind transients and solar wind substructure on the dynamics and energetics of the tail flank region and magnetotail and their corresponding ionospheric signatures and properties._x000D_
_x000D_
Our objective is to answer the following science questions (SQs)_x000D_
SQ1. What are the effects of enhanced SW and IMF fluctuations on tail flank magnetopause fluctuations?_x000D_
_x000D_
SQ2. What is the role of SW, IMF and tail magnetopause fluctuations on tail dynamics and energetic particle fluxes?_x000D_
_x000D_
SQ3. How do enhanced SW, IMF and magnetopause fluctuations affect Magnetosphere-Ionosphere (M-I) coupling? _x000D_
_x000D_
Methodology: _x000D_
_x000D_
Our study uses a _x000D_
1) statistical, empirical Solar wind And Magnetosphere Unification (SAMU) model (developed by PIs group) that currently has 15+ year of data from THEMIS and ARTEMIS thermal and suprathermal plasma and magnetic field instruments _x000D_
2) spacecraft case studies using THEMIS, ARTEMIS, MMS, DMSP, and AMPERE spacecraft._x000D_
3) machine learning and information theory to establish linear and nonlinear causal relationships and response time scales from solar wind to the magnetopause to the magnetosphere and to the ionosphere._x000D_
4) global, 3-D MHD simulations (OpenGGCM) on solar wind-magnetosphere-ionosphere system. E.g., For global simulation, we can add pressure perturbation or magnetic field fluctuation in the solar wind with certain frequency and see the responding response of the magnetosphere and ionosphere._x000D_
6) existing list of CMEs, SIRs, Substorms and Kelvin-Helmholtz waves._x000D_
7) geomagnetic activity indices (e.g., AE and Dst)_x000D_
_x000D_
Relevance: _x000D_
The proposed study is directly relevant to the Decadal Survey Goal 2: ``Determine the dynamics and coupling of Earth's MSP, ionosphere, and atmosphere and their response to solar and terrestrial inputs'' and LWS FST$\#$2 topic 4) ``understanding the role of solar wind fluctuations in the coupling of the solar wind to the Earth''. Our previous works (Nykyri et al., 2017, JGR) have shown that KHWs growth, and properties (e.g., size) depends on the nature of seed fluctuations in the shocked solar wind. Enhanced flank fluctuations during Geoeffective SW drivers may 1) help trigger tail reconnection, initiate substorms and affect energetic particle acceleration, transport and loss via interaction with radiation belts, 2) as well as help transport energetic particles from large-scale diamagnetic cavities further into the magnetotail.

Publication References:

no references