Project Details

ROSES ID: NNH17ZDA001N
Selection Year: 2017
Program Element: Focused Science Topic

Topic: Understanding Physical Processes in the Magnetosphere--Ionosphere / Thermosphere / Mesosphere System During Extreme Events

Project Title:
A nighttime ionospheric localized enhancement (NILE) at mid-latitudes during extreme storms

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Summary:
Science: This effort will identify the extreme storm (Dst

Method: The proposed work will combine advanced models with space-based data from NASA observatories along with ground-based measurements, all publicly available, to estimate the formation mechanism using the latest data assimilative techniques. The first principles model forming the a priori state will be SAMI3 (SAMI3 is Also a Model of the Ionosphere). Two data assimilative (DA) methods will subsequently ingest data to update the SAMI3 background: Ionospheric Data Assimilation 4-Dimensional (IDA4D) and Estimating Model Parameters from Ionospheric Reverse Engineering (EMPIRE). We will use SAMI3, IDA4D, and EMPIRE to understand the physical processes consistent with the existence of a localized mid-latitude persistent nighttime plasma enhancement. SAMI3 has global fidelity in producing storm enhanced density, a possible precursor to the NILE. IDA4D will update the SAMI3 background model of plasma density with ground- and space-based density data, including from COSMIC, to produce a global time-varying specification of plasma densities. EMPIRE will update background models of electric potential and neutral winds based on electron density from IDA4D and measurements of the drivers from TIMED, DMSP, and C/NOFS. With these data covering the last two solar maxima, we will examine both extreme and not extreme storms. Space-based data are key to assimilation for dynamic driver estimation. DA lets us address the science goals because, while models do not yet predict the NILE itself, observationally driven updates offer optimal updates to the models, giving insight into the physics distinguishing NILE conditions from null events.

FST Contributions: This proposal responds to Focused Science Topic 4: Understanding physical processes in the MITM system during extreme events. Global adjustments of first-principles electric potential based on observational stormtime conditions will indicate the states in which models most need adjustment during extreme storms. The study will help to show whether an extreme storm is a necessary condition for the NILE. This investigation will provide evidence of progress toward accurate simulation of extreme Space Weather events and their effects in the IT system by providing a rigorous uncertainty on the estimated state from DA. Output covariances and comparison to validation data provide metrics for determining the successful outcome of the research. We will contribute the electric field and neutral wind fields produced from SAMI3 and EMPIRE, and density specification from SAMI3 and IDA4D, to the FST. This effort will contribute insight into the low-to-mid-latitude electrodynamics during extreme storms, bringing a greater understanding of a phenomenon that has known consequences for the precision navigation availability of WAAS.

Publication References:

no references