Project Details

ROSES ID: NNH08ZDA001N
Selection Year: 2009
Program Element: Focused Science Topic

Topic: Determine and Quantify the Responses of Atmospheric/Ionospheric Composition and Temperature to Solar XUV Spectral Variability and Energetic Particles

Project Title:
Thermosphere--Ionosphere Response to Variability of Solar X-ray and EUV Radiation During Solar Flares

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Summary:
We propose to carry out an observational and modeling investigation of characteristics and driving mechanisms of the spatial and temporal responses of the thermosphere and ionosphere to rapid changes of solar X-ray (0.1-10 nm) and EUV (10-120 nm) radiation during solar flares. The primary scientific objectives are:
(1) Understand how locations of flares on the Sun affect their spectral characteristics and hence the neutral density and TEC responses;
(2) Examine whether neutral density and TEC responses scale directly to the intensity of solar flares as classified by their X-ray brightness for flares with the same location on the Sun;
(3) Investigate the timing of the response and recovery of the neutral density and TEC responses and the coupling/decoupling of the two as the flare responses evolve with time;
(4) Study whether the hemispheric asymmetry of the TEC response is coupled to the hemispheric asymmetry of O/N2 and whether there is hemispheric asymmetry in the neutral density response to solar flares.
TIMED Solar EUV Experiment (SEE), GOES X-Ray Sensor (XRS) , SDO EUV Variability Experiment (EVE), and a new flare model (FISM) will be analyzed for solar flares from 2001 to 2007; effects of these flares on the IT system will be investigated using TEC data (CHAMP, ground-based GPS) and neutral density data (CHAMP). These observational studies will result in establishment of characteristics of flare spectra and the IT responses. A modeling effort using the NCAR-TIMEGCM will be carried out in conjunction with these observational studies. The modeling effort will enable us to investigate the flow of physics and chemistry as the flare affects the ionosphere and the thermosphere. These combined observational and modeling studies will bring a better understanding of how the impulsive bursts of X-ray and EUV during solar flares affect the thermosphere and the ionosphere.

Publication References:

Summary: no summary

Reference: Qian, Liying; Burns, Alan G.; Chamberlin, Phillip C.; Solomon, Stanley C.; (2010), Flare location on the solar disk: Modeling the thermosphere and ionosphere response, Journal of Geophysical Research, Volume 115, Issue A9, CiteID A09311, doi: 10.1029/2009JA015225

Summary: no summary

Reference: Solomon, Stanley C.; Qian, Liying; Didkovsky, Leonid V.; Viereck, Rodney A.; Woods, Thomas N.; (2011), Causes of low thermospheric density during the 2007-2009 solar minimum, Journal of Geophysical Research, Volume 116, CiteID A00H07 , doi: 10.1029/2011JA016508

Summary: no summary

Reference: Qian, Liying; Burns, Alan G.; Chamberlin, Phillip C.; Solomon, Stanley C.; (2011), Variability of thermosphere and ionosphere responses to solar flares, Journal of Geophysical Research: Space Physics, Volume 116, Issue A10, CiteID A10309 , doi: 10.1029/2011JA016777

Summary: no summary

Reference: Deng, Yue; Huang, Yanshi; Solomon, Stan; Qian, Liying; Knipp, Delores; Weimer, Daniel R.; Wang, Jing-Song; (2012), Anomalously low geomagnetic energy inputs during 2008 solar minimum, Journal of Geophysical Research, Volume 117, Issue A9, CiteID A09307, doi: 10.1029/2012JA018039

Summary: no summary

Reference:
Huang, Yanshi; Richmond, Arthur D.; Deng, Yue; Chamberlin, Phillip C.; Qian, Liying; Solomon, Stanley C.; Roble, Raymond G. ; Xiao, Zuo; (2014), Wavelength dependence of solar irradiance enhancement during X-class flares and its influence on the upper atmosphere, Journal of Atmospheric and Solar-Terrestrial Physics, Volume 115, p. 87-94., doi: 10.1016/j.jastp.2013.10.011