Project Details

ROSES ID: NNH08ZDA001N
Selection Year: 2009
Program Element: Data, Tools, & Methods

Topic: Determine the possible role of galactic cosmic ray particles as a source for cloud condensation nuclei in the troposphere and lower stratosphere.

Project Title:
High-latitude auroral heating in the energy budget of the thermosphere

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Project Member(s):
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- Bowman, Bruce R; Collaborator; null

Summary:
The proposed project will investigate the flow of energy into the thermosphere during geomagnetic storms, and its later dissipation, along with the resulting changes in exospheric temperature and the altitude profile of the neutral density. The solar extreme ultraviolet flux provides a slowly varying background level of heating, while during geomagnetic storms electromagnetic energy deposited in the high-latitude ionosphere produces short-terms variations at a higher level. This heating by the aurora is calculated with empirical models that calculates the ionospheric fields and currents from measurements of the solar wind and interplanetary magnetic field. During the course of this project these empirical models will be improved. The thermosphere's response is observed by means of the neutral density that is derived from measurements of the atmospheric drag on satellites. From these neutral densities are derived the orbit-averaged neutral densities, the average exospheric temperature, and the total energy contained in the thermosphere. By comparing the heat flowing into the thermosphere from different sources with the measured total energy, and combined with the observed cooling rates, a predictive capability will be developed. A tool will be developed for calculating the change in the minimum, nighttime thermospheric temperature during geomagnetic storms. This temperature index can be used in the Jacchia-Bowman 2008 model of thermosphere, and improvements in satellite drag predictions will be evaluated. Another study will determine how quickly the neutral density around the globe responds to auroral heating.

The scientific results from the project will likely help to produce better understanding and prediction of the thermosphere's response, and the resulting anomalous satellite drag, during large geomagnetic storms. The measurements of the thermosphere's cooling rates will be useful for validation of numerical thermosphere-ionosphere coupling models.

This proposed project is submitted under the classification of "Tools and Methods." This work is highly relevant to Focused Science Topic e) "Determine and quantify the responses of atmospheric/ionospheric composition and temperature to solar XUV spectral variability and energetic particles," as well as the on-going Focused Science Topic started in the prior year to "determine the sources of daily variability in the thermosphere and ionosphere." There is relevance to the fourth-listed LWS Strategic Goal in that this project will help "to deliver understanding and predictive models of upper atmospheric and ionospheric responses to changes in solar electromagnetic radiation and and to coupling above and below." The tasks are relevant to NASA's "Strategic Goal 3," under Sub-goal 3B to "Understand the Sun and its effects on Earth."

Publication References:

Summary: no summary

Reference: Weimer, D. R.; Bowman, B. R.; Sutton, E. K.; Tobiska, W. K.; (2011), Predicting global average thermospheric temperature changes resulting from auroral heating, Predicting global average thermospheric temperature changes resulting from auroral heating, doi: 10.1029/2010JA015685