EGU22-8476
https://doi.org/10.5194/egusphere-egu22-8476
EGU General Assembly 2022

Perspectives on the thermosphere response to extreme magnetic storms: Current status of neutral mass density modeling

Denny Oliveira[1,2], Eftyhia Zesta[1], Piyush Mehta[3], Richard Licata[3], Marcin Pilinski[4], W. Kent Tobiska[5], and Hisashi Hayakawa[6,7,8]

[1]NASA Goddard Space Flight Center, Greenbelt, United States of America (denny@umbc.edu)
[2]University of Maryland, Baltimore County, Baltimore, United States of America
[3]University of West Virginia, Morgantown, United States of America
[4]University of Colorado, Boulder, United States of America
[5]Space Environment Technologies, Pacific Palisades, Los Angeles, United States of America
[6]Nagoya University, Nagoya, Japan
[7]UK Solar System Data Centre, Space Physics and Operations Division, RAL Space, Science and Technology Facilities Council, Rutherford Appleton Laboratory, Harwell Oxford, Didcot, United Kingdom
[8]Nishina Center, Riken, Wako, Japan

Orbits of human assets such as satellites, crewed spacecraft and stations in low-Earth orbit (LEO) are very sensitive to the highly dynamic environment in which they fly. Atmospheric drag caused by the interaction between the orbiting object and the local thermospheric neutral mass density affects the satellite's lifetime and orbital tracking, which becomes increasingly inaccurate or uncertain with storm intensity. Given the planned increase of government and private satellite presence in LEO, the need for accurate density predictions for collision avoidance and lifetime optimization, particularly during extreme events, has become an urgent matter and requires comprehensive international collaboration. Additionally, long-term solar activity models and historical data suggest that the solar activity will significantly increase in the following years and decades. In this presentation, we briefly summarize the main achievements in the research of thermospheric density response to magnetic storms occurring particularly after the launching of many satellites with state-of-the-art accelerometers for density determination (CHAMP, GRACE, GOCE, Swarm). We argue that specification models (e.g., HASDM) perform reasonably well during storm main and recovery phases of extreme storms, but forecasting models (e.g., JB2008) do not perform well throughout the storm cycle. We will discuss how forecasting models can be improved by looking into two directions: first, to the past, by adapting historical extreme storm datasets for density predictions, and second, to the future, by facilitating the assimilation of large-scale data sets that will be collected in future events. We invite the community to the discussion on the possible use of several hundreds of satellites with lower resolution density measurements along with data assimilation schemes or the use of ~100 high precision tracked satellites as a more effective approach for future density determinations.