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PROJECT TITLE: Modeling the Density of the Thermosphere

ABSTRACT:
The top level of the Earth's atmosphere is the thermosphere. Its density is so susceptible to change that it lends itself to control by weak external drivers such as solar extreme ultraviolet (EUV) and electromagnetic energy deposited in the polar atmosphere as a result of solar wind/magnetosphere interactions. It is nonetheless enough to exert significant drag on orbiting spacecraft, motivating numerous observational and modeling efforts since the dawn of space exploration. The need to predict the orbits of many objects in space (currently about 14,000 objects that can be tracked), and to predict conjunction between any two objects, emphasizes the need for improved methods of characterizing and predicting density variability as accurately and efficiently as possible. An important component of space weather characterization and prediction is the development of succinct and computationally efficient relationships between geospace variability and the solar and geomagnetic drivers that best capture that variability. In this project I have developed a computationally efficient emulator of the thermospheric density variability by analyzing the neutral density modeled by a general circulation model (GCM) of the thermosphere and ionosphere. In addition, I have utilized daily F10.7 and geomagnetic indices, solar wind data, and joule heating rate computed by the GCM, to gain a deeper understanding of thermospheric density changes. I tested the predictive capability of the emulator against the GCM as well as observations obtained from the accelerometer experiment on board the CHAMP satellite.