Atmospheric Density Modeling Using Neural Networks

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Atmospheric density during geomagnetic storms is usually poorly predicted due to the lack of clear understanding of the coupling mechanism between thermosphere and magnetosphere in such circumstances. Consequently, the orbit prediction in severe geomagnetic condition is affected. Neural networks are the technique of identifying nonlinear system without exactly knowing its physical model. In the present study, an attempt has been made to model the atmospheric density using neural networks. In developing such models, we use both the ring current index Dst and the geomagnetic index ap as model inputs. The ap index is commonly used in density models such as the MSIS and the Jacchia series to represent geomagnetic activity. On the other hand, Dst has been reported to have better correlation with the storm-time density, and to represent additional heating source to that represented by ap. The density data used for modeling is derived from satellites CHAMP and GRACE's accelerometer measurements. The performance of the neural network models (NNMs) is compared with that of the NRLMSISE-00 at different geomagnetic activity level, which reveals the advantages of the neural network technique and the Dst index.

Keywords: Atmospheric density, Neural networks modeling, Geomagnetic storm, Magnetic activity index