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Title: A Photometry-based Model of Global Thermospheric Column O/N2 Driven by Solar and Magnetospheric Conditions

Abstract: The principal goal of the proposed research work is to construct a photometry-based model of thermospheric atomic oxygen to molecular nitrogen column density ratios (O/N2) using satellite-based measurements of far ultraviolet (FUV) dayglow emissions. The proposed work will be carried out by processing and analyzing FUV images of OI 135.6 nm and N2 Lyman-Birge-Hopfield dayglow acquired by Polar ultraviolet imager (UVI), TIMED global ultraviolet imager (GUVI), and DMSP special sensor ultraviolet spectrographic imager (SSUSI). The multi-satellite image data sets provide unprecedented long term (one solar cycle) and simultaneous large spatial coverage not previously available and ensure the statistical significance of the planned result. The overall science objectives of the proposed research are (1) to characterize and quantify O/N2 column density ratios for both quiet and storm times, (2) to provide a tool for studying responses of thermospheric composition to geomagnetic disturbances, (3) to provide a tool for predicting (dayside) negative ionospheric storms, and (4) to provide validation for physics-based models. Images of dayglow emissions at 135.6 nm and LBH bands from different satellites will be cross-calibrated and converted to 2-dimensional maps of column density ratios of O relative to N2, referenced to a fixed N2 depth, using the updated empirical MSIS model of Hedin (NRLMSIS00) and the physics-based Atmospheric Ultraviolet Radiance Integrated Code (AURIC). The derived O/N2 column density ratios will be first resampled into regular bins and then assembled into a large historical database. Finally, an empirical O/N2 model will be obtained via a straightforward spherical harmonic fitting. Parameters that represent forcing from the polar latitudes (the auroral electrojet AE and/or the polar cap PC indices), the magnetosphere (the magnetic storm Dst index), and from the solar wind plasma and magnetic field will be included in the fitting. The unprecedented long term and large spatial coverage of the image data sets available for the proposed work ensure the statistical significance of the expected result. The proposal is aimed to support NASA LWS 2005 targeted investigation topic (T1): "Tools and Methods." The proposal directly addresses the science priority questions recommended by Geospace Mission Definition Team: "(2A) Determine the effects of long and short term variability of the Sun on the global-scale behavior of the ionospheric electron density" and "(3A) Determine the effects of solar and geospace variability on the atmosphere enabling an improved specification of the neutral density in the thermosphere." To a broader scope, this proposal addresses one of the NASA Strategic Objectives (IV): "Study the Earth system from space and develop new space-based and related capabilities for this purpose."