An EUV Model of Solar Eclipses using SDO-AIA Images and the Impacts on Ionosphere-Thermosphere System

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Solar eclipses cause profound effects on ionosphere-thermosphere dynamics due to the abatement of solar Extreme Ultra Violet (EUV) irradiance. The reduced EUV flux cause relative reduction of ionospheric plasma density and temperature, and well as it reduces thermospheric temperature, and alters neutral winds. Numerical simulations are used to understand and characterize the ionosphere-thermosphere response to solar eclipses and to compare the model results with observations. The models have traditionally implemented simplified solar eclipses, assuming spherically symmetric models with the maximum eclipse (obscuration) set to ~15%. We present a realistic model of solar eclipses, using Solar Dynamic Observatory (SDO) Atmospheric Imaging Assembly (AIA) images of the solar corona. This model computes the eclipse occultation factors as a function of geolocation and time for a chosen SDO AIA wavelength. The model includes an interface to retrieve raw high-resolution SDO AIA, the model includes horizon computation for a smooth and accurate transition at the terminators. The model is 100% pythonic, featuring parallel execution. We present observations and numerical simulations of the ionosphere-thermosphere system bolstering the importance of the accurate EUV eclipse description. We present use 21 August 2017, and 10 June 2021 solar eclipses as examples to show the effects of realistic EUV flux and transient gradients within the penumbra, and compare it with simulations using symmetric penumbra. We integrated the EUV penumbra in the Global Ionosphere Thermosphere Model (GITM), and show that the difference between EUV and symmetric eclipse amounts to as much as plus-minus 1 TECu.