Influence of Solar Flare Irradiance on Nitric Oxide in the Lower Thermosphere and Ionosphere

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Most of the energy in solar flare irradiance lies at solar soft X-ray wavelengths below 7 nm and especially below 2 nm. This energy is deposited in the altitude region near 110 km where Nitric Oxide (NO) peaks in concentration. NO is crucial to the structure of the lower thermosphere and ionosphere as it is a key source radiative of cooling and leads to the production of NO+, the terminal ion in many processes. The production of NO is driven by ionization of N2 and so solar flares photons efficiently lead to the production of NO. The integrated solar irradiance below 7 nm has been measured at high time cadence since the launch of the Solar Dynamics Observatory (SDO) by its EUV Variability Experiment (EVE). We use 1D and 3D models of the upper atmosphere driven by EVE observations updated at each time step to examine the spatial and temporal distribution of NO produced in response to a solar flare. We show that there is strong variation with altitude in both the magnitude and the time scale of the response. In addition, the small flares that EVE observes on many days induce horizontal variability that is significant and unseen in models that are not driven with solar irradiance updated in time steps on the scale of minutes to an hour. Model results are validated through comparisons to observations of both NO abundance and radiance.