IMPACT OF THE BASTILLE DAY SOLAR FLARE ON THE LOW- TO MID-LATITUDE IONOSPHERE

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We study the impact of the Bastille Day solar flare radiation on the low- to mid-latitude ionosphere. The methodology is as follows. We develop an EUV irradiance spectrum based upon observations for the Bastille Day flare. Since solar irradiance observations typically do not have the cadence necessary to follow the evolution of a flare, we have developed techniques for computing flare spectra from the available solar data. We then use this spectrum in the NRL three-dimensional ionosphere model SAMI3 to obtain the global impact of the flare on the mid- to low-latitude ionosphere. SAMI3 (Sami3 is Also a Model of the Ionosphere) is the NRL ionosphere code that models the plasma and chemical evolution of seven ion species (H^+, He^+, N^+, O^+, N_2^+, NO_2^+ and O_2^+) in the altitude range 85 km – 20,000 km. The complete ion temperature equation is solved for three ion species (H^+, He^+ and O^+) as well as the electron temperature equation. Ion inertia is included in the ion momentum equation for motion along the geomagnetic field. An offset, tilted dipole geomagnetic field is used and the plasma is modeled from hemisphere to hemisphere. No high altitude boundary conditions are not needed since a complete ionospheric flux tube is modeled. In addition, the $\mathbf{E} \times \mathbf{B}$ drift motion of the plasma is included for both zonal electric fields (vertical drifts) and meridional electric fields (zonal drifts). SAMI3 uses a nonorthogonal, nonuniform, fixed grid. The grid is designed to optimize the numerical mesh so that the spatial resolution decreases with increasing altitude. We assess the flare's impact by comparing simulation results with and without the solar flare enhanced EUV spectrum. A previous study using the NRL two dimensional ionosphere model SAMI2 and a more simplistic EUV spectrum of the Bastille Day storm found that flare radiation can increase the F-region ionosphere density by up to 50% [Meier et al., Geophys. Res. Lett. 29, 10.1029/2001GL013956, 2002].

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