Solar Flare Effects on the Thermosphere and Ionosphere

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The Solar Extreme-ultraviolet Experiment (SEE) on the TIMED satellite and by the X-ray Photometer System (XPS) on the SORCE satellite provide the first comprehensive irradiance measurements of the complete solar spectrum during large solar flares. However, the soft X-ray portion of these observations are performed using silicon photodiodes coated with metallic filters to provide photometric measurements with multiple band passes, which leads to complexities in obtaining spectral information. A new analysis technique developed specifically for flare conditions is used to infer flare spectra in this region. These are combined with spectrographic measurements in the extreme ultraviolet and far ultraviolet, and applied to the NCAR Thermosphere-Ionosphere-Electrodynamics General Circulation Model (TIE-GCM). The electron content, neutral density, and airglow response to large flares during the declining phase of solar cycle 23 are calculated using this model and compared to several measurement sets, obtaining good agreement. This supports both the validity of the solar X-ray analysis and the modeling methodology, showing that although flare-driven effects in the upper atmosphere are significant, they are shorter and of much smaller magnitude than geomagnetic disturbances.