A Combined Solar and Geomagnetic Index for Thermospheric Climate

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Infrared radiation from nitric oxide (NO) at 5.3 μm is a primary mechanism by which the thermosphere cools to space. The SABER instrument on the NASA TIMED satellite has been measuring thermospheric cooling by NO for over 13 years. Physically, changes in NO emission are due to changes in temperature, atomic oxygen, and the NO density. These physical changes however are driven by changes in solar irradiance and changes in geomagnetic conditions. We show that the SABER time series of globally integrated infrared power (Watts) radiated by NO can be replicated accurately by a multiple linear regression fit using the F10.7, Ap, and Dst indices. This fit enables several fundamental properties of NO cooling to be determined as well as their variability with time, permitting reconstruction of the NO power time series back nearly 70 years with extant databases of these indices. The relative roles of solar ultraviolet and geomagnetic processes in determining the NO cooling are derived and shown to be solar cycle dependent. This reconstruction provides a long-term time series of an integral radiative constraint on thermospheric climate that can be used to test climate models.