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Round the Clock Ground-based Observations of Space Weather Effects on the Thermosphere and Ionosphere Using Imaging Spectroscopy

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Visible optical emissions from the upper atmosphere carry signatures of the complex manifestation of the Sun-Earth connection. For a comprehensive understanding of the Space Weather effects on the thermosphere and ionosphere, we need to extend ground based optical observations to daytime (sunlit hours).

We have developed, tested and deployed two versions of an imaging spectrograph that is capable of routinely measuring faint airglow/auroral emissions buried in the bright solar background continuum of the daytime sky in the visible wavelength range. A multi-wavelength instrument, called High Throughput Imaging Echelle Spectrograph (HiTIES), has been used to simultaneously measure several optical emission features located anywhere in the visible range at moderate (0.03nm) resolution. The High Resolution Imaging Spectrograph using Echelle grating (HIRISE) has been used to study sunlit airglow and auroral emissions at higher (0.01 nm) resolution.

These rugged instruments have been deployed at several geophysically interesting sites including Sondre Stromfjord, Svalbard, Boston and Carmen Alto. They have been used to investigate such wide-ranging solar-terrestrial problems as the forecasting of Equatorial Spread-F development using 630.0nm dayglow, sunlit cusp as well as the October 30, 2003 daytime aurora over Boston. These proof-of-concept experiments have been validated by simultaneous, independent observations and have demonstrated the value of this new tool for studies of the dynamical processes in space physics and aeronomy.

We are presently incorporating improved capabilities and plan to deploy these instruments for tomographic studies. In this paper we will review the scientific contributions we have made, our future plans and outline their continued role in the investigations of the Sun-Earth connection.

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