Project Details

ROSES ID: NNH06ZDA001N
Selection Year: 2007
Program Element: Focused Science Topic

Topic: Solar Origins of Irradiance Variations

Project Title:
Understanding the sources of the solar spectral and total irradiance variability and forecasting tools

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Summary:
We propose new research into the physical origins of the UV solar spectral irradiance variations and their contribution to the total. This research will expand tools we have developed to relate the visible and infrared solar spectral irradiance variations to features observed on the solar disk, namely active regions and network, through semi-empirical atmospheric models constructed to explain their spectra. Our approach is based on the physical processes of non-Local Thermodynamic Equilibrium (NLTE) radiative transfer and observational diagnostics of physical parameters characterizing the solar atmosphere. This approach uses high-quality solar images at key wavelengths together with our published semi-empirical models, and has been very successful in reproducing observed spectral irradiance variations for lambda>400 nm during the last few years.

We propose here extending our techniques to the UV solar spectral irradiance, in the range 100-400 nm, and developing forecasting tools better than the currently available proxy methods. This wavelength range displays important variability and is critical for photochemical reactions and heating of the Earth s upper atmosphere and those of other planets.

By using image analysis and spectral irradiance synthesis in combination with far-side helioseismic imaging and data analysis of Lyman alpha backscattering from the interplanetary medium (observed by the SOHO/SWAN instrument) we will be able to infer the radiation spectra in any direction and forecast the solar irradiance based on the knowledge of the distribution and radiative characteristics of the active regions. Our research can produce very high spectral resolution (up to / ~106) and greatly improved predictions of UV spectral irradiance that can be used modeling the Earth s atmosphere .

This research has important applications for understanding long-term spectral and total irradiance trends, for connecting solar dynamo and magnetic field studies with the Sun's radiative output, and for short-term (~2 weeks) forecasting of the Earth radiative environment that is critical for predicting satellite drag.

Publication References:

Summary: no summary

Reference: Fontenla, J., Balasubramaniam, K.S., & Harder, J. 2007, "Semi-Empirical Models of the Solar Atmosphere. II. The Quiet-Sun Low-Chromosphere at Moderate Resolution" 2007, ApJ, 667, 1243

Summary: no summary

Reference: Fontenla, J., Curdt, W., Avrett, E.H., & Harder, J. 2007, "Log-Normal Intensity Distribution of the Quiet-Sun FUV Continuum Observed by SUMER", A&A, 468, 695

Summary: no summary

Reference: Fontenla, J.M., Peterson, W.K., & Harder, J. 2008, "Chromospheric Heating by the Farley-Buneman Instability", A&A, 480, 839

Summary: no summary

Reference: Platnick, S. & Fontenla, J.M. 2008, "Model Calculations of Solar Spectral Irradiance in the 3.7 um Band for Earth Remote Sensing Applications," Journal of Applied Meteorology & Climatology, 47, 124

Summary: no summary

Reference: Fontenla, J. M.; Curdt, W.; Haberreiter, M.; Harder, J.; Tian, H.; (2009), Semiempirical Models of the Solar Atmosphere. III. Set of Non-LTE Models for Far-Ultraviolet/Extreme-Ultraviolet Irradiance Computation, The Astrophysical Journal, Volume 707, Issue 1, pp. 482-502, doi: 10.1088/0004-637X/707/1/482