Possible Extraterrestrial Solar Radiation (ETR) Spectral Variations in the Ultraviolet and Visible: A Test for Ground-based Instrumentation

E.G. Dutton[1] and P. Disterhoft[2]

[1]NOAA Earth System Research Laboratory, 325 Broadway, Boulder, CO 80305; 303-497-6660, E-mail: ells.dutton@noaa.gov
[2]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309

There have been recent (2009/10) suggestions, based on satellite observations and certain theoretical estimates, that the magnitude of spectral variations of the ETR over the course of the last (and presumably other) sunspot cycle(s) could be considerably larger than previously known. These variations, when incorporated into global atmospheric models, have indicated a profound impact on both stratospheric ozone and the global heat budget with subsequent substantial effects on atmospheric circulations and hence decadal-scale climate. Although not intended to monitor the ETR but rather ozone-induced changes, near continuous spectral solar irradiance observations (300 nm to < 450 nm) at the earth's surface were begun by GMD and others in the mid 1990s and continue to date. It is proposed that with careful selection of these observations, the solar cycle ETR spectral variations can be further investigated. The selection of data is based on the availability of clear pristine days and use of an appropriate spectral range where no significant spectral variations are introduced by atmospheric constituents. This proposition is further based on the rather large magnitude and distinctive spectral signature of the recently suggested variations. This presentation will report on a preliminary effort to identify a subset of the proposed spectral ETR changes using surface observations from Mauna Loa Observatory (MLO). The spectrometer used at MLO was designed and built by the New Zealand National Institute for Water and Atmospheric Research (NIWA) and has been operated jointly by NIWA and GMD. The measurements are routinely calibrated with both internal and external standard lamps traceable to NIST and the instrumentation has proven to be remarkably stable and robust over the course of its near continual deployment at MLO. Our preliminary results (Fig. 1) suggest that many of the spectral features are similar between model-provided results and the observations. The intent of the ongoing investigation is to provide independent constraints for the recently suggested ETR spectral variations from satellite observations and various models. Similar observations have been made at other higher altitude GMD sites at the South Pole and Boulder that will be incorporated into this work. Further work will also include extending the useful wavelength range of the surface observations by accounting for ozone and atmospheric pressure variability. A near continuous, several-days-per-week, time series of these results over the past 16 years can be obtained from the MLO observations.

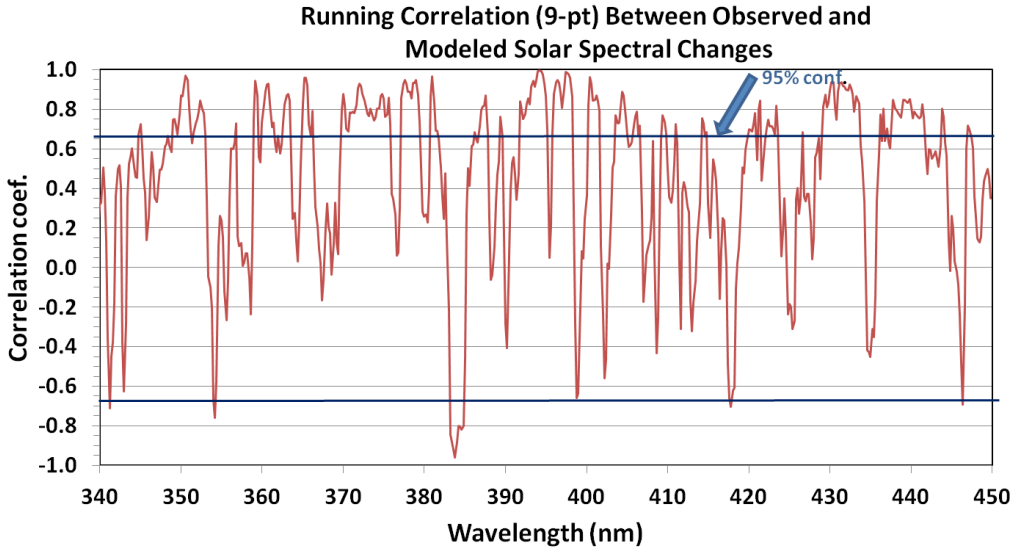

Figure 1. Correlation between the MLO surface-observed and modeled ETR solar spectra differences between high and low solar activity, (April. 2004 and Nov. 2007 respectively).