Irradiance Observations from the UARS/SUSIM and ATLAS/SUSIM Experiments

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The SUSIM (Solar Ultraviolet Spectral Irradiance Monitor) on board the UARS (Upper Atmosphere Research Satellite) has measured the solar UV output from 120 nm to 400 nm on a daily basis since October 1991. A reference channel records a solar spectrum semi-annually only to reduce the instrument degradation of this channel and to provide long-term stability marks. Four deuterium lamps are used at monthly, semi-annual and annual intervals to provide long term calibration of the instrument. A preliminary analysis of the long term stability of SUSIM-UARS indicates that the precision of the instrument should be better than a few percent. The repeatability of two scans is better than 0.2%. A simplified SUSIM instrument is flying on NASA's ATLAS Spacelab missions anually to provide calibration points for the SUSIM-UARS.

The ultraviolet variability below 400 nm shows two distinguishable components, of chromospheric and photospheric origin. The chromospheric component is dominated by plage emission, and correlates well with other chromospheric indices, such as the 10830 Å index. The photospheric component is determined by the sunspot radiation deficit in umbras and penumbras. Sunspots, in specific cases, can modulate the continuum emission in the entire wavelength region from 120 nm to 400 nm. Below the Al edge at 210 nm the continuum emission can be reduced by up to 5% if the radiation deficit of sunspot is not being compensated by strong plage emission. This is caused by the increasing photosphere/penumbra contrast with decreasing wavelength and the large size of penumbras, which have a larger contrast in the ultraviolet than in the visible spectrum. However, strong plage emission dominates the UV variability below the Al edge. Above the Mg edge at 260 nm sunspots dominate the UV variability which correlates well with the variation of the total solar irradiance and anticorrelates with chromospheric indices. In the transition wavelength region between the Al edge at 210 nm and the Mg edge at 260 nm, the UV variability is caused by a complex mixture of the chromospheric and photospheric components. The wavelength dependence of the UV variability is complicated even further by the change from a chromospheric component in the center of strong Fraunhofer lines to a photospheric component in the wings of these lines. Emission line variability strictly follows the chromospheric component. One case of short-term variability over a period of several days shows an ultraviolet energy deficit of 0.5 W/cm^2 integrated over the wavelength region 120 nm to 400 nm, which is equal to the energy deficit of the total solar irradiance. It remains to be seen, whether this is a more general rule.

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