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Measured Higher IR Irradiance on Solar Eclipse day

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Abstract

Direct solar irradiance between 1200 and 1700 nm have been measured using ground-based IR spectroradiometer during October 24, 1995, solar eclipse over Delhi (28.7°N, 77.2°E, 220 MSL), India. The irradiance value was found to be increased before and after the solar eclipse event. The variation in the IR irradiance has been compared with the control day observations over Delhi.

Key Words : Solar eclipse, IR irradiance

Introduction

The Sun provides energy to the terrestrial atmosphere in the form of radiation and, obscuration of solar eclipse is an important event for the earth's atmosphere. The rapid change in the light intensity of the sky and apparent sudden darkening at totality have developed a tremendous interest in the measurement of sky radiation during solar eclipse. Measurement of UV and visible radiation during solar eclipse and its theoretical calculations have been reported by several workers (Srivastava *et al.*, 1982; Potemkin, 1981; Silverman and Mullen, 1975; Shaw, 1978; Sharp *et al.*, 1971; Velasquez, 1971; Lloyd and Silverman, 1971; Hall, 1971). But, as per our knowledge no measurement is available of the IR radiation which constitutes about 42% of the total incoming solar radiation (Houghton, 1985) and plays an important role in the earth's radiation budget. Therefore, to study the changes in IR radiation during the solar eclipse on 24 October 1995, we have carried out some observations before, during and after the solar eclipse day.

Experimental set up and Observations

The details of the experimental setup have been discussed in the companion paper (Bose *et al.*, 1997) Observations of the variability of radiation components during a solar eclipse

were made over Delhi, India on 24 October 1995. Control day observations were also taken before and after solar eclipse day. The maximum obscuration of the sun was 95.7% at 08:29 (IST). The sky condition was exceptionally good. In spite of the lower signal to noise ratio in infrared region, the observations yielded interesting changes in the measured solar irradiance.

Results and discussion

Direct solar irradiance has been measured in the spectral range 1200 to 1700 nm. Atmospheric water vapour has strong absorption at about 1400 nm and also there are several other weak absorption lines present near 1400 nm. The absorption due to earth's atmospheric species are negligible at about 1200 nm and 1600 nm. Therefore these wavelengths, i.e. 1200 nm and 1600 nm have been used for the study of solar irradiance during the solar eclipse event.

The irradiance measured during different phases of the eclipse with respect to other control days are shown in Figures 1-3. An increase in the measured irradiance has been observed before and after the solar eclipse time as compared to normal day observations (Figures 1 and 3). During the maximum phase of the eclipse the measure irradiance found to be much lower compared to normal day observations as shown in Fig. 2.

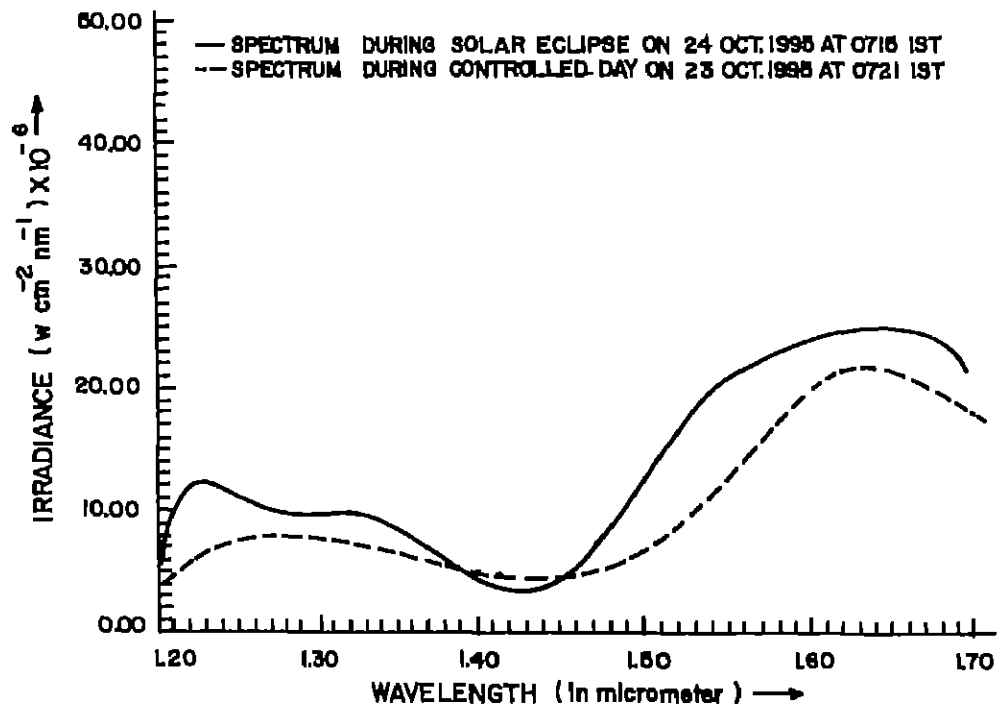

Figure 1 : Observed solar irradiance between 1200 nm and 1700 nm over Delhi before the solar eclipse.

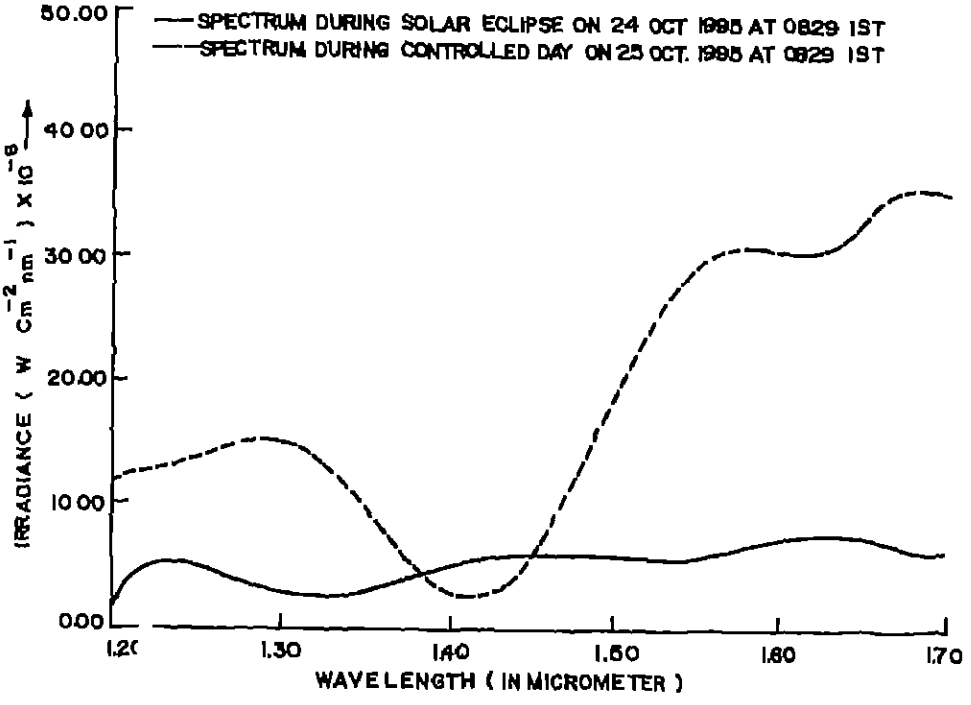

Figure 2 : Observed solar irradiance between 1200 nm and 1700 nm over Delhi during solar eclipse.

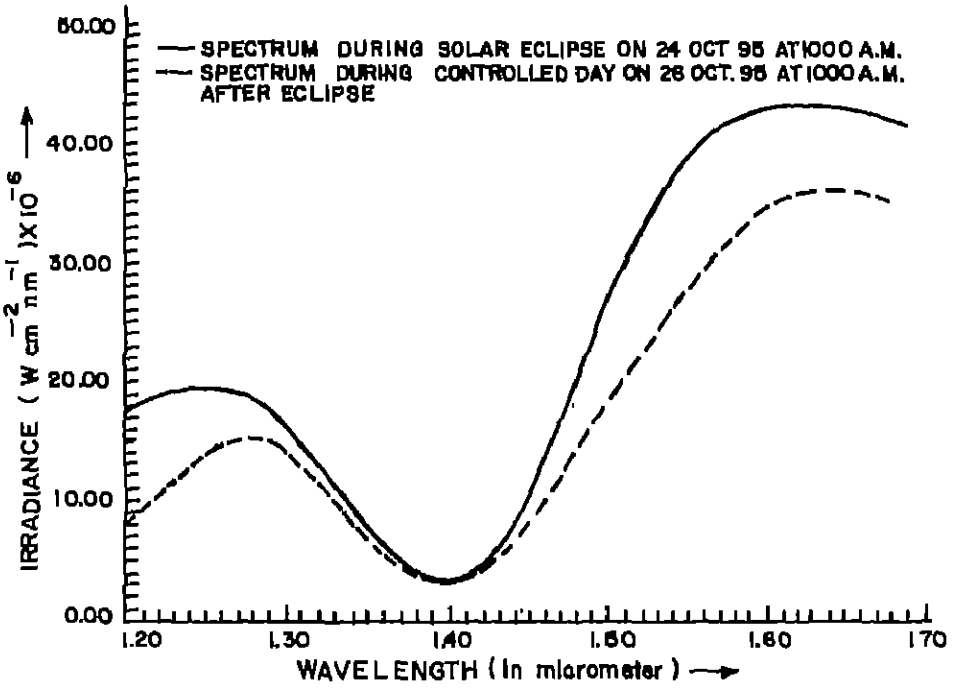

Figure 3 : Observed solar irradiance between 1200 nm and 1700 nm over Delhi after solar eclipse.

During the solar eclipse, sharp decrease in air temperature has been observed and that might have changed the phase of water vapour to liquid water. The presence of liquid water may lead to the formation of bigger size aerosols due to coagulation, and these type of aerosols scatter the higher wavelength of radiation. As shown in the figures described above, the measured higher irradiance before and after the solar eclipse period might be due to the lunar positioning during eclipse or due to the scattering of larger size aerosols present in the atmosphere. The instrumental field of view is about 5°. On the eclipse day, before and after the eclipse event, sun as well as moon both come into the field of view of the instrument. Thus the measured higher irradiance might be due to the combined effects of solar as well as lunar emissions. The reflected light or emitted light from the day side moon might have modulated the incoming solar radiation and caused the increase of the irradiance before and after the solar eclipse.

Conclusion

The measured higher irradiance before and after the solar eclipse may be due to the presence of atmospheric aerosols or due to the lunar positioning during the solar eclipse. The measured higher irradiance is important to study the radiation characteristics during the eclipse. It is also important to find the exact cause of such an increase.

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