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Solar Ultraviolet Flux Variation in the Biological Band during the Total Solar Eclipse of October 24, 1995

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Abstract

Solar UV B Flux measurements have been made at four discrete wavelengths of 290,300, 310 and 320 nm during and around the solar eclipse day of 24th October 1995. The Diurnal variation of the UV flux has shown a significant decrease following the obscuration of the sun during the eclipse. However, during the recovery phase, the flux has shown a sharp increase compared to the normal control day values, for about one to two hours depending on the wavelength. The direct solar flux recorded in the visible and near IR wavelengths did not show any such increase, indicating that there could be some atmospheric ozone decrease either at the surface level or in the columnar level leading to an increase in the measured global UV Flux.

Key Words : Solar UV flux, Solar eclipse, Radiometer, Ozone

Introduction

A number of studies have indicated a direct relationship between atmospheric Ozone and solar activity. The most plausible mechanism coupling these two is the change in the solar flux from solar maximum to solar minimum and the consequent changes in the solar UV flux intensities. Changes in the UV flux during solar eclipse may contribute to local Ozone changes to various extents depending on the height under consideration (Subbaraya *et al.*, 1982 and Chatterjee *et al.*, 1982). With these facts in mind, the solar UV flux in the biological band has been measured during the total solar eclipse of 24th October 1995 with a view to examine the changes in the ground reaching solar ultra violet flux at 290, 300, 310 and 320 nm. Another experimental system namely the Multiwavelength Radiometer which measures the direct solar flux in the visible and near Infra Red regions has also been operated to see the relative changes in the flux at visible and IR wavelengths as compared to that at UV wavelengths.

Experiment

The UV B Photometer measures the integrated (direct plus diffuse) solar flux at 290, 300, 310 and 320 nm. The wavelength selection is done through narrow band interference filters and the direct and diffuse flux integration is done through an integrating sphere coated with barium sulfide. After the integrating sphere the flux is focused onto a Photomultiplier tube for further processing. The UV Photometer has been calibrated at the National Physical Laboratories for retrieving the absolute solar flux in Watts/Sq.cms/nm. The Multiwavelength Radiometer measures the direct solar flux at nine different wavelengths viz. 400, 450, 500, 600, 650, 750, 850, 940 and 1025 nms using narrow band interference filters (Krishna Moorthy *et al.* 1993). It has got the collimating optics for getting the direct solar beam which is focused on a Photo diode amplifier (UDT 455) for further processing. The system tracks the sun.

Results and Discussion

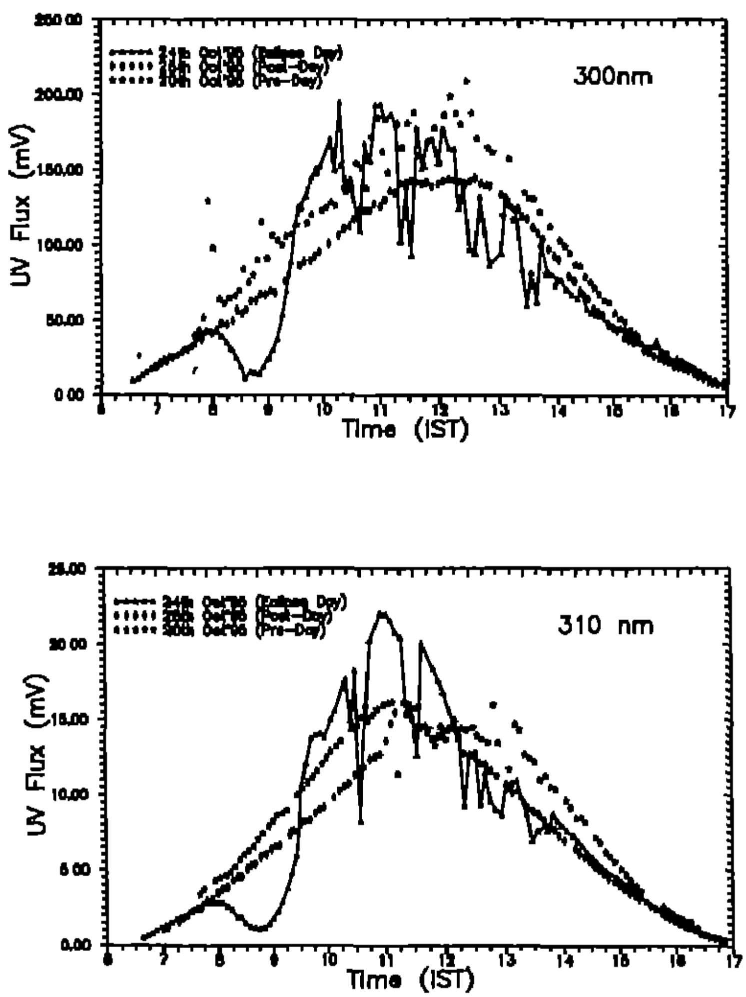

Figure 1 : Diurnal variations of UV flux on control days and on the day of total solar eclipse.

Figure 1 shows the measured solar UV B flux at two typical wavelengths namely the 300 and 310 nm on solar eclipse day of 24th October 1995 and for two control days 20th and 25th October 1995. It may be observed from this figure that the UV flux started decreasing with the first contact of the eclipse at 07:32 hrs on 24th and minimum UV flux was recorded at the time of maximum obscuration at 08:44 hrs with no time lag. The flux started recovering with the decrease of the solar obscuration during the recovery phase. One interesting point observed was the sharp increase of the UV flux during the recovery phase and also beyond the control day values after the eclipse. This increase has been observed for about two hours after the eclipse and it slowly regained the normal control day values with in about two hours. This feature was observed at all the four UV wavelengths under consideration.

The direct solar flux recorded at various wavelengths in the visible and Infra red regions by the Multiwavelength Radiometer has also shown the typical decrease and recovery with the onset and recovery of the eclipse. However, the increase beyond the control day values seen at the Ultra violet wavelengths was not seen at the visual and near IR wavelengths.

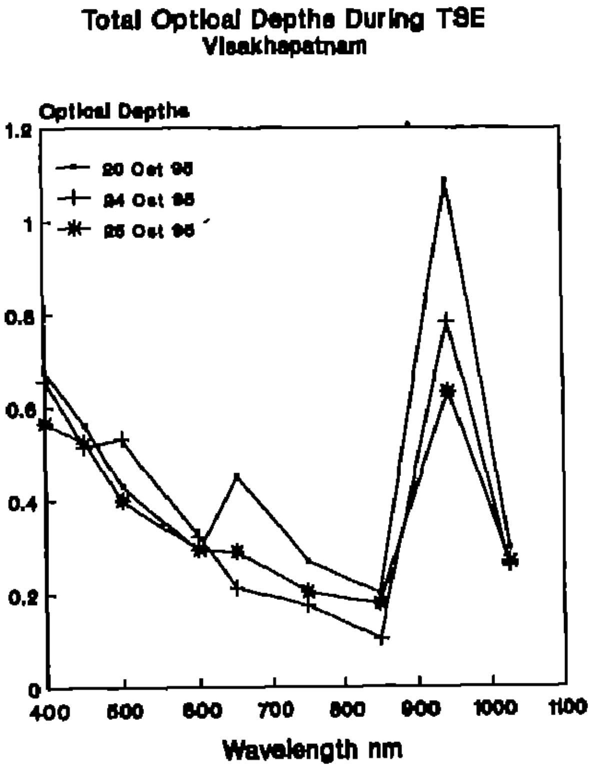

Figure 2 : Total optical depths retrieved from the multiwavelength radiometer measurements.

Fig. 2 shows the total optical depths retrieved from the multiwavelength radiometer data (Krishna Moorthy *et al.*, 1993) which do not show much of a change for the eclipse and non eclipse days indicating that the neutral composition of the atmosphere did not change significantly which could lead to an increase in the UV flux. There is only a marginal increase in the atmospheric water vapour content as indicated by an increase in the optical depth at the 935 nm which is the central wavelength for the absorption band of the water vapour. However, the measured direct flux at 600 nm which is close to the Chappius ozone absorption band has also shown a slight increase in the flux for about an hour after the eclipse. From these observations, it is felt that there could be a drop in the atmospheric ozone level during the eclipse which might have caused an increase in the solar UV flux transmission in the biological band. This could be either at the surface level which may result in a greater effect in the diffuse UV flux or in the columnar level which could effect both the direct as well as the diffuse fluxes. We have made theoretical calculations to estimate the extent of ozone drop that can cause the observed changes in the UV flux and our preliminary estimate shows that it could be approximately by 15 to 20 DU. Further analysis to identify other causes, if any, is in progress.

References

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