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Stratospheric Ozone and Ultraviolet-B Radiation Measurements at Saturna Island, British Columbia in 1992

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STRATOSPHERIC OZONE AND ULTRAVIOLET-B RADIATION OBSERVATIONS AT SATURNA ISLAND, B.C. FOR JUNE TO DECEMBER, 1992.

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INTRODUCTION

Stratospheric ozone depletion has become a concern due to the increasing atmospheric concentrations of ozone depleting substances. In response to this concern, the Atmospheric Environment Service has installed a Brewer Spectrophotometer at Saturna Island, B.C. (48'47", 123' 08") to monitor both total column ozone and ultraviolet-B (UV-B) radiation. This paper compares total column ozone and UV-B radiation for the last half of 1992 for Saturna Island, B.C. with the 13 year (1978-1991) average.

METHODOLOGY

Daily total column ozone and daily maximum UV-B radiation values were obtained from the Saturna Island spectrophotometer site for the period July through December 1992. The Brewer Spectrophotometer measures total column ozone. However, on average, approximately 97% of this ozone is in the stratosphere (Mészaros 1981). Cloudiness late in the year resulted in some cases of missing ozone thickness data. Ozone and UV-B observations were compared to weekly averages of total column ozone and UV-B abstracted from climatologies developed by Burrows (Burrows et al 1992) from 13 years of ozone thickness observations. These observations were made by the Total Ozone Mapping Spectrometer aboard a U.S. polar-orbiting satellite. UV Index values were obtained from UV-B climatologies (Burrows et al, 1992) calculated from an empirical equation relating UV-B flux at the surface to ozone thickness and solar angle (Wilson et al 1992).

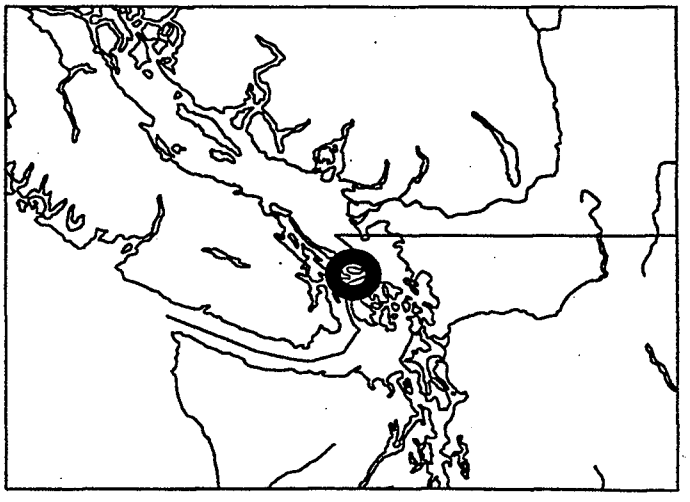

Figure 1. Saturna Island is located in Georgia Strait between Vancouver and Victoria, B.C.

DISCUSSION

Stratospheric Ozone

Stratospheric Ozone is normally measured in Dobson Units (DU). One DU represents 0.01 millimetre thickness of pure ozone at standard sea level temperature and pressure. In mid-latitudes, climatologically averaged ozone thicknesses usually peak in March and decline through the spring and summer, reaching their lowest point in October.

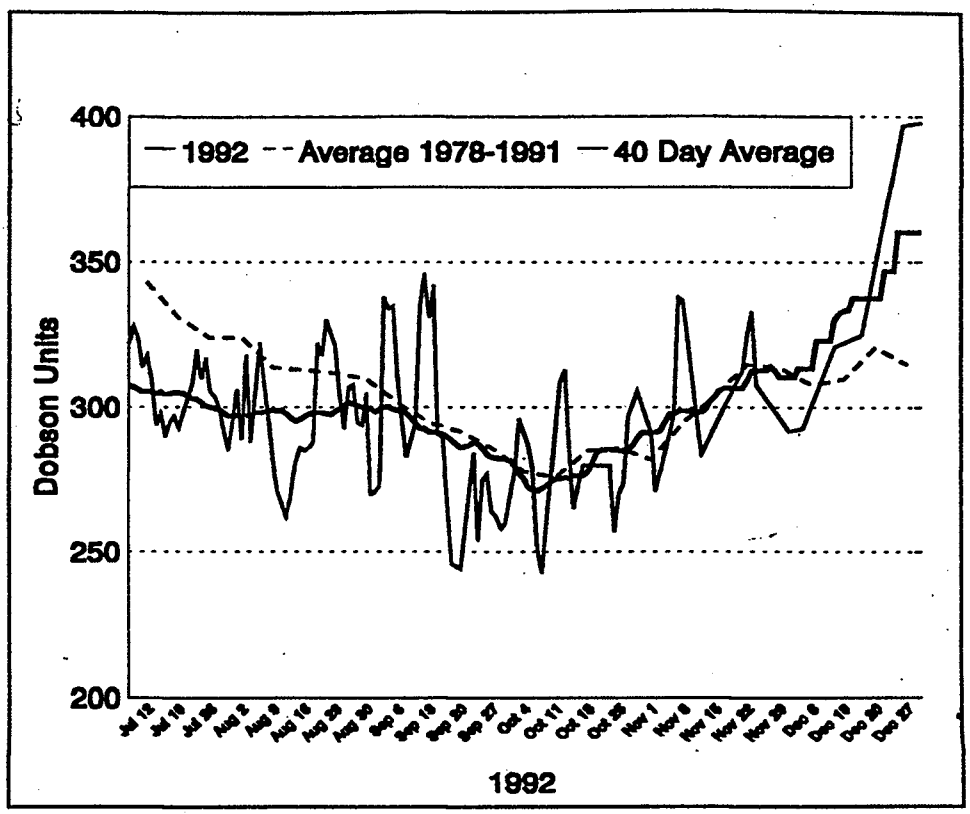

Figure 2. Total column ozone over Southwestern B.C. as measured at Saturna Island for the latter half of 1992.

Figure 2 shows the 1992 daily, the 1992 40-day moving average, and the long term (1978-1991) average total column ozone thicknesses over Saturna Island. 1992 data were only available for the period July 12-December 31. Average ozone thickness for July and August were 6% - 9% below the 1978-91 average. This may be partially attributed to a dominant upper ridge which has been shown to correlate with lower than normal ozone thicknesses (Wilson, 1992). Ozone thicknesses were near the long term average through the remainder of the year. The 40-day moving average ozone thickness reached a low of 243.4 DU on October 9 1992.

UV-B Radiation

The UV Index is calculated by weighting the measured UV-B radiation to account for increasing biological damage for shorter UV-B wavelengths. The UV Index is this weighted measurement, in milliwatts per square metre, divided by 25. Typical maximum daily UV Index values in July are about 8.0 for southern Canada (200 mw/m^2) and about 10.0 (250 mw/m^2)in the tropics. Annual maximum daily UV-B radiation for Saturna Island follows a bell curve shape with a maximum near the summer solstice and a minimum near the winter solstice.

Figure 3 shows the maximum observed daily UV Index at Saturna Island in the latter half of 1992. Also shown is the average clear-sky maximum daily UV calculated to have reached the site based upon an ozone climatology from 1978-1991 (Burrows 1992). The below average spikes in the 1992 time series are due to attenuation by thick cloud and rain. Comparison with figure 2 shows that above average UV Index values are associated with periods of lower than average ozone thickness. From mid-July through to the end of the year, maximum daily UV Index values were near the 1978-1991 average.

UV-B was below average from late August through December. However, due to extrapolation difficulties, late fall and winter UV Index climatology values may be imprecise. A comparison with figure 2 shows slightly above average stratospheric ozone during late fall and winter.

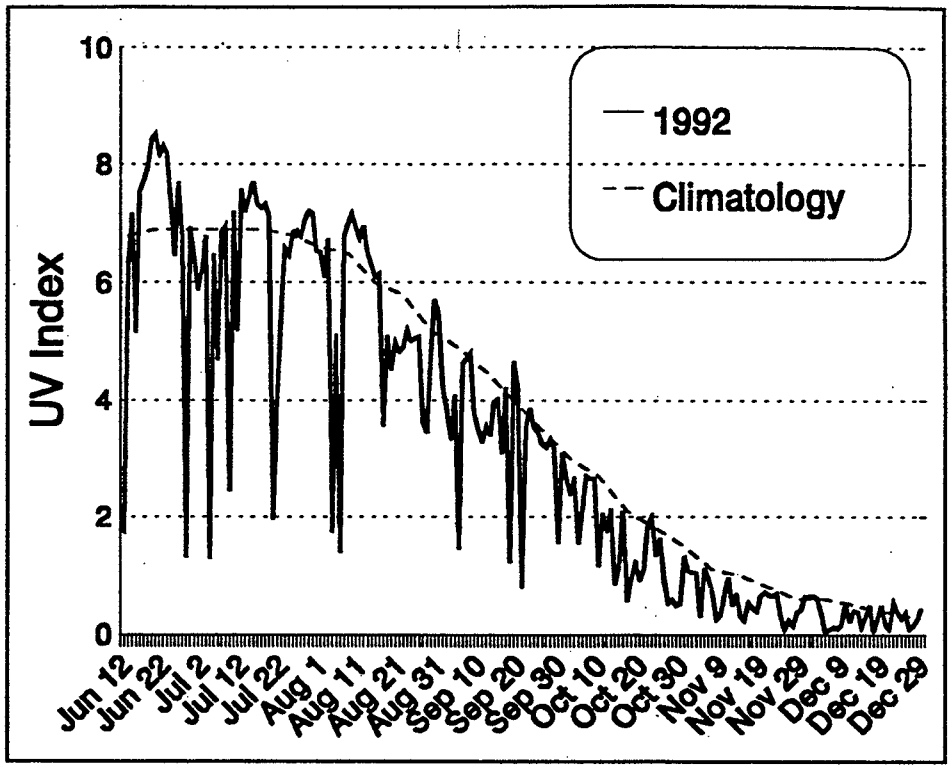

Figure 3. Ultraviolet Index values measured at Saturna Island, B.C. in 1992. Climatolgy is the 13 year (1978-1991) calculated average clear sky UV Index for the same location.

SUMMARY

Forty-day moving average total ozone thickness over Saturna Island, B.C. fell from about 310 Dobson Units (DU) in mid-July 1992 and to about 272 DU by early October. Ozone thickness averages then climbed to about 330 DU by the end of the year. These thicknesses were near the 13 year average, except for a thinner than average period in July.

For the period June 8 - December 31, 1992, the UV index at Saturna Island, B.C. reached a maximum of 8.5 on June 21, 1992. The UV Index was close to the 13 year average for the latter half of 1992, though it was slightly higher than average around the summer solstice.

REFERENCES -

Burrows, W.R., Vallee, M, Wilson, L.J., Climatology of Daily Total Ozone and Ultraviolet-B Radiation Levels, Atmospheric Environment Service, Research Report # 92-005. 1992.

Mészaros, E. Atmospheric Chemistry. 1981. Institute for Atmospheric Physics, Budapest, Hungary. Elsevier Scientific Publishing Company. 200 p.

Wilson L., Vallee M., Tarasick, D, Kerr J., Wardle D., Operational Forecasting of Daily Total Ozone and Ultraviolet-B Radiation Levels for Canada, Atmospheric Environment Service, Research Report # 92-004. 1992.