7.6. Barrow, Alaska

UV data from Barrow differ from the austral high latitude sites in several ways. The "ozone sensitive" plots, particularly the dose-weighted irradiance and the integrals around 300 nm, show much smaller variability than seen at the austral sites due to less severe ozone depletion in the Arctic. Figure 7.6.1 shows that total column ozone in 1999 was close to the maximum values measured between 1991-1994. This situation is similar to 1998, but quite different from 1997, when ozone values in March and early April dropped to the lowest value observed at Barrow.

The low ozone values on 5/12/99 appear as a peak in short-wave UV irradiance, like the 298.51 - 303.03 nm integral (Figure 7.6.2) and DNA-weighted irradiance (Figure 7.6.3). The influence of ozone is less obvious in UV-B irradiance (Figure 7.6.4) because this integral is less sensitive to ozone than DNA-weighted irradiance. In general, UV and visible measurements (Figure 7.6.5) of 1999 are comparable to data from the 1991-1998 period.

In contrast to the Antarctic sites, Barrow is in the northern hemisphere and consequently data are shifted by six months. Figure 7.6.6, Figure 7.6.7, and Figure 7.6.8 show daily DNA dose, daily erythemal dose, and daily irradiation in the 400-600 nm band, respectively. The 400-600 nm band indicates higher variability in May-October than during March and April. This pattern can also be found in the erythemal dataset and in the DNA doses, though less pronounced. This suggests that seasonal differences in UV doses are mostly caused by sun angle, albedo, and cloudiness rather than variation in total column ozone.

A direct comparison of DNA dose with 400-600 nm daily irradiation reveals a strong asymmetry between both datasets (Figure 7.6.9). The 400-600 nm curve is not centered around the summer solstice but appears to be shifted by about 15 days towards spring. The DNA curve on the other hand is nearly symmetrical with respect to solstice. The reasons for these differences have been evaluated in greater detail and the results were presented at the XXV General Assembly of the European Geophysical Society, Nice, France, April 25-29, 2000. The viewgraphs of the presentation "Effect of albedo and total column ozone on long-term spectral UV measurements in Barrow, Alaska" can be downloaded from www.biospherical.com. In brief, the analysis showed that the annual pattern in DNA dose can be quantitatively explained by the influence of the seasonal cycles of column ozone, cloud cover, and albedo. A more detailed discussion can be found in Section 7.9.

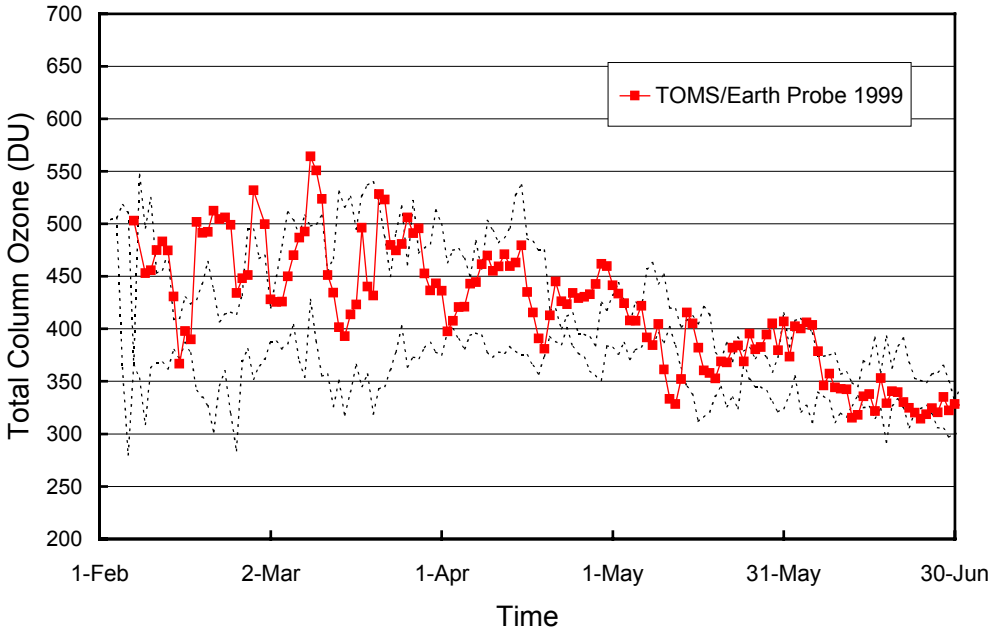

Figure 7.6.1. *Total column ozone at Barrow. TOMS/Earth Probe measurements from 1999 are contrasted with minimum and maximum values (broken lines) from the years 1991-1994 recorded by TOMS onboard NASA's Nimbus-7 and Meteor-3 satellites. A 1.5 year gap in data occurred after the loss of the Meteor-3 satellite in December 1994.*

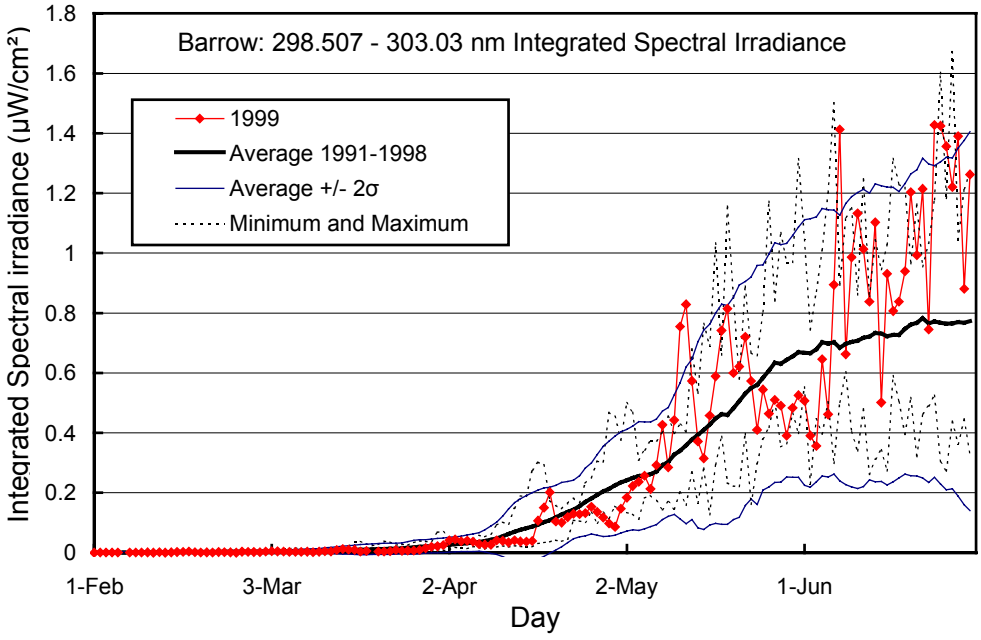

Figure 7.6.2. *Noontime integrated spectral UV irradiance (298.51 - 303.03 nm) at Barrow. The measurements from 1999 (diamonds) are contrasted with the mean of measurements taken from 1991 through 1997 (thick line). The thin lines are the mean ±2 standard deviation (±2σ) limits, also calculated for the 1991-1997 period. A ten-day running average was applied to both mean and mean ±2σ to reduce day-to-day fluctuations for clearer presentation. The broken lines represent historical (1991-1997) minima and maxima without data smoothing.*

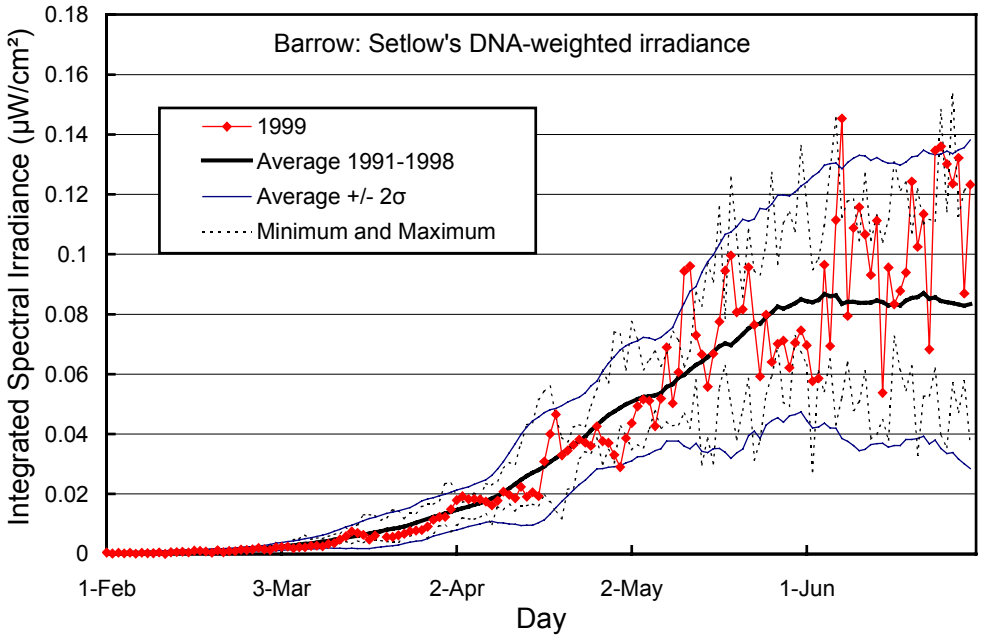

Figure 7.6.3. *Setlow's DNA-weighted irradiance at Barrow. Measurements from 1999 are contrasted with the mean of measurements taken from 1991 through 1997 (thick line). Thin lines and broken lines represent the mean±2σ limits, and historical minima and maxima values as in Figure 7.6.2.*

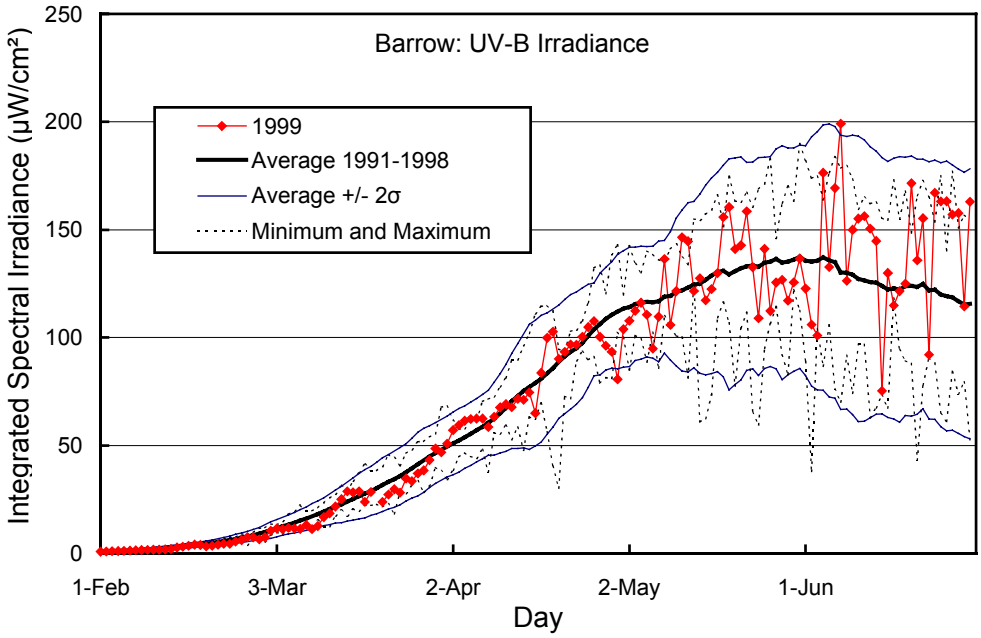

Figure 7.6.4. *Noontime Barrow UV-B Irradiance. Measurements from 1999 are contrasted with the mean of measurements taken from 1991 through 1997 (thick line). Thin lines and broken lines represent the mean±2σ limits and historical minima and maxima values as in Figure 7.6.2.*

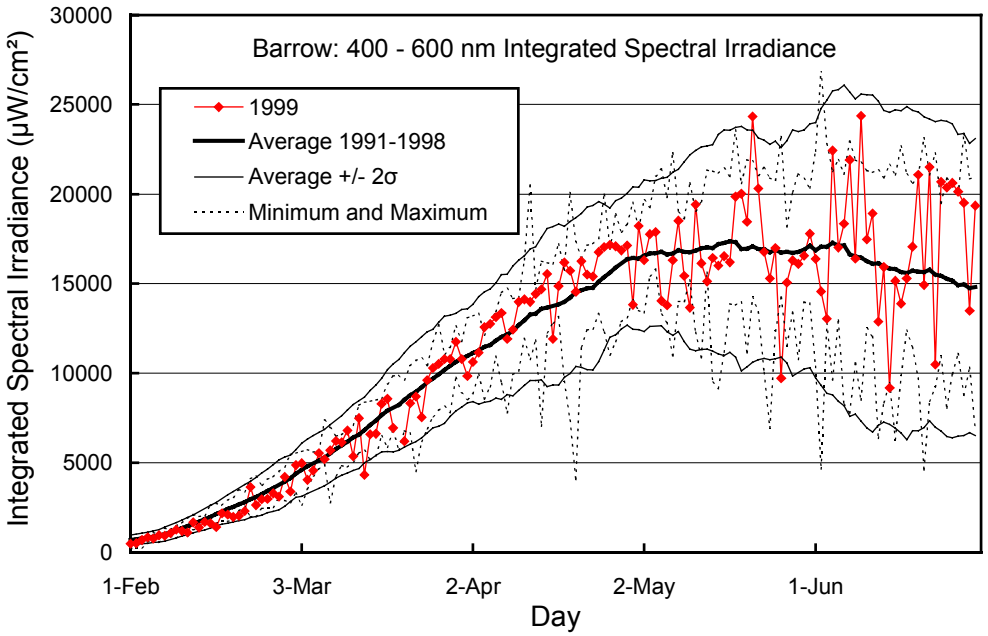

Figure 7.6.5. *Noontime broadband visible irradiance (400 - 600 nm) at Barrow. Measurements from 1999 are contrasted with the mean of measurements taken from 1991 through 1997 (thick line). Thin lines and broken lines represent the mean±2σ limits, and historical minima and maxima values as in Figure 7.6.2.*

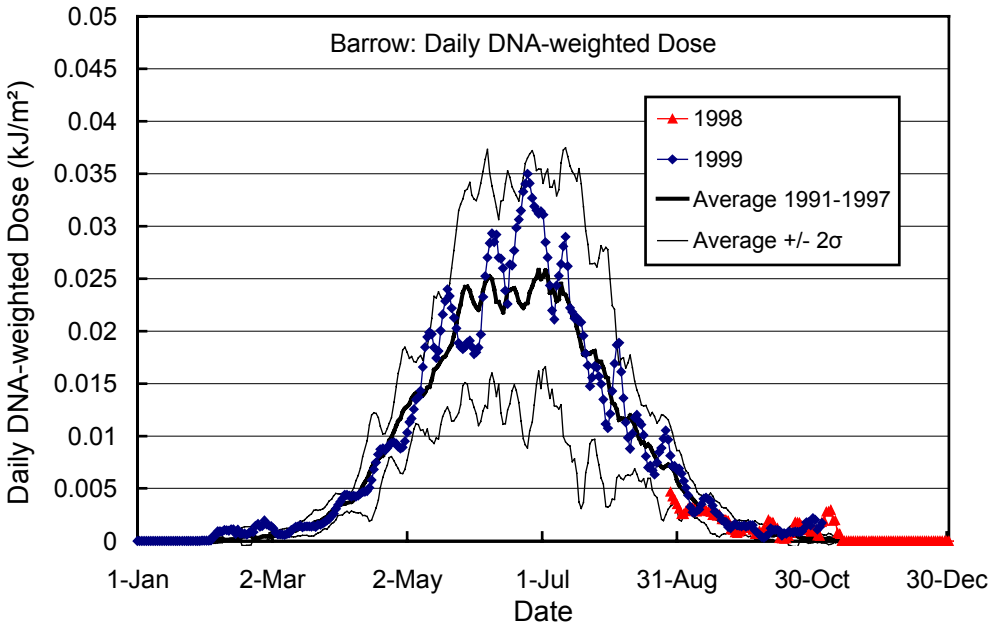

Figure 7.6.6. *Daily DNA-weighted dose for Barrow. The measurements from 1998 and 1999 are contrasted with the mean of measurements taken from 1991 through 1997 (thick line). The thin lines are mean±2σ limits, also calculated for the 1991-1997 period. A five-day running average was applied to all curves to reduce day-to-day fluctuations for clearer presentation.*

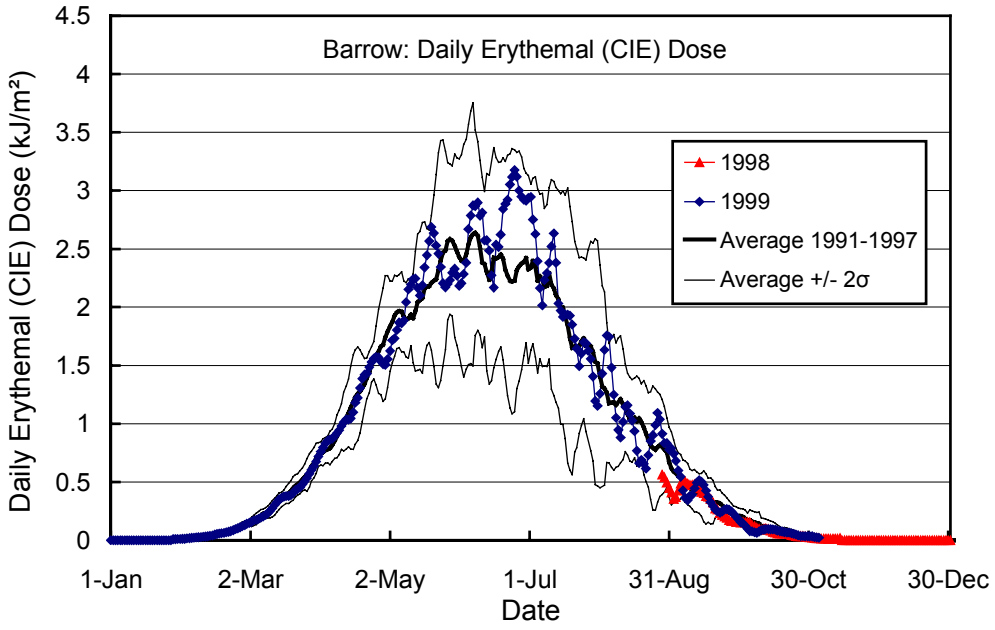

Figure 7.6.7. *Daily erythemal dose for Barrow. Measurements from 1998 and 1999 are contrasted with the mean of measurements taken from 1991 through 1997 (thick line). Thin lines represent the mean±2σ as in Figure 7.6.6.*

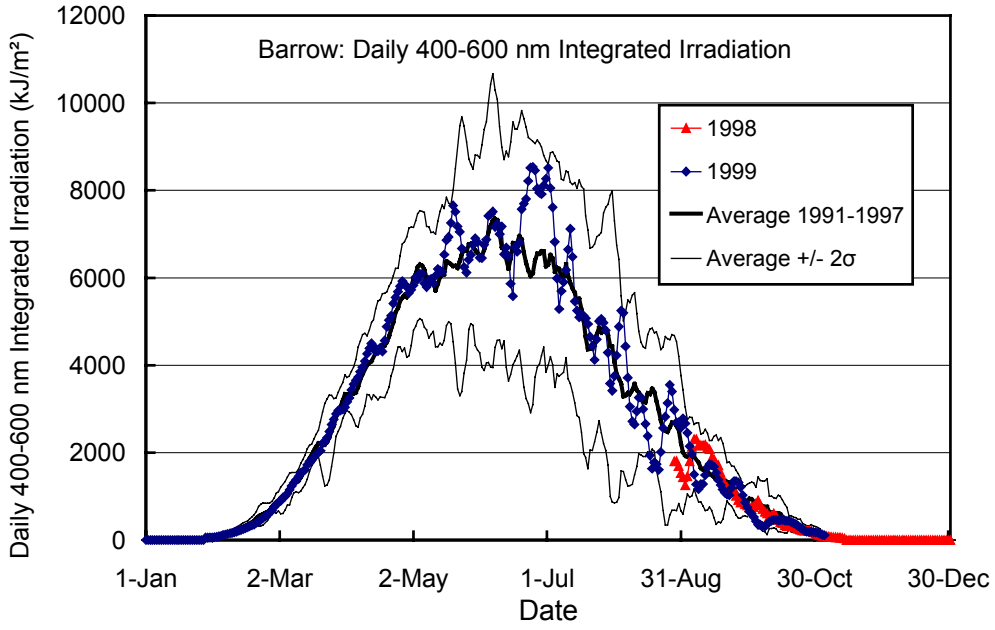

Figure 7.6.8. *Daily irradiation of the 400-600 nm band for Barrow. Measurements from 1998 are contrasted with the mean of measurements taken for 1991 through 1997 (thick line). Thin lines represent the mean±2σ as in Figure 7.6.6.*

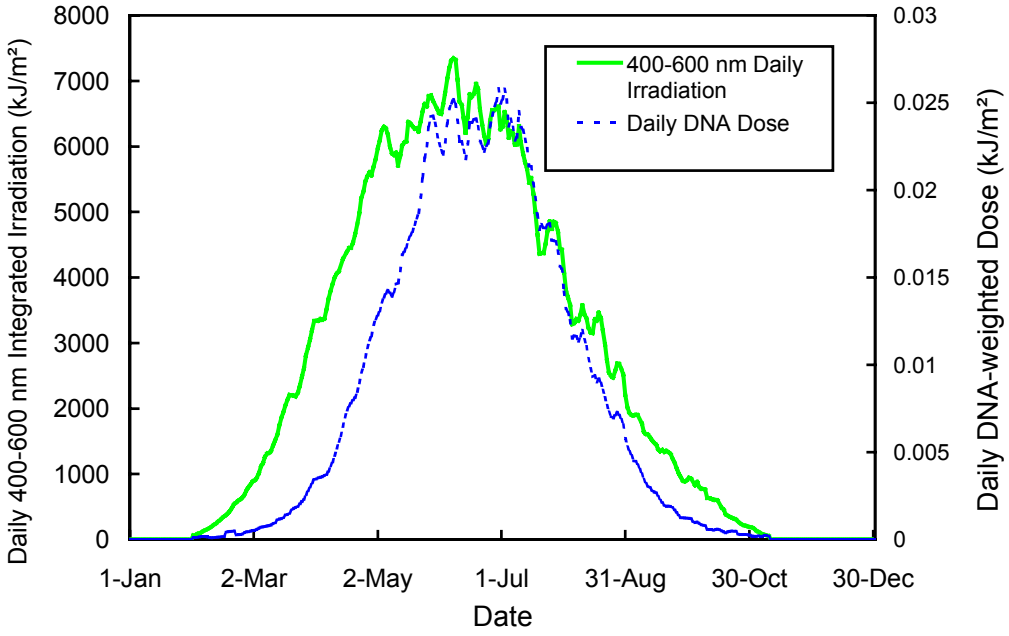

Figure 7.6.9. *Comparison of DNA-weighted dose (right axis) with daily irradiation in the 400-600 nm spectral range (left axis) at Barrow. Both curves represent the mean values for the period 1991-1997 with a 5-day running average applied.*