7.6. Barrow, Alaska

UV data from Barrow differ from the austral high latitude sites in several ways. For example, the “ozone sensitive” plots, particularly dose-weighted irradiance and the integral around 300 nm, show much smaller short-term variability than seen at the austral sites due to less severe ozone depletion in the Arctic.

Figure 7.6.1 shows the ozone climatology for Barrow. Column ozone values in 2000 were generally within the limits set by previous seasons. Between 3/12/00 and 4/14/00 ozone values were below the long-term average whereas they were slightly above average between 4/16/00 and 6/2/00. Worth mentioning is also a drop in ozone between 9/28/00 and 10/8/00. Ozone column measured by TOMS on 10/3/00 is the lowest of the whole dataset.

Note that during the 1999/2000 winter, the Third European Stratospheric Experiment on Ozone (THESEO 2000) sponsored by European Union and the NASA sponsored SAGE III Ozone Loss and Validation Experiment (SOLVE) took place. Although THESEO/SOLVE measurements were mainly performed over Northern Europe and Siberia, the results may also be interesting for the interpretation of measurements at Barrow. Scientists found that at altitudes around 18 km cumulative losses of over 60% have occurred between January and March. These were among the largest chemical losses at this altitude observed during the 1990s. The average polar column amount of ozone for the first two weeks of March was 16% lower than observed in the 1980's[1]. In contrast to the ozone losses reported by THESEO/SOLVE, the ozone reduction in Barrow was less severe; compared to the 1991-1999 average, ozone values in the second half of March 2000 were reduced by about 8% only.

The distinct drops in ozone on 3/25/00 and 10/3/00 occurred during days with low solar elevations. The effect can be seen as two barely noticeable “humps” close to the zero-line in the 298.51 - 303.03 nm irradiance integral (Figure 7.6.2). This demonstrates that low ozone values in March and October lead to negligible increases in UV radiation, because of the low sun angles prevailing during these months. The situation is different in the summer when the signatures of ozone changes can clearly be seen in UV data. For example, low ozone values on 7/15/00 and 8/16/00 coincide with peaks in the 298.51 - 303.03 nm integral. In contrast to the pattern of this wavelength range, day-to-day changes in noontime erythemal irradiance (Figure 7.6.3) show only little correlation with ozone. Most variability is introduced by clouds. Erythemal irradiance peaks on 6/5/00, a clear sky day with below-average ozone values.

Figure 7.6.4 and Figure 7.6.5 show the annual cycles in DNA-weighted daily dose and daily dose, respectively. Both doses are generally within the range of previous years with the exception of few days centered around 6/5/00 and 8/16/00, when both doses peak.

Daily irradiance in the 400-600 nm band (Figure 7.6.6) 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, and is caused by difference in cloudiness between in spring and fall.

A direct comparison of DNA dose with 400-600 nm daily irradiation reveals a strong asymmetry between both datasets (Figure 7.6.7). 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 of the 1998/99 Operations Report.

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[1] According to a press release issued by the European Commission, see http://europa.eu.int/comm/research/press/2000/pr0504en.html

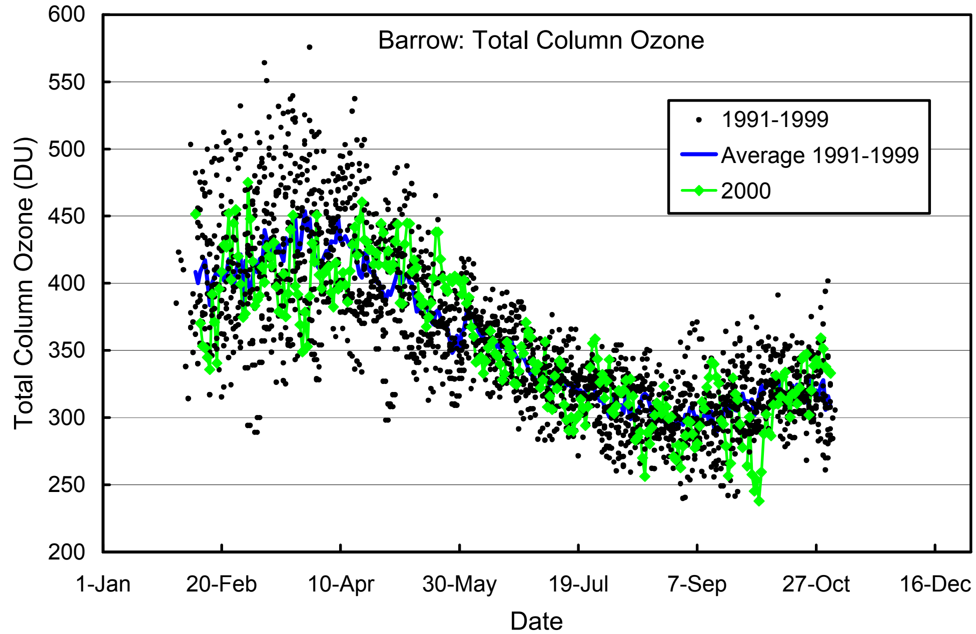

Figure 7.6.1. *Total column ozone at Barrow. TOMS/Earth Probe measurements from 2000 (diamonds) are contrasted with ozone data from the years 1991-1998 recorded by TOMS /Nimbus-7(1991-1993),TOMS/ Meteor-3 (1993-1994), NOAA/TOVS (1995-1996), and TOMS/Earth Probe (1997-1999) satellites.*

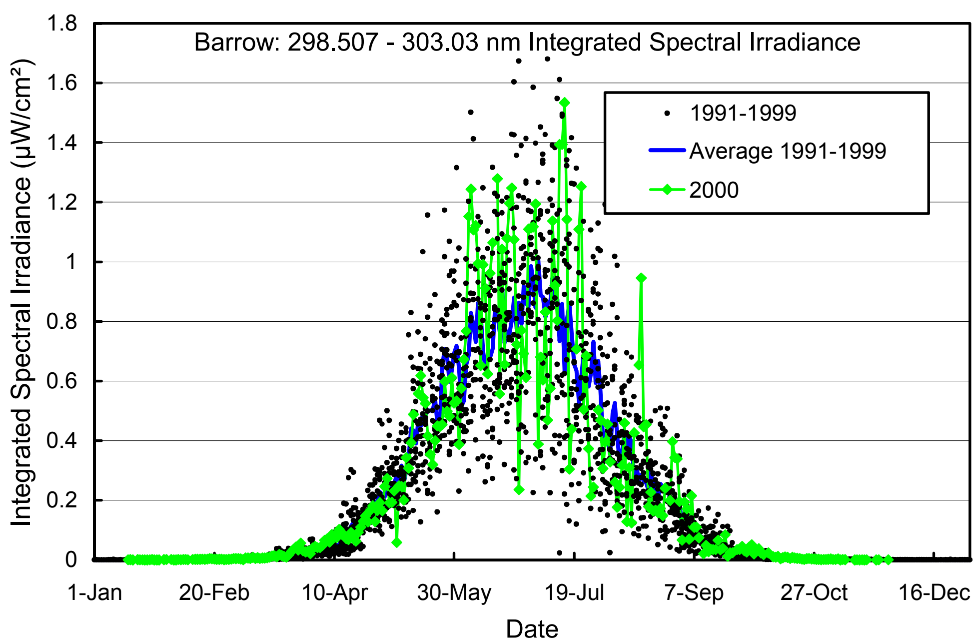

Figure 7.6.2. *Noontime integrated spectral UV irradiance (298.51 - 303.03 nm) at Barrow. Measurements from 2000 (diamonds) are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*

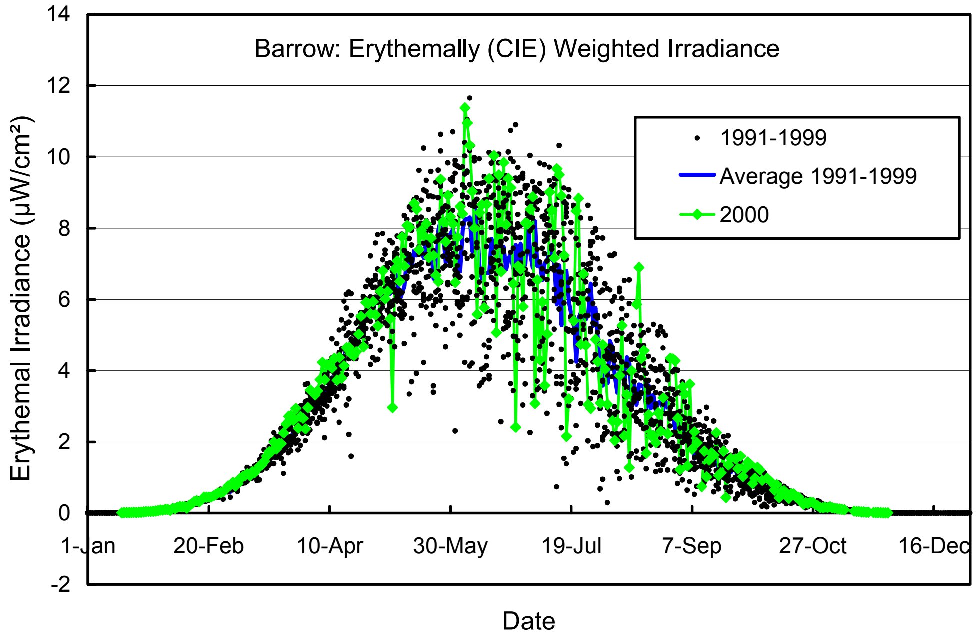

Figure 7.6.3. *Erythemally (CIE) weighted irradiance at Barrow. Measurements from 2000 (diamonds) are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*

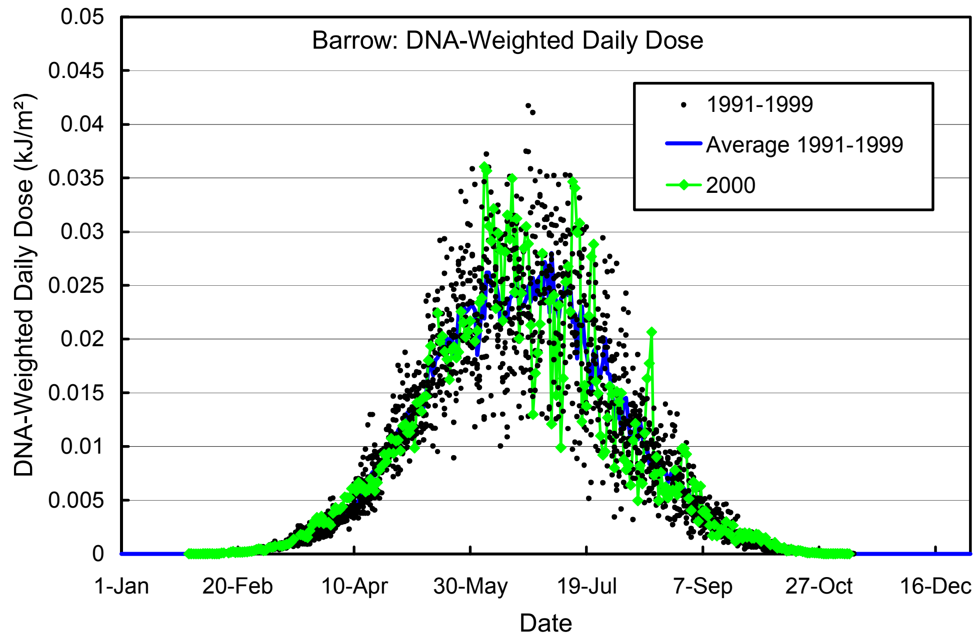

Figure 7.6.4. *Daily DNA-weighted dose at Barrow. Volume 9 measurements from 2000 (diamonds) are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*

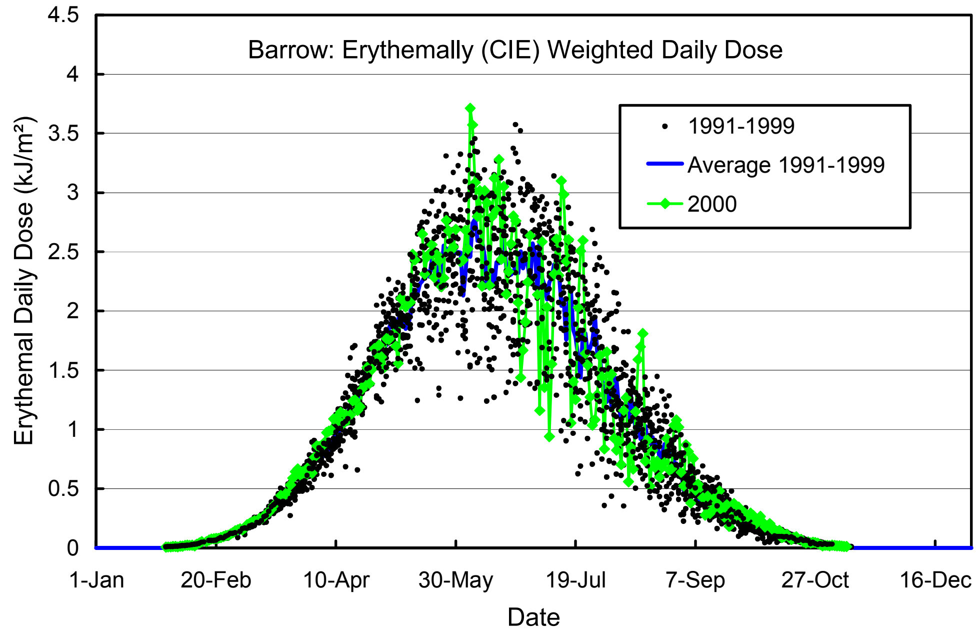

Figure 7.6.5. *Daily erythemal dose at Barrow. Volume 9 measurements from 2000 (diamonds) are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*

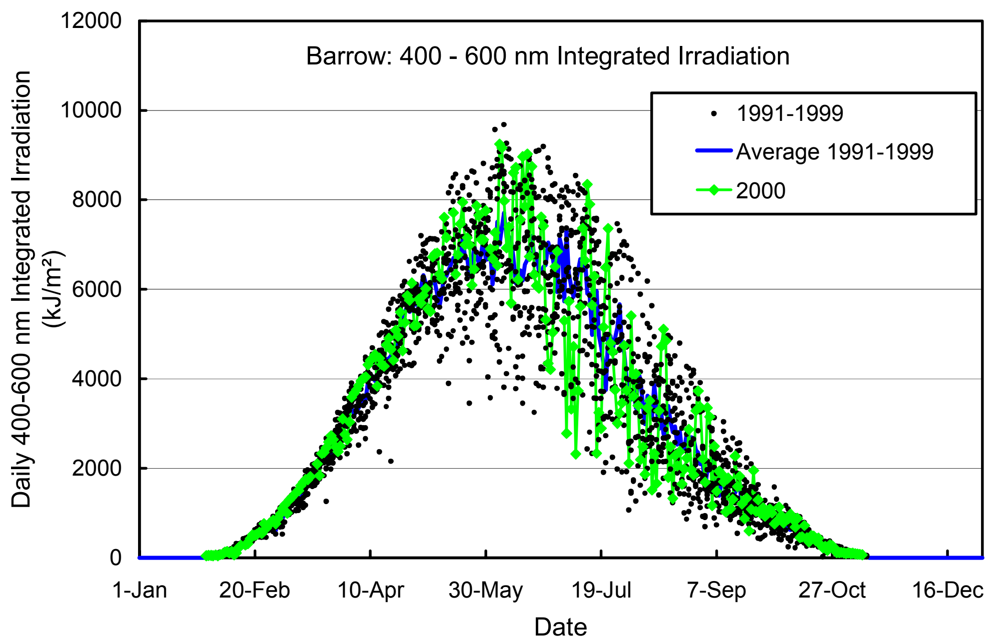

Figure 7.6.6. *Daily irradiation of the 400-600 nm band at Barrow. Volume 9 measurements from 2000 are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*

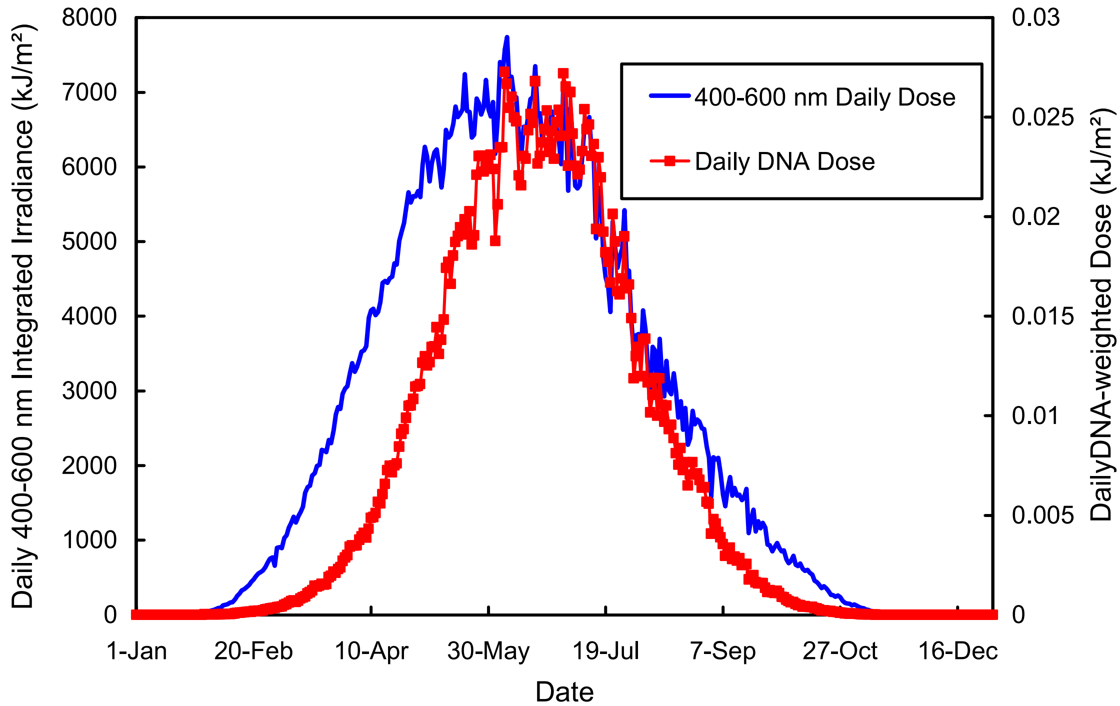

Figure 7.6.7. *Comparison of DNA-weighted dose (right axis) with daily irradiation in the 400-600 nm spectral range (left axis) at Barrow. Both curves are average values for the period 1991-2000.*