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.

In Figure 7.6.1, TOMS/Earth Probe column ozone values from 2001 are compared with ozone records from the years 1991-2000. During the spring 2001 (specifically until 5/28/01) ozone levels were generally higher than the long-term average. In particular in May, ozone values were slightly above the envelope formed by the data points of years prior to 2001. In the second half of 2001, ozone levels compared well with the records from the 1990s.

Several days in 2001 (i.e. 2/15/01, 5/14/01, 4/27/01, and 5/10/01) showed ozone values close to or slightly above 500 DU. Short-wave UV data of these days were generally below average, for example, the peak in ozone on 5/10/01 lead to a clear drop in the 298.51 - 303.03 nm irradiance integral (Figure 7.6.2). On the other hand, comparatively low ozone values during several days in summer (e.g. 6/4/01, 6/23/01, 7/3/01, 7/16/01) lead to spikes in the short-wave UV integral. Figure 7.6.2 also shows that short-wave UV levels in 2001 were generally low until end of May, which is consistent with the comparatively high ozone values observed during the period.

Noontime erythemally weighted irradiance (Figure 7.6.3) is considerably less affected by total ozone than the 298.51 - 303.03 nm irradiance integral. Most day-to-day variability in erythemal data is introduced by clouds. However, also erythemal irradiance peaks on 6/4/01, 6/23/01, 7/3/01, 7/16/01 when ozone is low.

Figure 7.6.4 and Figure 7.6.5 show the annual cycles in DNA-weighted daily dose and erythemally weighted daily dose, respectively. Generally, there is higher variability in May-October than during March and April. This dissimilarity is caused by the difference in cloudiness between in spring and fall. Doses in April and May 2001 tend to be lower than the long-term average, which can again be explained by the comparatively high ozone values in 2001.

Daily irradiation in the 400-600 nm band is shown in Figure 7.6.6. Values from 2001 agree well with measurements from the 1990s, as radiation in the visible is only very weakly affected by total ozone. Also visible radiation is much more affected by clouds during fall than during spring.

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 quantitatively be explained by the influence of the seasonal cycles of column ozone, cloud cover, and albedo. A more detailed discussion can also be found in Section 7.9 of the 1998/99 Operations Report.

Note that during March and April 2001, the campaign "Total Ozone Measurements by Satellites, Sondes, and Spectrometers at Fairbanks" (TOMS3F) took place. One objective of this campaign was to compare TOMS/Earth Probe ozone measurements at Fairbanks, Alaska, with data from balloon sondes and ground-based instruments in order to examine the performance and limitations of the different monitoring techniques. The SUV-100 UV spectroradiometer in Barrow also took part in this campaign. Total ozone column data was retrieved from the SUV-100 UV spectra and compared with TOMS ozone values and observations of a Dobson spectrophotometer operated by NOAA's Climate Monitoring and Diagnostics Laboratory (CMDL) at the CMDL facility near Barrow. SUV-100, TOMS and Dobson ozone values agreed to within ±2.5% for solar zenith angles (SZA) smaller than 75%, which is within the uncertainty of the new ozone retrieval algorithm. At larger SZAs, retrievals become dependent on the vertical ozone distribution. The analysis revealed that limited knowledge of the ozone profile increases the uncertainty of the calculated ozone values. More details of the new ozone retrieval algorithm and additional results of the comparison can be found in "G. Bernhard, C.R. Booth, J.C. Ehramjian, Comparison of measured and modeled spectral ultraviolet irradiance at Antarctic stations used to determine biases in total ozone data from various sources, in: *Ultraviolet Ground- and Space-based Measurements, Models, and Effects*, Proceedings SPIE 4482, 2001." An additional publication examining the long-term performance of ozone records from various instruments at Barrow is in preparation. Please contact Biospherical Instruments for further information.

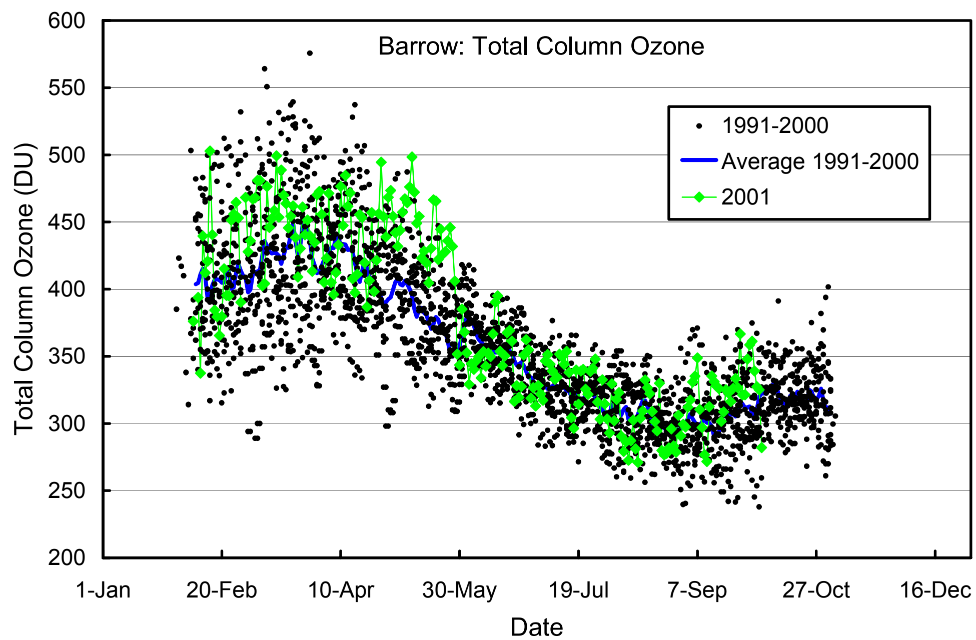

Figure 7.6.1. *Total column ozone at Barrow. TOMS/Earth Probe measurements from 2001 (diamonds) are contrasted with ozone data from the years 1991-2000 recorded by TOMS /Nimbus-7(1991-1993),TOMS/ Meteor-3 (1993-1994), NOAA/TOVS (1995-1996), and TOMS/Earth Probe (1997-2000) satellites.*

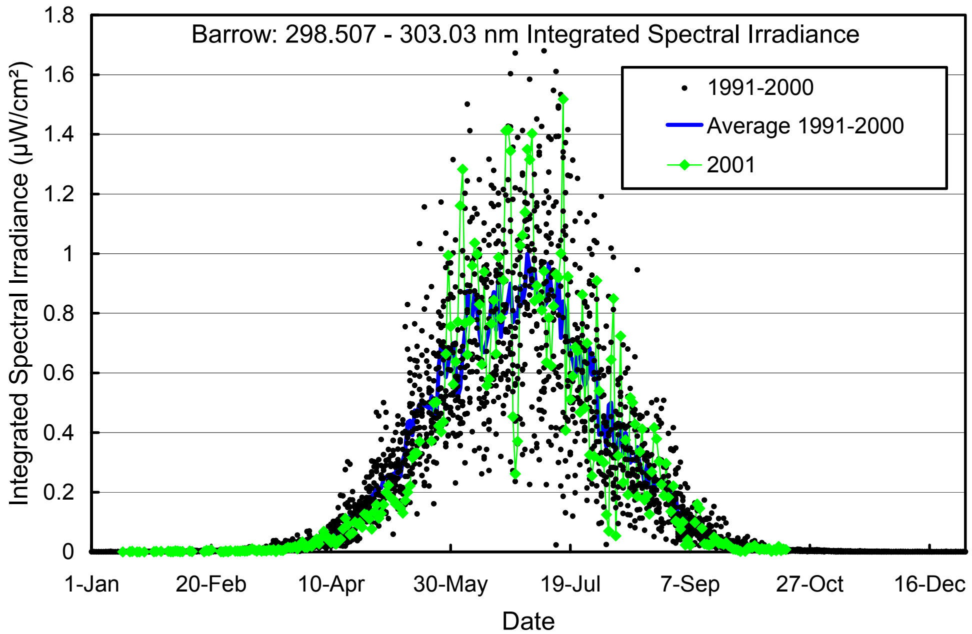

Figure 7.6.2. *Noontime integrated spectral UV irradiance (298.51 - 303.03 nm) at Barrow. Measurements from 2001 (diamonds) are contrasted with individual data points and the average of measurements taken between 1991 and 2000.*

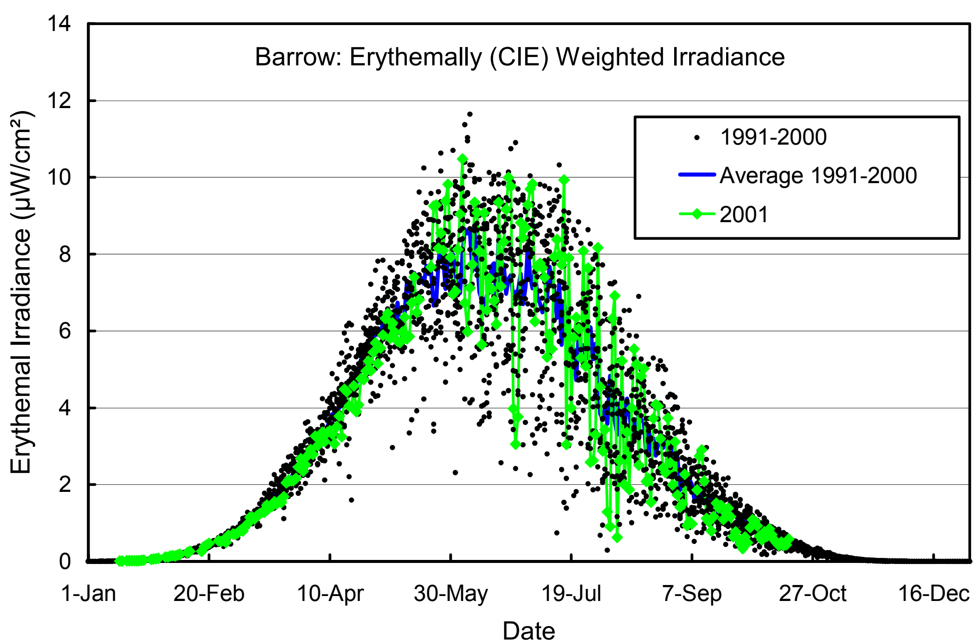

Figure 7.6.3. *Erythemally (CIE) weighted irradiance at Barrow. Measurements from 2001 (diamonds) are contrasted with individual data points and the average of measurements taken between 1991 and 2000.*

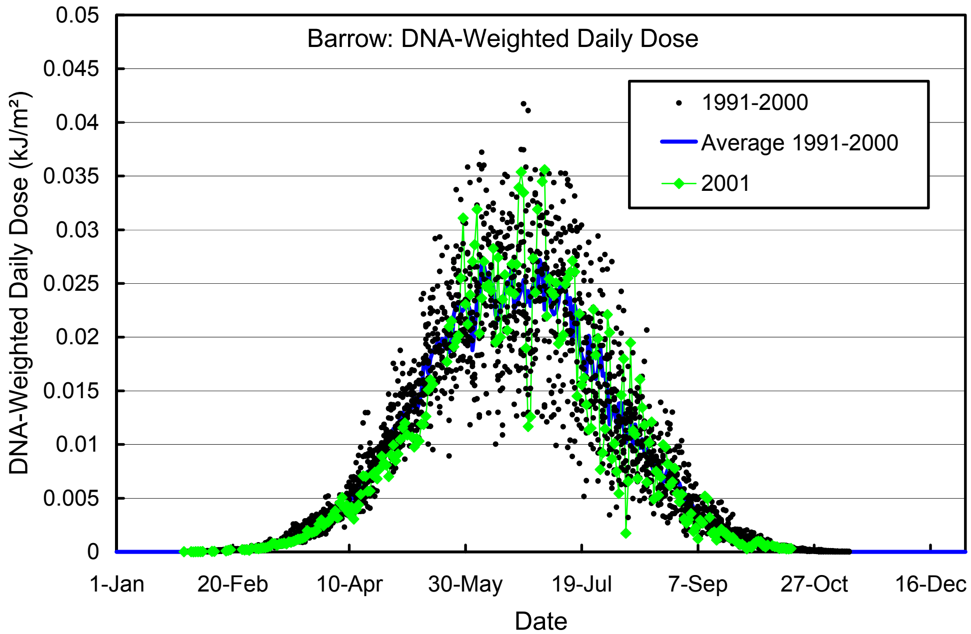

Figure 7.6.4. *Daily DNA-weighted dose at Barrow. Volume 10 measurements from 2001 (diamonds) are contrasted with individual data points and the average of measurements taken between 1991 and 2000.*

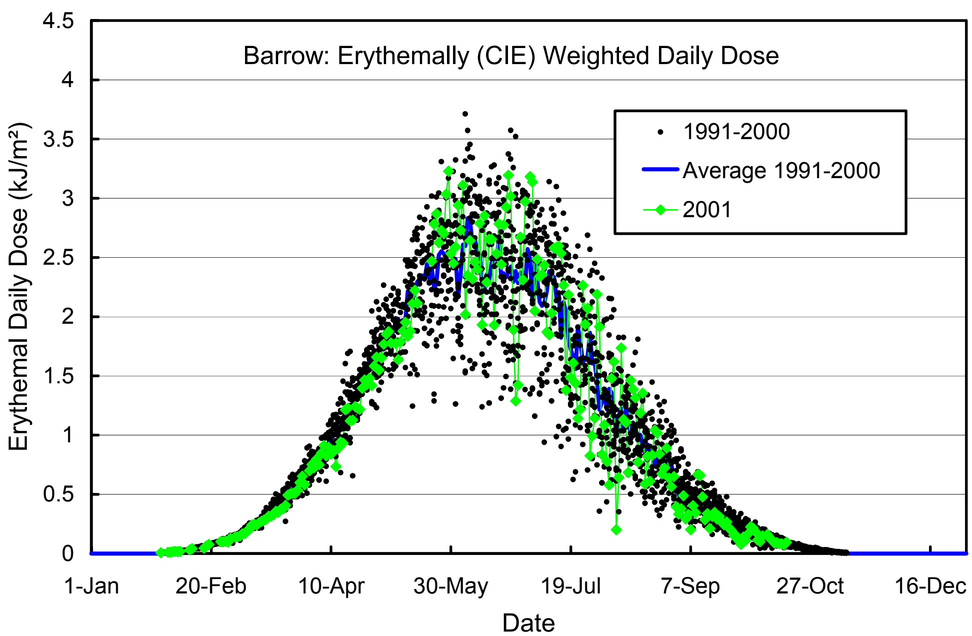

Figure 7.6.5. *Daily erythemal dose at Barrow. Volume 10 measurements from 2001 (diamonds) are contrasted with individual data points and the average of measurements taken between 1991 and 2000.*

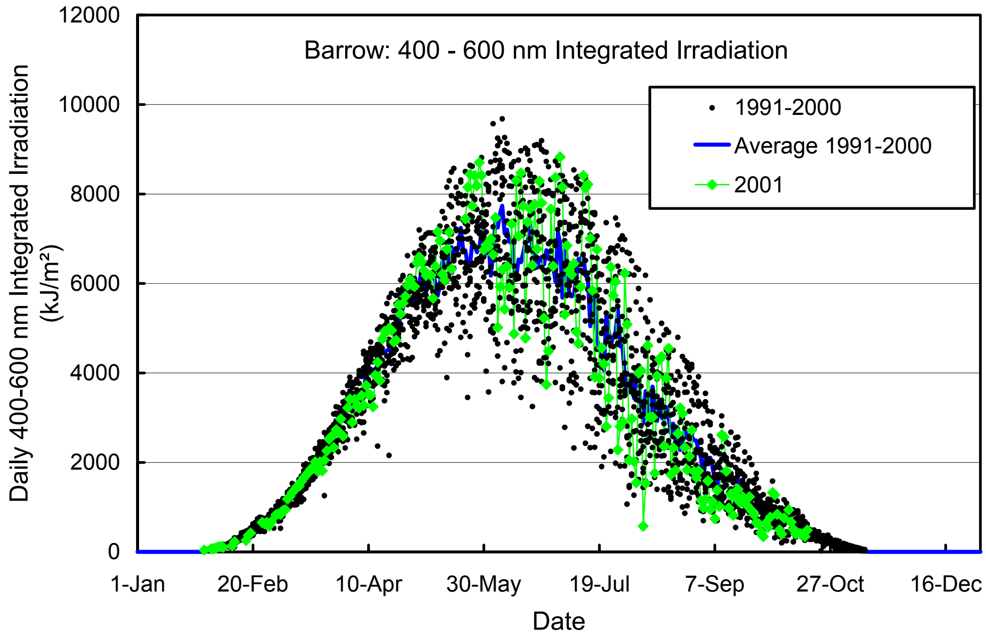

Figure 7.6.6. *Daily irradiation of the 400-600 nm band at Barrow. Volume10 measurements from 2001 are contrasted with individual data points and the average of measurements taken between 1991 and 2000.*

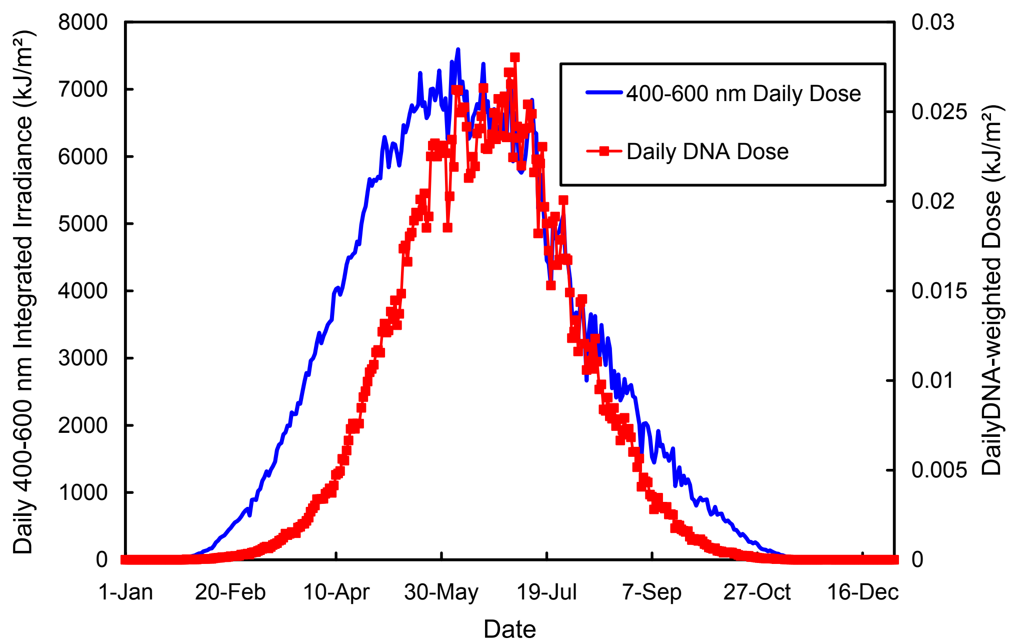

Figure 7.6.7. *Comparison of DNA-weighted dose (right axis) with daily irradiation in the 400-600 nm spectral range (left axis) at Barrow. Both curves are average values for the period 1991-2001.*