7.2. Palmer Station

The Antarctic "ozone hole" in the austral fall of 2002 was one of the smallest since 1988. The maximum total area in late September was about 19 million km^2, which is considerably less than the area of 26.5 million km^2 observed in 2001. The ozone hole was virtually gone by late-October, one of its earliest disappearances since more than a decade. The small size and early disappearance can be attributed to the occurrence of a comparatively large number of "planetary waves", which lead to a warming of the lower stratosphere. Warmer stratospheric temperatures lead in turn to a lower frequency of Polar Stratospheric Clouds, which help to transform inactive forms of chorine to ozone-destroying active forms. It should be pointed out that the small hole in 2002 is not an indication that the ozone layer is recovering. The small size is rather caused by an unusual global weather pattern in 2002.

Between 9/7/02 and 9/19/02, the ozone hole was approximately centered at the South Pole with its "outskirts" frequently reaching to Palmer Station. During this short period, total ozone column at Palmer Station was below the long-term average (Figure 7.2.1). On 9/24/02, the ozone hole split in two and the part that was closer to Palmer Station dissolved quickly during the following week. This lead to unusually large total ozone values: during the first three weeks in October, total ozone values reached values as high as 400 DU, which have not been observed during this month at Palmer since more than a decade. The remnant of the ozone hole was centered at the South Pole between 10/12/02 and 10/20/02. During this time, its size remained small and did not reach as far as Palmer. During the last week of October, it moved toward the Antarctic peninsula and was centered over Palmer Station on 10/31/02. This lead to a significant drop of total ozone column (Figure 7.2.1). During the first week of November, the hole continued to shrink and disappeared by 11/10/02.

The pronounced variation in total ozone can clearly be seen in UV measurements. Noontime values of the 298.51 - 303.03 nm integral were virtually zero until 10/21/02 (Figure 7.2.2). Values were comparable to the long-term average during the period 10/22/02-11/3/02 when the remnant of the ozone hole was centered over Palmer Station. From 11/4/02 onward, values were substantially below the long-term mean. Erythemally weighted noontime irradiance exhibited a similar pattern (Figure 7.2.3).

Figure 7.2.4 and Figure 7.2.5 show the annual cycles in DNA-weighted daily dose and erythemally weighted daily dose, respectively. In general, daily doses show a similar pattern in the day-to-day variation as noon-time UV levels. Doses observed during the first three months of 2003 compare well to historic records. Both figures also demonstrate that variability in daily UV doses is much lower between January and March than it is between September and November, the period affected by the ozone hole. Historically, UV levels measured during the austral spring have frequently been a factor of two to three higher, compared to values measured six months earlier. This was not the case in 2002, when spring and fall values were quite comparable.

Daily doses in the 400-600 nm range are shown in Figure 7.2.6. The plot indicates that radiation levels during 11/27/02 and 12/17/02 were significantly below the long-term mean. Low values were also measured by the pyranometer, which complements the spectral measurements. These low values can be attributed to unusually large cloud cover. A closer inspection of measurements performed between July and December 2002 revealed that there was no single clear-sky day during this period.

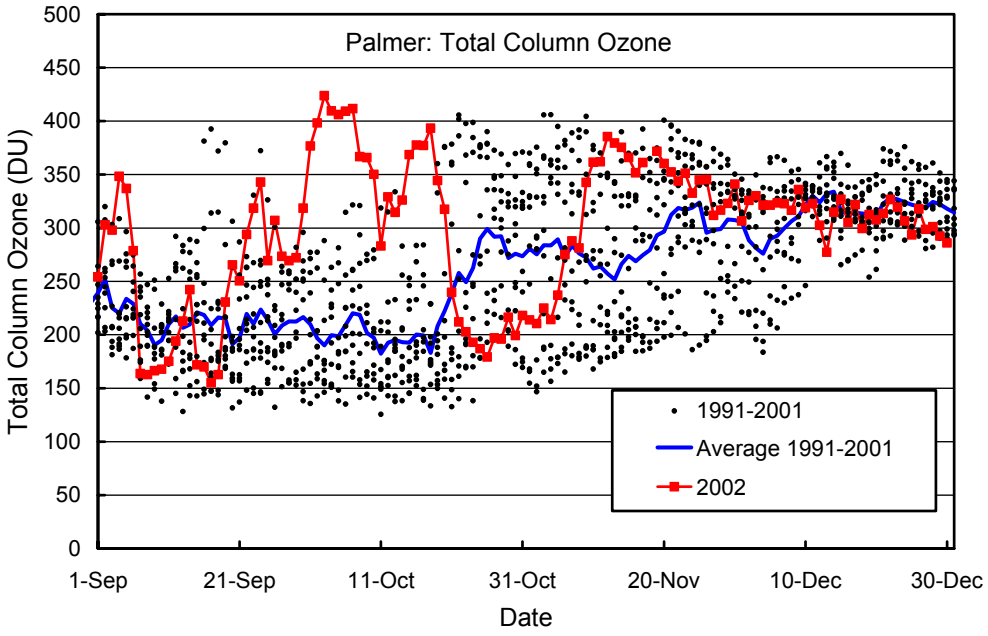

Figure 7.2.1. *Total column ozone in Palmer. TOMS/Earth Probe measurements from 2002 are contrasted with ozone data from the years 1991-1999 recorded by TOMS /Nimbus-7(1991-1993),TOMS/ Meteor-3 (1993-1994), NOAA/TOVS (1995-1996), and TOMS/Earth Probe (1997-2001) satellites.*

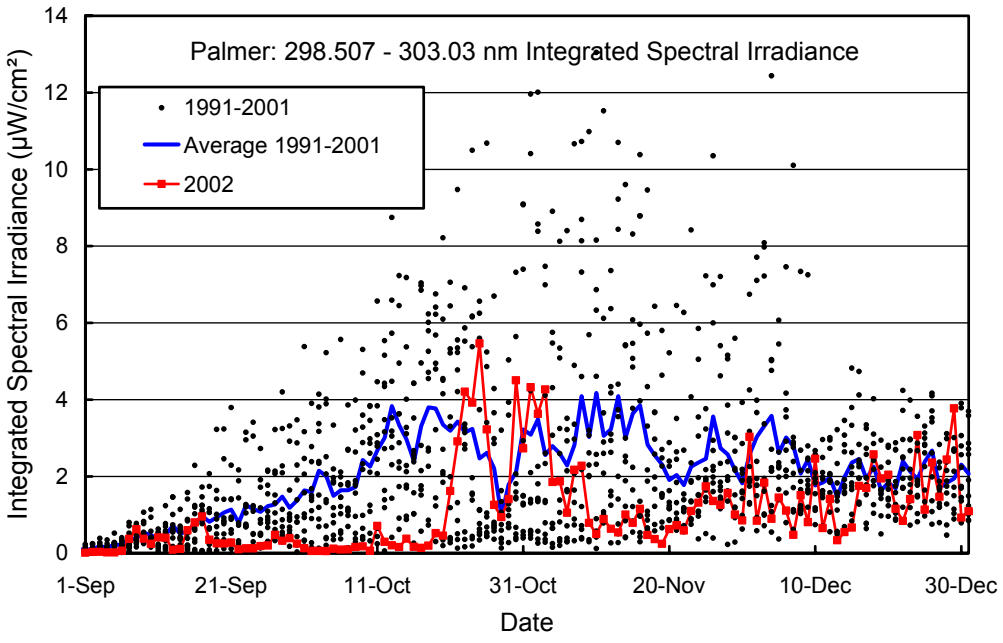

Figure 7.2.2. *Noontime integrated spectral UV irradiance (298.51 - 303.03 nm) at Palmer. Measurements from 2002 (squares) are contrasted with individual data points and the average of measurements taken between 1991 and 2001.*

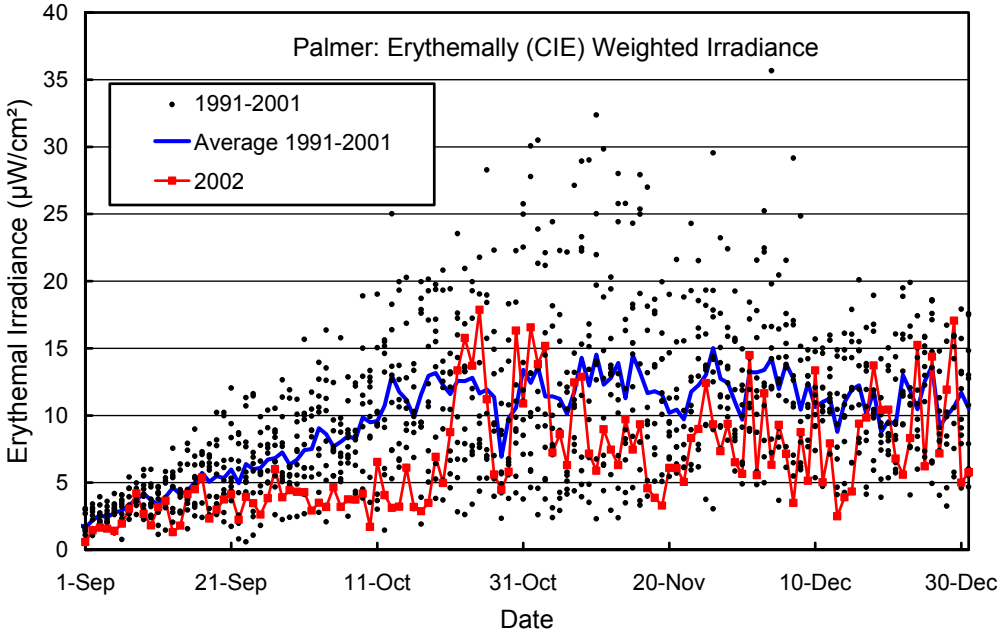

Figure 7.2.3. *Erythemally (CIE) weighted irradiance at Palmer. Measurements from 2002 (squares) are contrasted with individual data points and the average of measurements taken between 1991 and 2001.*

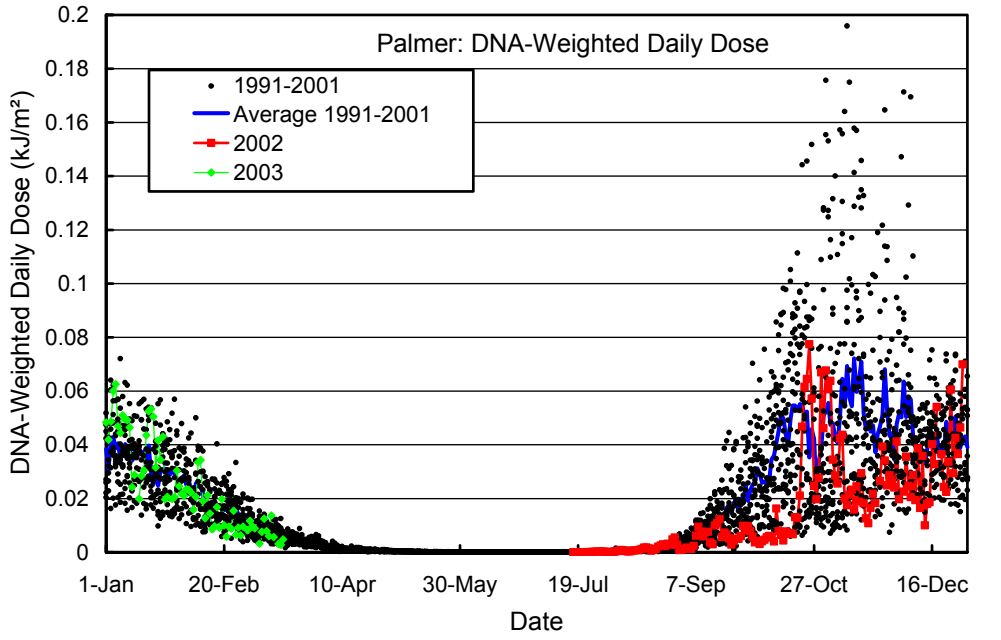

Figure 7.2.4. *Daily DNA-weighted dose for Palmer. Volume 12 measurements from 2002 and 2003 are contrasted with individual data points and the average of measurements taken between 1991 and 2001.*

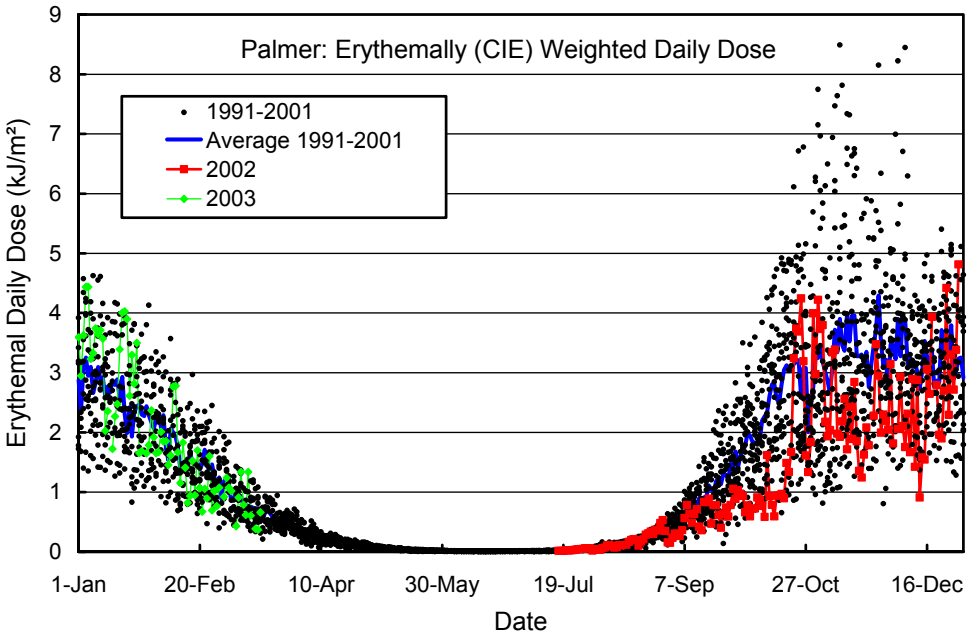

Figure 7.2.5. *Daily erythemal dose for Palmer. Volume 12 measurements from 2002 and 2003 are contrasted with individual data points and the average of measurements taken between 1991 and 2001.*

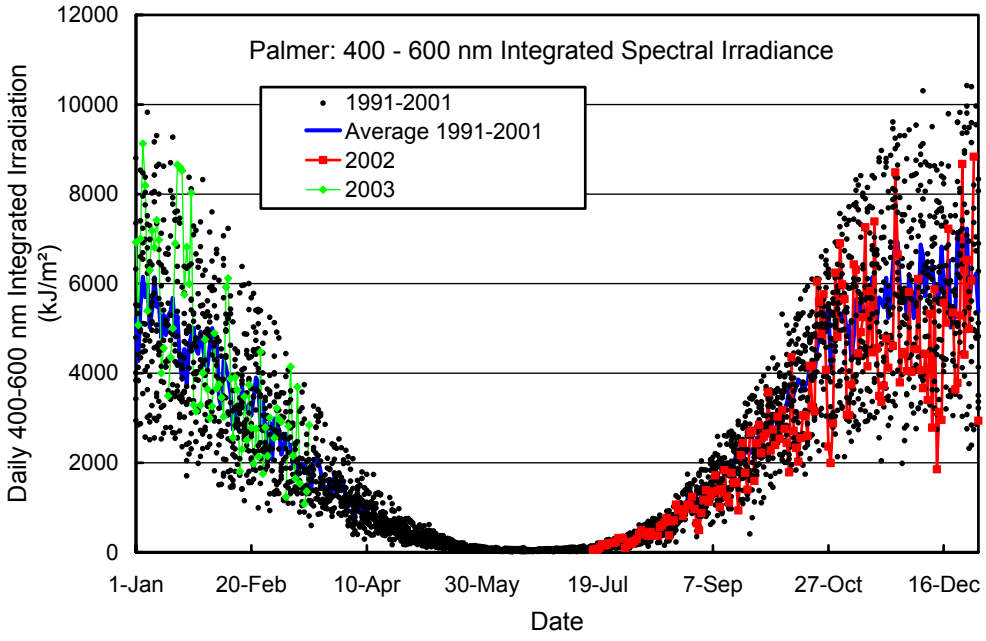

Figure 7.2.6. *Daily irradiation of the 400-600 nm band for Palmer. Volume 12 measurements from 2002 and 2003 are contrasted with individual data points and the average of measurements taken between 1991 and 2001.*