7.3. Amundsen Scott South Pole Station

The ozone hole in the austral fall of 2000 was very unusual. Already in early August an exceptionally large area of very low stratospheric temperatures was noted over Antarctica, which set the state for the earlier than usual development of the annual Austral Spring ozone hole. After a particularly rapid growth during August, the ozone hole reached the largest size on record with an extent of close to 30 million km^2 on September 9. In early October , it was also the deepest with ozone losses exceeding 50% within most of the area of the ozone hole when compared to the pre-ozone-hole conditions. The hole in 2000 grew three weeks earlier than in 1999 and reached its peak one week earlier than in 1999. Its edge was located above southern South America several times in September and October, leading to record UV levels at Ushuaia (see Section 7.4.). After October 20, 2000, the ozone hole begun a very rapid, sustained decreased in size, closing between November 20 and 25. This was the earliest break-up since 1991 and took place almost a month earlier than in 1998 and 1999.[1]

Figure 7.3.1 shows total column ozone over Amundsen-Scott South Pole Station as measured by TOMS. From the beginning of October 2000 until 10/17/00, ozone levels were similar to the 1991-1999 climatology. From then onward, ozone depletion over the South Pole rapidly decreased. Between October 18 and the beginning of November, the center of the ozone hole was displaced toward South America and the Atlantic Ocean, with the edge rather than the center being located above the South Pole. Between November 7 and November 25, the ozone hole still existed with total column ozone below 220 DU at some locations. By then, however, the hole was displaced toward the Atlantic Ocean and South Africa and did not affect the South Pole. On November 27, the remnants of the hole had a frayed shape with lowest ozone values located over the South Pole. This caused the drop seen in Figure 7.3.1. After 12/01/00, ozone levels over the South Pole finally returned to undisturbed conditions.

The effect of the unusual ozone hole can clearly be seen in UV data. Until 10/16/00, noontime values of the 298.51 - 303.03 nm integral (Figure 7.3.2) measured in 2000 are comparable with the average measured between 1991 and 1999. Between 10/18/00 and 12/6/00, UV levels in 2000 were well below the average. From 12/7/00 onward, levels were similar compared to other years as the ozone hole usually dissipates during the first half of December.

A similar pattern can also be observed in the time series of erythemally weighted noon-time irradiance, as shown in Figure 7.3.3. Erythemal UV levels in November 2000 were only two thirds of the average from the 1990s. Between 10/28/00 and 10/30/00, UV levels show a peak, when the center of the ozone hole's remnant moved over the South Pole.

Figure 7.3.4 and Figure 7.3.5 show the annual cycles in DNA-weighted daily dose and erythemally weighted daily dose, respectively. Daily doses exhibit the same pattern as noon-time values. Doses from 2000 are significantly below the average from the 1990s between mid-October and mid-December.

In Figure 7.3.6, daily doses in the 400-600 nm range are shown. Volume 10 measurements agree well with measurements from previous years since radiation in the visible is not affected by atmospheric ozone concentrations. The good agreement also confirms that the modification of the instrument's collector in January 2000 did not introduce an appreciable bias in the measurement of daily doses. The upper limit of the data set is well-defined by clear-sky days. Note that the day-to-day variability in the visible is much lower at South Pole than it is at the other network sites due to the comparatively low attenuation of radiation by clouds.

[1] The summary of the year 2000 ozone hole was compiled from Pablo O. Canziani, "The Evolution of the Antarctic zone hole in 2000", http://www.aero.jussieu.fr/~sparc/News16/16_Canziani.html, and the WMO Antarctic ozone bulletins, http://www.wmo.ch/web/arep/00/

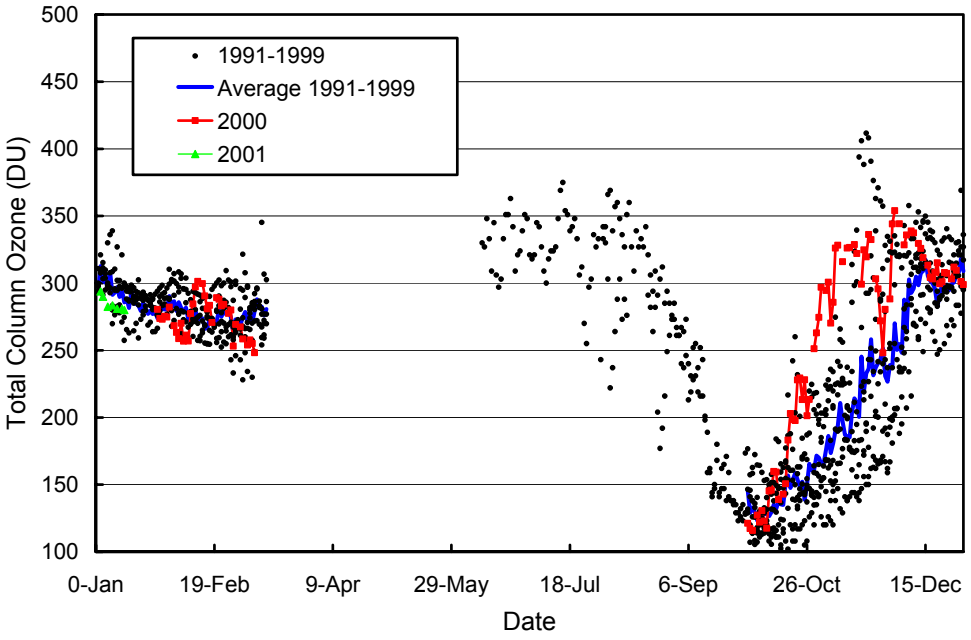

Figure 7.3.1. *Total column ozone at South Pole. TOMS/Earth Probe measurements from2000 and 2001 are contrasted with ozone data from the years 1991-1999 recorded by TOMS /Nimbus-7(1991-1993),TOMS/ Meteor-3 (1993-1994), NOAA/TOVS (1995-1996), and TOMS/Earth Probe (1997-1999) satellites. Data measured during the polar night are from NOAA/TOVS measurements in 1995 and 1996. Ozone values are typically between 300 and 375 DU before they start dropping in August as the ozone hole builds up. Minimum ozone values occur beginning October.*

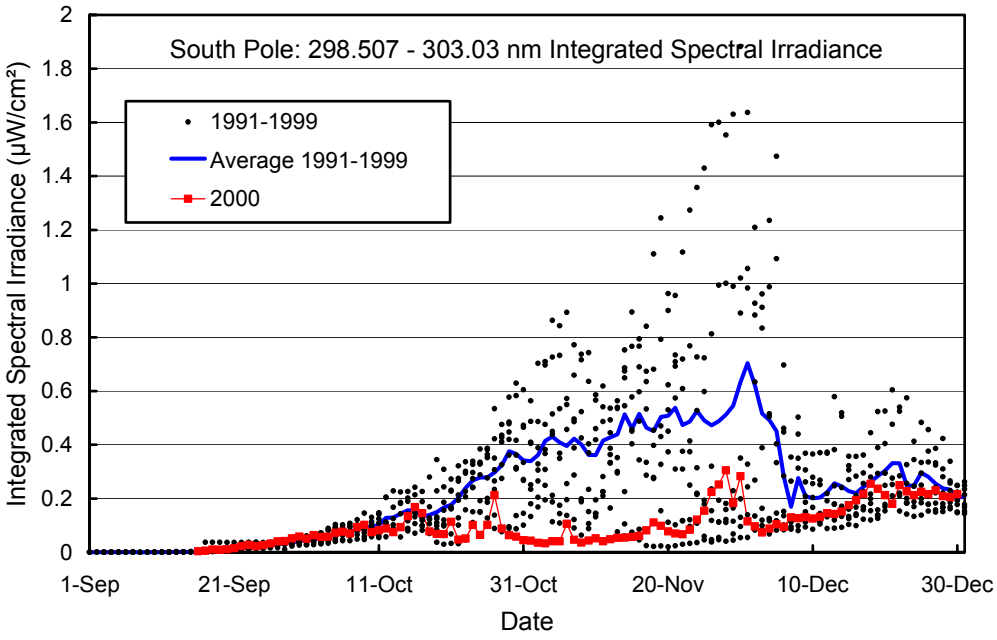

Figure 7.3.2. *Noontime integrated spectral UV irradiance (298.51 - 303.03 nm) at South Pole. Measurements from 2000 (squares) are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*

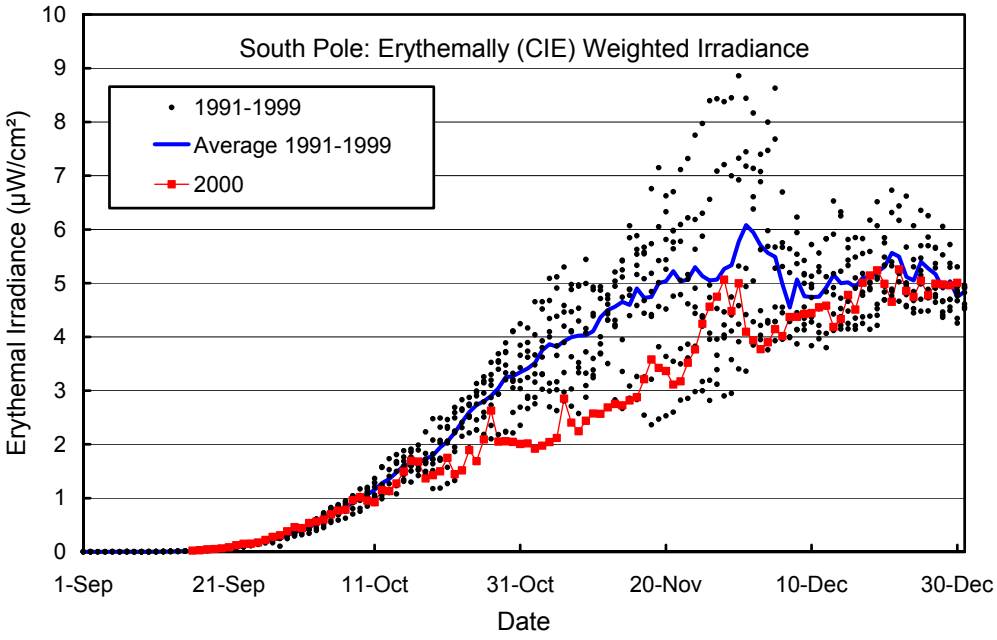

Figure 7.3.3. *Erythemally (CIE) weighted irradiance at South Pole. Measurements from 2000 (squares) are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*

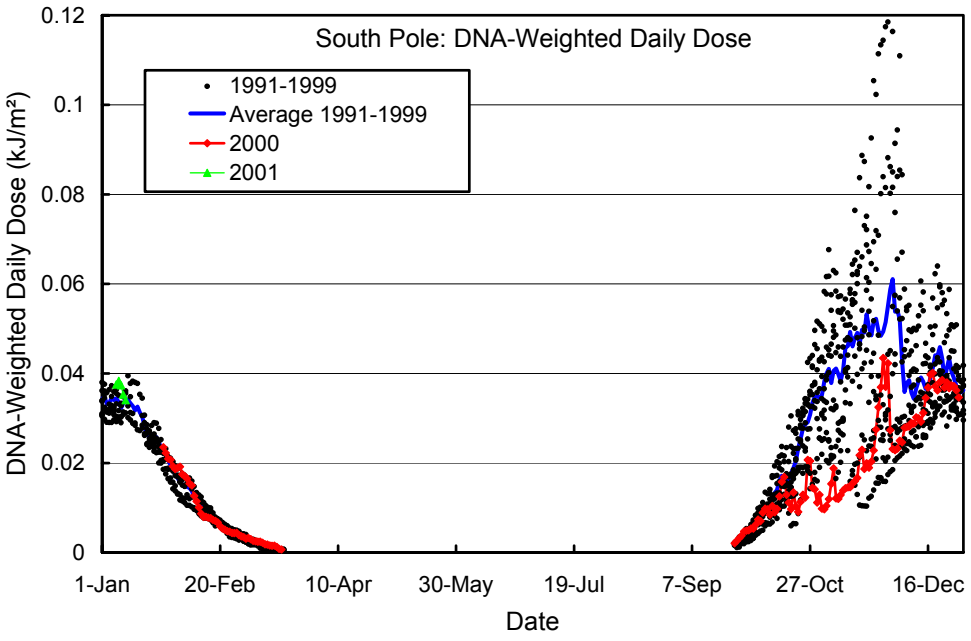

Figure 7.3.4. *Daily DNA-weighted dose at South Pole. Volume 10 measurements from 2000 and 2001 are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*

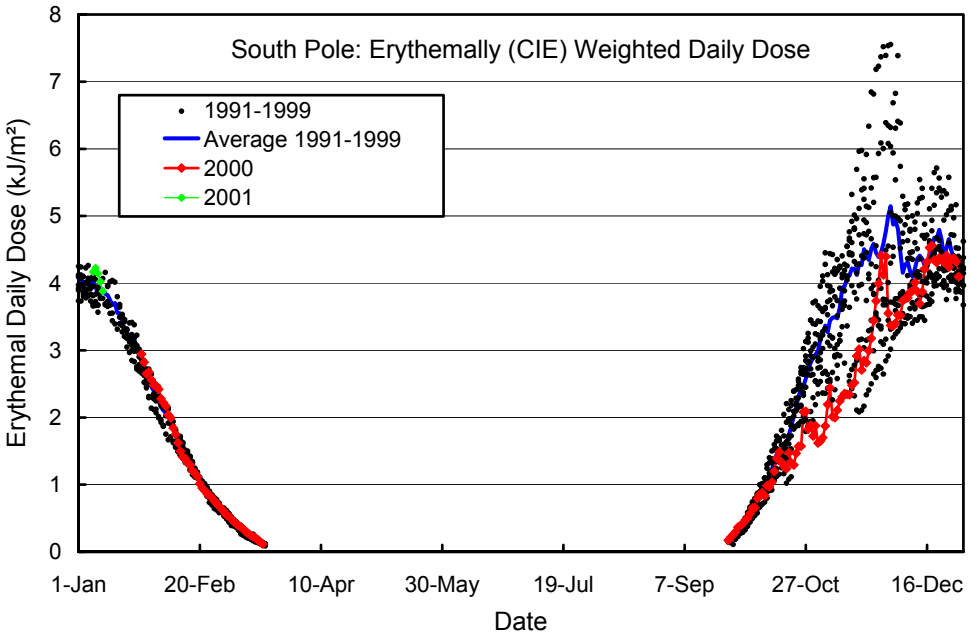

Figure 7.3.5. *Daily erythemal dose at South Pole. Volume 10 measurements from 2000 and 2001 are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*

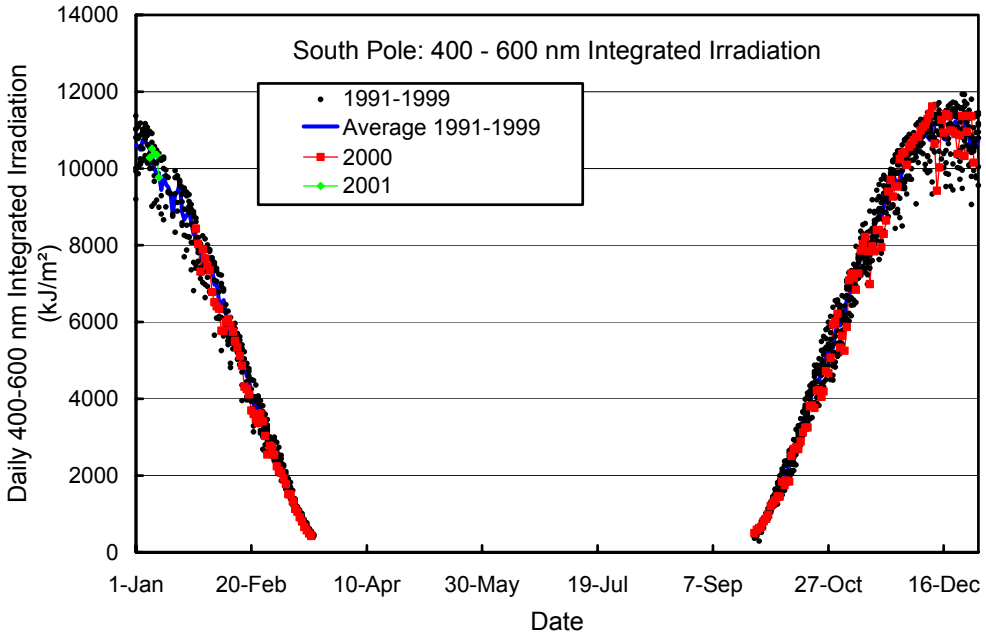

Figure 7.3.6. *Daily irradiation of the 400-600 nm band at South Pole. Volume 10 measurements from 2000 and 2001 are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*