7.3. Amundsen Scott South Pole Station

The "ozone hole" in the austral fall of 2001 was one of the largest and deepest on record. Ozone levels below 200 DU were observed by TOMS over the Antarctic continent until 12/7/01. This contrasts the situation in 2000, when a very rapid and sustained decrease of the ozone hole area started already in October.

Figure 7.3.1 shows total column ozone over Amundsen-Scott South Pole Station as measured by TOMS. From the beginning of October 2001 until 11/5/01, ozone levels were similar to the average of measurements performed between 1991 and 2000. From then until 12/16/01, ozone levels were about 40-50 DU below the average from the 1990s. Thereafter ozone levels were close to or slightly below average.

The pattern in ozone can clearly be seen in UV data. Until 11/5/01, noontime values of the 298.51 - 303.03 nm integral (Figure 7.3.2) measured in 2001 are comparable with the average of measurements conducted between 1991 and 2000. From then onward, short-wave UV levels in 2001 were well above the average. In particular between 7/11/01 and 12/16/01, there was a clear gap between the average and measurements from 2001. Between 12/6/01 and 12/7/01 UV levels changed by almost a factor of three when the ozone hole finally broke down. Note that UV levels after this date were still above the average, in agreement with the lower-than-average ozone levels. A similar pattern can also be observed in the time series of erythemally weighted noon-time irradiance, as shown in Figure 7.3.3.

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. From 11/5/01 onward, doses from 2001 are significantly above the average. However, absolute values generally stay below the maximum values from the 1990s.

Radiation in the visible is only marginally affected by total ozone. Daily doses in the visible measured during the Volume 11 period should therefore be similar to historical observations. Yet Figure 7.3.6 suggest that Volume 11 data are a few percent below measurements of previous years. This is very unlikely due to an actual change of radiation levels in 2001. It is most likely due to the radiometer's detector upgrade in January 2000 (see 2000-2001 Operations Report). Before the modification, the instrument's angular response exhibited an azimuth asymmetry that was substantially reduced by the upgrade. In principle, the correction of the azimuth dependence does not have to lead to a change in daily doses. At the South Pole, the Sun describes a 360° circle within one day with a neglible change in zenith angle. The azimuth dependence should therefore average out. However, the collector modification may have affected the average cosine error of the instrument, which may have contributed to the observed change between 2001 and years prior to 2000. Note that measurements in the visible are more affected by the cosine error than measurements in the UV as the ratio of direct/global irradiance increases with increasing wavelength. The fact that daily doses of the different years calculated from measurements in the 337.5 – 342.5 nm wavelength band (see Figure 7.3.7) are more consistent than measurements in the visible indicates that the observed differences between the years may indeed be caused by the difference in the cosine error of the two periods. The good agreement of measurements in the 337.5 – 342.5 nm band (which is not affected by ozone variations) further suggests that the upgrade introduced only a small step-change in time-series of biologically weighted daily doses. Note that radiation measurements in the 400-600 nm wavelength range appear to be slightly smaller in 2001 than in 2000. This cannot be due the collector as it was not changed during the site visit in 2001. The actual reason is likely a combination of various causes such as drifts of calibration lamps and a different acceptance angle of the two monochromators used during the Volume 10 and 11 seasons (see Section 5.3 for details).

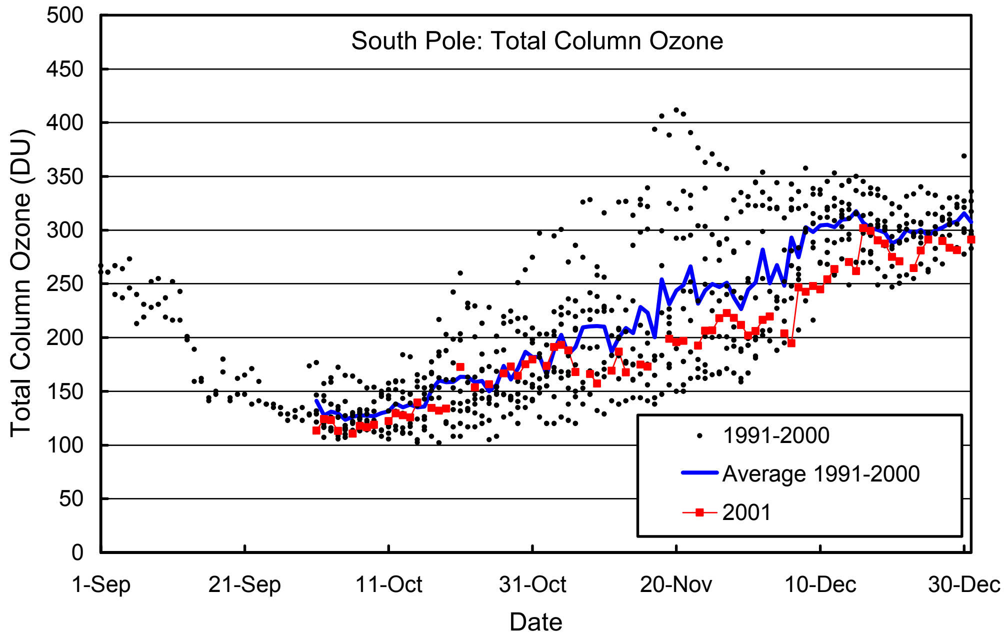

Figure 7.3.1. *Total column ozone at South Pole. TOMS/Earth Probe measurements from 2001 are contrasted with ozone data from the years 1991-2000 recorded by TOMS /Nimbus-7(1991-1993),TOMS/ Meteor-3 (1993-1994), NOAA/TOVS (1995-1996), and TOMS/Earth Probe (1997-2000) satellites. September data are from NOAA/TOVS measured in 1995 and 1996.*

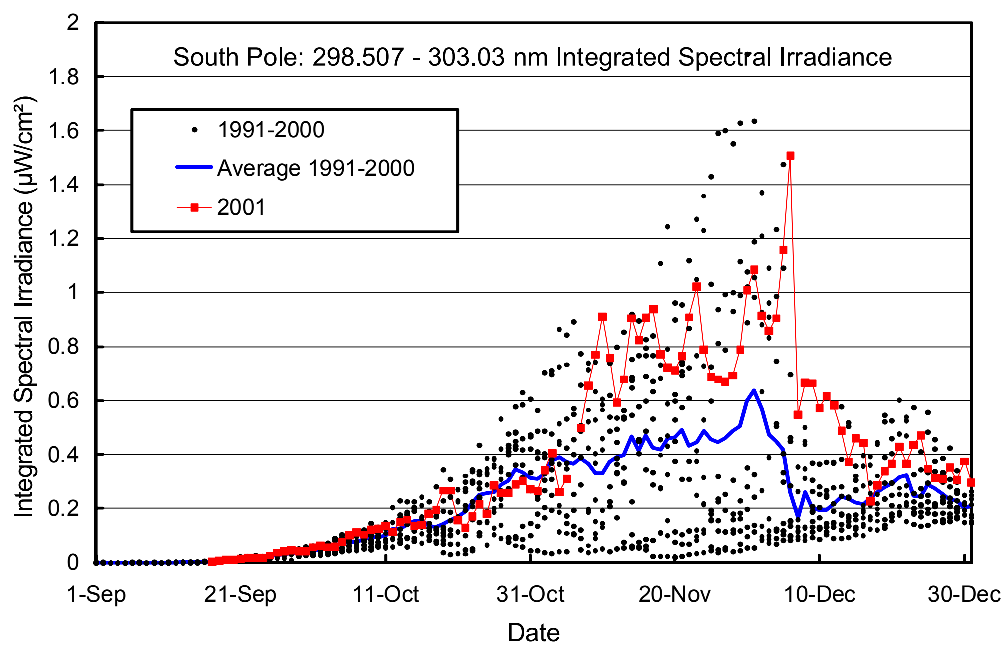

Figure 7.3.2. *Noontime integrated spectral UV irradiance (298.51 - 303.03 nm) at South Pole. Measurements from 2001 (squares) are contrasted with individual data points and the average of measurements taken between 1991 and 2000.*

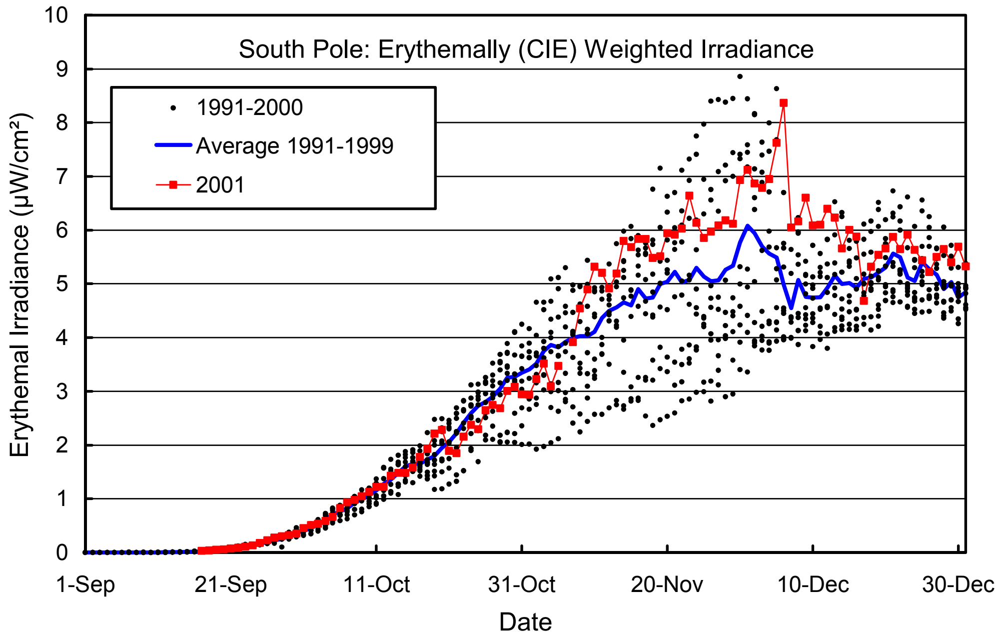

Figure 7.3.3. *Erythemally (CIE) weighted irradiance at South Pole. Measurements from 2001 (squares) are contrasted with individual data points and the average of measurements taken between 1991 and 2000.*

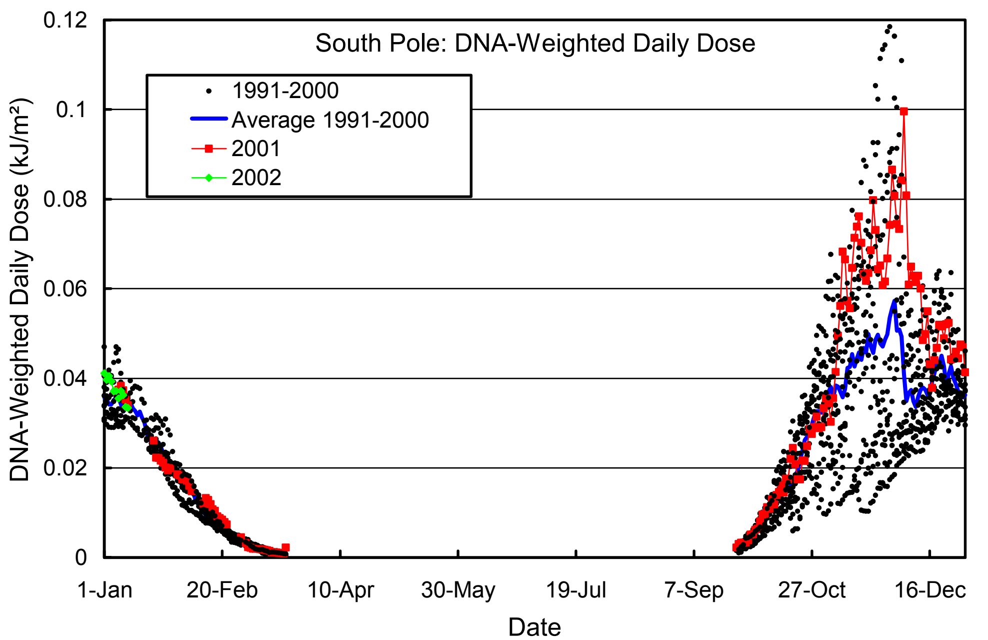

Figure 7.3.4. *Daily DNA-weighted dose at South Pole. Volume 11 measurements from 2001 and 2002 are contrasted with individual data points and the average of measurements taken between 1991 and 2000.*

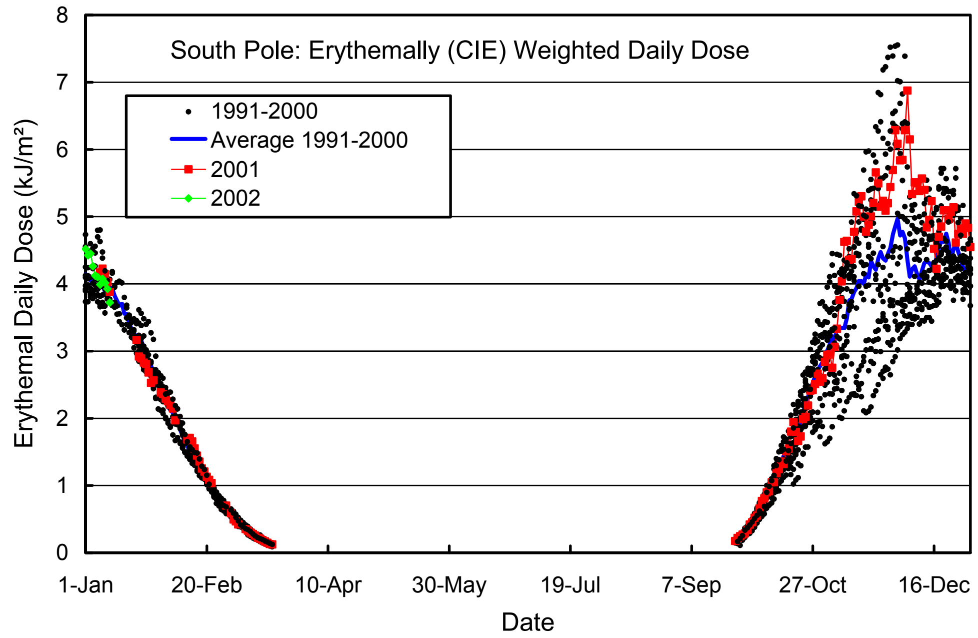

Figure 7.3.5. *Daily erythemal dose at South Pole. Volume 11 measurements from 2001 and 2002 are contrasted with individual data points and the average of measurements taken between 1991 and 2000.*

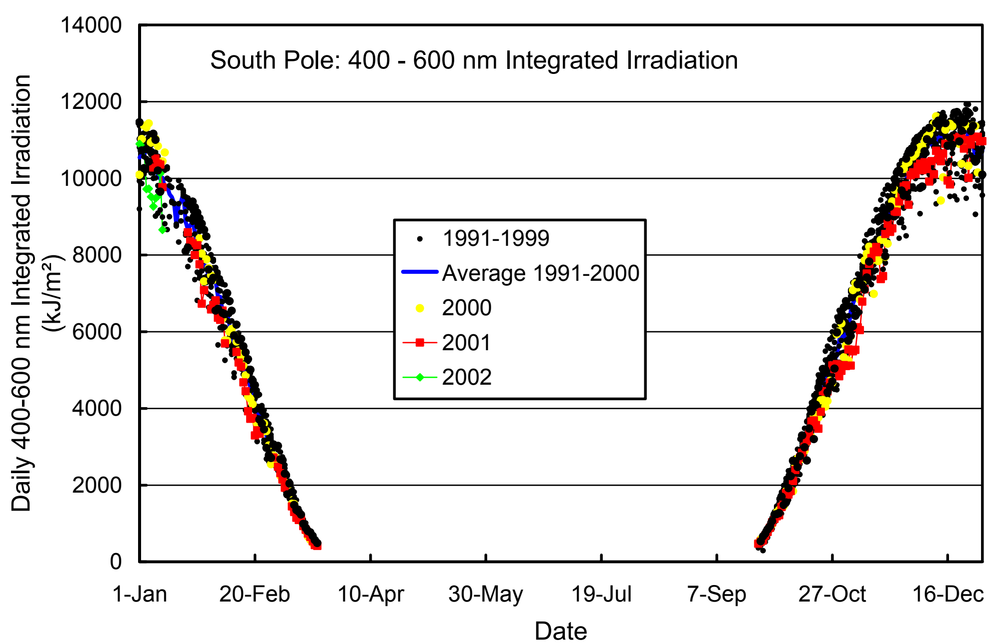

Figure 7.3.6. *Daily irradiation of the 400-600 nm band at South Pole. Measurements from 2000 - 2002 are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*

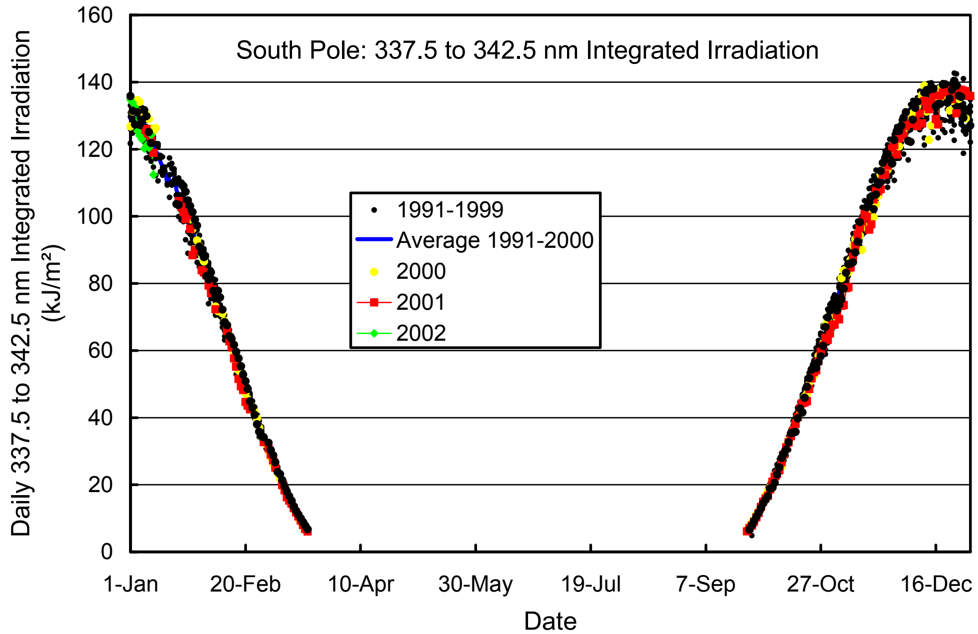

Figure 7.3.7. *Daily irradiation of the 337.5 – 342.5 nm band at South Pole. Measurements from 2000 - 2002 are contrasted with individual data points and the average of measurements taken between 1991 and 1999.*