7.1. McMurdo Station

The Antarctic "ozone hole" in the austral fall of 2003 was one of the largest on record; its size peaked at about 28 million square kilometers in September. However, the size decreased faster than in many of the previous years. UV levels between October and December 2003 observed at McMurdo were equal or smaller than the long-term average, with few exceptions. For example, relatively high UV levels (UV Index = 5.8) were observed on 12/8/03 when a pocket of ozone depleted air moved over McMurdo at a time when the 2003 ozone hole had already disappeared.

Figure 7.1.1 shows total column ozone at McMurdo Station measured by TOMS. Ozone levels were comparatively low in September 2003. During October and November, they oscillated around the long-term mean. Particularly low ozone values were observed on 10/30/03, 11/22/03, and 12/8/03. Comparatively high values occurred on 10/7/03, 10/23/03, and 11/5/03. The variation of irradiance at 300 nm (Figure 7.1.2) and of erythemal noon-time irradiance (Figure 7.1.3) anticorrelated with total column ozone, as expected, and exhibited distinct peaks on 11/22/03 and 12/8/03. The same pattern can also be seen in the plots of daily DNA dose (Figure 7.1.4) and daily erythemal dose (Figure 7.1.5).

Radiation in the visible is only marginally affected by total ozone. Daily doses in the visible measured under cloudless skies during the Volume 13 period should therefore be similar to historical observations. Yet Figure 7.1.6 suggest that daily doses in the 400-600 nm wavelength range were about 10-15% lower in 2003 compared to the envelope formed by clear-sky observations from years prior to 2003. The reason is related to the collector upgrade performed during the site visit in January 2000 (see Volume 10 and 11 Operations Reports). Before the modification, the instrument's angular response exhibited an azimuth asymmetry that was most pronounced when the sun was in the North. Noon-time measurements in the visible were overestimated by about 5-10%. This also affected daily doses due to the large contribution of measurements taken around solar noon to the daily integral. The collector upgrade removed the azimuth asymmetry, but slightly increased the average cosine error. Measurements taken after the collector upgrade tend to be low by 3-5%. The diffuser modification therefore introduced a step-change of about 8-15% in time series of "visible" solar data. Measurements in the UV are less affected by this problem as the contribution of the direct solar beam to global irradiance is comparatively small in the UV. We estimate the step change in biologically weighted data to be less than 5%. The effect of the collector modification on solar data is described in more detail in the introduction to Section 5. We are planning to reprocess our entire data set to remove step changes and improve overall data accuracy. See *Bernhard et al.* (2003) and http://www.biospherical.com/nsf/Version2/Version2.asp for details.

On 11/23/03, a partial solar eclipse was visible in Antarctica. At McMurdo, the moon started to block the sun at 22:09 UT. The time of maximum eclipse was 23:07, when approximately 77% of the sun's disk was blocked. Radiation levels during this time were 20% of the levels observed before the eclipse's start. Some of the reduction can also be associated with changes in cloud cover.

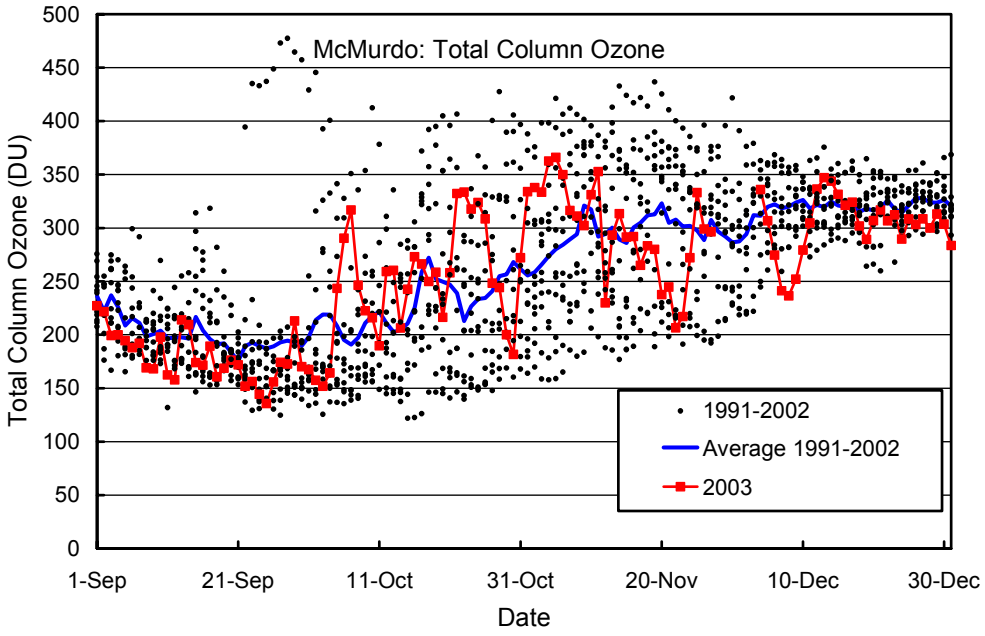

Figure 7.1.1. *Total column ozone in McMurdo. TOMS/Earth Probe measurements from 2003 are contrasted with ozone data from the years 1991-2002 recorded by TOMS /Nimbus-7(1991-1993),TOMS/ Meteor-3 (1993-1994), NOAA/TOVS (1995-1996), and TOMS/Earth Probe (1997-2002) satellites.*

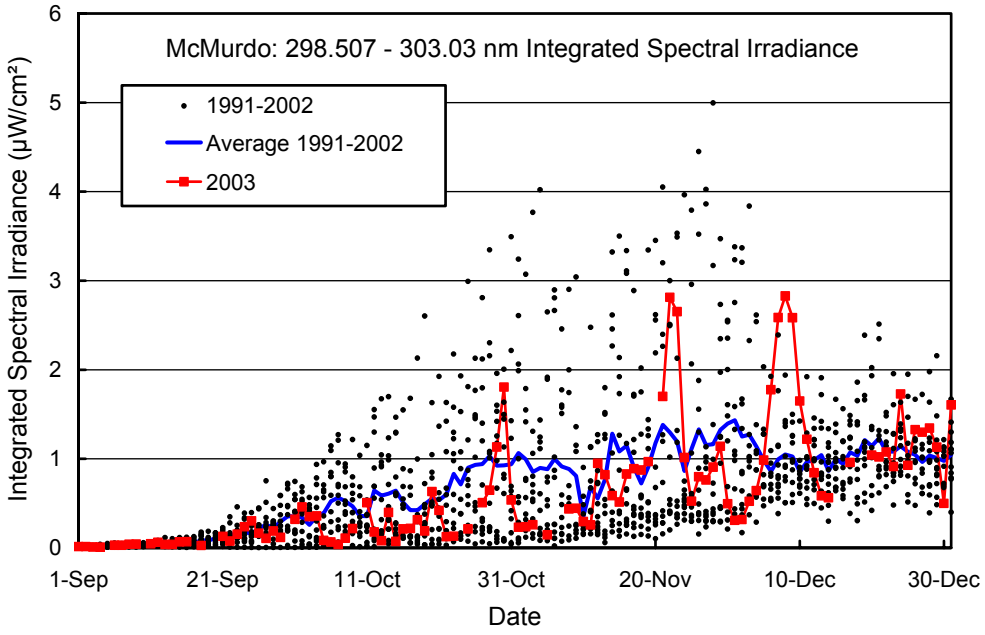

Figure 7.1.2. *Noontime integrated spectral UV irradiance (298.51 - 303.03 nm) at McMurdo. Measurements from 2003 (squares) are contrasted with individual data points and the average of measurements taken between 1991 and 2002.*

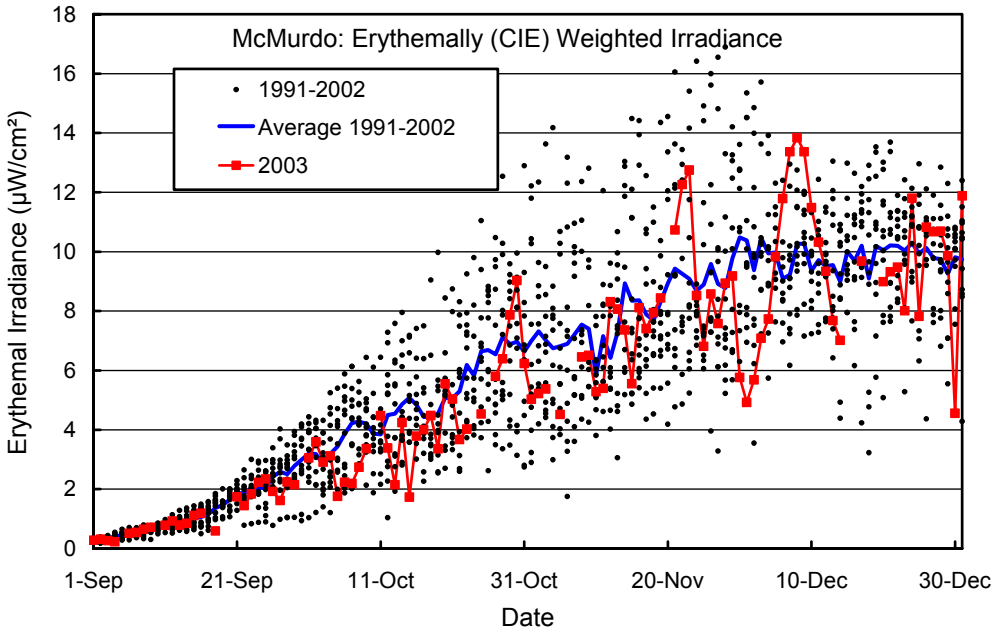

Figure 7.1.3. *Erythemally (CIE) weighted irradiance at McMurdo. Measurements from 2003 (squares) are contrasted with individual data points and the average of measurements taken between 1991 and 2002.*

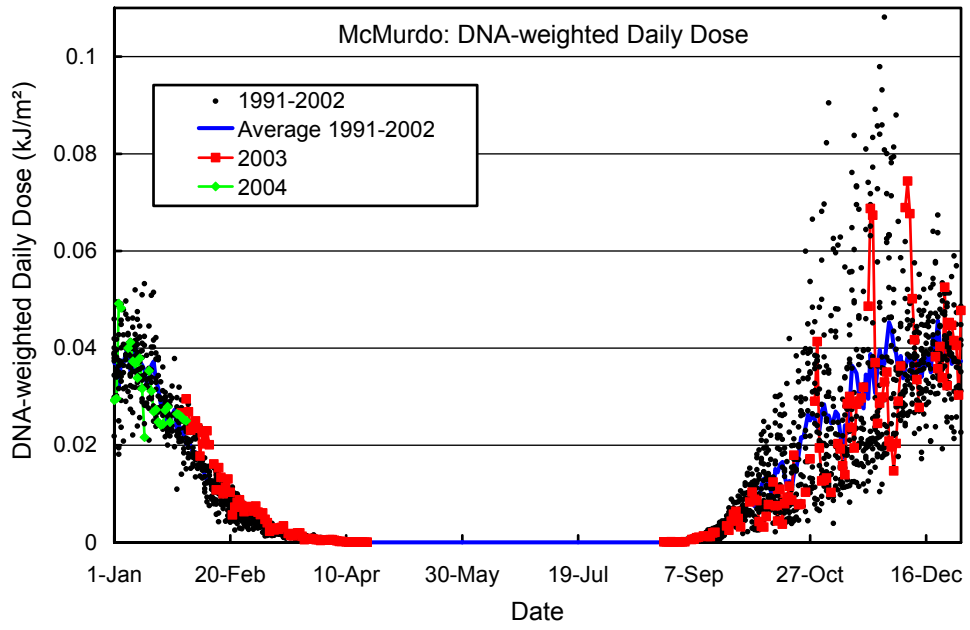

Figure 7.1.4. *Daily DNA-weighted dose for McMurdo. Volume 13 measurements from 2003 and 2004 are contrasted with individual data points and the average of measurements taken between 1991 and 2002.*

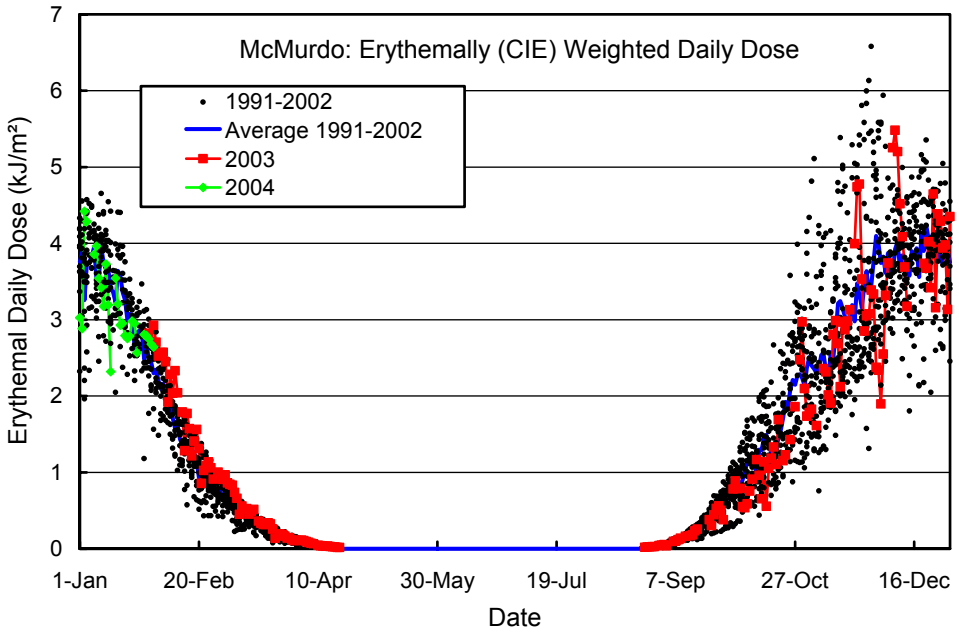

Figure 7.1.5. *Daily erythemal dose for McMurdo. Volume 13 measurements from 2003 and 2004 are contrasted with individual data points and the average of measurements taken between 1991 and 2002.*

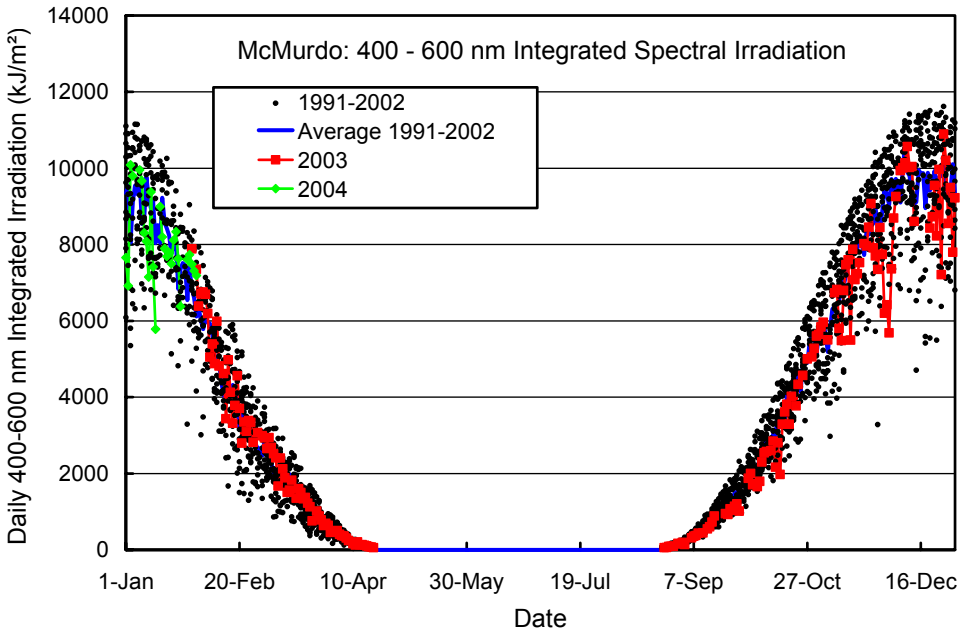

Figure 7.1.6. *Daily irradiation of the 400-600 nm band for McMurdo. Volume 13 measurements from 2003 and 2004 are contrasted with individual data points and the average of measurements taken between 1991 and 2002.*