7.1. McMurdo Station

According to World Meteorological Organisation[+], the Antarctic "ozone hole" in the austral fall of 2006 was one of the largest and deepest on record. The 21-30 September average area of the ozone hole derived from data of the Ozone Monitoring Instrument (OMI) onboard NASA's AURA satellite was 27.4 million km^2. This is the largest area on record since satellite measurements began in 1979. The ozone mass deficit, averaged over the entire vortex period from 19 July to 1 December reached a record of 16.3 megatons. The previous maximum of 15.0 megatons was observed in 1998. The minimum total ozone column within the vortex was approximately 90 DU and was observed by OMI on 8 October 2006. The unusual size and persistence of the ozone hole and the record high ozone mass deficit can be explained by the low temperatures that have reigned in the south polar region in combination with an unusually stable and large vortex.

Figure 7.1.1 shows total column ozone at McMurdo Station measured by OMI. Total ozone observations between 10 September and 4 December ranged from 124 to 315 DU. Total ozone was frequently below 220 DU until mid-November. Notable exceptions were 3 October and 20 October, when McMurdo was located close to the edge of the ozone hole, and ozone values were above 240 DU. Record-low total ozone values were observed on 10 October, when OMI measured 125 DU.

Figure 7.1.2 shows measurements of the 298.51 - 303.03 nm integral at 01:00 UT. This integral is strongly affected by the atmospheric ozone amount. Measurements frequently exceeded the climatological mean, particularly between 9 October and 15 October, and between 5 November and 9 November. Observations during these periods were close to the upper limit of the range defined by measurements from the last 16 years. UV intensities below the long-term mean were observed for short periods only (i.e., 30 September – 4 October, 19 October – 24 October and 22 November – 25 November).

Figure 7.1.3 shows the daily maximum UV Index at McMurdo. As the Sun rose, the UV Index increased from about 1 on 1 October to 6 on 1 December. The UV Index was above the long-term mean by about 40% on 15 October and by about 75% on 6 November. On 2 December, when the 2006 ozone hole started to disintegrate and ozone-depleted air masses moved over McMurdo, total ozone dropped to 187 DU and record UV intensities were observed. The maximum UV Index of this day was 7.7 and only slightly below the all-time maximum of 7.4, measured in late November 1998. After 4 December 2006, total ozone was above 300 DU, and the UV Index remained below 4.

The DNA-weighted daily dose and the erythemal daily dose are shown in Figures 7.1.4 and 7.1.5, respectively. The effect of the ozone hole can clearly be seen when comparing measurements from spring and fall. Both datasets exhibit a similar pattern but the amplitude of the ozone influence is smaller for erythemal dose.

Figure 7.1.6 shows daily doses integrated over the wavelength range 400-600 nm. Measurements in this wavelength range are only marginally affected by ozone absorption. Data measured under cloudless skies during the Volume 16 period should therefore be similar to historical observations. Figure 7.1.6 suggest that daily doses were about 10-12% lower in 2006 compared to the envelope formed by clear-sky observations from previous years. 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 since the contribution of the direct solar beam to global irradiance is comparatively small in the UV. The step change in biologically weighted data is typically less than 5%. In order to remove the step change and to improve the overall data accuracy we have reprocessed the entire

[+] See http://www.wmo.ch/web/arep/gawozobull06.html

McMurdo data set. The new "Version 2" dataset is available at http://www.biospherical.com/nsf/Version2/Version2.asp. Figure 7.1.6 was redrawn based on Version 2 data, and results are shown in Figure 7.1.7. Clear-sky data from the Volume 16 period agree well with the upper envelope formed by historic measurements. A publication introducing Version 2 data from McMurdo was published by *Journal of Geophysical Research* (*Bernhard et al*., 2006). We recommend the use Version 2 data due to their higher accuracy.

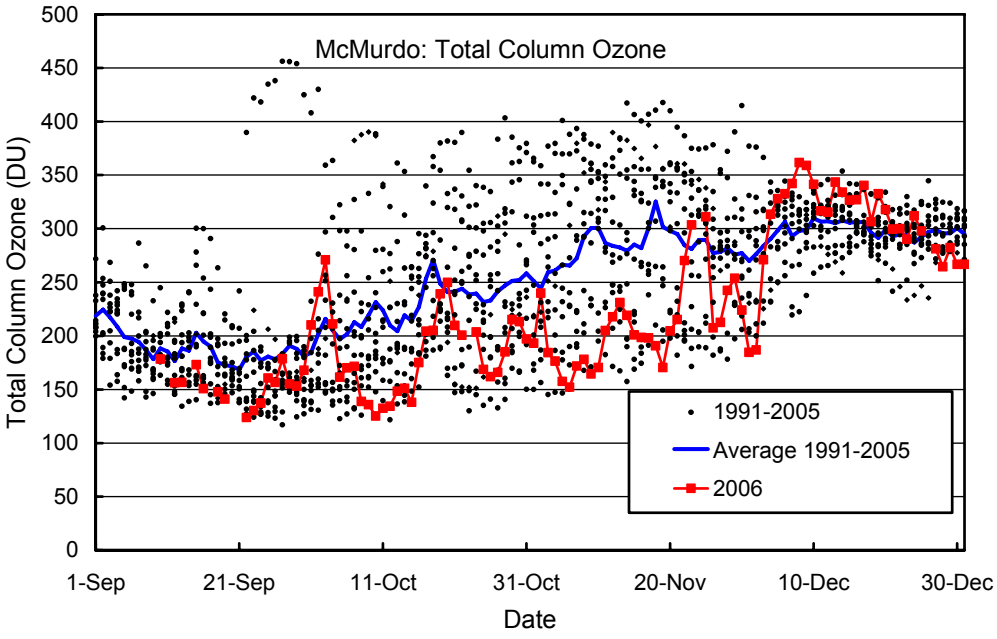

Figure 7.1.1. *Total column ozone in McMurdo. OMI measurements from 2006 are contrasted with ozone data from the years 1991-2005 recorded by TOMS /Nimbus-7(1991-1993), TOMS/Earth Probe (1996-2004), and OMI (2005). TOMS data are from the "TOMS Version 8" data edition.*

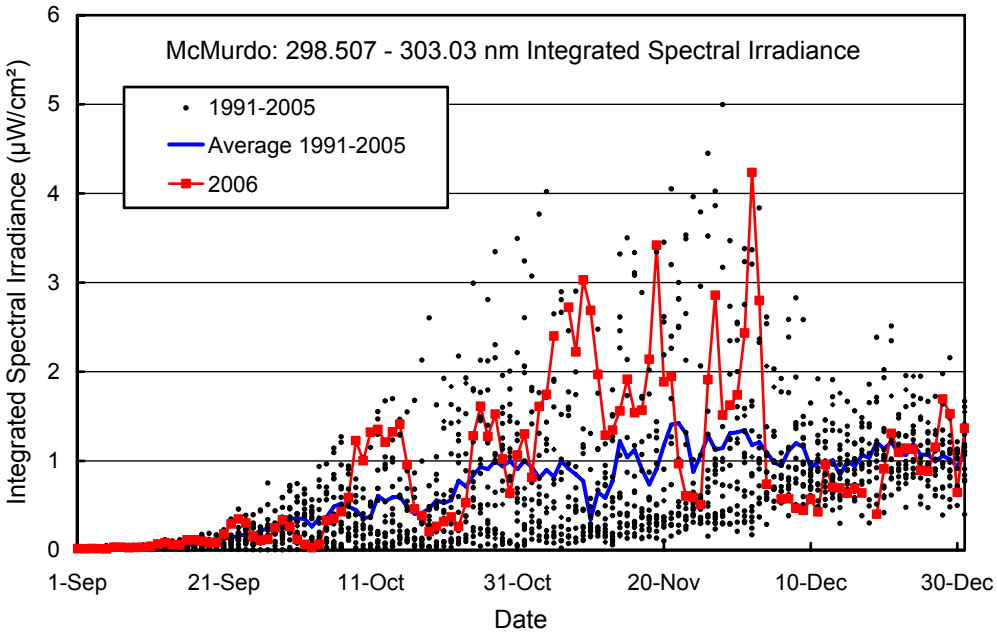

Figure 7.1.2. *Noontime integrated spectral UV irradiance (298.51 - 303.03 nm) at McMurdo. Measurements from 2006 (squares) are contrasted with individual data points and the average of measurements taken between 1991 and 2005.*

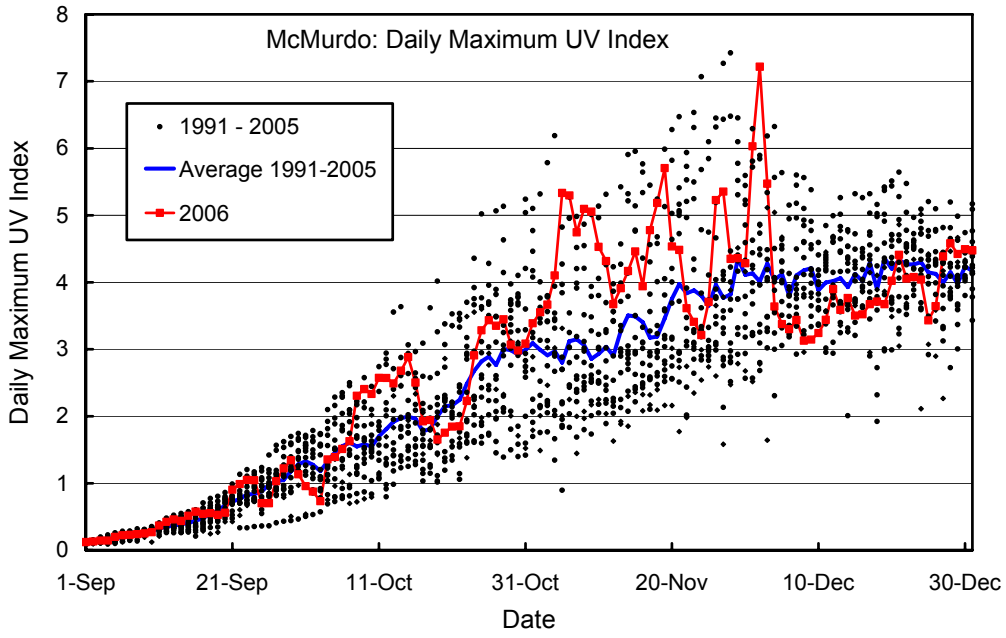

Figure 7.1.3. *Daily Maximum UV Index at McMurdo. Measurements from 2006 (squares) are contrasted with individual data points and the average of measurements taken between 1991 and 2005.*

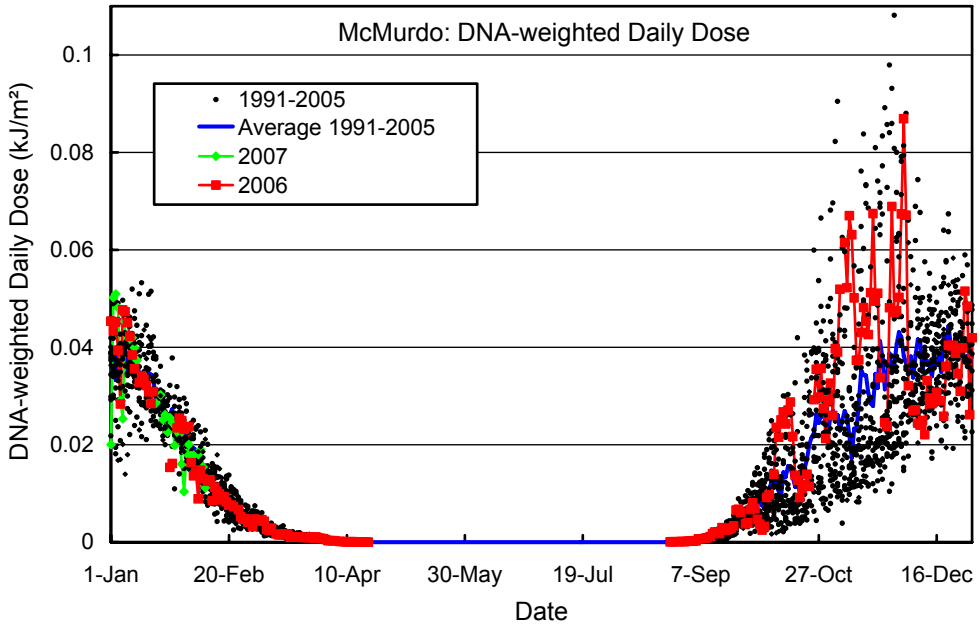

Figure 7.1.4. *Daily DNA-weighted dose for McMurdo. Volume 16 measurements from 2006 and 2007 are contrasted with individual data points and the average of measurements taken between 1991 and 2005.*

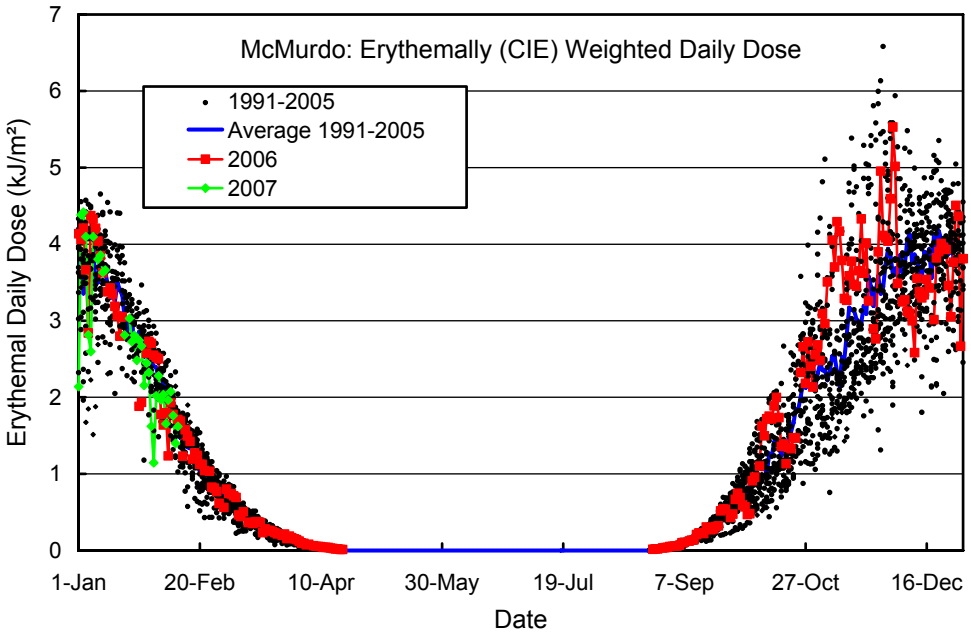

Figure 7.1.5. *Daily erythemal dose for McMurdo. Volume 16 measurements from 2006 and 2007 are contrasted with individual data points and the average of measurements taken between 1991 and 2005.*

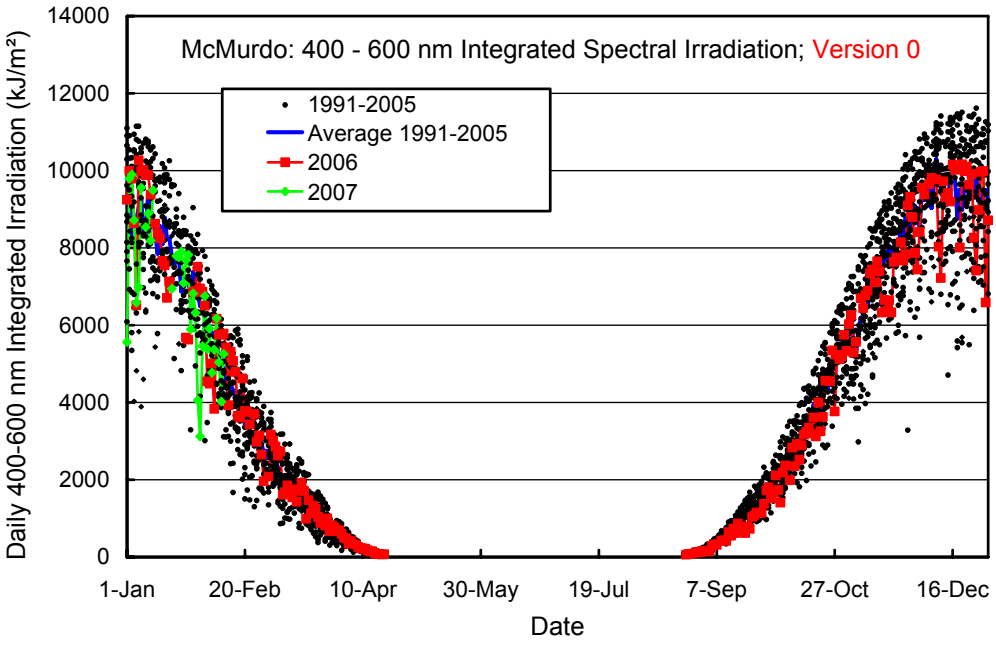

Figure 7.1.6. *Daily irradiation of the 400-600 nm band for McMurdo. Volume 16 measurements from 2006 and 2007 are contrasted with individual data points and the average of measurements taken between 1991 and 2005. Data are based on the "Version 0" data release discussed in this report. Figure 7.1.7 shows the same wavelength integral based on "Version 2" data.*

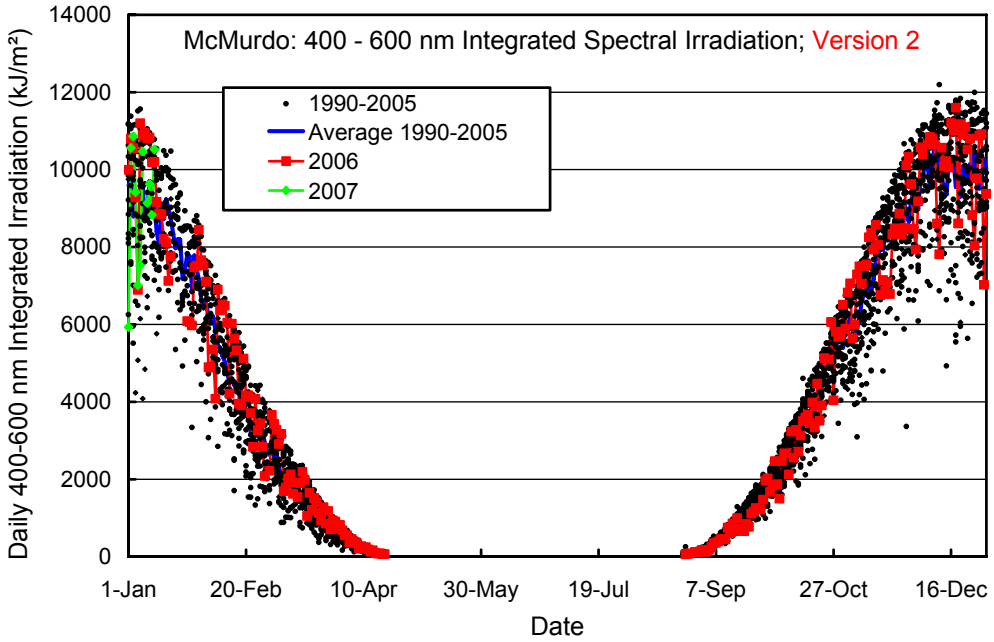

Figure 7.1.7. *Daily irradiation of the 400-600 nm band for McMurdo. Volume 16 measurements from 2006 and 2007 are contrasted with individual data points and the average of measurements taken between 1990 and 2005. Data are based on the "Version 2" data release , which are generally not subject of this report.*