7.1. McMurdo Station

According to the World Meteorological Organisation[+], the Antarctic "ozone hole" in the austral fall of 2008 reached a maximum 27 million km^2. This is only slightly smaller than the all-time record of 29 million km^2 that was observed in 2006. The ozone hole is typically closed by mid-December but lasted exceptionally long in 2008: areas with total ozone below 220 DU were observed until the end of December 2008, according to measurements of NOAA's SBUV/2 satellites[1]. The minimum ozone column in 2008 was 100 DU and was reached on 4-October, according to measurements by the Ozone Monitoring Instrument (OMI) onboard NASA's AURA satellite. The value of 100 DU is similar to the average "minimum total ozone" observed between 1990 and 2001[2].

On 7 February 2008, a partial solar eclipse was visible in Antarctica. At McMurdo, the moon started to block the Sun at 02:22 UT. The time of maximum eclipse was 03:28, when 82.4% of the Sun was blocked. The end of the eclipse was on 04:33. There was considerable influence by clouds during the period. Figure 7.1.1 shows the UV Index measured by GUV-511 and SUV-100 during the time of the eclipse.

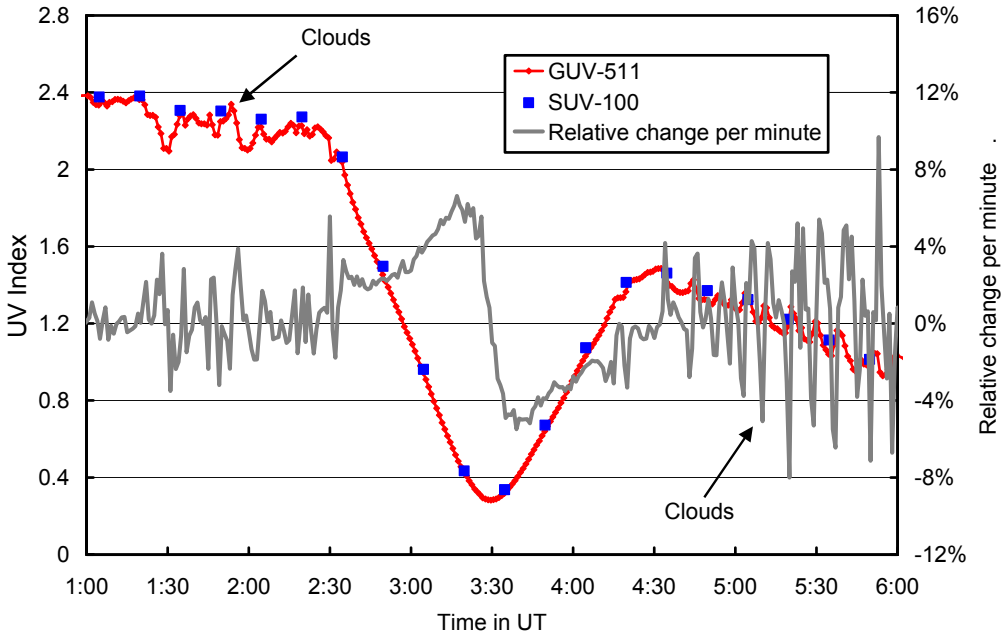

Figure 7.1.1. *UV Index measured by SUV-100 and GUV-511 radiometers during the time of the solar eclipse on 7 February 2008.*

Figure 7.1.2 shows total column ozone at McMurdo Station measured by satellites. Total ozone observations between 5 and 19 November 2007 were generally below the long-term average of the years 1991-2007 with the exception of several short periods. The late break-up of the ozone hole is most apparent by the low ozone values between 7 and 16 December.

Figure 7.1.3 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 spiked on 9 and 16-19 November and on 1, 8, and 14 December. The value on 14 December exceeded the previous record of that day by 45%.

Figure 7.1.4 shows the daily maximum UV Index at McMurdo. UV Indices were close to the all-time record for the period 7-19 November, and exceeded historical observations on 7-8 and 13-15 December

[+] See http://www.wmo.ch/pages/prog/arep/gawozobull06_en.html
[1] See http://www.cpc.ncep.noaa.gov/products/stratosphere/polar/gif_files/ozone_hole_plot.png
[2] See ftp://jwocky.gsfc.nasa.gov/pub/eptoms/images/qcplots/zmqchl_v8.png

(UV Index was as high as 5.9). UV Indices measured in 2008 were still below the all-time record of 7.4, which was observed on 28 November 1998.

The DNA-weighted daily dose and the erythemal daily dose are shown in Figures 7.1.5 and 7.1.6, 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 7.1.7 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 18 period should therefore be similar to historical observations. Figure 7.1.7 suggest that daily doses were about 8-10% lower in 2008 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 McMurdo data set. The new "Version 2" dataset is available at http://www.biospherical.com/nsf/Version2/Version2.asp. Figure 7.1.7 was redrawn based on Version 2 data, and results are shown in Figure 7.1.8. Clear-sky data from the Volume 18 period agree well with the upper envelope formed by historical 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.

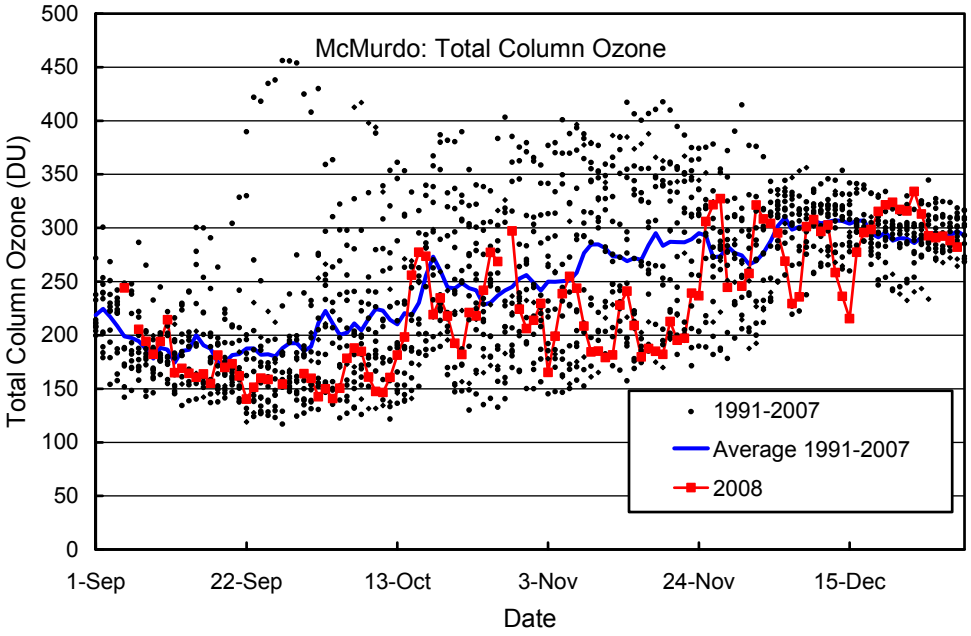

Figure 7.1.2. *Total column ozone in McMurdo. OMI measurements from 2008 are contrasted with ozone data from the years 1991-2005 recorded by TOMS /Nimbus-7(1991-1993), TOMS/Earth Probe (1996-2004), and OMI (2005-2007). TOMS data are from the "TOMS Version 8" data edition. OMI data are from the Version 8.5 (collection 3) data edition.*

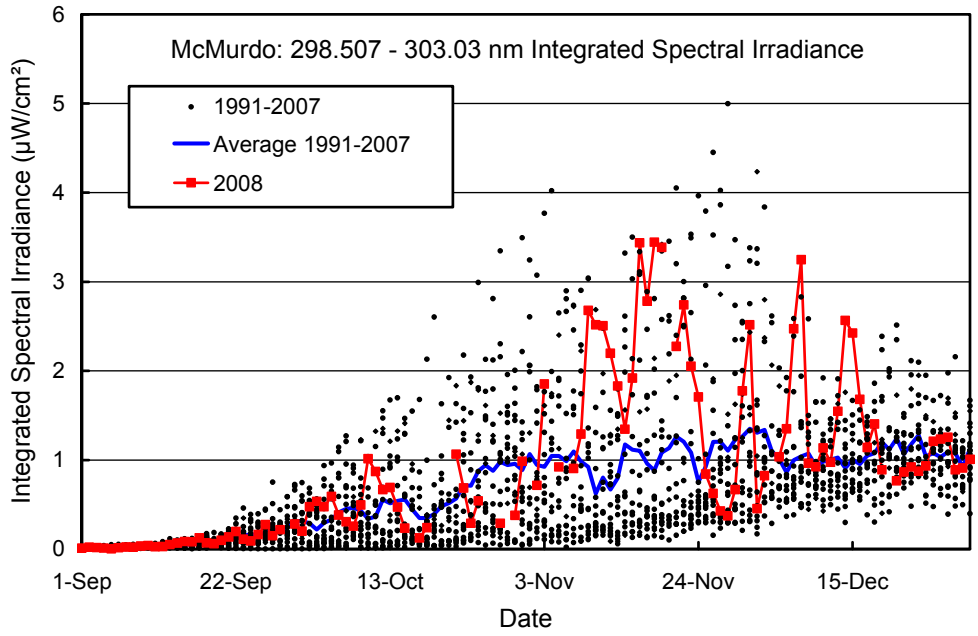

Figure 7.1.3. *Noontime integrated spectral UV irradiance (298.51 - 303.03 nm) at McMurdo. Measurements from 2008 are contrasted with individual data points and the average of measurements taken between 1991 and 2007.*

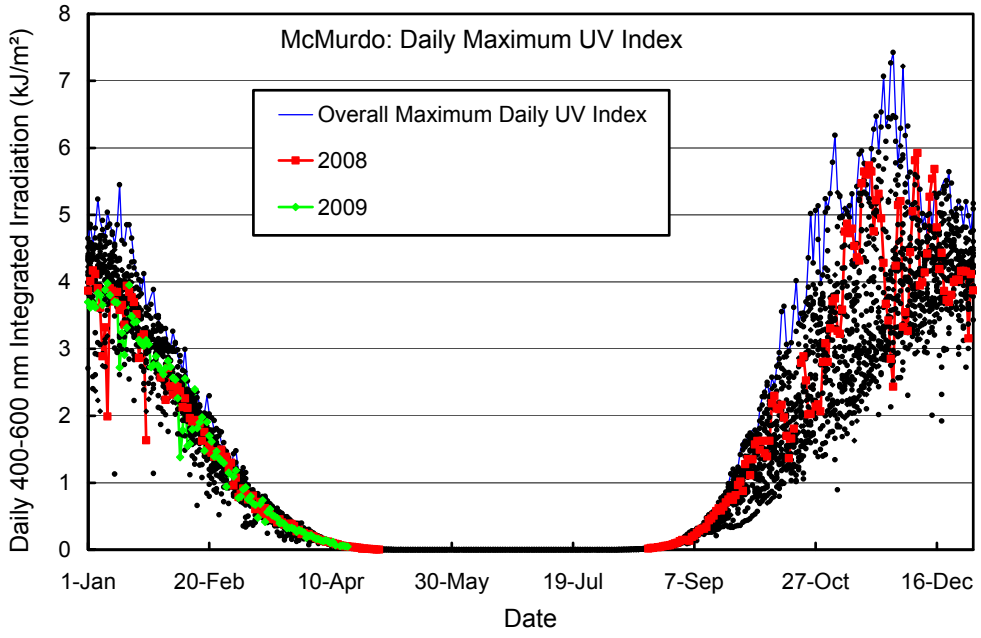

Figure 7.1.4. *Daily Maximum UV Index at McMurdo. Measurements from 2008 and 2009 are contrasted with individual data points and the average of measurements taken between 1991 and 2007.*

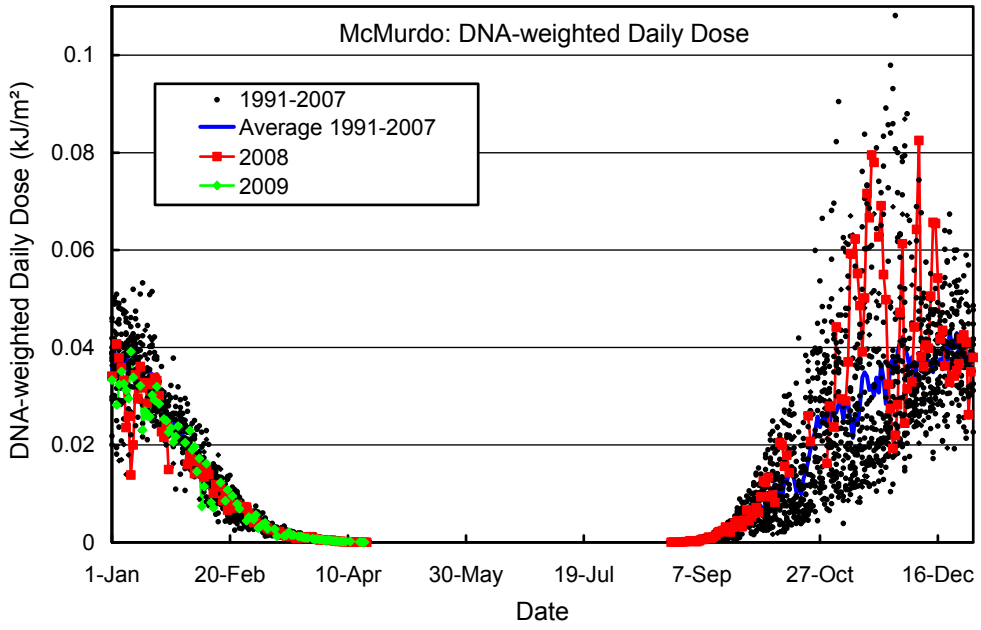

Figure 7.1.5. *Daily DNA-weighted dose for McMurdo. Volume 18 measurements from 2008 and 2009 are contrasted with individual data points and the average of measurements taken between 1991 and 2007.*

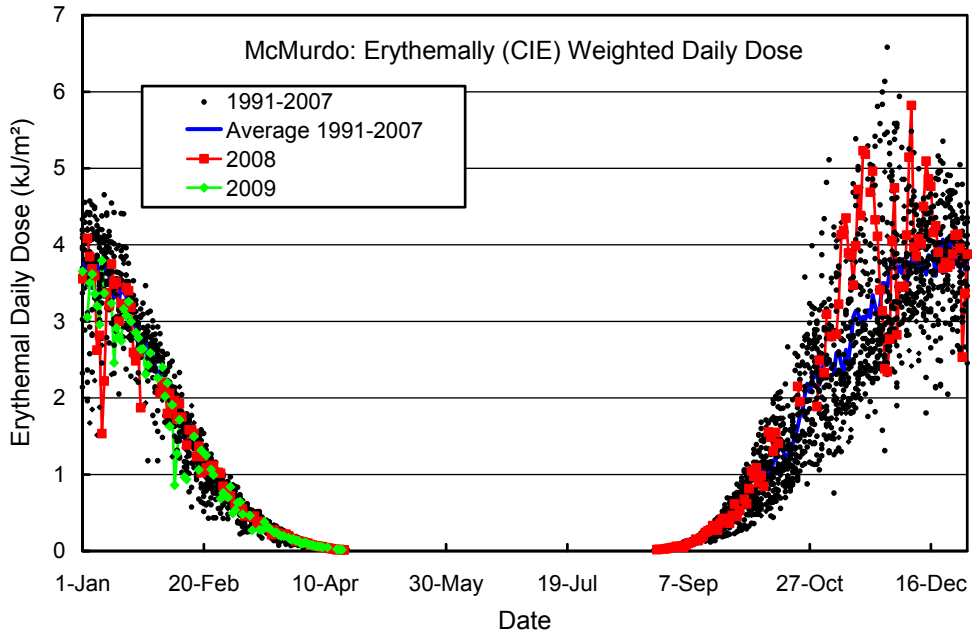

Figure 7.1.6. *Daily erythemal dose for McMurdo. Volume 18 measurements from 2008 and 2009 are contrasted with individual data points and the average of measurements taken between 1991 and 2007.*

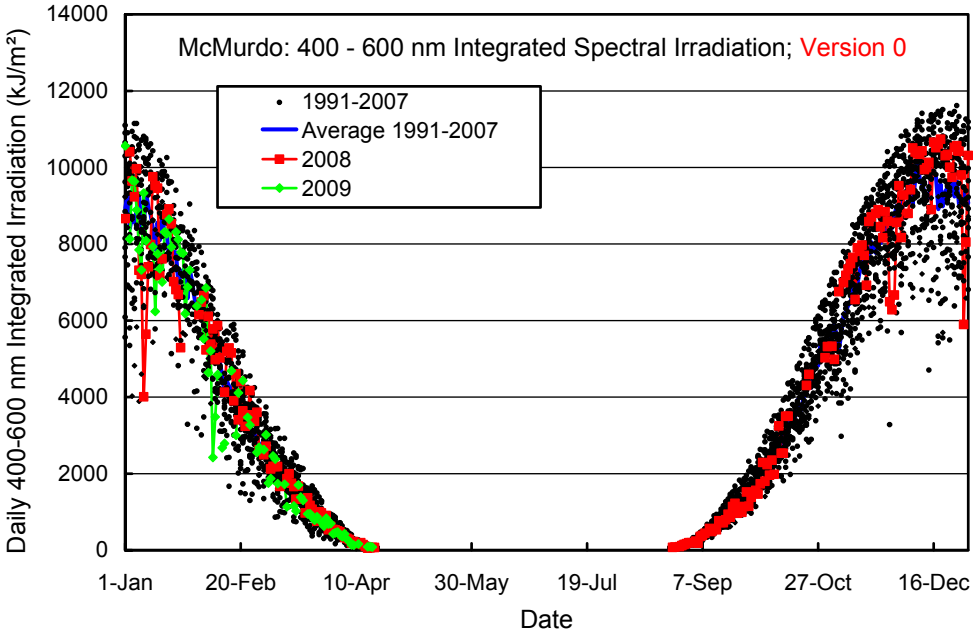

Figure 7.1.7. *Daily irradiation of the 400-600 nm band for McMurdo. Volume 18 measurements from 2008 and 2009 are contrasted with individual data points and the average of measurements taken between 1991 and 2007. Data are based on the "Version 0" data release discussed in this report. Figure 7.1.7 shows the same wavelength integral based on "Version 2" data.*

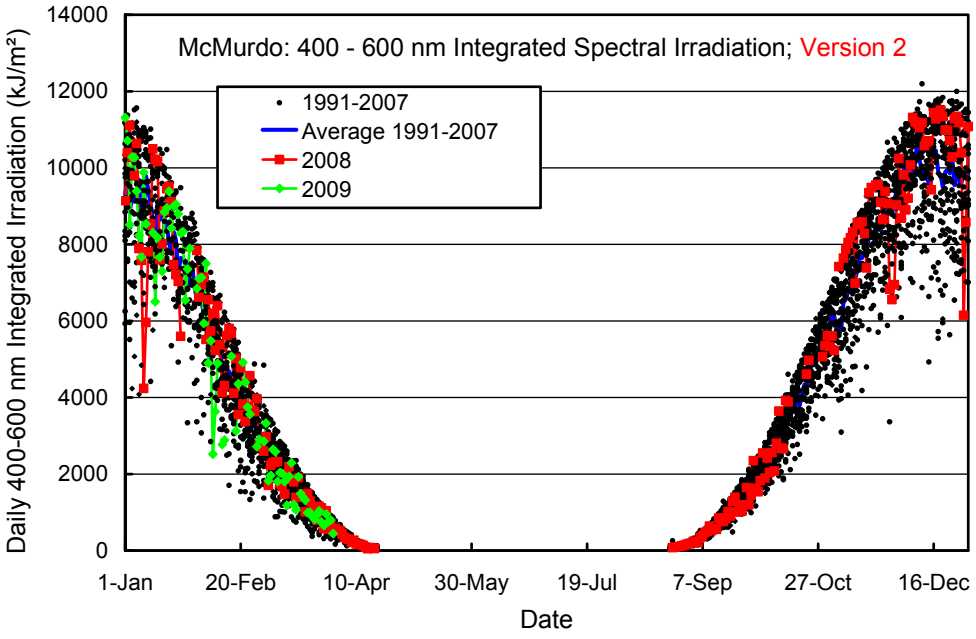

Figure 7.1.8. *Daily irradiation of the 400-600 nm band for McMurdo. Volume 18 measurements from 2008 and 2009 are contrasted with individual data points and the average of measurements taken between 1991 and 2007. Data are based on the "Version 2" data release, which are generally not subject of this report.*