Australian Government
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The 2011 Antarctic Ozone Hole and Ozone Science Summary: Final Report

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OMI - TOMS data used in this report

Data from the Ozone Monitoring Instrument (OMI) on board the Earth Observing Satellite (EOS) Aura, that have been processed with the NASA TOMS Version 8.5 algorithm, were utilized again in our 2011 weekly ozone hole reports and in this final report. OMI continues the NASA TOMS satellite record for total ozone and other atmospheric parameters related to ozone chemistry and climate.

In 2008, stripes of bad data began to appear in the OMI products apparently caused by a small physical obstruction in the OMI instrument field of view and is referred to as a row anomaly. NASA scientists guess that some of the reflective Mylar that wraps the instrument to provide thermal protection has torn and is intruding into the field of view. On 24 January 2009 the obstruction suddenly increased and now partially blocks an increased fraction of the field of view for certain Aura orbits, which led to the larger stripes of bad data in the OMI images. Since 5 July 2011, the row anomaly that manifested itself on 24 January 2009 now affects all Aura orbits, which can be seen as thick white stripes of bad data in the OMI total column ozone images. Affected data have been flagged and removed from the images. However, once the polar night reduced enough each year then this was not an issue for determining ozone hole metrics, as there is more overlap of the satellite passes at the polar regions which essentially 'fills-in' these missing data.

In June 2009, all of the OMI ozone data were reprocessed/updated by NASA. These were subsequently processed by CSIRO, which resulted in small changes in the ozone hole metrics. In mid-2007, a corrected version of all the Earth Probe TOMS (EPTOMS) data (1996-2005) was released. The correction addressed a degradation of the scanner mirror on TOMS that resulted in latitudinal dependent calibration errors. An empirical correction was applied based on the NOAA-16 SBUV/2 ozone record. The above mentioned reprocessed and corrected datasets are used throughout this report.

The analyses of the 2006 – 2011 Antarctic ozone holes are based on OMI data only, whereas the analysis of the 2005 hole is based on both OMI and TOMS data, and the analysis of 2004 and earlier holes is based on TOMS data only.

The 2011 Antarctic ozone hole

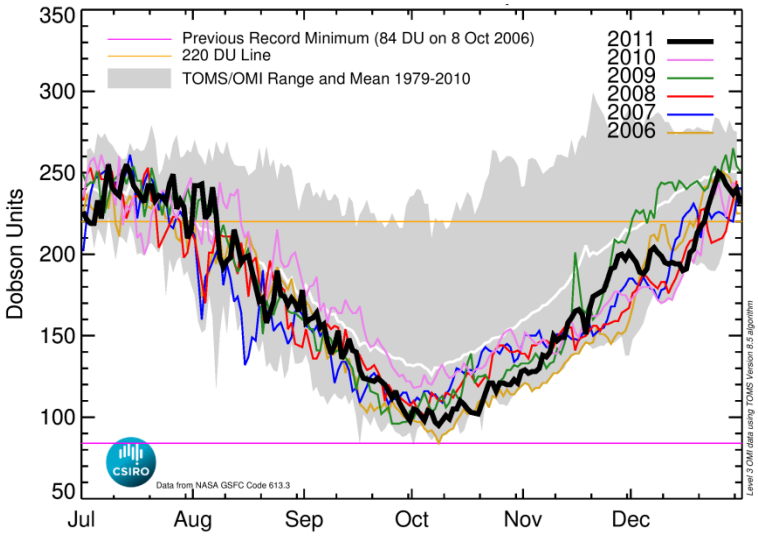

Figure 1: Ozone hole 'depth' (minimum ozone, DU) based on OMI and TOMS satellite data. The 2011 hole (OMI data) is indicated by the thick black line, the holes for selected previous years 2006-2010 (OMI data) are indicated by the thin orange, blue, red, green and pink lines respectively; the grey shaded area shows the 1979-2010 TOMS/OMI range and mean.

Figure 1 shows the Antarctic ozone hole 'depth', which is the daily minimum ozone (DU) observed south of 35°S throughout the season. The 2011 ozone hole was relatively deep. The minimum ozone level recorded in 2011 was 95 DU in early October, the 8th deepest hole recorded. The deepest hole ever was in 2006 (84

DU) during the second week of October, the second deepest in 1998 (86 DU) and the 3rd deepest in 2000 (89 DU).

Figure 2 shows the average amount of ozone (DU) within the Antarctic ozone hole throughout the 2011 season. The minimum average ozone within the hole in 2011 was 151 DU in early October, the 11th lowest ever recorded, again indicating a relatively deep hole. The lowest reading was in 2000 (138 DU), the second lowest in 2006 (143 DU) and the 3rd lowest in 1998 (147 DU).

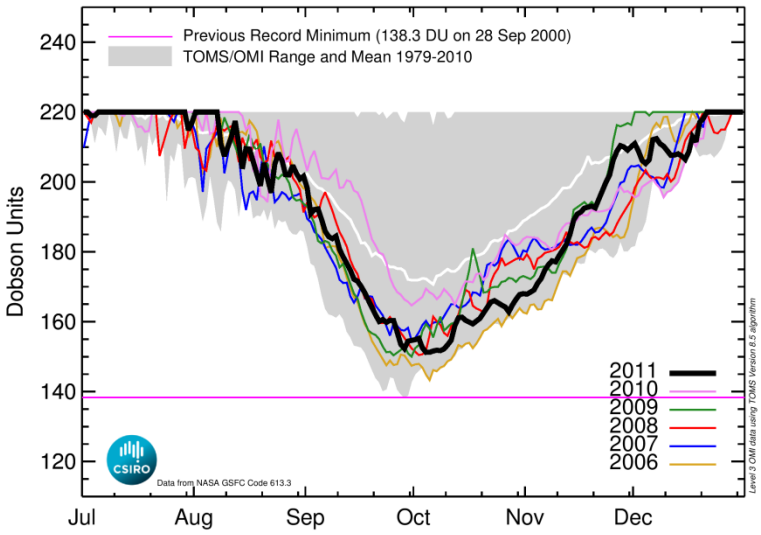

Figure 2: Average amount (DU) of ozone within the Antarctic ozone hole throughout the season based on OMI and TOMS satellite data. The 2011 hole (OMI data) is indicated by the thick black line, the holes for selected previous years 2006-2010 (OMI data) are indicated by the thin orange, blue, red, green and pink lines respectively; the grey shaded area shows the 1979-2010 TOMS/OMI range and mean.

Figure 3 shows the Antarctic ozone hole area (defined as the area within the 220 DU contour) throughout the 2011 season. The maximum daily area of the hole (25.7 million km^2 in early October) was the 11th largest hole ever, the largest in 2000 (29.8 million km^2), the 2nd largest in 2006 (29.6 million km^2) and the 3rd largest in 2003 (28.4 million km^2). The 15-day average ozone hole area for 2011 was 25.0 million km^2, the 9th largest area ever recorded, with the largest in 2000 (28.7 million km^2).

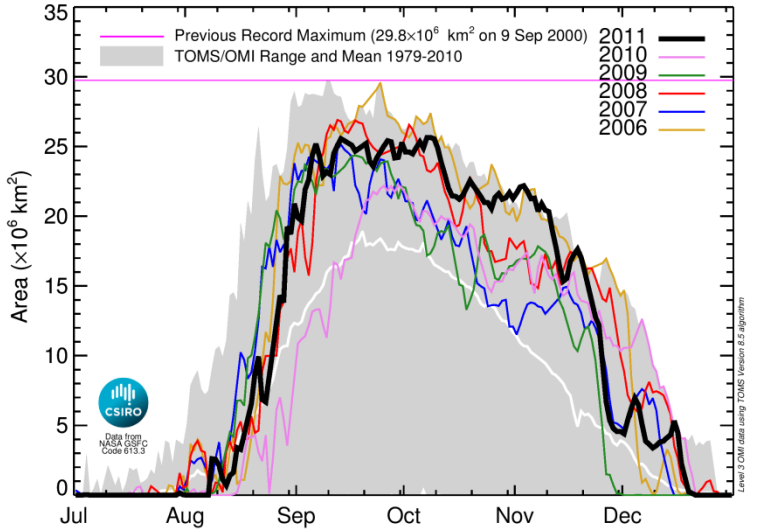

Figure 3: Ozone hole area based on TOMS and OMI satellite data. The 2011 hole (OMI data) is indicated by the thick black line, the holes for selected previous years 2006-2010 (OMI data) are indicated by the thin orange, blue, red, green and pink lines respectively; the grey shaded area shows the 1979-2010 TOMS/OMI range and mean.

Figure 4 shows the daily (24 hour) maximum ozone deficit in the Antarctic ozone hole, which is a function of both ozone hole depth and area. This metric is not the amount of ozone lost within the hole each day, but is a measure of the accumulated loss summed over the lifetime of ozone within the hole as measured each day. The maximum daily ozone deficit in 2011 was 37.5 million tonnes (Mt) in early-October, the 9th largest deficit ever, the largest was in 2006 (45.2 Mt).

Integrated over the whole ozone-hole season, the total ozone deficit (the sum of the daily ozone deficits) was about 2119 Mt of ozone in 2011, the 7th largest cumulative ozone deficit ever recorded, the largest was in 2006 (2579 Mt).

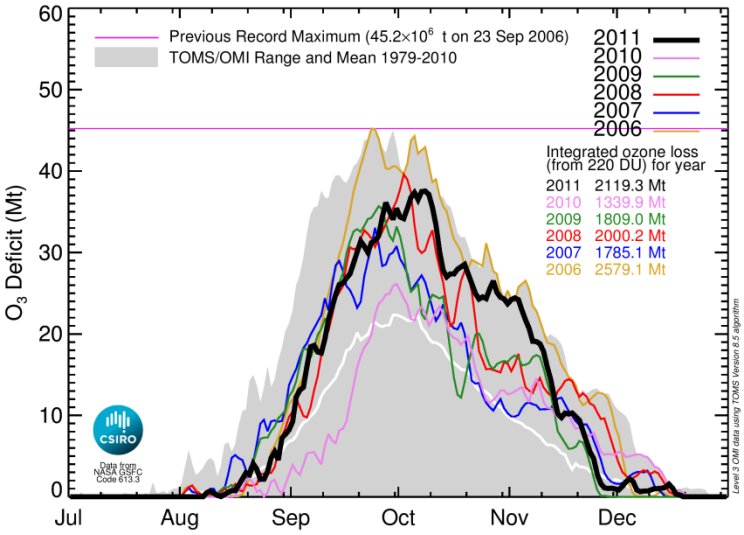

Figure 4: OMI estimated daily ozone deficit (in millions of tonnes, Mt) within the ozone hole. The 2010 hole (OMI data) is indicated by the thick black line, the holes for selected previous years 2006-2010 (OMI data) are indicated by the thin orange, blue, red, green and pink lines respectively; the grey shaded area shows the 1979-2010 TOMS/OMI range and mean. The estimated total (integrated) ozone loss for each year is shown in the legend.

Table 1 contains the ranking for all 32 ozone holes recorded since 1979 for the various metrics that measure the 'size' of the Antarctic ozone hole: 1 = lowest ozone minimum, greatest area, greatest ozone loss etc.; 2 = second largest….

The metric definitions are:

- Daily ozone hole area is the maximum daily ozone hole area on any day during ozone hole season.
- 15-day average ozone hole area is based on a 15-day moving average of the daily ozone hole area.
- Ozone hole depth (or daily minima) is based on the minimum column ozone amount on any day during ozone hole season.
- The 15-day average ozone hole depth (or minima) is based on a 15-day moving average of the daily ozone hole depth.
- Minimum average ozone is the minimum daily average ozone amount (within the hole) on any day during ozone hole season.
- Daily maximum ozone deficit is the maximum ozone deficit on any day during ozone hole season.
- Ozone deficit is the integrated (total) ozone deficit for the entire ozone hole season.