Global Ozone and Surface UV Climatology Data Products for NASA Earth Observations (NEO) and Science on the Sphere (SOS)

1) Tropospheric Column Ozone in Dobson Units
2) Stratospheric Column Ozone in Dobson Units
3) Total Column Ozone in Dobson Units
4) Surface UV-Index

(These four data products represent 12-month climatologies with horizontal resolution of 1^{o} latitude by 1.25^{o} longitude)

Contact person: Dr. Jerry Ziemke, Code 614
Ph: 301-614-6034 Email: Jerald.R.Ziemke@nasa.gov

The Data Arrays

- Given as both an IDL save file

  global_ozone_uv_climatology_data_arrays.sav

  and as an HDF EOS5 file (compressed using gzip command)

  global_ozone_uv_climatology_data_arrays.h5.gz

- These data files can be obtained from the following NASA websites:

(1) https://acd-ext.gsfc.nasa.gov/Data_services/cloud_slice/

(2) https://avdc.gsfc.nasa.gov/pub/data/project/Ozone_Climatology/

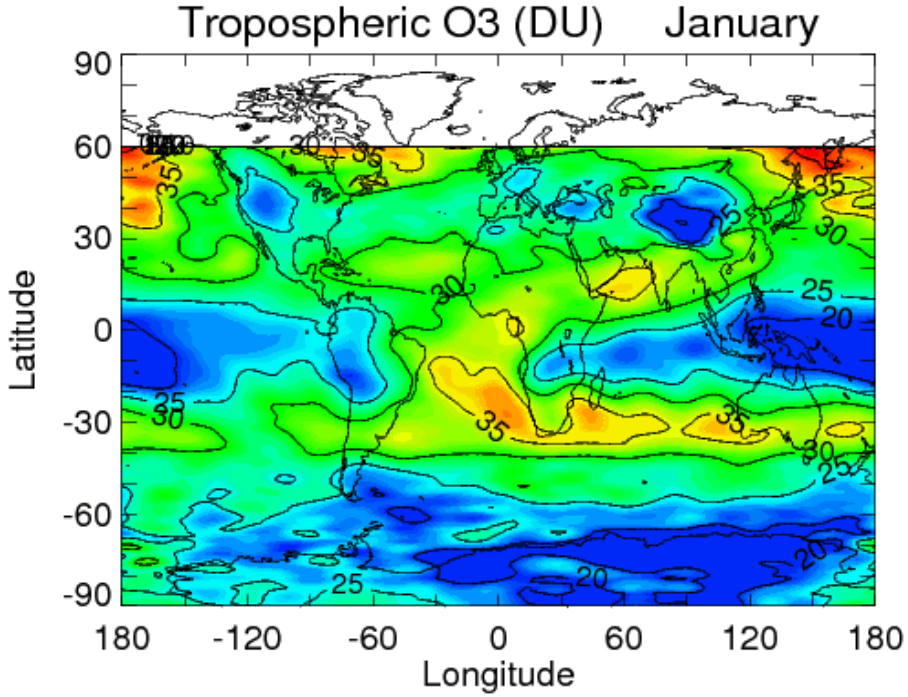
Reference: Ziemke, J. R., S. Chandra, G. J. Labow, P. K. Bhartia, L. Froidevaux, and J. C. Witte, A global climatology of tropospheric and stratospheric ozone derived from Aura OMI and MLS measurements, Atmos. Chem. Phys., 11, 9237-9251, doi:10.5194/acp-11-9237-2011, 2011.

Global Tropospheric Column Ozone Climatology in Dobson Units

- Derived from Aura OMI v8.5 Total Column Ozone Minus Aura MLS v3.3 Stratospheric Column Ozone for Oct2004 through Jan2011

- Uses WMO/NCEP 2K/km lapse rate tropopause pressure to separate tropospheric from stratospheric column ozone

- There is missing data in polar night latitudes including additional measurements at high latitudes/high solar zenith angles flagged as missing because of questionable data quality


Tropospheric O3 (DU) January
Latitude
Longitude
90
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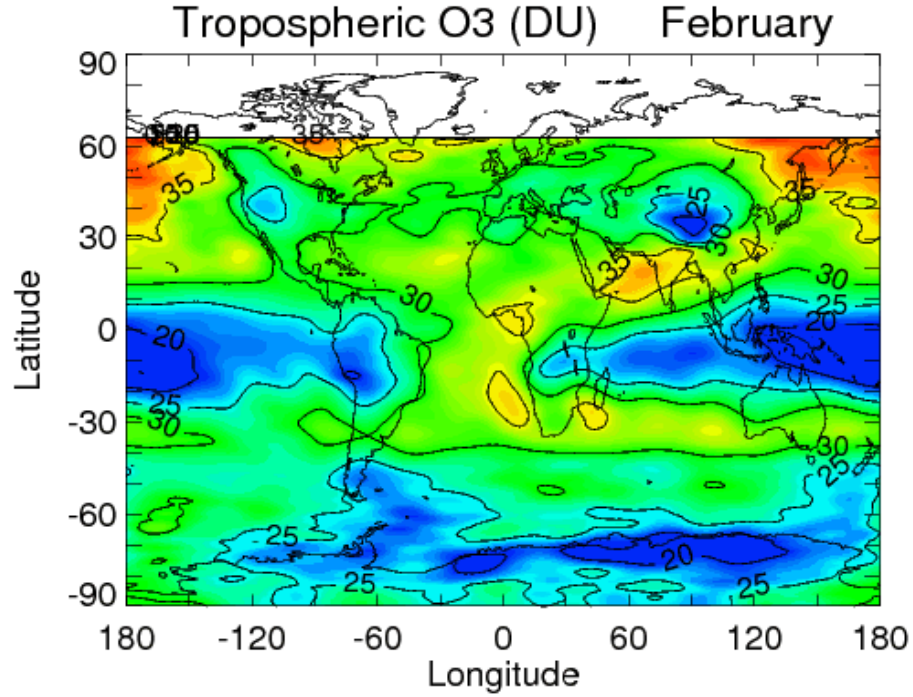
-30
-60
-90
180
-120
-60
0
60
120
180


Tropospheric O3 (DU) February
Latitude
Longitude
90
60
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0
-30
-60
-90
180
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-60
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60
120
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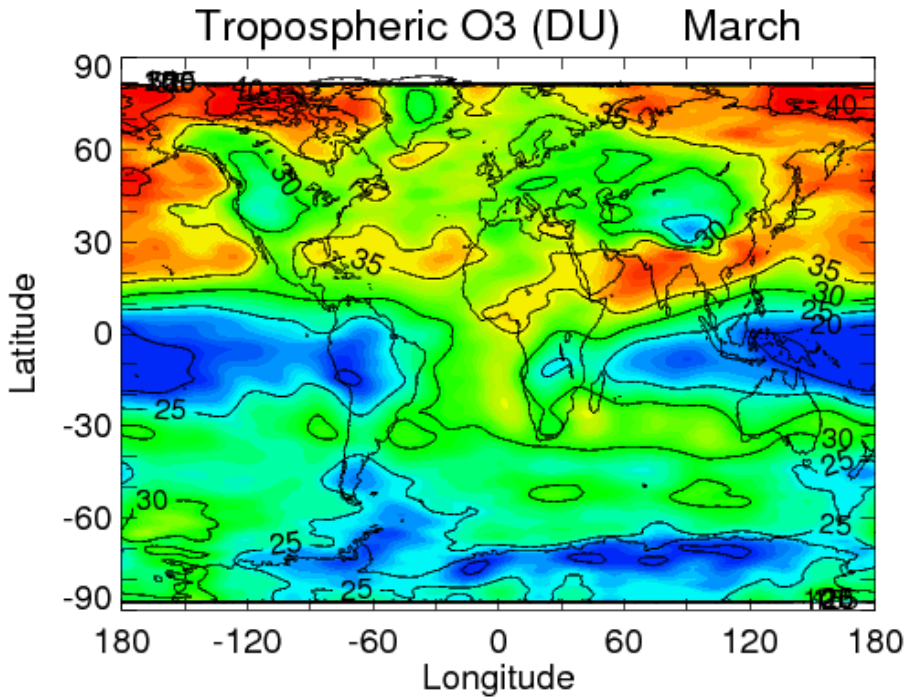
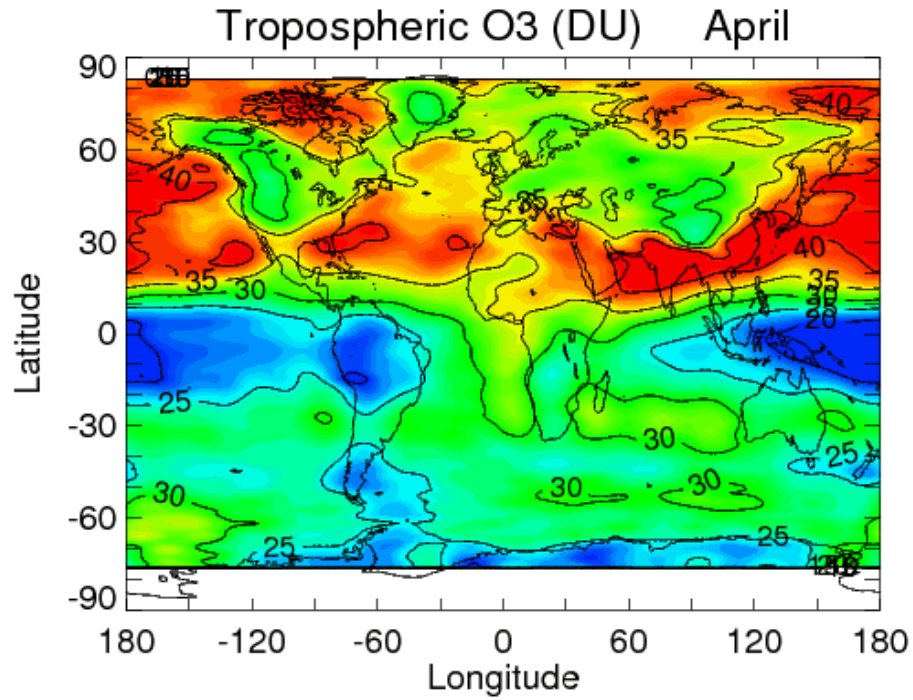

Tropospheric O3 (DU) March
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


Tropospheric O3 (DU) April
Latitude
Longitude
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60
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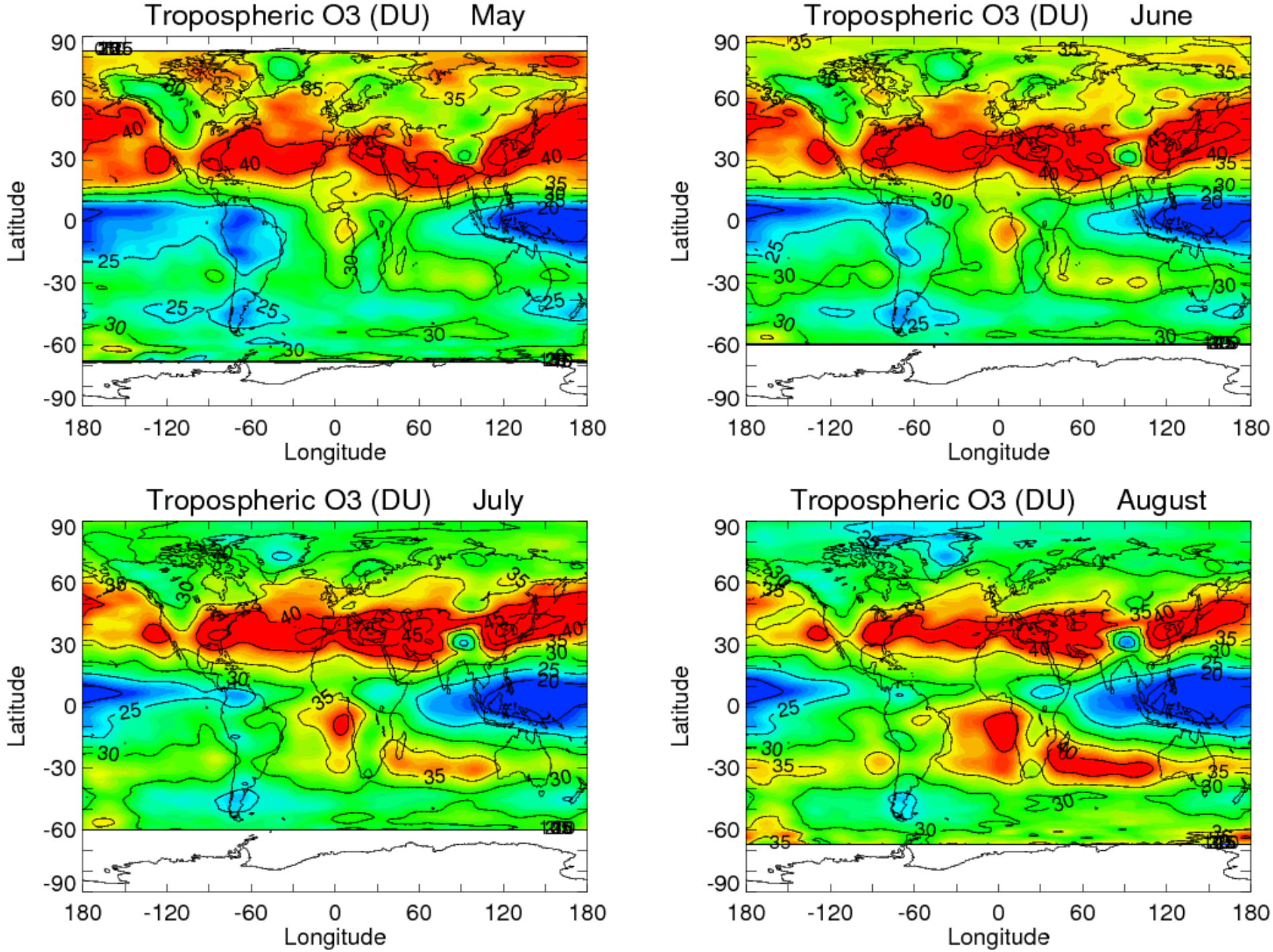
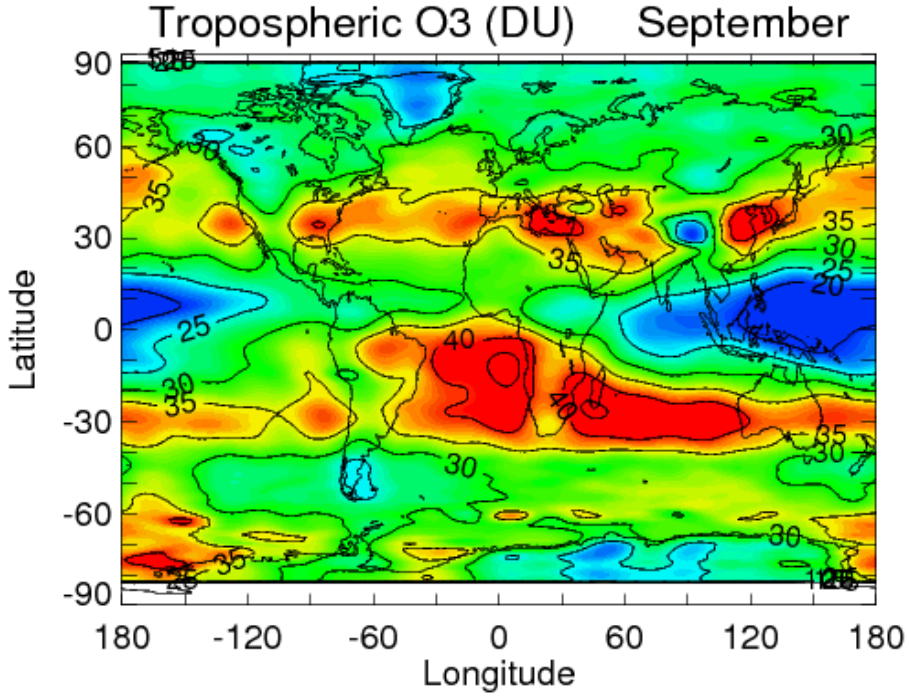
0
-30
-60
-90
180
-120
-60
0
60
120
180


Tropospheric O3 (DU) May
Tropospheric O3 (DU) June
Tropospheric O3 (DU) July
Tropospheric O3 (DU) August
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


Tropospheric O3 (DU) September
Latitude
Longitude
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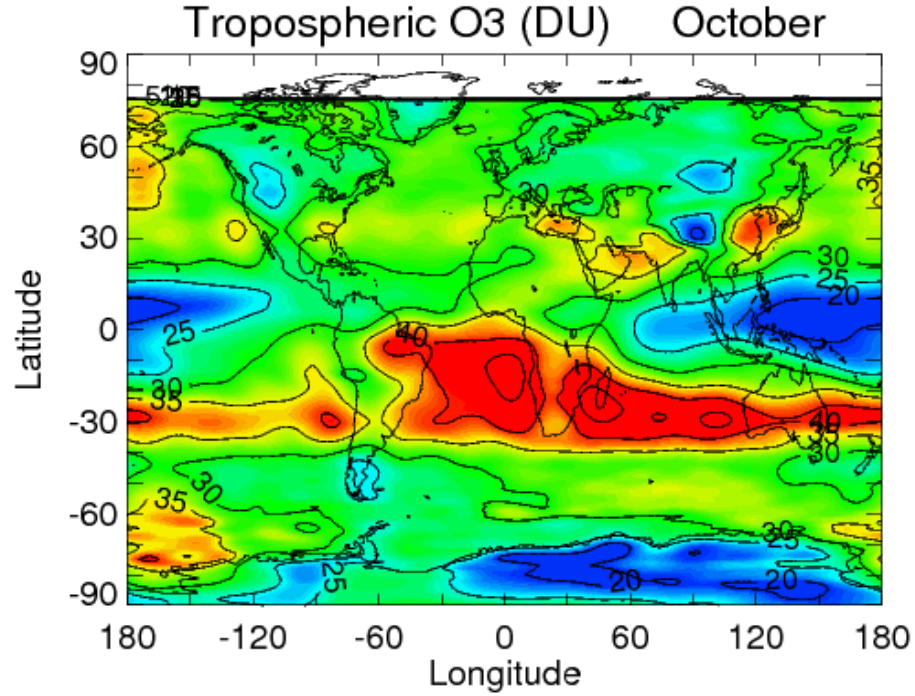
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


Tropospheric O3 (DU) October
Latitude
Longitude
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60
30
0
-30
-60
-90
180
-120
-60
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60
120
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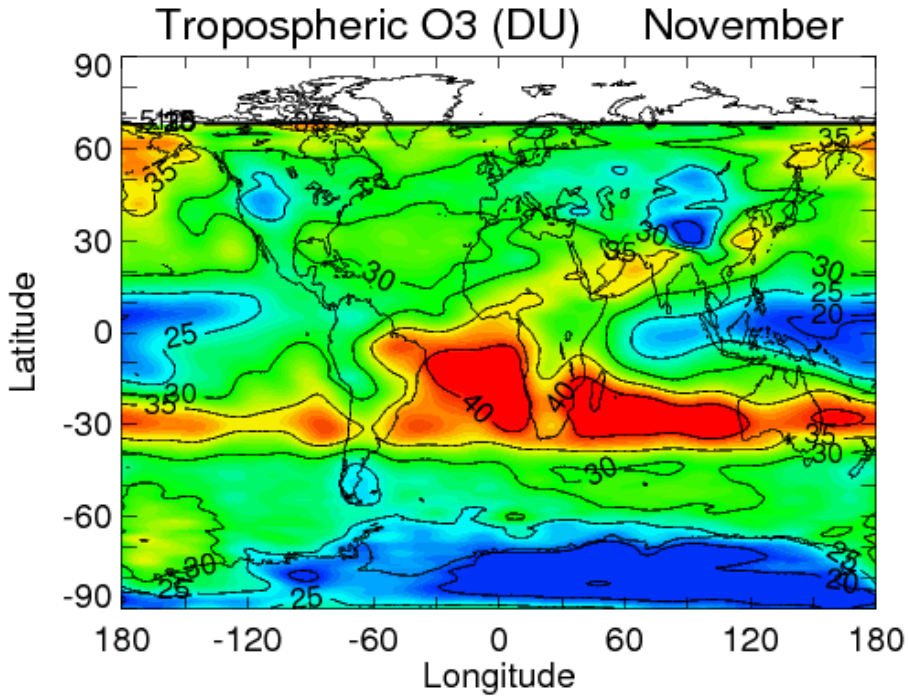
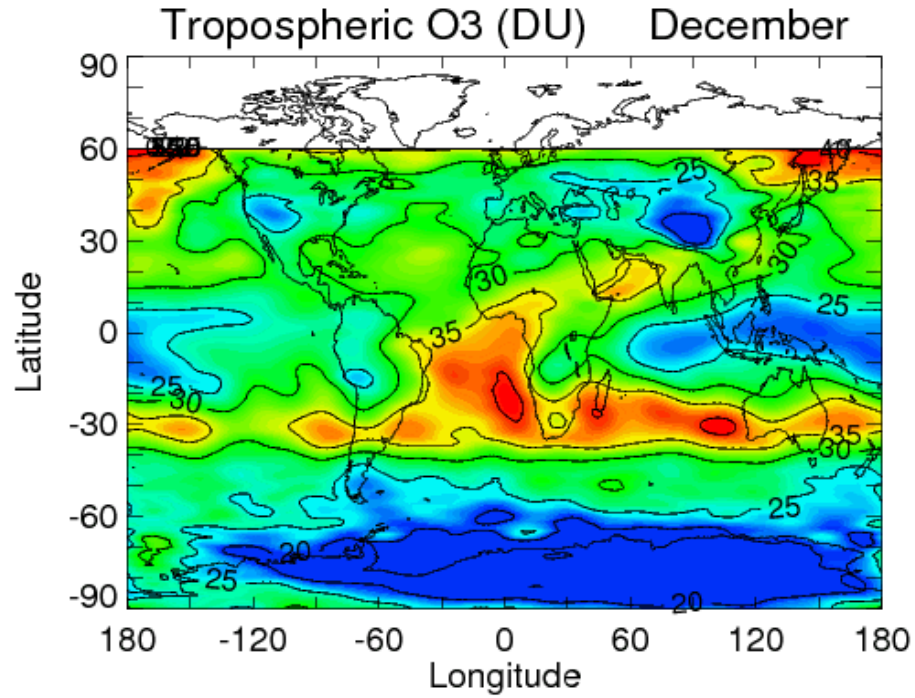
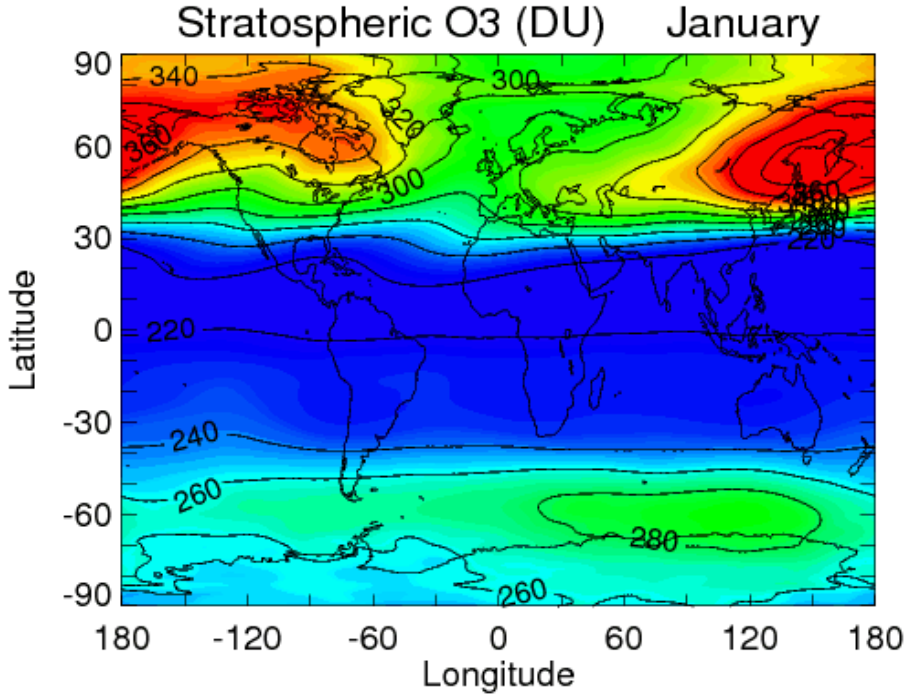
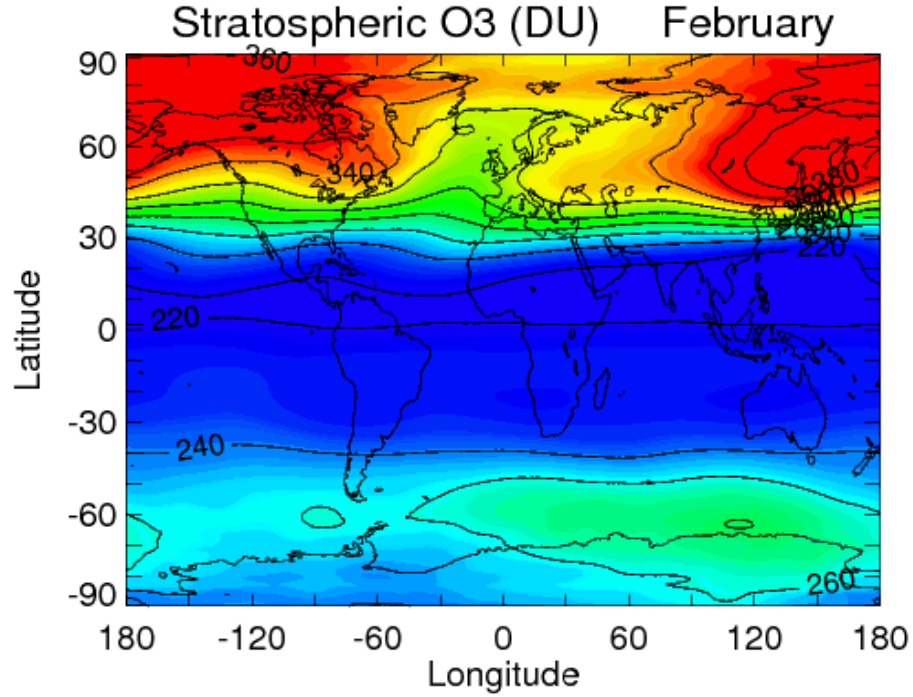

Tropospheric O3 (DU) November
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180

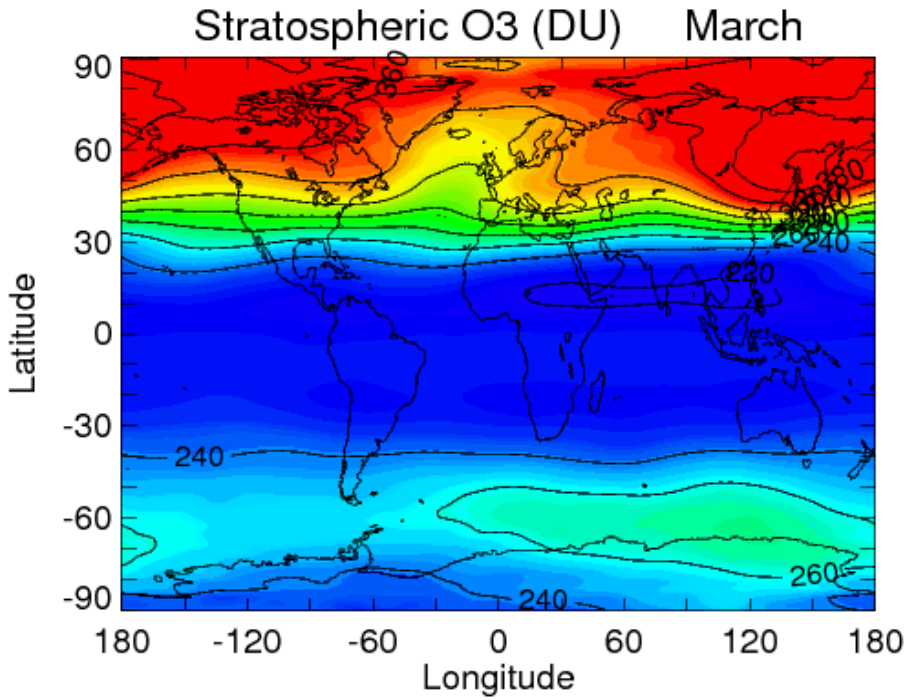

Tropospheric O3 (DU) December
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180

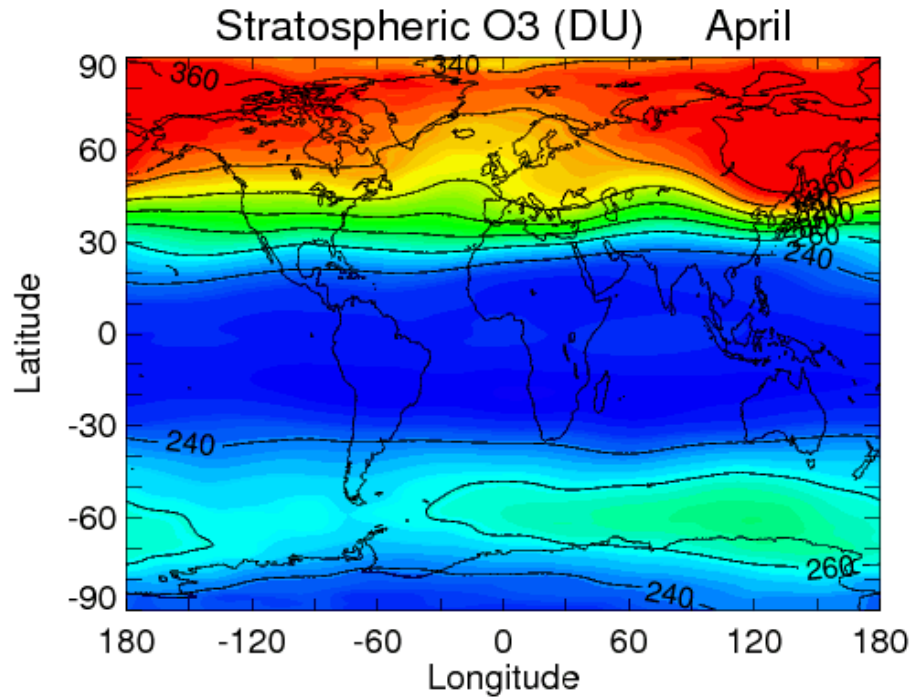
Global Stratospheric Column Ozone Climatology in Dobson Units

- Derived from Aura MLS v3.3 ozone profile measurements from October 2004 through January 2011
- Uses WMO/NCEP 2K per km lapse rate tropopause pressure definition to derive stratospheric column ozone
- Missing MLS data within a few degrees of latitude from the poles are filled in using extrapolated MLS measurements from nearby lower latitudes


Stratospheric O3 (DU) January
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
340
300
320
360
300
220
220
240
260
280
260


Stratospheric O3 (DU) February
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
360
340
220
220
240
260


Stratospheric O3 (DU) March
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
360
240
220
240
260


Stratospheric O3 (DU) April
Latitude
Longitude
90
60
30
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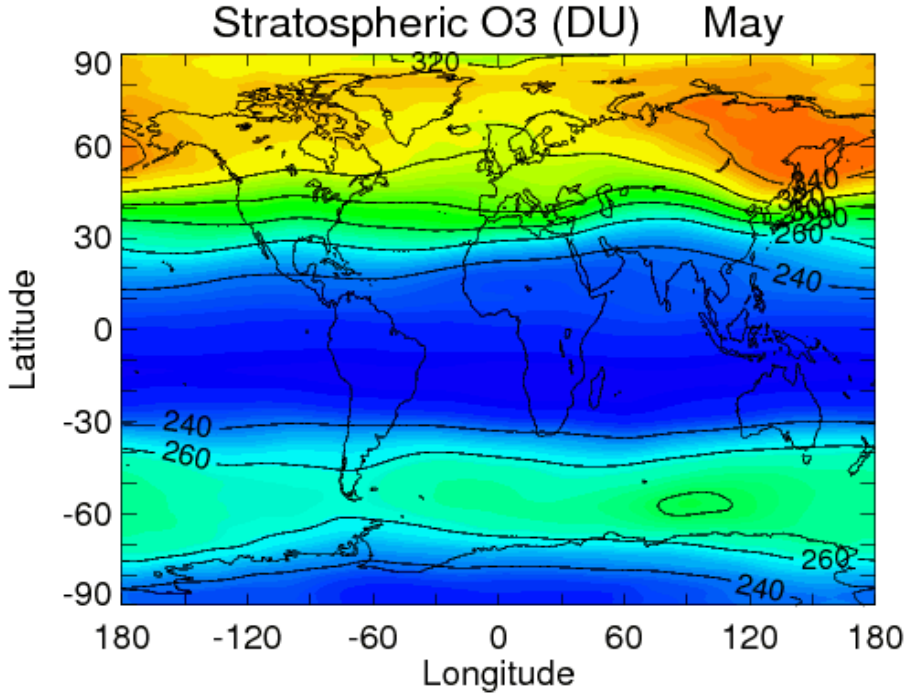
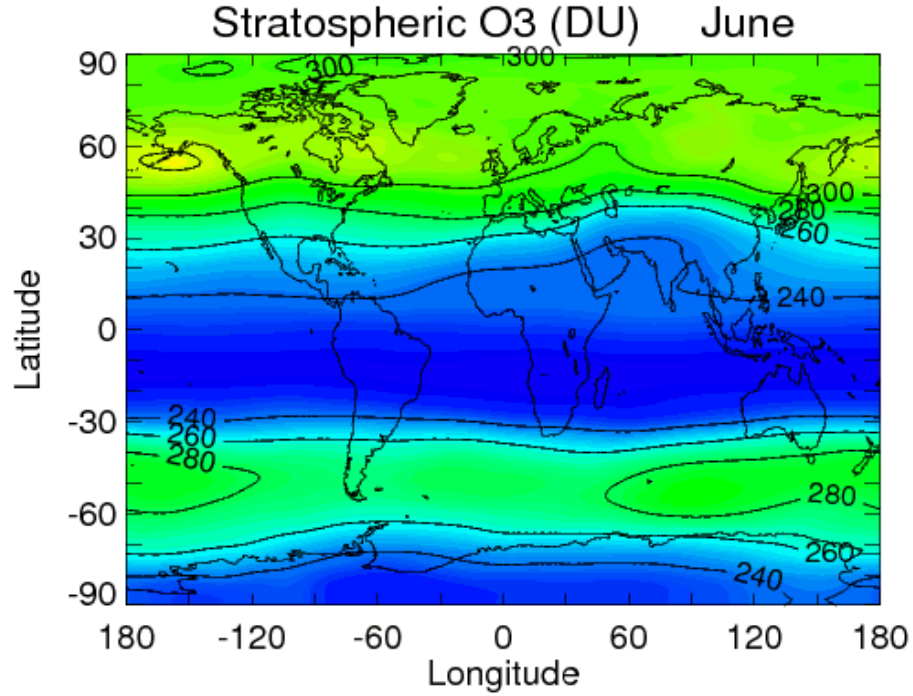
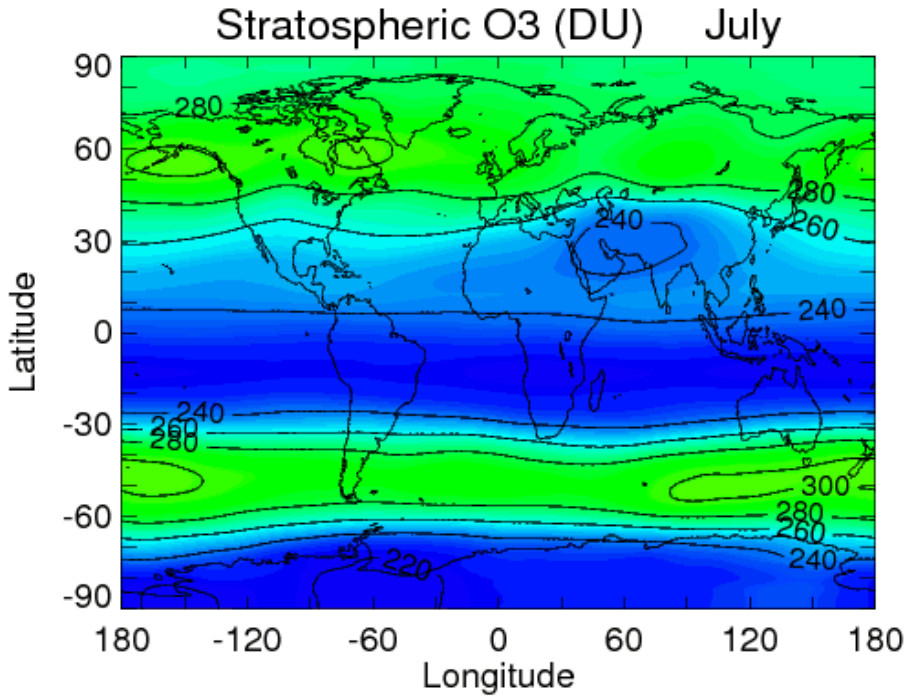
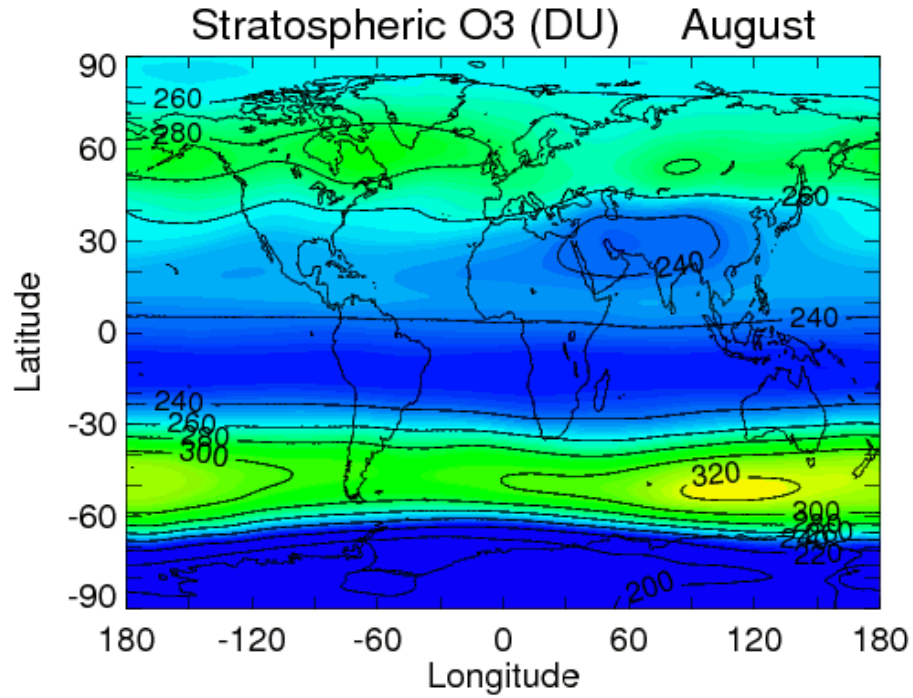
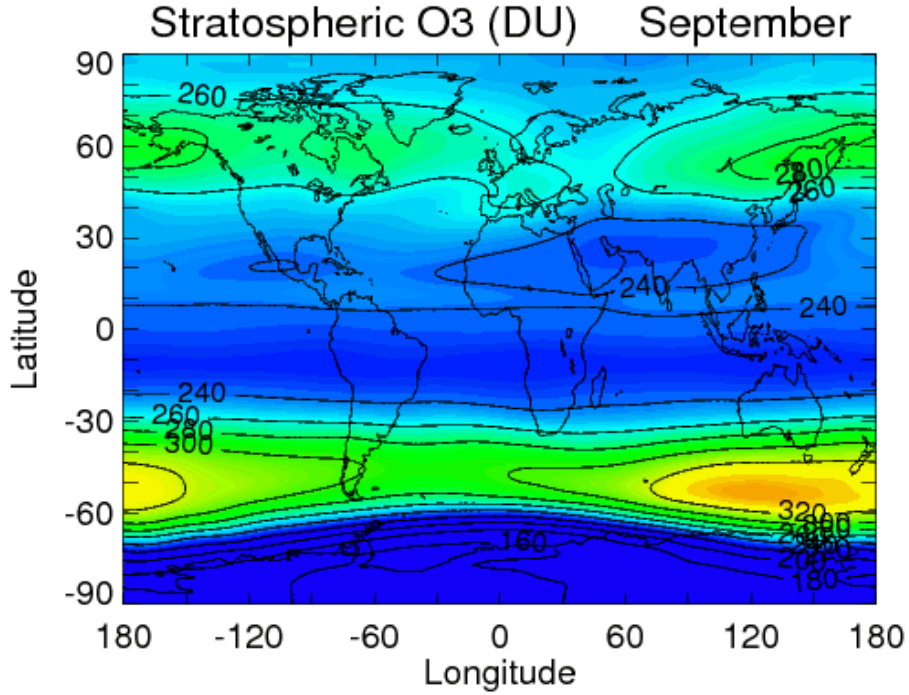
-30
-60
-90
180
-120
-60
0
60
120
180
360
340
240
240
260

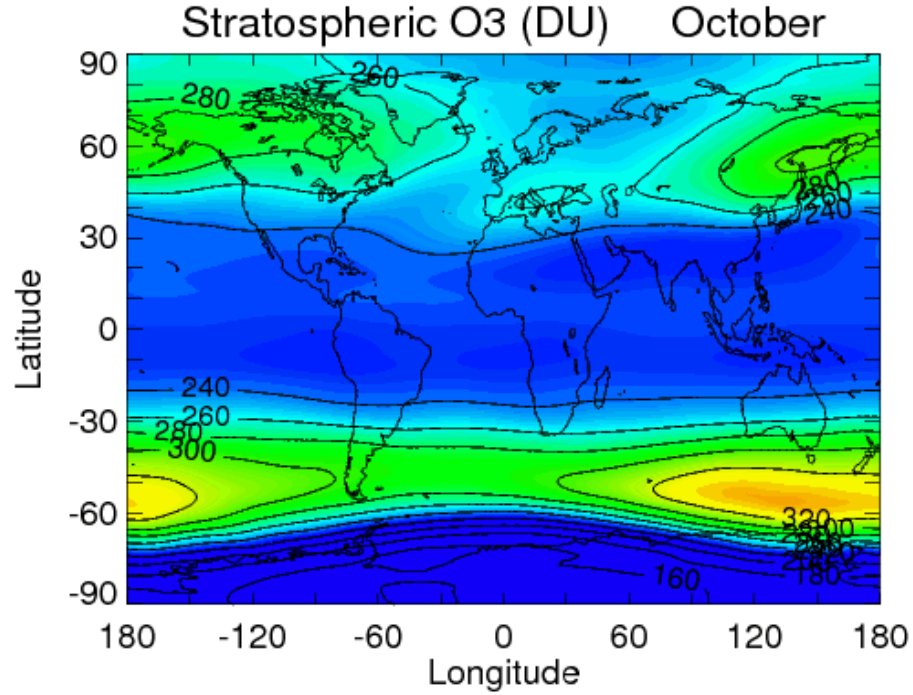

Stratospheric O3 (DU) May
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
320
240
260

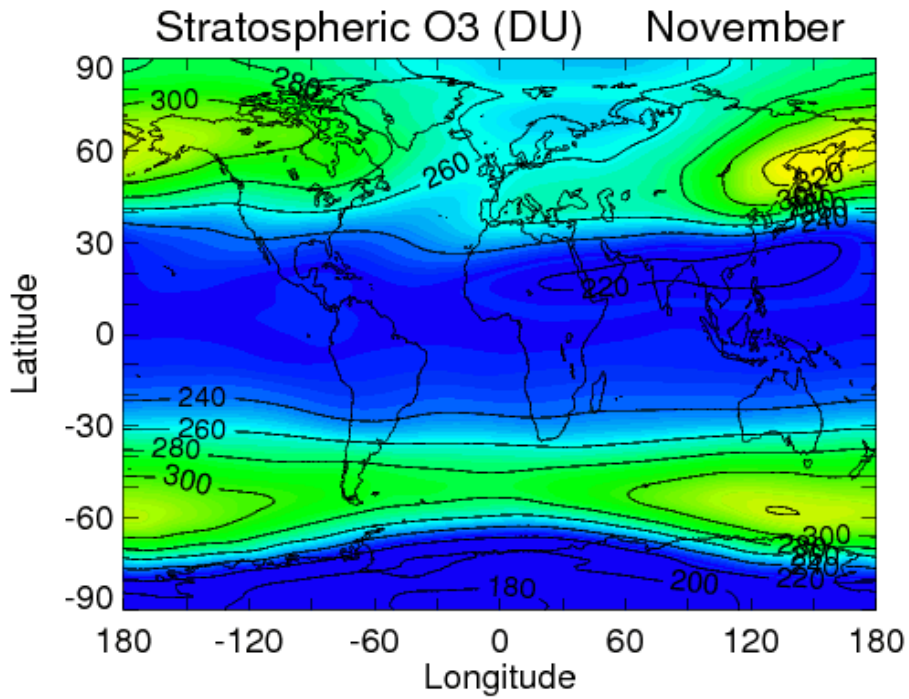

Stratospheric O3 (DU) June
Latitude
Longitude
300
280
260
240

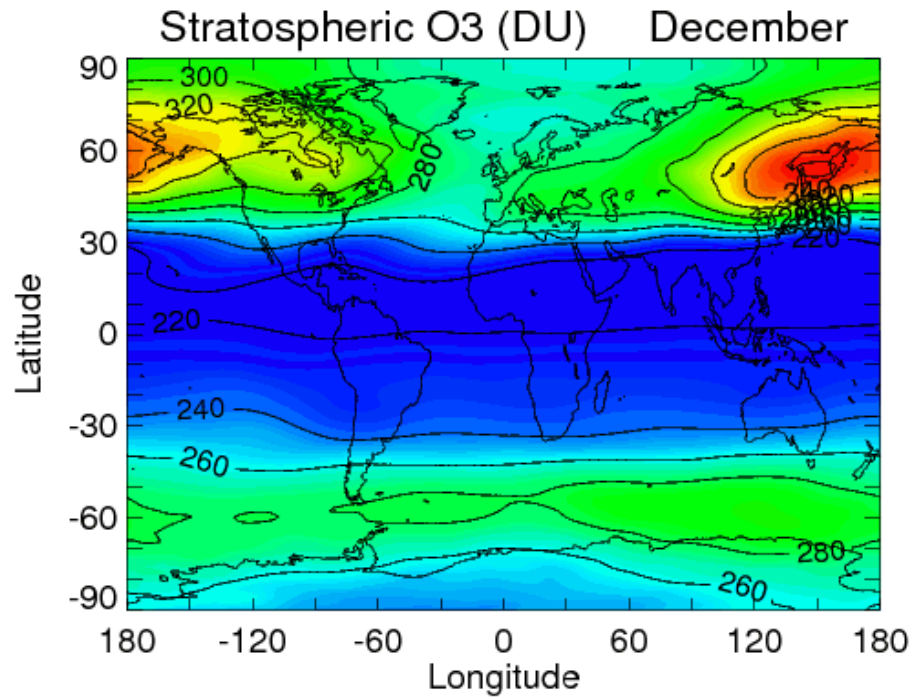

Stratospheric O3 (DU) July
Latitude
Longitude
280
260
240
300
220


Stratospheric O3 (DU) August
Latitude
Longitude
260
280
240
300
320
220
200


Stratospheric O3 (DU) September
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
260
240
300
320
160
200


Stratospheric O3 (DU) October
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
280
260
240
300
320
160

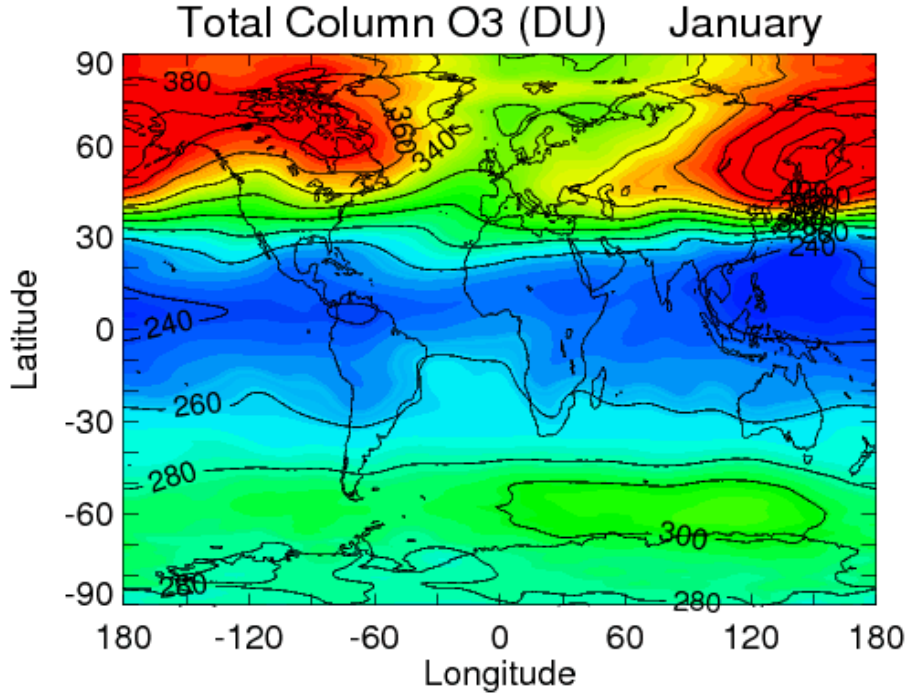

Stratospheric O3 (DU) November
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
300
280
260
240
220
200
180

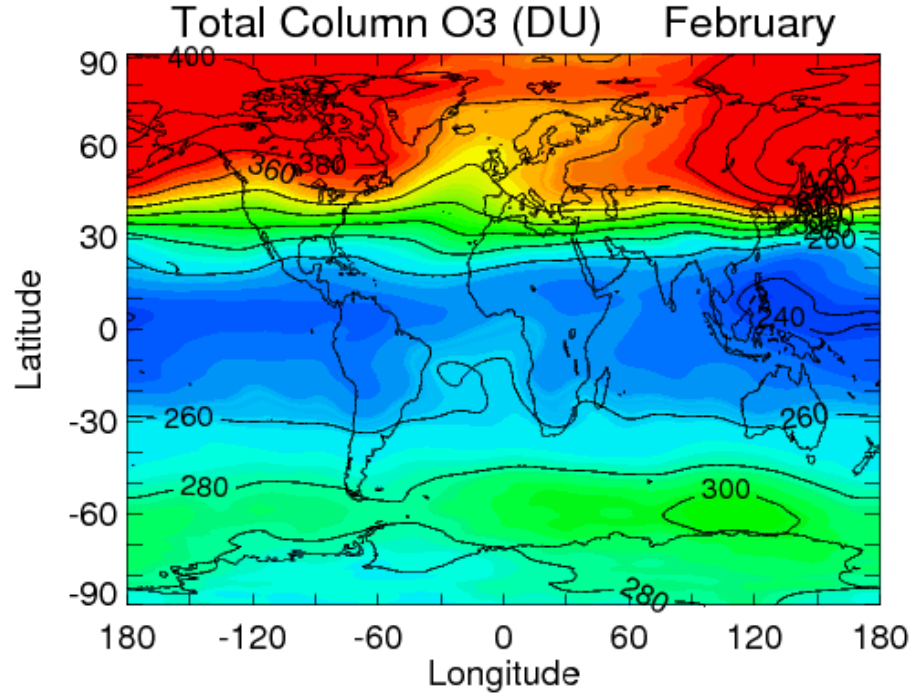

Stratospheric O3 (DU) December
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
300
320
280
260
240
220

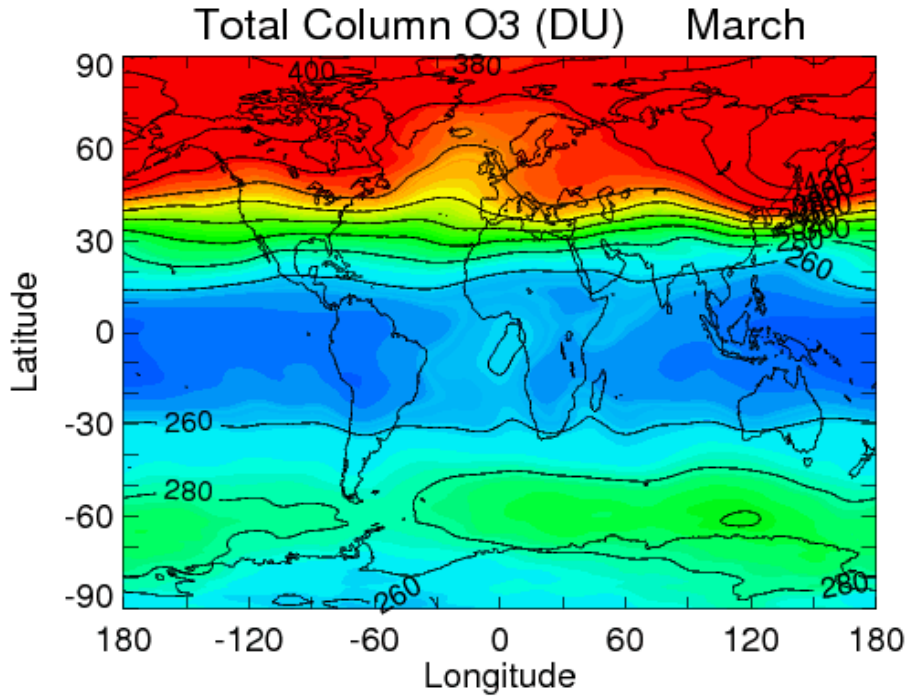
Global Total Column Ozone Climatology in Dobson Units

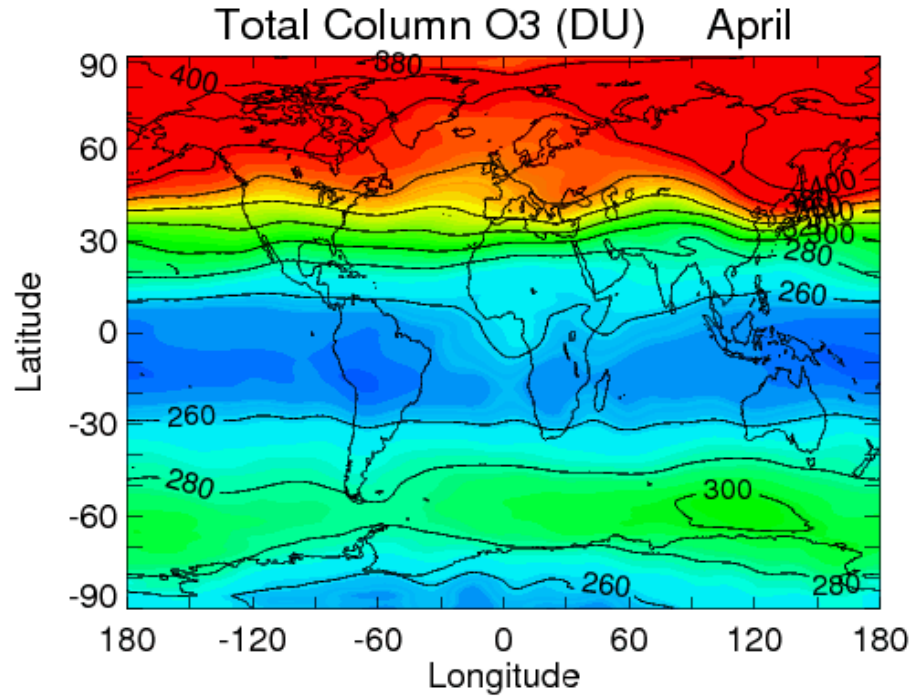
- Derived from Aura OMI v8.5 measurements everywhere except in polar night latitudes

- For polar night latitudes, MLS v3.3 stratospheric column ozone is about 90-95% of total column ozone – the tropospheric column ozone product is extrapolated from lower latitudes and then added to MLS stratospheric column ozone to give a close estimate of total column ozone in polar night latitudes (result: total column ozone is an entire global map for each month, just like MLS stratospheric column ozone)


Total Column O3 (DU) January
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
380
360
340
240
260
280
300


Total Column O3 (DU) February
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
400
360
380
240
260
280
300


Total Column O3 (DU) March
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180
400
380
260
280


Total Column O3 (DU) April
Latitude
Longitude
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180
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-60
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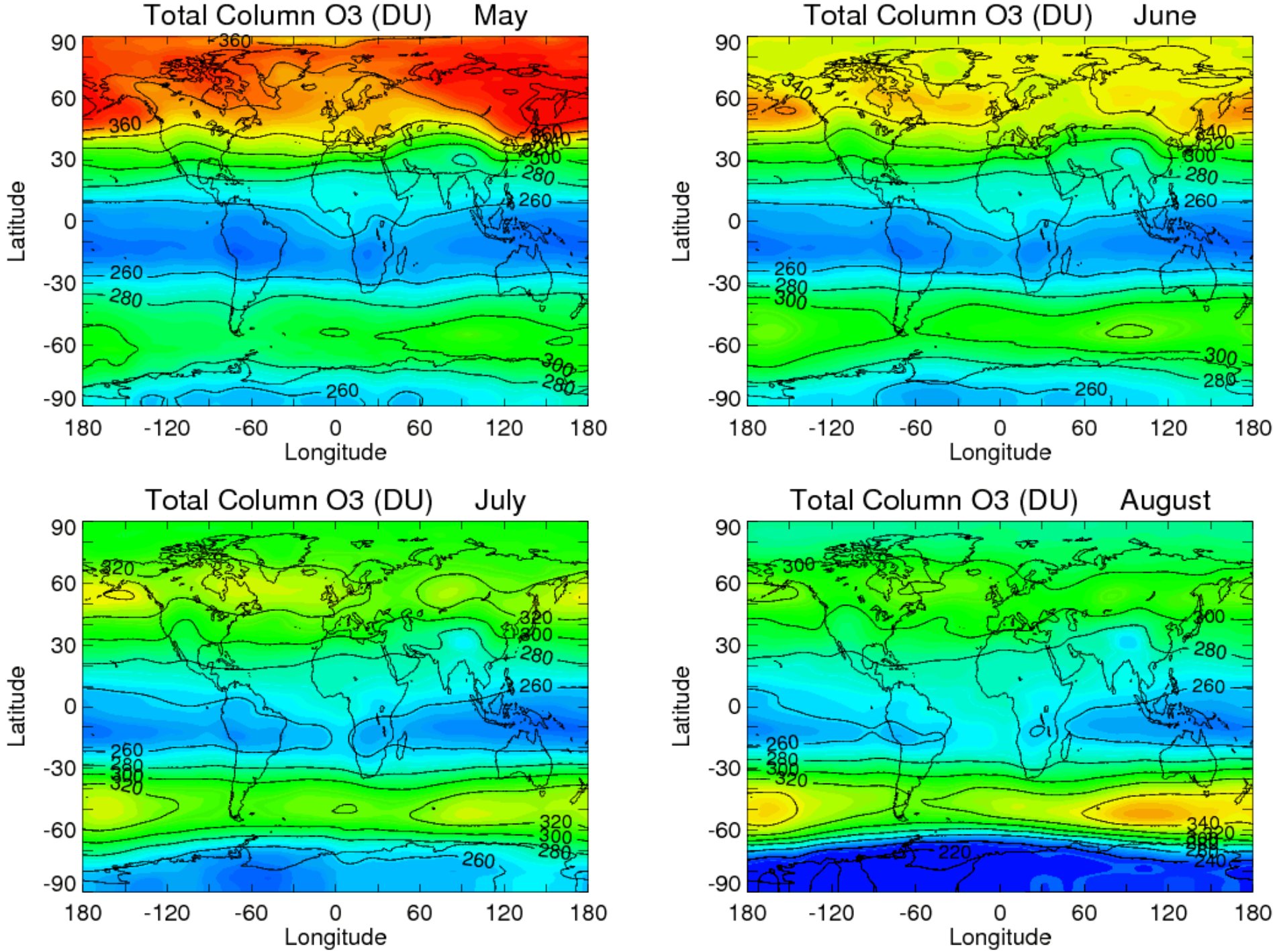
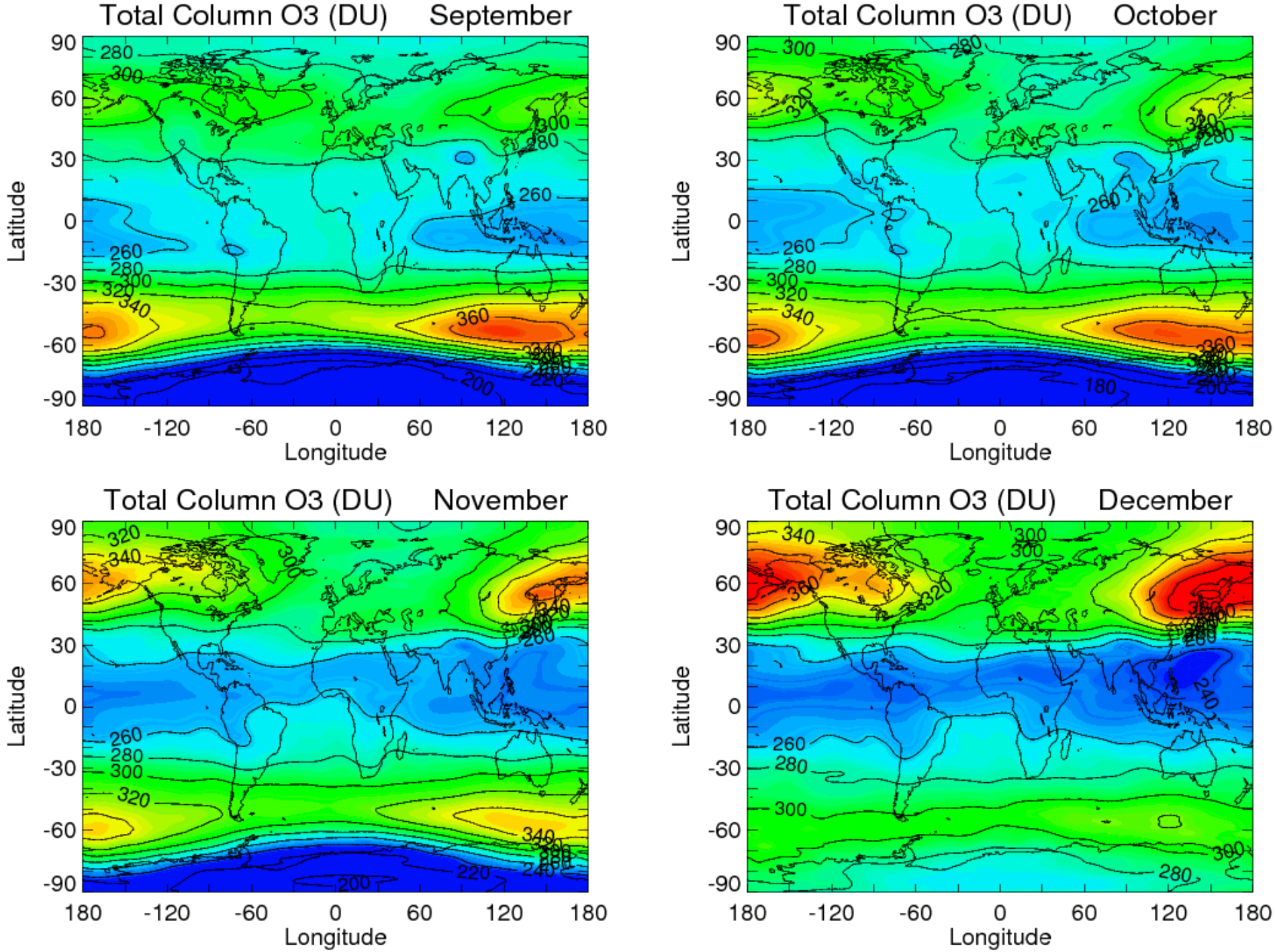
400
380
260
280
300


Total Column O3 (DU) May
Total Column O3 (DU) June
Total Column O3 (DU) July
Total Column O3 (DU) August
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180

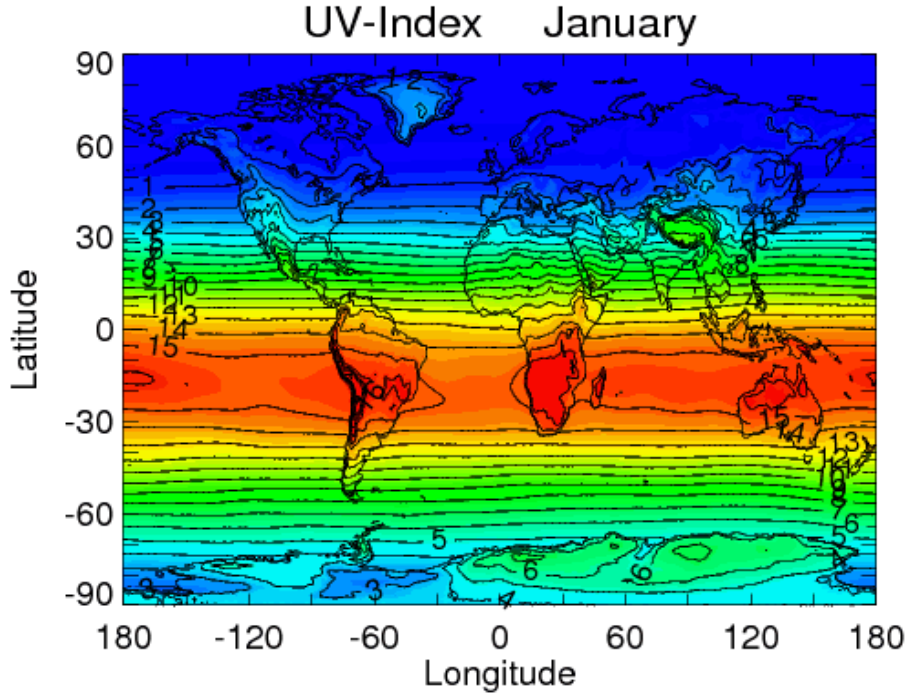

Total Column O3 (DU) September
Total Column O3 (DU) October
Total Column O3 (DU) November
Total Column O3 (DU) December
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180

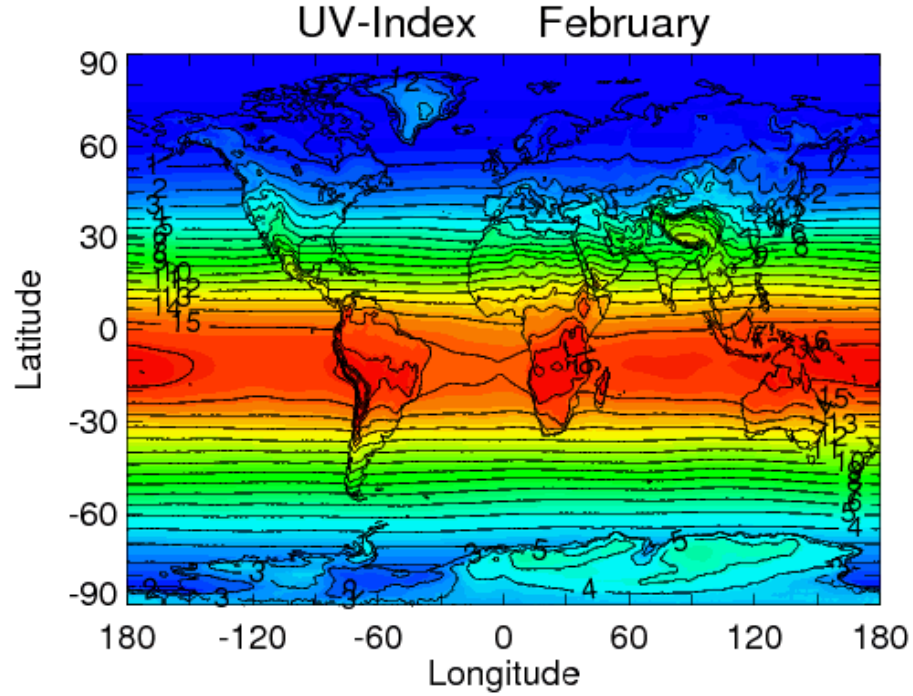
Global UV Index Climatology

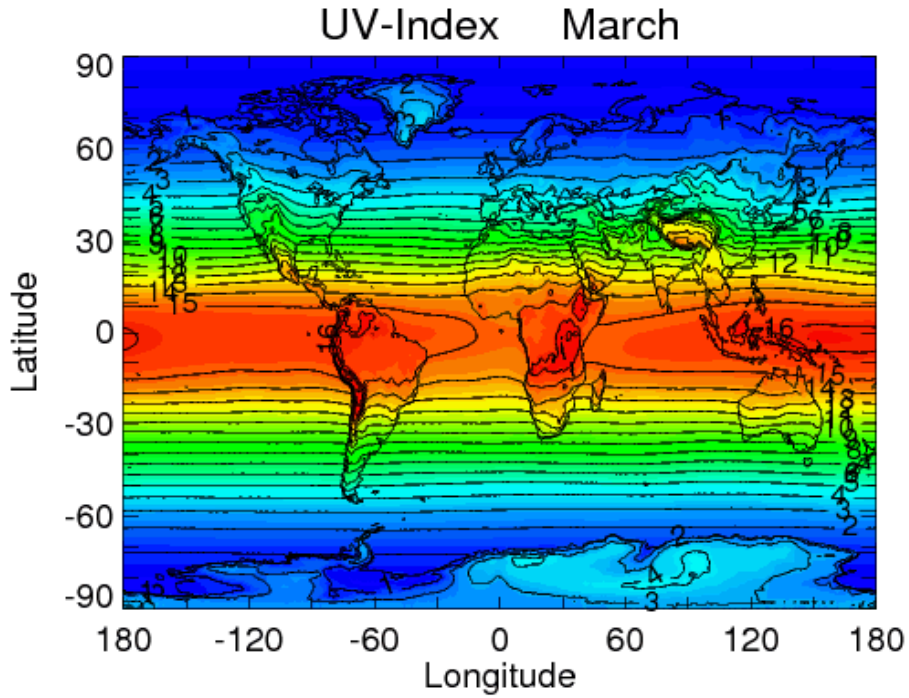
- Derived directly from the total column ozone climatology product

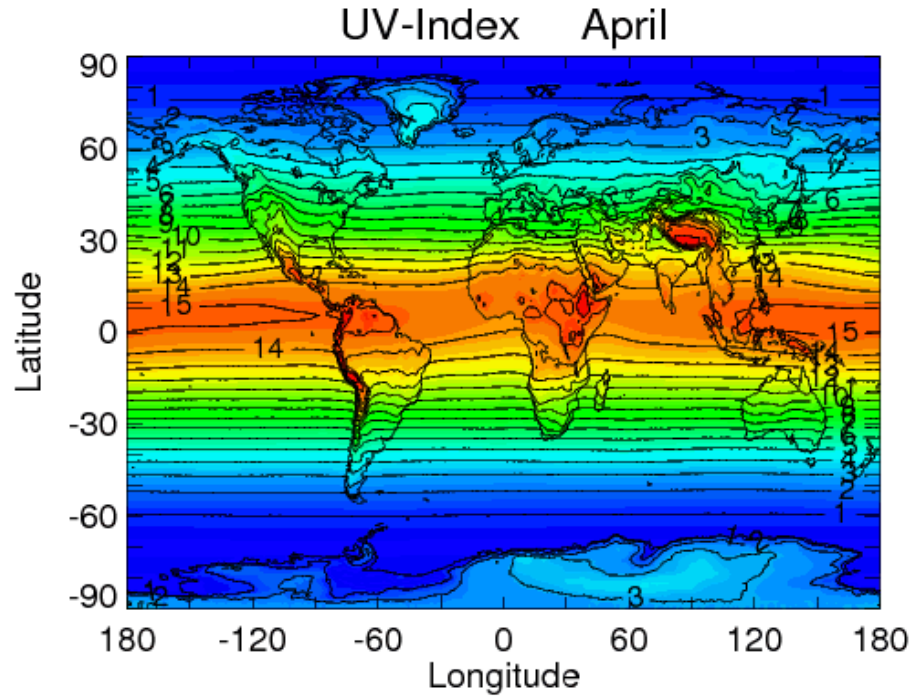
- Derived using a UV-Index source code from P. Newman [e.g., *Newman and McKenzie*, 2011, Photochem. Photobiol. Sci.] which converts total column ozone and solar zenith angle at a fixed grid point to a single UV Index number

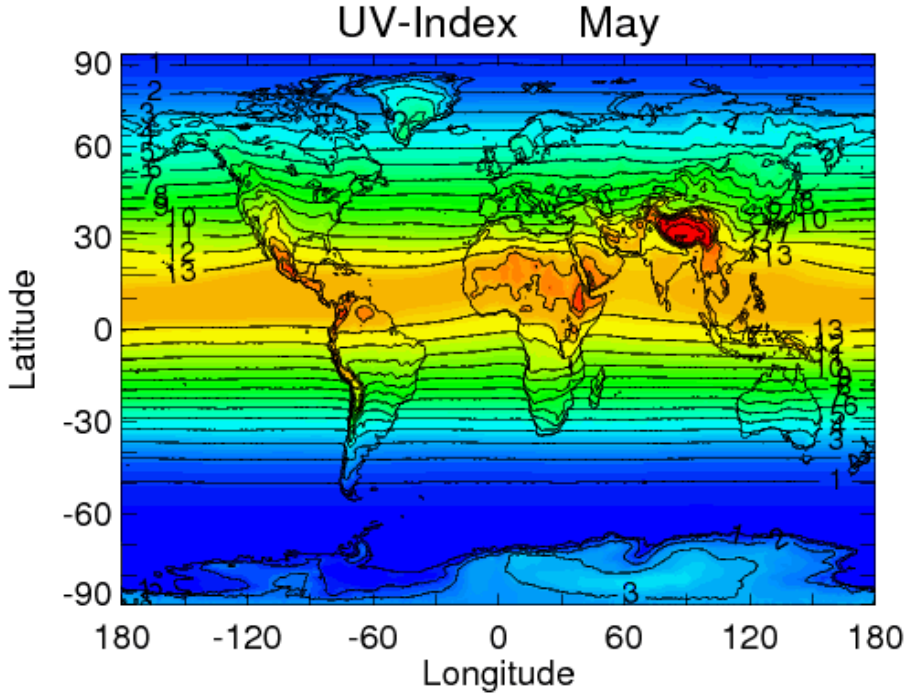
- The UV-Index maps include adjustments for both local terrain altitude and also the time-averaged Earth-Sun distance for each of the months of the climatology

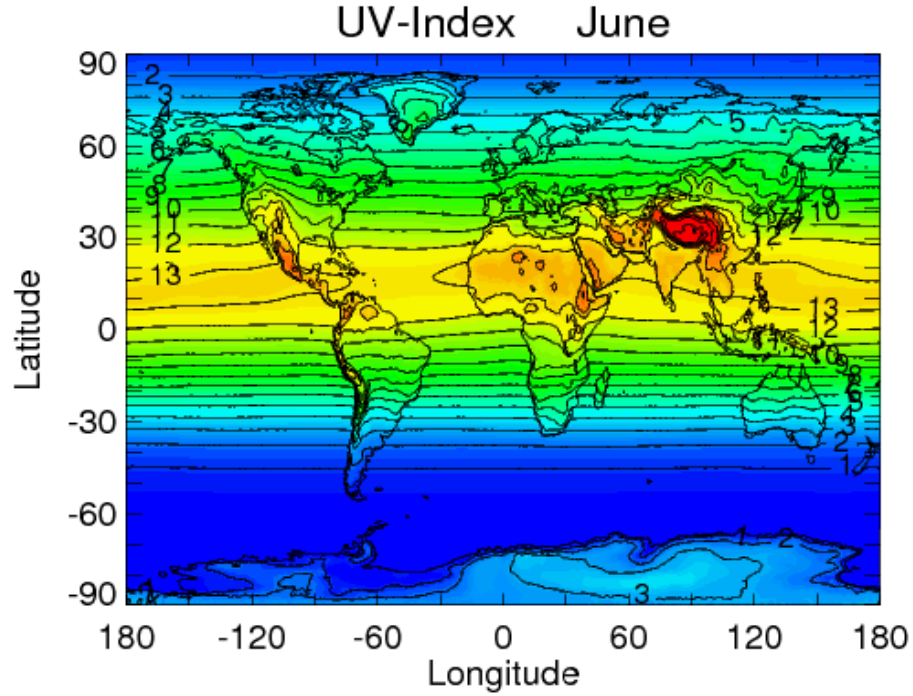

UV-Index January
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


UV-Index February
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


UV-Index March
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


UV-Index April
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


UV-Index May
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


UV-Index June
Latitude
Longitude
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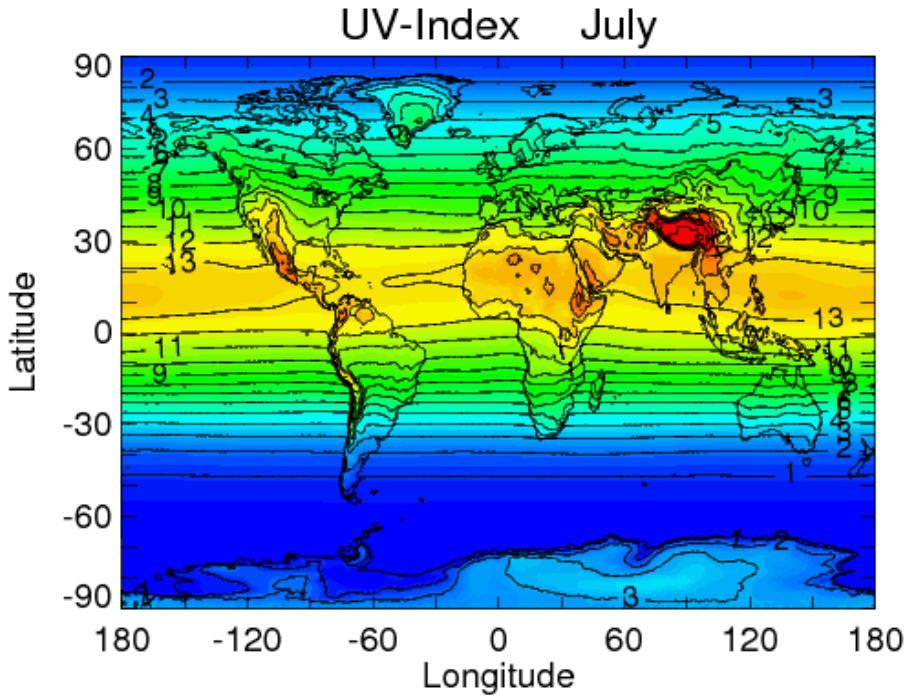
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


UV-Index July
Latitude
Longitude
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60
30
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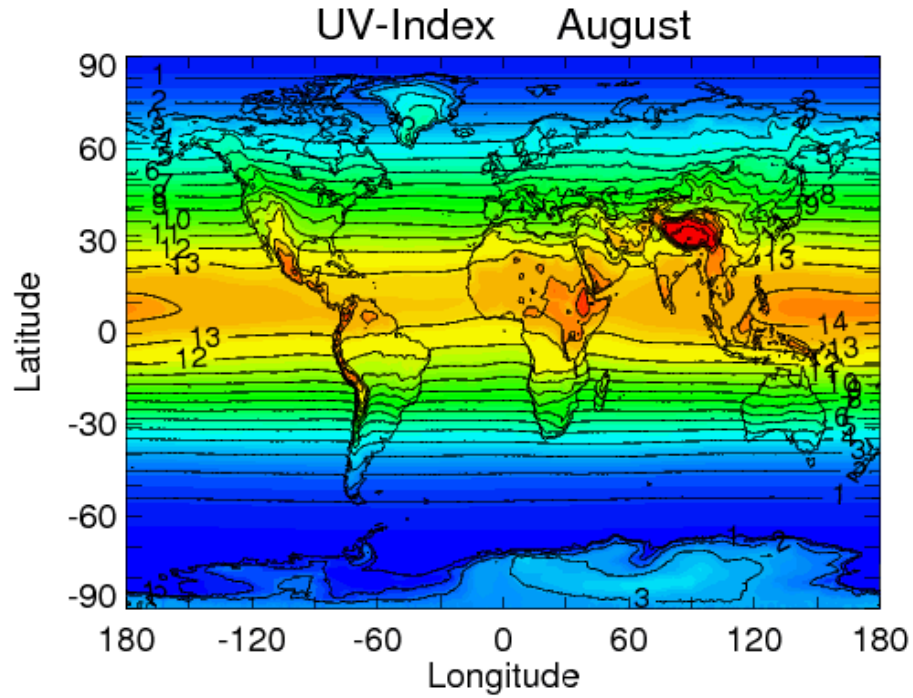
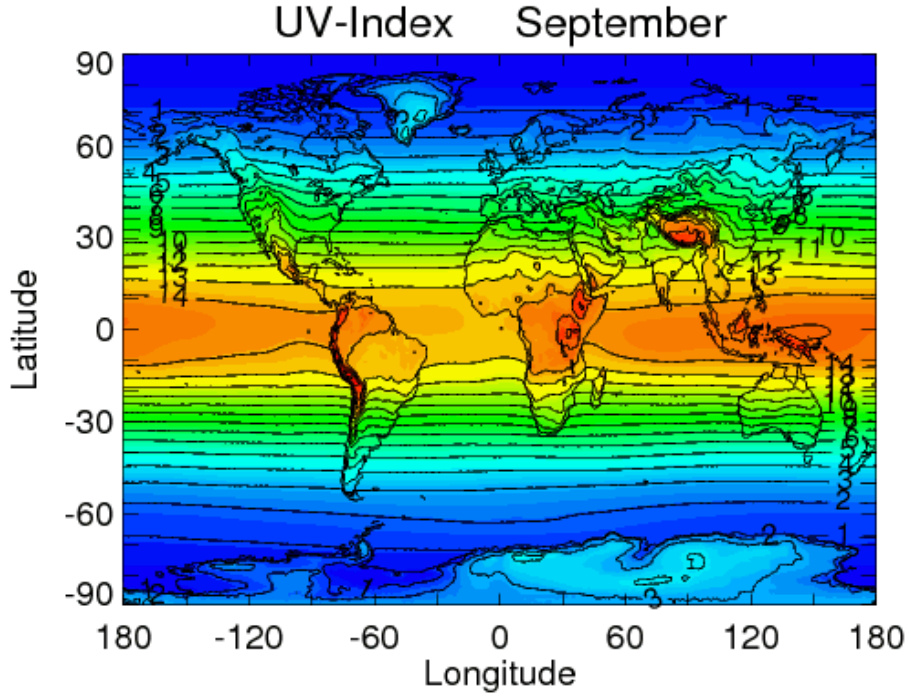
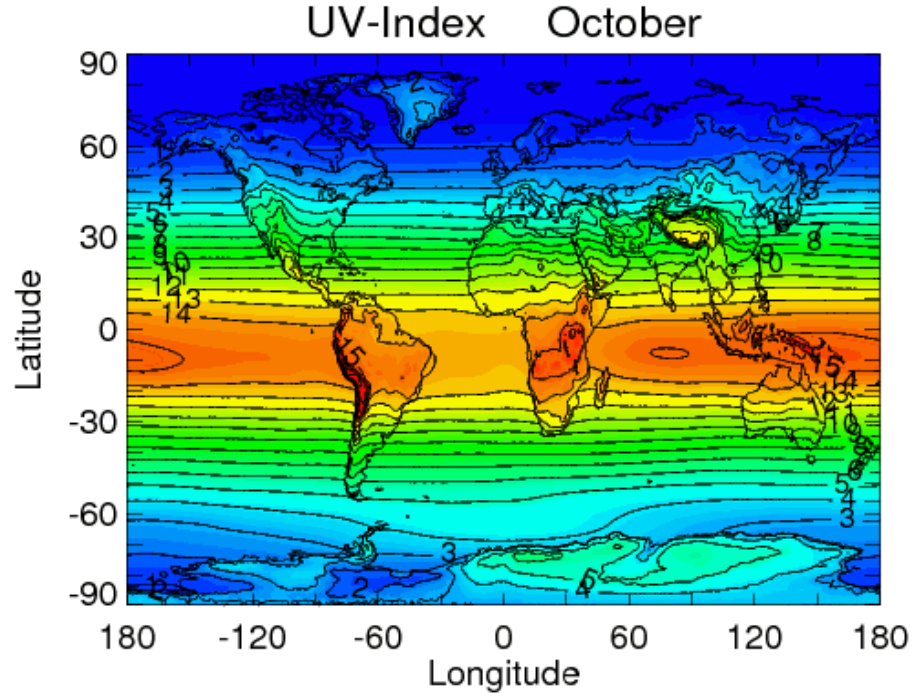
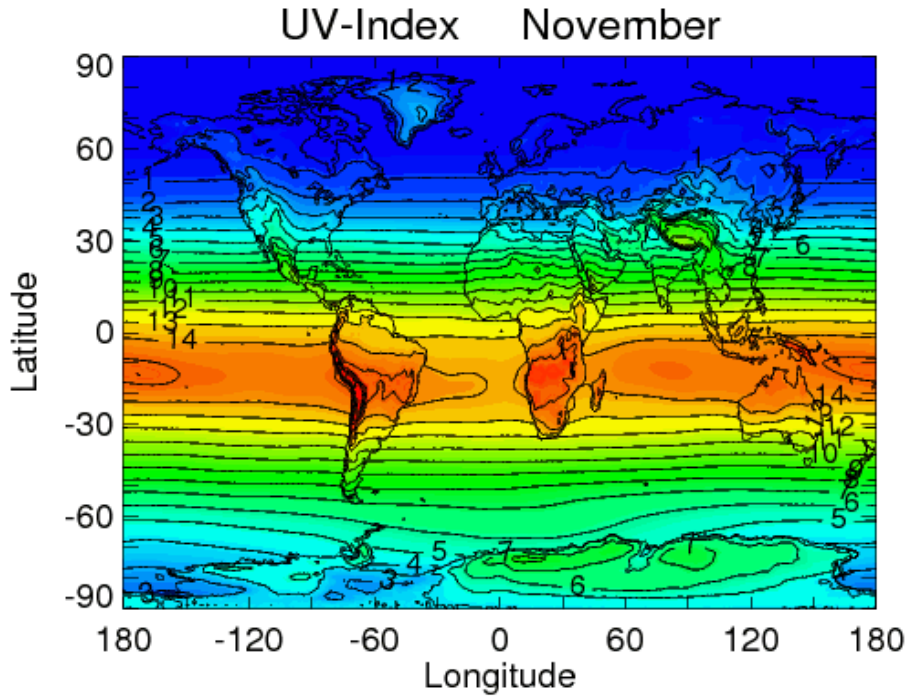
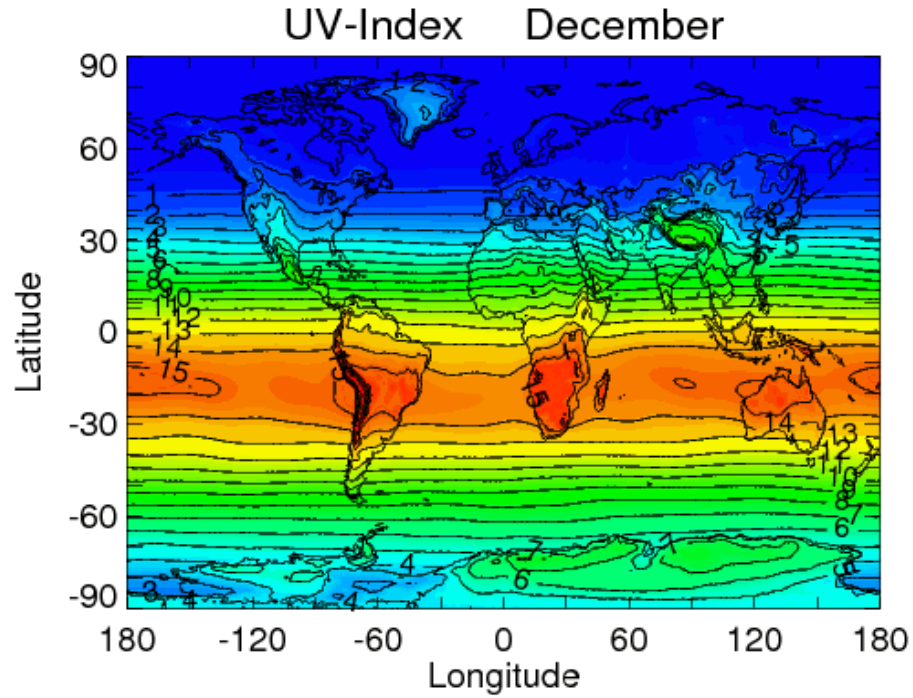
-30
-60
-90
180
-120
-60
0
60
120
180


UV-Index August
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


UV-Index September
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


UV-Index October
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180

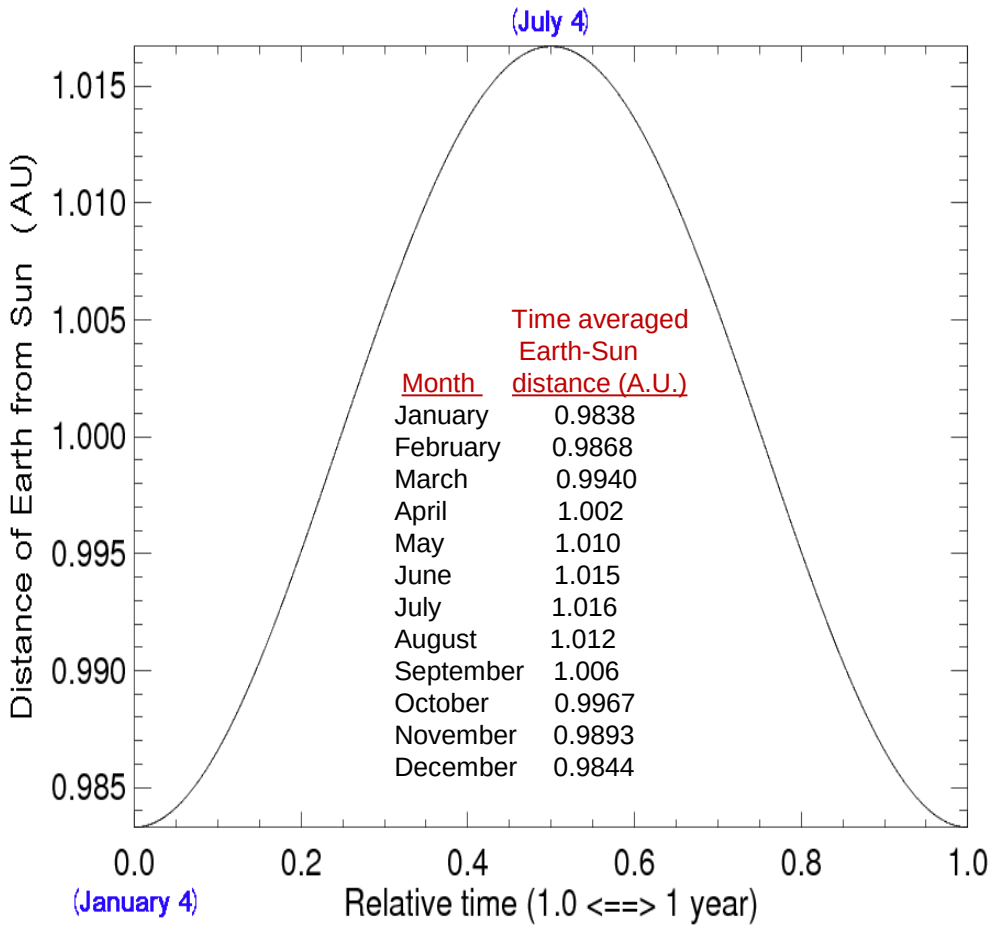

UV-Index November
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180


UV-Index December
Latitude
Longitude
90
60
30
0
-30
-60
-90
180
-120
-60
0
60
120
180

Extra Slides

Adjustment of Surface UV for Earth-Sun Distance

Distance of Earth from Sun as Function of Time of Year



Month	Time averaged Earth-Sun distance (A.U.)
January	0.9838
February	0.9868
March	0.9940
April	1.002
May	1.010
June	1.015
July	1.016
August	1.012
September	1.006
October	0.9967
November	0.9893
December	0.9844

Exact Analytical Solution To General Two-body Gravitational Problem

$$R = \frac{L^2/(Gm_1m_2m)}{1+(Lv_p/Gm_1m_2)\cos\phi} = \frac{a(1-e^2)}{1+e\cos\phi} \quad (1)$$

$$\frac{t}{T} = \frac{-e\sqrt{1-e^2}\sin\phi}{2\pi(1+e\cos\phi)} + \frac{1}{\pi}\tan^{-1}\left(\sqrt{\frac{1-e}{1+e}}\tan\frac{\phi}{2}\right) \quad (2)$$

where $T^2 = \frac{4\pi^2a^3}{G(m_1+m_2)}$

$$\left|\frac{d\vec{R}}{dt}\right| = \frac{2\pi a}{T\sqrt{1-e^2}}\left(\sin^2\phi + (\cos\phi+e)^2\right)^{1/2} \quad (3)$$

$$\left|\frac{d\vec{R}_1}{dt}\right| = \left|\frac{d\vec{R}}{dt}\right| \cdot \frac{m_2}{m_1+m_2} \quad (4)$$

$$\left|\frac{d\vec{R}_2}{dt}\right| = \left|\frac{d\vec{R}}{dt}\right| \cdot \frac{m_1}{m_1+m_2}$$