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° latitude by 1.25^{o} longitude)

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The Data Arrays

- Given as a small IDL save file (slightly under 10 Mbytes) – in IDL type

  restore, ’global_ozone_uv_climatology_data_arrays.sav’

- The IDL save file can be obtained from the following:

  > ftp jwocky.gsfc.nasa.gov

  > Name: anonymous

  > Password: <your email address>

  > cd pub/ccd

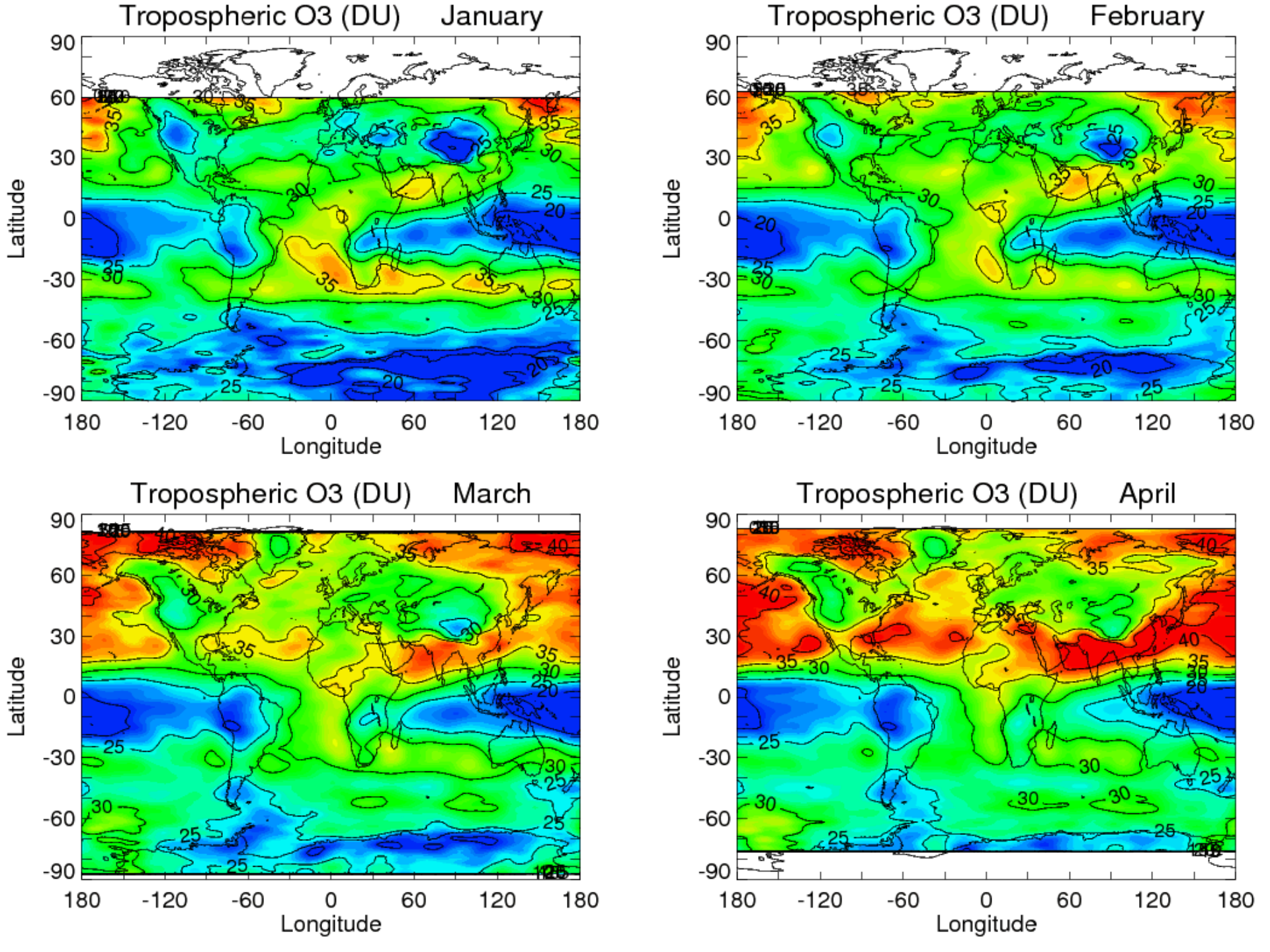
  > get global_ozone_uv_climatology_data_arrays.sav

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
Tropospheric O3 (DU) February
Tropospheric O3 (DU) March
Tropospheric O3 (DU) April
Latitude
Longitude
90
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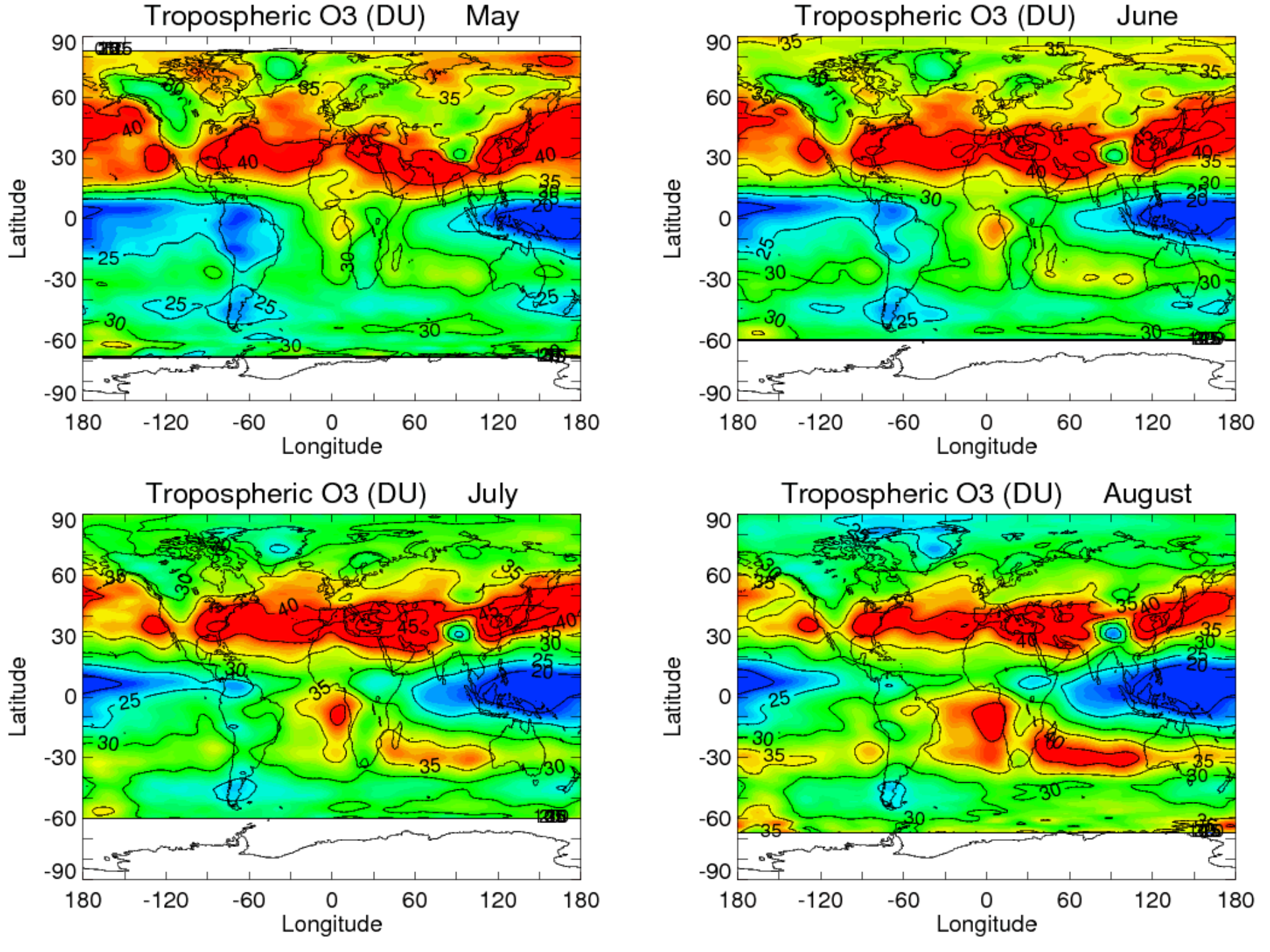
Tropospheric O3 (DU) May
Tropospheric O3 (DU) June
Tropospheric O3 (DU) July
Tropospheric O3 (DU) August
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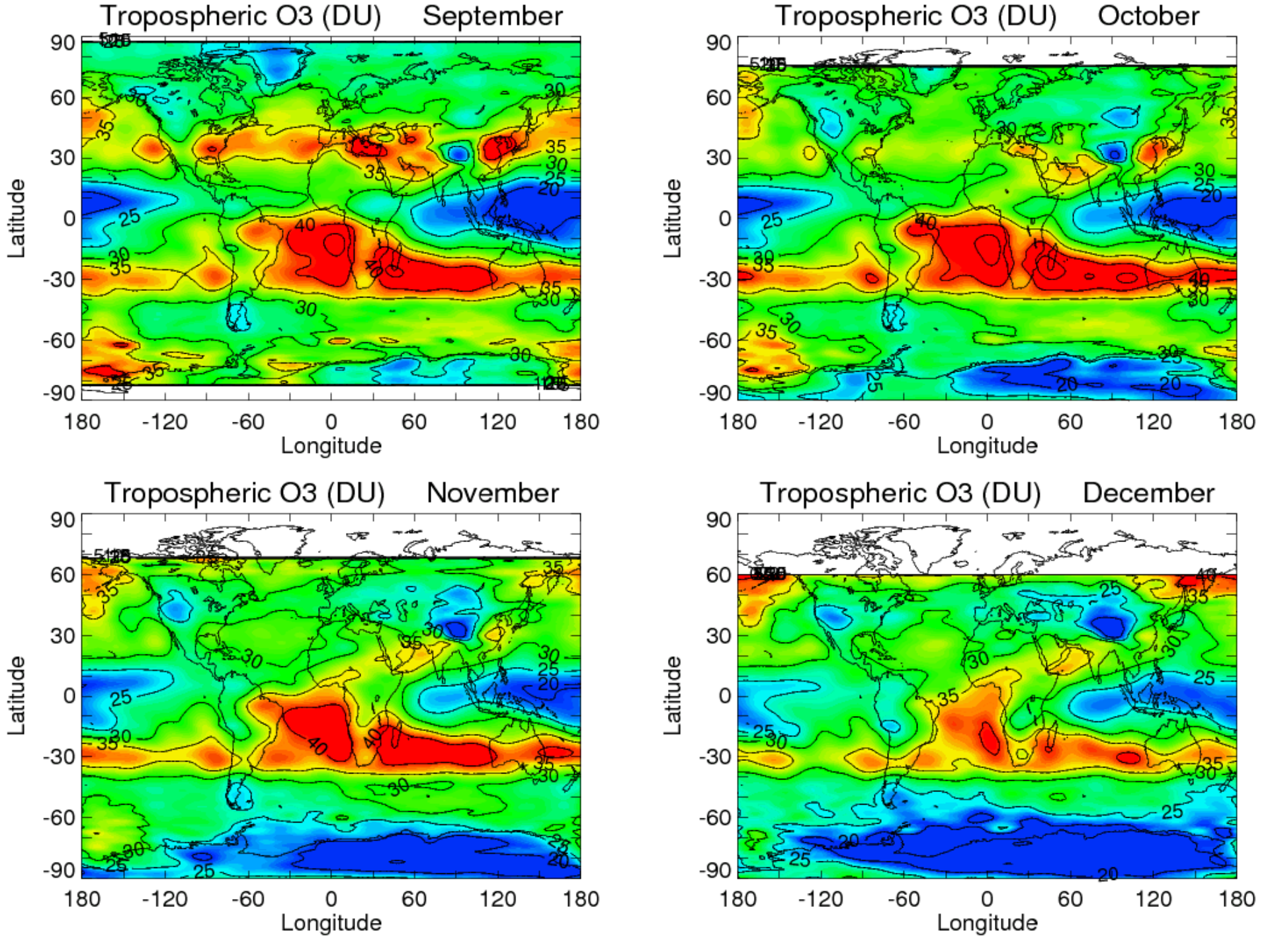
Tropospheric O3 (DU) September
Tropospheric O3 (DU) October
Tropospheric O3 (DU) November
Tropospheric O3 (DU) December
Latitude
Longitude
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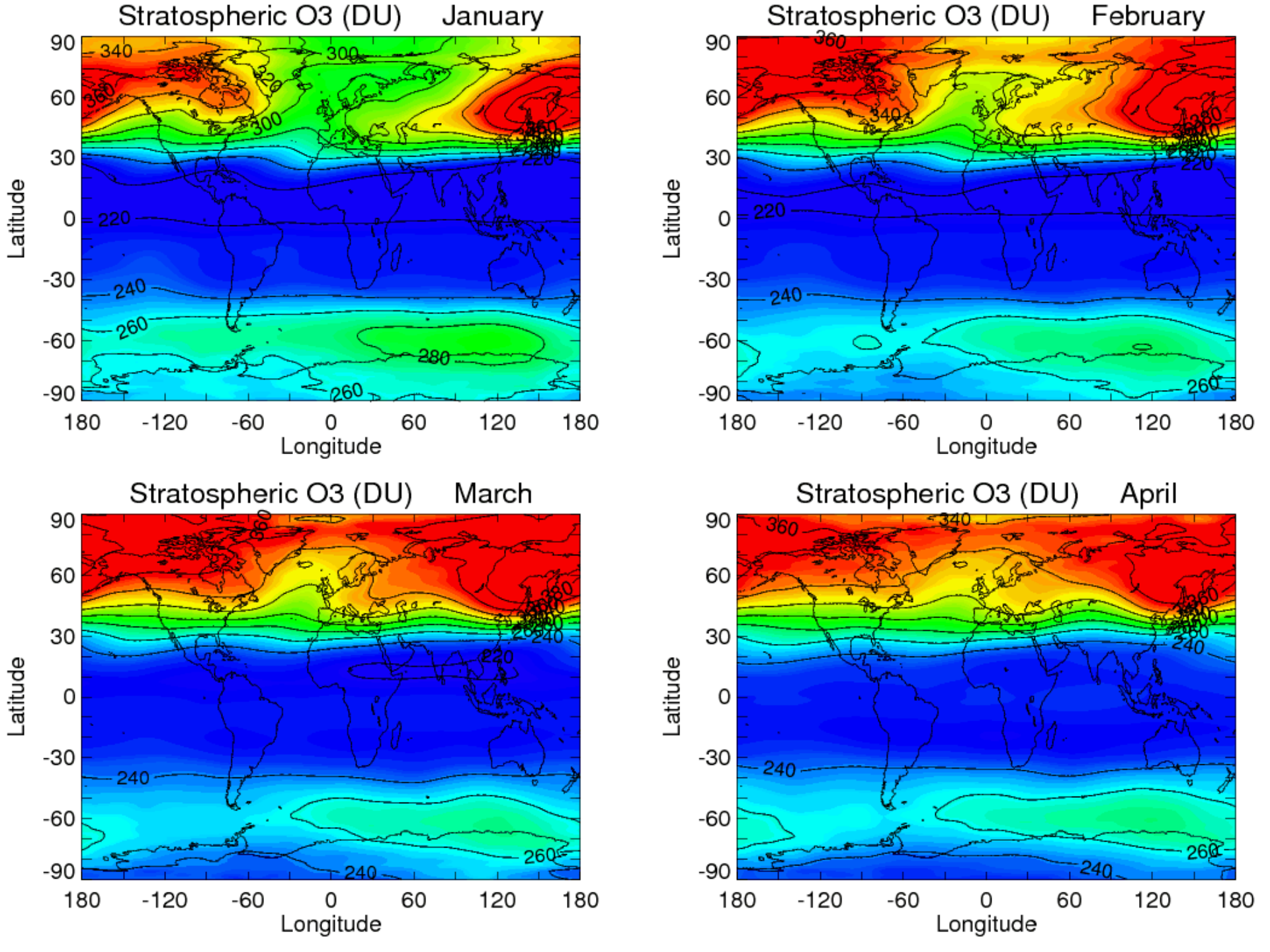
Global Stratospheric Column Ozone Climatology in Dobson Units

- 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
Stratospheric O3 (DU) February
Stratospheric O3 (DU) March
Stratospheric O3 (DU) April
Latitude
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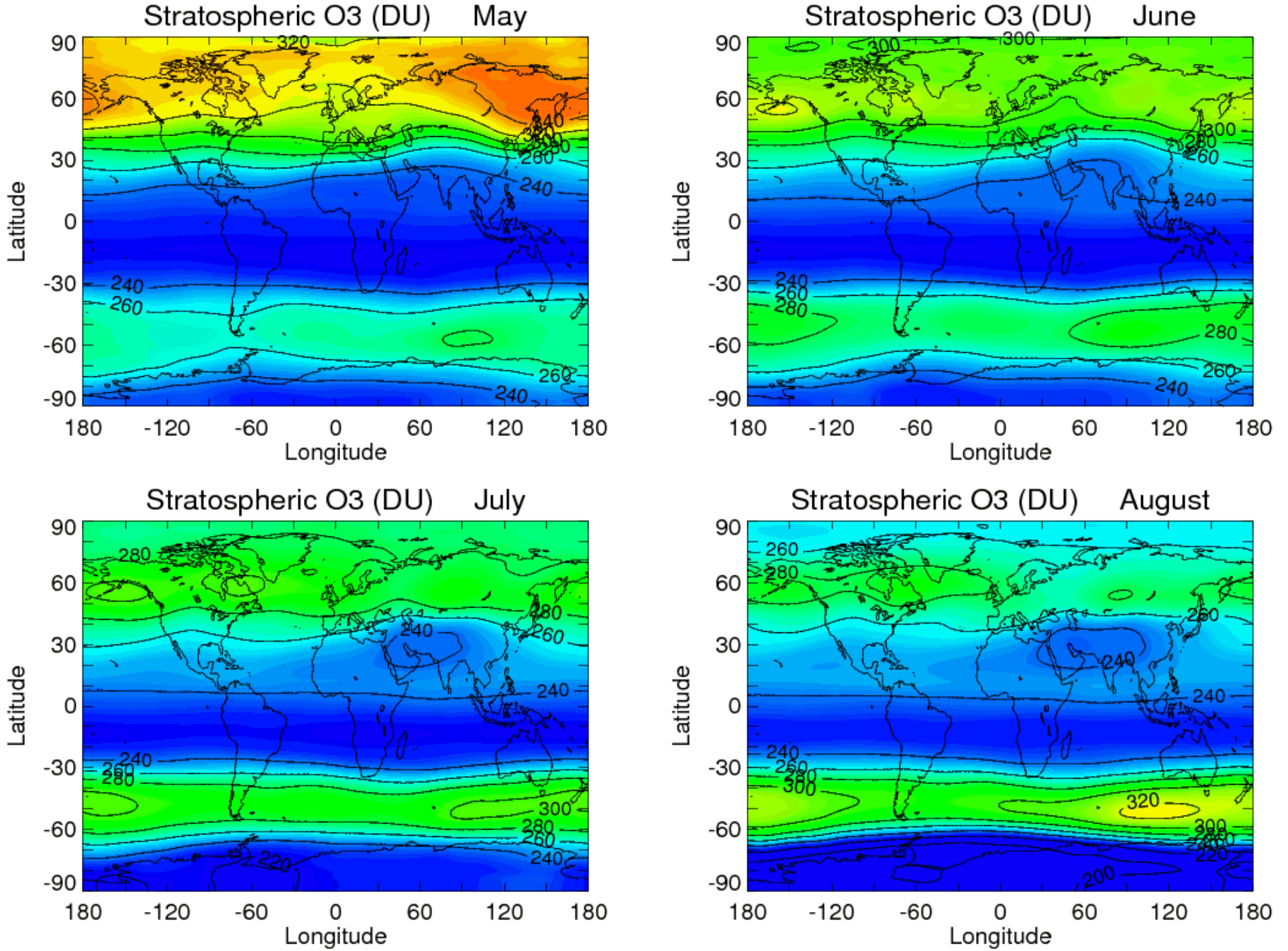
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Stratospheric O3 (DU) June
Stratospheric O3 (DU) July
Stratospheric O3 (DU) August
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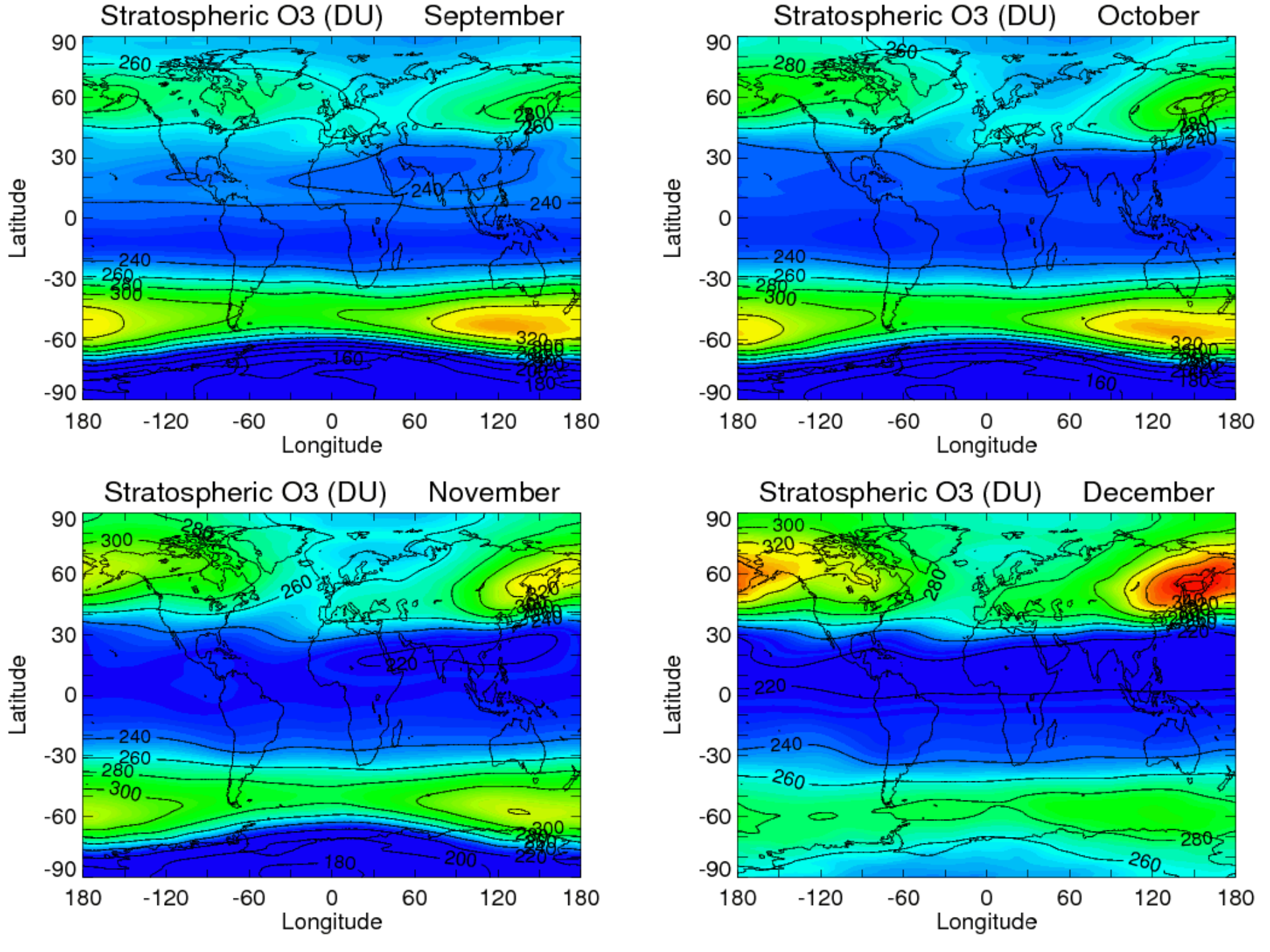
Stratospheric O3 (DU) September
Stratospheric O3 (DU) October
Stratospheric O3 (DU) November
Stratospheric O3 (DU) December
Latitude
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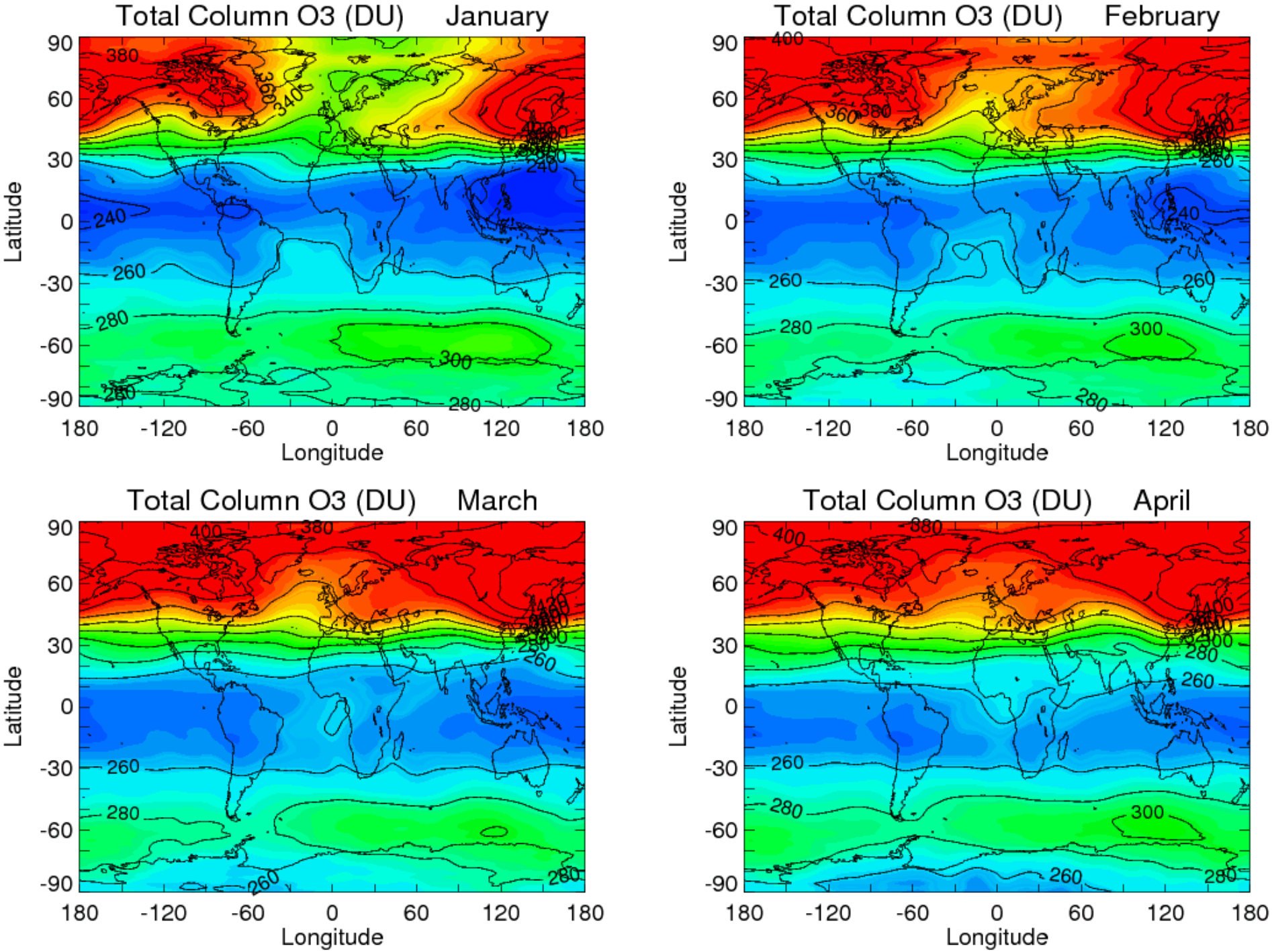
Global Total Column Ozone Climatology in Dobson Units

- 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
Total Column O3 (DU) February
Total Column O3 (DU) March
Total Column O3 (DU) April
Latitude
Longitude
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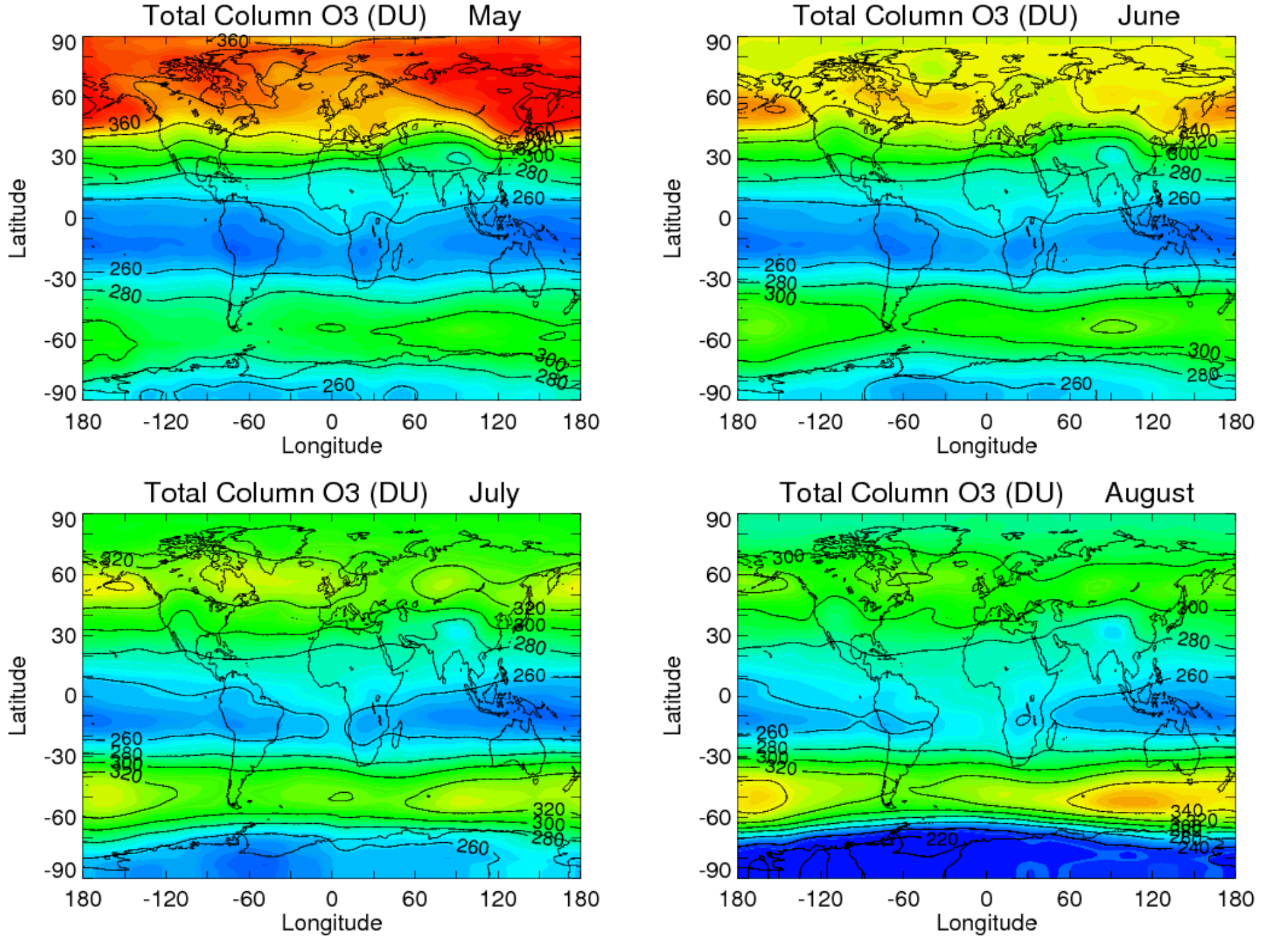
Total Column O3 (DU) May
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Total Column O3 (DU) July
Total Column O3 (DU) August
Latitude
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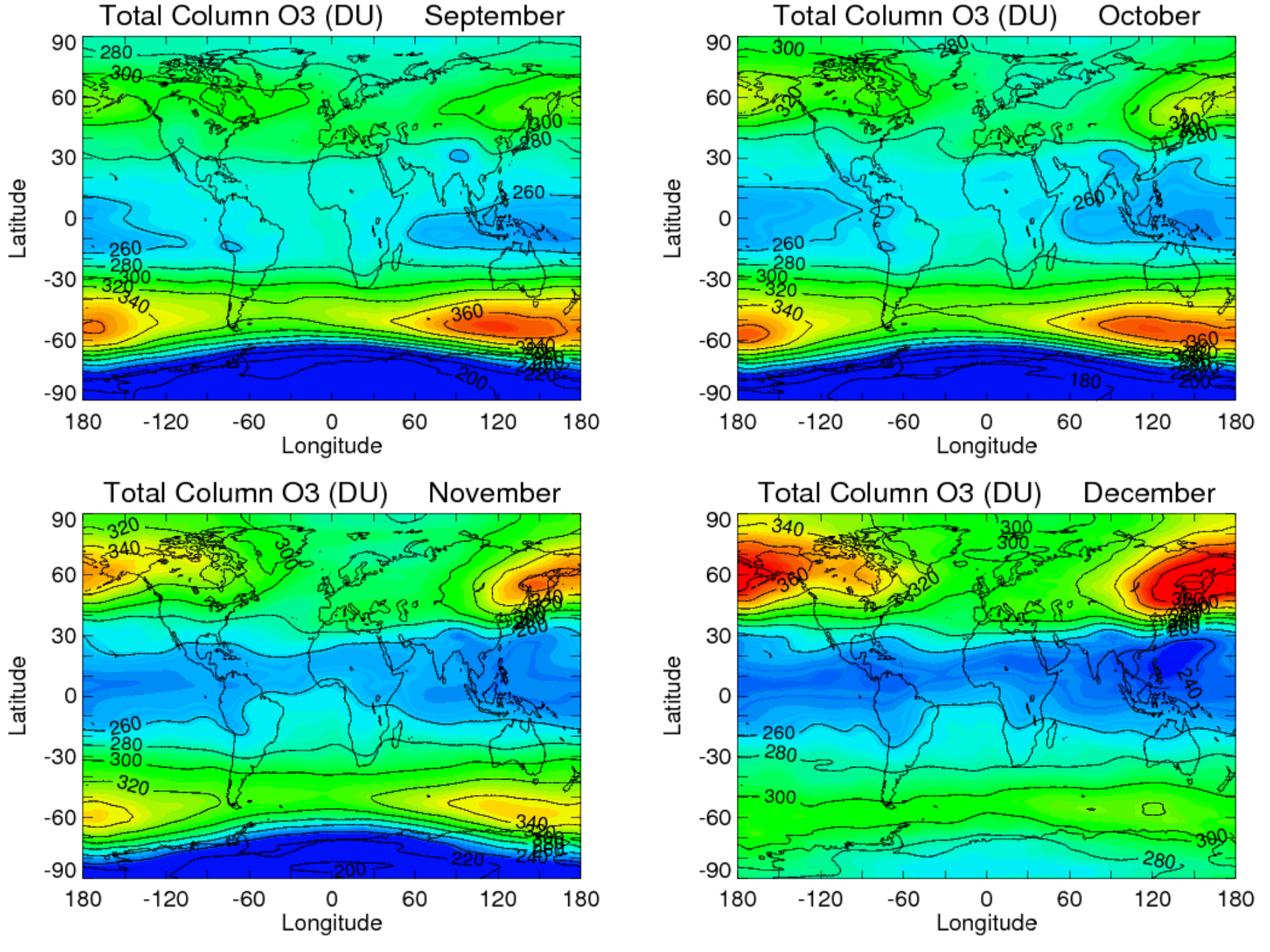
Total Column O3 (DU) September
Total Column O3 (DU) October
Total Column O3 (DU) November
Total Column O3 (DU) December
Latitude
Longitude
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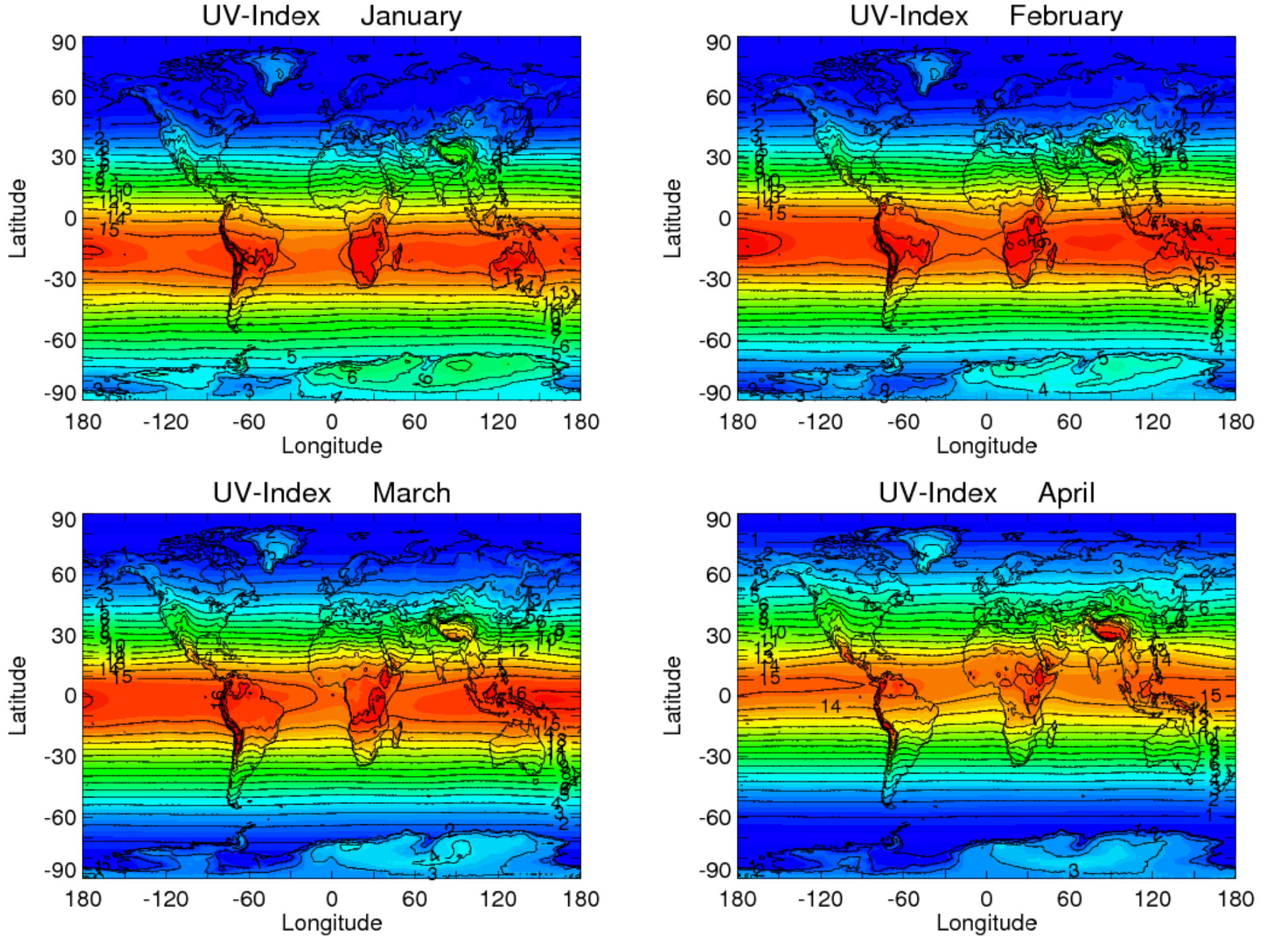
Global UV Index Climatology

- 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
UV-Index February
UV-Index March
UV-Index April
Latitude
Longitude
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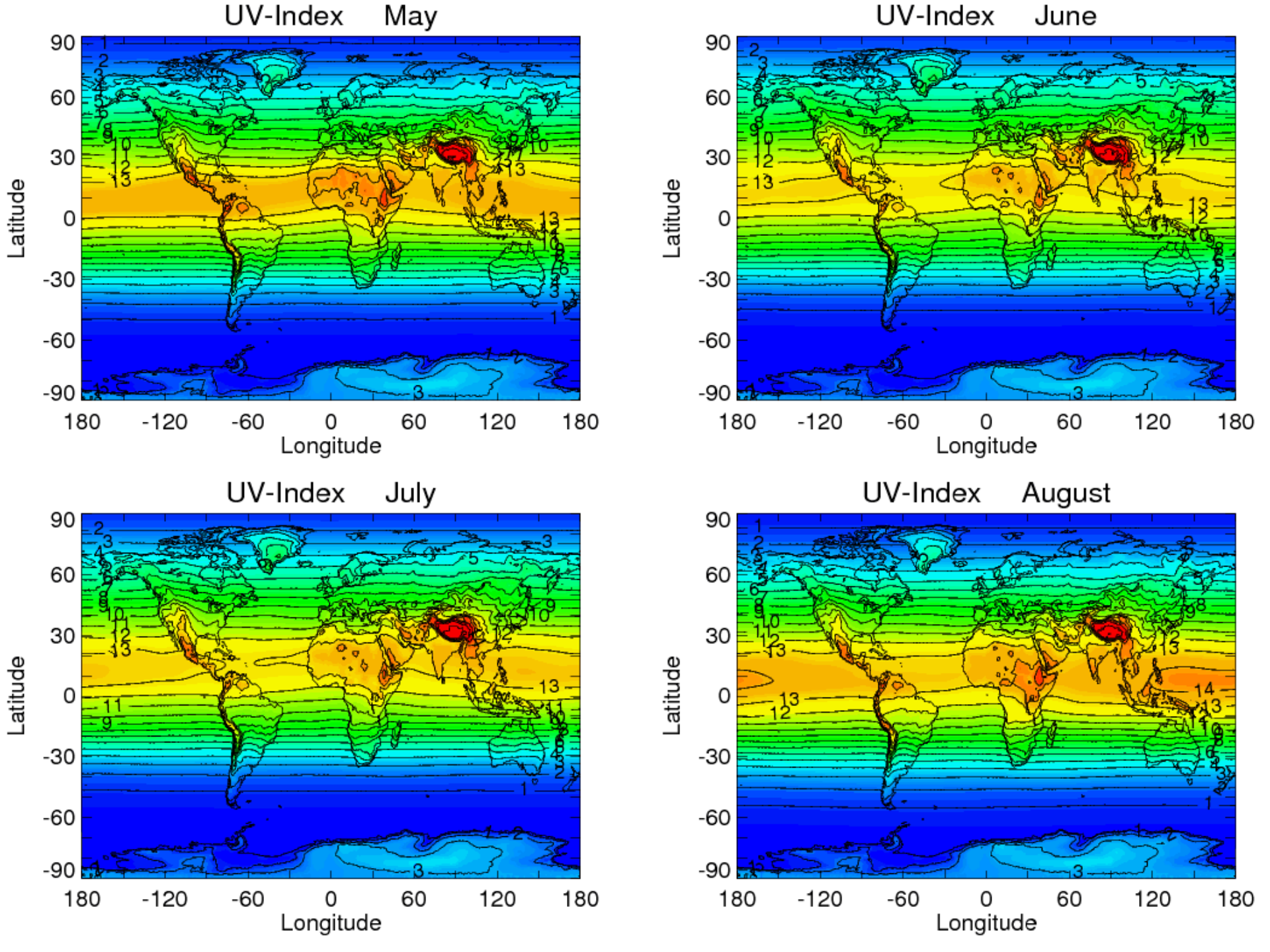
UV-Index May
UV-Index June
UV-Index July
UV-Index August
Latitude
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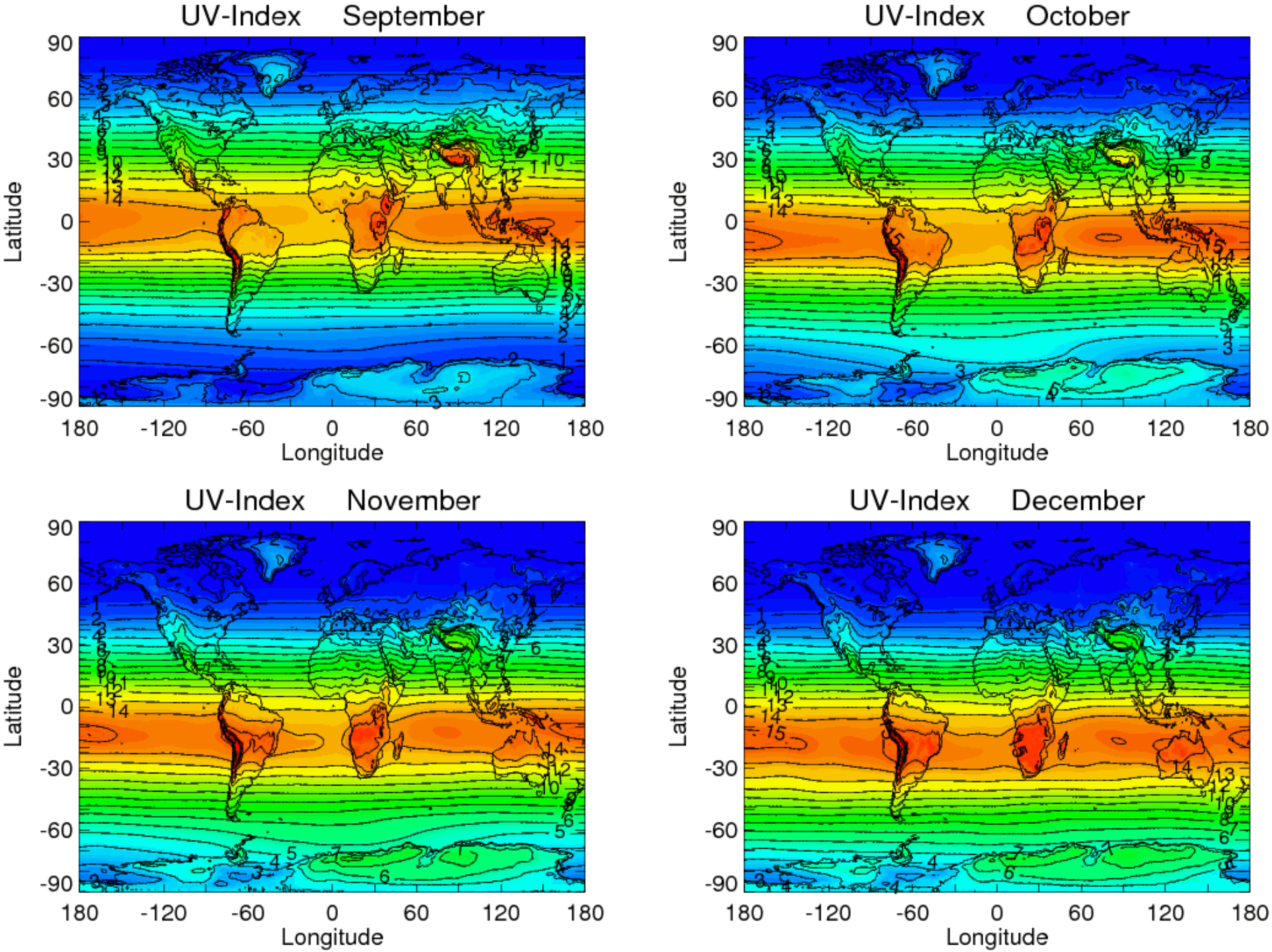
UV-Index September
UV-Index October
UV-Index November
UV-Index December
Latitude
Longitude
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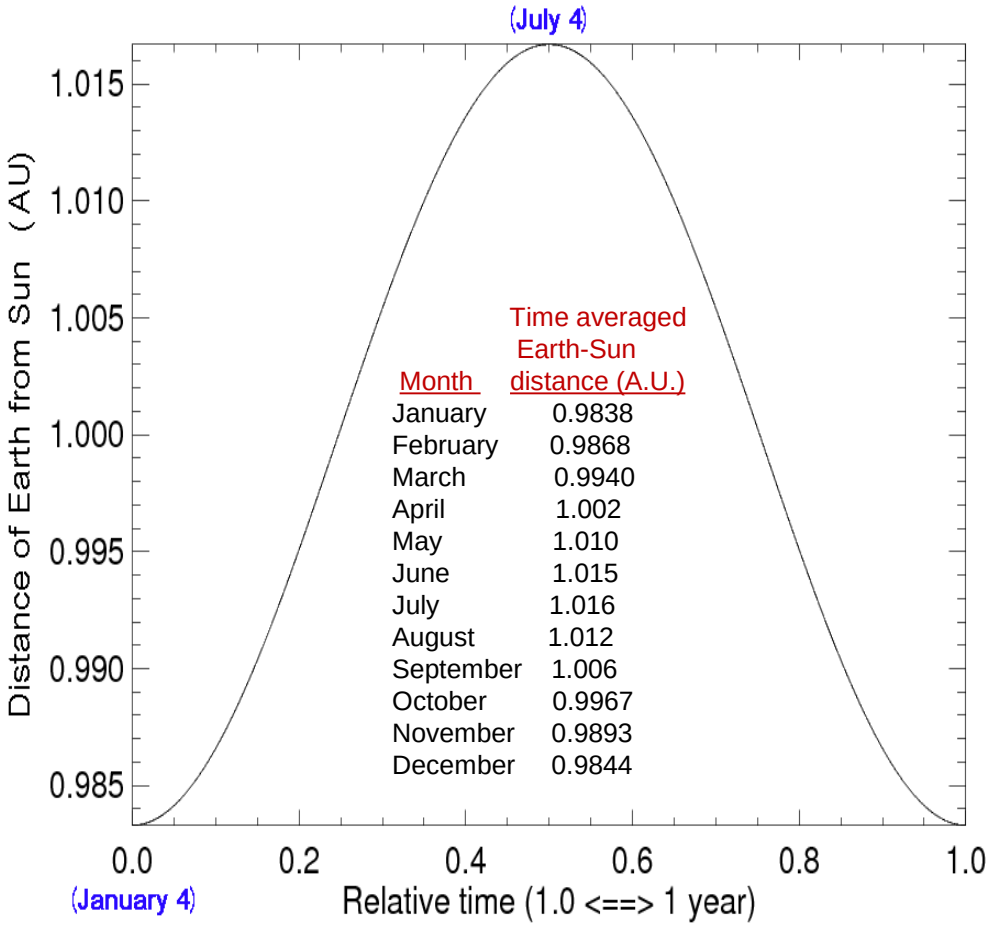
Extra Slides

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

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

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

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

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

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

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