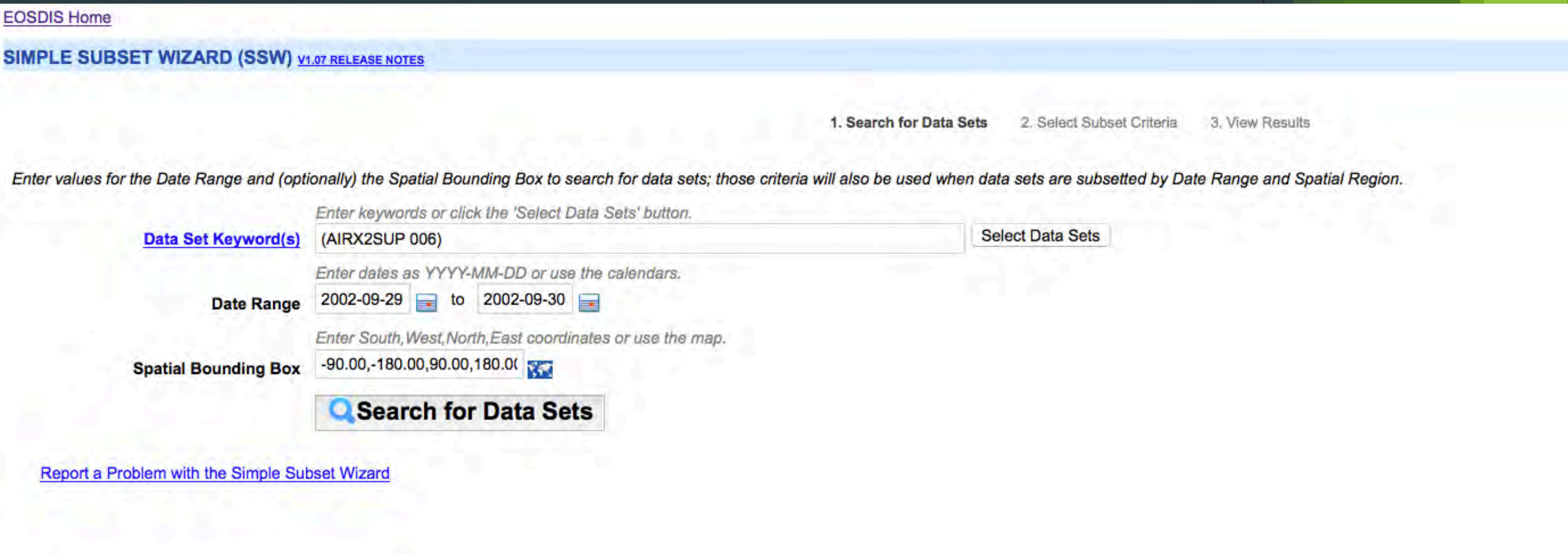
Visualizing AIRS

Colby Francoeur, Student Intern
Science and Technology Corporation
Columbia, Maryland

With help from Hal Bloom, Antonia Gambacorta, Brendan Bloom and Chris Barnet

The AIRS Level 2 Support product using Simple Subset Wizard



An alternative way to expedite the downloading process: automatize the creation of the downloading script

```
targetDir = 'ftp/data/s4pa/Aqua_AIRS_Level2/AIRX2SUP.006/' + year + '/'

oUrl = OBJ_NEW('IDLnetUrl', URL_SCHEME='ftp', $
    URL_HOST='airsl2.gesdisc.eosdisc.nasa.gov
<http://airsl2.gesdisc.eosdisc.nasa.gov>', $
    URL_USERNAME='anonymous', URL_PASSWORD='', $
    URL_PATH=targetDir)
   dirArray = oURL->GetFTPDirList()


nDay = n_elements(dirArray)
doy_string_vector = STRARR(nDay)

for d_v = 0L, nDay - 1L do begin
     doy_string_vector[d_v] = STRMID(dirArray[d_v], 2, 3, /reverse_offset)
endfor
```

- Thanks to Thomas Hearty, Ed Seiler, Eric Fetzer and Ed Olsen for help during this process

Variables downloaded from Simple Subset Wizard			
TSurfStd	TSurfStd_QC	olr,	olr_QC
PSurfStd	PSurfStd_QC	clrolr	clrolr_QC
TSurfAir	TSurfAir_QC	Forecast_Wind (U+V)	landFrac
TAirSup	TAirSup_QC	TAirMWOnly	TAirMWOnly_QC
H2OCDSup	H2OCDSup_QC	H2OCDMWOnly	H2OCDMWOnly_QC
O3CDSup	O3CDSup_QC	CH4CDSup,	CH4CDSup_QC
COCDSup	COCDSup_QC		
dust_flag	dust_score	BT_diff_SO2	BT_diff_SO2_QC

- We downloaded 10 years of these variables

Preparing the data

- Uncompressed all the downloaded sub-setted AIRS standard level-2
- Created a program that read in files, and calculated count, sum and sum^2 for selected variables
- Outputted a new, much smaller file for every day (nearly 1/730th the size of the original)

	Per granule	Per day	Per year
Level.2 Support	22.5 Mega-byte	5.4 Giga-byte	1970 Giga-byte
Subset of Support	6.3 Mega-byte	1.5 Giga-byte	540 Giga-byte
Daily Gridded File	n/a	7.4 Mega-byte	2.7 Giga-byte

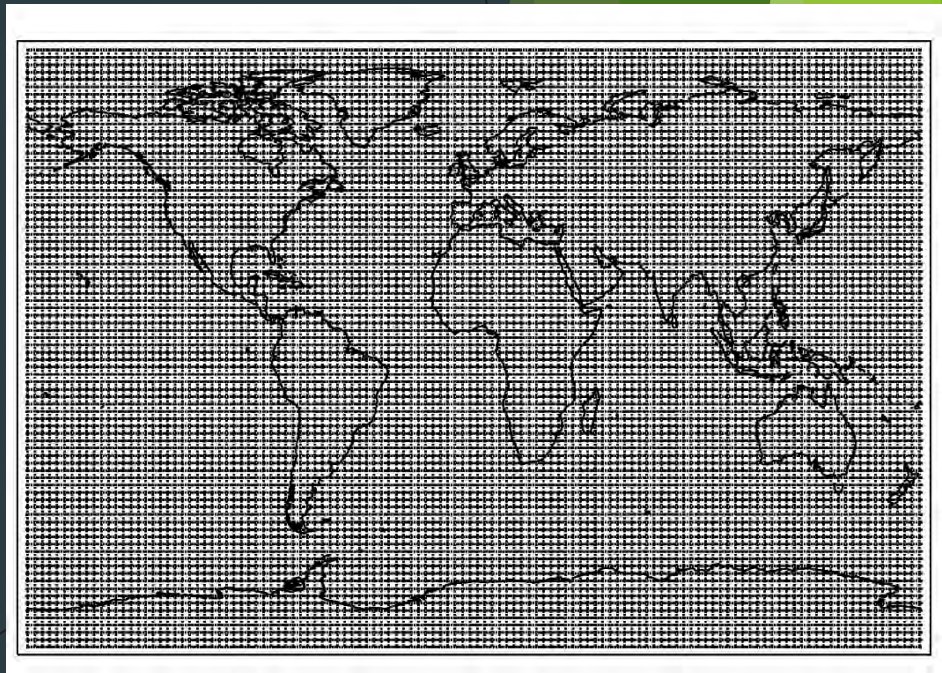
Variable	Pressure level (hPa)	Standard Deviation	QC used
Methane	450	yes	CH4CDSup_QC
Carbon Monoxide	450	yes	COCDSup_QC
Total Precipitable Water	Integral over all levels	yes	H2OCDSup_QC*
Ozone	Integral over all levels	yes	O3CDSup_QC
Outgoing LongWave Radiation	-	yes	olr_QC
Specific Humidity	850	no	H2OCDSup_QC
Temperature	190	yes	TAirSup_QC
Surface Air Temperature	Surface	yes	TSurfAir_QC
Percent Probability of -65C	190	no	TAirSup_QC

*= Used H20CDSup_QC at 450 mb for entire profile

Can also Plot Number of points accepted for any variables

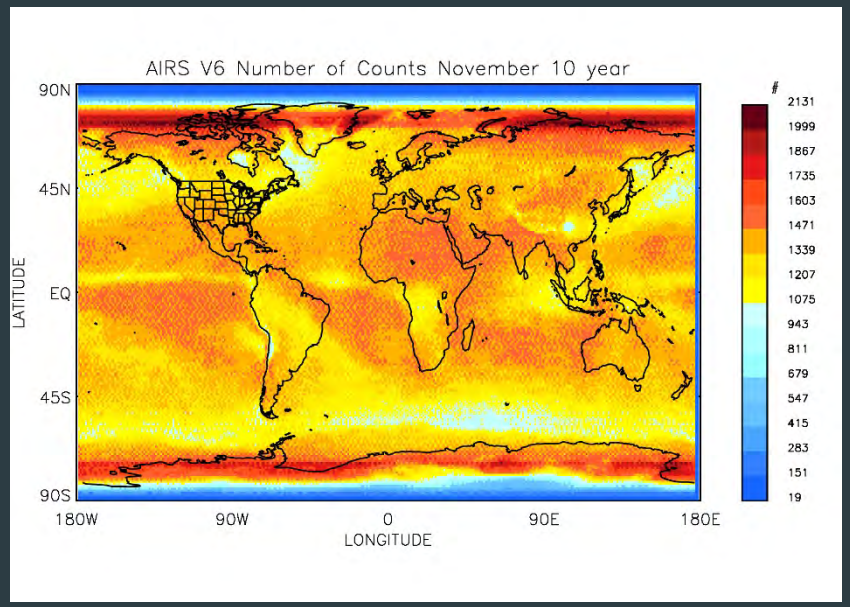
Processing the Data

- Used quality control to remove bad cases
- Used the latitude and longitude to regrid the data from Level 2 (Satellite sampling) to Level 3 (lat/lon grid)
- Computed average and standard deviation in each cell
- Plotted total counts to verify a statistically significant observation

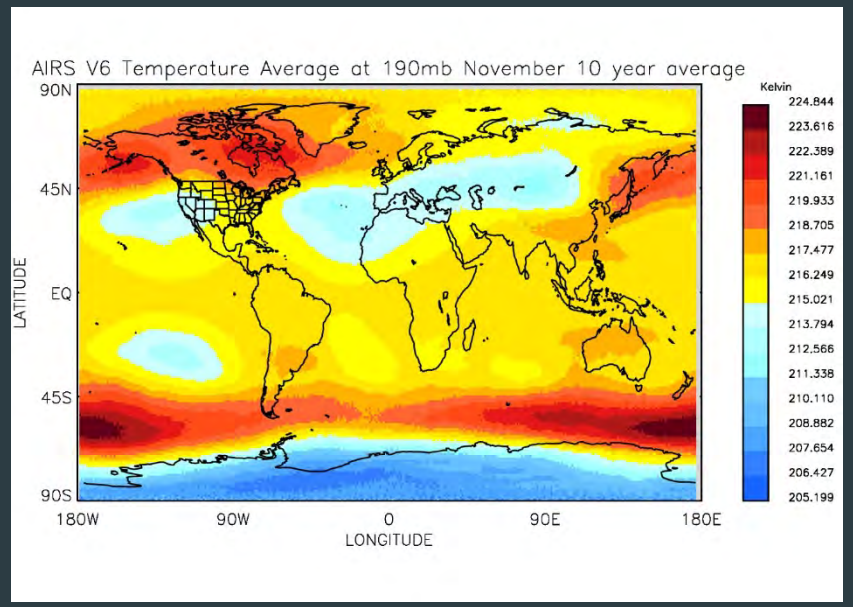


Temperature at 190mb, November 10 year average

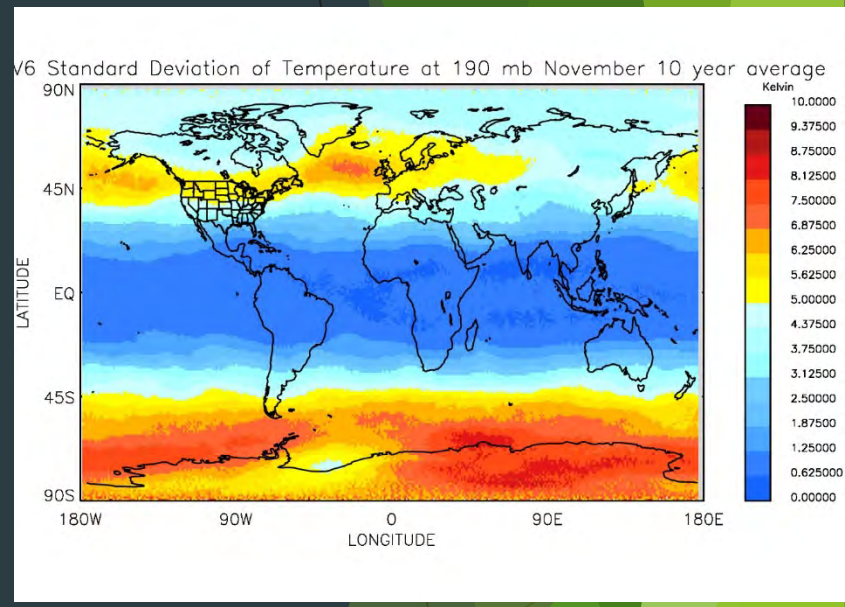
Number of Good Measurements



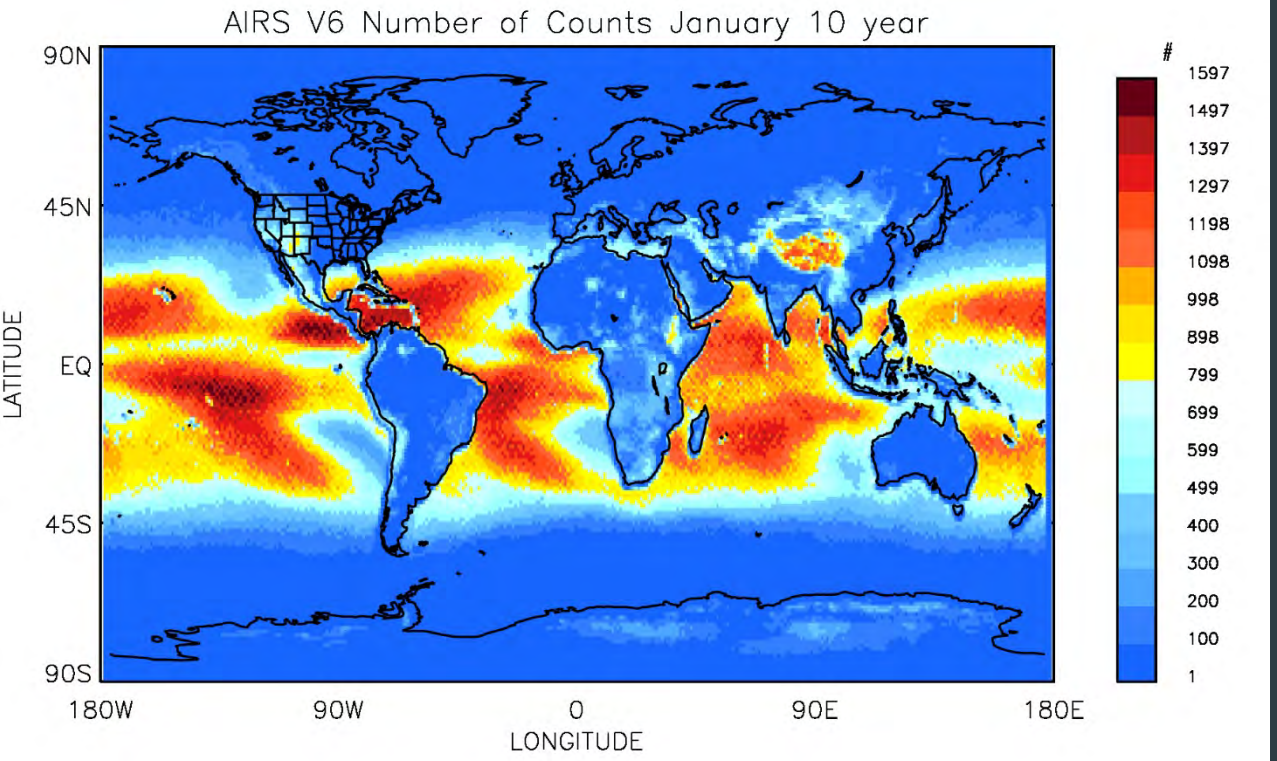
Mean



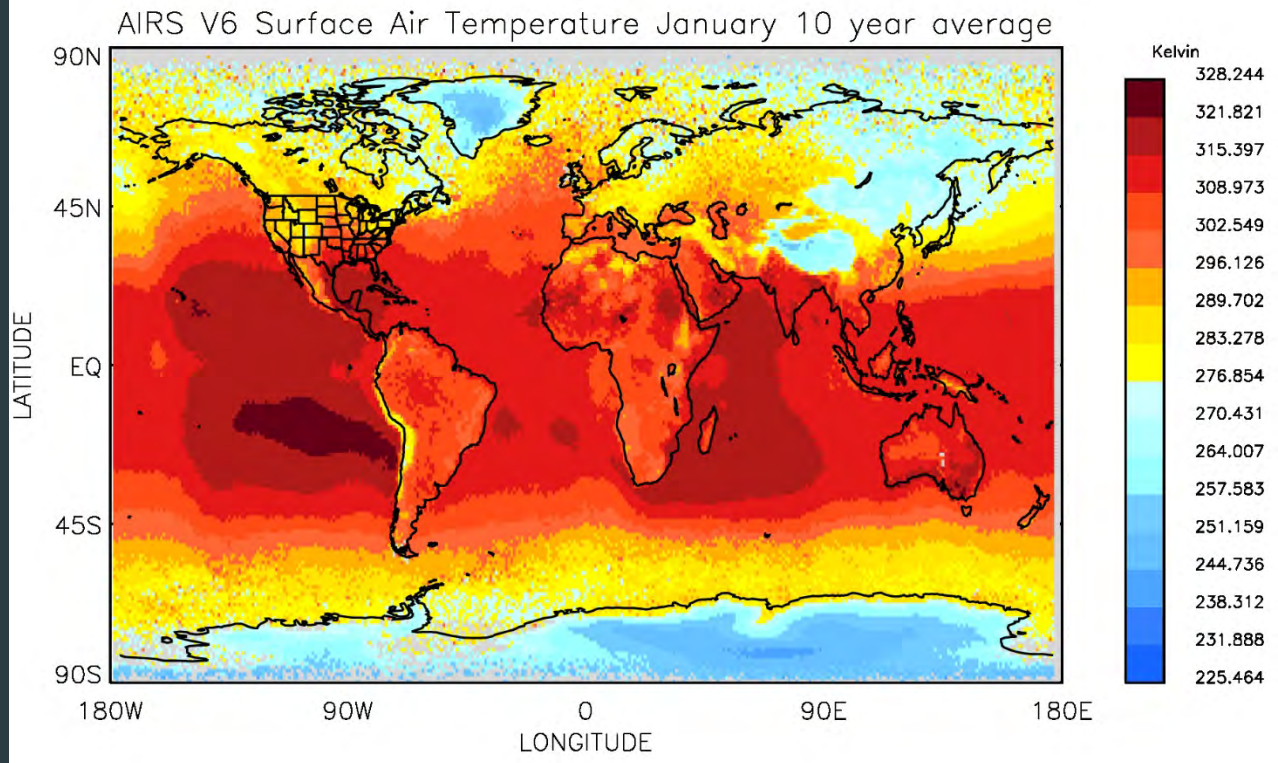
Standard Deviation



For any time period

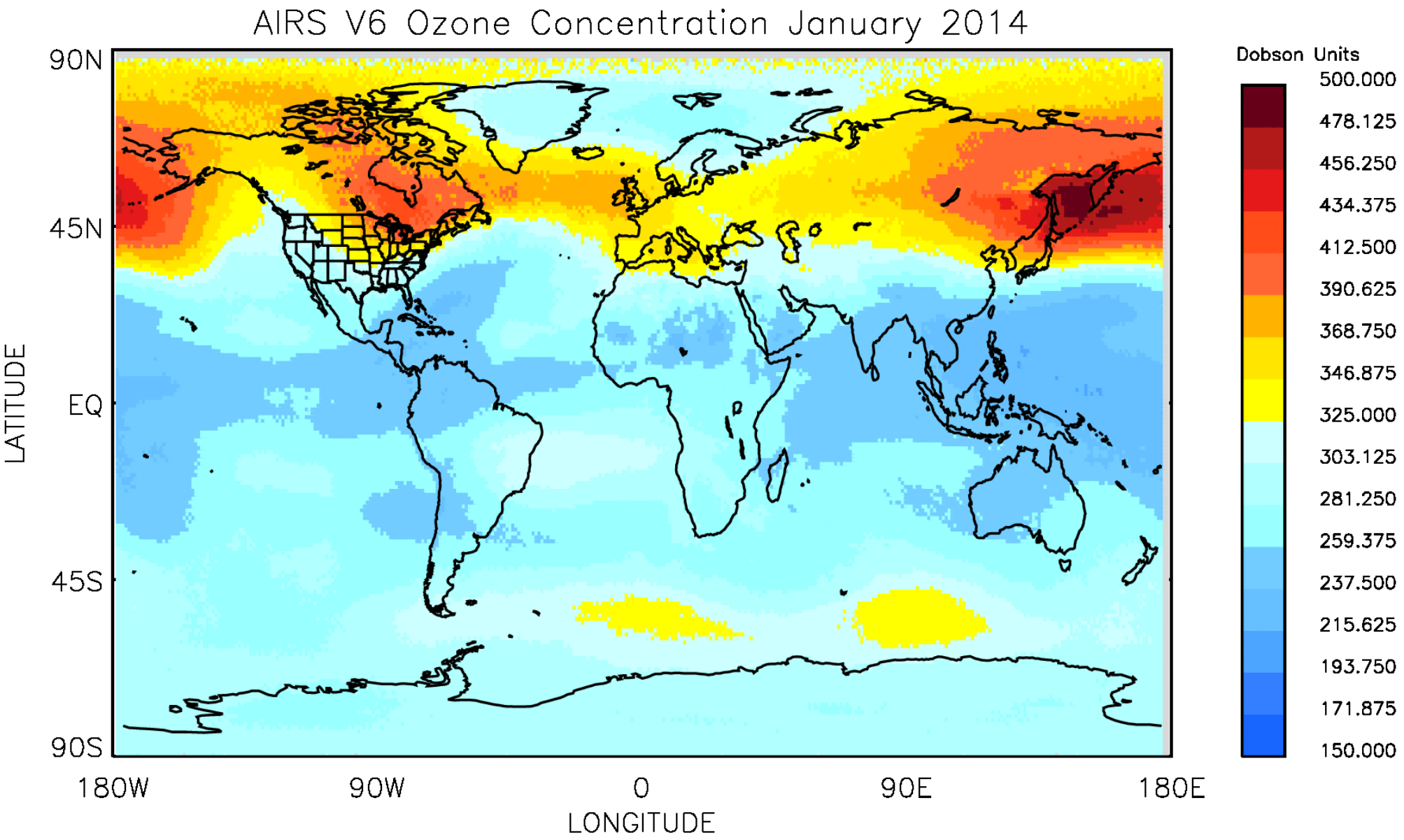


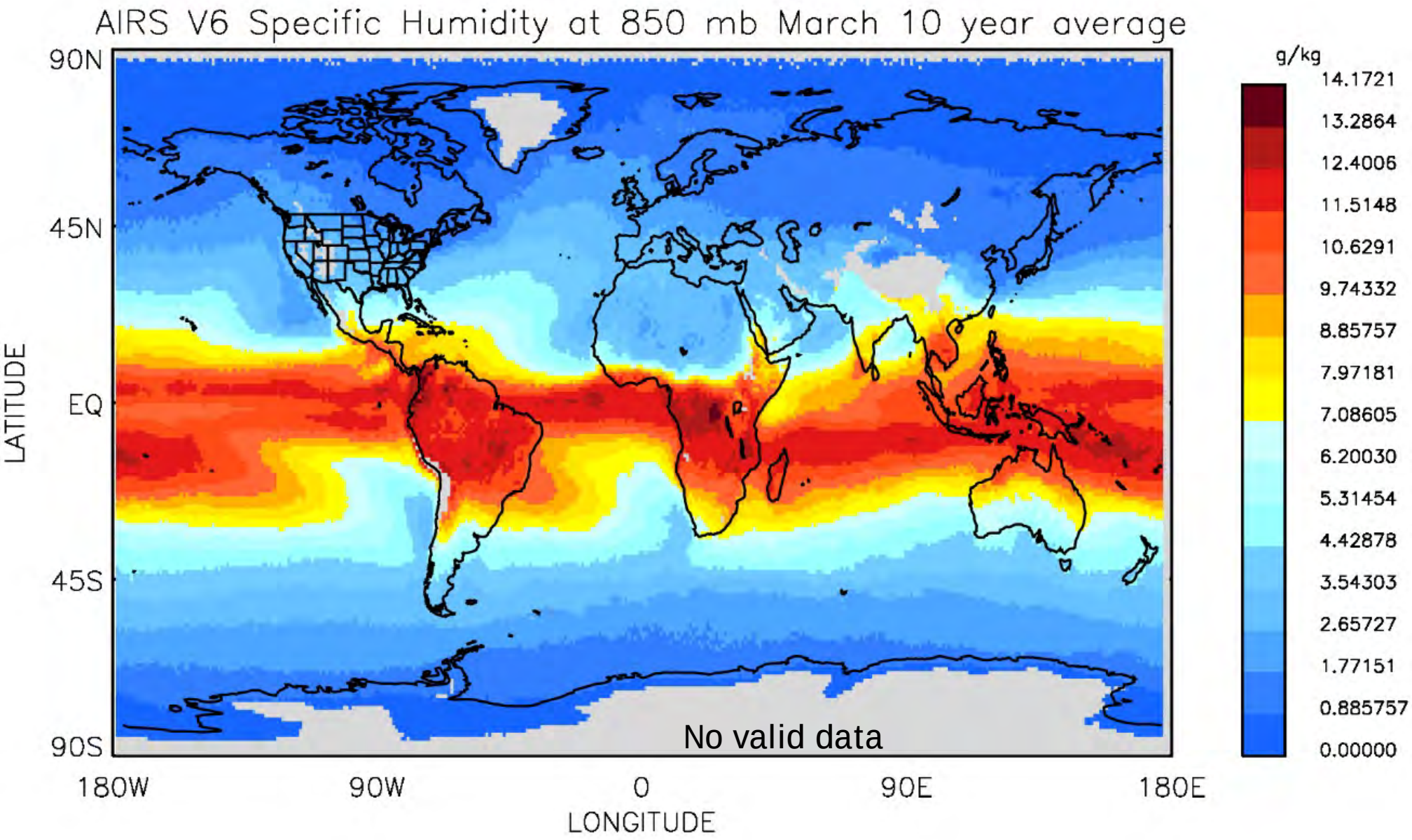
Mean Graph= Sum/total count(per cell)

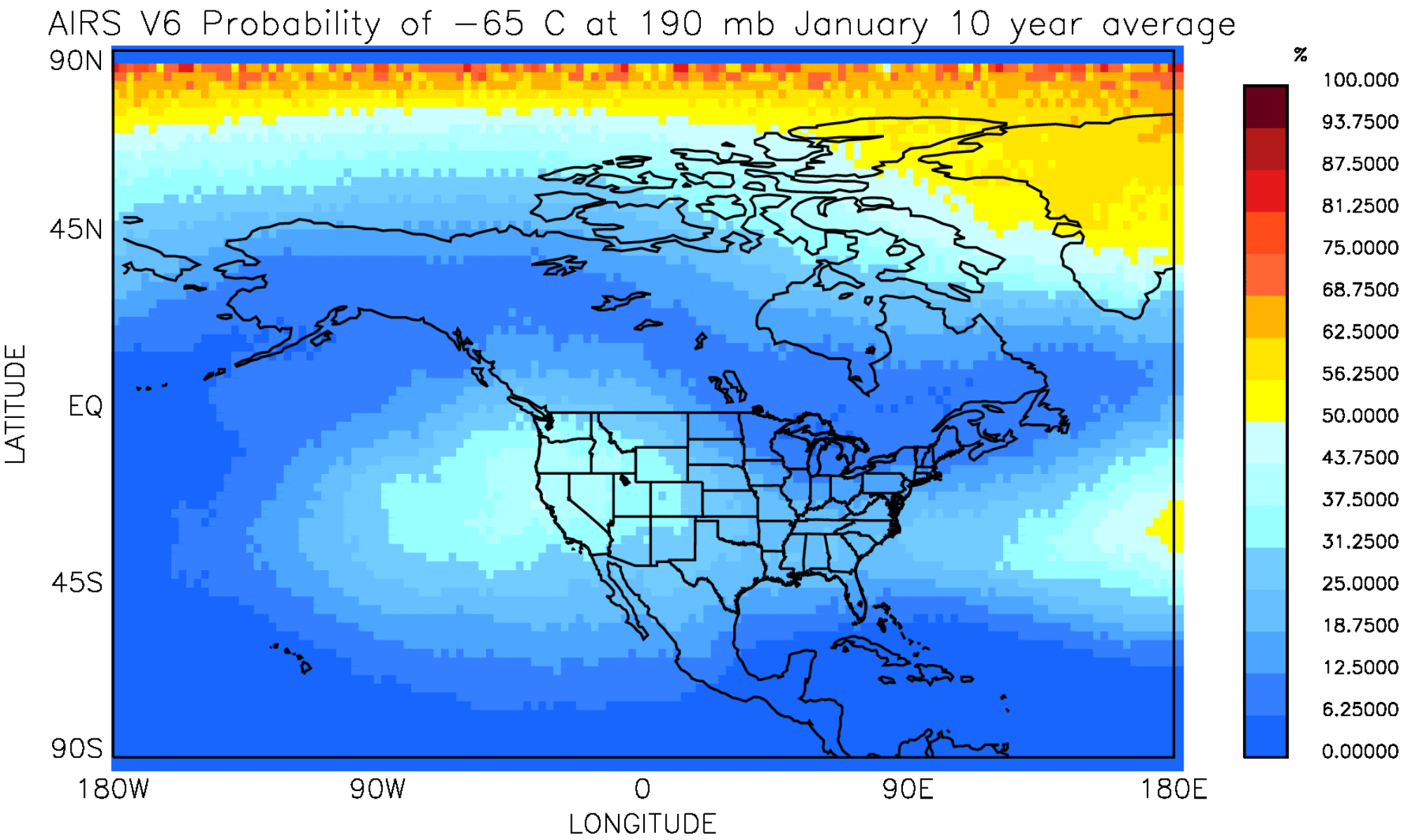


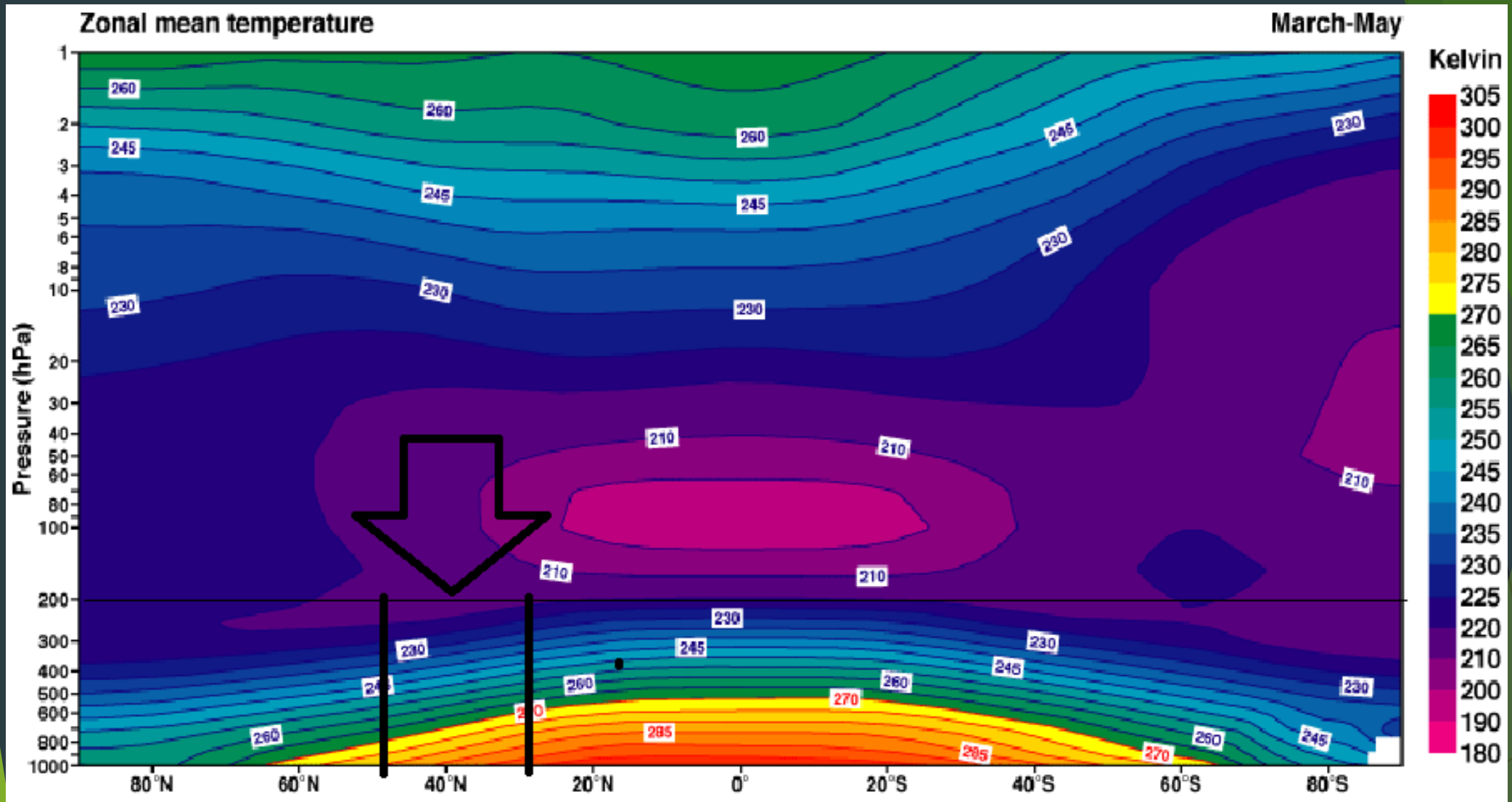
Making an Efficient System

- Reading and parsing the hdf files takes a long time
- Created a program that can create a climatology for an arbitrary number of days
  - This is why we saved sum and Sum^2
  - Idea came from Smith,N.,et al. 2013 J. Appl. Meteorology and Climate.
- Allows for flexibility between time periods and fast switching between plot types
- The use of the NASA level 3 daily files would not allow this flexibility since counts vary day to day

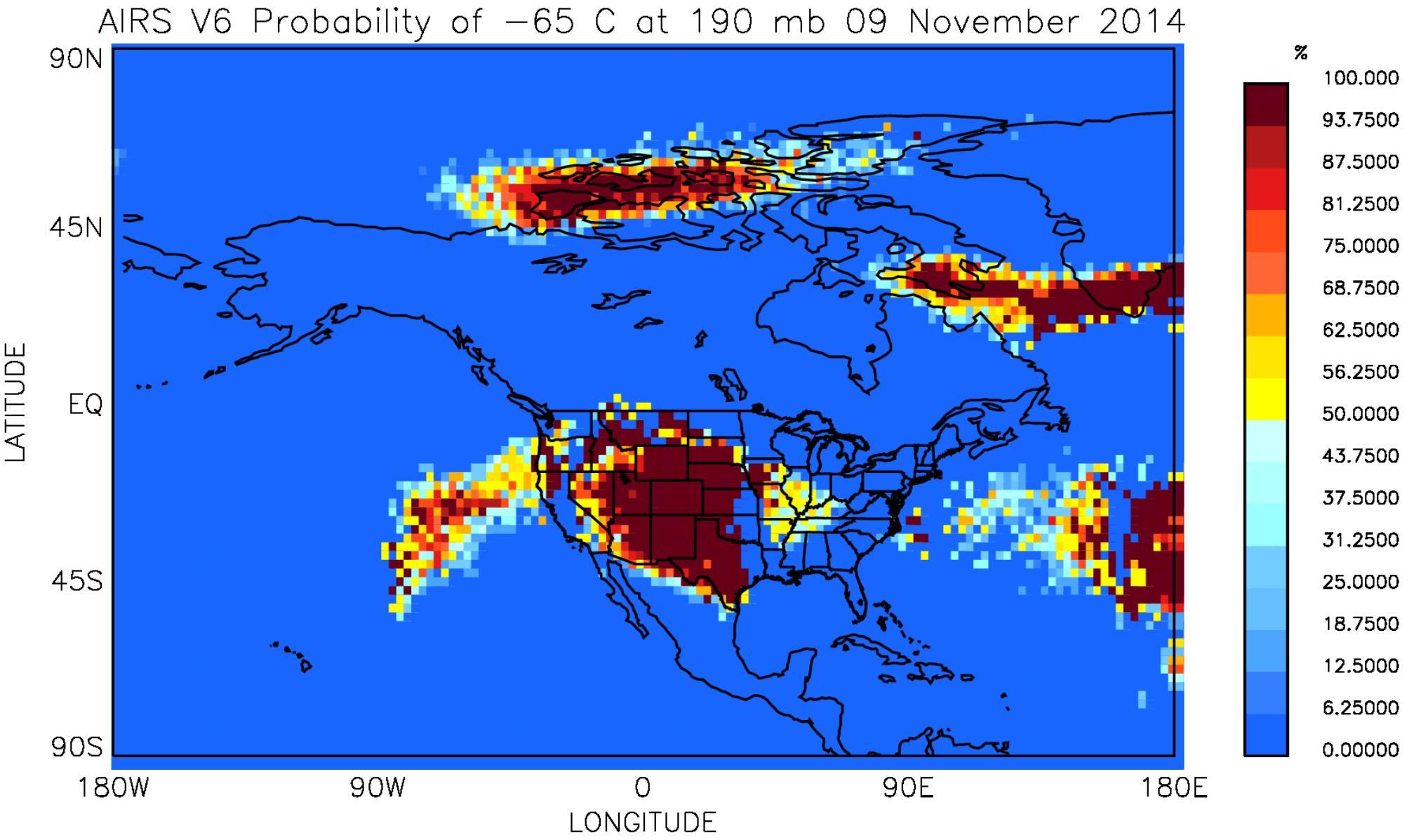

AIRS V6 Ozone Concentration January 2014
90N
45N
EQ
45S
90S
LATITUDE
180W
90W
0
90E
180E
LONGITUDE
Dobson Units
500.000
478.125
456.250
434.375
412.500
390.625
368.750
346.875
325.000
303.125
281.250
259.375
237.500
215.625
193.750
171.875
150.000

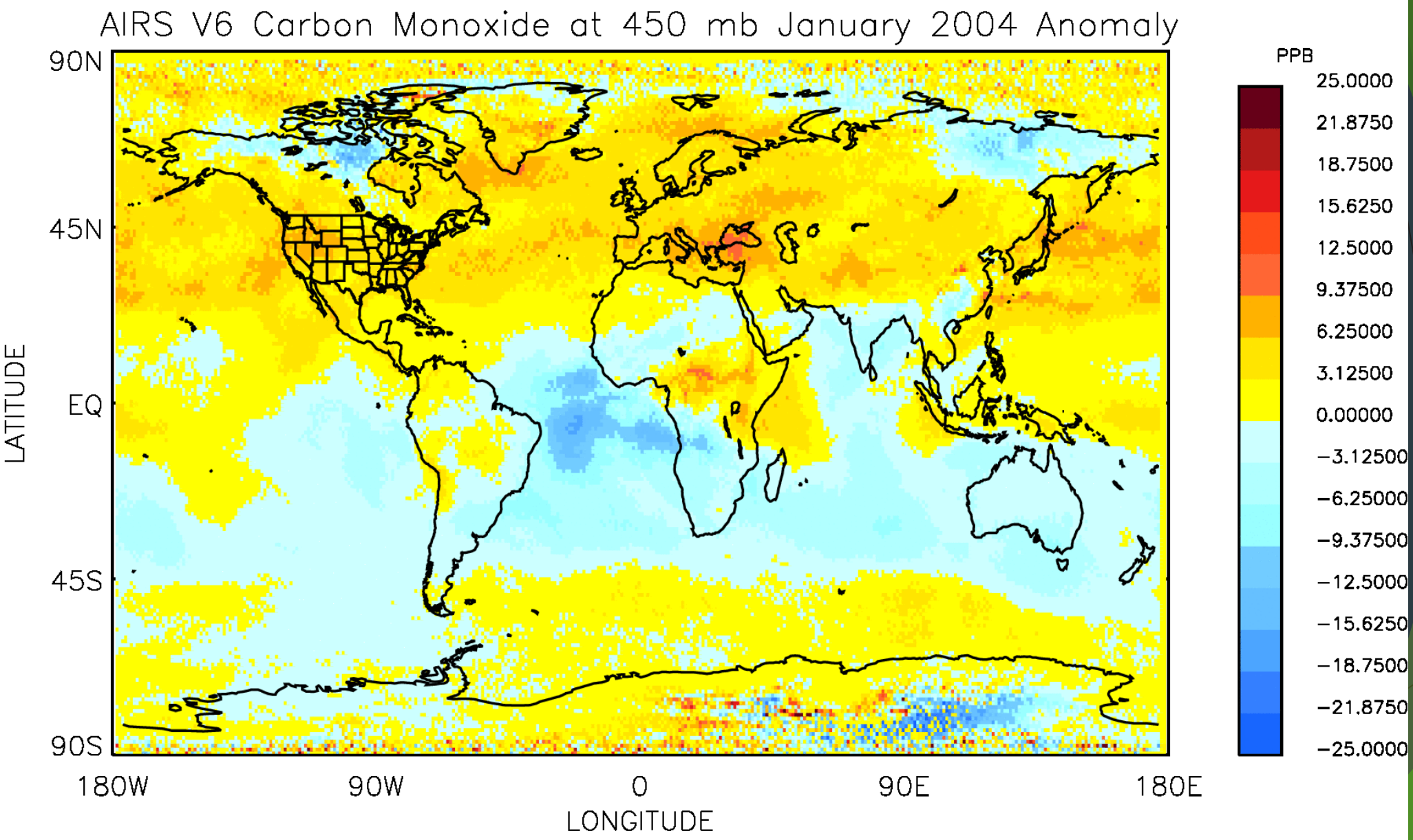

AIRS V6 Specific Humidity at 850 mb March 10 year average
90N
45N
EQ
45S
90S
LATITUDE
180W
90W
0
90E
180E
LONGITUDE
No valid data
g/kg
14.1721
13.2864
12.4006
11.5148
10.6291
9.74332
8.85757
7.97181
7.08605
6.20030
5.31454
4.42878
3.54303
2.65727
1.77151
0.885757
0.00000

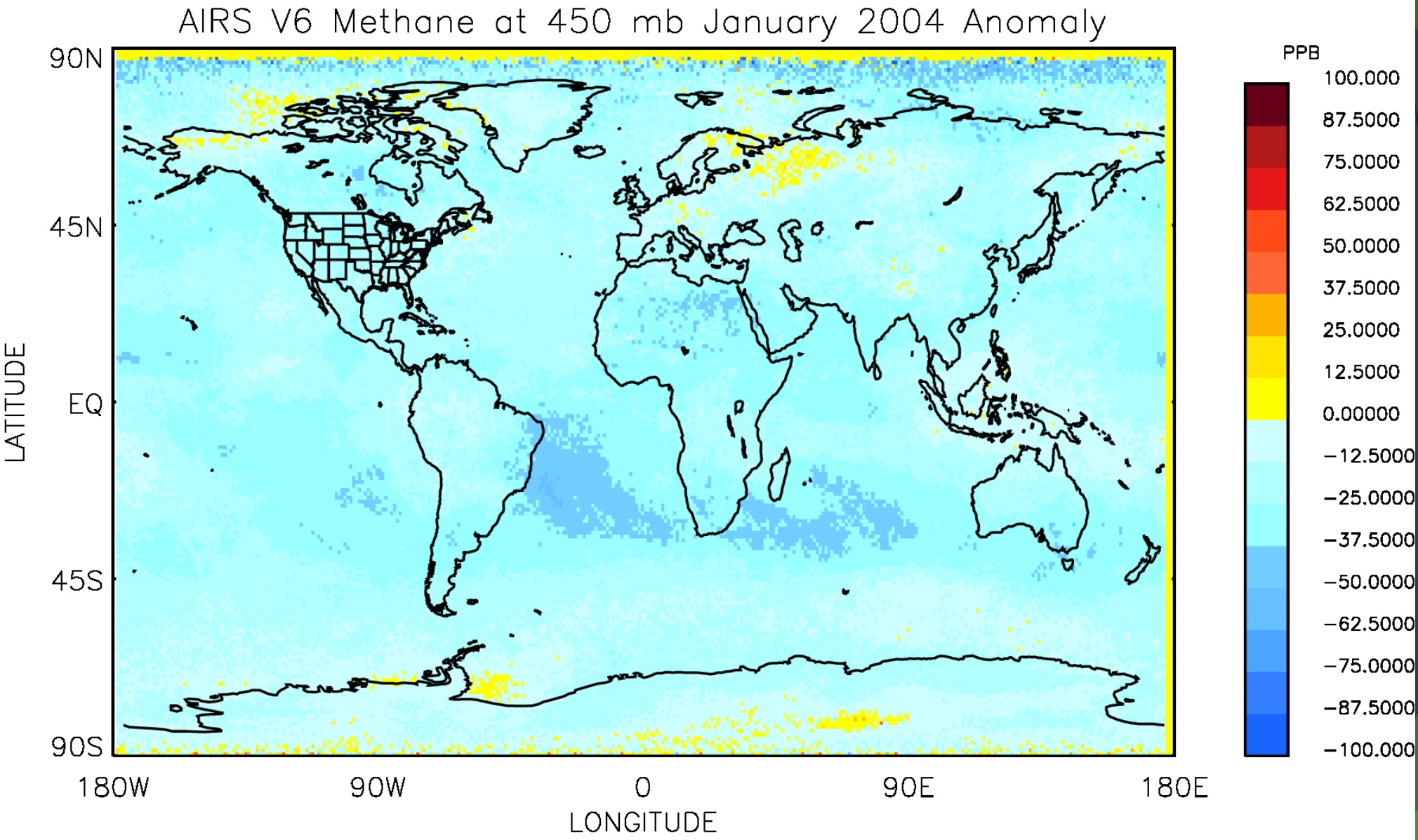

AIRS V6 Probability of −65 C at 190 mb January 10 year average
90N
45N
EQ
45S
90S
LATITUDE
180W
90W
0
90E
180E
LONGITUDE
%
100.000
93.7500
87.5000
81.2500
75.0000
68.7500
62.5000
56.2500
50.0000
43.7500
37.5000
31.2500
25.0000
18.7500
12.5000
6.25000
0.00000

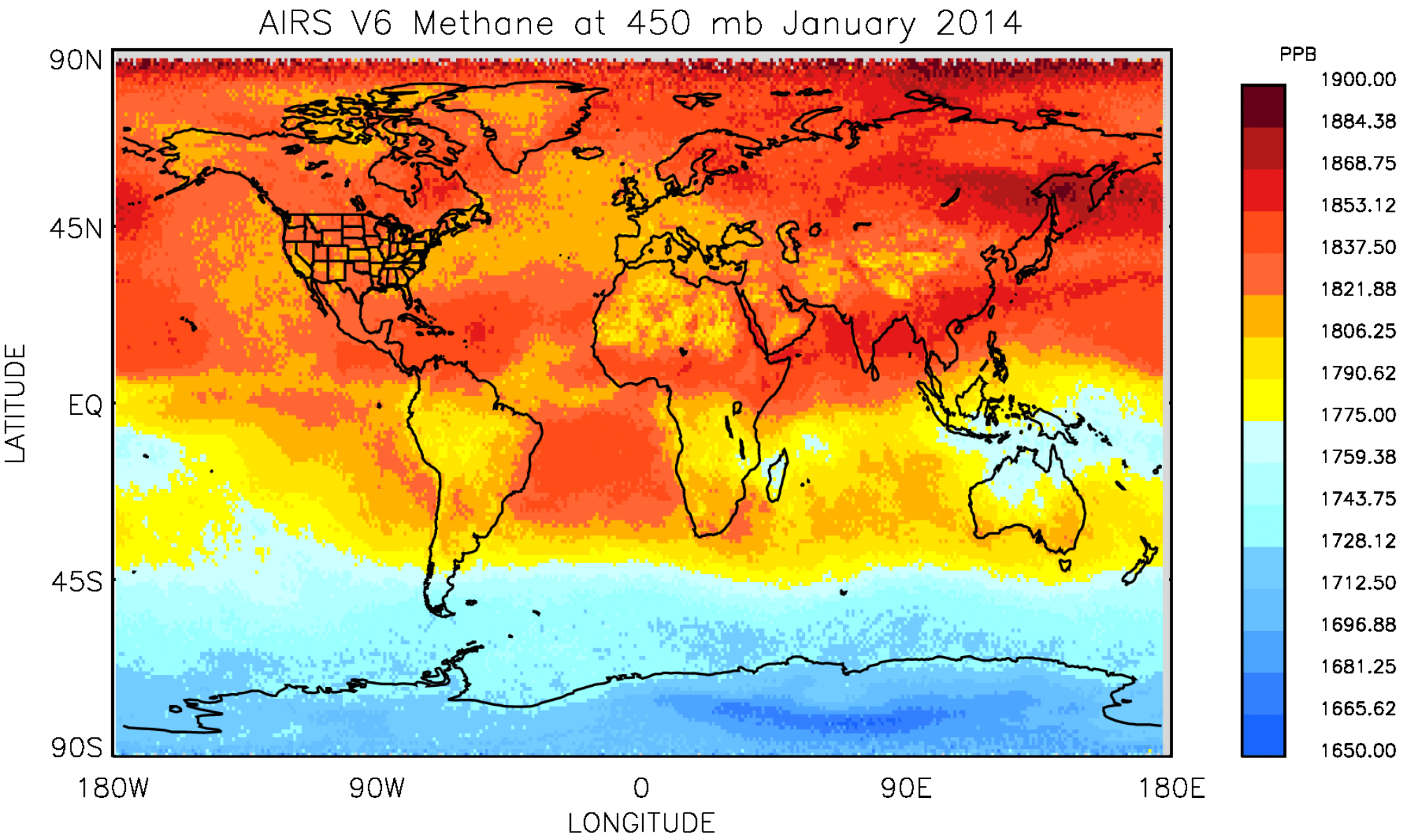


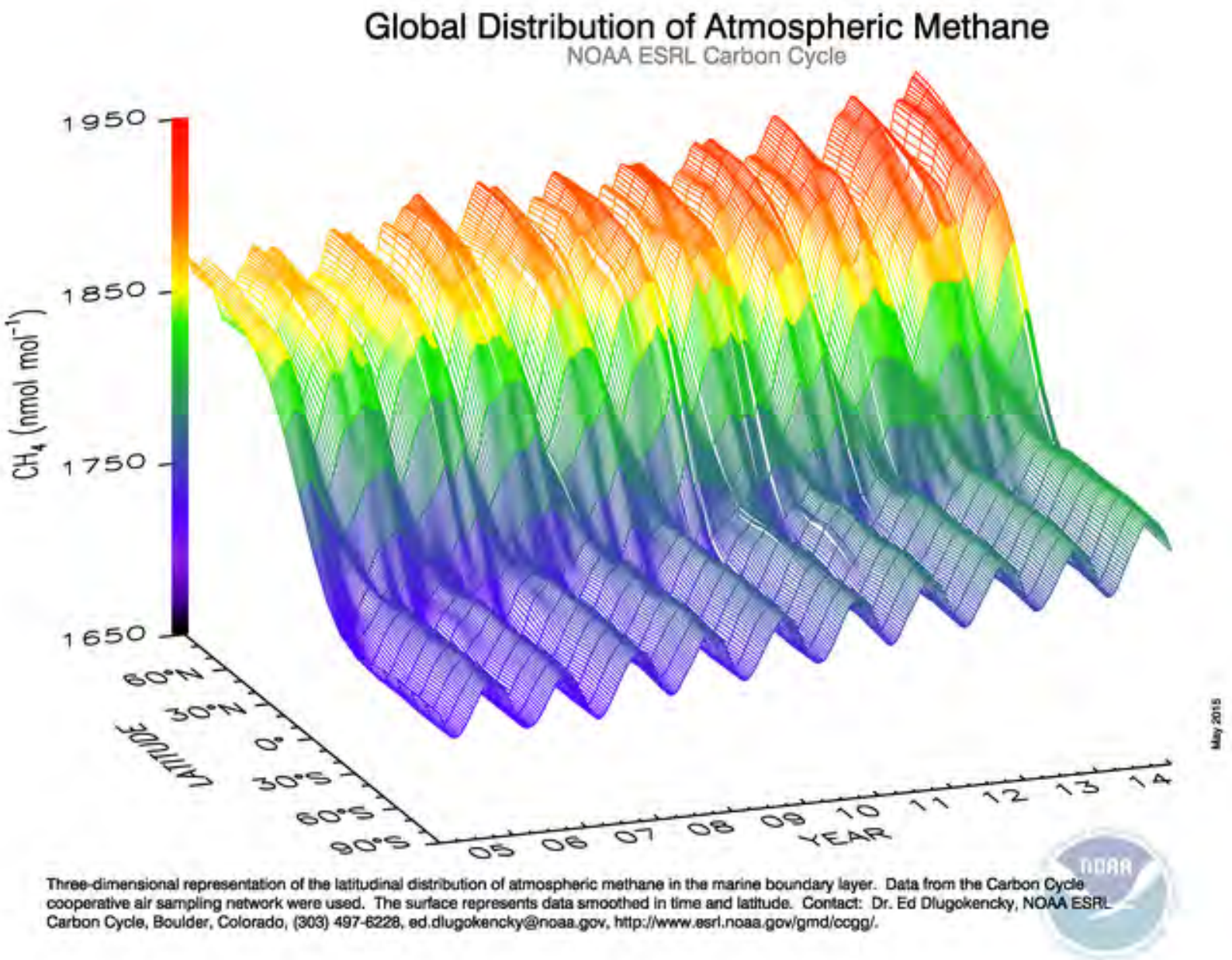
http://old.ecmwf.int/research/era/ERA-40_Atlas/docs/section_D25/parameter_zmtsp.html#


AIRS V6 Probability of −65 C at 190 mb 09 November 2014
90N
45N
EQ
45S
90S
LATITUDE
180W
90W
0
90E
180E
LONGITUDE
%
100.000
93.7500
87.5000
81.2500
75.0000
68.7500
62.5000
56.2500
50.0000
43.7500
37.5000
31.2500
25.0000
18.7500
12.5000
6.25000
0.00000

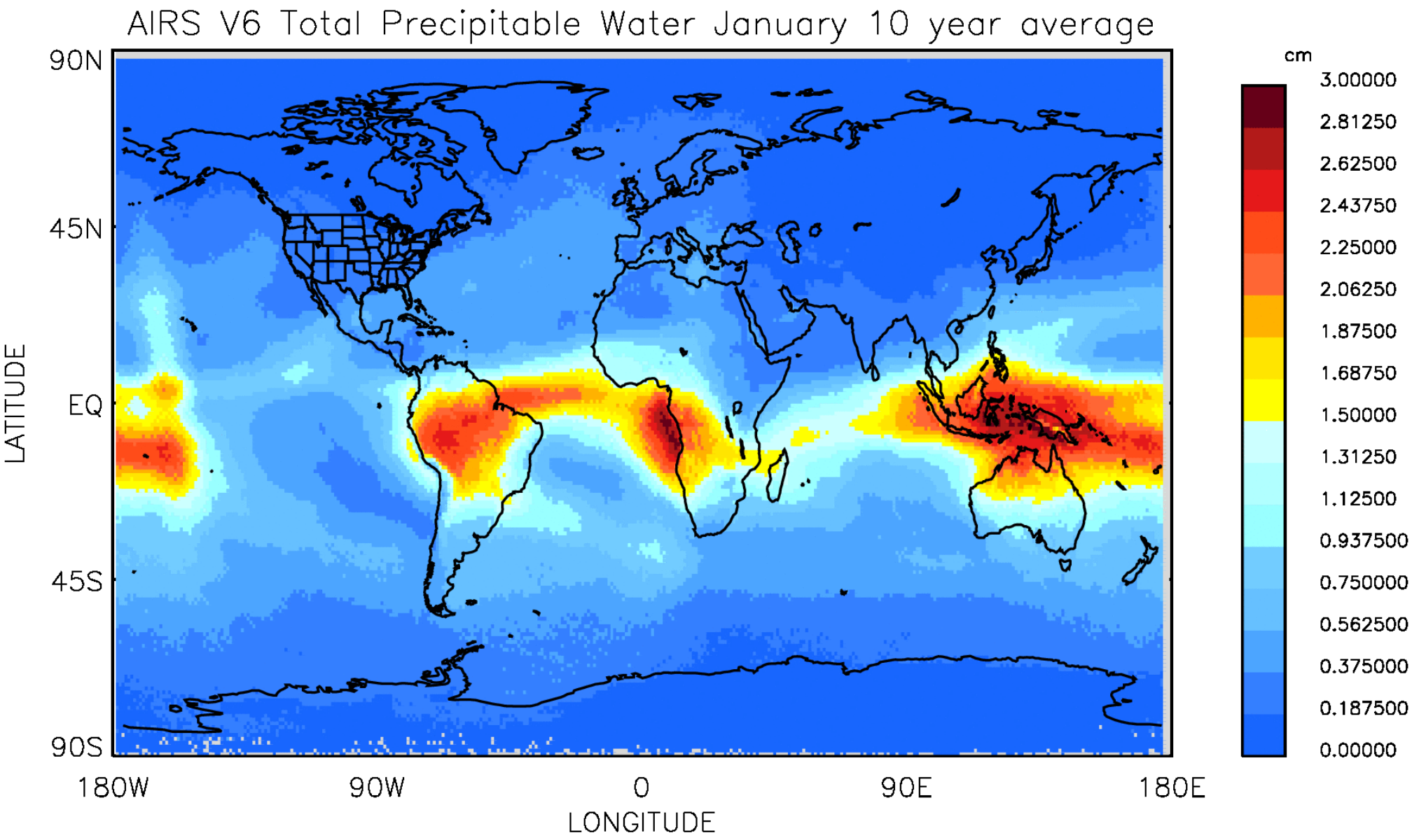

AIRS V6 Carbon Monoxide at 450 mb January 2004 Anomaly
90N
45N
EQ
45S
90S
LATITUDE
180W
90W
0
90E
180E
LONGITUDE
PPB
25.0000
21.8750
18.7500
15.6250
12.5000
9.37500
6.25000
3.12500
0.00000
−3.12500
−6.25000
−9.37500
−12.5000
−15.6250
−18.7500
−21.8750
−25.0000

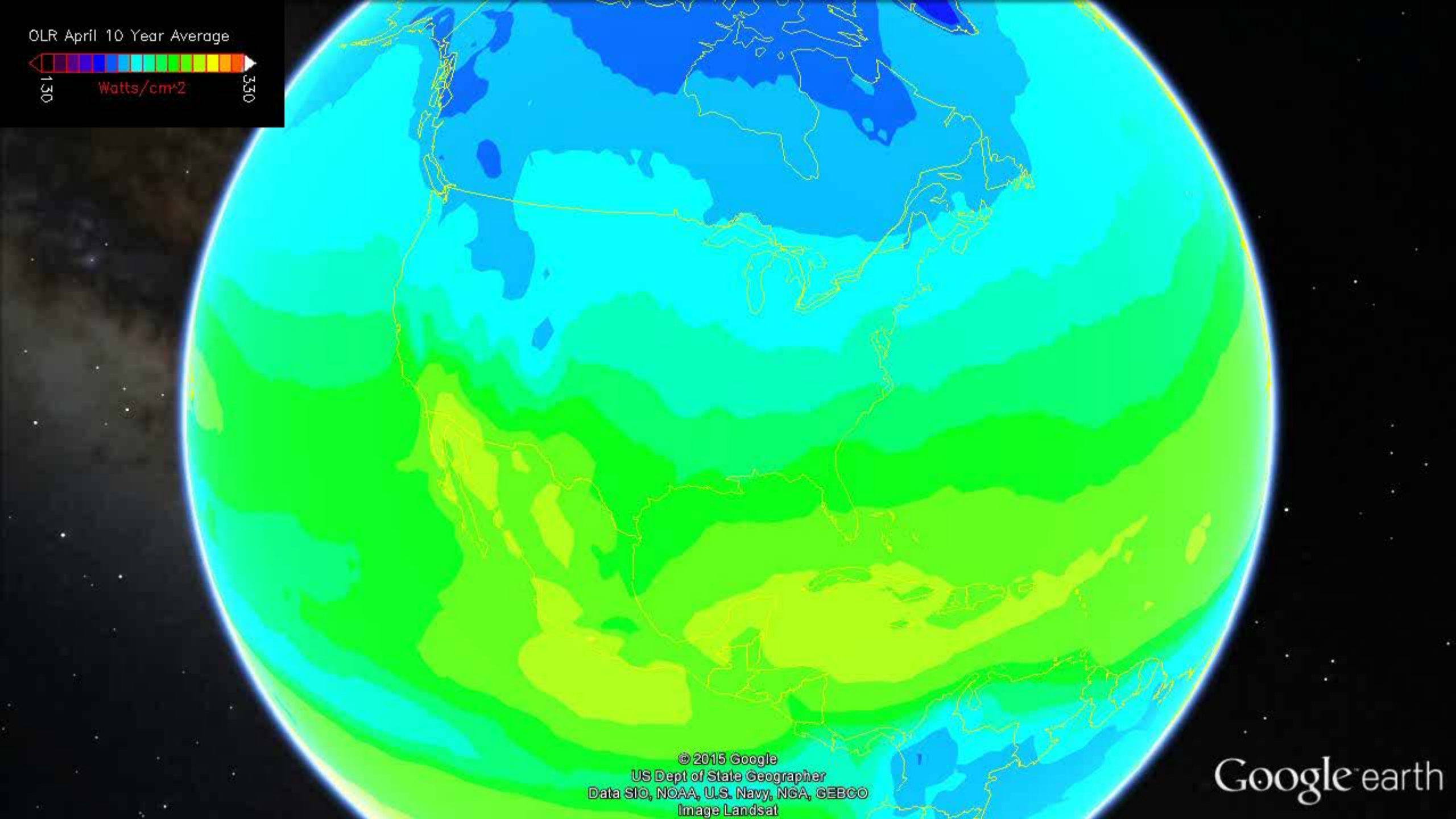

AIRS V6 Methane at 450 mb January 2004 Anomaly
90N
45N
EQ
45S
90S
LATITUDE
180W
90W
0
90E
180E
LONGITUDE
PPB
100.000
87.5000
75.0000
62.5000
50.0000
37.5000
25.0000
12.5000
0.00000
−12.5000
−25.0000
−37.5000
−50.0000
−62.5000
−75.0000
−87.5000
−100.000

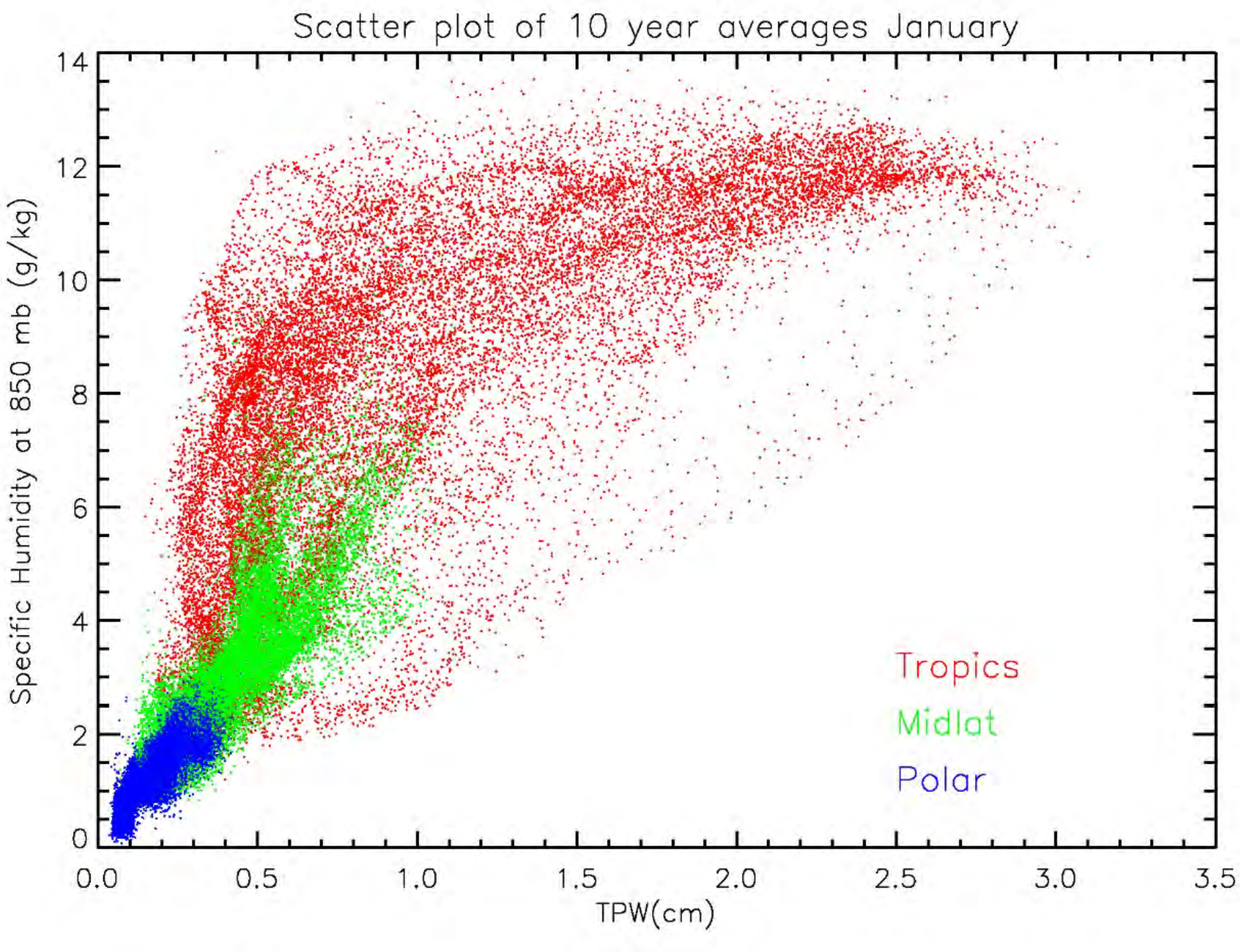

AIRS V6 Methane at 450 mb January 2014
90N
45N
EQ
45S
90S
LATITUDE
180W
90W
0
90E
180E
LONGITUDE
PPB
1900.00
1884.38
1868.75
1853.12
1837.50
1821.88
1806.25
1790.62
1775.00
1759.38
1743.75
1728.12
1712.50
1696.88
1681.25
1665.62
1650.00



http://www.noaanews.noaa.gov/stories2006/s2709.htm


AIRS V6 Total Precipitable Water January 10 year average
90N
45N
EQ
45S
90S
LATITUDE
180W
90W
0
90E
180E
LONGITUDE
cm
3.00000
2.81250
2.62500
2.43750
2.25000
2.06250
1.87500
1.68750
1.50000
1.31250
1.12500
0.937500
0.750000
0.562500
0.375000
0.187500
0.00000


OLR April 10 Year Average
130
Watts/cm^2
330
© 2015 Google
US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Google earth


Scatter plot of 10 year averages January
Specific Humidity at 850 mb (g/kg)
TPW(cm)
0
2
4
6
8
10
12
14
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Tropics
Midlat
Polar

Looking Forward

- Need to work on CAPE program (Convective Available Potential Energy)
- Make it easier to add variables
- Exploring applications
  1. Would like to look at correlation between other variables
  2. Use Percent of -65C to determine where/when it is inefficient to fly
  3. Study tendencies in all of the variables and attempt to predict future events