Science Made Simple with McIDAS-V and CDP

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McIDAS Users' Group Meeting
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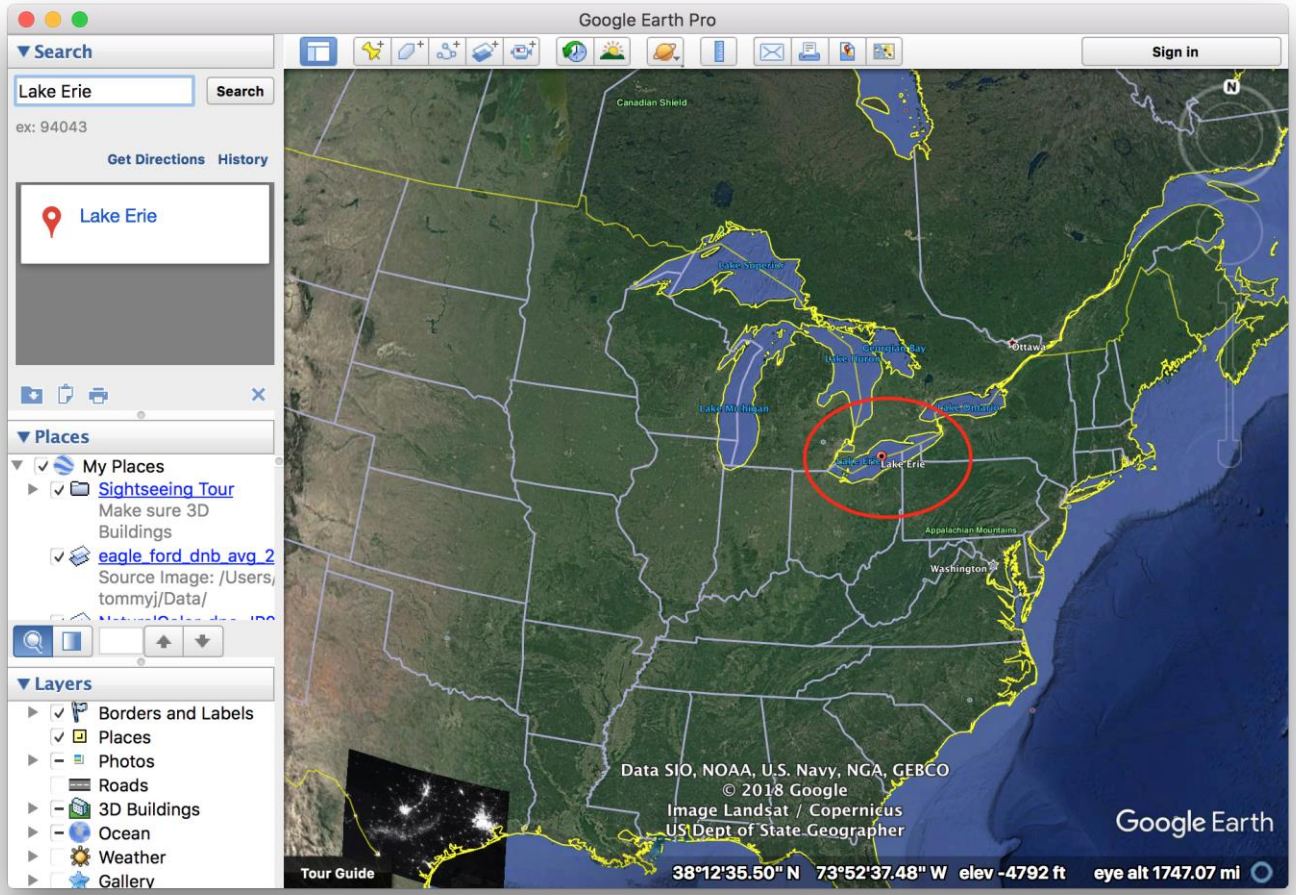
A Simple Question

Are large freshwater lakes warming?

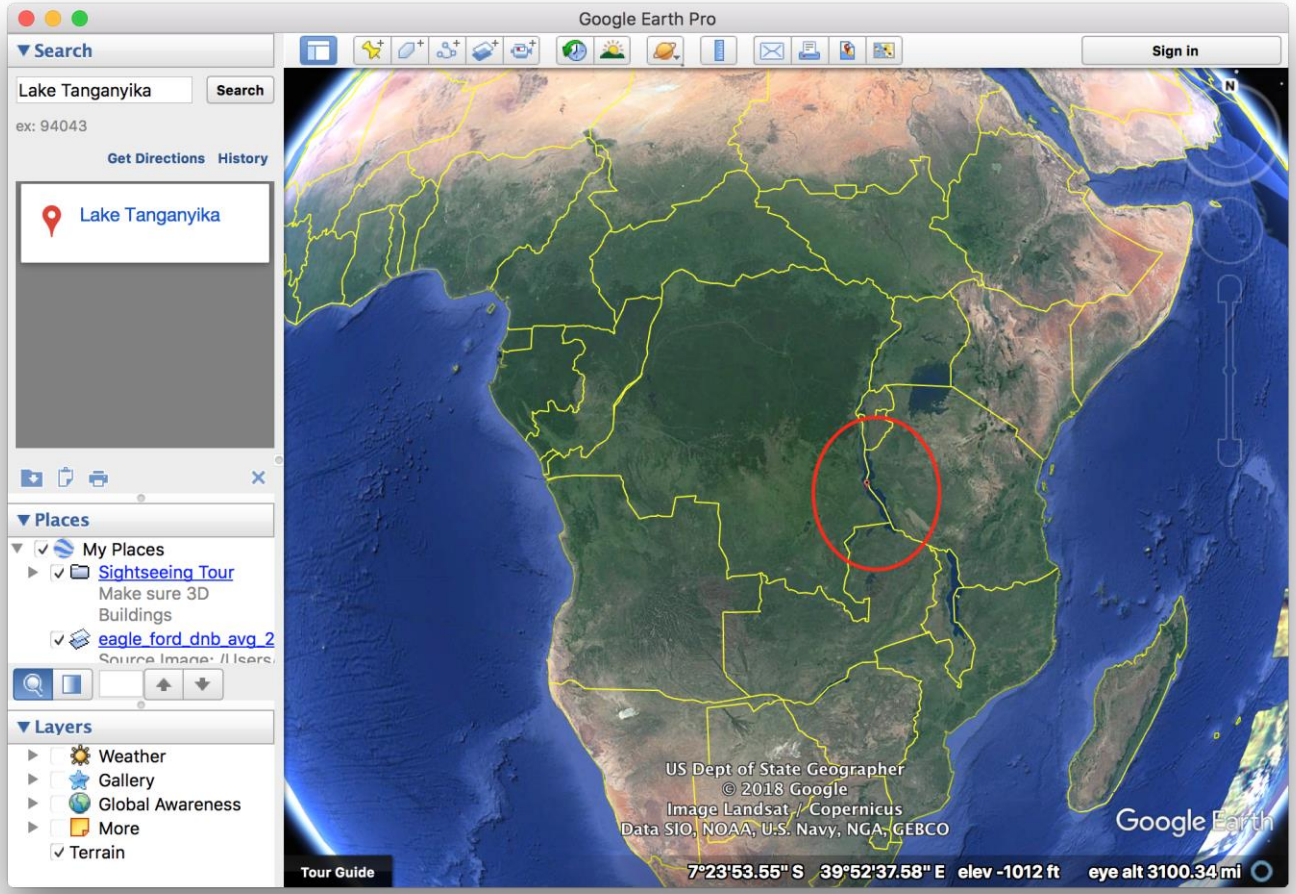
What do we need?

1. Source of data (CDP)
2. Tools to analyze the data (McIDAS-V, Python)

Lake Erie


Google Earth Pro
Search
Lake Erie
Search
ex: 94043
Get Directions
History
Lake Erie
Places
My Places
Sightseeing Tour
Make sure 3D Buildings
eagle_ford_dnb_avg_2
Source Image: /Users/tommyj/Data/
Layers
Borders and Labels
Places
Photos
Roads
3D Buildings
Ocean
Weather
Gallery
Sign in
Canadian Shield
Ottawa
Lake Erie
Appalachian Mountains
Washington
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2018 Google
Image Landsat / Copernicus
US Dept of State Geographer
Google Earth
Tour Guide
38°12'35.50" N 73°52'37.48" W elev -4792 ft eye alt 1747.07 mi

Lake Tanganyika



Source of Data

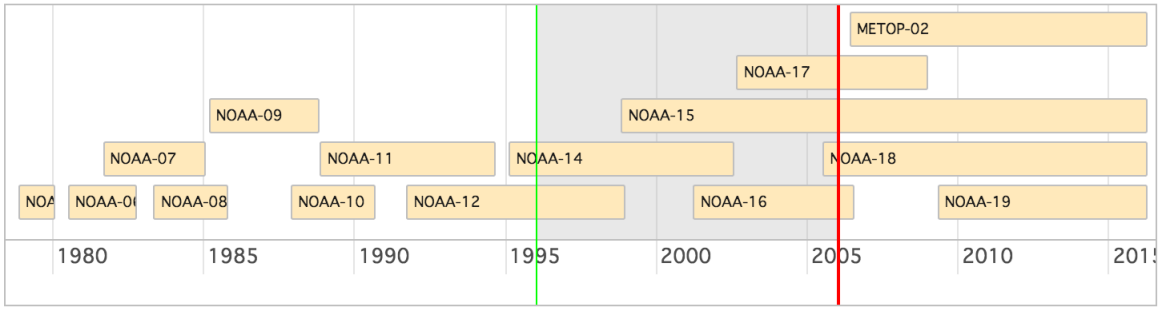
CIMSS Climate Data Portal (CDP)

http://www.ssec.wisc.edu/cdp/main

- Entire PATMOS-x AVHRR Archive – 1979 to present
- Spatial, Temporal, and Product Subsetting
- FTP Pickup, NetCDF Formatting
- Freely Available

Signed in as: Tommy Jasmin Sign Out

Status:
This form has been pre-filled to match order ID: 284



Satellite:

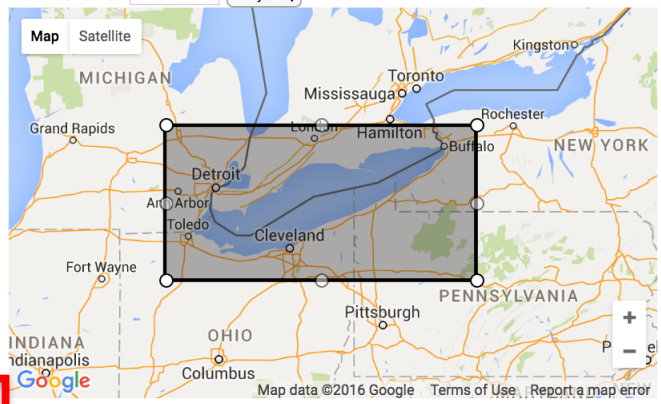
- METOP-02
- NOAA-05
- NOAA-06
- NOAA-07
- NOAA-08
- NOAA-09
- NOAA-10
- NOAA-11
- NOAA-12
- NOAA-14
- NOAA-15
- NOAA-16
- NOAA-17
- NOAA-18
- NOAA-19

Product:

- cld_emiss_acha
- cld_opd_dcomp
- cld_opd_dcomp_unc
- cld_press_acha
- cld_reff_dcomp
- cld_reff_dcomp_unc
- cld_temp_acha
- cloud_fraction
- cloud_fraction_uncertainty
- cloud_probability
- cloud_type
- cloud_water_path
- refl_0_65um_nom
- refl_0_86um_nom
- refl_1_60um_nom
- refl_3_75um_nom
- surface_temperature_retrieved
- temp_11_0um_nom
- temp_11_0um_nom_clear_sky
- temp_12_0um_nom
- temp_3_75um_nom

Node:
Day

Start Date: 1996-01-01 yyyy-mm-dd
End Date: 2005-12-31 yyyy-mm-dd
At Intervals: 1 Days

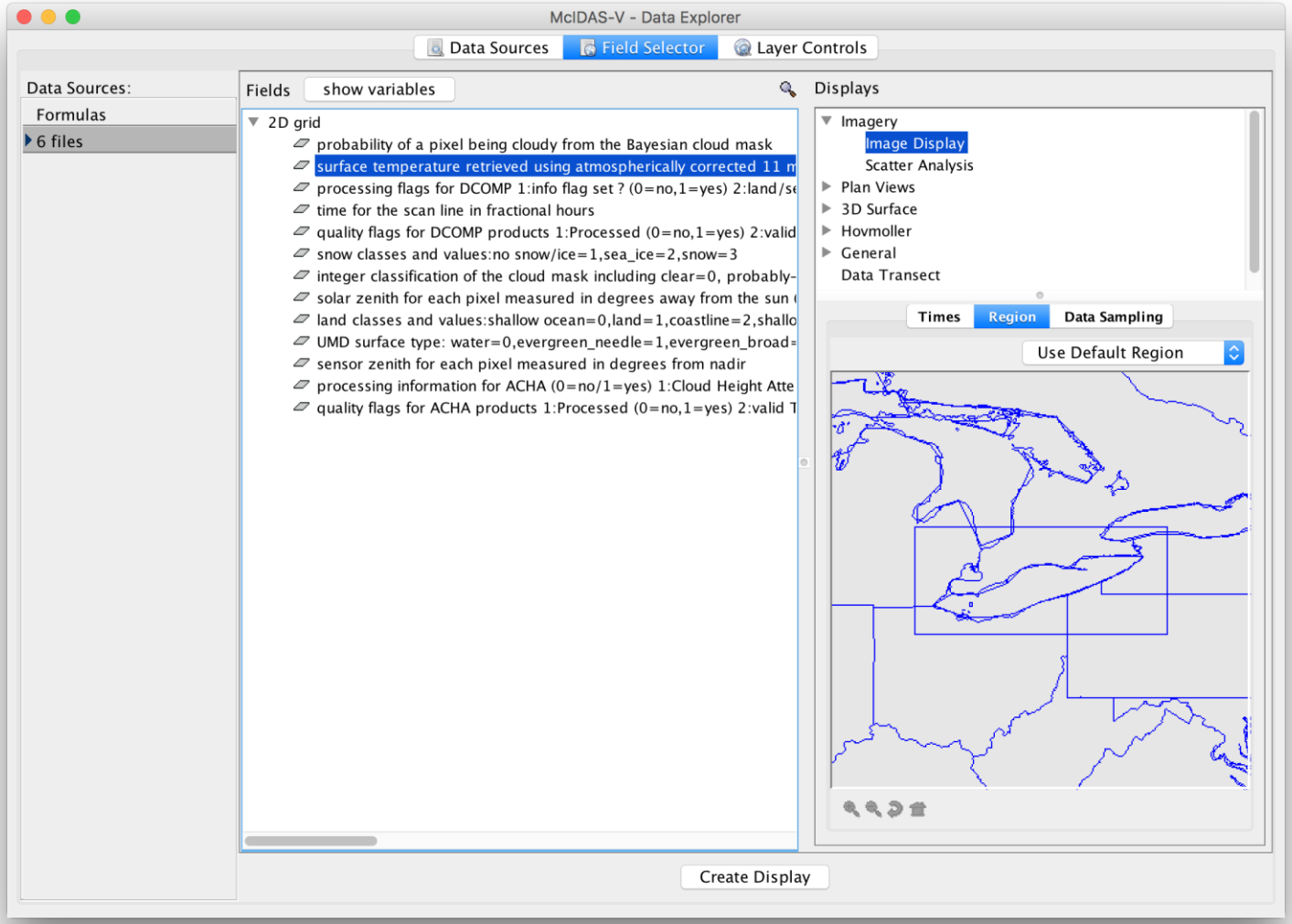


Select a PATMOS-x domain:
North Pacific | USA | Europe | Great Lakes | Brazil | Sahara | Greenland | Dome C | Global

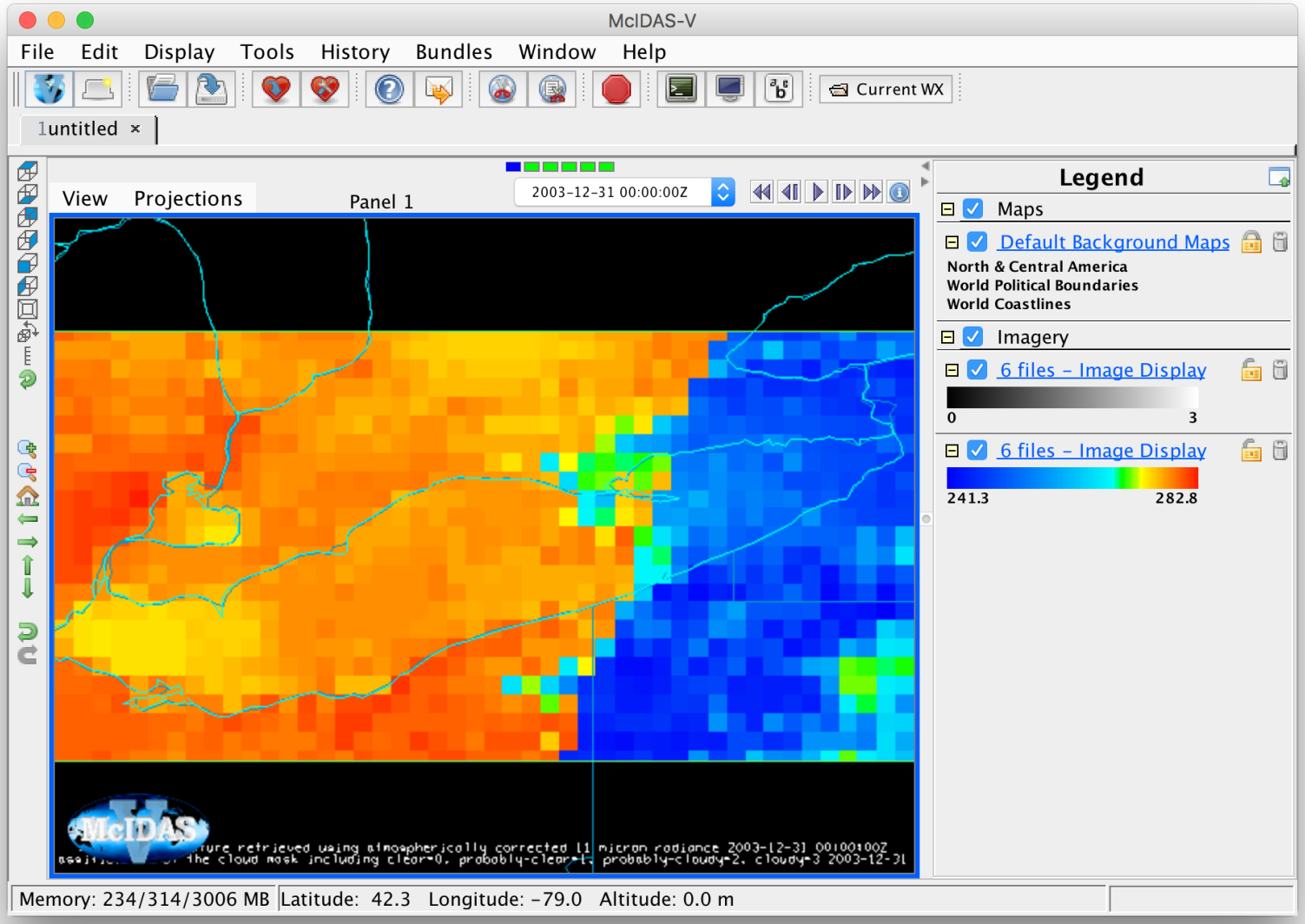
Or set custom geographic bounds:
Upper Right Latitude: 43.1578 Upper Right Longitude: -78.2782
Lower Left Latitude: 41.0559 Lower Left Longitude: -83.9774

Get File Count | Place Order

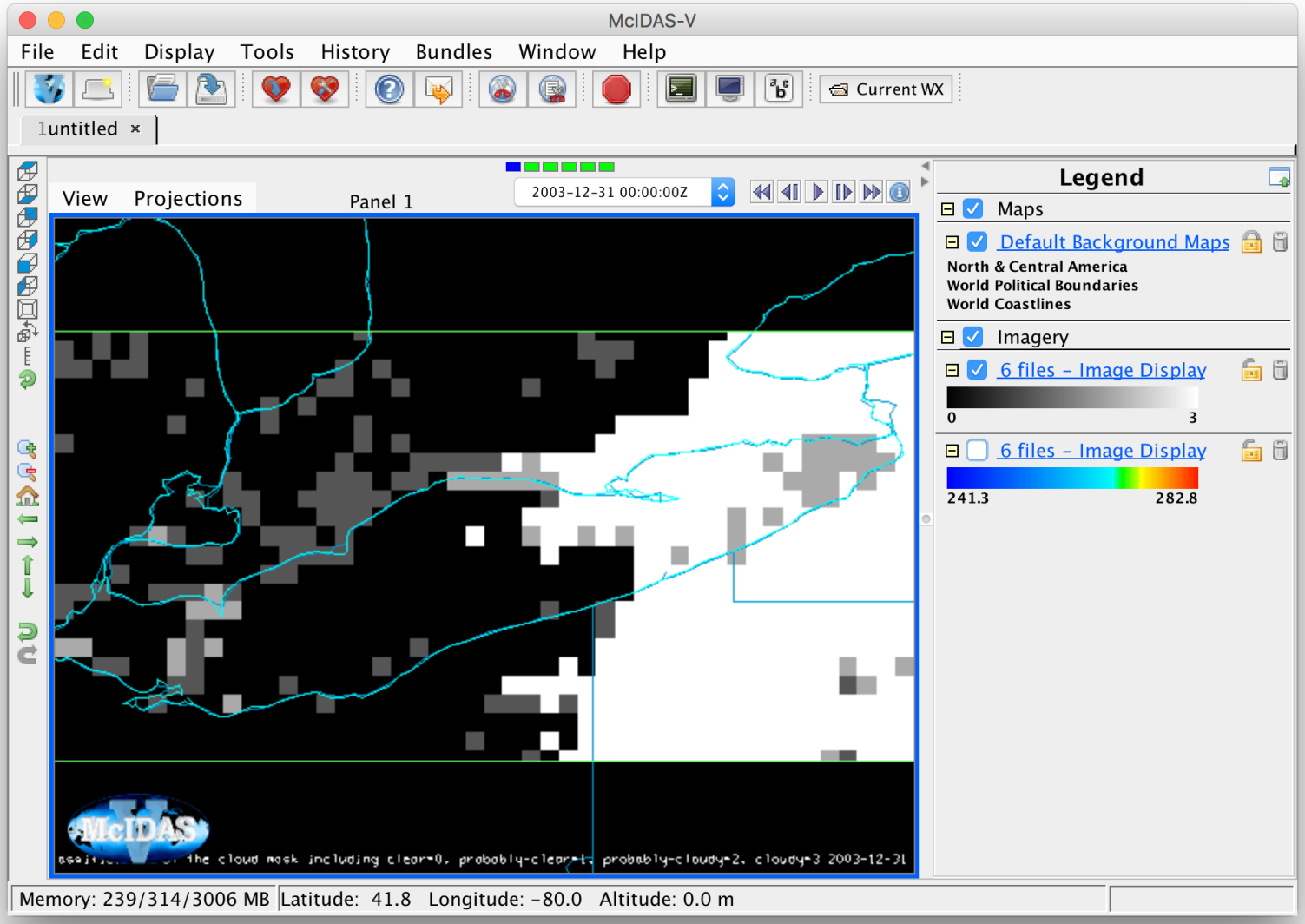
Initial Data Assessment – McIDAS-V



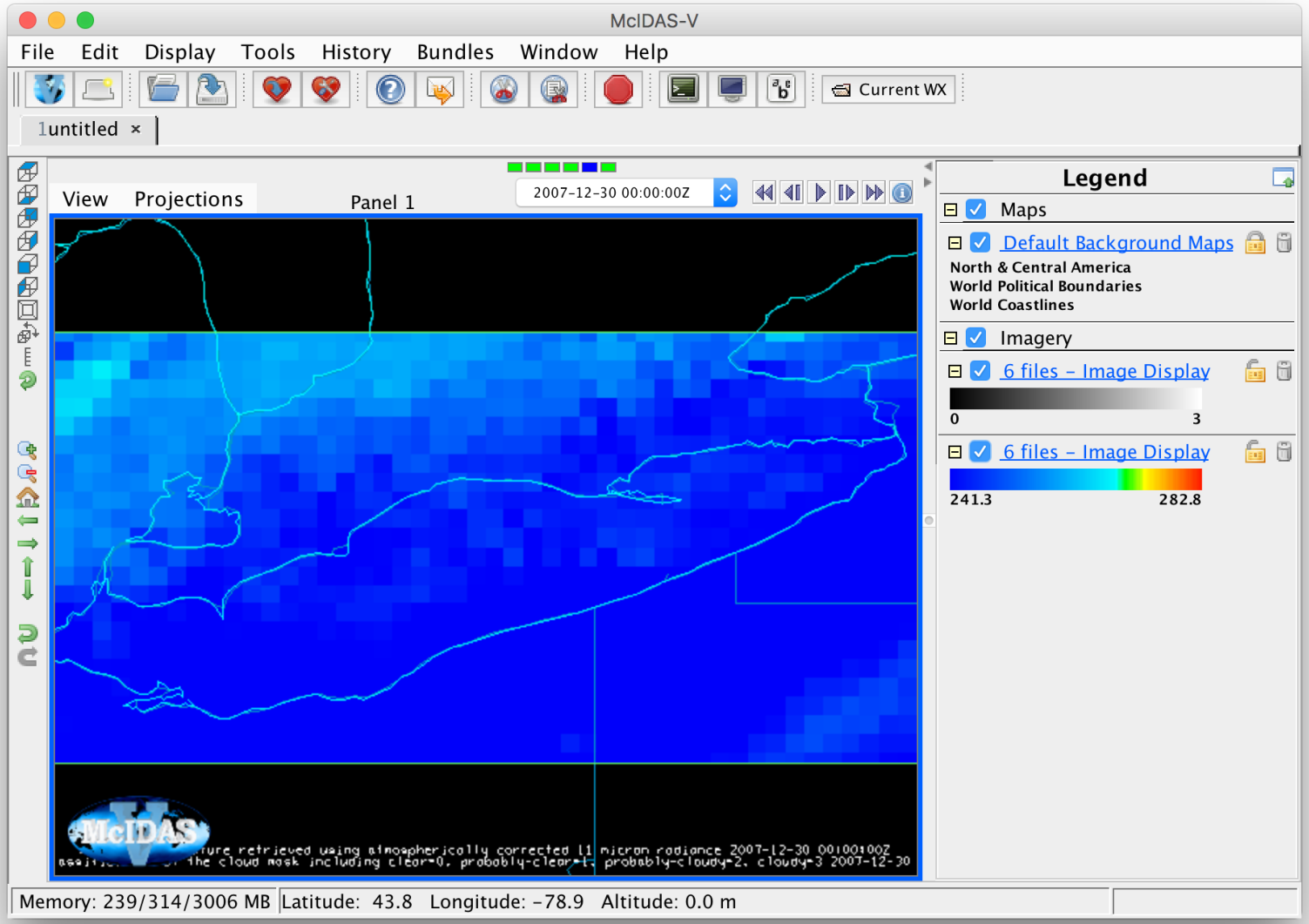
Initial Data Assessment – McIDAS-V



Initial Data Assessment – McIDAS-V



Initial Data Assessment – McIDAS-V



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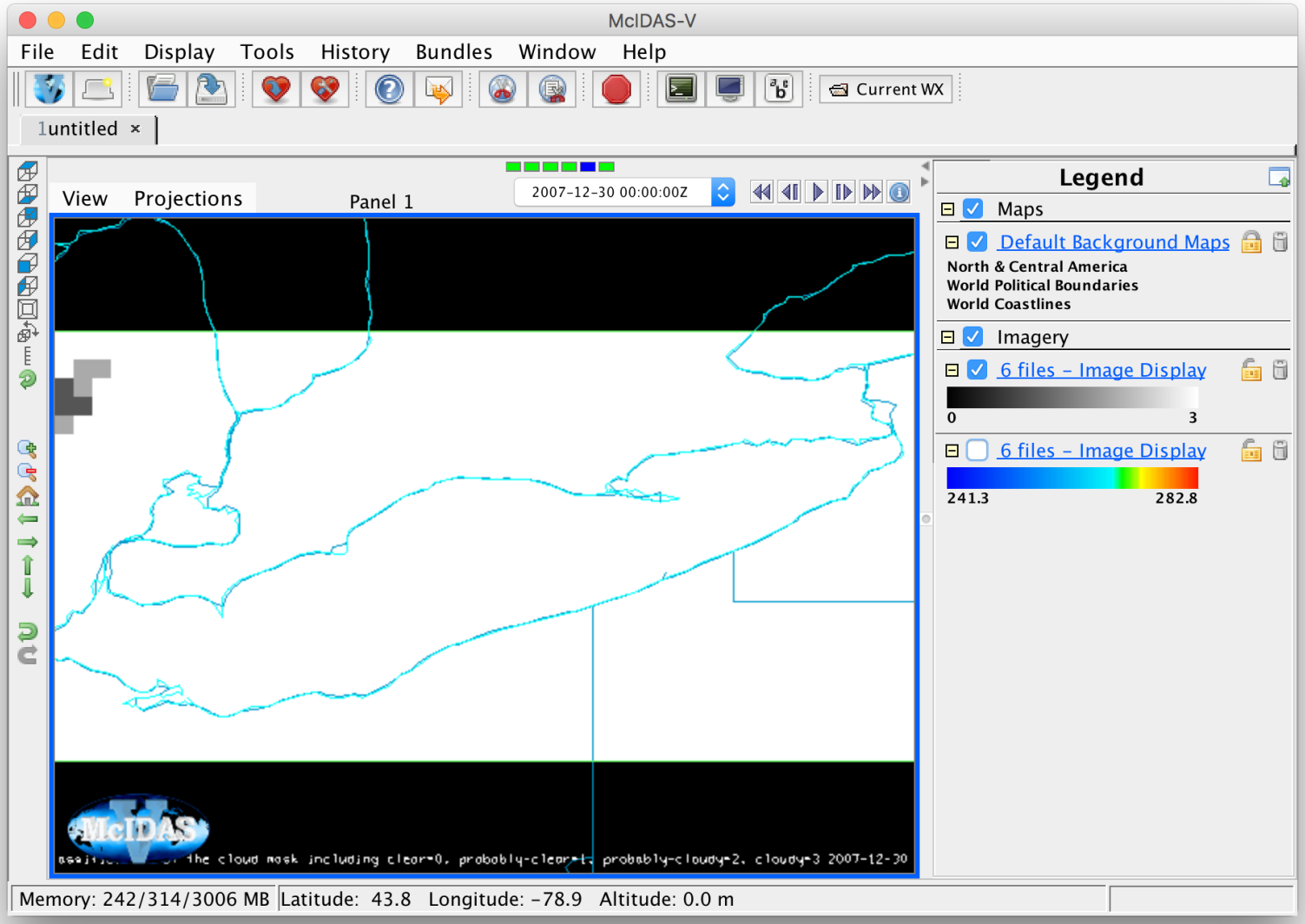
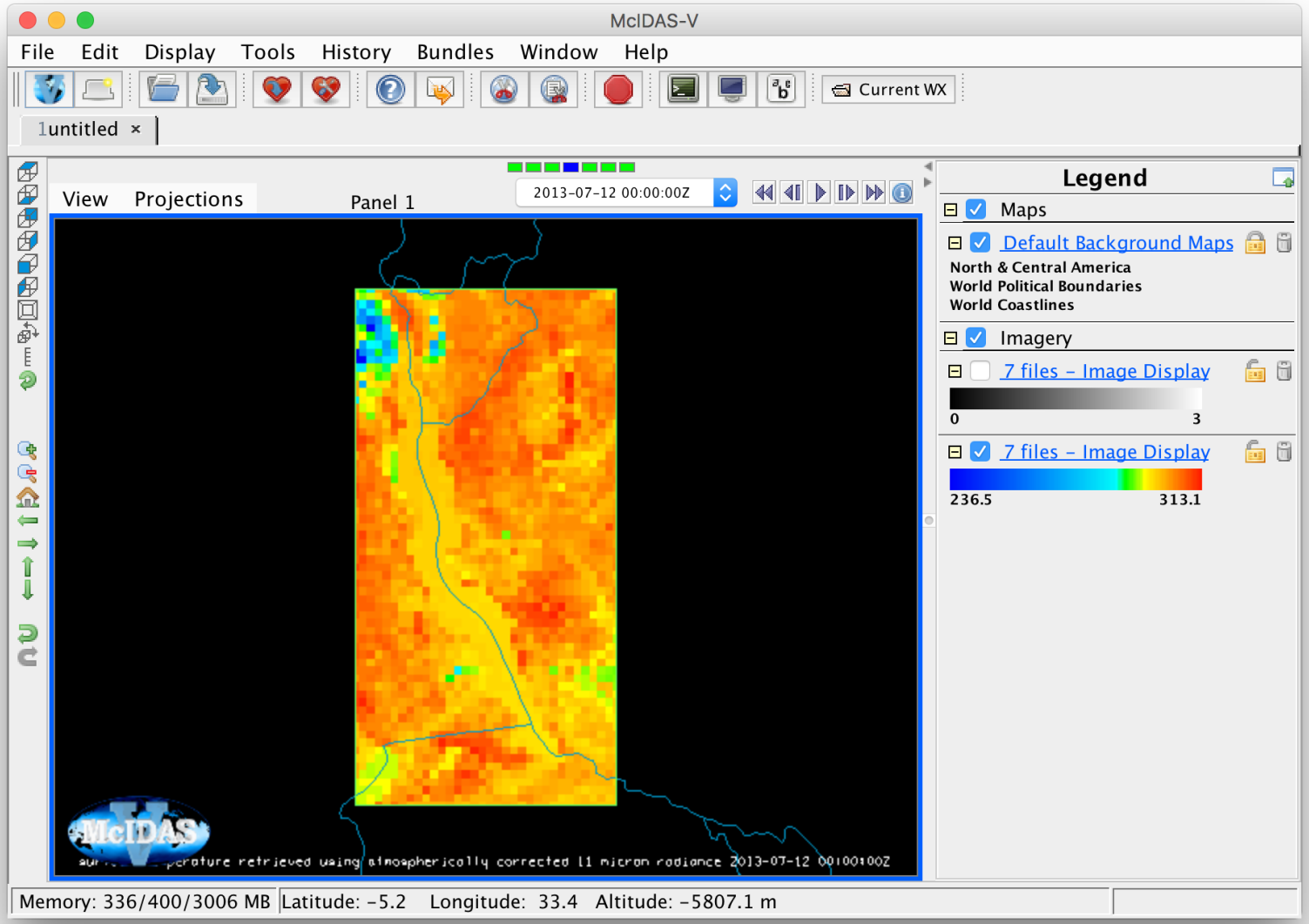
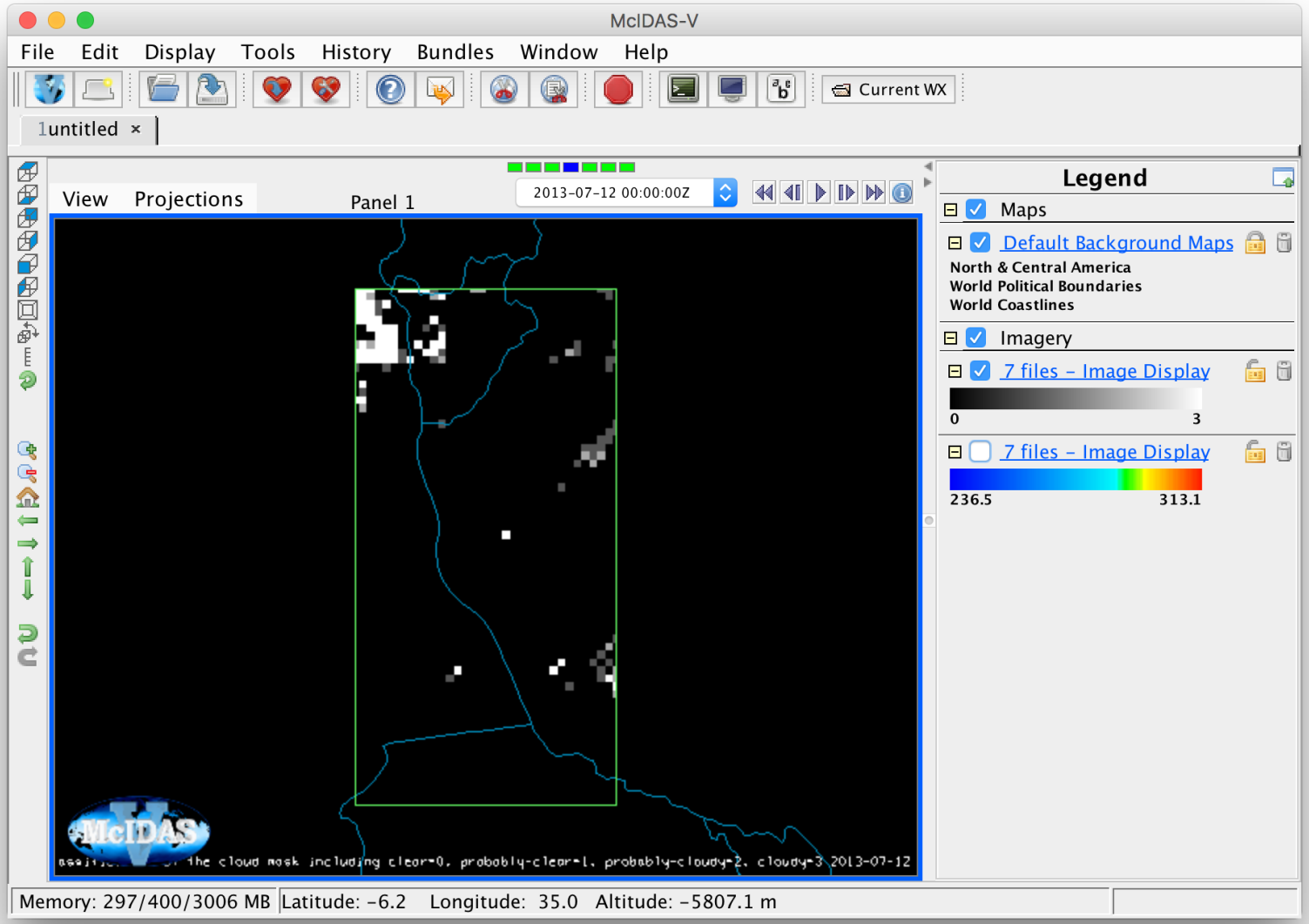


Initial Data Assessment – McIDAS-V

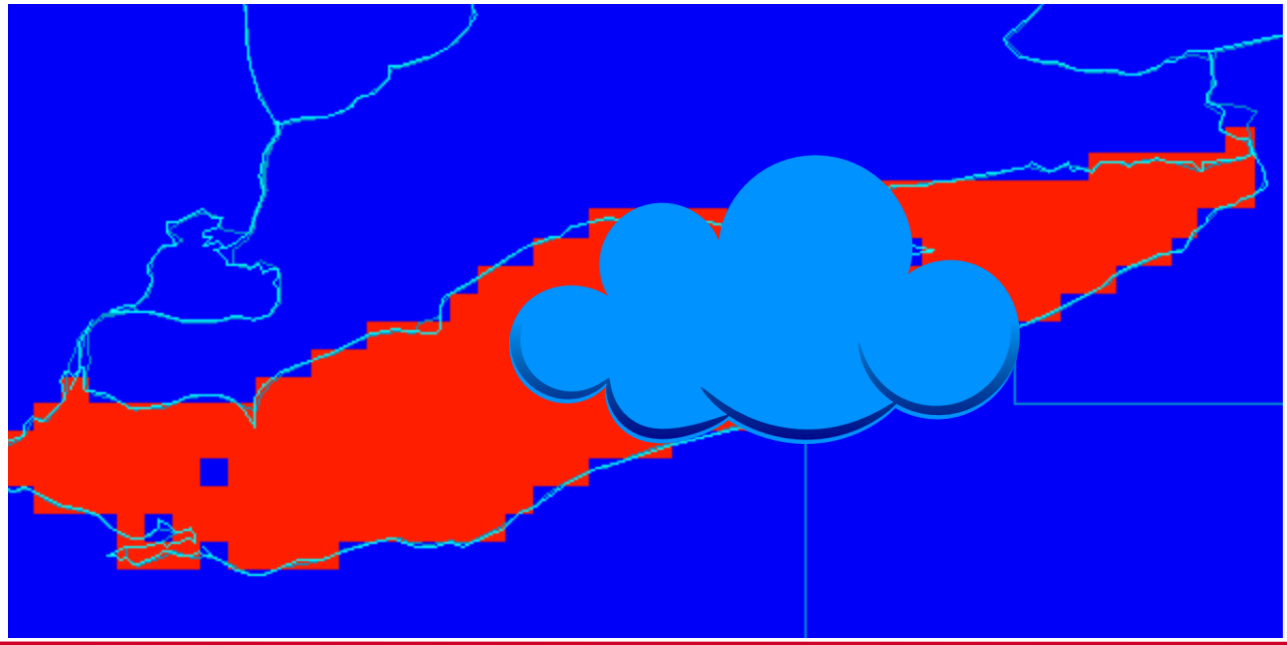


Initial Data Assessment – McIDAS-V



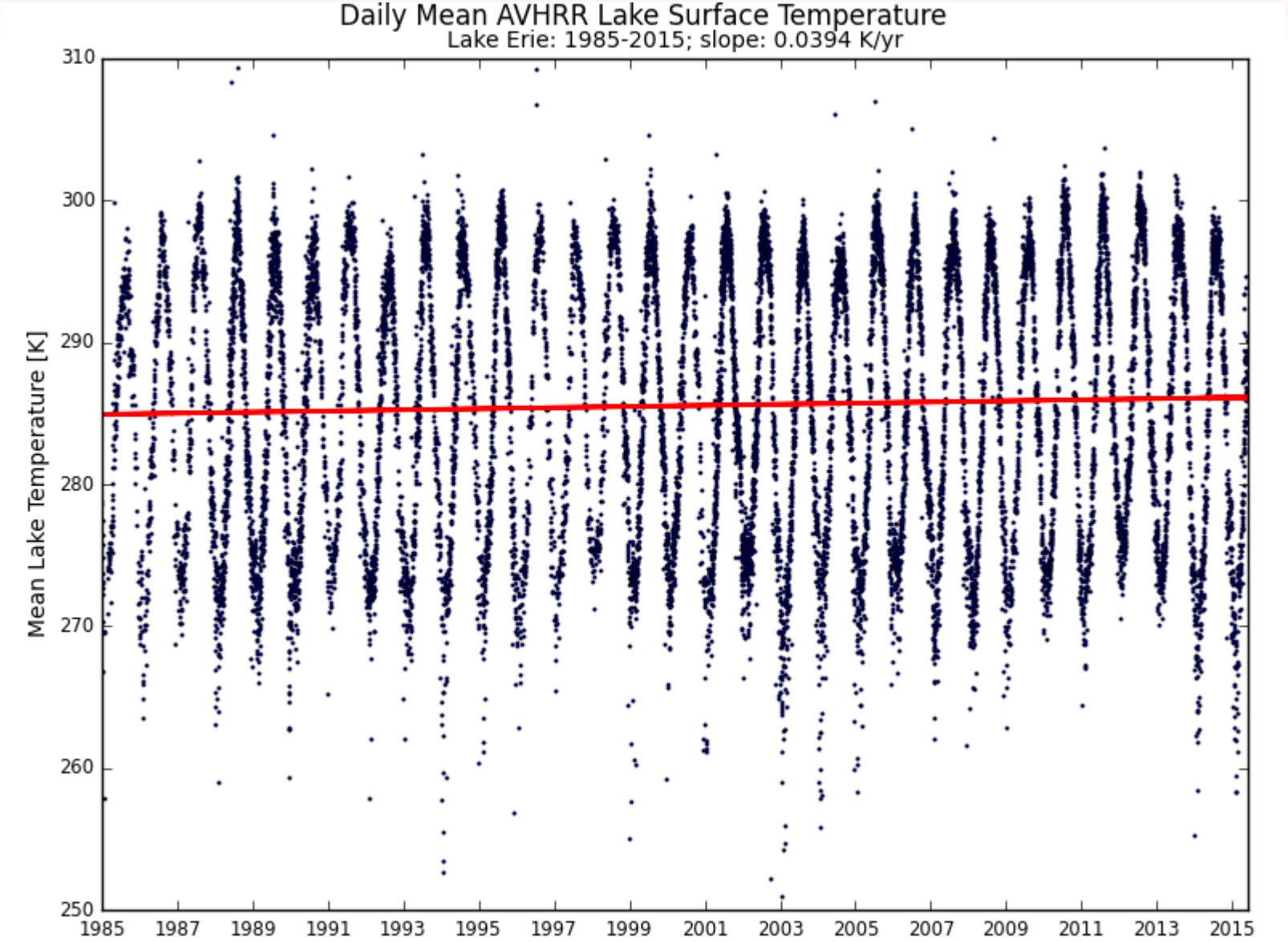
Data Processing and Methods

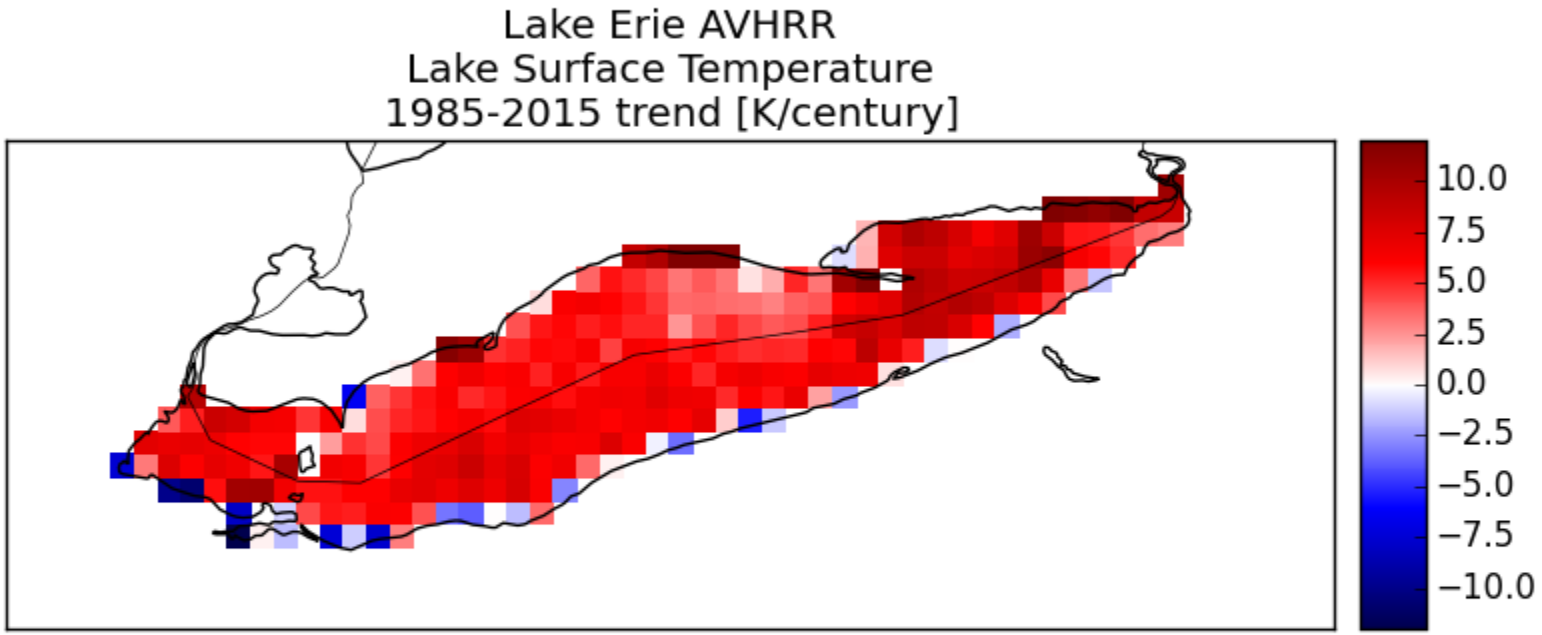
For Each Image:
- Land Mask
- Cloud Mask
- Average Remaining Pixels
- For Each Remaining Pixel:
  - Accumulate Trend Data

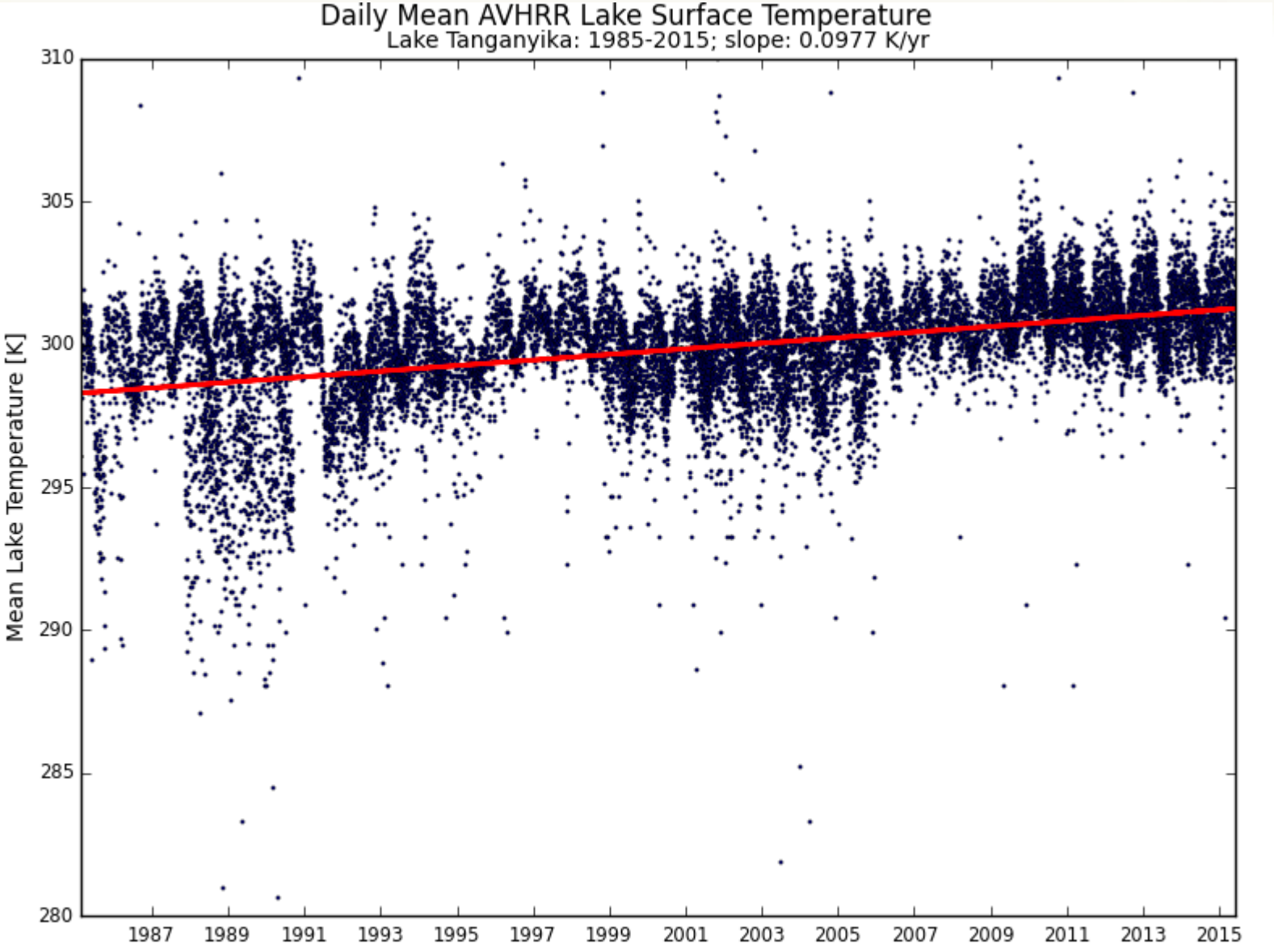


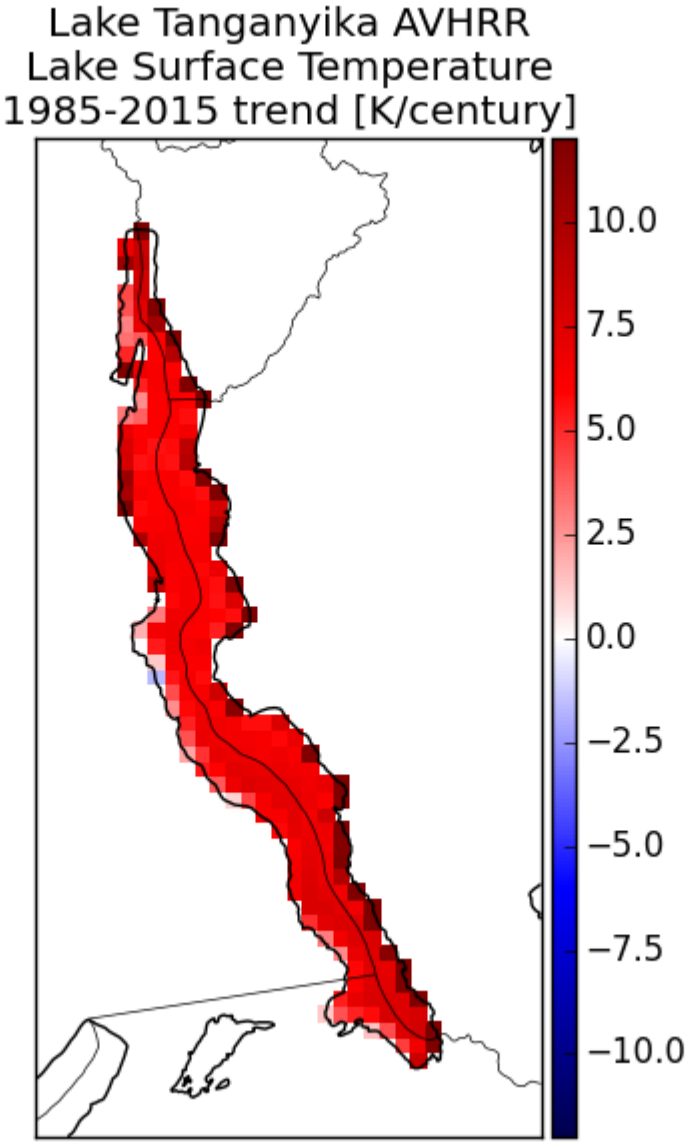
A Few Python Scripts

```
def analyze_region(water_mask, data, day, region, lon_bounds, lat_bounds, r):

    lon = data['lon']
    lat = data['lat']
    cloud_prob = data['cloud_prob']
    sfc_temp_retr = data['sfc_temp_retr'].copy()

    bad = ((lon < lon_bounds[0]) |
           (lon > lon_bounds[1]) |
           (lat < lat_bounds[0]) |
           (lat > lat_bounds[1]) |
           (water_mask < 255) |
           (cloud_prob > 0.25))

    sfc_temp_retr[bad] = np.ma.masked
    if np.ma.any(sfc_temp_retr):
        mean_sfc_temp_retr = np.ma.mean(sfc_temp_retr)
        date_and_mean = (date2num(day), mean_sfc_temp_retr)
        print(date_and_mean, 'Temperature')
        r[region].append(date_and_mean)
    else:
        print('no useful pixels: {}'.format(day))
```


Daily Mean AVHRR Lake Surface Temperature
Lake Erie: 1985-2015; slope: 0.0394 K/yr
Mean Lake Temperature [K]
310
300
290
280
270
260
250
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015


Lake Erie AVHRR
Lake Surface Temperature
1985-2015 trend [K/century]
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0


Daily Mean AVHRR Lake Surface Temperature
Lake Tanganyika: 1985-2015; slope: 0.0977 K/yr
Mean Lake Temperature [K]
310
305
300
295
290
285
280
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015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Lake Surface Temperature
1985-2015 trend [K/century]
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0

Some Considerations

Some dates have multiple samples (multiple concurrently functioning satellites)

Some dates have no samples (extensive clould cover)

Uncertainty for values near coastline

Conclusions

SSEC/CIMSS is a scientist's toolbox
McIDAS-V and CDP, freely available

McIDAS-V is great for rapid visualization and validation

Ok, science is not simple, but these tools are making the job easier.

With remote sensing, we can now monitor key atmospheric and climate trends over long time periods.

Thank You!