

Space Journalism!

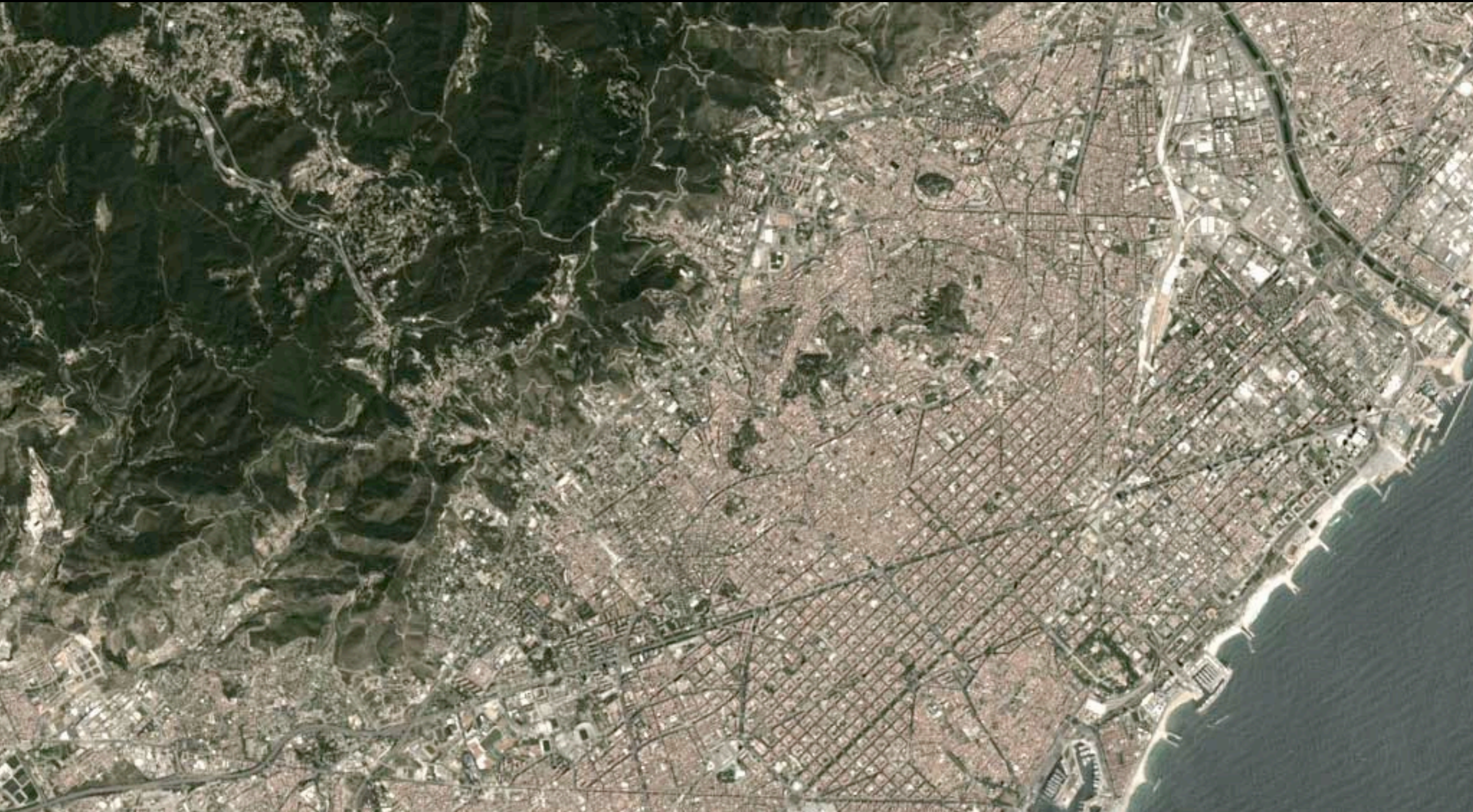
Al Shaw

al.shaw@propublica.org

@A_L

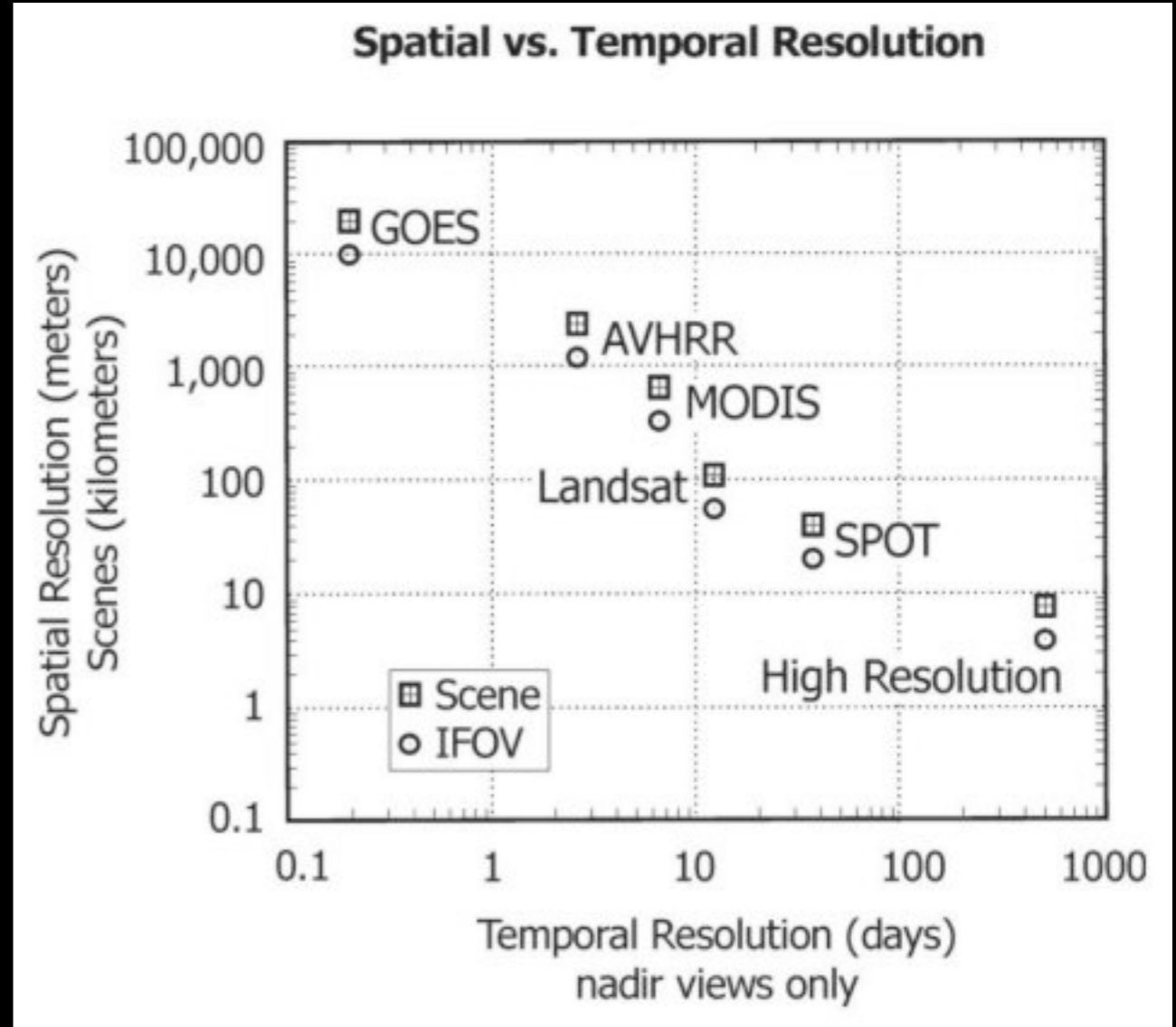
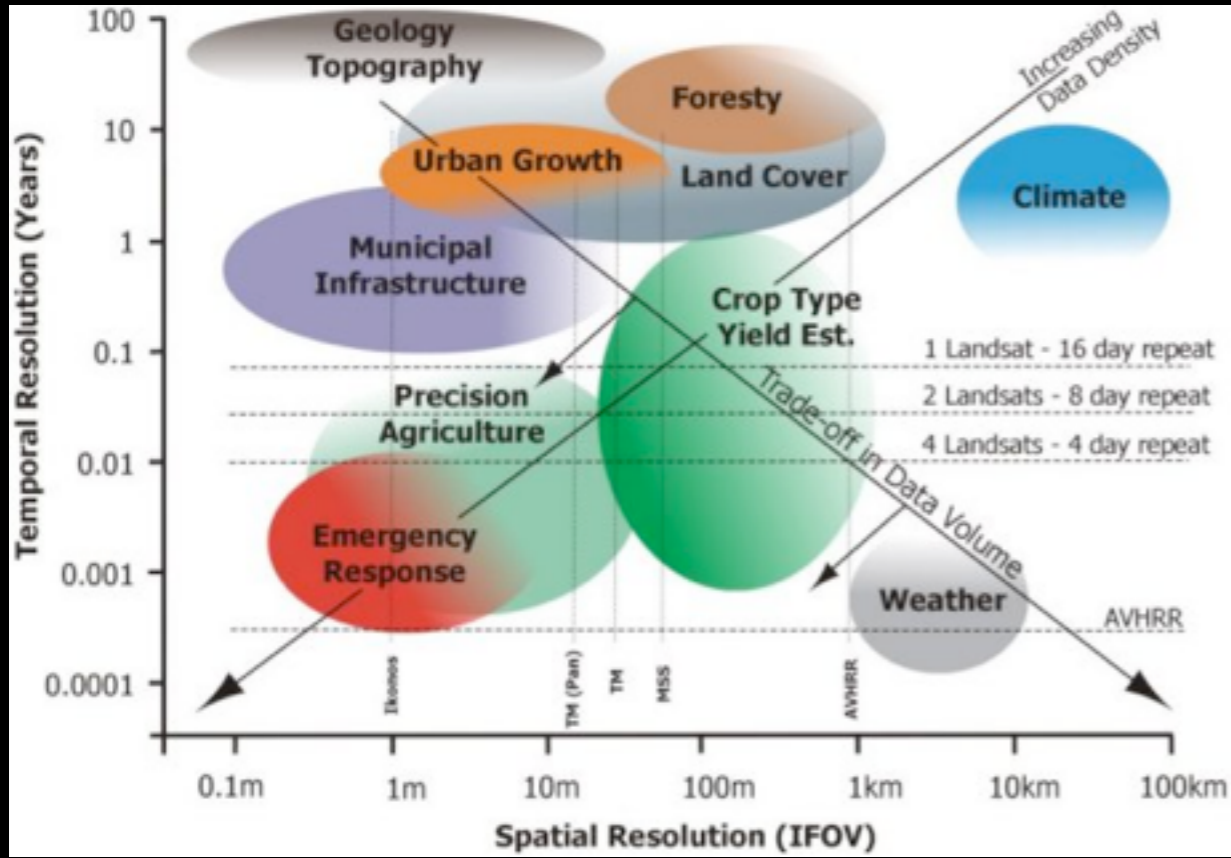
<http://j.mp/nicar16-space>

- 1. What sensors can I use, and when should I use them?**
- 2. How can I get the data?**
- 3. How can I process the data?**
- 4. More resources and examples**



Resolution

Spectral, Spatial, Temporal



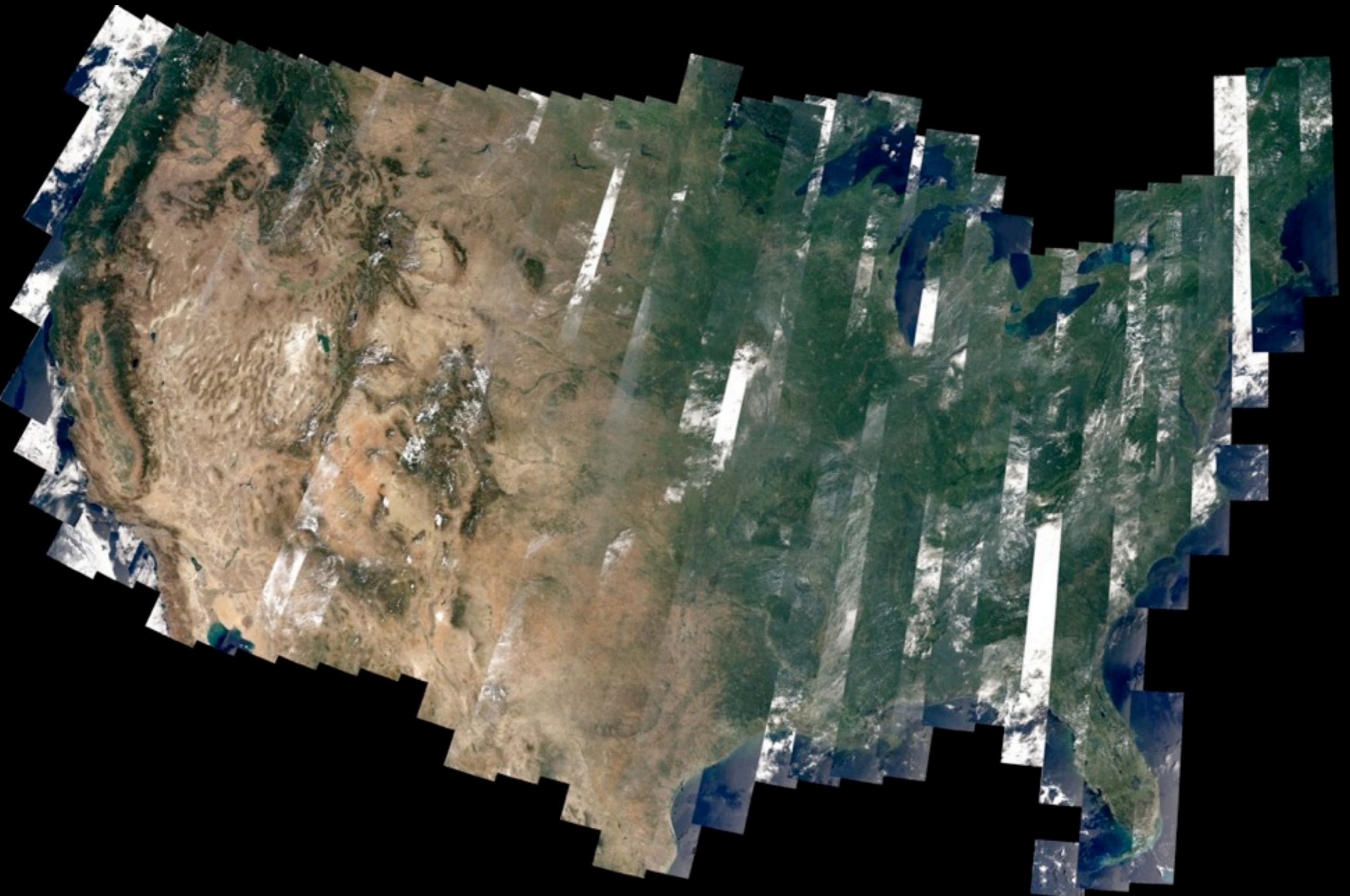
MODIS: 250m resolution



Landsat 8: 15-30m resolution

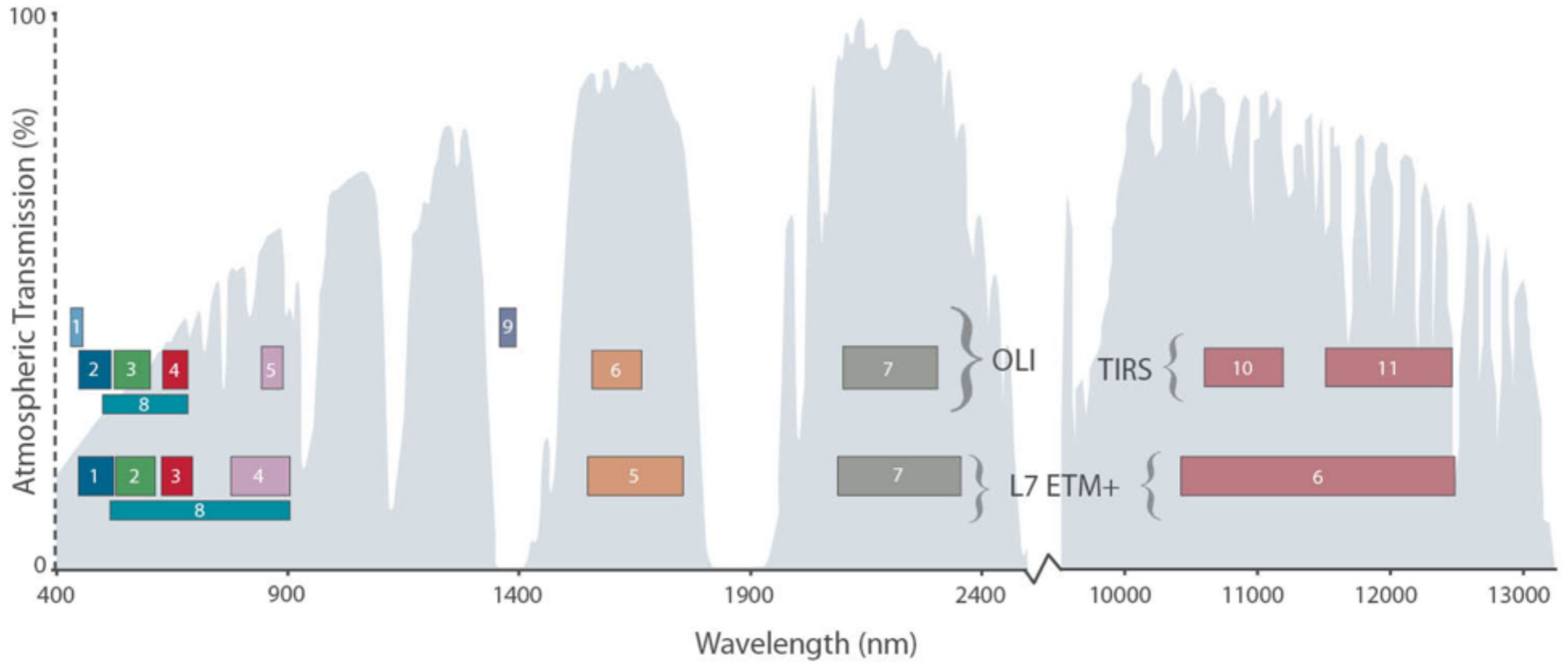


Temporal Resolution — Landsat 8: 16 days

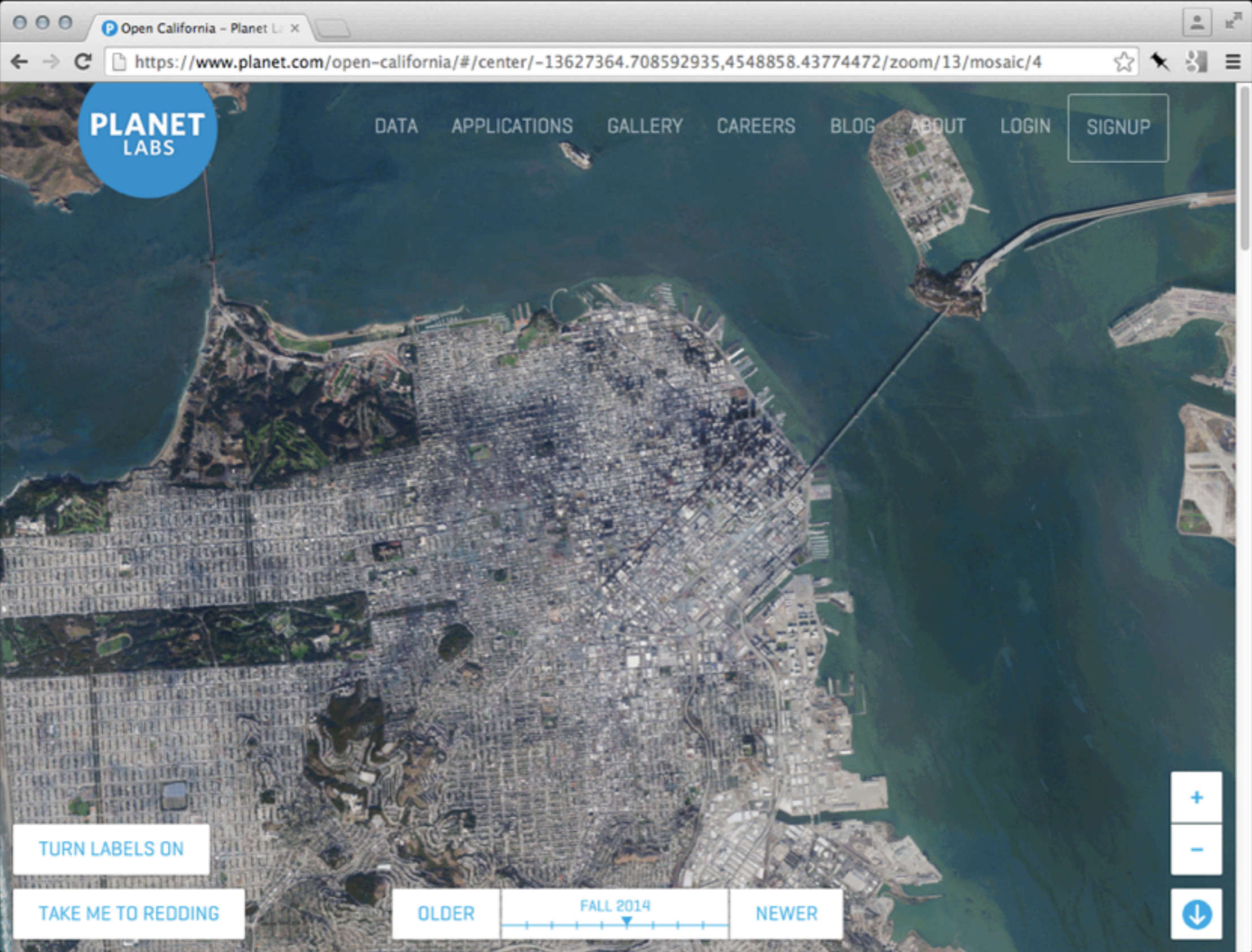


<http://earthobservatory.nasa.gov/IOTD/view.php?id=83099>

Spectral Resolution: Landsat 8

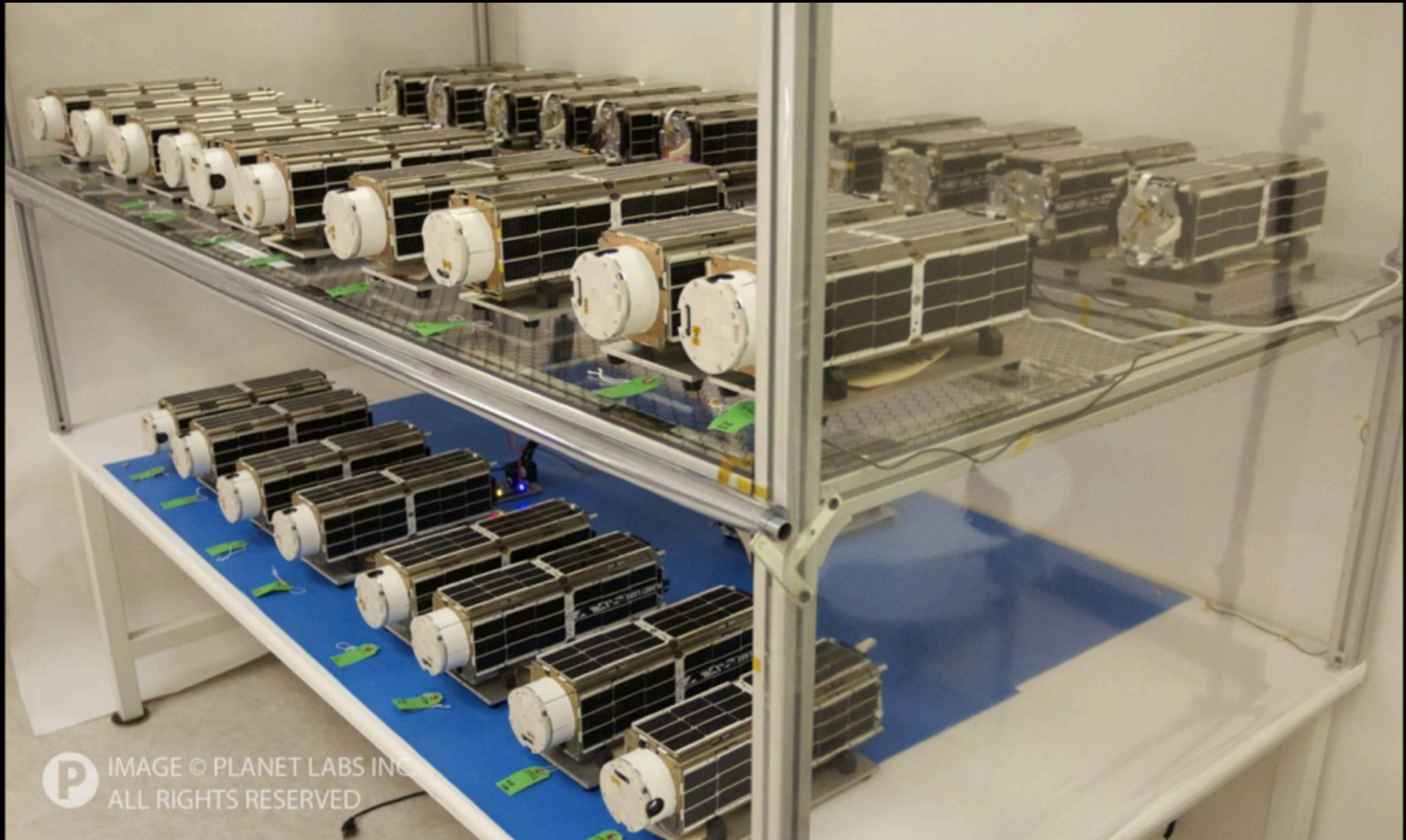


Private satellites



Spectral Resolution: RGB

Temporal Resolution: \sim (ツ) \sim



Spectral Resolution: Landsat 8

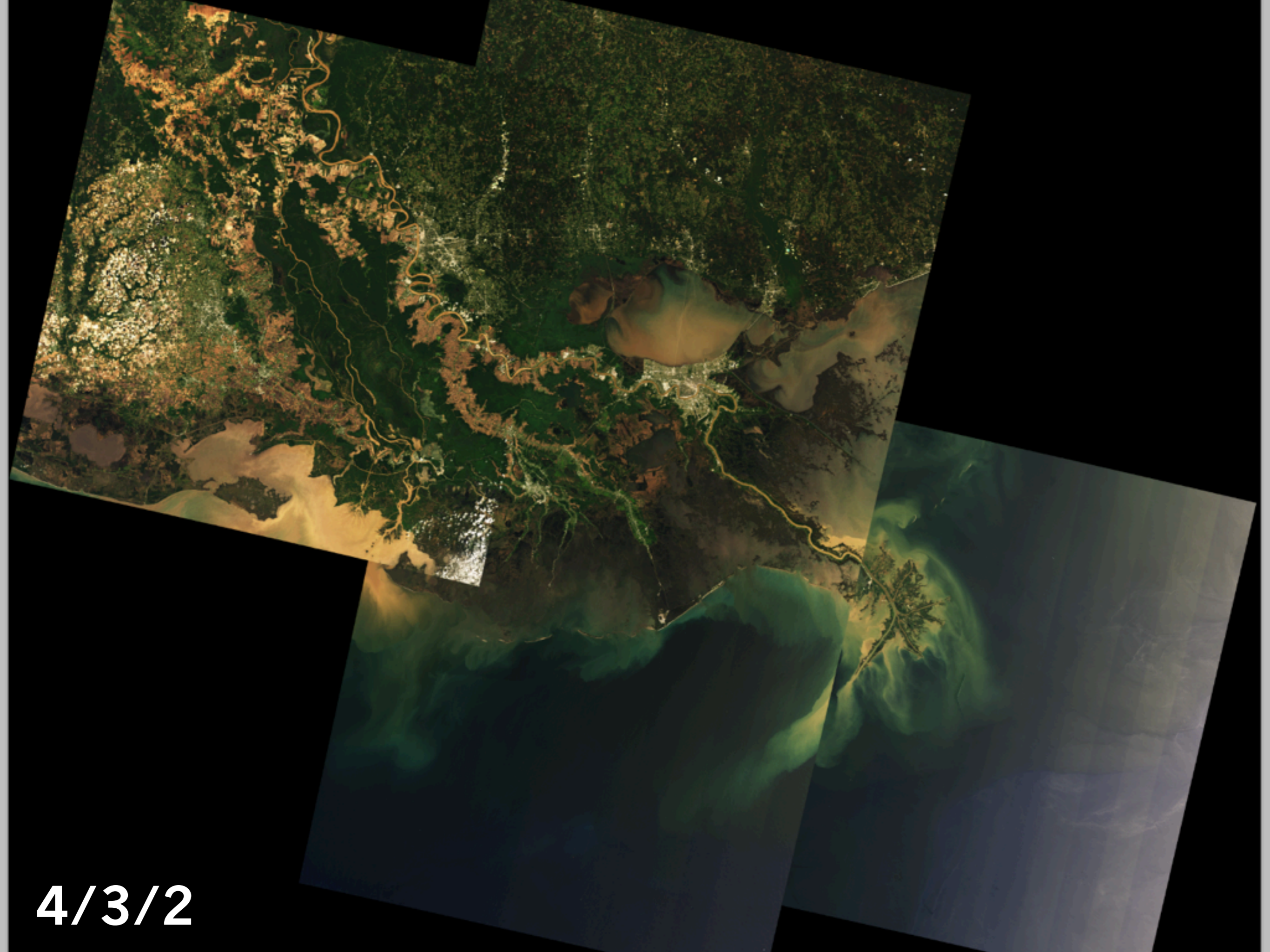
Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) Launched February 11, 2013	Bands	Wavelength (micrometers)	Resolution (meters)
	Band 1 - Coastal aerosol	0.43 - 0.45	30
	Band 2 - Blue	0.45 - 0.51	30
	Band 3 - Green	0.53 - 0.59	30
	Band 4 - Red	0.64 - 0.67	30
	Band 5 - Near Infrared (NIR)	0.85 - 0.88	30
	Band 6 - SWIR 1	1.57 - 1.65	30
	Band 7 - SWIR 2	2.11 - 2.29	30
	Band 8 - Panchromatic	0.50 - 0.68	15
	Band 9 - Cirrus	1.36 - 1.38	30
	Band 10 - Thermal Infrared (TIRS) 1	10.60 - 11.19	100 * (30)
Band 11 - Thermal Infrared (TIRS) 2	11.50 - 12.51	100 * (30)	

Landsat 8 Band Combinations

Natural Color	4	3	2
False Color (urban)	7	6	4
Color Infrared (vegetation)	5	4	3
Agriculture	6	5	2
Atmospheric Penetration	7	6	5
Healthy Vegetation	5	6	2
Land/Water	5	6	4
Natural With Atmospheric Removal	7	5	3
Shortwave Infrared	7	5	4
Vegetation Analysis	6	5	4

Example: “Losing Ground”

<http://projects.propublica.org/louisiana/>



4/3/2



7/5/3



4/3/2 + 5 mask

How to get the data

WorldView: MODIS (preprocessed)

The screenshot displays the NASA WorldView web application interface. The browser address bar shows the URL: https://earthdata.nasa.gov/labs/worldview/?p=geographic&l=MODIS_Aqua_CorrectedReflectance_...

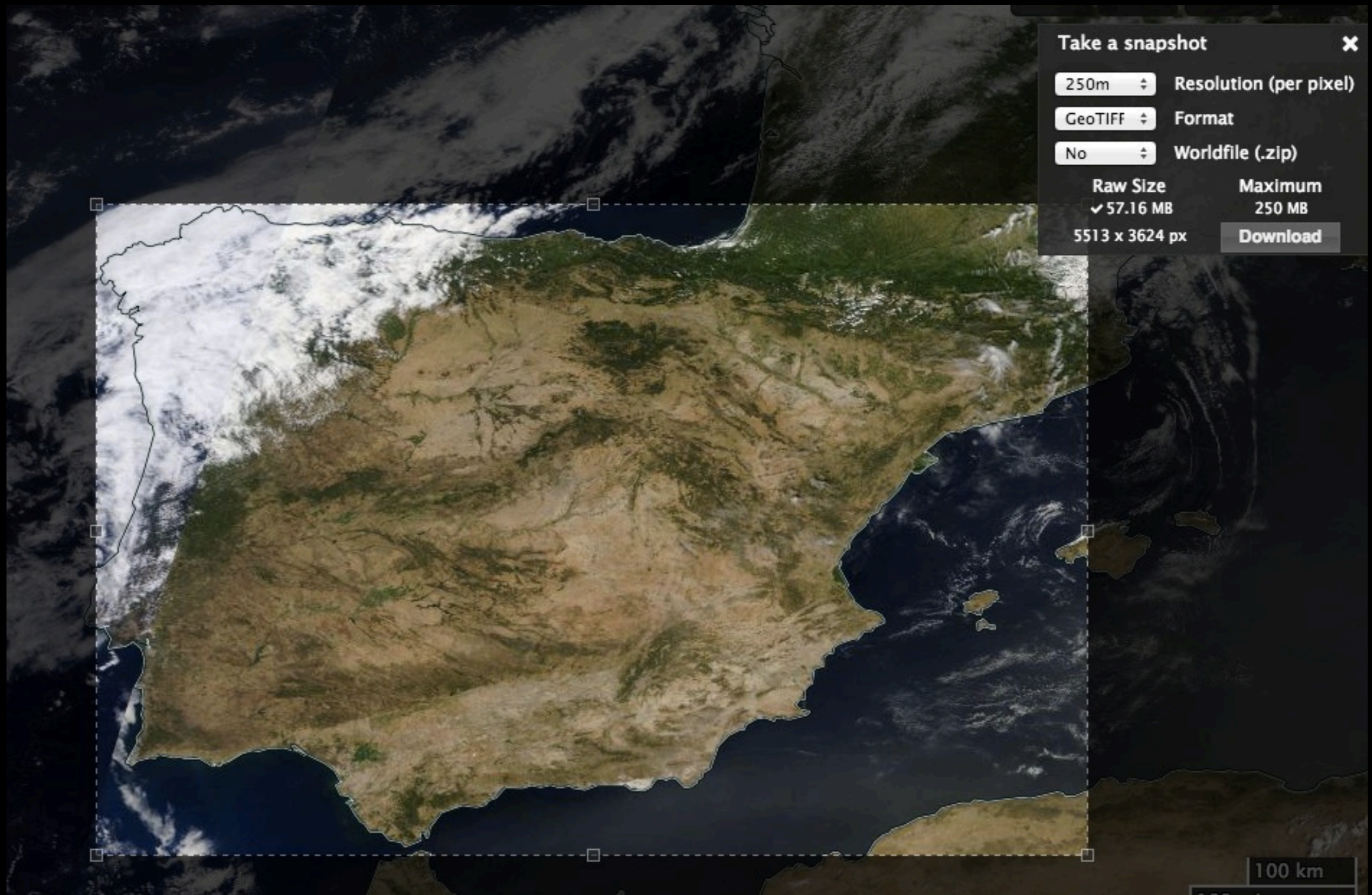
The interface includes a sidebar on the left with the following layers:

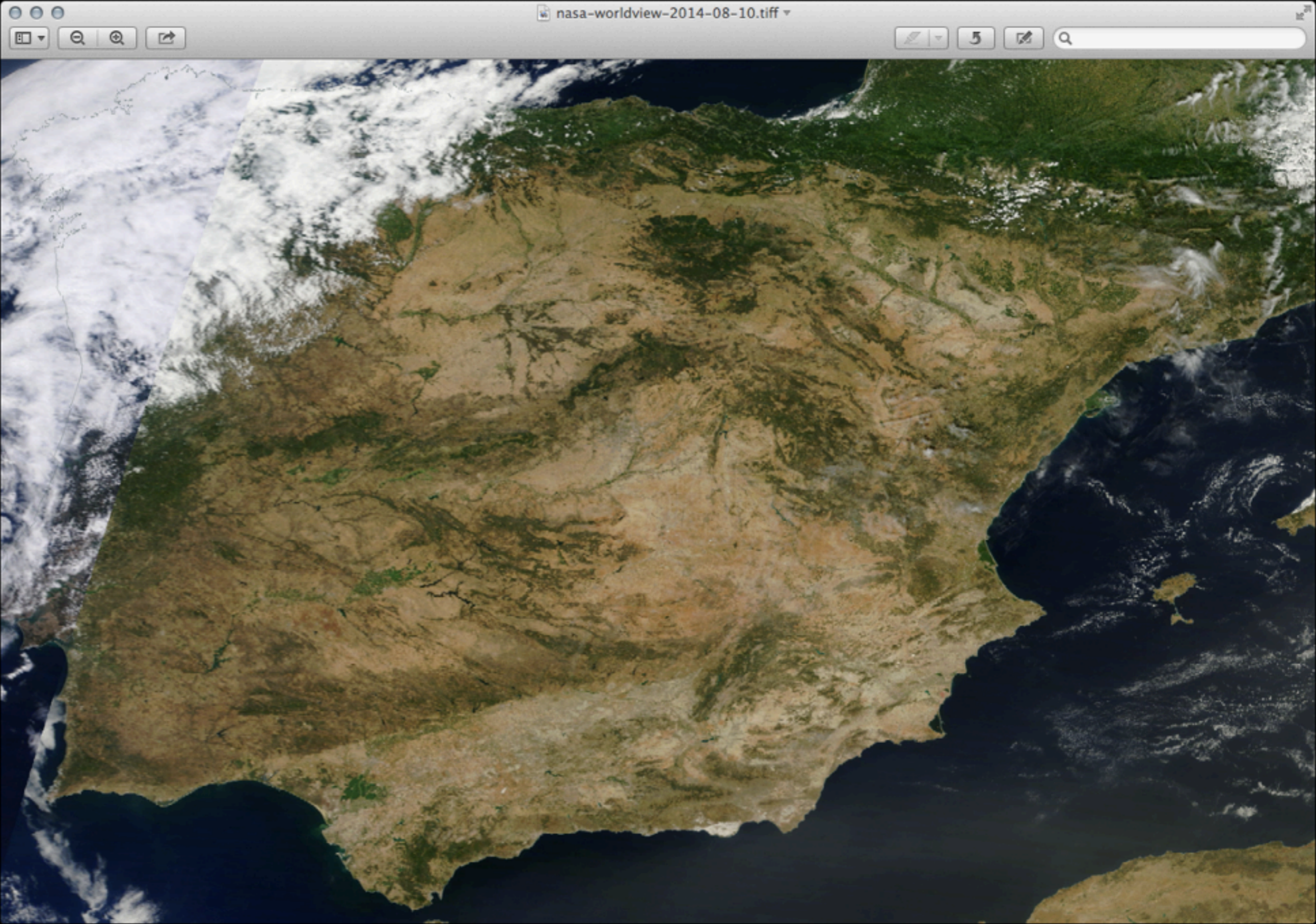
- BASE LAYERS**
 - Corrected Reflectance (True Color) Aqua / MODIS
 - Corrected Reflectance (True Color) Terra / MODIS
- OVERLAYS**
 - Place Labels © OpenStreetMap (license), Natural Earth
 - Coastlines / Borders / Roads © OpenStreetMap (license), Natural Earth
 - Coastlines © OpenStreetMap (license)

The main map area shows a satellite view of the Mediterranean region. A scale bar indicates 100 km and 100 mi. The coordinates $41^{\circ}45'16''\text{N}$, $2^{\circ}17'42''\text{W}$ EPSG:4326 are displayed. A timeline at the bottom shows the date 2014 AUG 10, with navigation arrows and a dropdown menu for time intervals (DAYS, MONTHS, YEARS).

<https://earthdata.nasa.gov/labs/worldview/>

WorldView: MODIS (preprocessed)





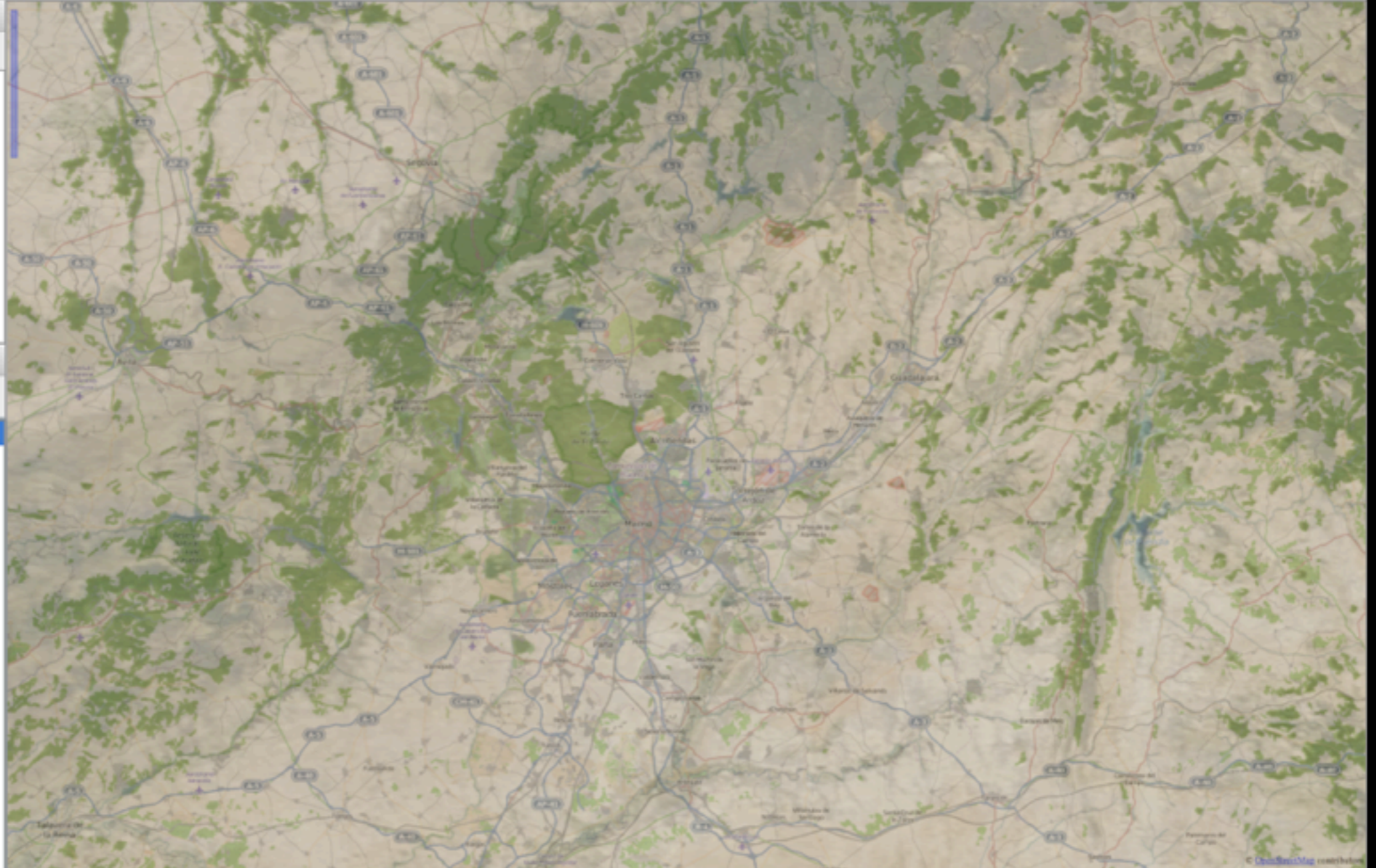


Browser

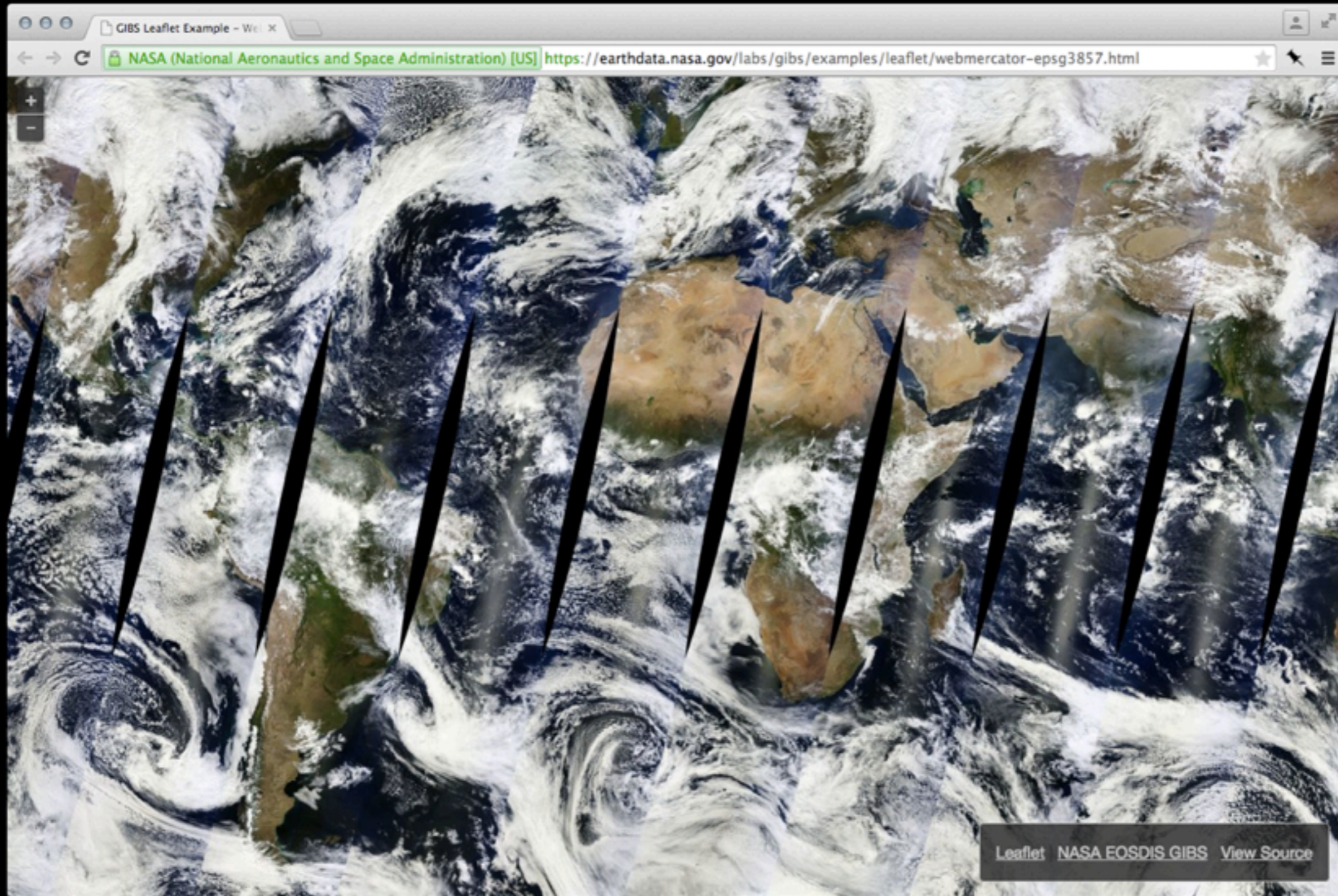
Home
Favourites
/Volumes
MSSQL
PostGIS
SpatiaLite
OWS
WCS
WFS
WMS

Layers

- nasa-worldview-20...
- OpenStreetMap



Use Directly In Your Own Leaflet/Google Maps



<https://github.com/nasa-gibs/gibs-web-examples>

Use Directly In Your Own Leaflet/Google Maps

```
"http://map1{s}.vis.earthdata.nasa.gov/wmts-webmerc/" +  
"{layer}/default/{time}/{tileMatrixSet}/{z}/{y}/{x}.jpg";
```

<https://github.com/nasa-gibs/gibs-web-examples>

EarthExplorer (raw data)

The screenshot displays the EarthExplorer interface with search results on the left and a map on the right. The search results list four data sets with their respective Entity IDs, coordinates, acquisition dates, paths, and rows. The map shows a satellite view of a coastal region with a large, semi-transparent satellite image overlaid on it. The interface includes navigation controls, a search criteria summary, and a data set dropdown menu.

4. Search Results
If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.
Note: You must be logged in to download and order scenes

Show Result Controls

Data Set [Click here to export your results](#)

LS OLI/TIRS

5		Entity ID: LC80210392015047LGN00 Coordinates: 30.30605,-88.57946 Acquisition Date: 16-FEB-15 Path: 21 Row: 39
6		Entity ID: LC80230382015045LGN00 Coordinates: 31.74238,-91.2838 Acquisition Date: 14-FEB-15 Path: 23 Row: 38
7		Entity ID: LC80230392015045LGN00 Coordinates: 30.30618,-91.66444 Acquisition Date: 14-FEB-15 Path: 23 Row: 39
8		Entity ID: LC80220382015038LGN00 Coordinates: 31.74201,-89.75133 Acquisition Date: 07-FEB-15 Path: 22 Row: 38

Entity ID: LC80220392015038LGN00

Search Criteria Summary (show) [Clear Criteria](#)

(30° 26' 38" N, 092° 32' 35" W) Options Overlays Map Satellite

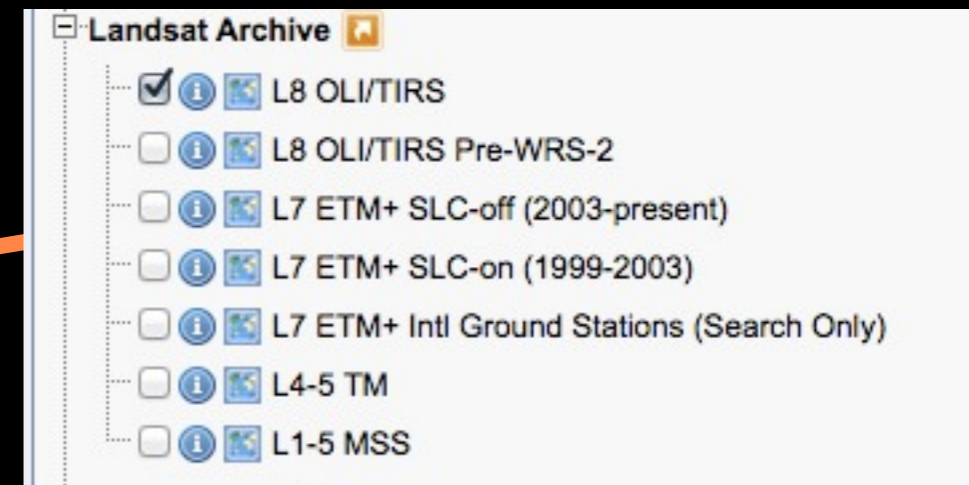
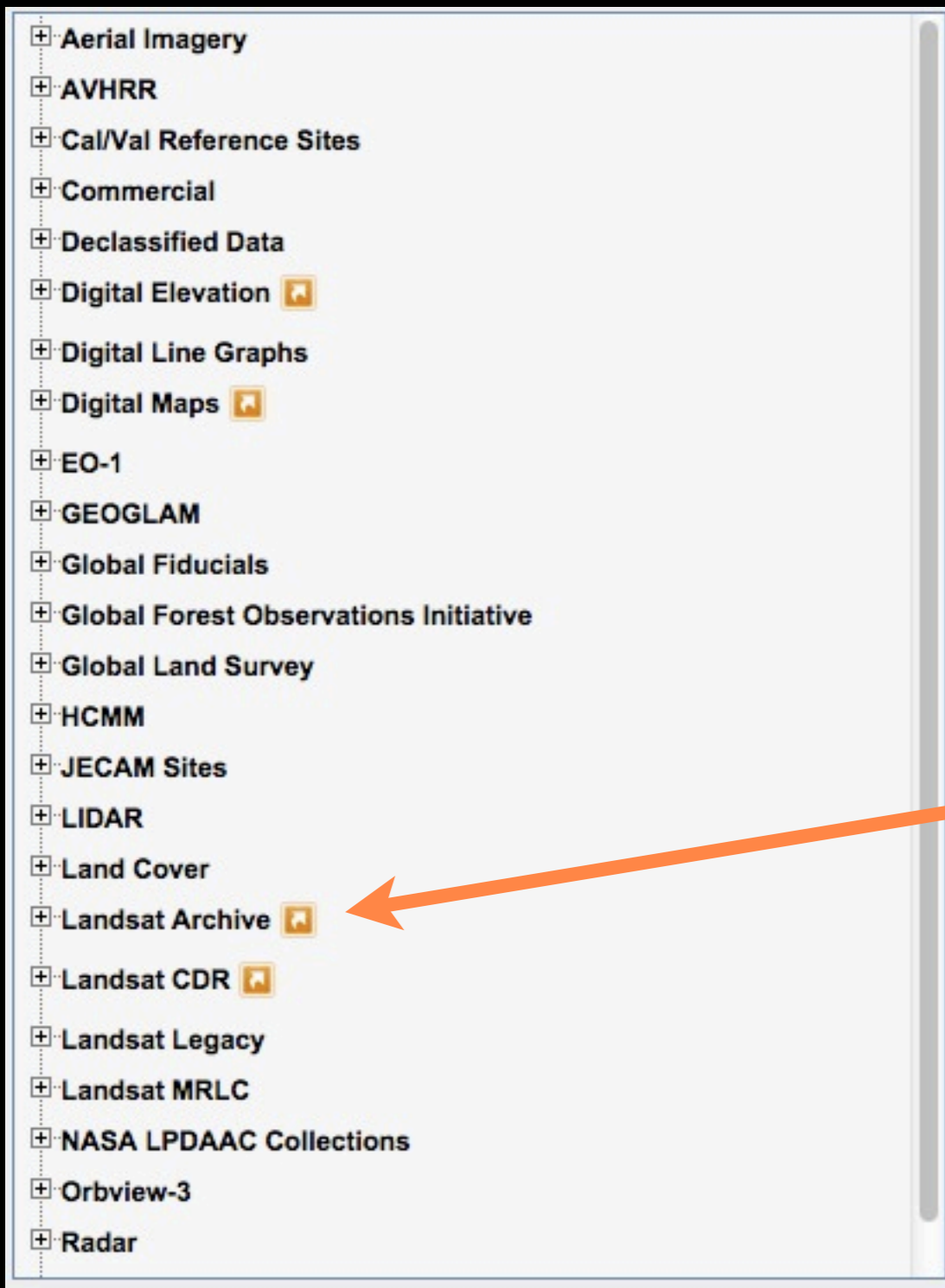
Google

Map data ©2015 Google Imagery ©2015 TerraMetrics 20 km Terms of Use

The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

<http://earthexplorer.usgs.gov>

EarthExplorer



<http://earthexplorer.usgs.gov>

EarthExplorer

3. Additional Criteria (Optional)

If you have more than one data set selected, use the dropdown to select the additional criteria for each data sets.

Data Sets:

L8 OLI/TIRS

OLI_TIRS
TIRS

Data Type Level 1

All
Level 1GT
Level 1T

Data Type Level 0Rp

All
Level 0Rp

Cloud Cover

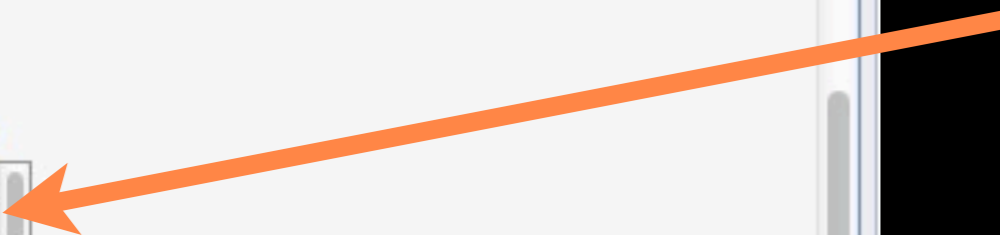
All
Less than 10%
Less than 20%
Less than 30%
Less than 40%

Day/Night

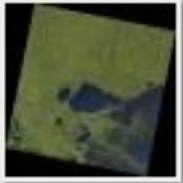
All
Day
Night

Nadir/Off Nadir


All
Nadir



EarthExplorer

7 

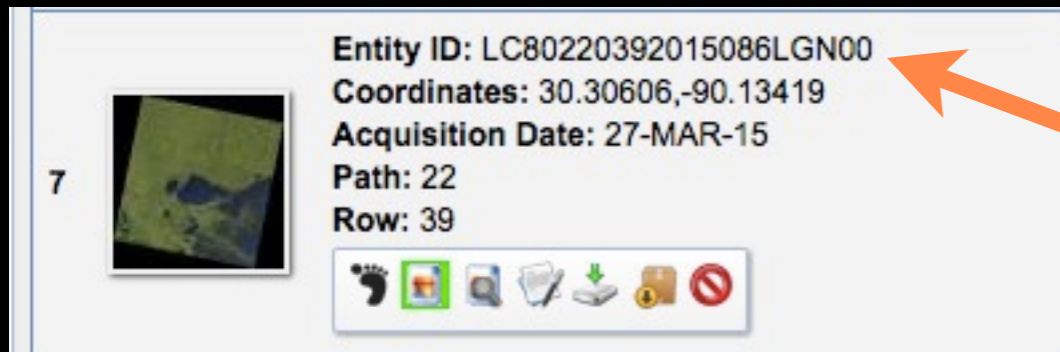
Entity ID: LC80220392015086LGN00
Coordinates: 30.30606,-90.13419
Acquisition Date: 27-MAR-15
Path: 22
Row: 39

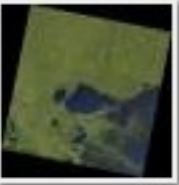


Download Options ✕


- [Download](#) LandsatLook "Natural Color" Image (8.0 MB)
- [Download](#) LandsatLook "Thermal" Image (2.6 MB)
- [Download](#) LandsatLook "Quality" Image (564.6 KB)
- [Download](#) LandsatLook images with Geographic Reference (11.1 MB)
- [Download](#) Level 1 GeoTIFF Data Product (875.1 MB)

Hint!



7 

Entity ID: LC80220392015086LGN00
Coordinates: 30.30606,-90.13419
Acquisition Date: 27-MAR-15
Path: 22
Row: 39



landsat-util

<https://github.com/developmentseed/landsat-util>

```
> pip install landsat-util
```

```
> landsat download LC80220392015086LGN00 -b 4,3,2
```

Landsat on AWS

<http://aws.amazon.com/public-data-sets/landsat/>

3. How to process the data

Two Methods

- 1. Open Source Software + Command Line Tools**
- 2. Photoshop**

GDAL

```
> brew install gdal
```

```
> sudo apt-get install gdal-bin
```

Windows: <http://trac.osgeo.org/osgeo4w/wiki>

ImageMagick/convert (Photoshop of the command line)

```
> brew install --with-libtiff imagemagick
```

```
> sudo apt-get install --with-libtiff imagemagick
```

Windows: <http://www.imagemagick.org/script/binary-releases.php>

Let's use GDAL tools to combine band files to process the Landsat image.

1. Reproject to 3857

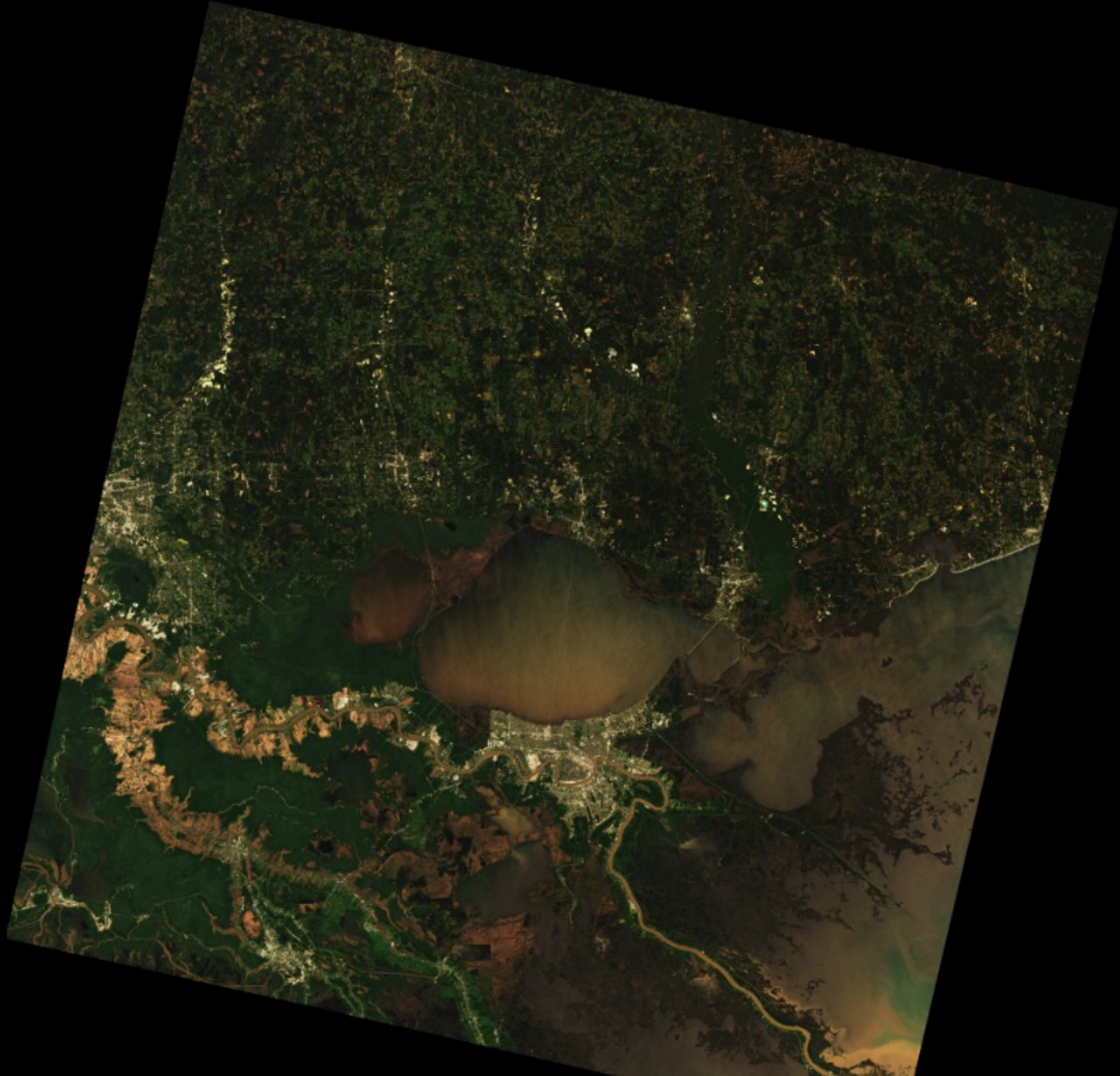
```
> for band in {4,3,2}
do
gdalwarp -t_srs EPSG:3857 LC80220392015086LGN00_B$band.TIF
LC80220392015086LGN00_B$band-projected.tif
done
```


2. Combine & Adjust

```
> convert -combine LC80220392015086LGN00_B{4,3,2}-projected.tif  
LC80220392015086LGN00_RGB-projected.tif
```

```
> convert -channel B -gamma 0.925 -channel R -gamma 1.03 -channel  
RGB -sigmoidal-contrast 50x16% LC80220392015086LGN00_RGB-  
projected.tif LC80220392015086LGN00_RGB-projected-corrected.tif
```

```
> convert -depth 8 LC80220392015086LGN00_RGB-projected-corrected.tif  
LC80220392015086LGN00_RGB-projected-corrected-8bit.tif
```



3. Rescue geo headers

```
> listgeo -tfw LC80220392015086LGN00_B4-projected.tif
```

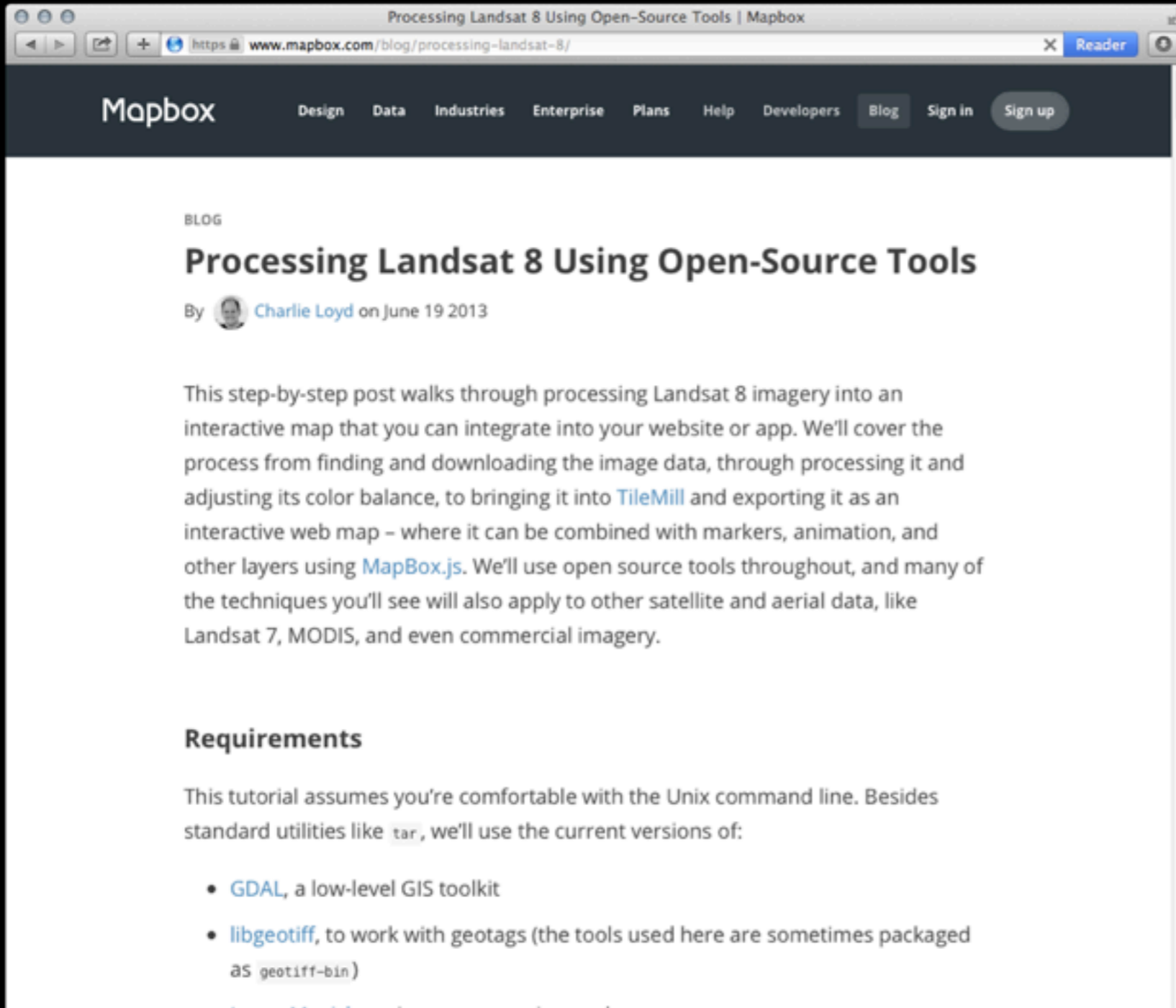
```
> mv LC80220392015086LGN00_B4-projected.tfw  
LC80220392015086LGN00_RGB-projected-corrected-8bit.tfw
```

```
> gdal_edit.py -a_srs EPSG:3857 LC80220392015086LGN00_RGB-projected-  
corrected-8bit.tif
```

```
> gdal_translate -a_nodata 0 LC80220392015086LGN00_RGB-projected-  
corrected-8bit.tif LC80220392015086LGN00_RGB-projected-  
corrected-8bit-nodata.tif
```

What we just did

<https://www.mapbox.com/blog/processing-landsat-8/>

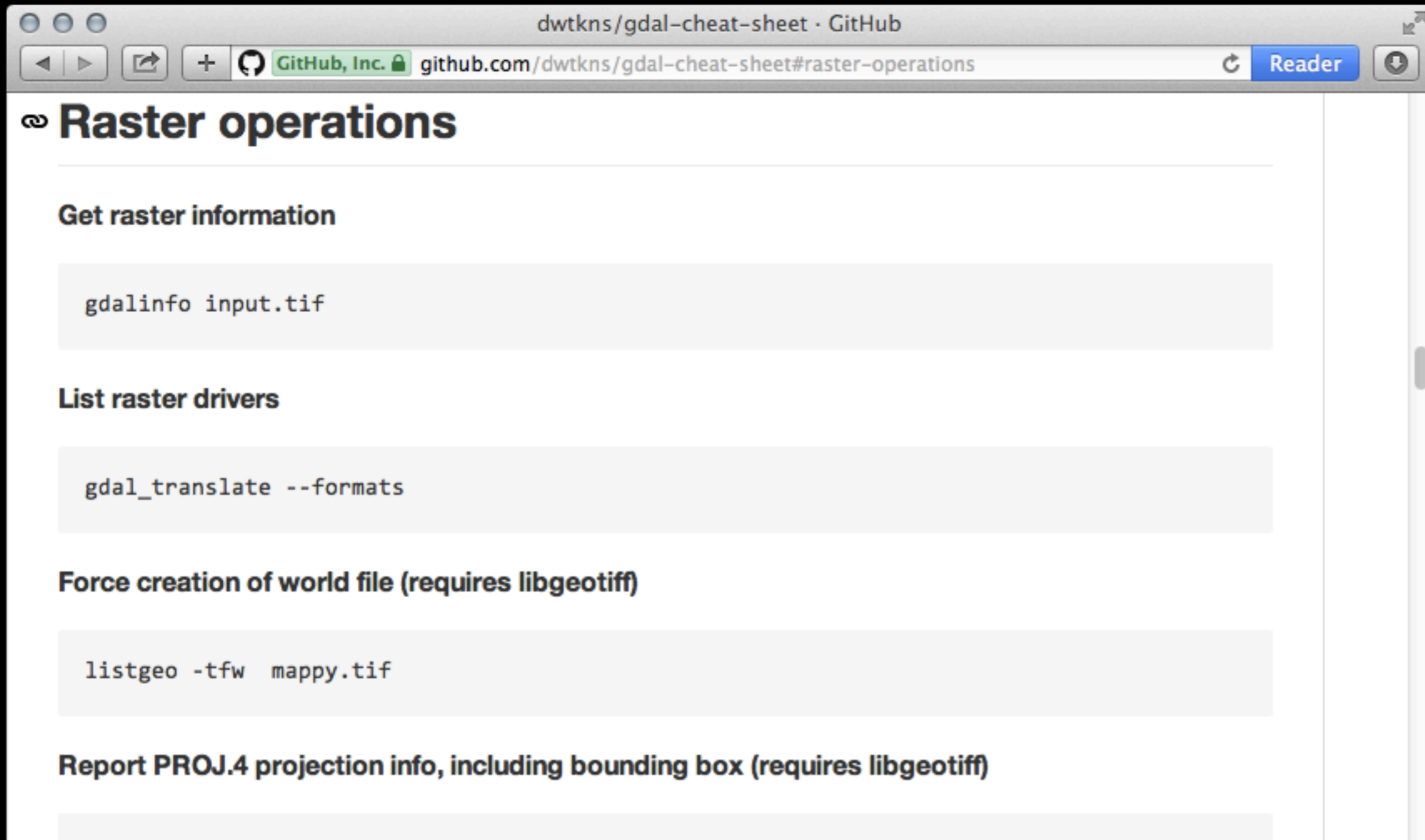


The screenshot shows a web browser window with the address bar displaying <https://www.mapbox.com/blog/processing-landsat-8/>. The page header includes the Mapbox logo and navigation links for Design, Data, Industries, Enterprise, Plans, Help, Developers, Blog, Sign in, and Sign up. The main content area features a blog post titled "Processing Landsat 8 Using Open-Source Tools" by Charlie Loyd, dated June 19, 2013. The post's introduction describes a step-by-step guide to processing Landsat 8 imagery into an interactive map. The "Requirements" section lists the following tools:

- [GDAL](#), a low-level GIS toolkit
- [libgeotiff](#), to work with geotags (the tools used here are sometimes packaged as `geotiff-bin`)
- [ImageMagick](#), an image processing package

Derek Watkins' GDAL cheat sheet

<https://github.com/dwtkns/gdal-cheat-sheet#raster-operations>

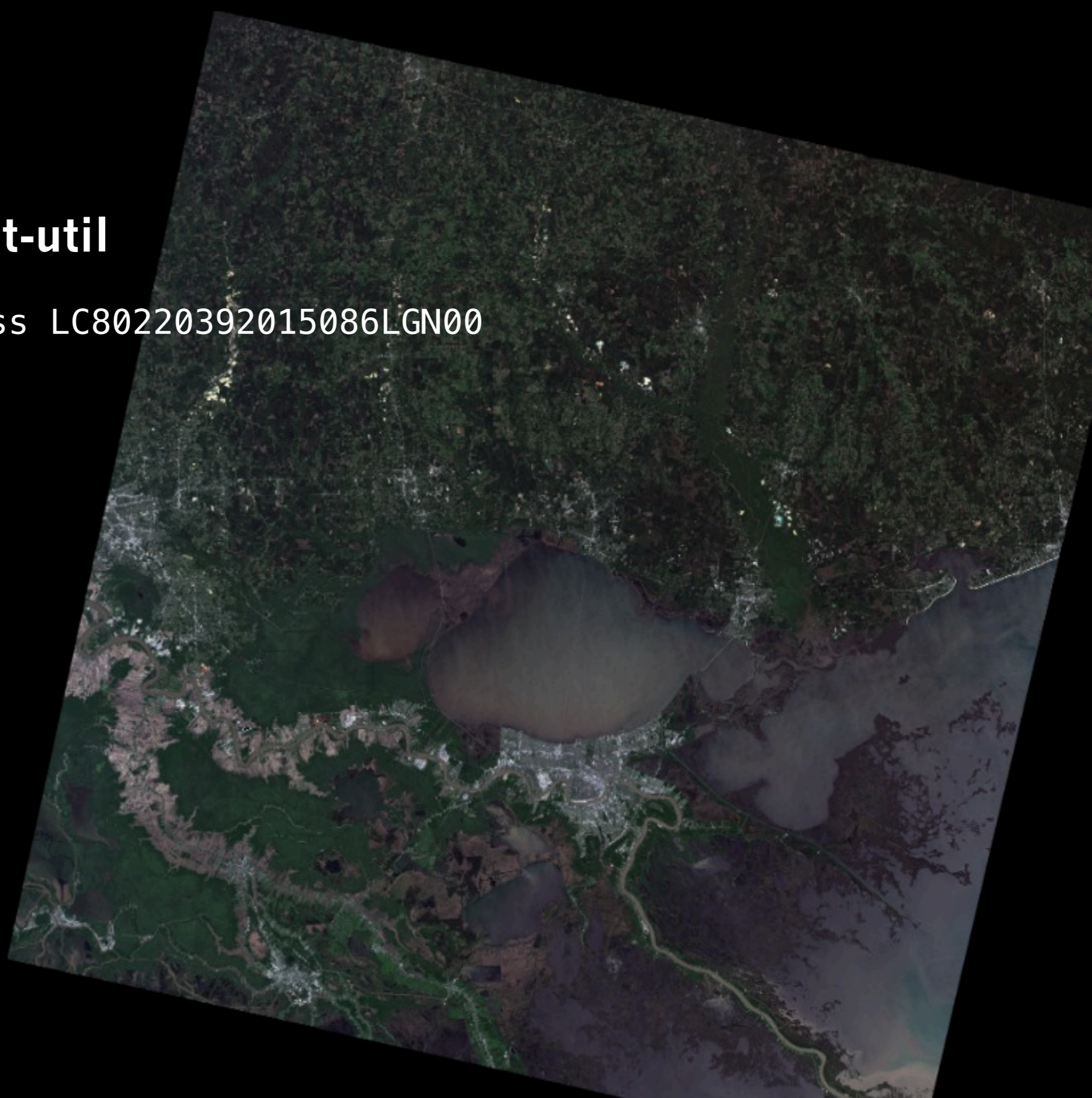


The screenshot shows a web browser window with the address bar displaying 'dwtkns/gdal-cheat-sheet · GitHub' and 'github.com/dwtkns/gdal-cheat-sheet#raster-operations'. The page content is titled 'Raster operations' and lists several GDAL commands:

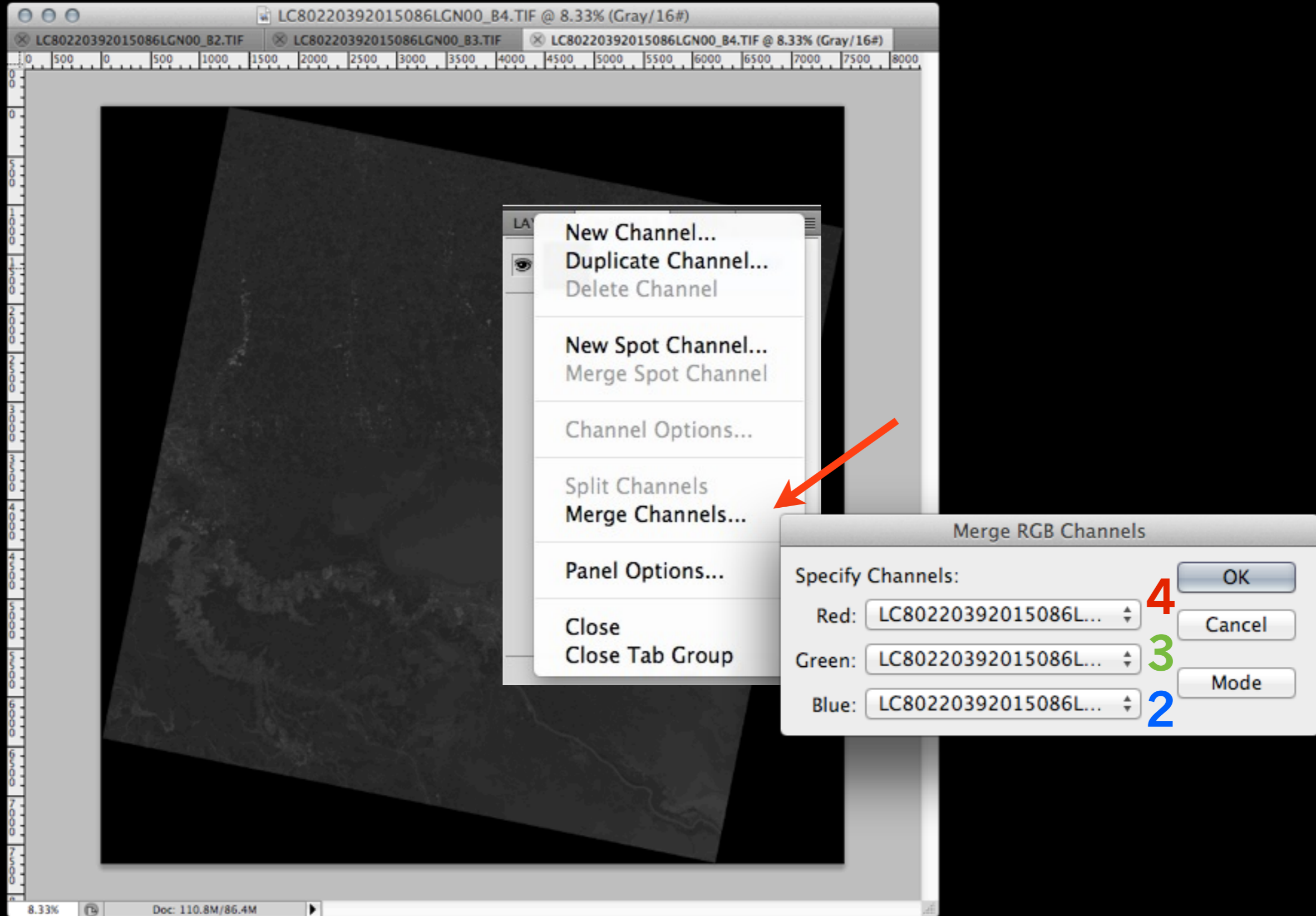
- Get raster information**
`gdalinfo input.tif`
- List raster drivers**
`gdal_translate --formats`
- Force creation of world file (requires libgeotiff)**
`listgeo -tfw mappy.tif`
- Report PROJ.4 projection info, including bounding box (requires libgeotiff)**

Or, with landsat-util

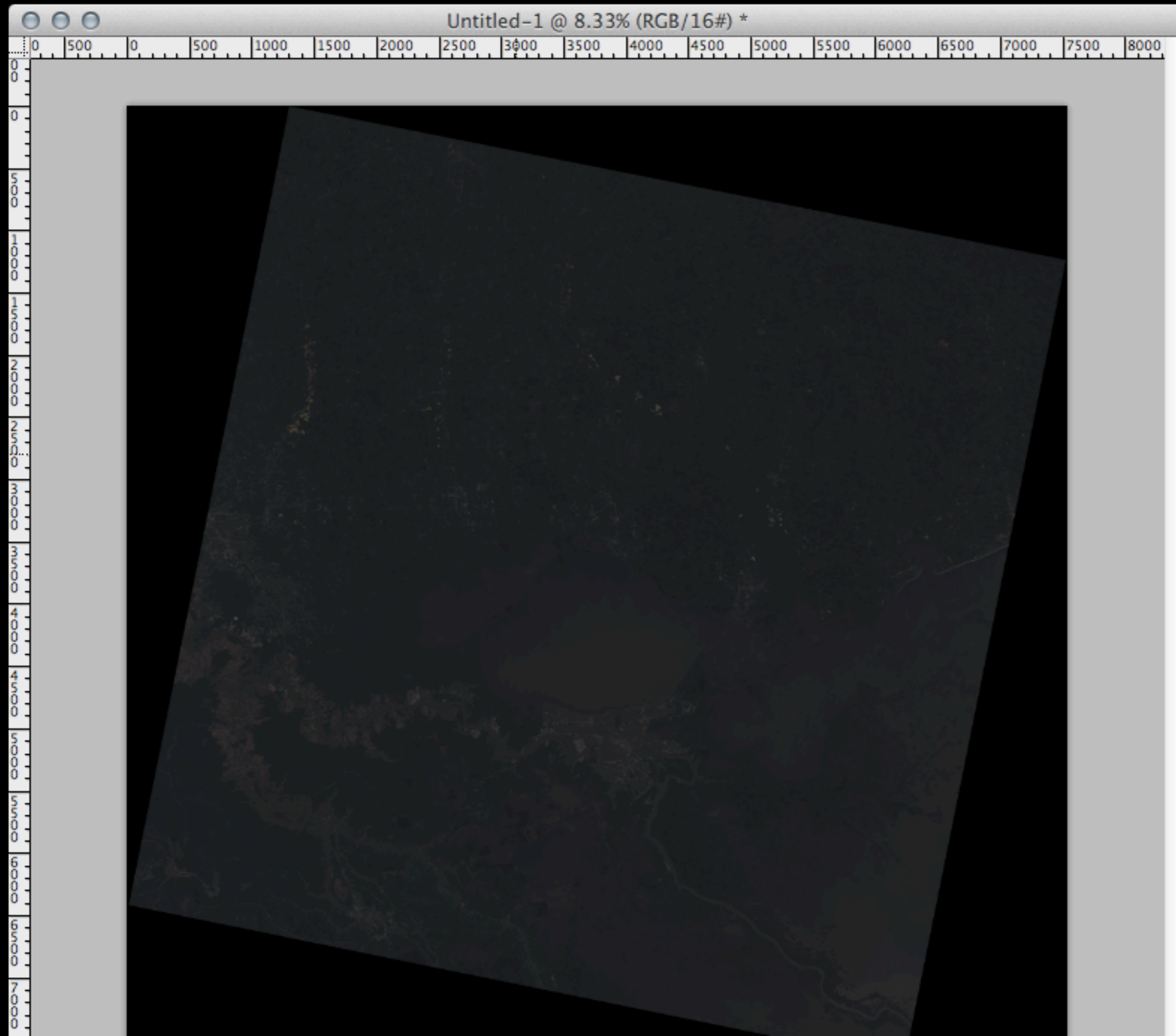
> landsat process LC80220392015086LGN00



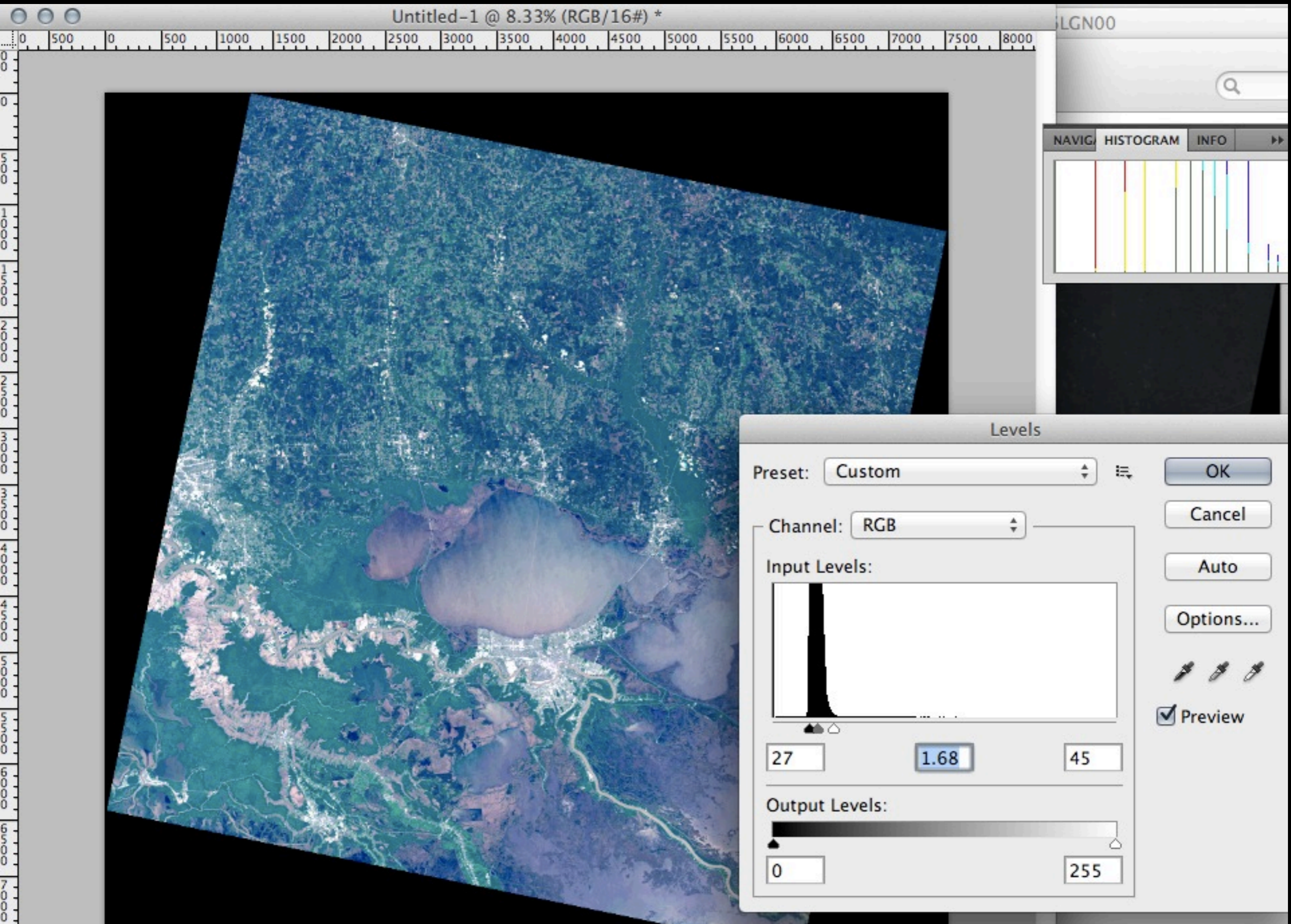
Or, with Photoshop



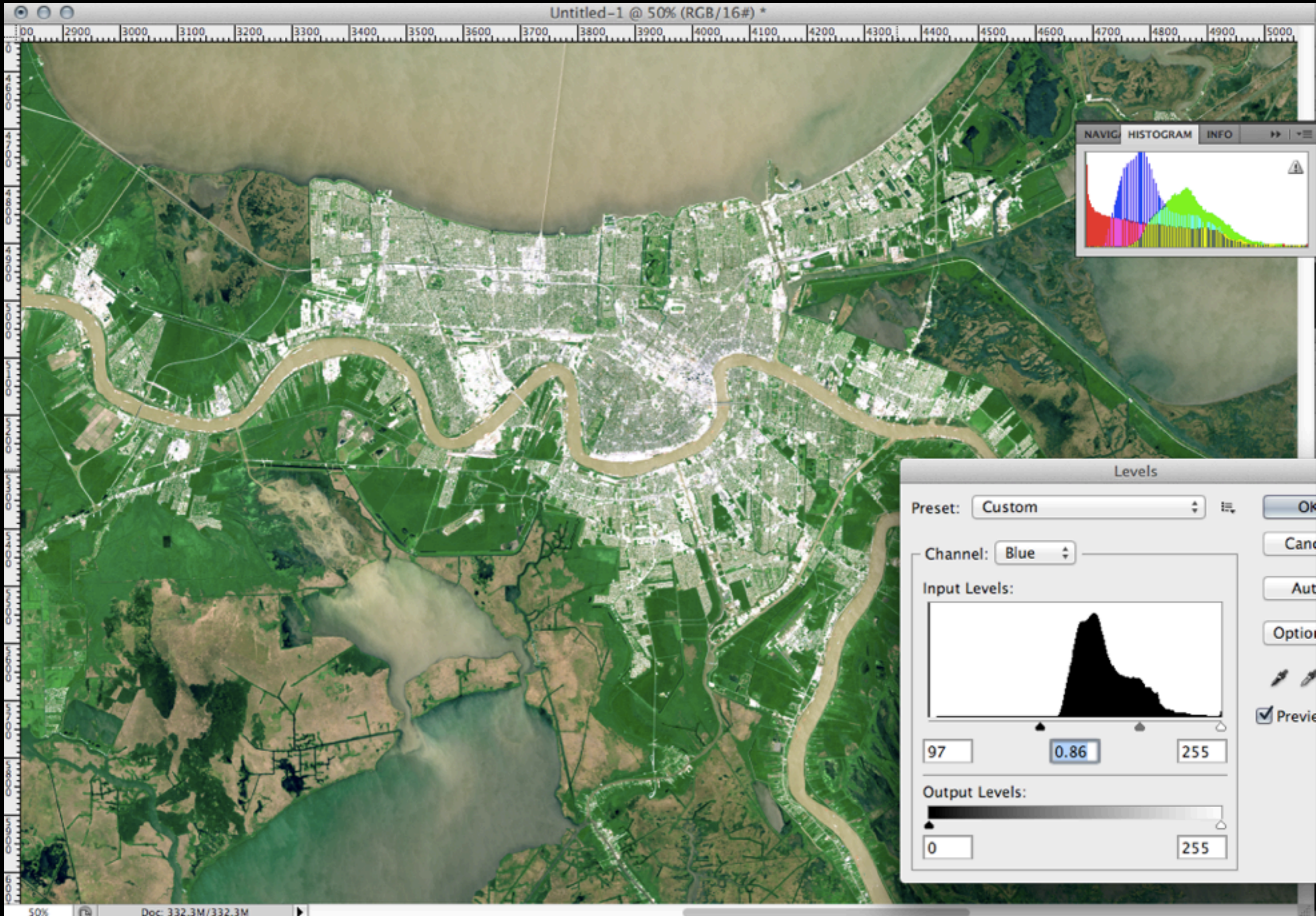
Or, with Photoshop



Or, with Photoshop



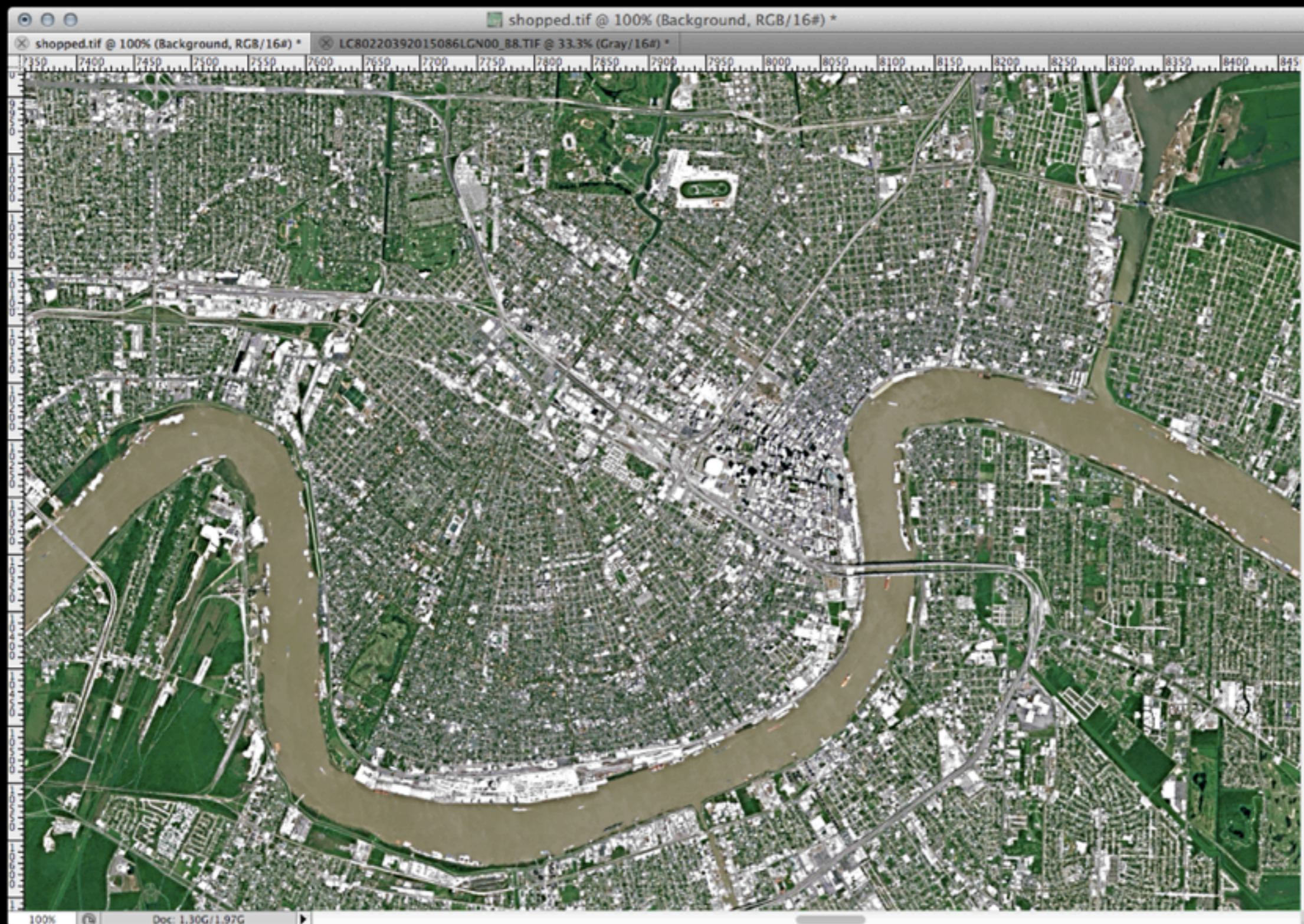
Or, with Photoshop



Or, with Photoshop

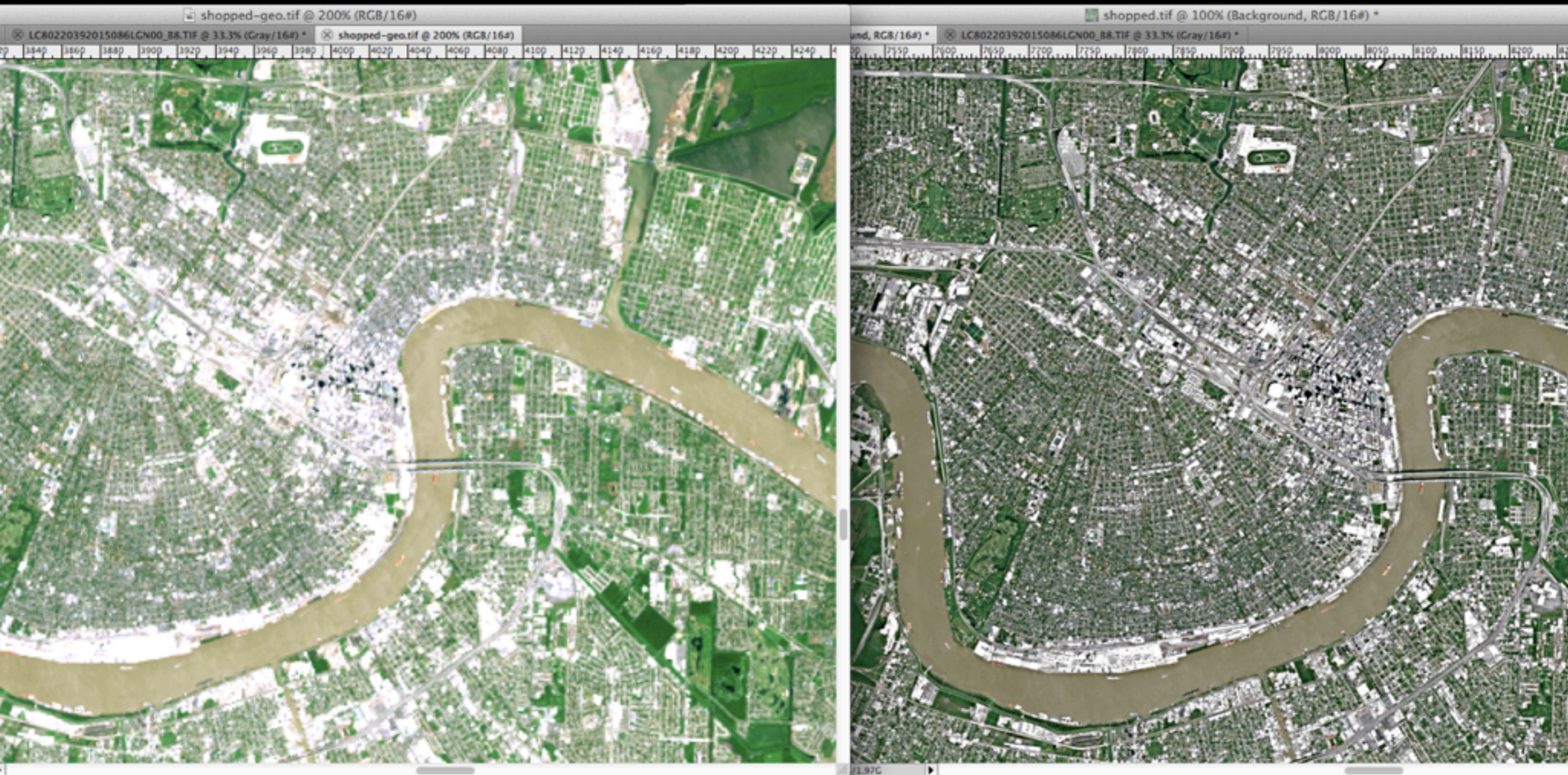


Pansharpening: 15m resolution with Landsat using band 8



<http://www.shadedrelief.com/landsat8/landsat8panchrom.html>

Pansharpening: 15m resolution with Landsat using band 8



<http://www.shadedrelief.com/landsat8/landsat8panchrom.html>

Save the geodata!

```
> listgeo -no_norm LC80220392015086LGN00_B4.TIF > shopped.geo
```

```
> geotifcp -g shopped.geo shopped.tif shopped-geo.tif
```

```
$ gdalinfo shopped-geo.tif
```

```
Driver: GTiff/GeoTIFF
```

```
Files: shopped-geo.tif
```

```
Size is 7541, 7701
```

```
Coordinate System is:
```

```
PROJCS["WGS 84 / UTM zone 15N",
```

```
    GEOGCS["WGS 84",
```

```
        DATUM["WGS_1984",
```

```
            SPHEROID["WGS 84",6378137,298.257223563,
```

```
                AUTHORITY["EPSG","7030"]],
```

```
            AUTHORITY["EPSG","6326"]],
```

```
        PRIMEM["Greenwich",0],
```

```
        UNIT["degree",0.0174532925199433],
```

```
        AUTHORITY["EPSG","4326"]],
```

```
    PROJECTION["Transverse_Mercator"],
```

```
    PARAMETER["latitude_of_origin",0],
```

```
    PARAMETER["central_meridian",-93],
```

```
    PARAMETER["scale_factor",0.9996],
```

```
    PARAMETER["false_easting",500000],
```

```
    PARAMETER["false_northing",0],
```

```
    UNIT["metre",1,
```

```
        AUTHORITY["EPSG","9001"]],
```

```
    AUTHORITY["EPSG","32615"]]
```

```
Origin = (662385.000000000000000,3471015.000000000000000)
```

```
Pixel Size = (30.000000000000000,-30.000000000000000)
```

```
Metadata:
```

**Or, use
Geographic Imager
(\$700)**

More

<http://j.mp/mapbox-landsat8>


<http://j.mp/eo-truecolor>

Mapbox


Design Data Develop Showcase Plans Help Blog Sign in Try it for free

BLOG

Putting Landsat 8's Bands to Work

By  Charlie Loyd on June 14 2013

Here's a picture of LA, just like an ordinary digital camera would take (if it had ten times as many megapixels and were in space). The image is only two weeks old, taken from Landsat 8, launched by NASA late this winter. Landsat 8 is already one of our favorite data sources - and not just ours: at [State of the Map](#) last weekend, it kept coming up in conversation with people from all kinds of backgrounds. More than just adding fresh true-color imagery from Landsat 8 to MapBox Satellite, we're investing in data services using the multispectral information that the satellite provides. Its non-visual bands let us analyze everything from terrain types to crop growth to natural disasters - all around the world, sometimes within hours. This post introduces some of Landsat 8's features, to give you a feel for what the world looks like through its lens.









NASA EARTH OBSERVATORY
Where every day is Earth Day


Home Images Global Maps Features News & Notes

Home / Blogs / [Elegant Figures](#) / How To Make a True-Color Landsat 8 Image

How To Make a True-Color Landsat 8 Image

October 22nd, 2013 by Robert Simmon       [Share](#)

Since its launch in February 2013, [Landsat 8](#) has collected about 400 scenes of the Earth's surface per day. Each of these scenes covers an area of about 185 by 185 kilometers (115 by 115 miles)—34,200 square km (13,200 square miles)—for a total of 13,690,000 square km (5,290,000 square miles) per day. An area about 40% larger than the united states. Every day.



More

schooner-tk

<https://github.com/propublica/schooner-tk>

schooner-blend

schooner-cloud

schooner-contrast

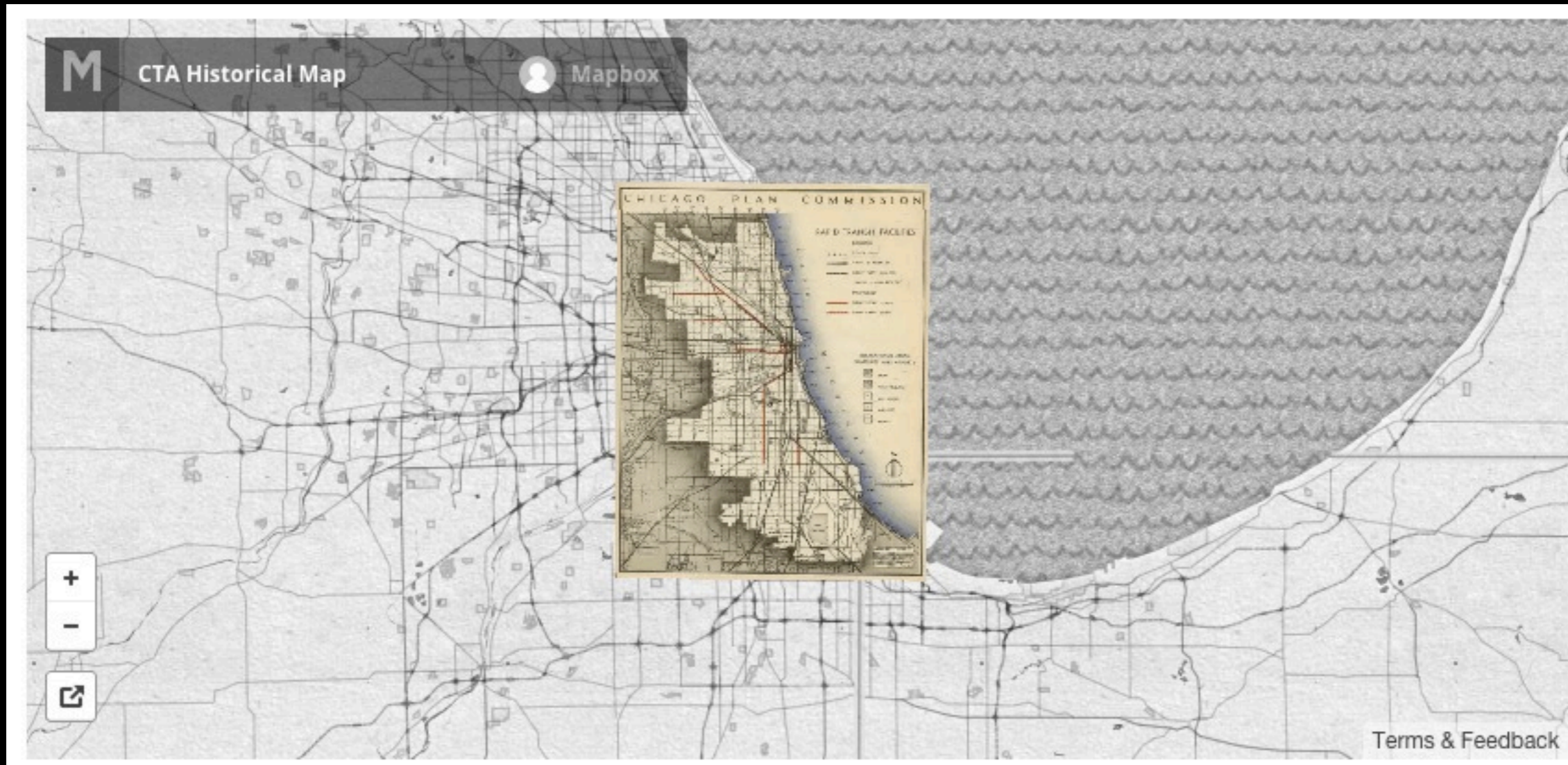
schooner-multibalance

schooner-stitch



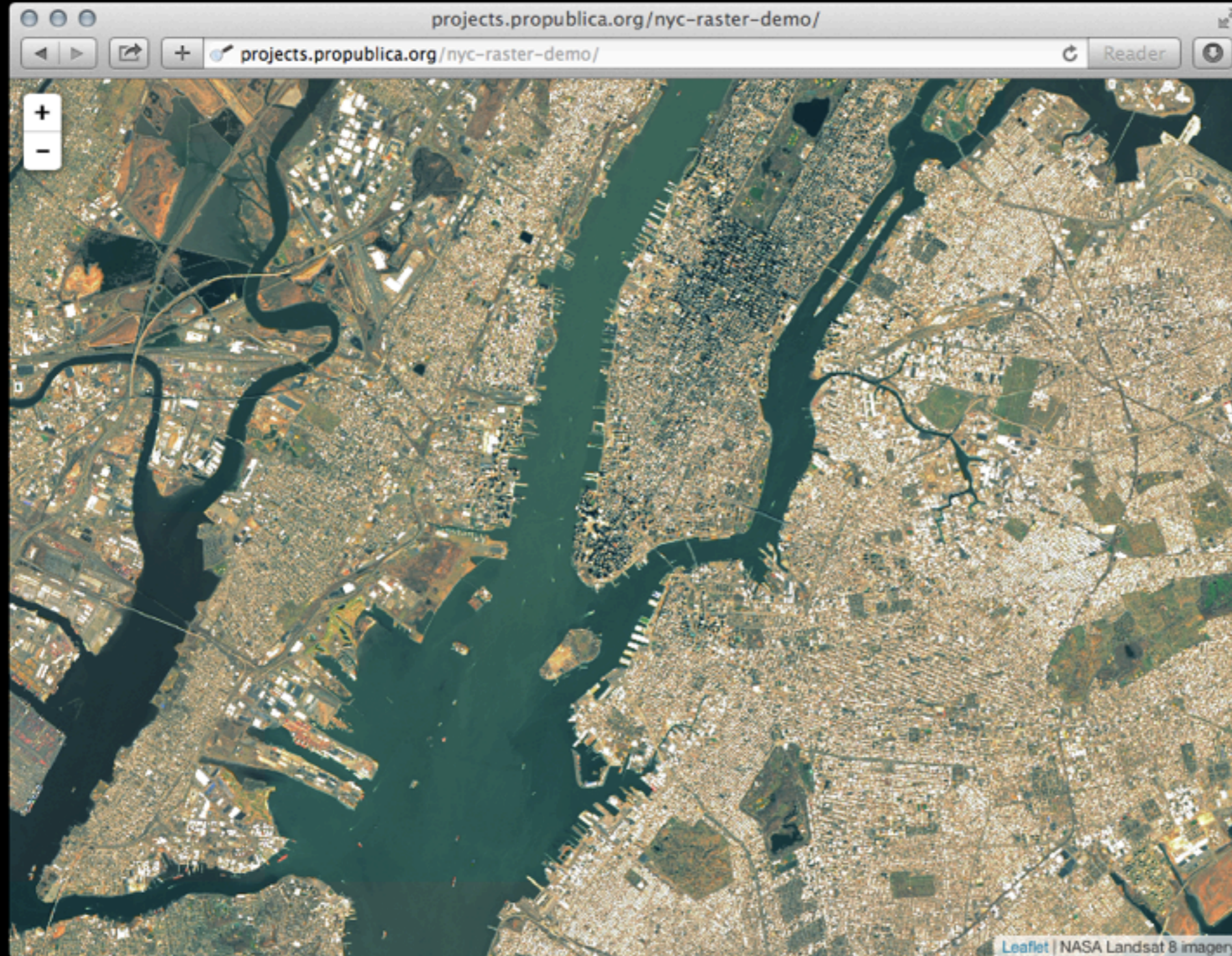
Using the data

Mapbox



<https://www.mapbox.com/blog/one-step-raster-imagery-mapboxcom/>

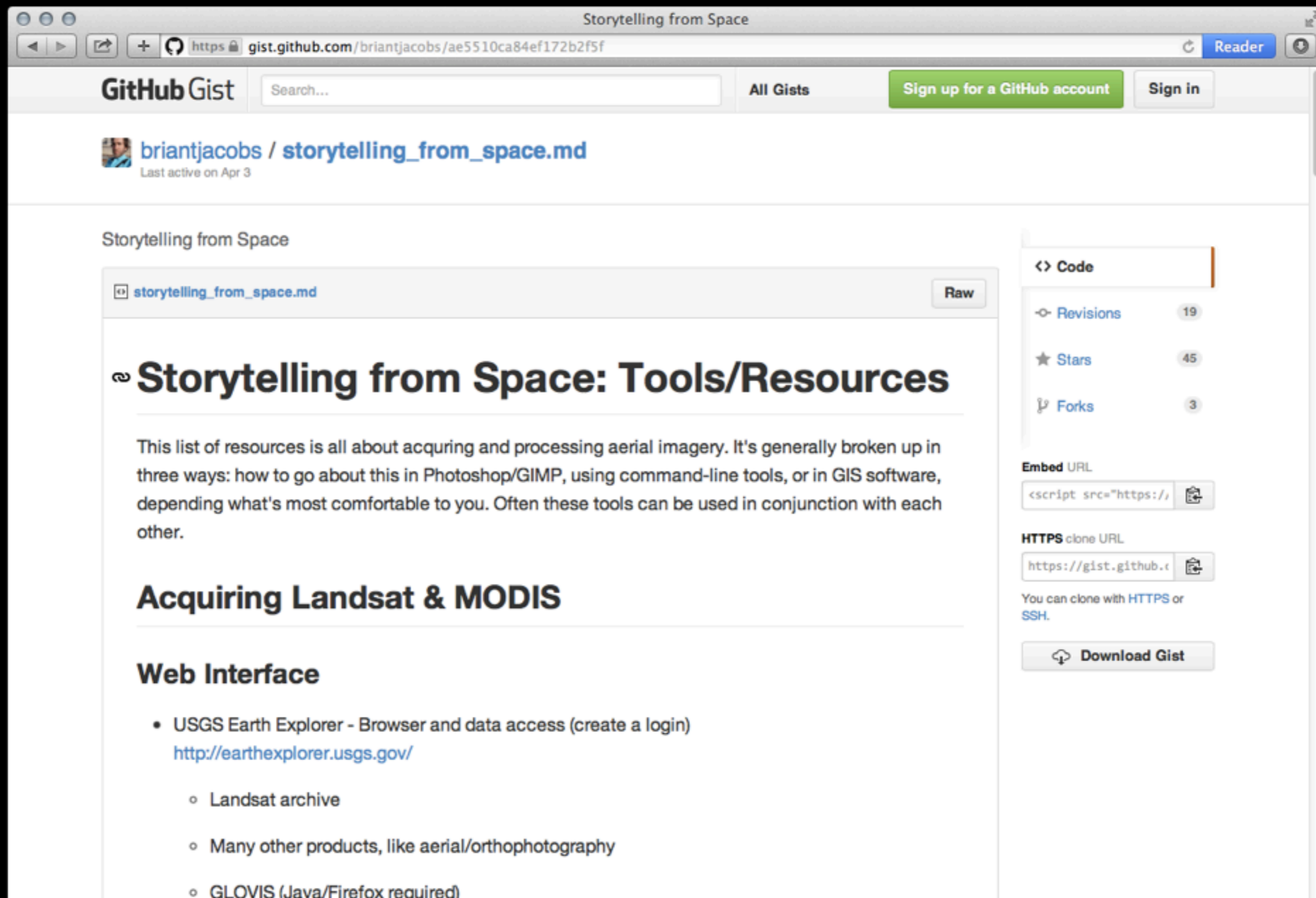
SimpleTiles (ProPublica)



<http://www.propublica.org/nerds/item/announcing-raster-support-for-simple-tiles>

Resources from Brian Jacobs

<http://j.mp/spacejournalism>



The image shows a browser window displaying a GitHub Gist page. The browser's address bar shows the URL `https://gist.github.com/brianjacobs/ae5510ca84ef172b2f5f`. The page title is "Storytelling from Space". The user profile for "brianjacobs" is visible, with a note that they were last active on Apr 3. The main content of the gist is a Markdown document titled "Storytelling from Space: Tools/Resources". The document text describes a list of resources for acquiring and processing aerial imagery, mentioning tools like Photoshop/GIMP, command-line tools, and GIS software. It also includes a section titled "Acquiring Landsat & MODIS" and a "Web Interface" section with a list of resources, including USGS Earth Explorer and GLOVIS. On the right side of the page, there are statistics for the gist: 19 Revisions, 45 Stars, and 3 Forks. There are also fields for "Embed URL" and "HTTPS clone URL", and a "Download Gist" button.

Storytelling from Space

[storytelling_from_space.md](#) Raw

Storytelling from Space: Tools/Resources

This list of resources is all about acquiring and processing aerial imagery. It's generally broken up in three ways: how to go about this in Photoshop/GIMP, using command-line tools, or in GIS software, depending what's most comfortable to you. Often these tools can be used in conjunction with each other.

Acquiring Landsat & MODIS

Web Interface

- USGS Earth Explorer - Browser and data access (create a login)
<http://earthexplorer.usgs.gov/>
 - Landsat archive
 - Many other products, like aerial/orthophotography
 - GLOVIS (Java/Firefox required)

Code

Revisions 19

Stars 45

Forks 3

Embed URL

```
<script src="https://
```

HTTPS clone URL

```
https://gist.github.c
```

You can clone with [HTTPS](#) or [SSH](#).

Download Gist

Examples

Telling stories from space

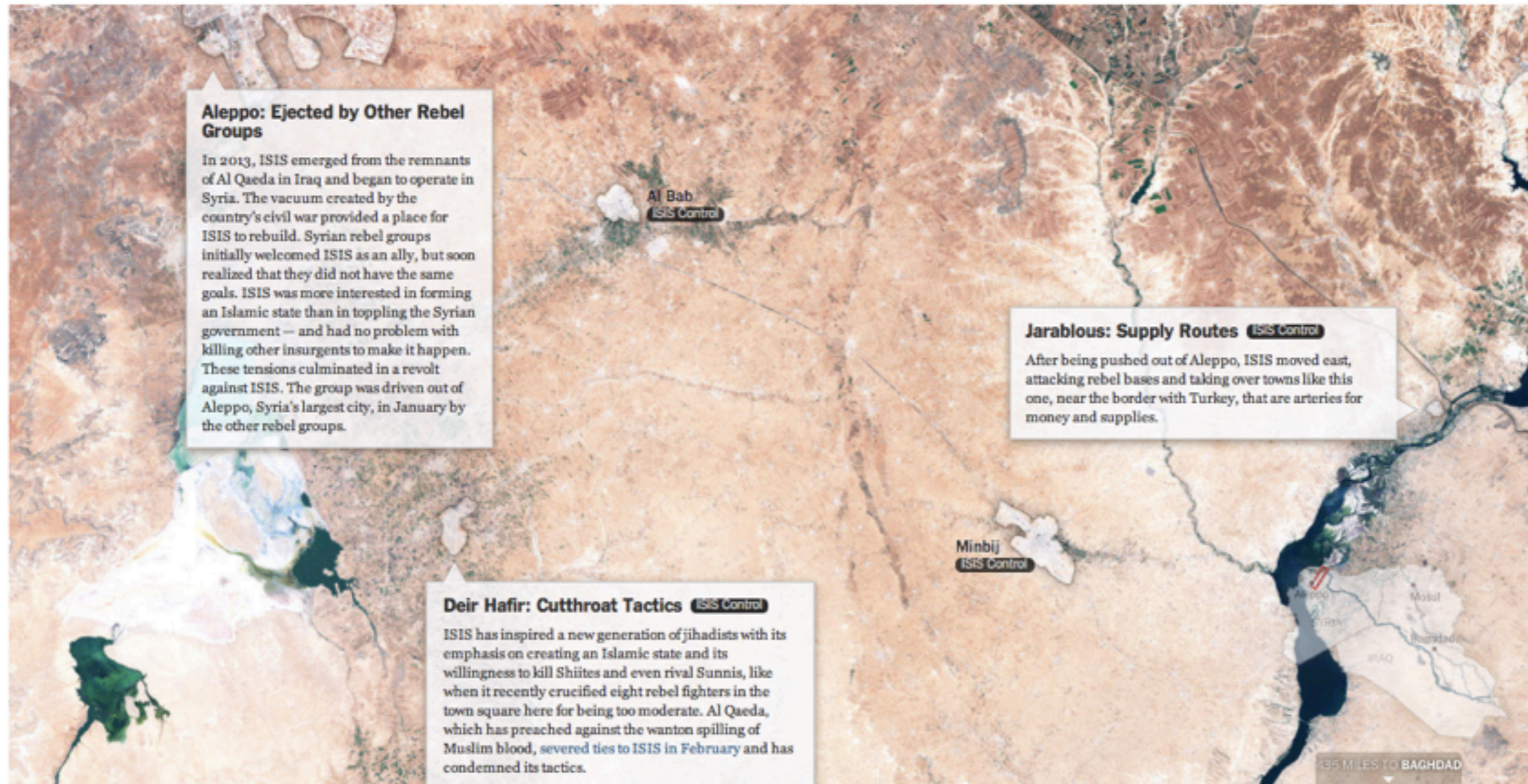
A Rogue State Along Two Rivers

How ISIS Came to Control Large Portions of Syria and Iraq

By JEREMY ASHKENAS, ARCHIE TSE, DEREK WATKINS and KAREN YOURISH July 3, 2014

The militant group called the Islamic State in Iraq and Syria, or ISIS, seemed to surprise many American and Iraqi officials with the recent gains it made in its violent campaign to create a new religious state. But the rapid-fire victories achieved over a few weeks in June were built on months of maneuvering along the Tigris and Euphrates Rivers.

The Euphrates

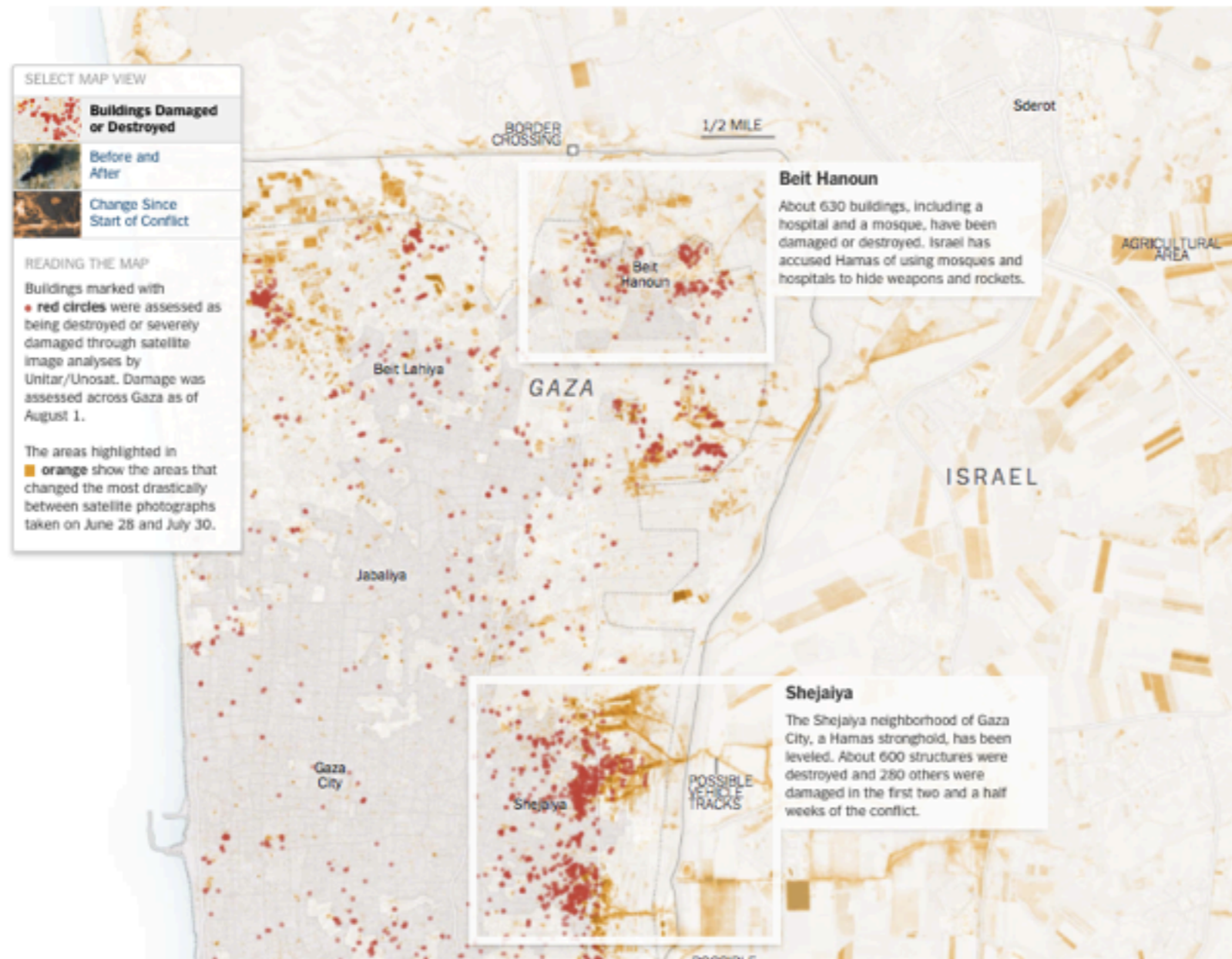


MIDDLE EAST

SHARE

Assessing the Damage and Destruction in Gaza

The damage to Gaza's infrastructure from the current conflict is more severe than the destruction caused by either of the last two Gaza wars, according to the United Nations Relief and Works Agency (Unrwa) and other organizations with staff on the ground, like Oxfam and Human Rights Watch. The fighting has displaced about a fourth of Gaza's population. Nearly 60,000 people have lost their homes, and the number of people taking shelter in Unrwa schools is nearly five times as many as in 2009. The cost to Gaza's already fragile economy will be significant: the 2009 conflict caused losses estimated at \$4 billion — almost three times the size of Gaza's annual gross domestic product. **UPDATED** August 15, 2014



Losing Ground

by Bob Marshall, The Lens, Brian Jacobs and Al Shaw, ProPublica, Aug. 28, 2014

In 50 years, most of southeastern Louisiana not protected by levees will be part of the Gulf of Mexico. The state is losing a football field of land every 48 minutes — 16 square miles a year — due to climate change, drilling and dredging for oil and gas, and levees on the Mississippi River. At risk: Nearly all of the nation's offshore oil and gas production, much of its seafood production, and millions of homes.

EXPLORE THE COAST



2008

2012

2014

Pointe à la

Lake Hermitage

C

B

A

1 km
3000 ft

New Orleans

2008

2012

2014

Lake Hermitage

C

B

A

pumped sediment

1 km
3000 ft

New Orleans

<http://projects.propublica.org/larestoration>



KILLING the Colorado

- Read the Latest Story
- What You Need to Know

- BIG THOMPSON PROJECT
- MOFFAT TUNNEL
- FLAMING GORGE DAM
- NAVAJO GENERATING STATION
- GLEN CANYON DAM
- HOOVER DAM**
- CENTRAL ARIZONA PROJECT
- PARKER DAM
- IMPERIAL DAM
- YUMA DESALTING COMPLEX
- ALL-AMERICAN CANAL

Las Vegas



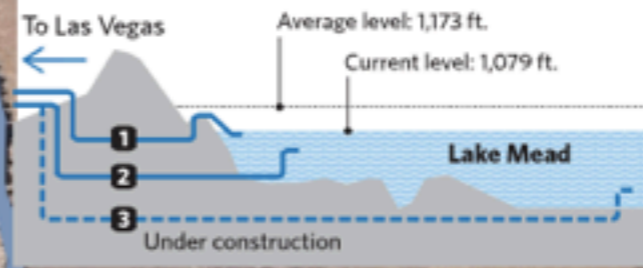
HOOVER DAM

GETS US...
Up to 4 billion kilowatt-hours of electricity annually

COSTS US...
Up to 283 billion gallons lost to evaporation annually

COMPLETED	COST
1936	\$165M

Lake Mead, behind the Hoover Dam, is the nation's largest reservoir, holding as much as 9.4 trillion gallons — providing much of the water in Nevada, Arizona, California and Northern Mexico. As of May 2015, Lake Mead levels had dropped within 12 inches of triggering a federal emergency that would cut back supplies to the 23 million people served by the reservoir. Las Vegas, which gets 90 percent of its water from the lake, is building a third drain intake to ensure it can still draw water as levels drop.





1975

WATER USE
40.8 billion gallons

<http://j.mp/vegas-water>

16 Hours before Landfall Flood Level Storm makes landfall

Hurricane Ike devastated Galveston Island in 2008.



<http://propublica.org/highwater>

Thank you!

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