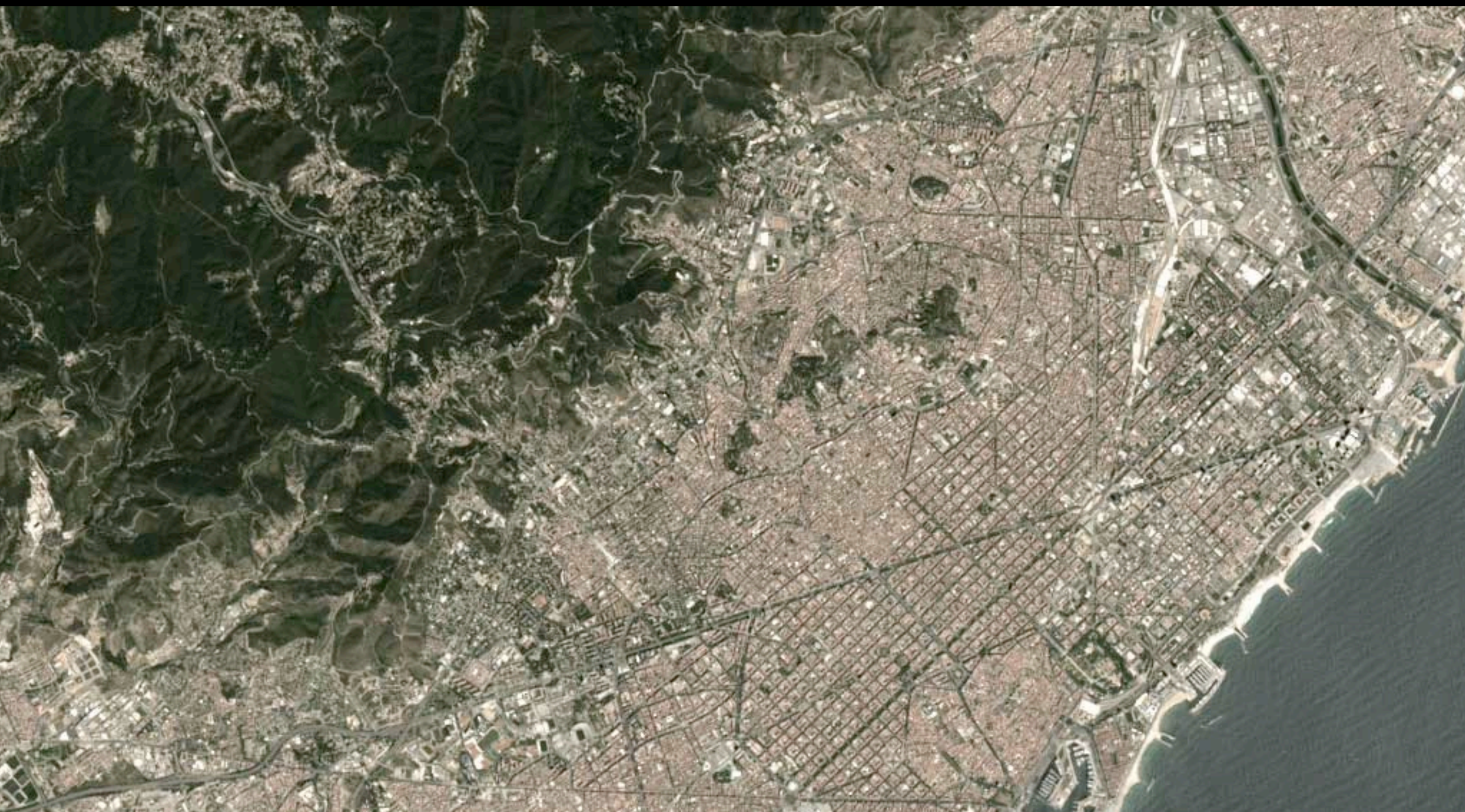
Space Journalism!

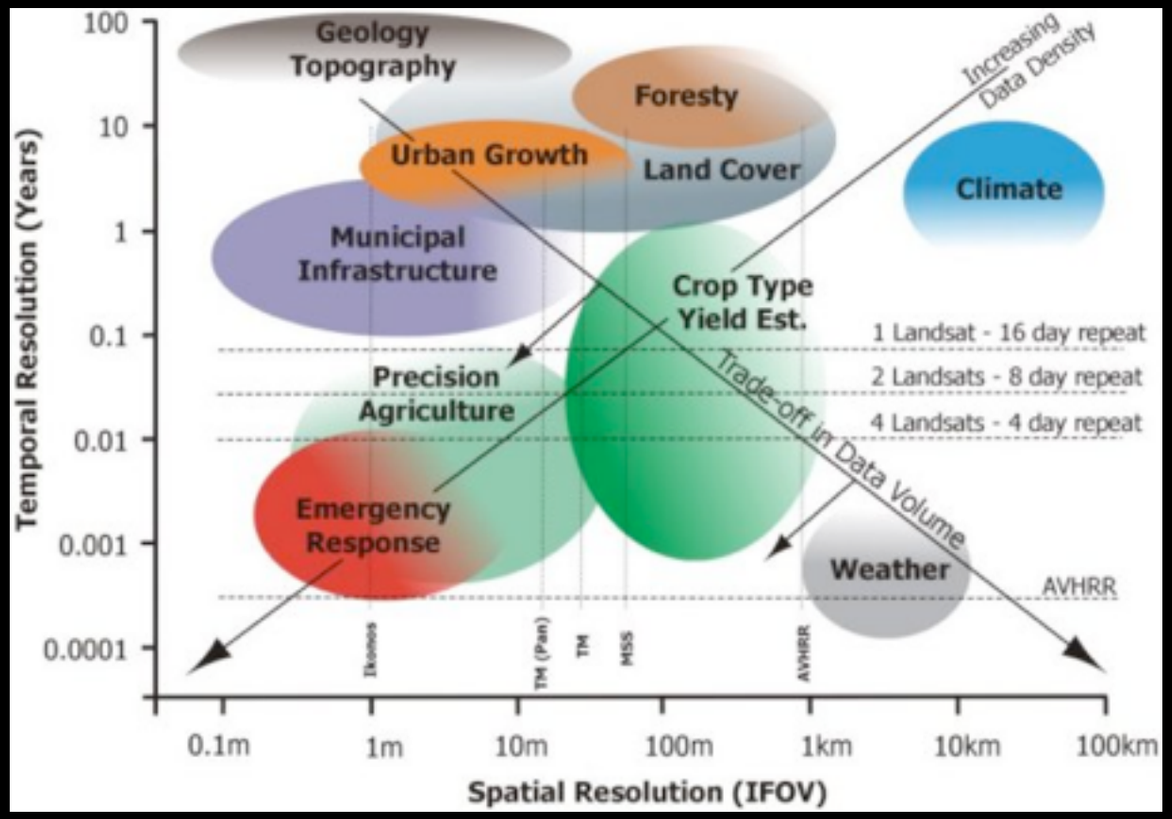
Al Shaw
al.shaw@propublica.org @A_L

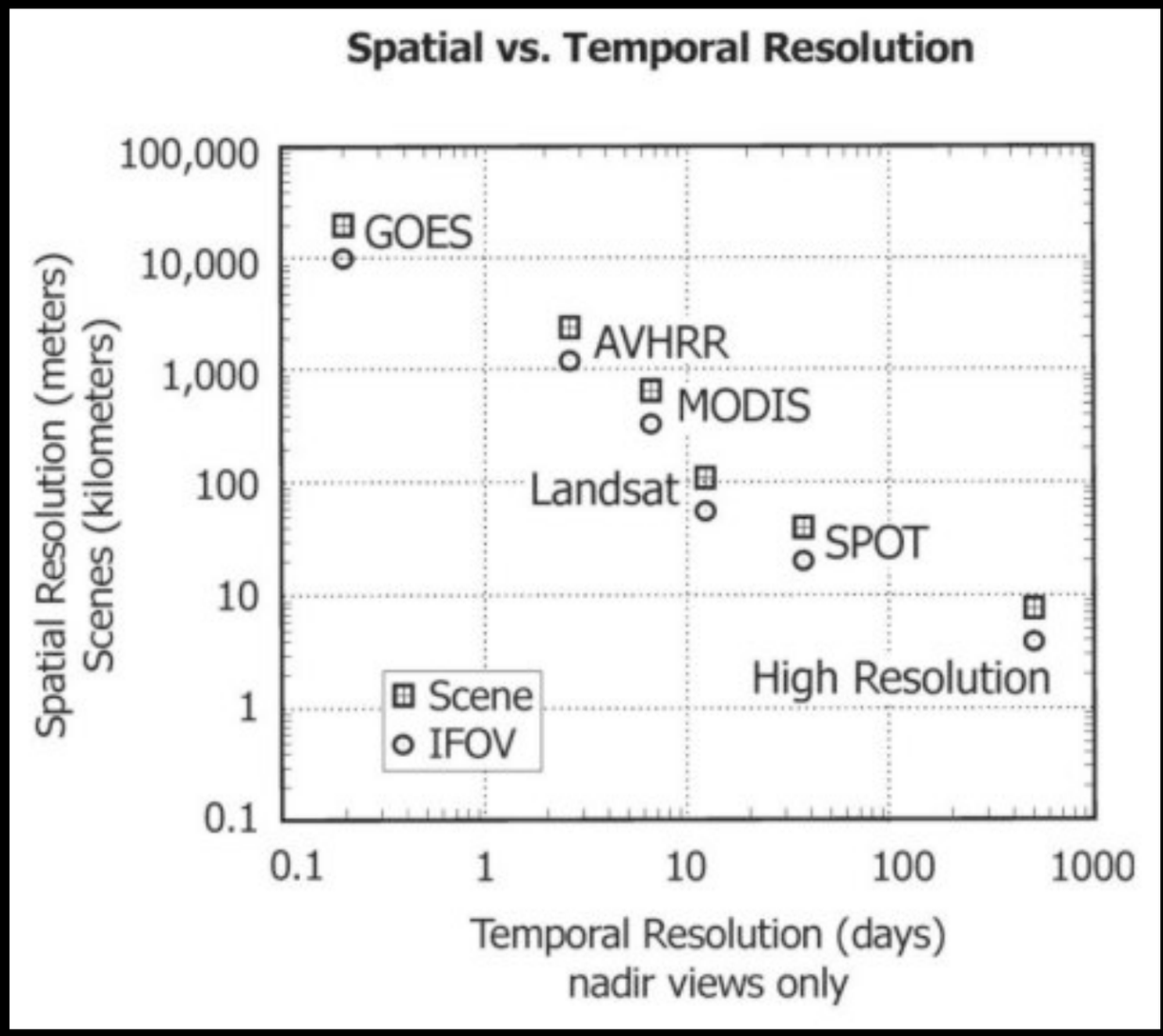
http://j.mp/nicar16-space

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

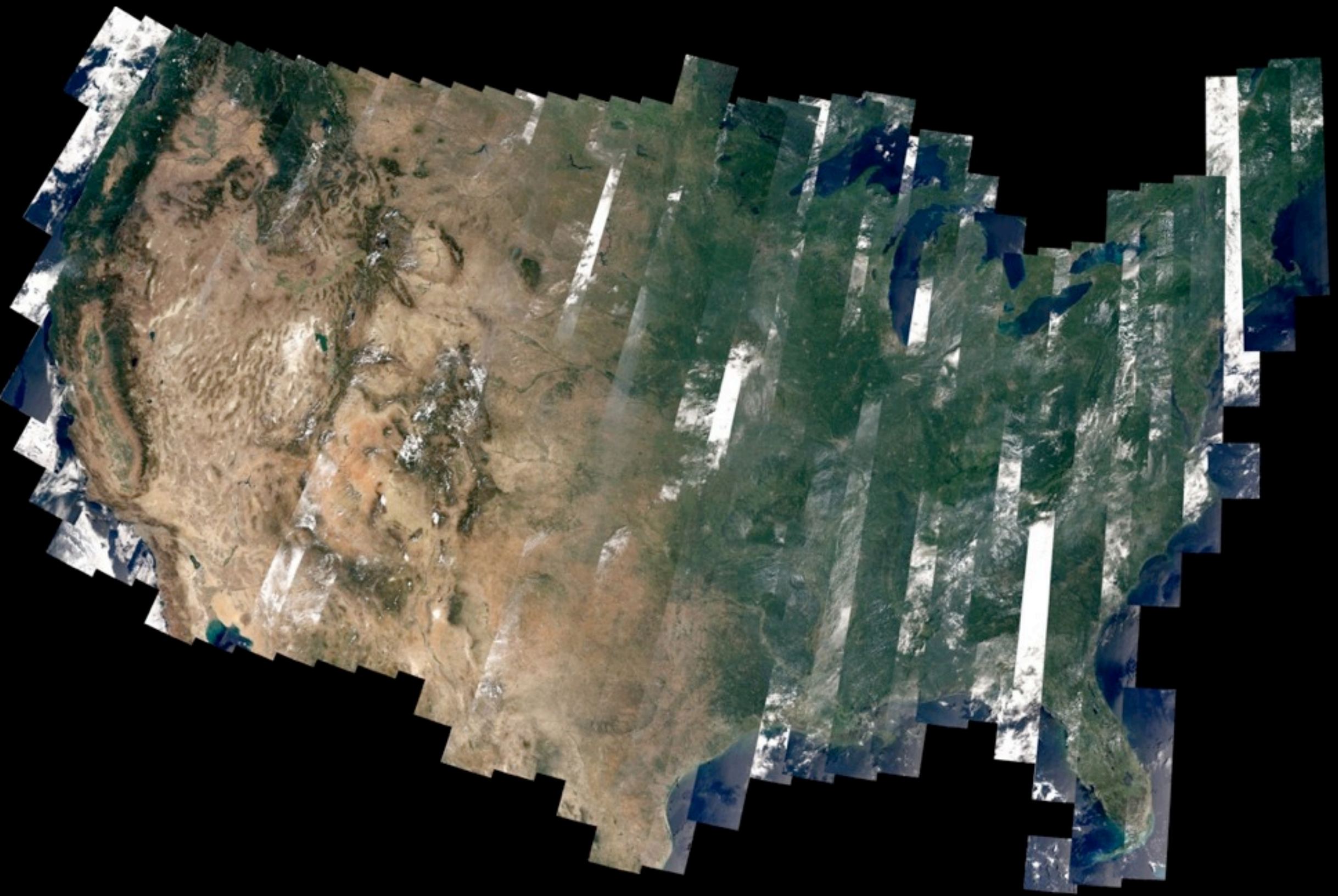




MODIS: 250m resolution

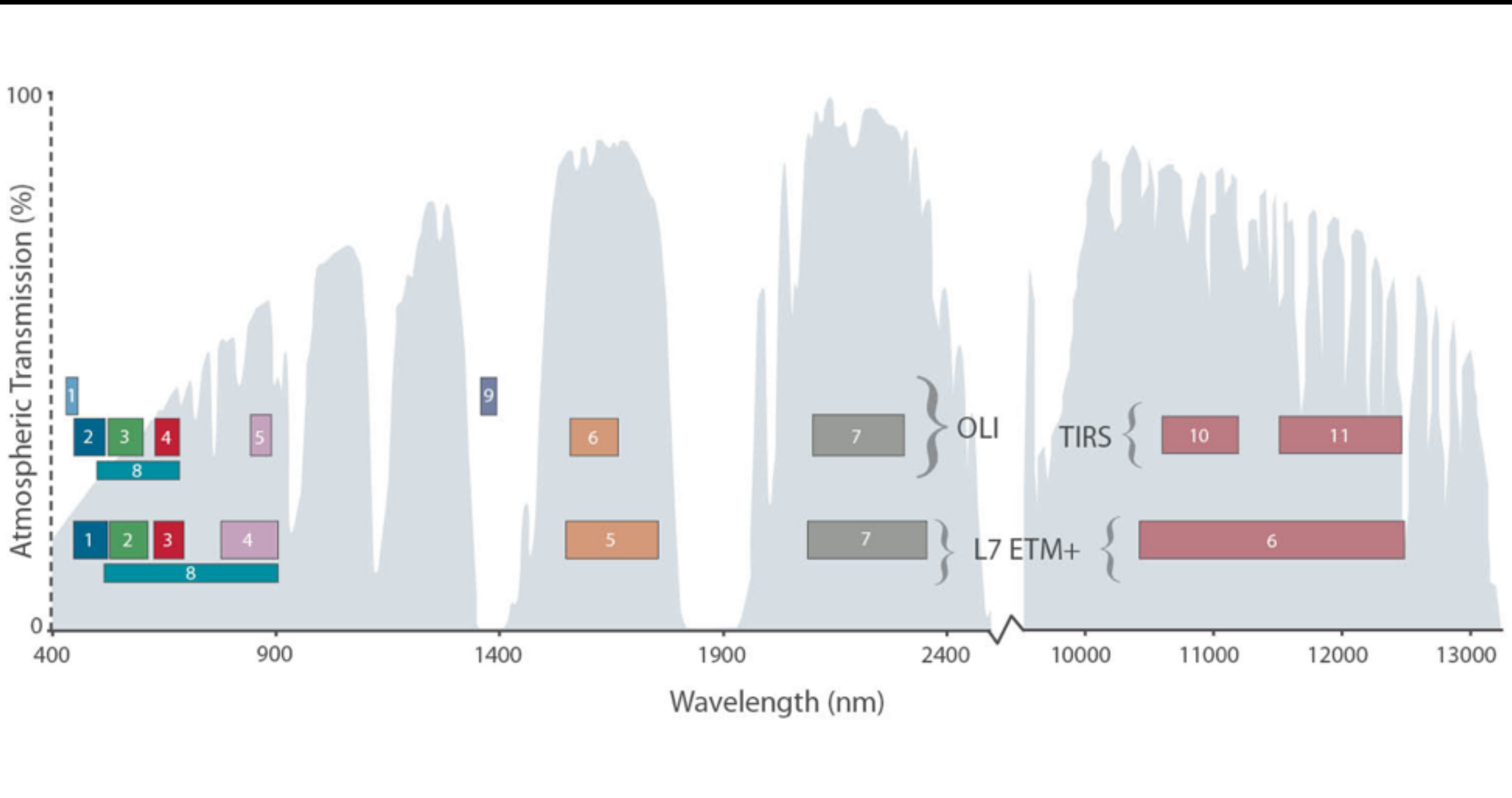
Landsat 8: 15-30m resolution

Temporal Resolution — Landsat 8: 16 days

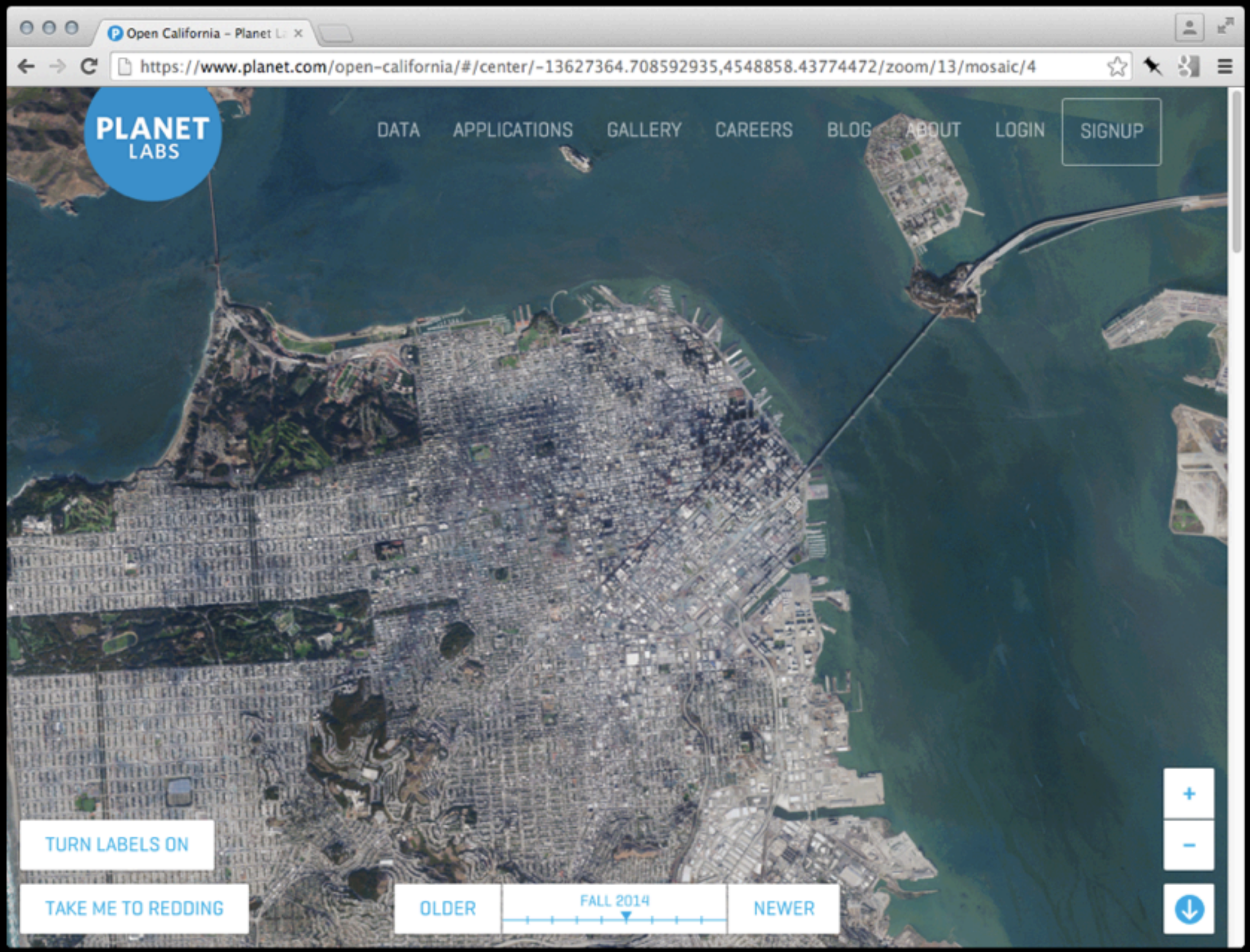


http://earthobservatory.nasa.gov/IOTD/view.php?id=83099

Spectral Resolution: Landsat 8



Private satellites



Spectral Resolution: RGB
Temporal Resolution: ¯_(ツ)_/¯

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)

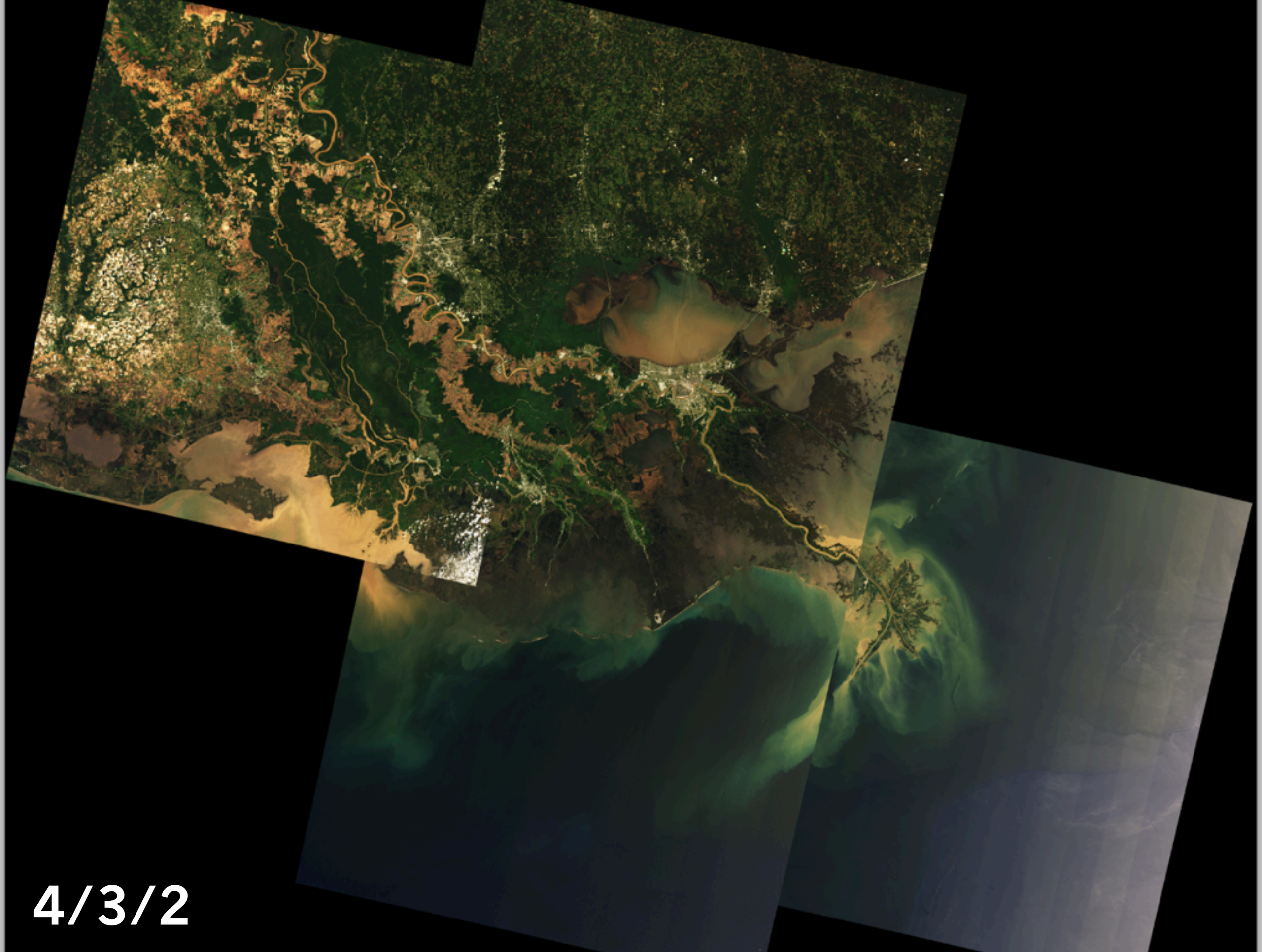
Landsat 8 Band Combinations

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

http://blogs.esri.com/esri/arcgis/2013/07/24/band-combinations-for-landsat-8/

Example: “Losing Ground”

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



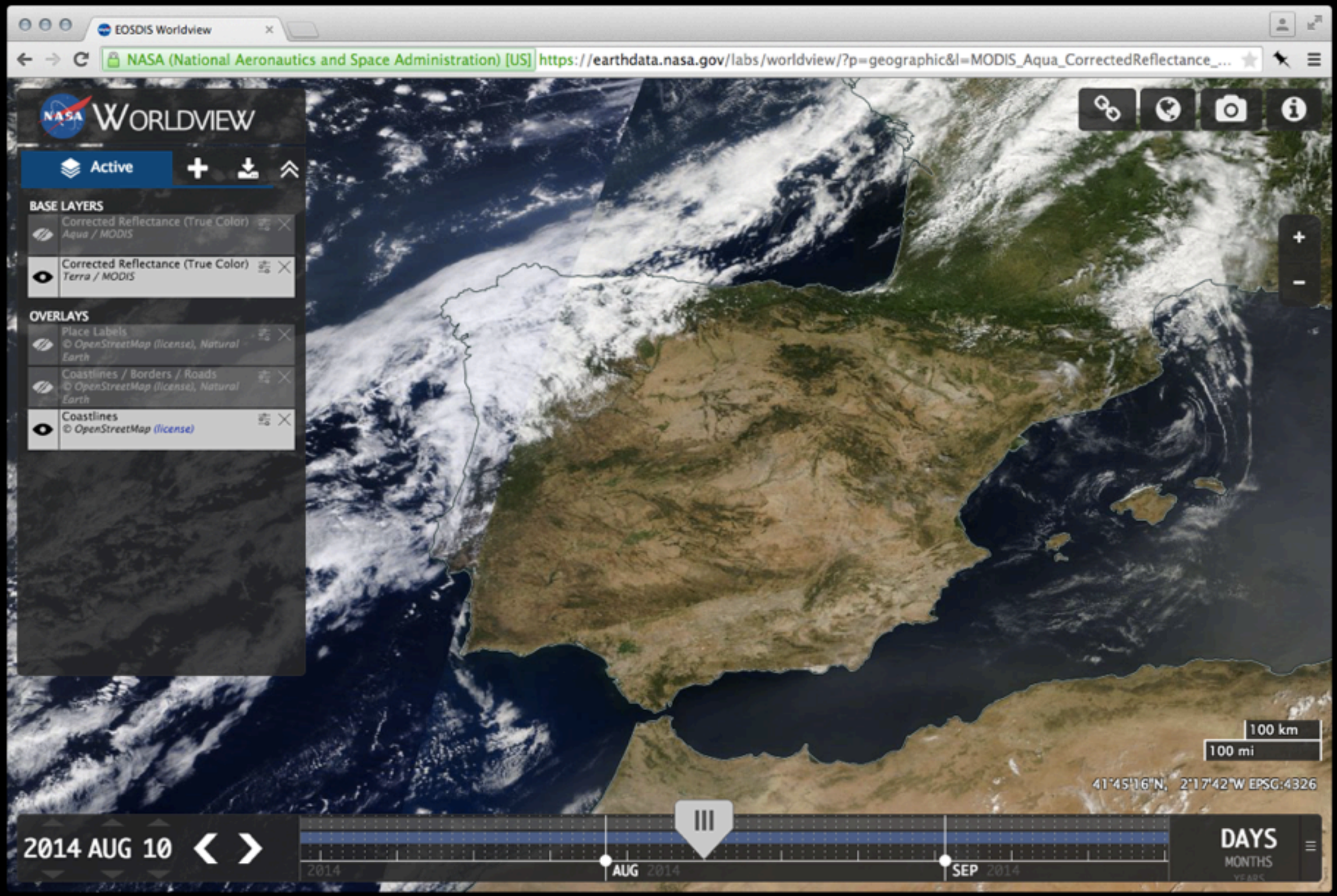
4/3/2

7/5/3

4/3/2 + 5 mask

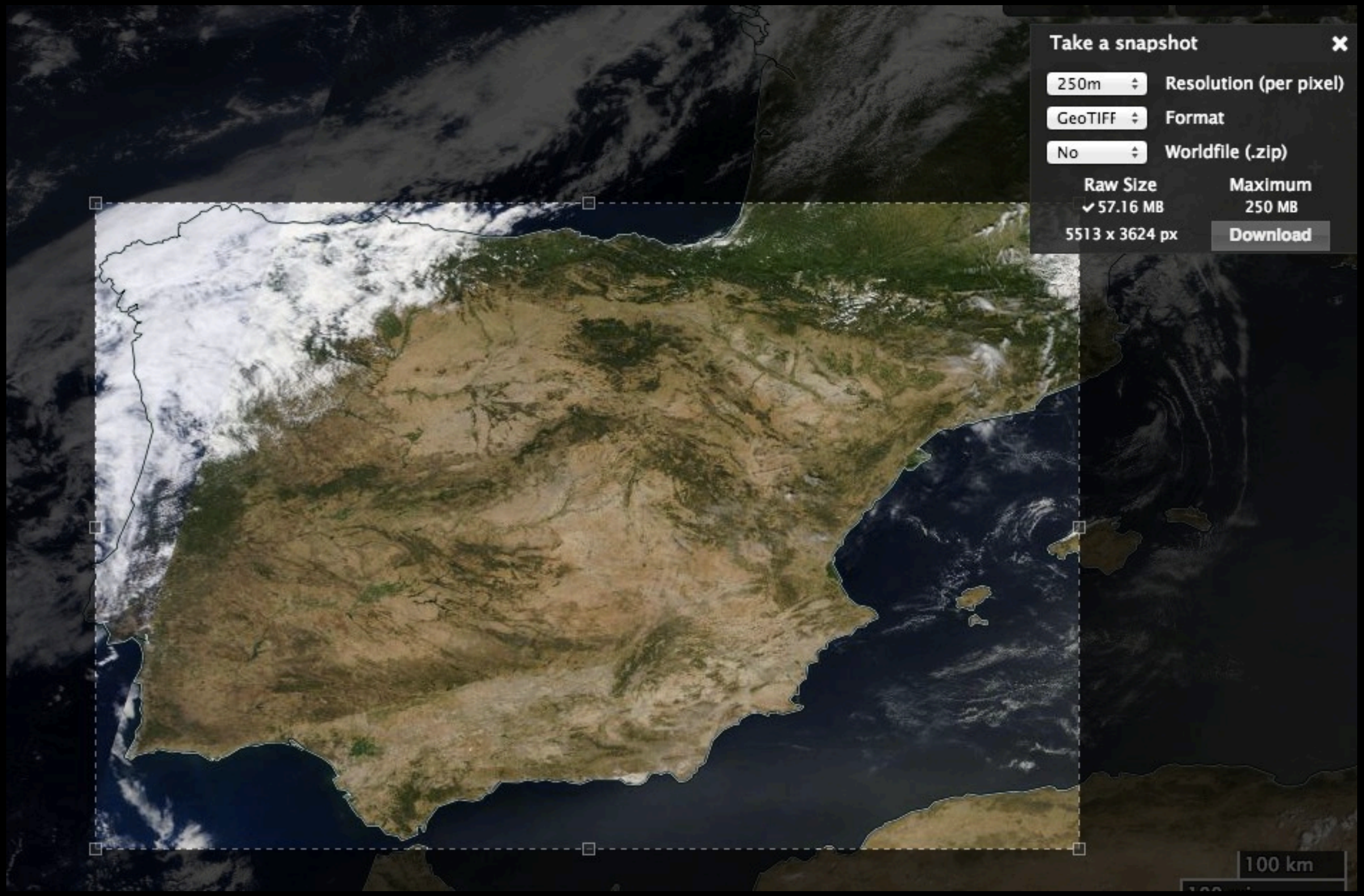
How to get the data

WorldView: MODIS (preprocessed)



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

WorldView: MODIS (preprocessed)



nasa-worldview-2014-08-10.tiff

QGIS 2.6.1-Brighton

Browser

Add

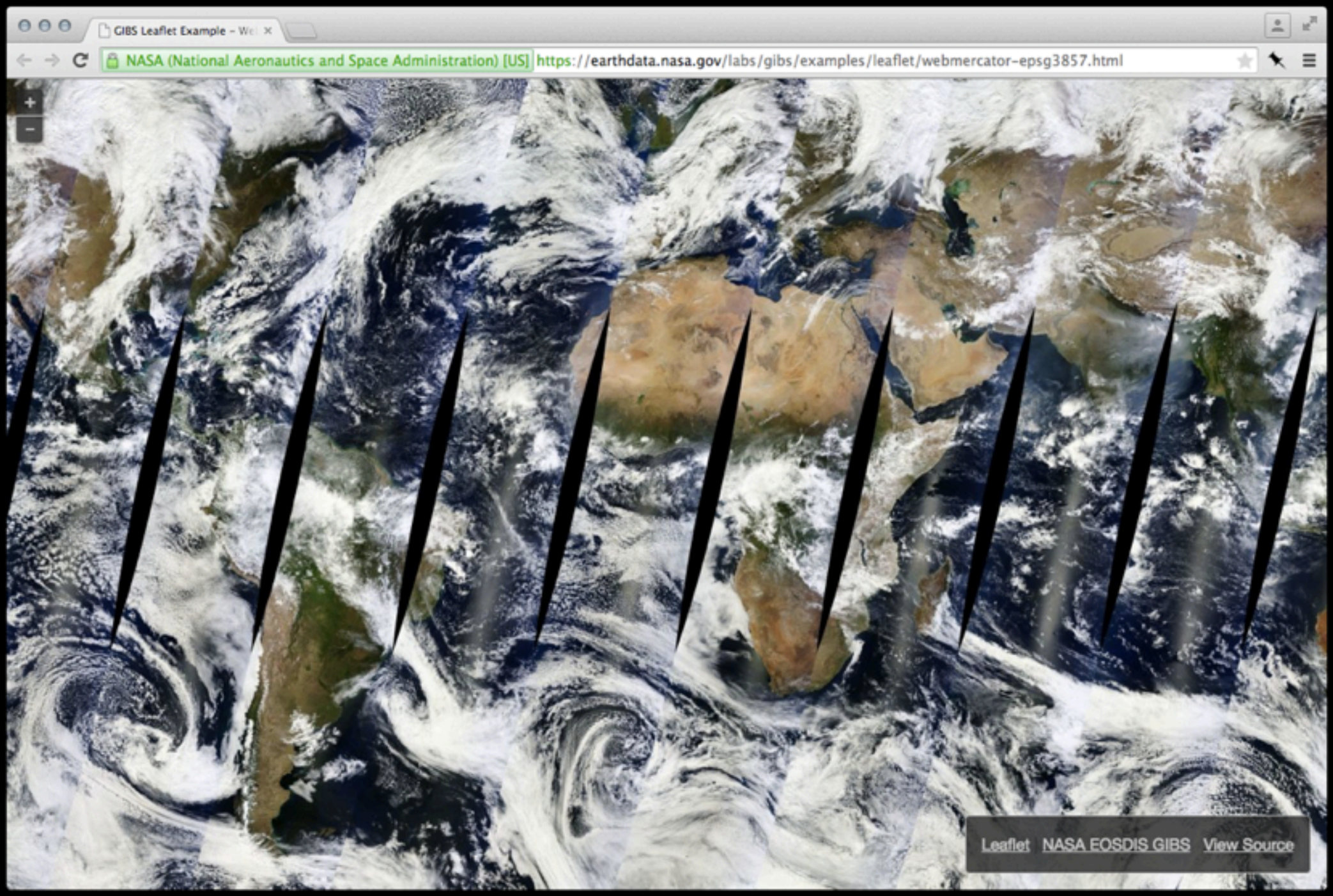
Home
Favourites
/
/Volumes
MSSQL
PostGIS
SpatiaLite
OWS
WCS
WFS
WMS

Layers

nasa-worldview-20...
OpenStreetMap

Coordinate: -509111,5017260 Scale 1:748,601 Render EPSG:3857

Use Directly In Your Own Leaflet/Google Maps



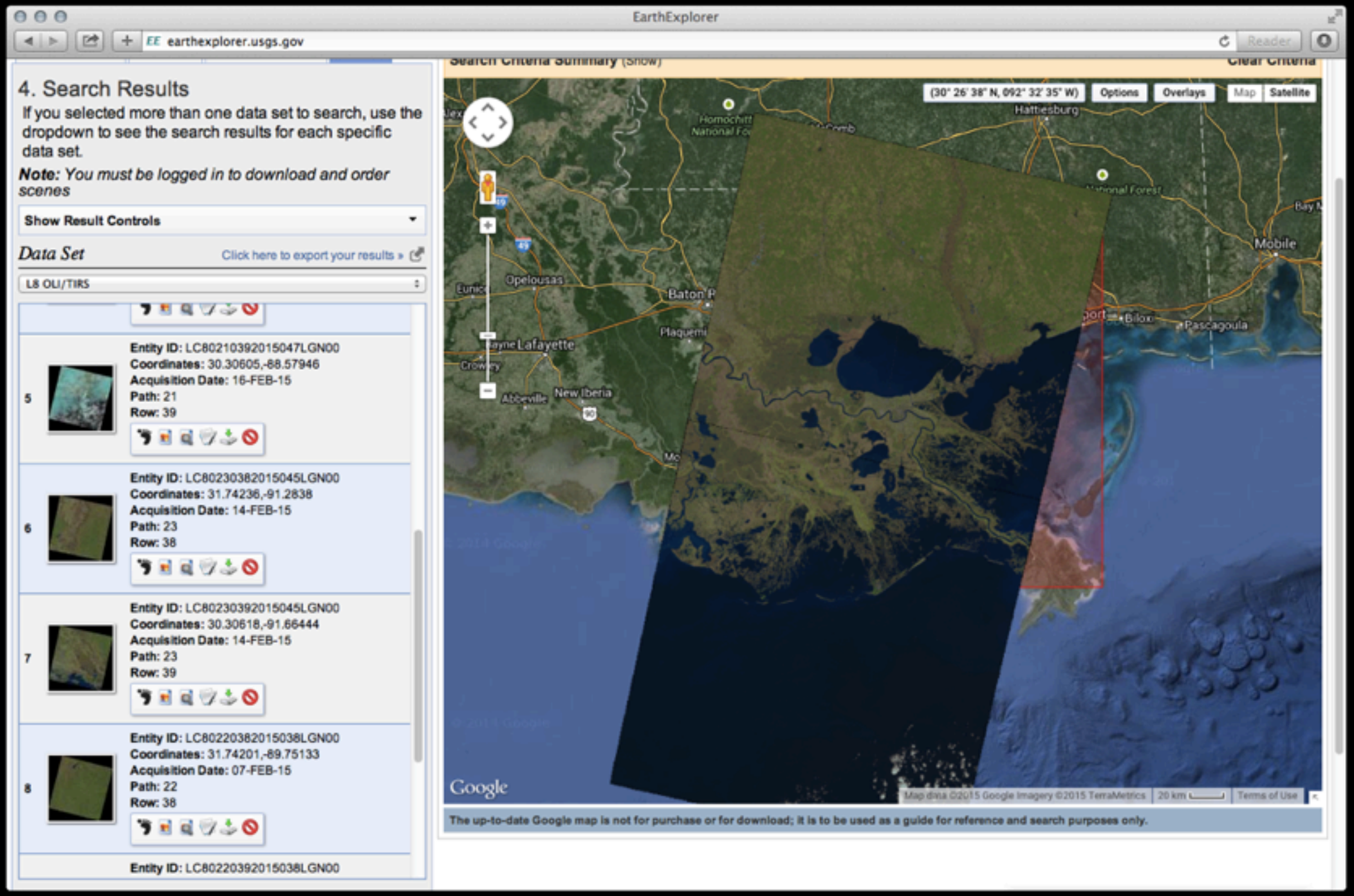
https://github.com/nasa-gibs/gibs-web-examples

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";
```

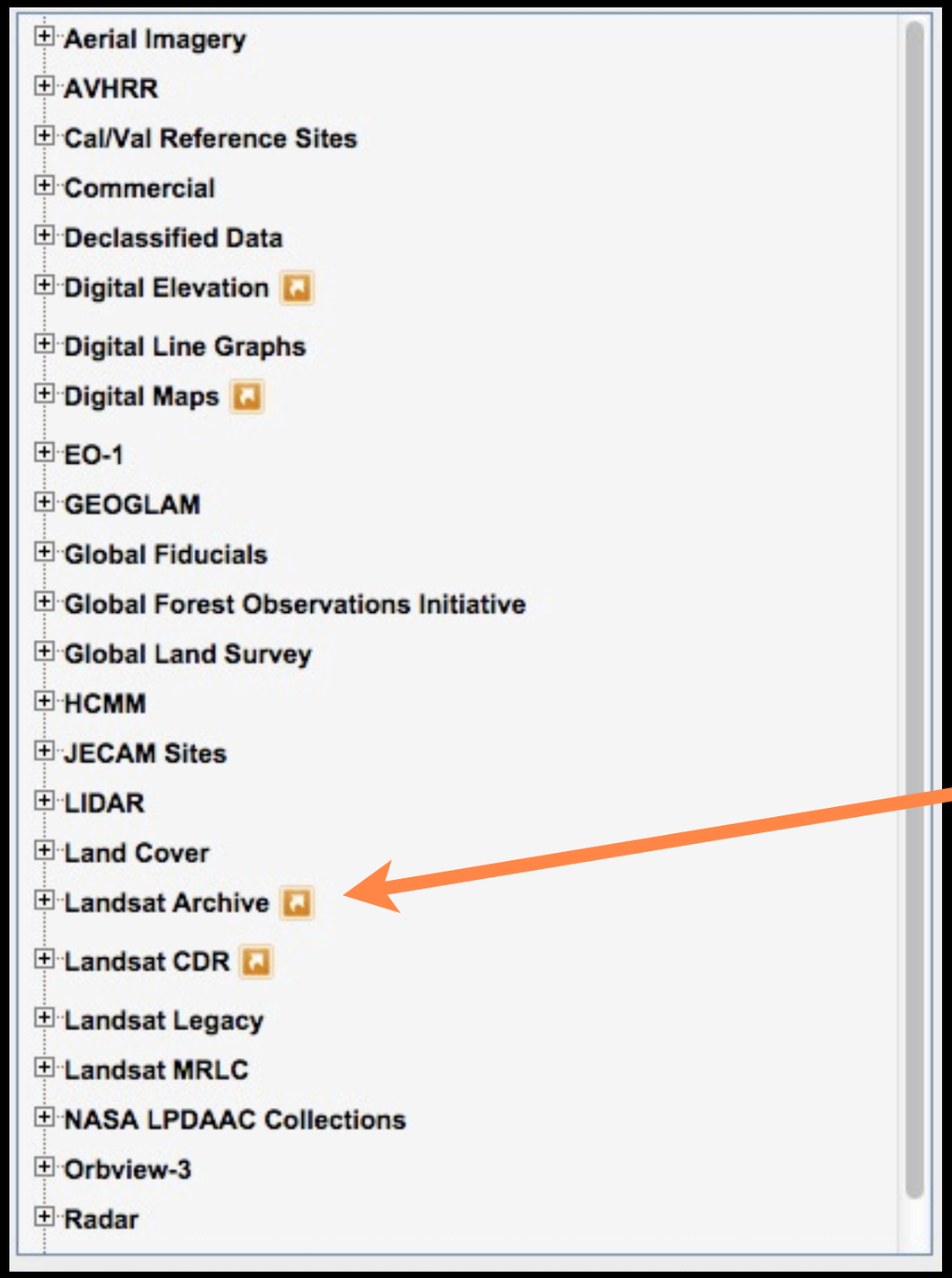
https://github.com/nasa-gibs/gibs-web-examples

EarthExplorer (raw data)



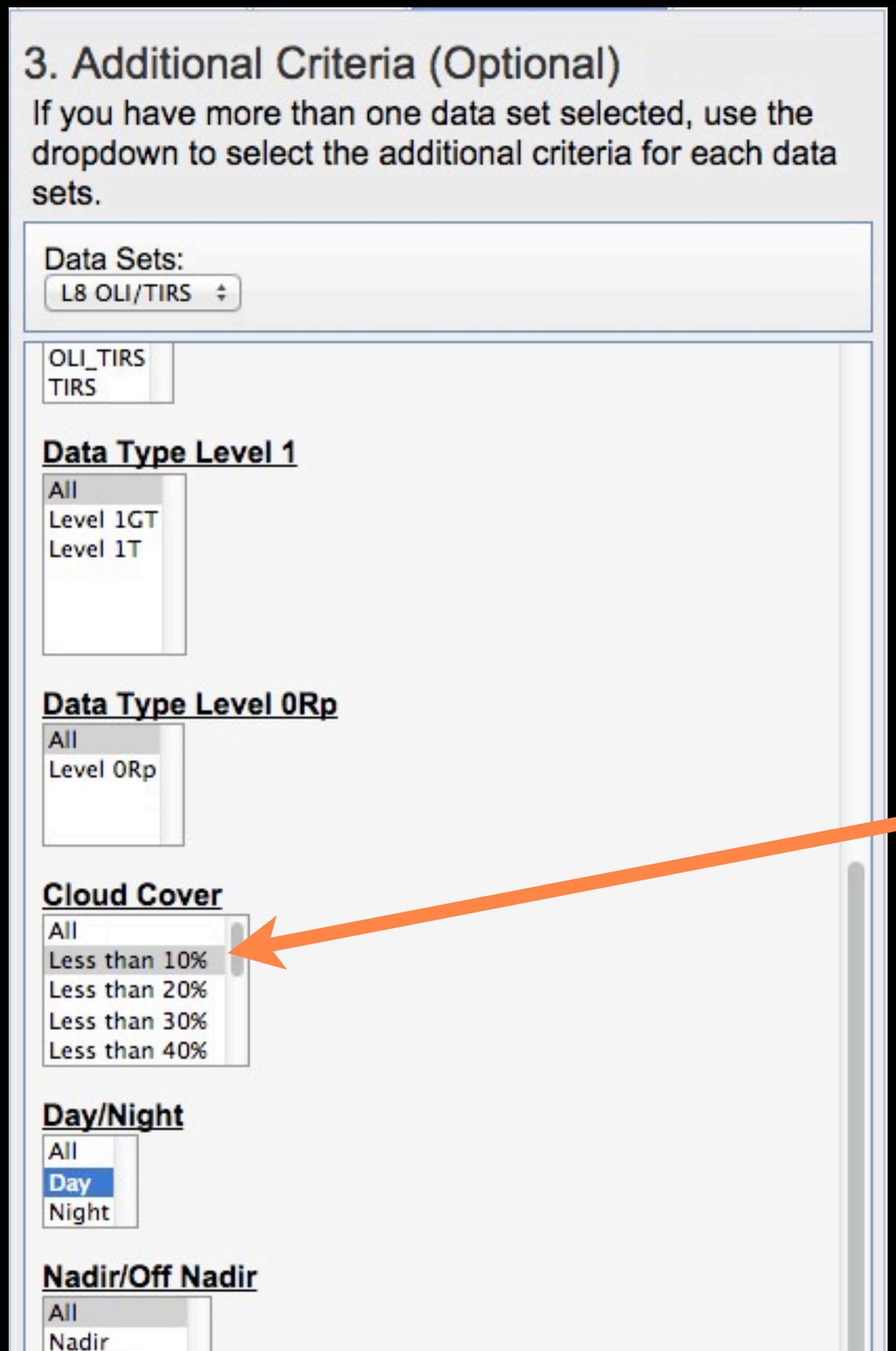
http://earthexplorer.usgs.gov

EarthExplorer

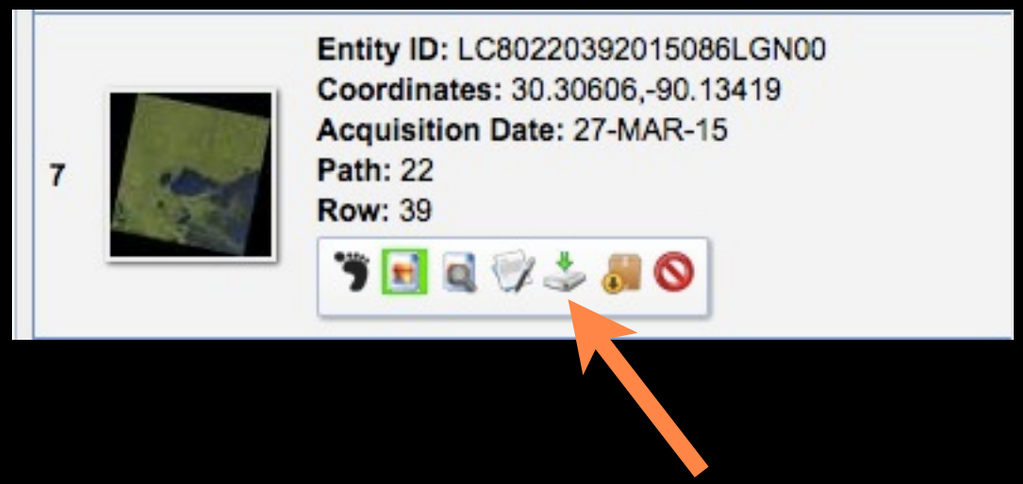


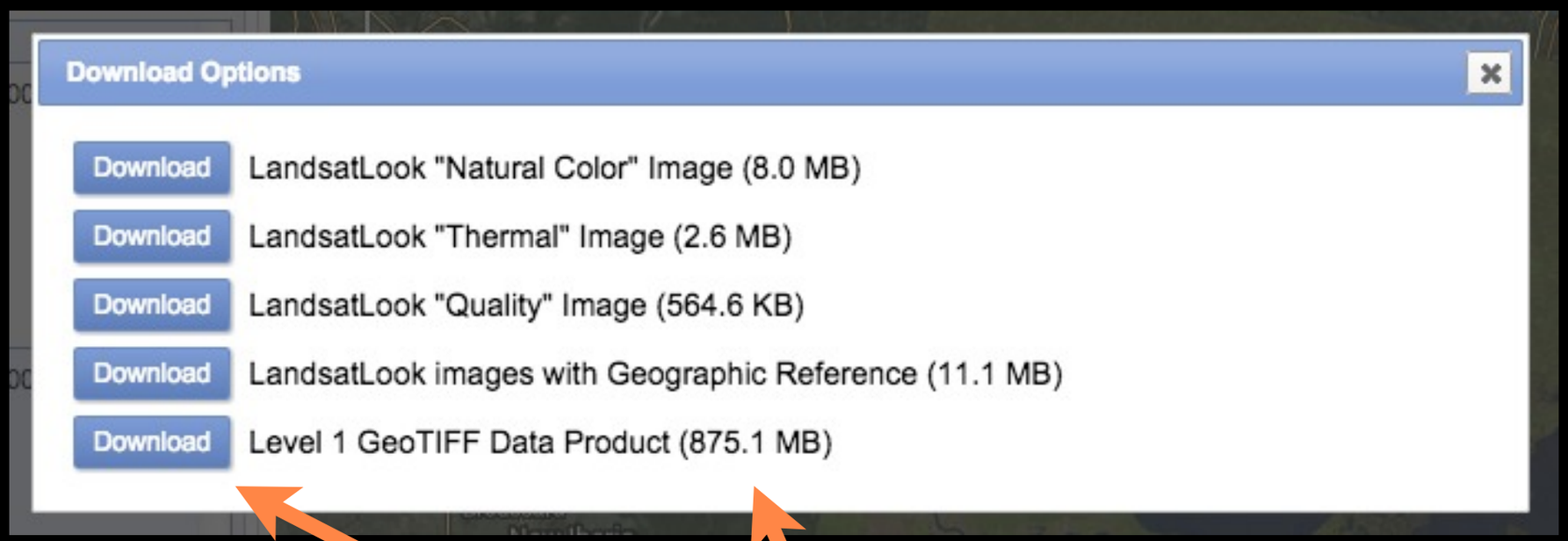
http://earthexplorer.usgs.gov

EarthExplorer

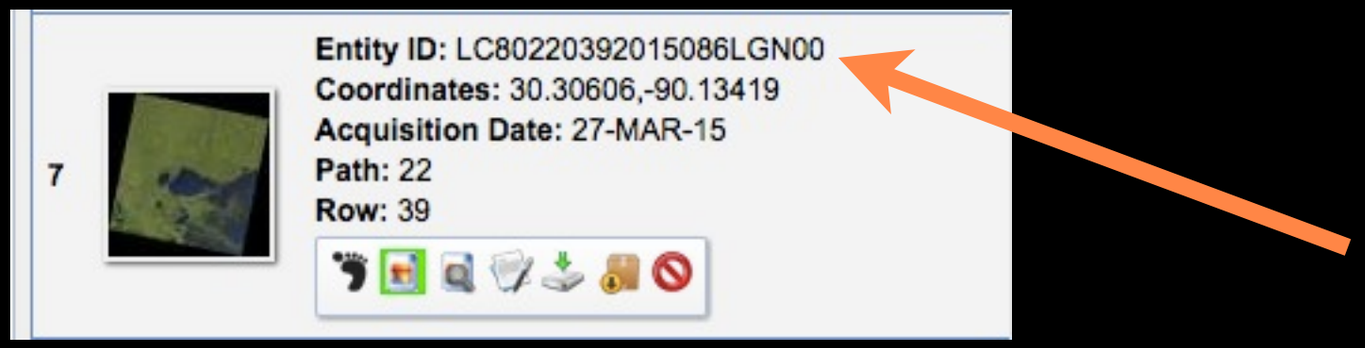


EarthExplorer





Hint!



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

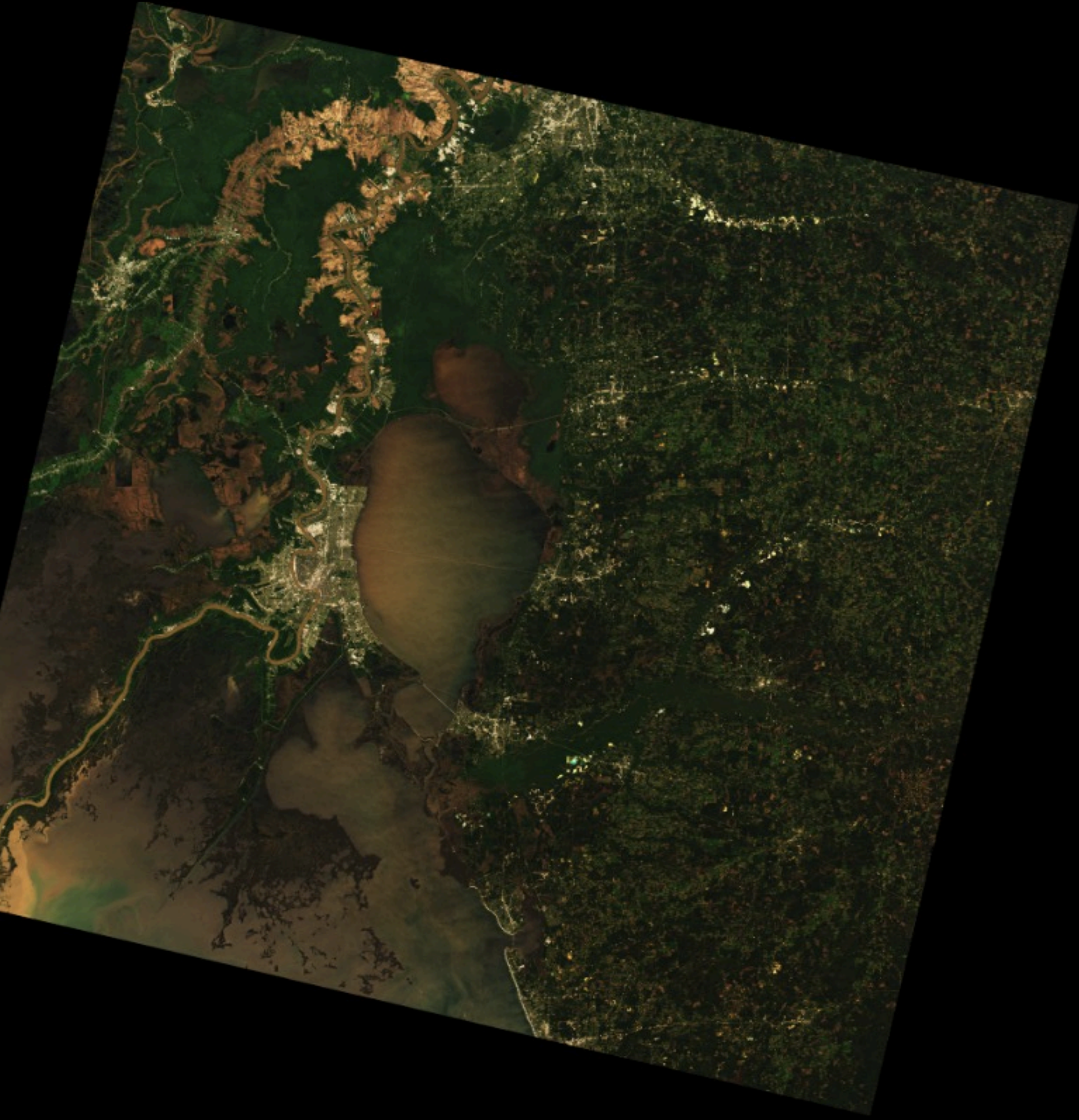
Let’s use GDAL tools to combine band files to process the Landsat image.

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
```

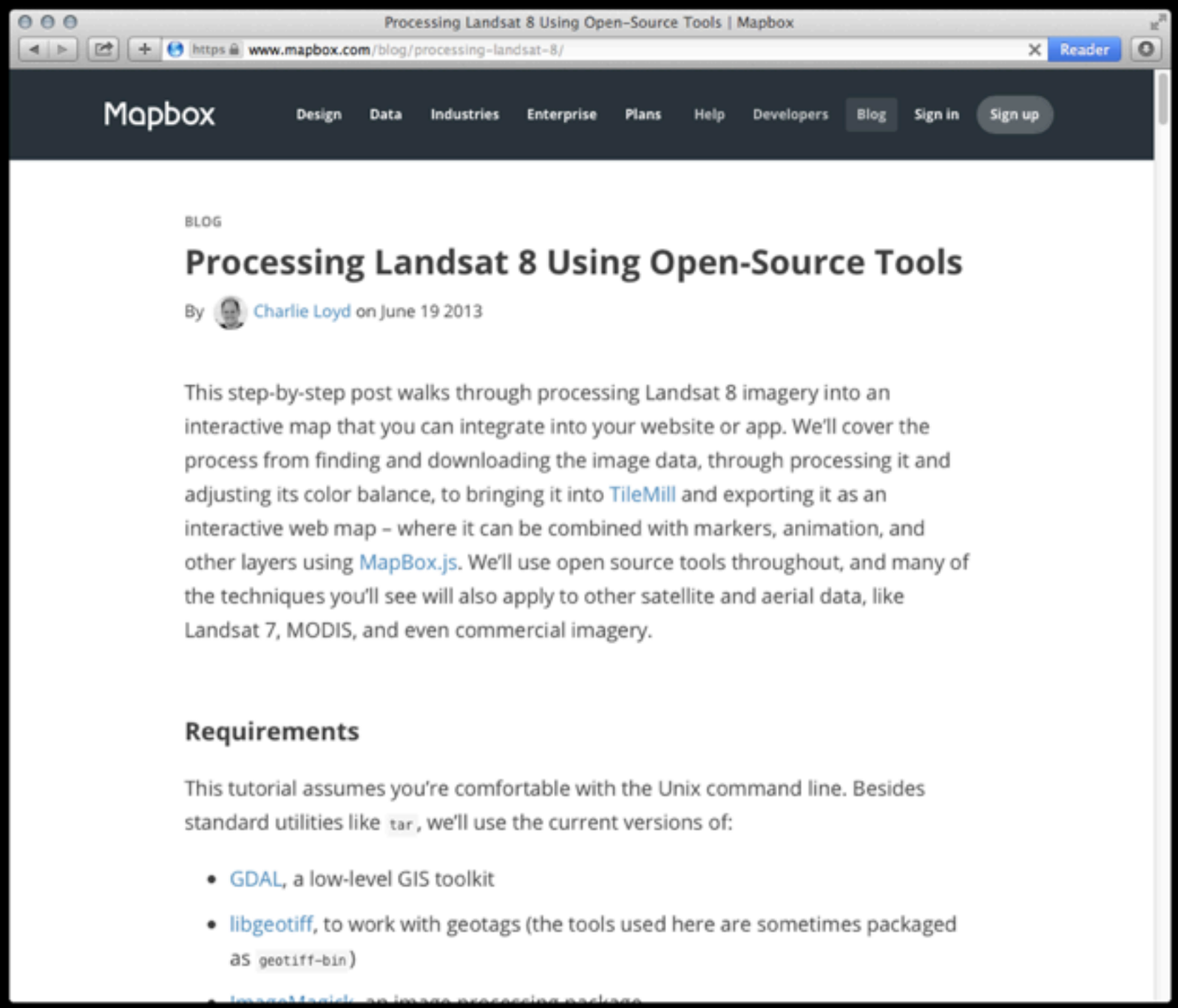


3. Rescue geo headers

```
> 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
```

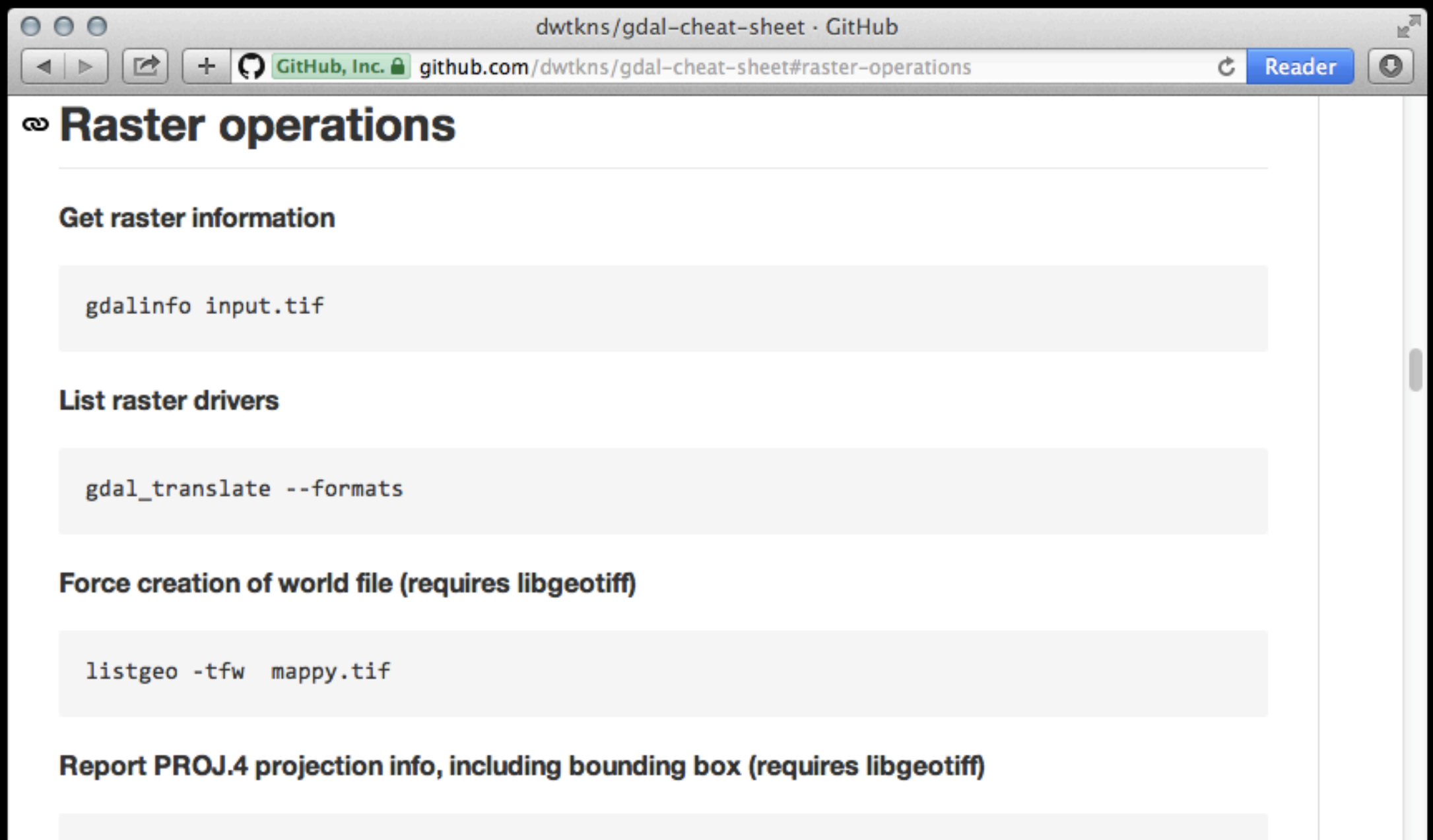
What we just did

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



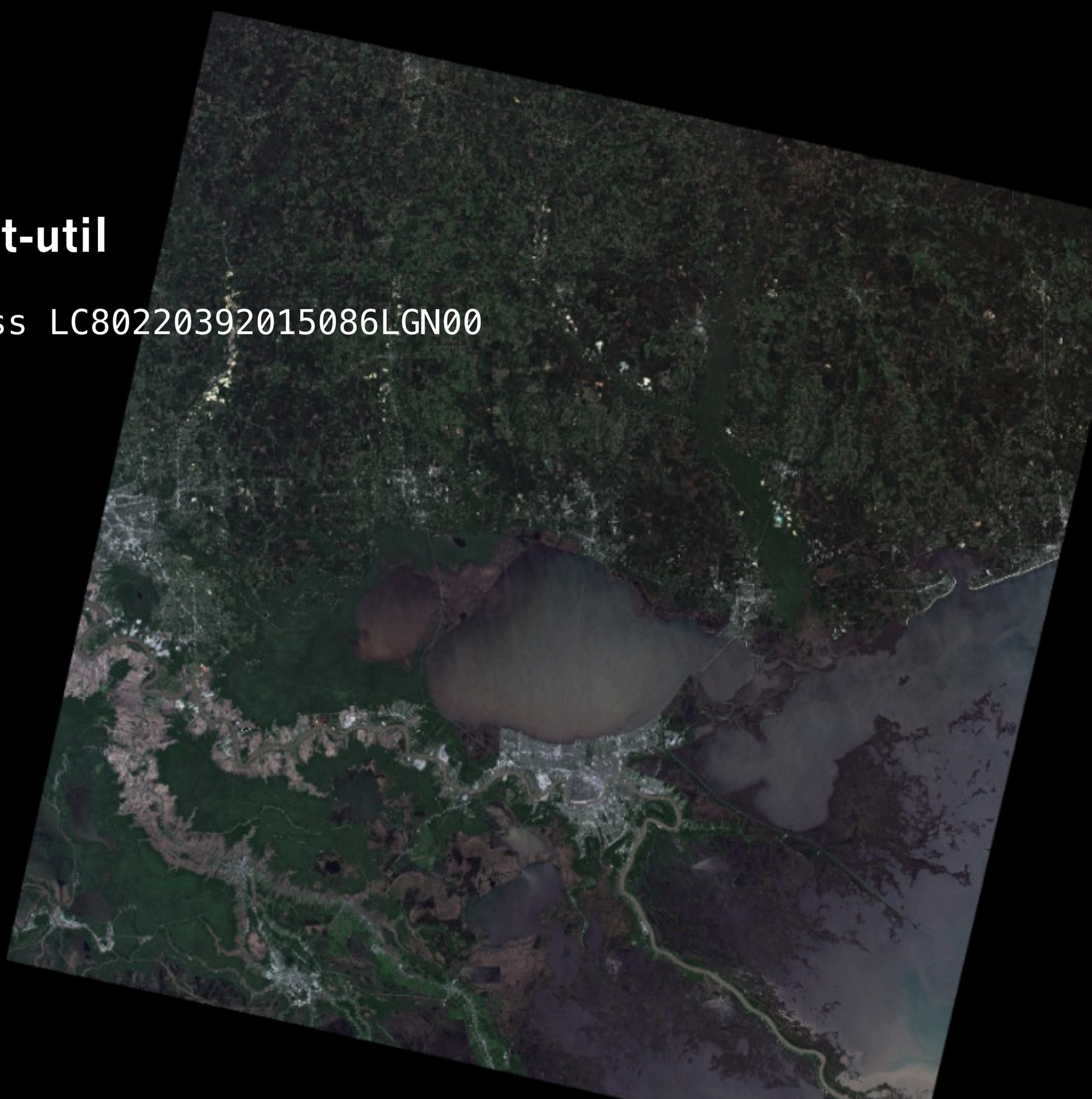
Derek Watkins' GDAL cheat sheet

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

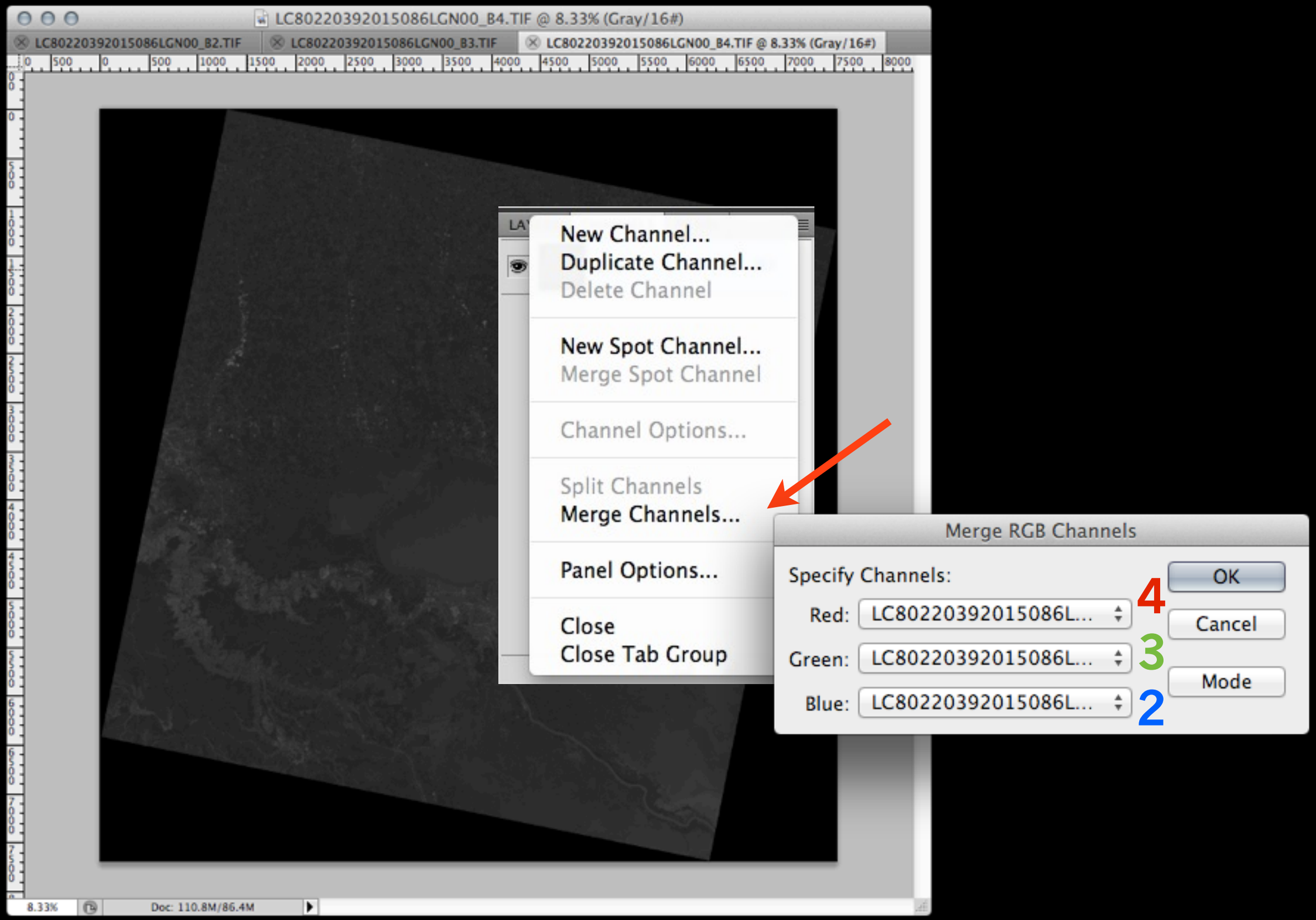


Or, with landsat-util

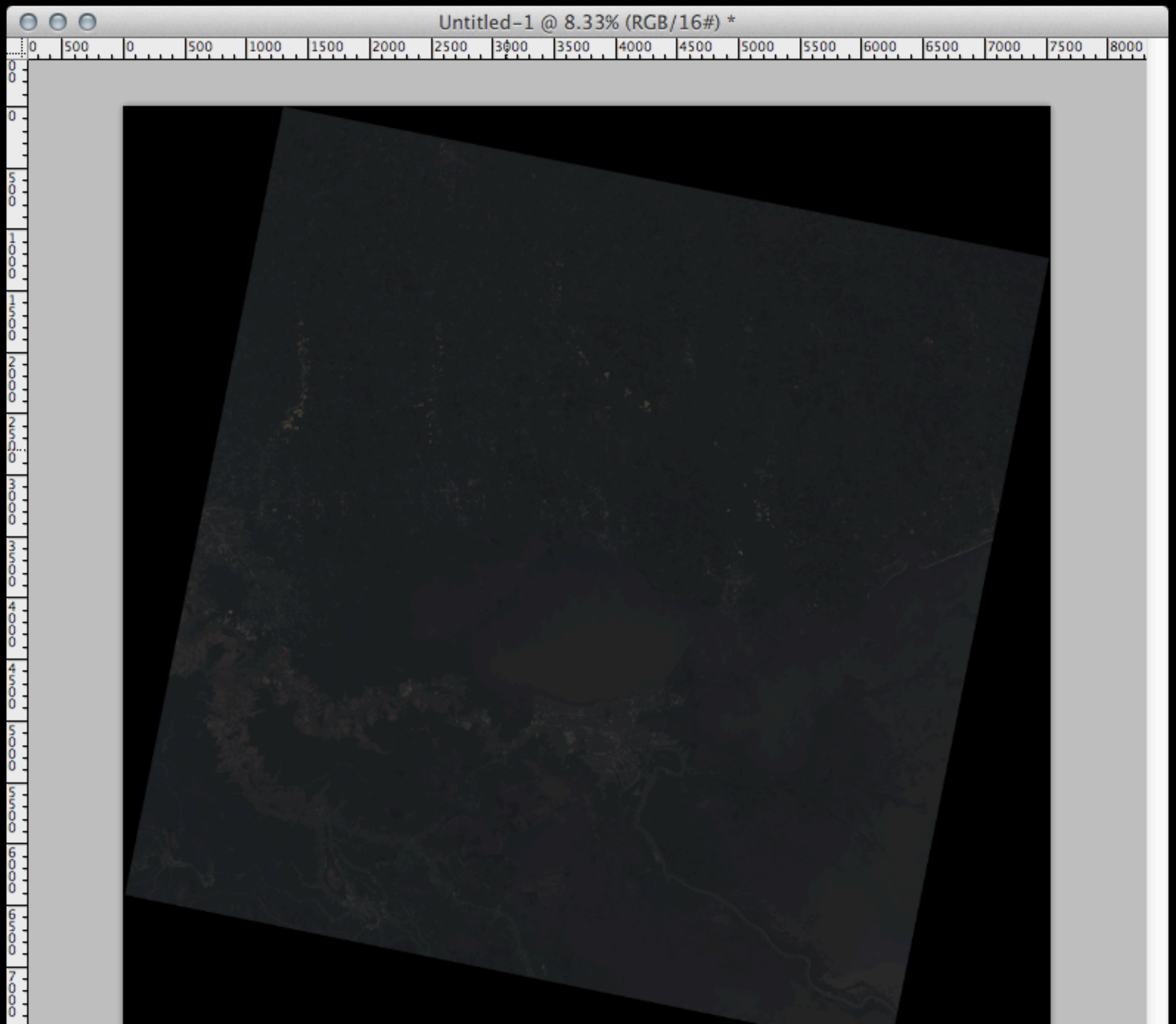
```
> landsat process LC80220392015086LGN00
```



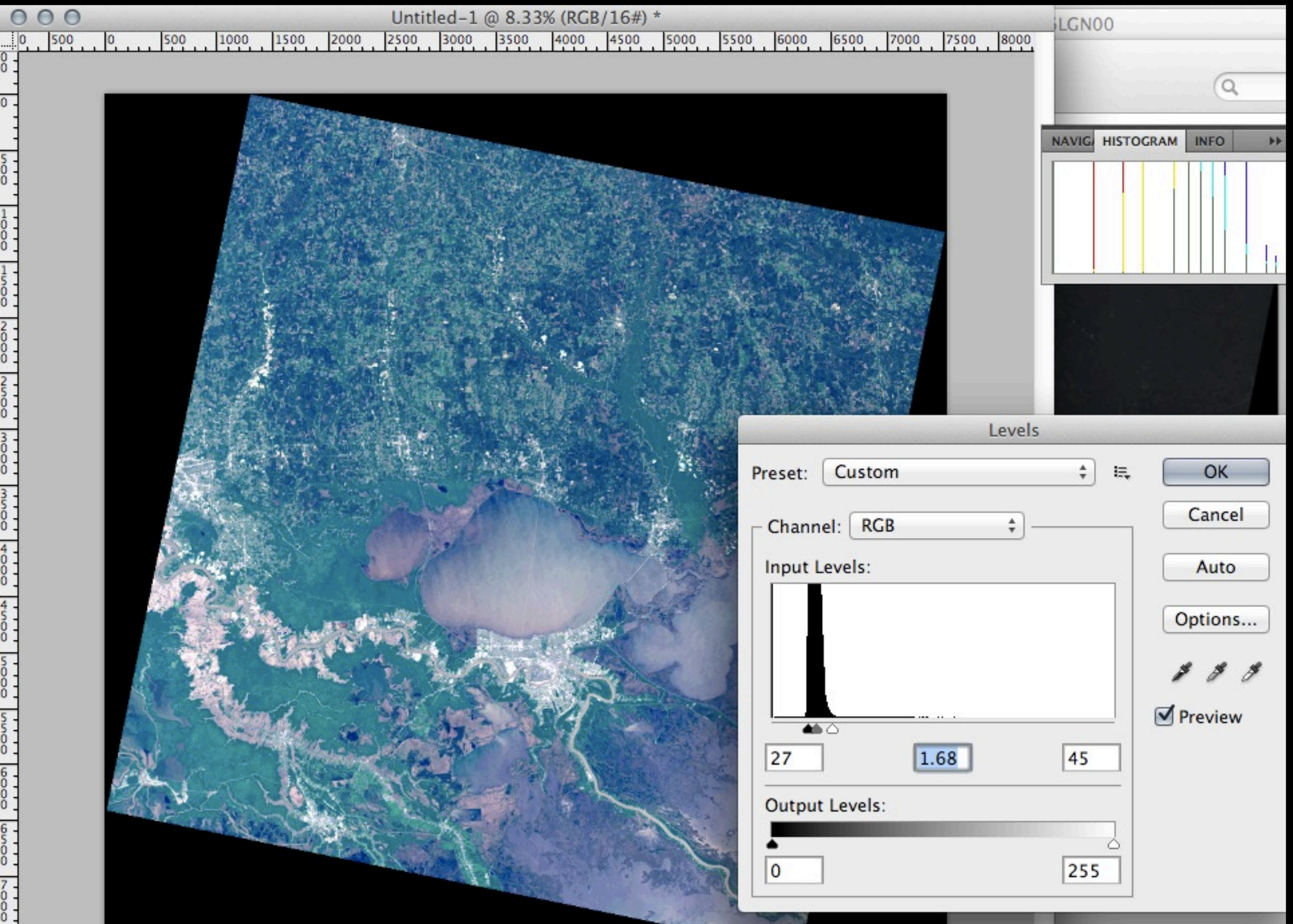
Or, with Photoshop



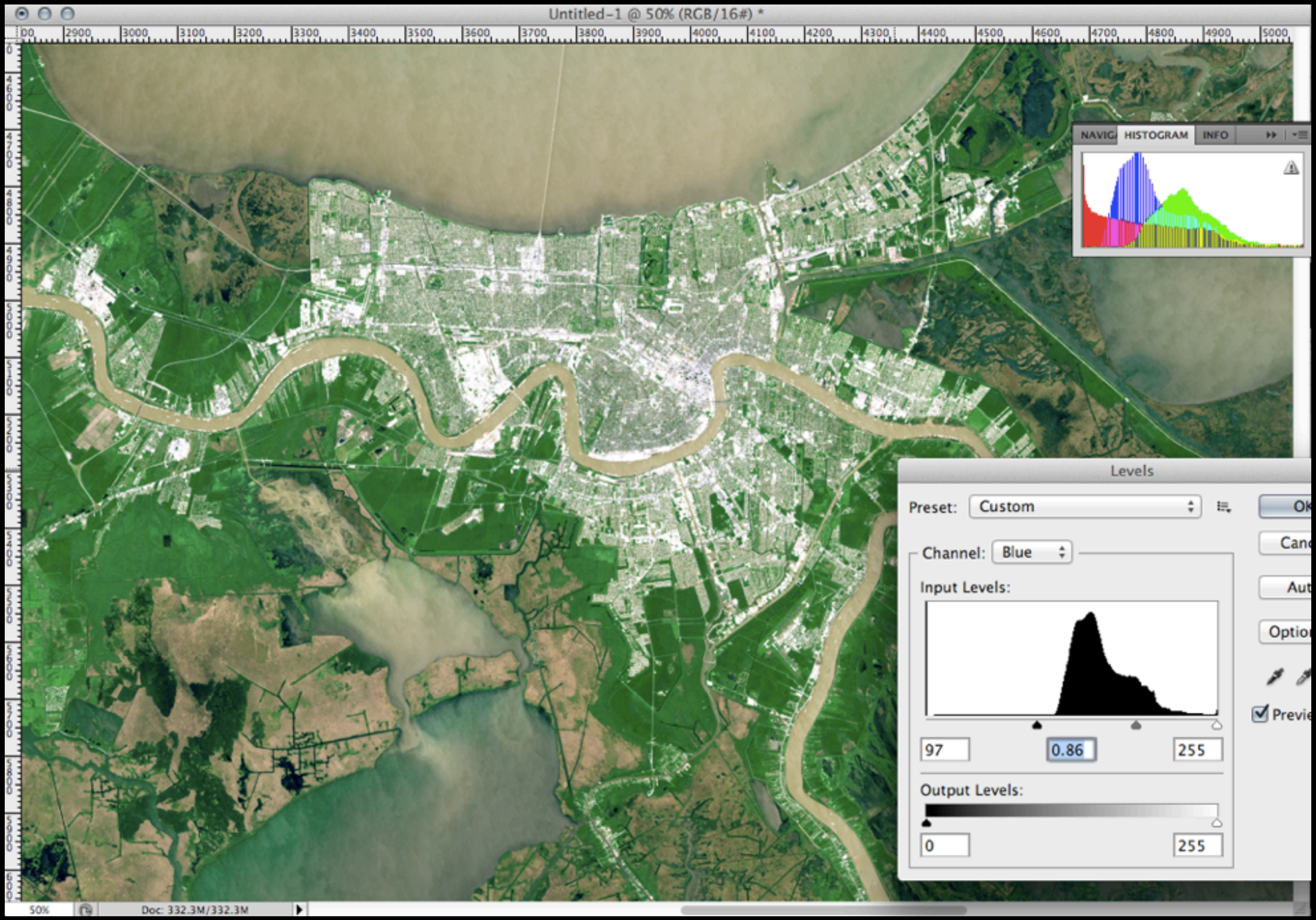
Or, with Photoshop



Or, with Photoshop

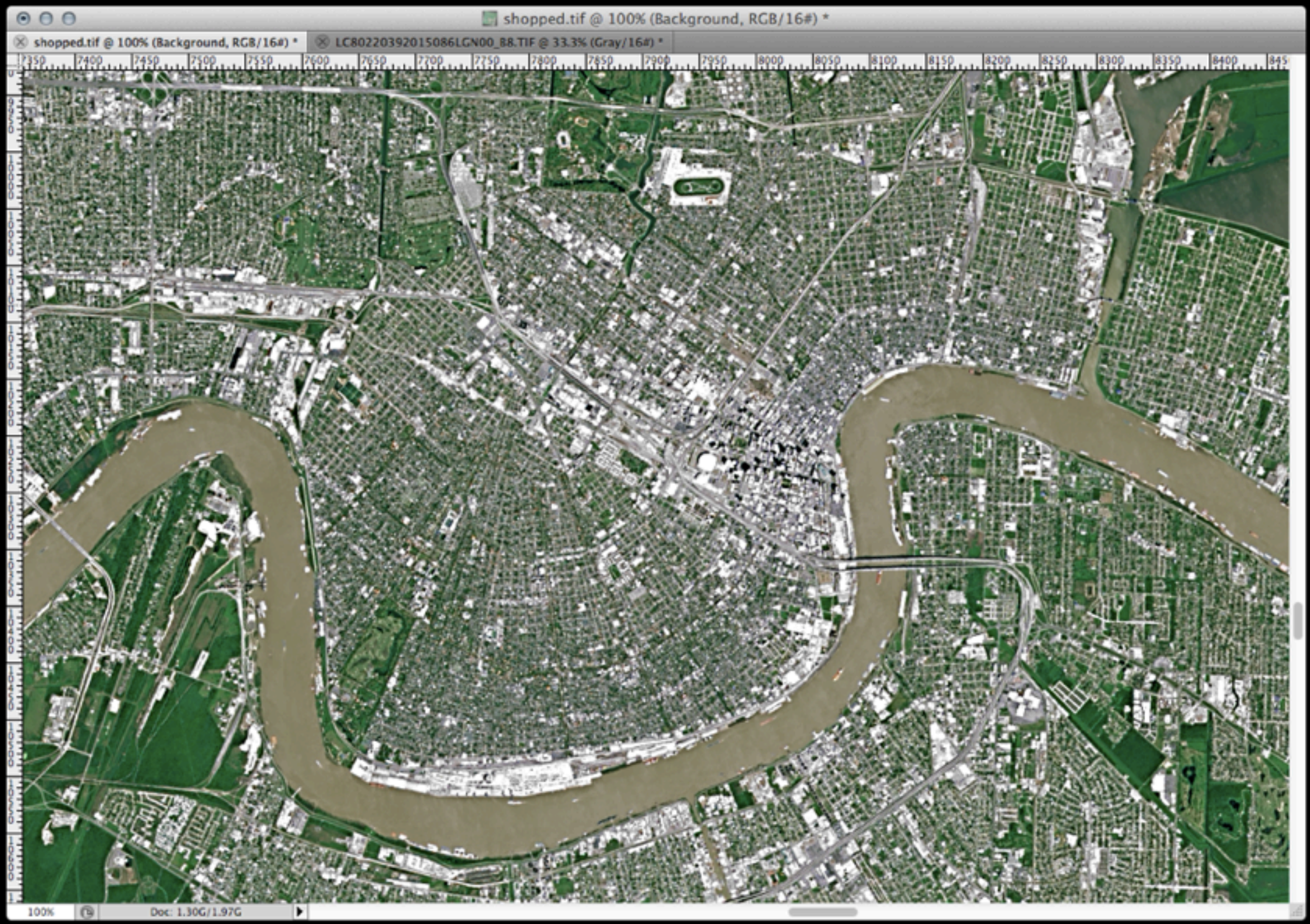


Or, with Photoshop



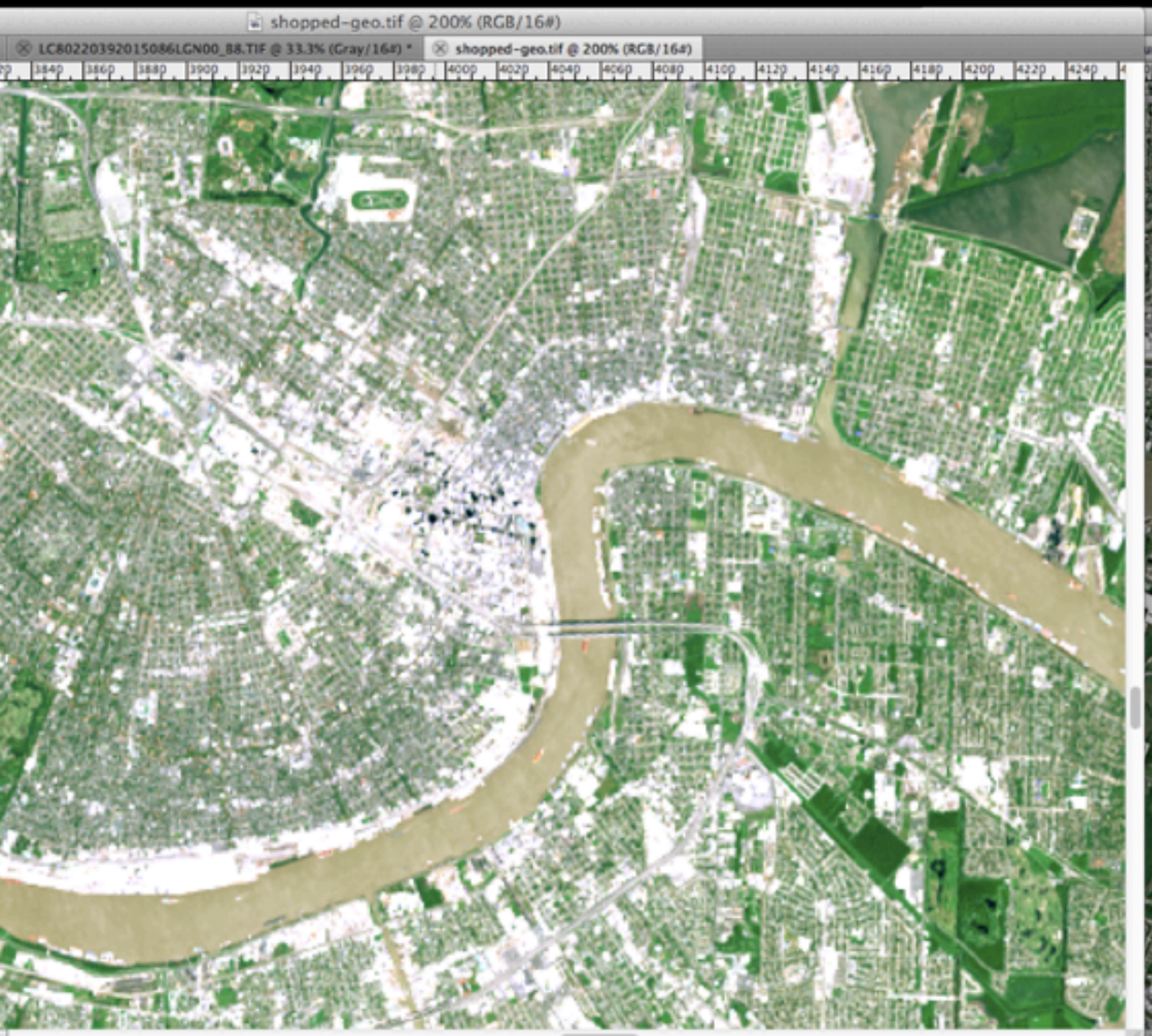
Or, with Photoshop

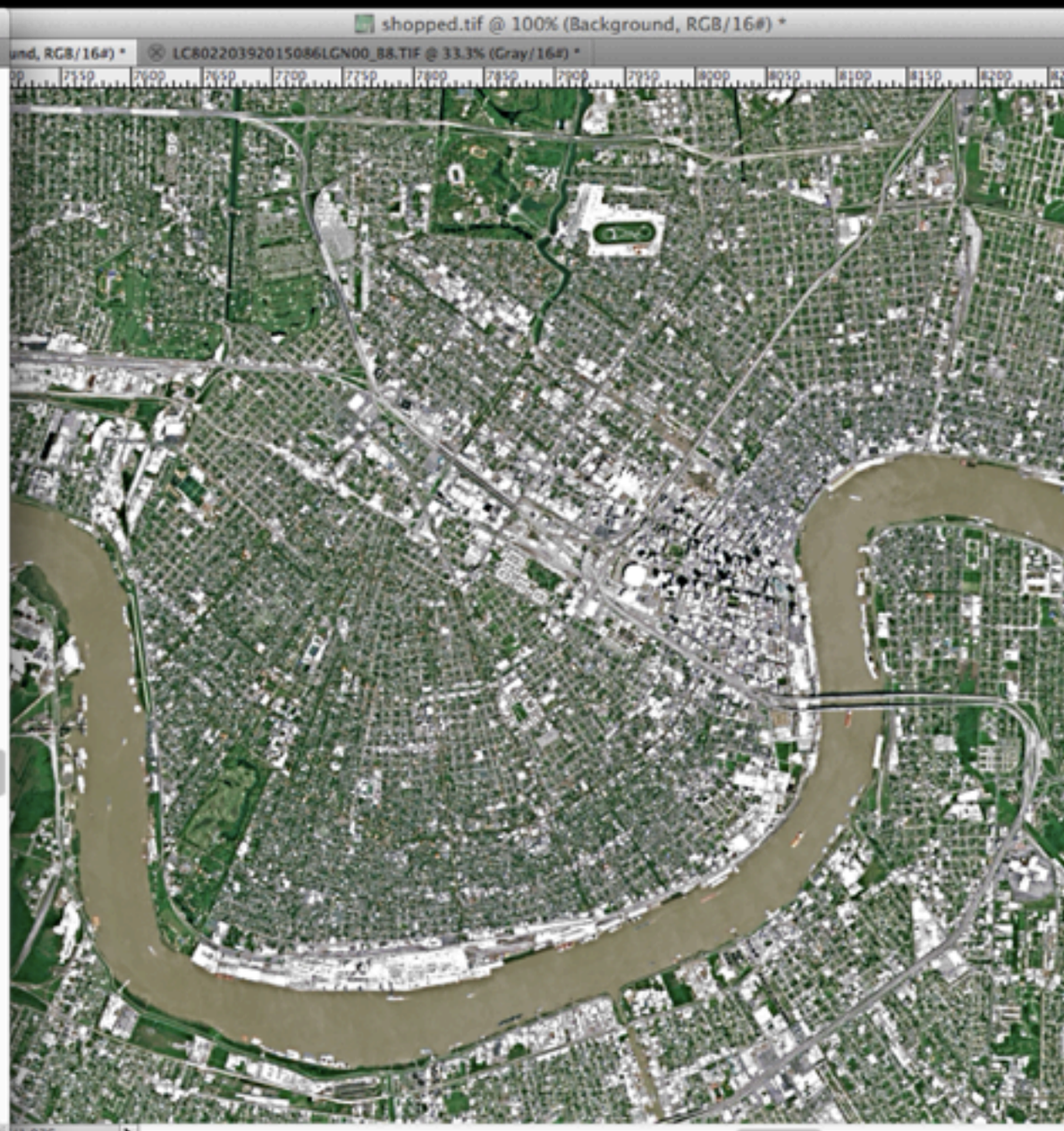
Pansharpening: 15m resolution with Landsat using band 8



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

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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 & Note

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.

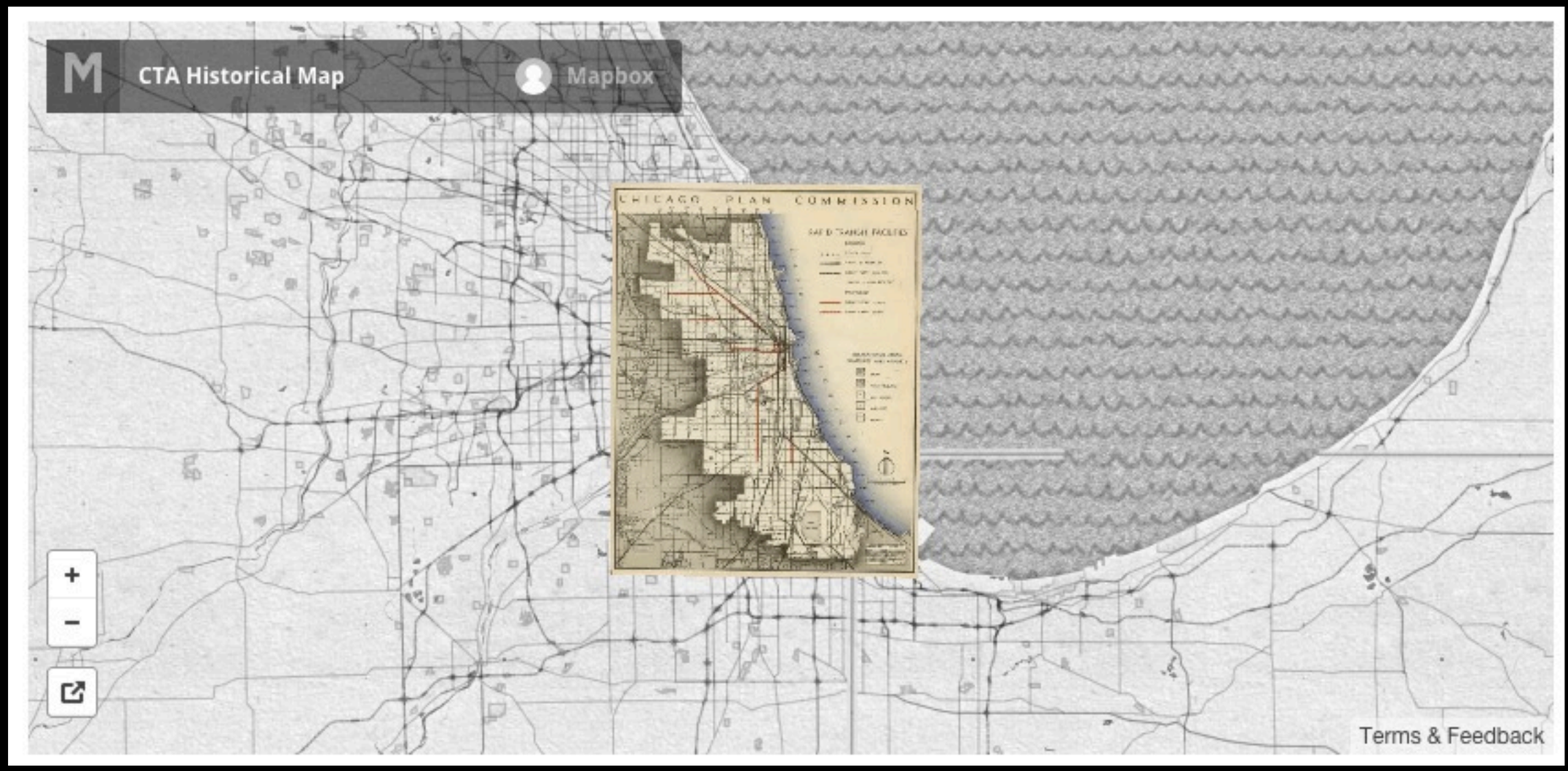
More

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

schooner-blend
schooner-cloud
schooner-contrast
schooner-multibalance
schooner-stitch

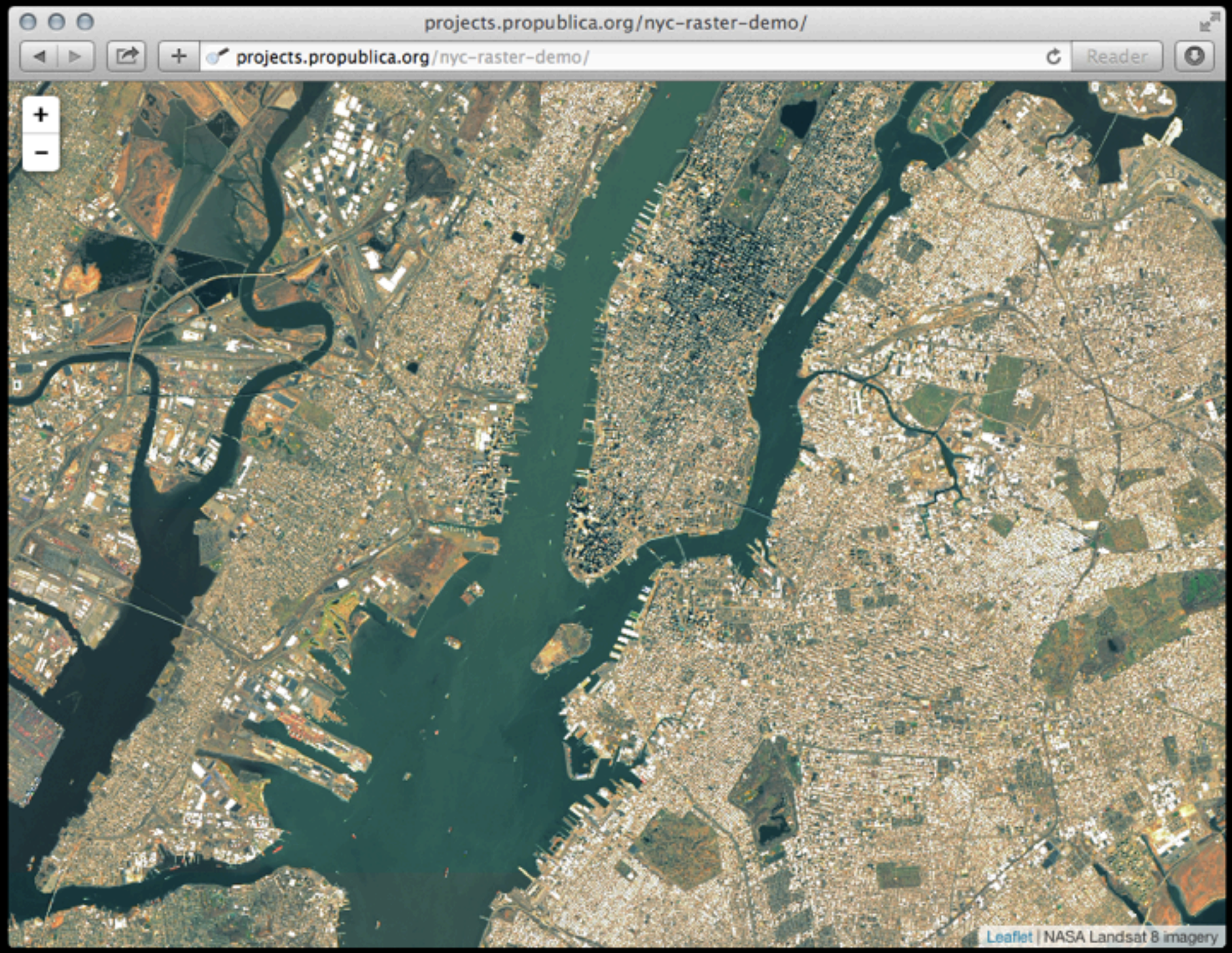
Using the data

Mapbox



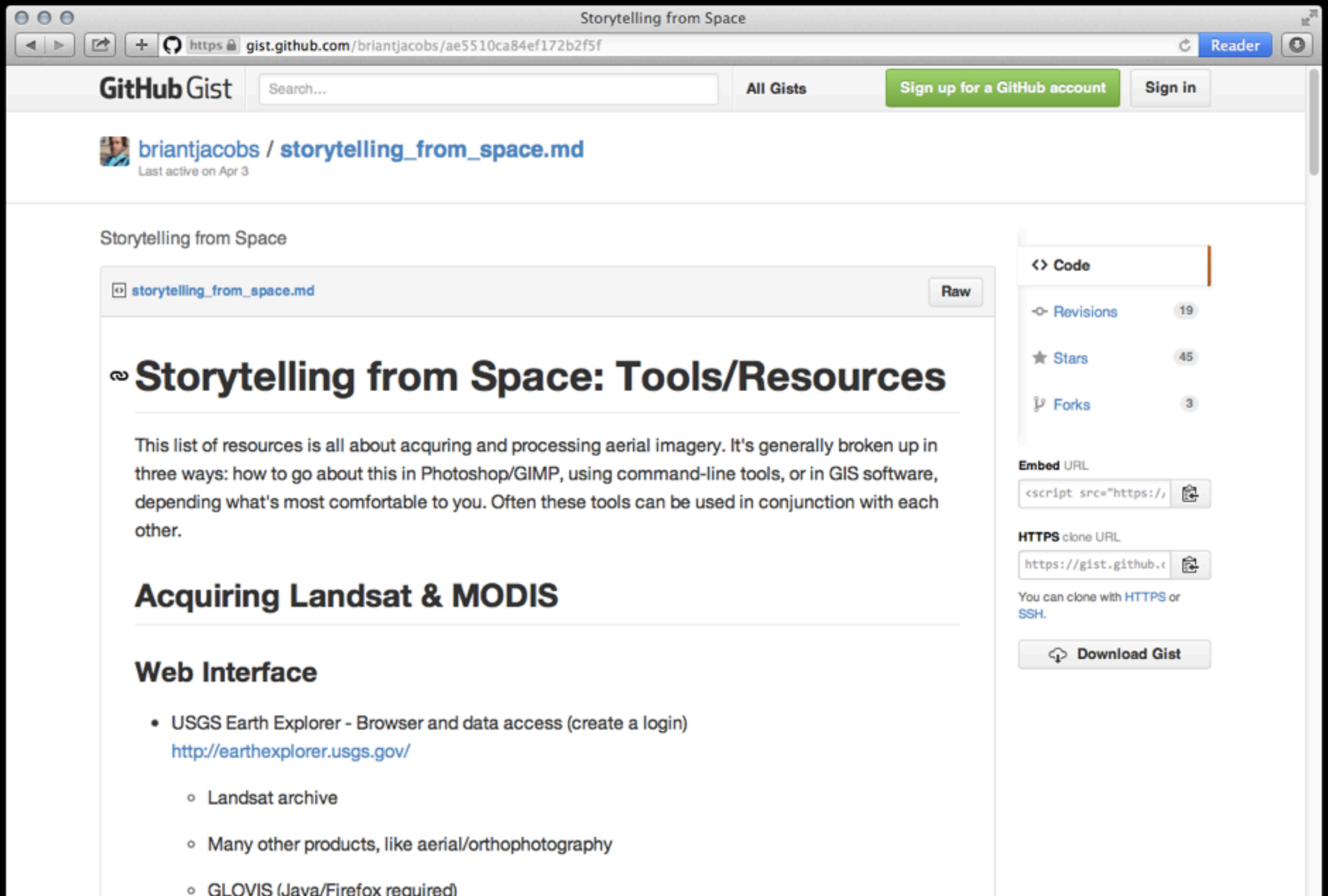
https://www.mapbox.com/blog/one-step-raster-imagery-mapboxcom/

SimpleTiles (ProPublica)



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

Resources from Brian Jacobs
http://j.mp/spacejournalism



Examples

Telling stories from space

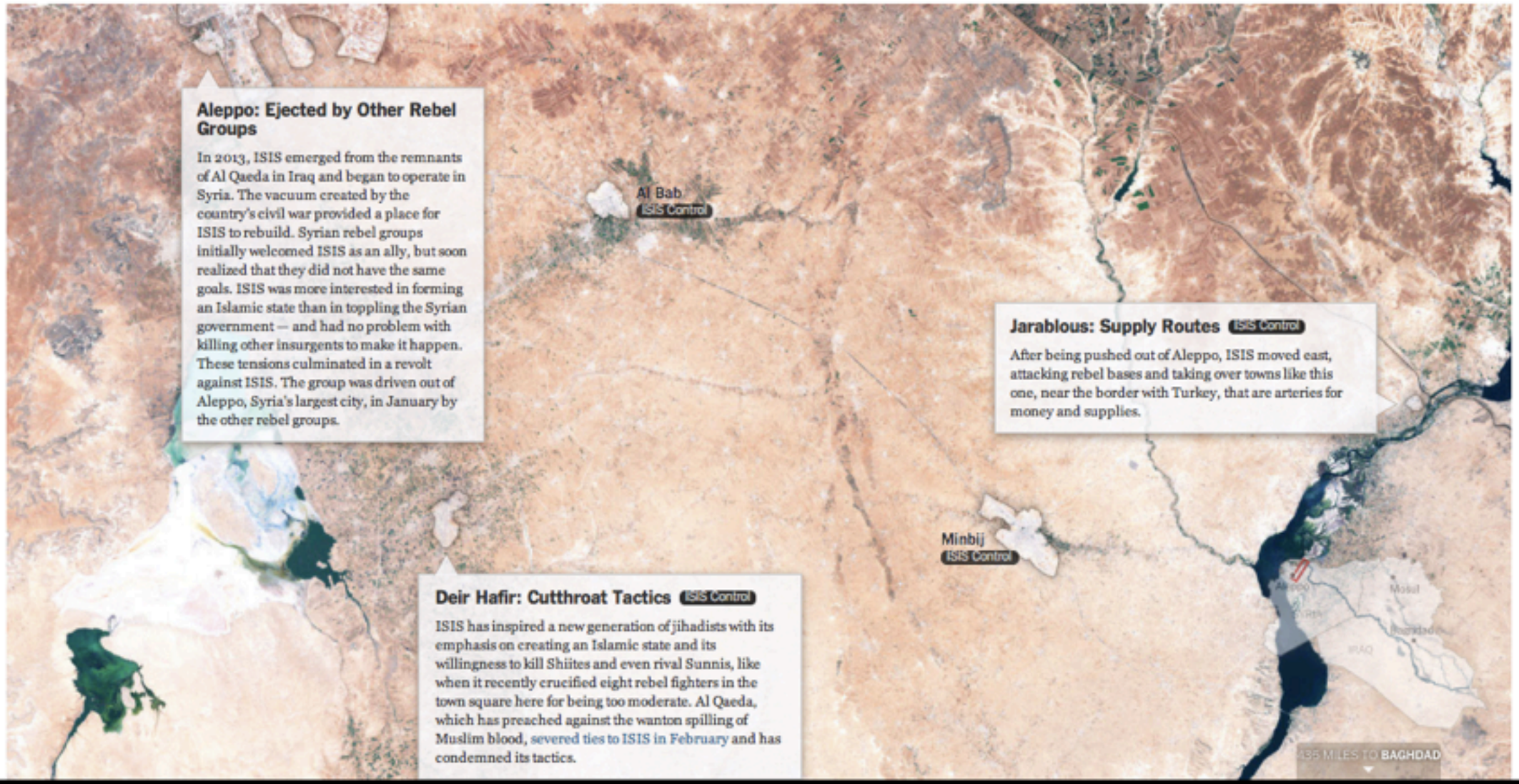
A Rogue State Along Two Rivers

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

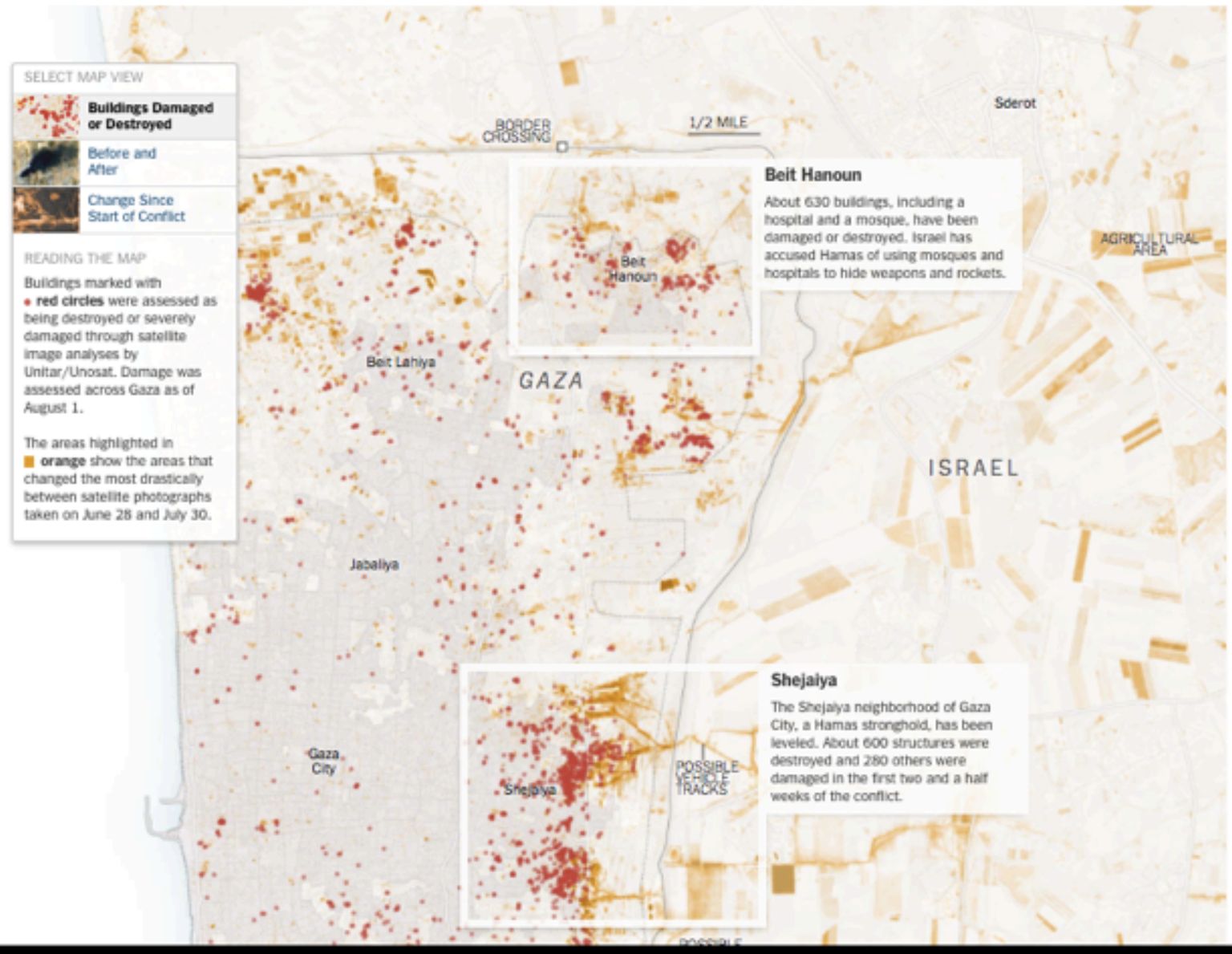


MIDDLE EAST

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

projects.propublica.org/louisiana/

Reader

PRO PUBLICA | THE LENS

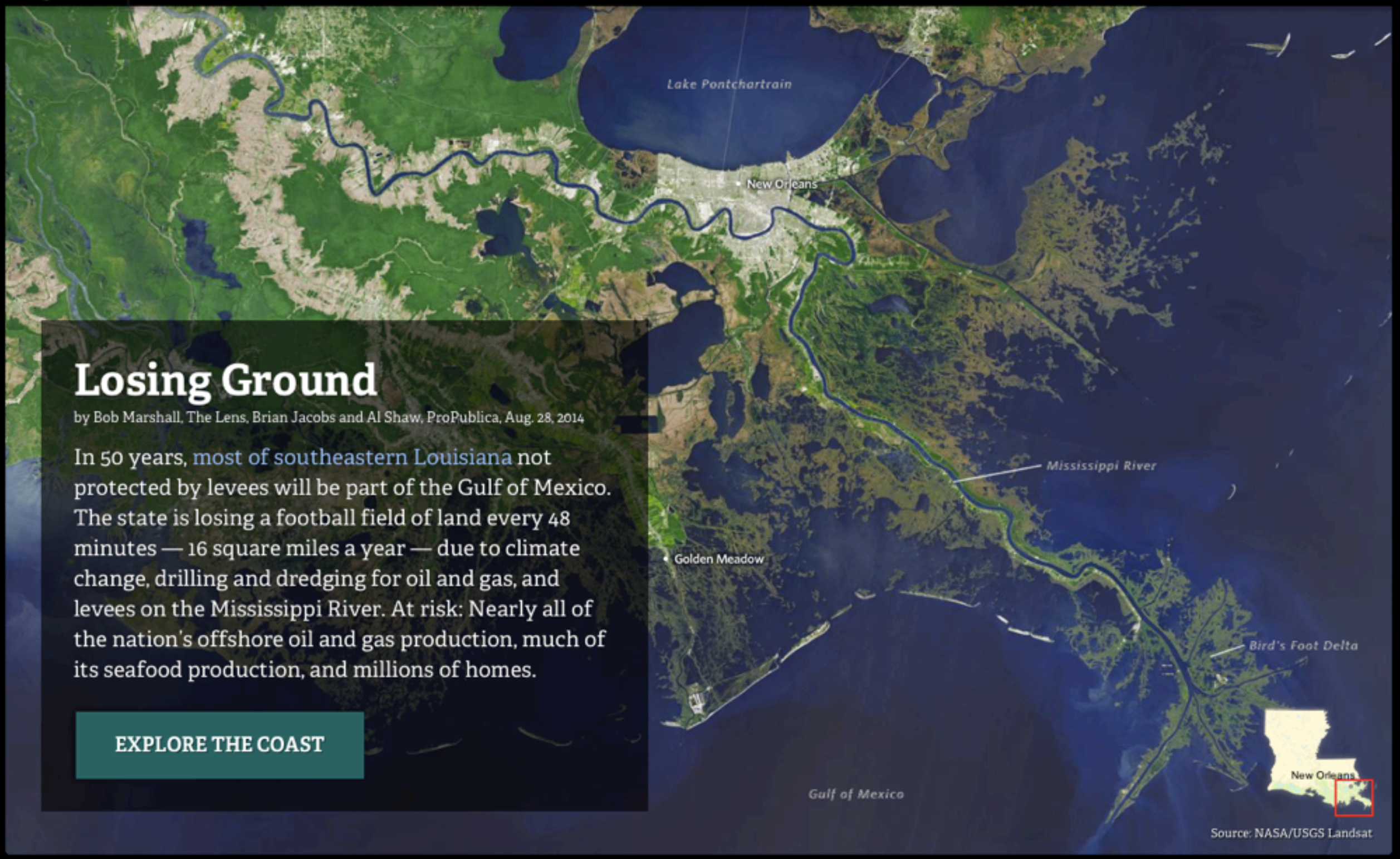
DONATE TO PROPUBLICA | DONATE TO THE LENS

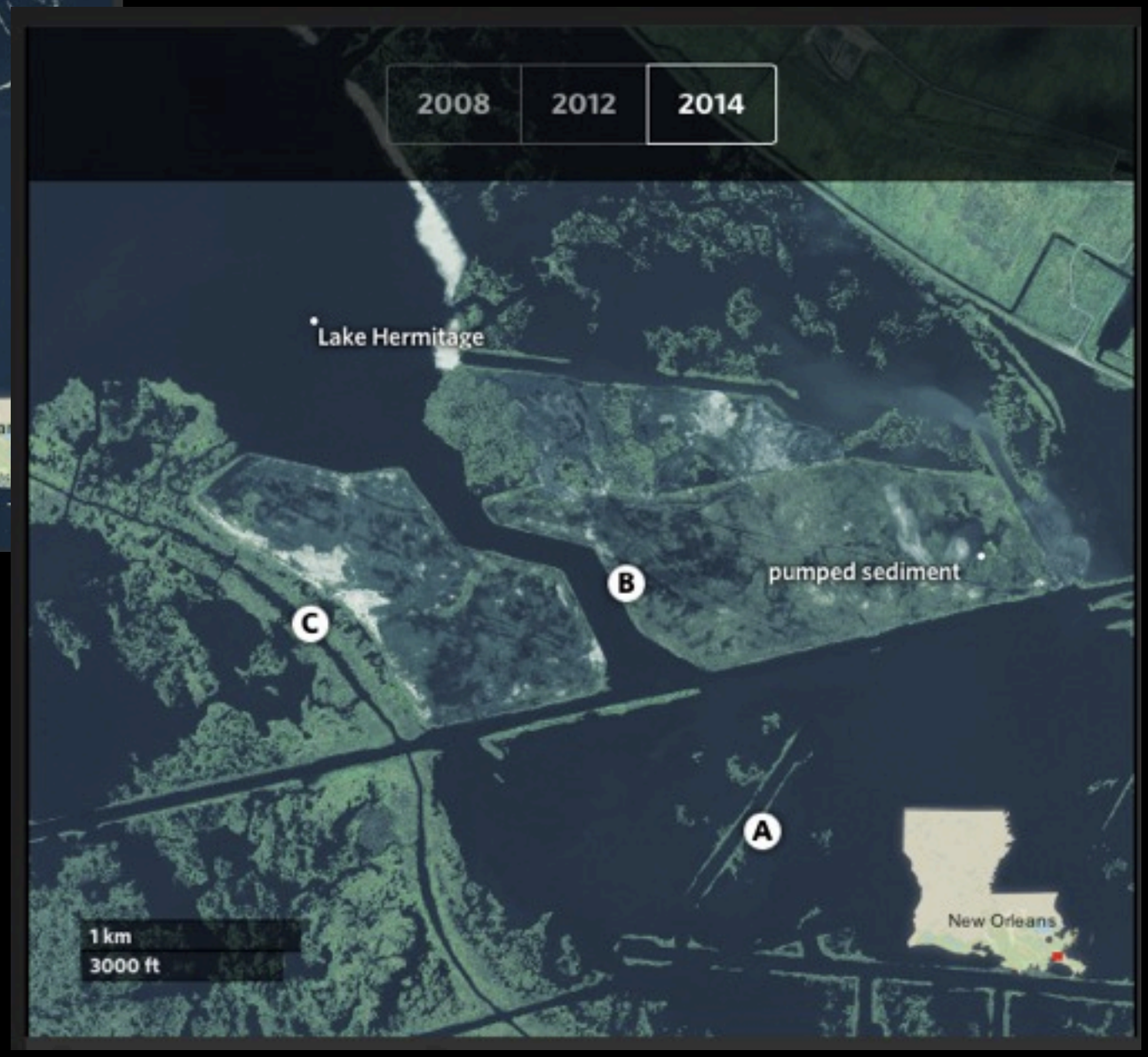
Losing Ground

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





http://projects.propublica.org/larestoration

Explore the River – Killing the Colorado – ProPublica

https projects.propublica.org/killing-the-colorado/explore-the-river#hoover-dam

Reader

PRO PUBLICA

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

DONATE

LAKE MOJAVE

HOOVER DAM

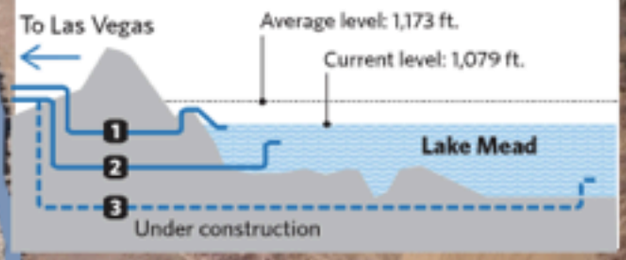
GETS US...
Up to 4 billion kilowatt-hours of electricity annually

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

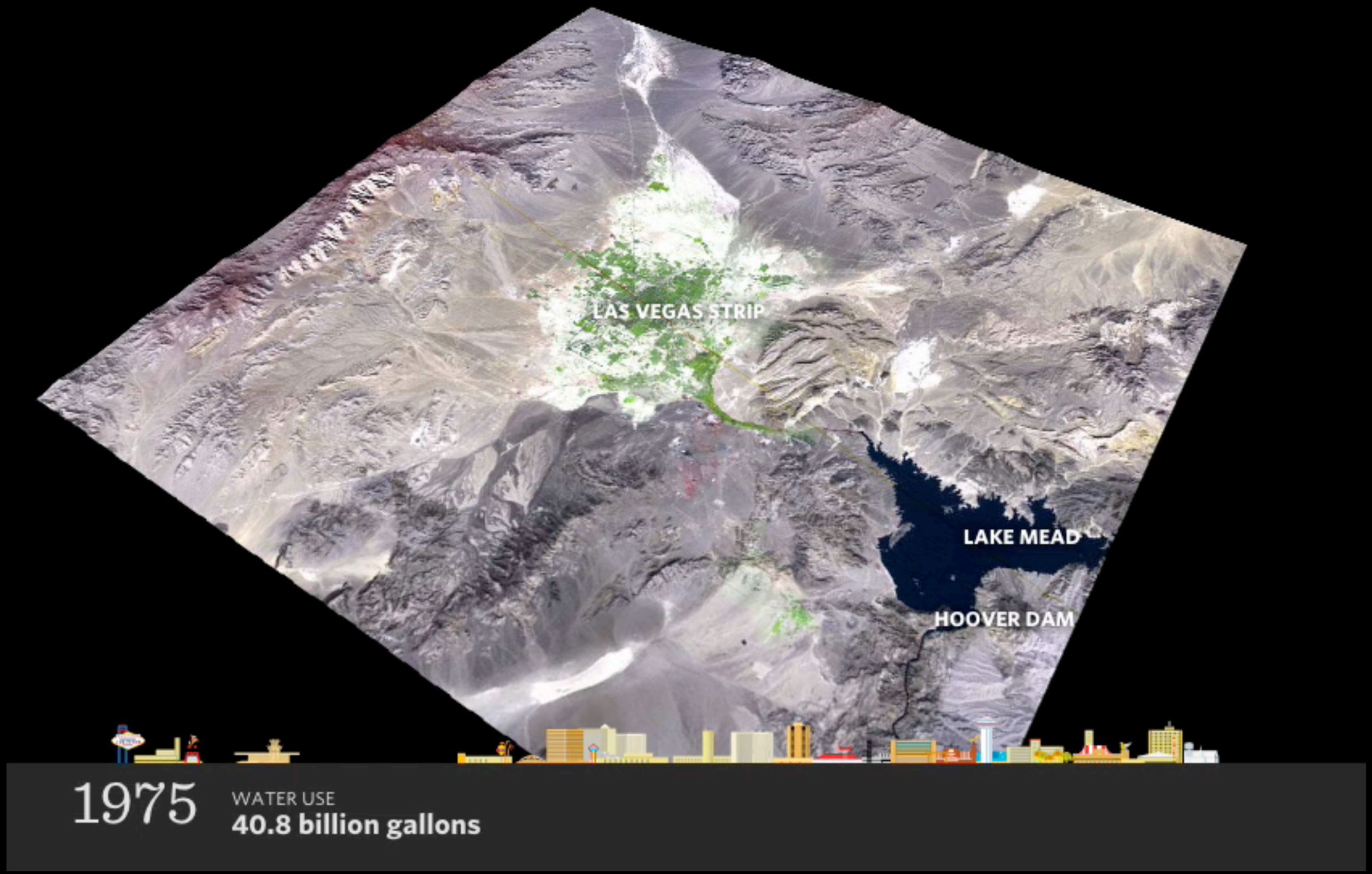
COMPLETED
1936

COST
$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.



http://j.mp/robot-river



http://j.mp/vegas-water

Why Isn't Texas Ready for

https://projects.propublica.org/houston/

PRO PUBLICA | THE TEXAS TRIBUNE Hell and High Water

Plain Text Version Donate

16 Hours before Landfall | Flood Level | Storm makes landfall

Hurricane Ike devastated Galveston Island in 2008.

About the maps | Flood levels in top chart taken at Kemah Boardwalk. | Sources: NOAA/GOES, USGS/NASA Landsat, SSPEED Center at Rice University, University of Texas Institute for Computational Engineering and Sciences, University of Houston Dept. of Civil and Environmental Engineering, Texas A&M Galveston Institute for Sustainable Coastal Communities, Jackson State University/Coastal Hazards Center, Harris County Appraisal District, U.S. Census

http://propublica.org/highwater

Thank you!

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