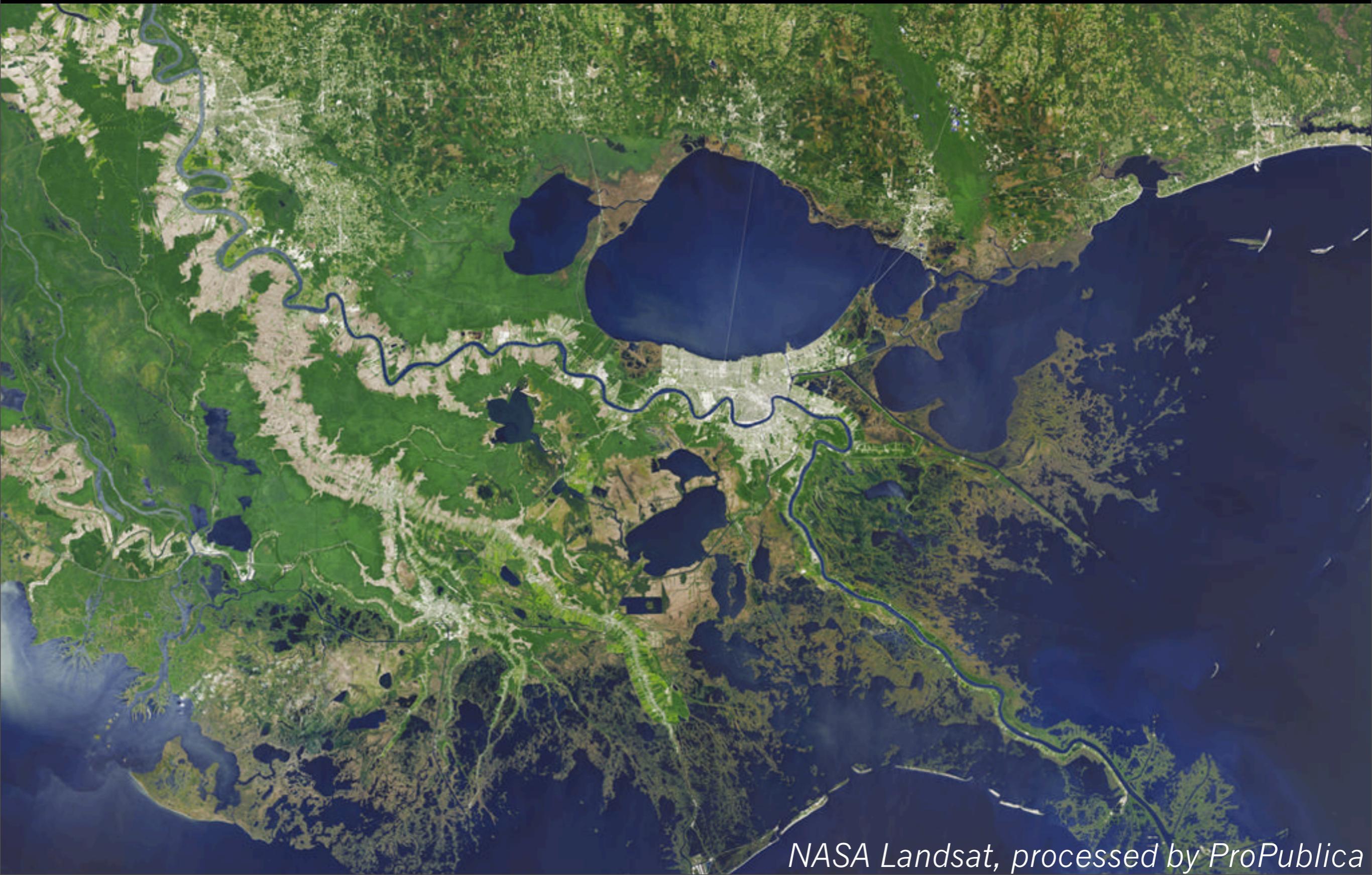


# Case Study: “Losing Ground”

@A\_L

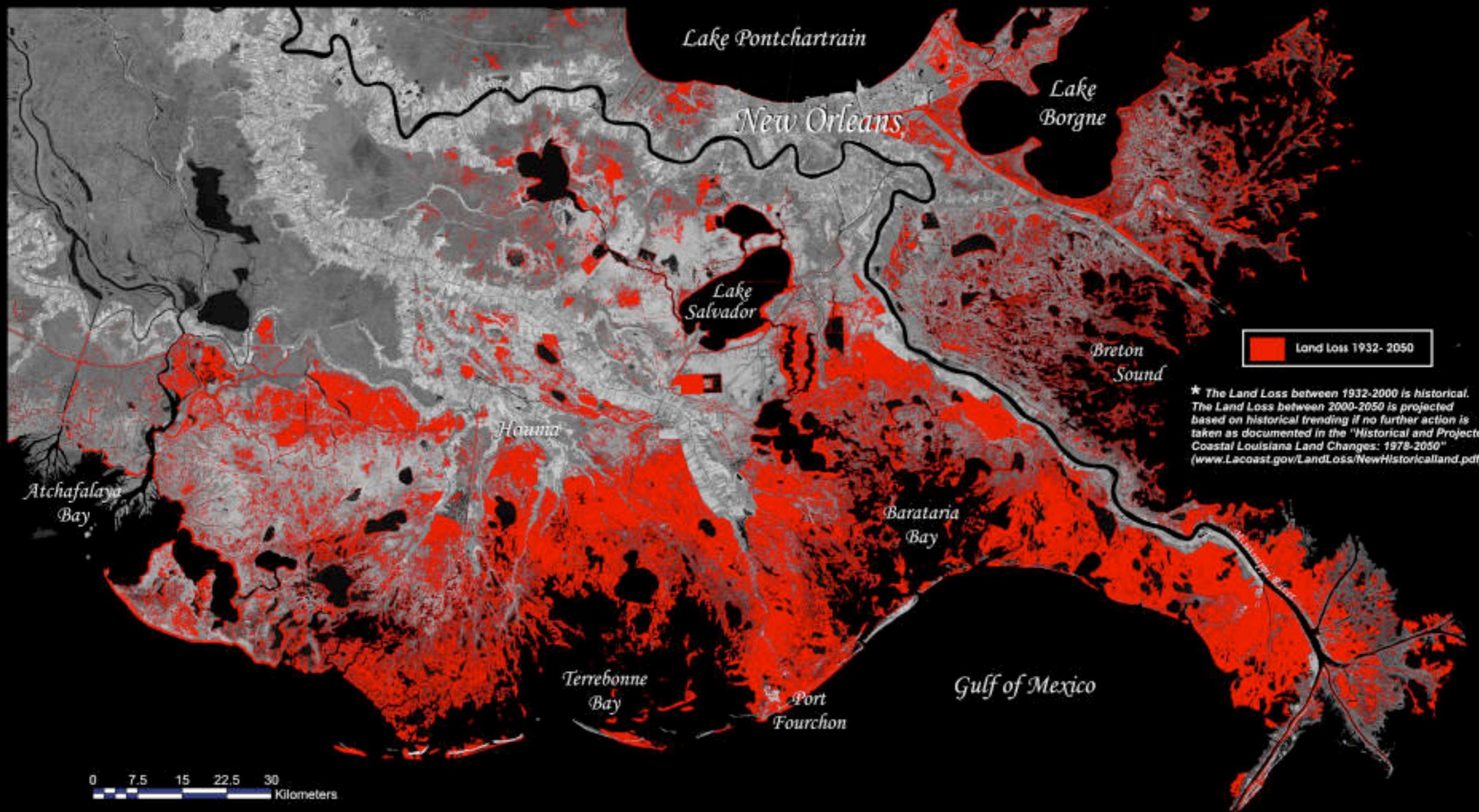
<http://j.mp/nicar-louisiana>



NASA Landsat, processed by ProPublica

# Southeast Louisiana Land Loss

\*Historical and Projected Land Loss in the Deltaic Plain



## Changing Louisiana shoreline

Shoreline surveys done after the 2005 hurricane season showed that storms, erosion, subsidence and other factors had changed the coastal landscape. The first of several announced results of this work takes 31 place names off National Oceanic and Atmospheric Administration charts.

Port Sulphur

Empire

Buras

Venice

Pilottown

West Bay

East Bay

N

- 1 Bay Pomme d'Or
- 2 Little Pomme d'Or
- 3 English Bay
- 4 Bayou Auguste
- 5 Bayou le Boon
- 6 Bay Jacquin
- 7 Cyprien Bay
- 8 English Bayou
- 9 Scofield Bay
- 10 Bay Crapaud
- 11 Skipjack Bay
- 12 Bayou la Chute
- 13 Bayou Long
- 14 Drakes Bay
- 15 Bay Cheri
- 16 Dry Cypress Bayou
- 17 Bob Taylors Pond
- 18 Tom Loar Pass
- 19 Williams Pass
- 20 Pass de Wharf
- 21 Little Pass de Wharf
- 22 Bayou Tony
- 23 Bayou Caiman
- 24 Fleur Pond
- 25 Venice Canal
- 26 Locust Pond
- 27 Andres Pond
- 28 Yellow Cotton Bay
- 29 Bayou Dum Barr
- 30 Bayou Petit Liard
- 31 Grand Bayou Carrion Crow

Source: NOAA, LSU Coastal Studies Institute

Advocate graphic



1956

1972

2013

“Wagon wheel,” Venice, La.

USGS Aerials

# Investigative Space Journalism!



# Acquiring Imagery

EarthExplorer

Search Criteria Summary (Show)

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

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 >

L8 OLI/TIRS

Entity ID: LC80210392015047LGN00  
Coordinates: 30.30605,-88.57946  
Acquisition Date: 16-FEB-15  
Path: 21  
Row: 39

Entity ID: LC80230382015045LGN00  
Coordinates: 31.74236,-91.2838  
Acquisition Date: 14-FEB-15  
Path: 23  
Row: 38

Entity ID: LC80230392015045LGN00  
Coordinates: 30.30618,-91.66444  
Acquisition Date: 14-FEB-15  
Path: 23  
Row: 39

Entity ID: LC80220382015038LGN00  
Coordinates: 31.74201,-89.75133  
Acquisition Date: 07-FEB-15  
Path: 22  
Row: 38

Entity ID: LC80220392015038LGN00

5 6 7 8

© 2014 Google

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.

The screenshot shows the EarthExplorer software interface. On the left, there is a sidebar titled '4. Search Results' containing five entries for L8 OLI/TIRS data sets, each with a thumbnail, entity ID, coordinates, acquisition date, path, row, and a set of control icons. On the right, there is a main window titled 'Search Criteria Summary (Show)' showing a map of the Gulf Coast region. A red rectangle highlights a specific area on the map, likely indicating the footprint of one of the acquired scenes. The map includes state boundaries, county lines, and major cities like Mobile, Biloxi, Pascagoula, Hattiesburg, and Baton Rouge. A legend at the top right of the map window shows coordinate values (30° 26' 38" N, 092° 32' 35" W). The bottom of the map window contains copyright information from Google and a note about the map's purpose.

<http://earthexplorer.usgs.gov>

**landsat-util**

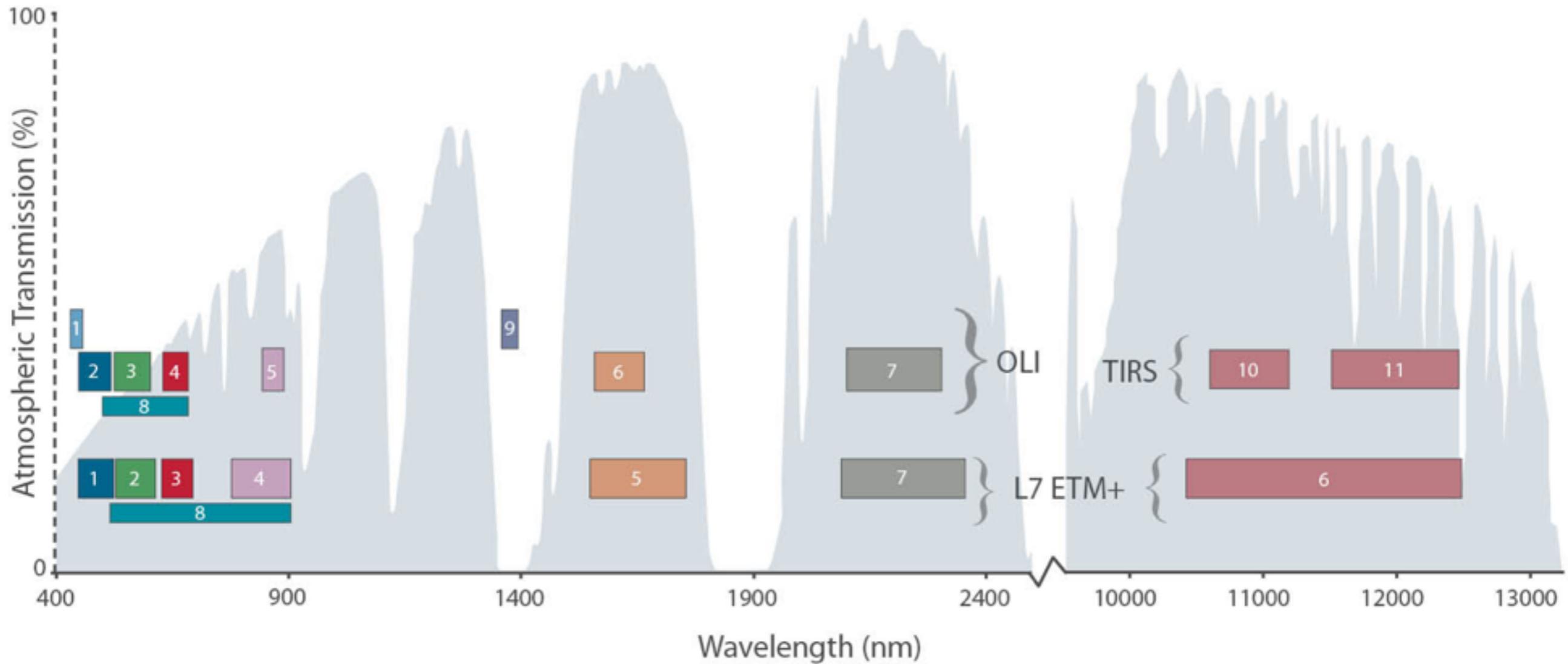
**<https://github.com/developmentseed/landsat-util>**

```
landsat search --download --cloud 4 --start "january 01 2014"  
--end "january 10 2014" pr 009 045
```

```
landsat process path/to/LC80090452014008LGN00.tar.bz
```

**TBA command line processing hotness:  
Jeff Larson's lightning talk tomorrow**

# Landsat 8



# Landsat 8

<b>Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)</b>  <b>Launched February 11, 2013</b>	<b>Bands</b>	<b>Wavelength (micrometers)</b>	<b>Resolution (meters)</b>
	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)

LC80450292013225LGN00\_B1.TIF  
**LC80450292013225LGN00\_B2.TIF**  
**LC80450292013225LGN00\_B3.TIF**  
**LC80450292013225LGN00\_B4.TIF**  
LC80450292013225LGN00\_B5.TIF  
LC80450292013225LGN00\_B6.TIF  
LC80450292013225LGN00\_B7.TIF  
LC80450292013225LGN00\_B8.TIF  
LC80450292013225LGN00\_B9.TIF  
LC80450292013225LGN00\_B10.TIF  
LC80450292013225LGN00\_B11.TIF  
LC80450292013225LGN00\_BQA.TIF  
LC80450292013225LGN00\_MTL.txt

<https://www.mapbox.com/blog/putting-landsat-8-bands-to-work/>

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.



<http://earthobservatory.nasa.gov/blogs/elegantfigures/2013/10/22/how-to-make-a-true-color-landsat-8-image/>

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.



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

The screenshot shows a web browser window with the URL <https://www.mapbox.com/blog/processing-landsat-8/> in the address bar. The page is titled "Processing Landsat 8 Using Open-Source Tools" by Charlie Loyd on June 19 2013. The content discusses the process of processing Landsat 8 imagery into an interactive map using open-source tools like GDAL, libgeotiff, and TileMill.

This step-by-step post walks through processing Landsat 8 imagery into an interactive map that you can integrate into your website or app. We'll cover the process from finding and downloading the image data, through processing it and adjusting its color balance, to bringing it into [TileMill](#) and exporting it as an interactive web map – where it can be combined with markers, animation, and other layers using [MapBox.js](#). We'll use open source tools throughout, and many of the techniques you'll see will also apply to other satellite and aerial data, like Landsat 7, MODIS, and even commercial imagery.

## Requirements

This tutorial assumes you're comfortable with the Unix command line. Besides standard utilities like `tar`, we'll use the current versions of:

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

<http://j.mp/charlie-loyd-rake>

# charlie-loyd.rake

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

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

1 # https://www.mapbox.com/blog/processing-landsat-8/
2 task :landsat_2014 => :environment do
3   dirs = Dir["#{Rails.root.to_s}/db/initial/raster/*"].reject { |q| q =~ /tar\.gz/ }
4   dirs.each do |dir|
5     scene_id = dir.split("/")[-1]
6     [4,3,2].each do |band|
7       `gdalwarp -t_srs EPSG:3857 #{dir}/#{scene_id}_B#{band}.TIF #{dir}/#{scene_id}_B#{band}-projected.tif`
8     end
9     `convert -combine #{dir}/#{scene_id}_B{4,3,2}-projected.tif #{dir}/#{scene_id}_RGB-projected.tif && \
10    convert -channel B -gamma 0.925 -channel R -gamma 1.03 -channel RGB -sigmoidal-contrast 50x16% #{dir}/
11      #{scene_id}_RGB-projected.tif #{dir}/#{scene_id}_RGB-projected-corrected.tif && \
12    convert -depth 8 #{dir}/#{scene_id}_RGB-projected-corrected.tif  #{dir}/#{scene_id}_RGB-projected-
13      corrected-8bit.tif && \
14      listgeo -tfw #{dir}/#{scene_id}_B4-projected.tif && \
15      mv #{dir}/#{scene_id}_B4-projected.tifw #{dir}/#{scene_id}_RGB-projected-corrected-8bit.tifw && \
16      gdal_edit.py -a_srs EPSG:3857 #{dir}/#{scene_id}_RGB-projected-corrected-8bit.tif && \
17      gdal_translate -a_nodata 0 #{dir}/#{scene_id}_RGB-projected-corrected-8bit.tif #{dir}/#{scene_id}_RGB-
18      projected-corrected-8bit-nodata.tif`
19   end
20 end

21 task :landsat_2014_merge => :environment do
22   dirs = Dir["#{Rails.root.to_s}/db/initial/raster/*"].reject { |q| q =~ /\..*$/ }
23   scenes = dirs.map do |q|
24     scene_id = q.split("/")[-1]
25     corrected = "#{q}/#{scene_id}_RGB-projected-corrected-8bit-nodata.tif"
26   end
27   `cd #{Rails.root.to_s}/db/initial/raster/ && gdalwarp --config GDAL_CACHEMAX 3000 -wm 3000 #{scenes.join(" \
28     ")} #{Rails.root.to_s}/db/initial/raster/merged.tif`
```

# charlie-loyd.rake

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

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

1 # https://www.mapbox.com/blog/processing-landsat-8/
2 task :landsat_2014 => :environment do
3   dirs = Dir["#{Rails.root.to_s}/db/initial/raster/*"].reject { |q| q =~ /tar\.gz/ }
4   dirs.each do |dir|
5     scene_id = dir.split("/")[-1]
6     [4,3,2].each do |band|
7       `gdalwarp -t_srs EPSG:3857 #{dir}/#{scene_id}_B#{band}.TIF #{dir}/#{scene_id}_B#{band}-projected.tif`  

stitch scenes together and reproject
8   end
9   `convert -combine #{dir}/#{scene_id}_B{4,3,2}-projected.tif #{dir}/#{scene_id}_RGB-projected.tif && \
10  convert -channel R -gamma 0.925 -channel G -gamma 1.03 -channel B -gamma 1.03 -channel RGB -sigmoidal-contrast 50x16% #{dir}/
11    #{scene_id}_RGB-projected-corrected.tif #{dir}/#{scene_id}_RGB-projected-corrected.tif && \
12  convert -depth 8 #{dir}/#{scene_id}_RGB-projected-corrected.tif #{dir}/#{scene_id}_RGB-projected-
13    corrected.tif && \
14  listgeo -tfw #{dir}/#{scene_id}_B4-projected.tif && \
15  mv #{dir}/#{scene_id}_B4-projected.tifw #{dir}/#{scene_id}_RGB-projected-corrected-8bit.tifw && \
16  gdal_edit.py -a_nodata -9999 #{dir}/#{scene_id}_RGB-projected-corrected-8bit.tif && \
17  gdal_translate -a_nodata 0 #{dir}/#{scene_id}_RGB-projected-corrected-8bit.tif #{dir}/#{scene_id}_RGB-
18    projected-corrected.tif && \
19  end
20 end

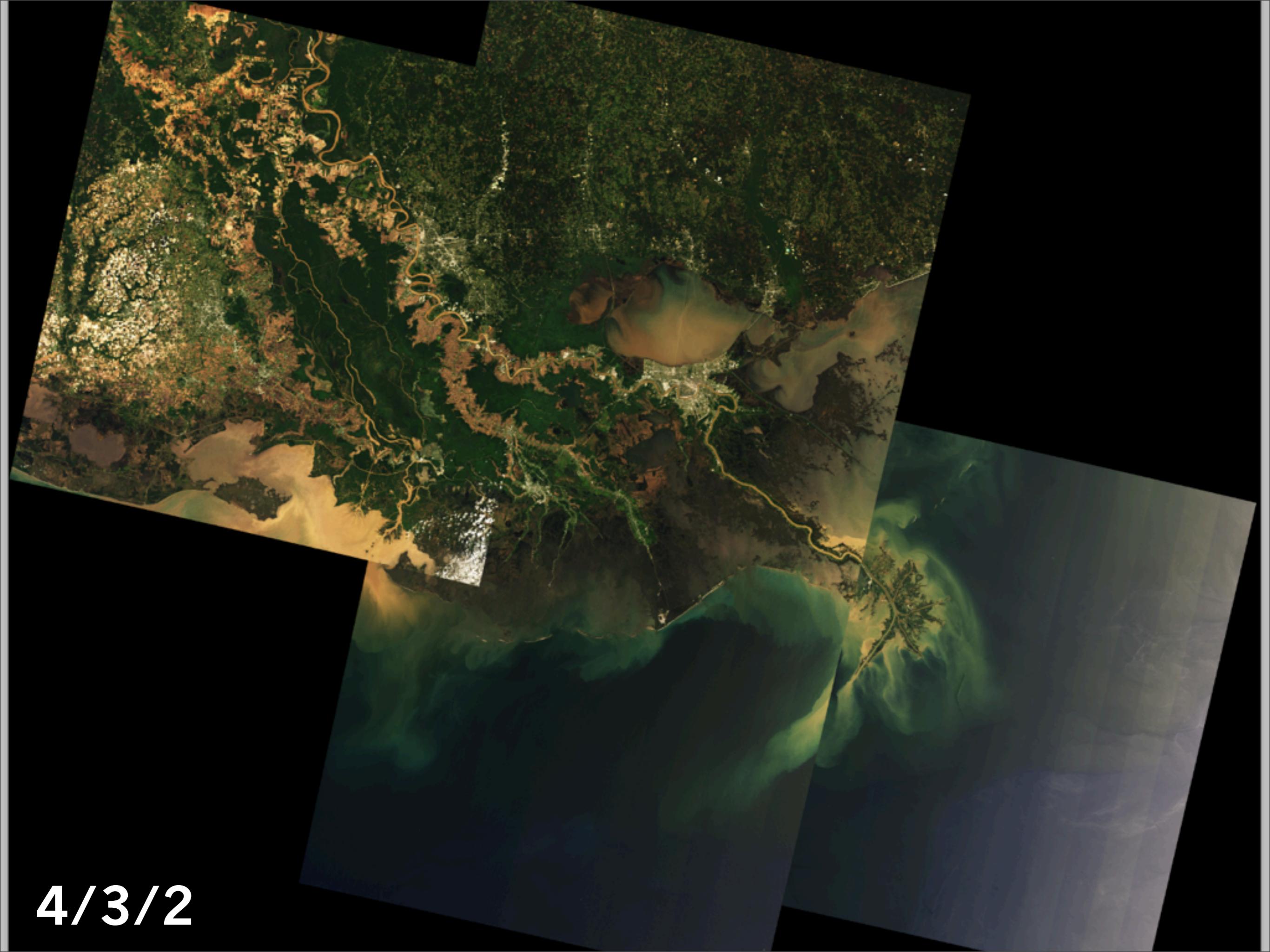
21 task :landsat_2014_merge => :environment do
22   dirs = Dir["#{Rails.root.to_s}/db/initial/raster/*"].reject { |q| q =~ /\..*$/ }
23   scenes = dirs.map do |q|
24     scene_id = q.split("/")[-1]
25     corrected = "#{q}/#{scene_id}_RGB-projected-corrected-8bit-nodata.tif"
26   end
27   `cd #{Rails.root.to_s}/db/initial/raster/ && gdalwarp --config GDAL_CACHEMAX 3000 -wm 3000 #{scenes.join(" ")} #{Rails.root.to_s}/db/initial/raster/merged.tif`  

add geo headers back in
convert between formats
ImageMagick on the command line
save geo headers to use files with Photoshop or ImageMagick
gdal edit.py
gdal_translate

```

More!

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



4/3/2



7/5/3



4/3/2 + 5 mask

# Creating “land”

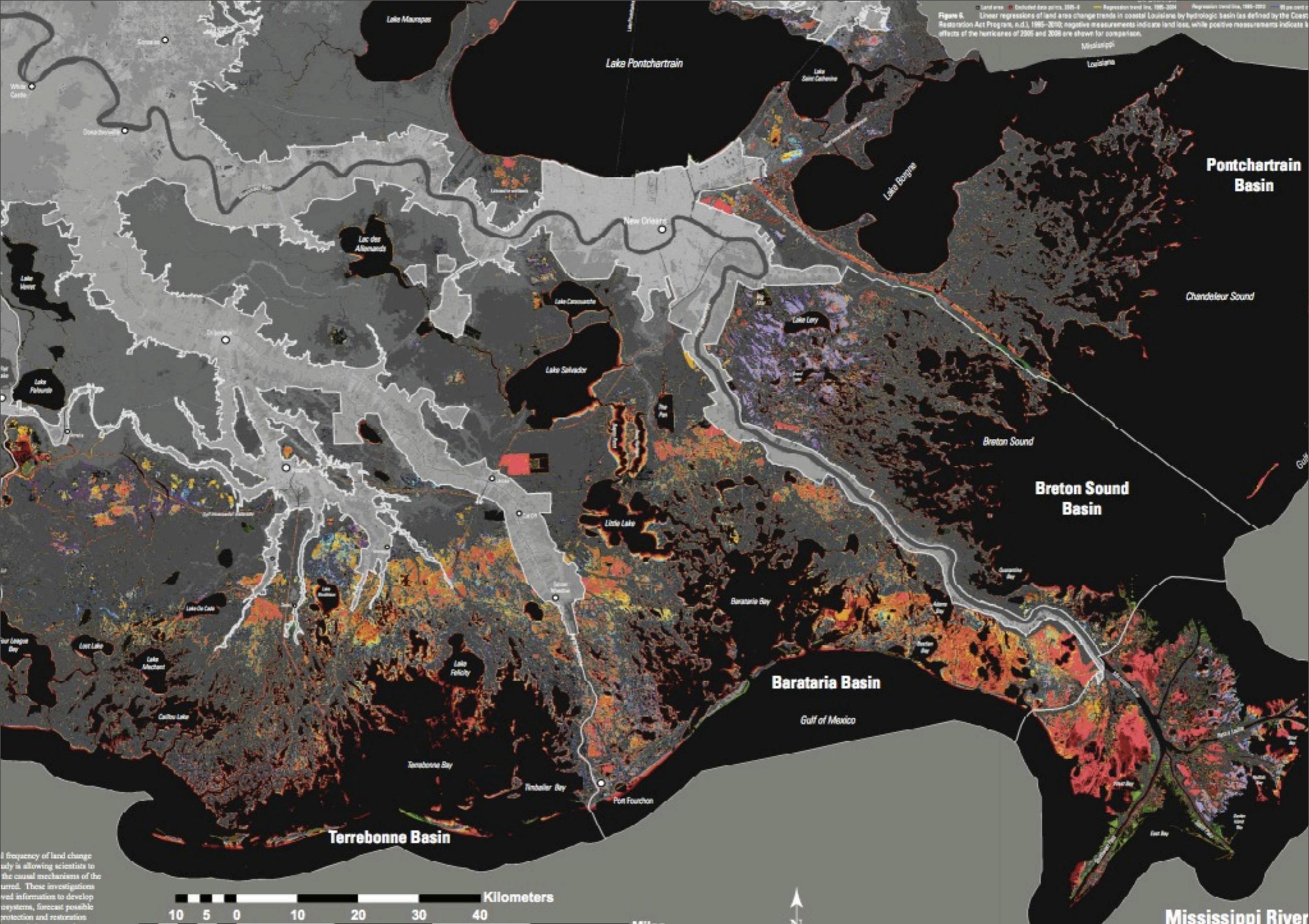


Buras, La. land loss 1932 to present via USGS, over 2014 Landsat 8

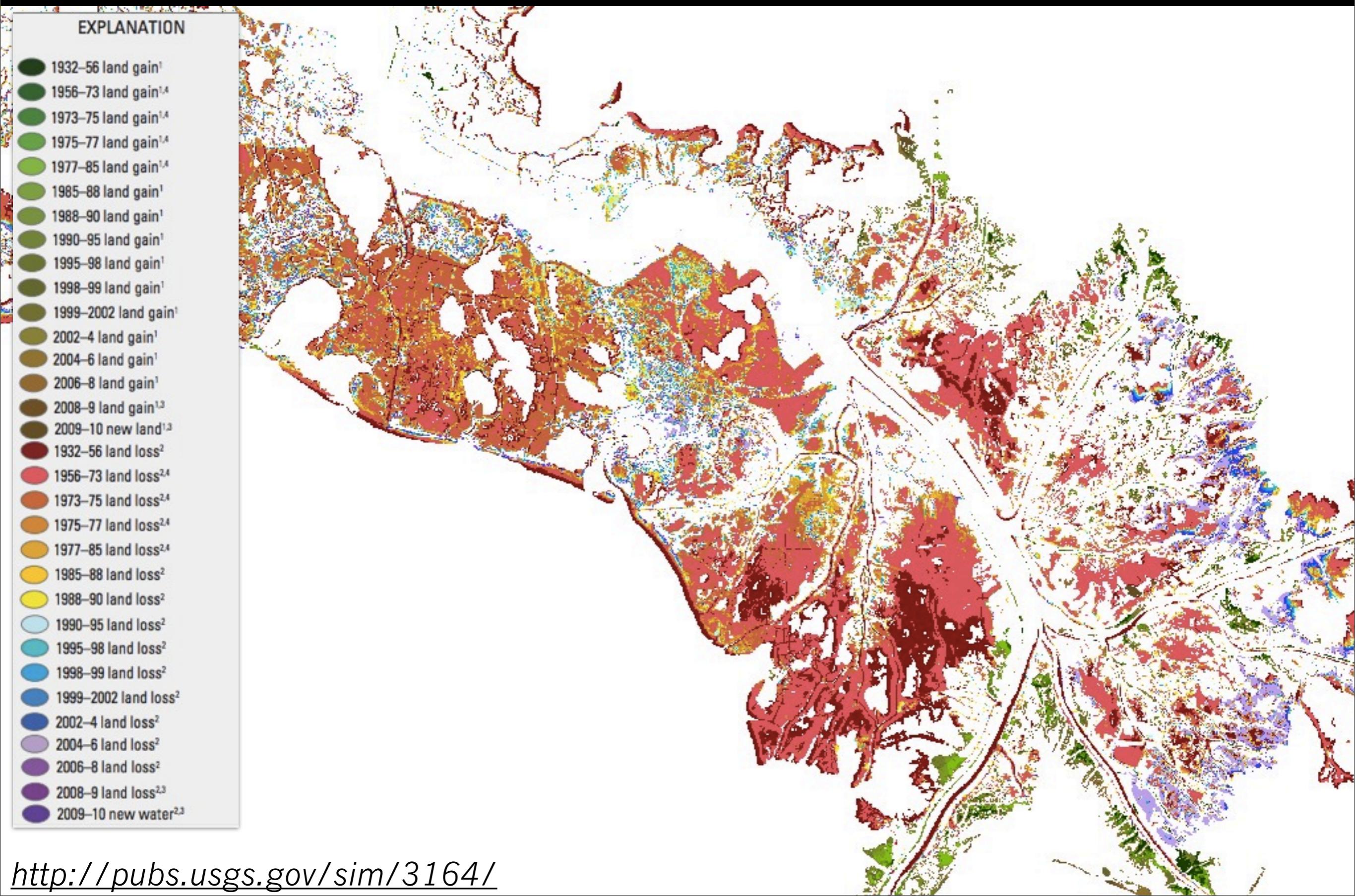
# Creating “land”



Buras, La. land loss 2009 via USGS, over 2014 Landsat 8



# Creating “land”



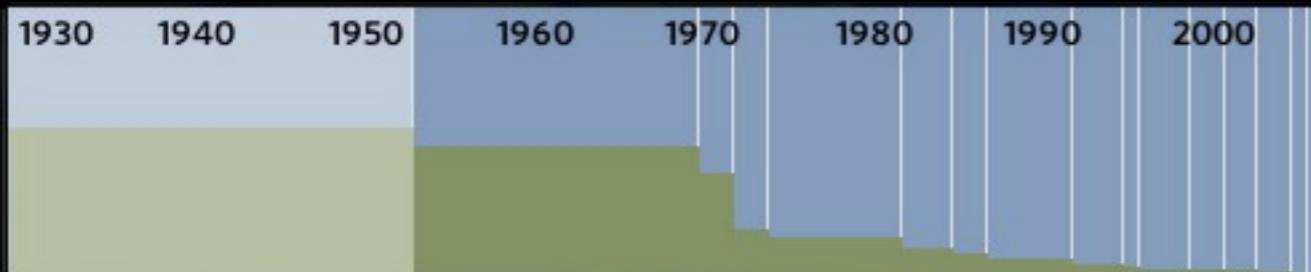
# Creating “land”

```
colors = {
    "1932-1956-gain" => "srgba(0,66,0,1)",
    "1956-1973-gain" => "srgba(28,102,0,1)",
    "1973-1975-gain" => "srgba(51,135,5,1)",
    "1975-1977-gain" => "srgba(76,168,10,1)",
    "1977-1985-gain" => "srgba(102,201,15,1)",
    "1985-1988-gain" => "srgba(109,165,28,1)",
    "1988-1990-gain" => "srgba(109,150,33,1)",
    "1990-1995-gain" => "srgba(107,135,38,1)",
    "1995-1998-gain" => "srgba(102,119,40,1)",
    "1998-1999-gain" => "srgba(96,107,45,1)",
    "1999-2002-gain" => "srgba(112,114,45,1)",
    "2002-2004-gain" => "srgba(135,132,43,1)",
    "2004-2006-gain" => "srgba(147,117,43,1)",
    "2006-2008-gain" => "srgba(153,104,43,1)",
    "2008-2009-gain" => "srgba(104,79,33,1)",
    "2009-2010-gain" => "srgba(114,79,33,1)",
    "1932-1956-loss" => "srgba(137,0,0,1)",
    "1956-1973-loss" => "srgba(239,71,84,1)",
    "1973-1975-loss" => "srgba(211,94,43,1)",
    "1975-1977-loss" => "srgba(219,132,35,1)",
    "1977-1985-loss" => "srgba(229,165,25,1)",
    "1985-1988-loss" => "srgba(255,198,17,1)",
    "1988-1990-loss" => "srgba(244,242,10,1)",
    "1990-1995-loss" => "srgba(168,255,255,1)",
    "1995-1998-loss" => "srgba(2,191,201,1)",
    "1998-1999-loss" => "srgba(5,163,229,1)",
    "1999-2002-loss" => "srgba(10,130,234,1)",
    "2002-2004-loss" => "srgba(76,30,242,1)",
    "2004-2006-loss" => "srgba(198,153,239,1)",
    "2006-2008-loss" => "srgba(168,38,204,1)",
    "2008-2009-loss" => "srgba(130,51,137,1)",
    "2009-2010-loss" => "srgba(107,7,168,1)"
}
```

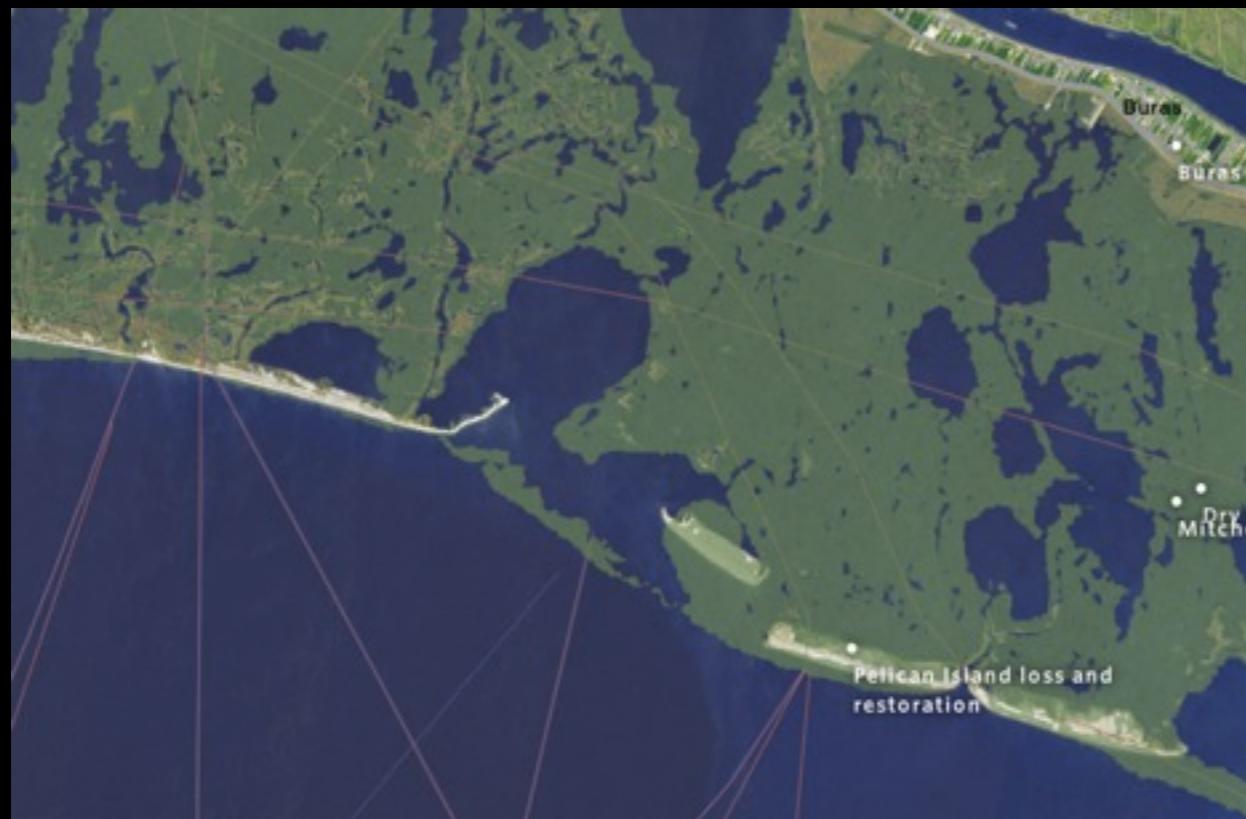
## Creating “land”

For each time period, create an image by combining land loss from the current period to the last period, and land gain from the first period to the current period

# Buras, La.: 1932-2014



```
pixels = `convert #{file} -colorspace rgb -colors 10 -format "%c"  
histogram:info:`  
transPixels = pixels.match(/[:]*/)  
transPct = `convert #{file} -format "%[fx:100*#{transPixels}/(w*h)]%"` info:
```



# projects.propublica.org/louisiana

Losing Ground

projects.propublica.org/louisiana/ Reader

PRO PUBLICA THE LENS Losing Ground

PAST / PRESENT AN ENGINEERED COAST AN UNCERTAIN FUTURE

1922 2014 LEVEES CANALS OIL/GAS SEVERE MODERATE

**2014**

Today, residents of Southeast Louisiana face a losing equation: They live on narrow slices of high ground that are sinking as the Gulf rises. The state has an ambitious plan that could balance that equation by 2060, but it doesn't have the \$50 billion to pay for it.

30 km  
20 mi

Lake Pontchartrain  
New Orleans  
Houma  
Golden Meadow  
Mississippi River  
1922 Coastline  
Gulf of Mexico  
Bird's Foot Delta

Source: NASA/USGS Landsat

**Louisiana is drowning, quickly.**

In just 80 years, some 2,000 square miles of its coastal landscape have turned to open water, wiping places off maps, bringing the Gulf of Mexico to the back door of New Orleans and posing a lethal threat to an energy and shipping corridor vital to the nation's economy.

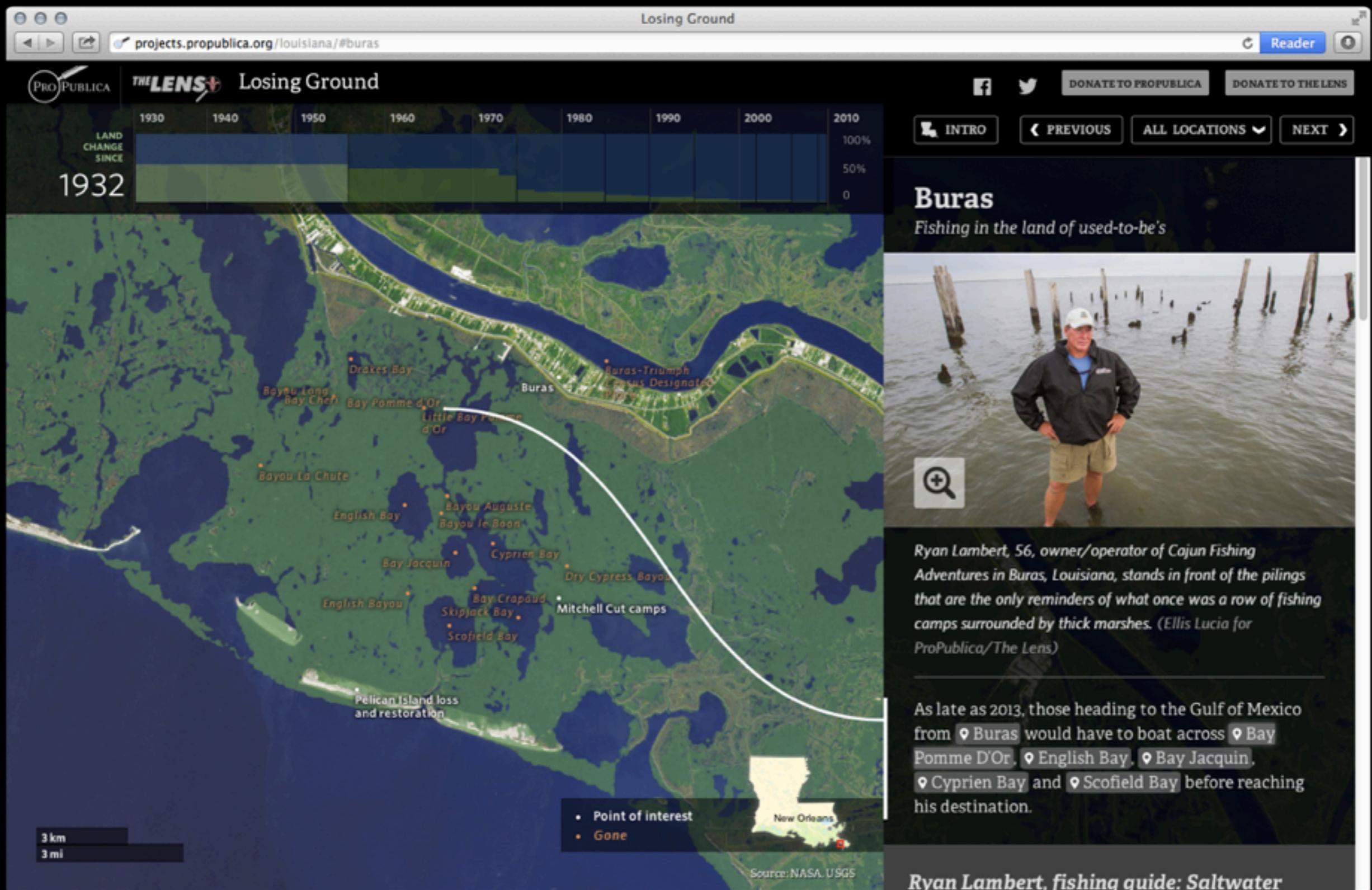
And it's going to get worse, even quicker.

Scientists now say one of the greatest environmental and economic disasters in the nation's history is rushing toward a catastrophic conclusion over the next 50 years, so far unabated and largely unnoticed.

At the current rates that the sea is rising and land is sinking, National Oceanic and Atmospheric Administration scientists say by 2100 the Gulf of Mexico could rise as much as 4.3 feet across this landscape, which has an average elevation of about 3 feet. If that happens, everything outside the protective levees — most of Southeast Louisiana — would be underwater.

Explore Delacroix, La.

# projects.propublica.org/louisiana



# projects.propublica.org/louisiana

Losing Ground

projects.propublica.org/louisiana/#buras

PRO PUBLICA THE LENS+ Losing Ground

LAND CHANGE SINCE 2009

1930 1940 1950 1960 1970 1980 1990 2000 2010

100%  
50%  
0

INTRO PREVIOUS ALL LOCATIONS NEXT

Buras

Fishing in the land of used-to-be's

3 km  
3 mi

Source: NASA, USGS

Ryan Lambert, 56, owner/operator of Cajun Fishing Adventures in Buras, Louisiana, stands in front of the pilings that are the only reminders of what once was a row of fishing camps surrounded by thick marshes. (Ellis Lucia for ProPublica/The Lens)

As late as 2013, those heading to the Gulf of Mexico from [Buras](#) would have to boat across [Bay Pomme D'Or](#), [English Bay](#), [Bay Jacquin](#), [Cyprien Bay](#) and [Scofield Bay](#) before reaching his destination.

Ryan Lambert, fishing guide: Saltwater

# What is the state doing about this?

State of Louisiana  
The Honorable Bobby Jindal, Governor

 Louisiana's Comprehensive  
Master Plan for a Sustainable Coast

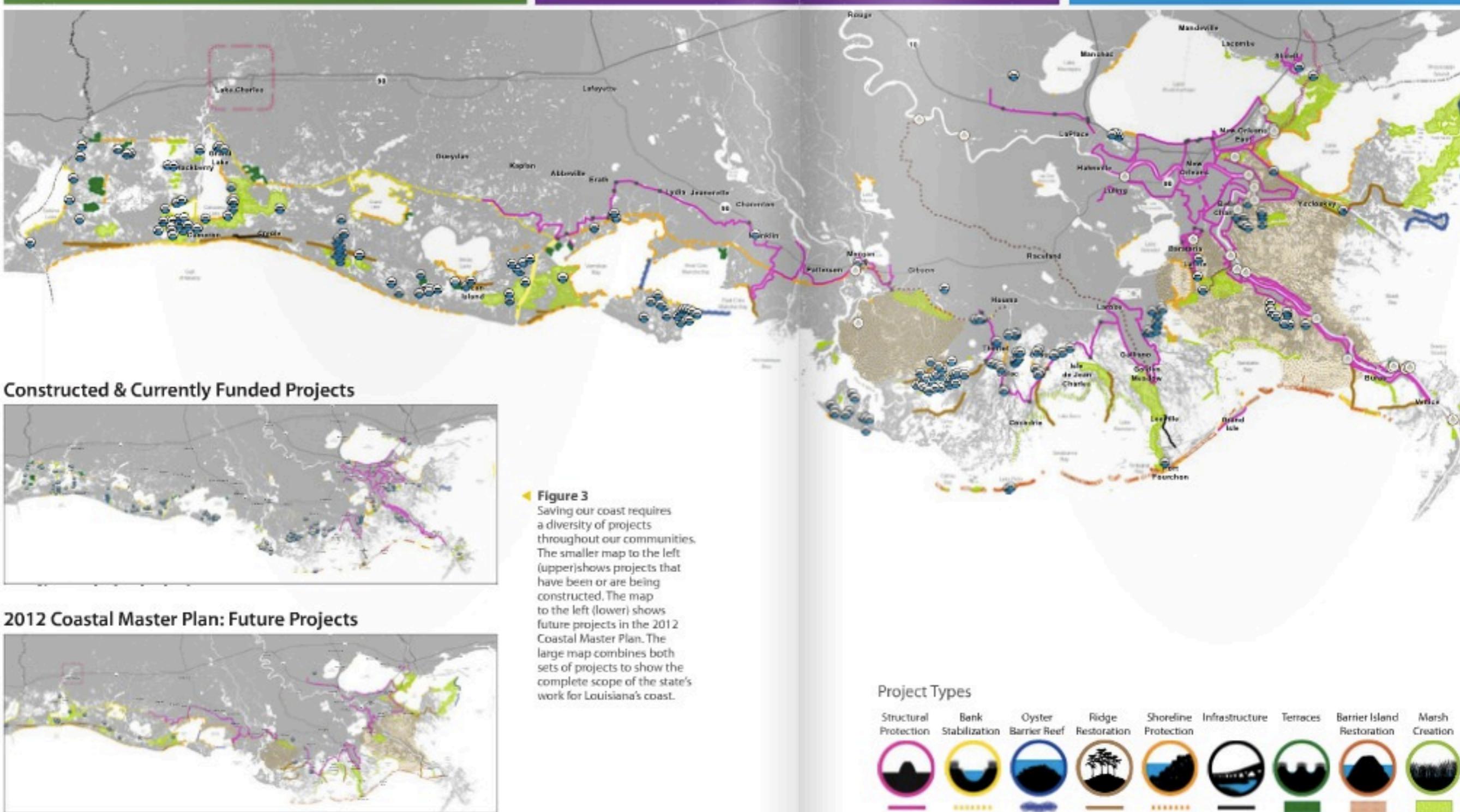
---

committed to [our coast](#)



# Responding to the Crisis

Louisiana's Coastal Program: Past, Present, and Future



# Marsh Creation: Lake Hermitage



# Sediment Diversions: West Bay



# Imagery: 2012—now?



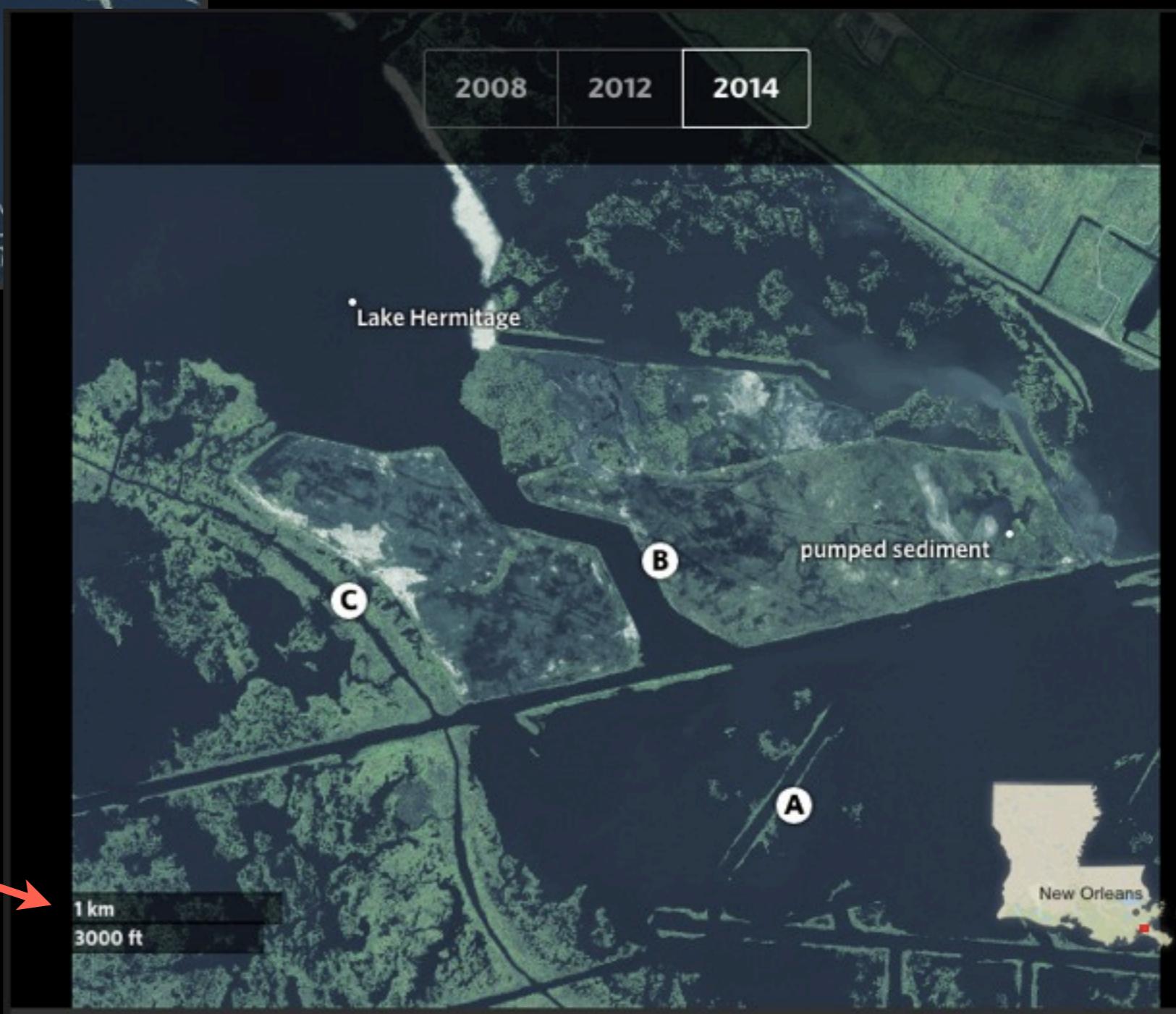
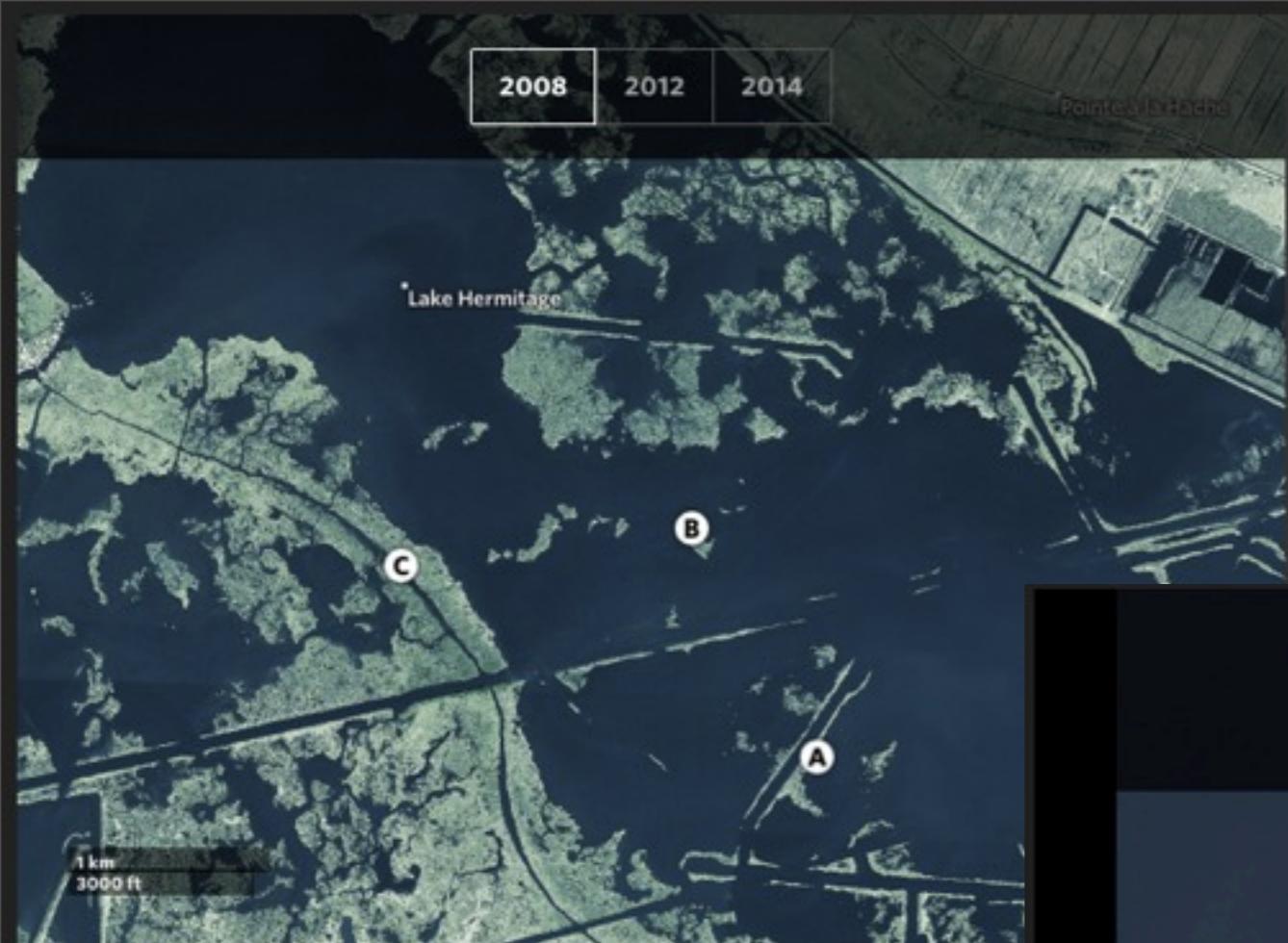
# Lake Hermitage



# Lake Hermitage



# When you have to buy imagery: Digital Globe



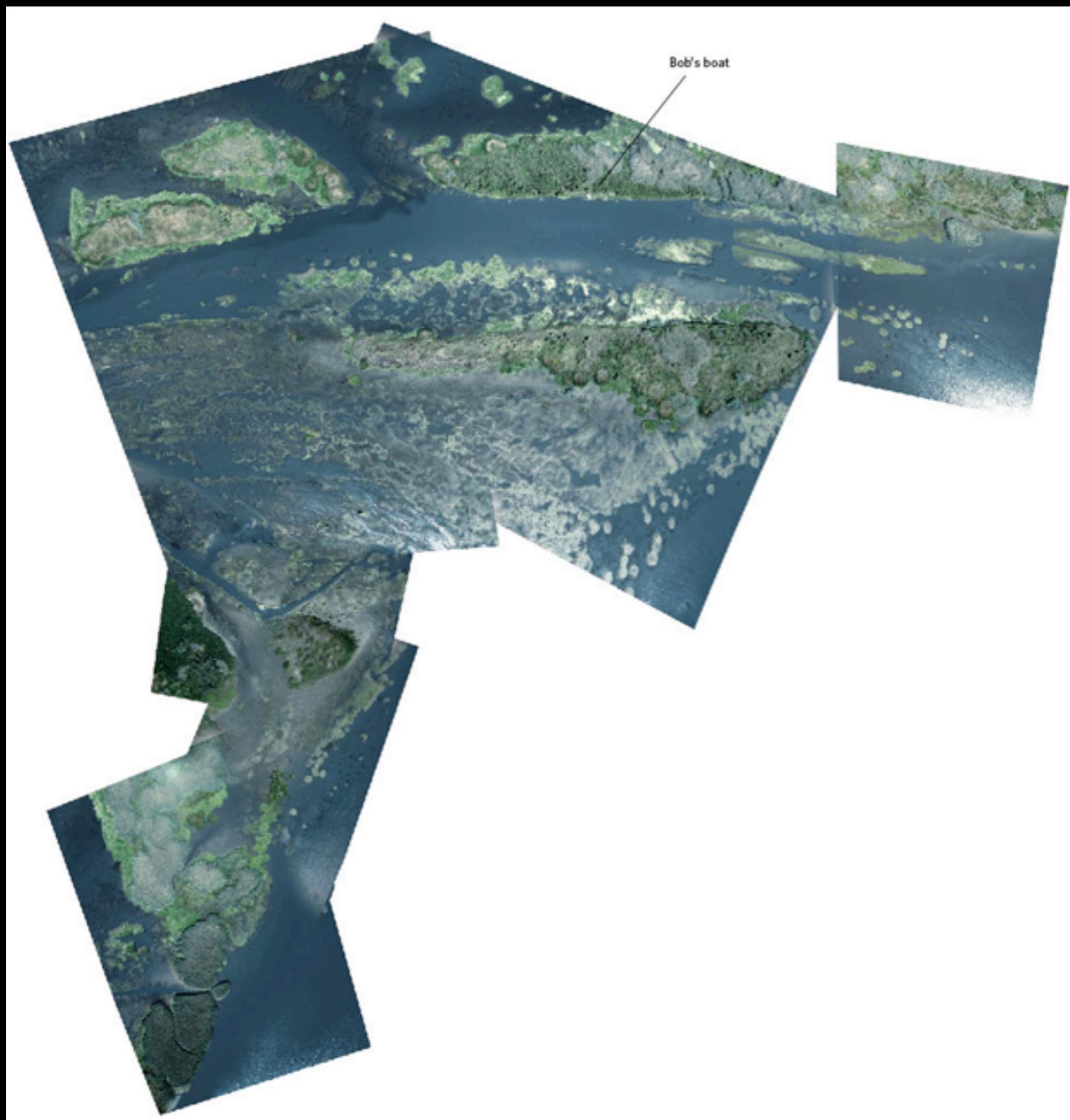
# West Bay Diversion



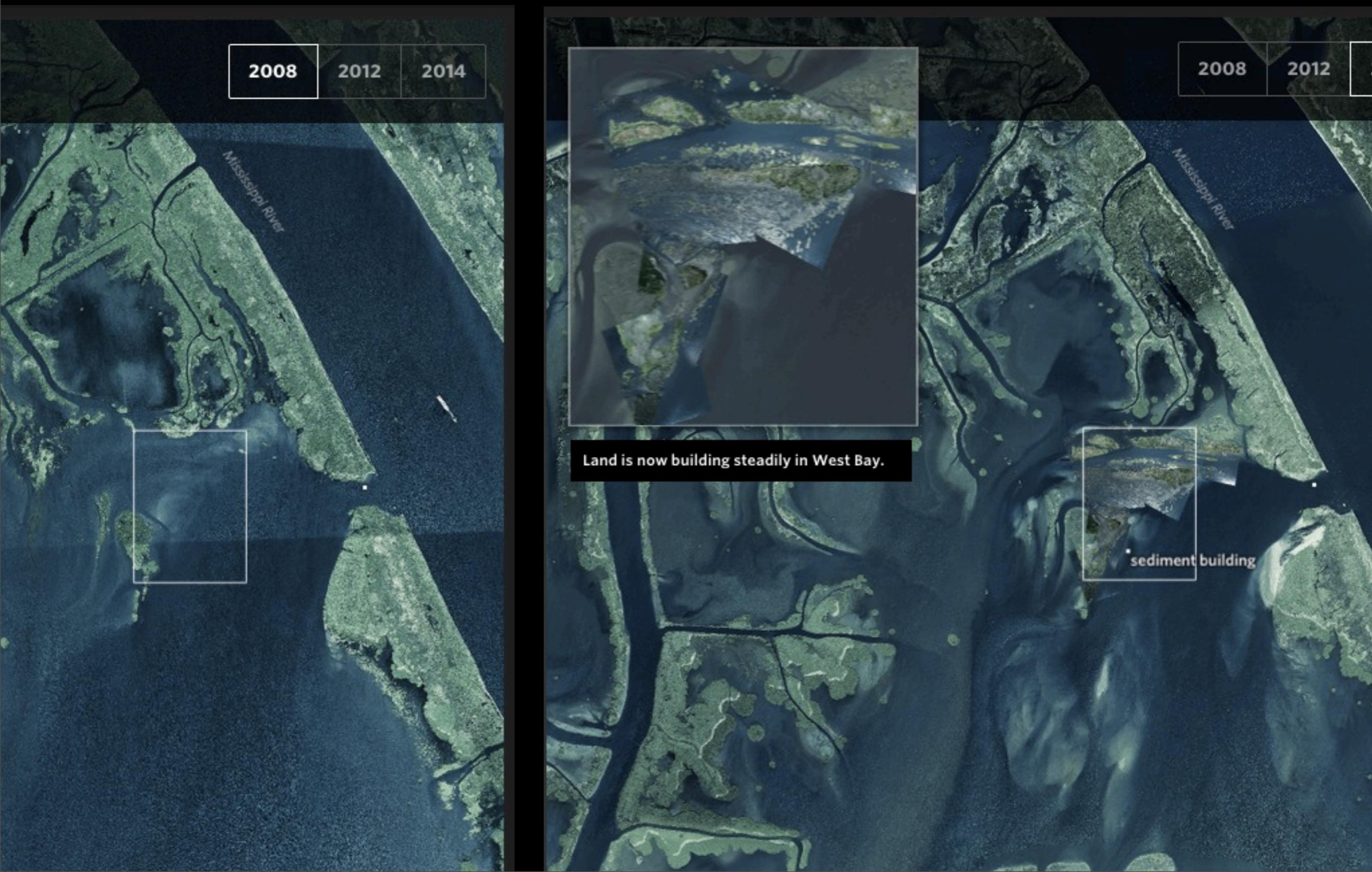
# West Bay Diversion



# West Bay Diversion



# West Bay Diversion



# [projects.propublica.org/larestoration](http://projects.propublica.org/larestoration)

