



Climate change, sea level rise
and transportation in northern NJ

NJTPA, November 12, 2019
Benjamin Strauss, Climate Central

1. Higher
2. Faster
3. More

1. Higher

2. Faster

3. More



Installation: Olafur Eliasson
Photo: Martin Argyroglou

1941

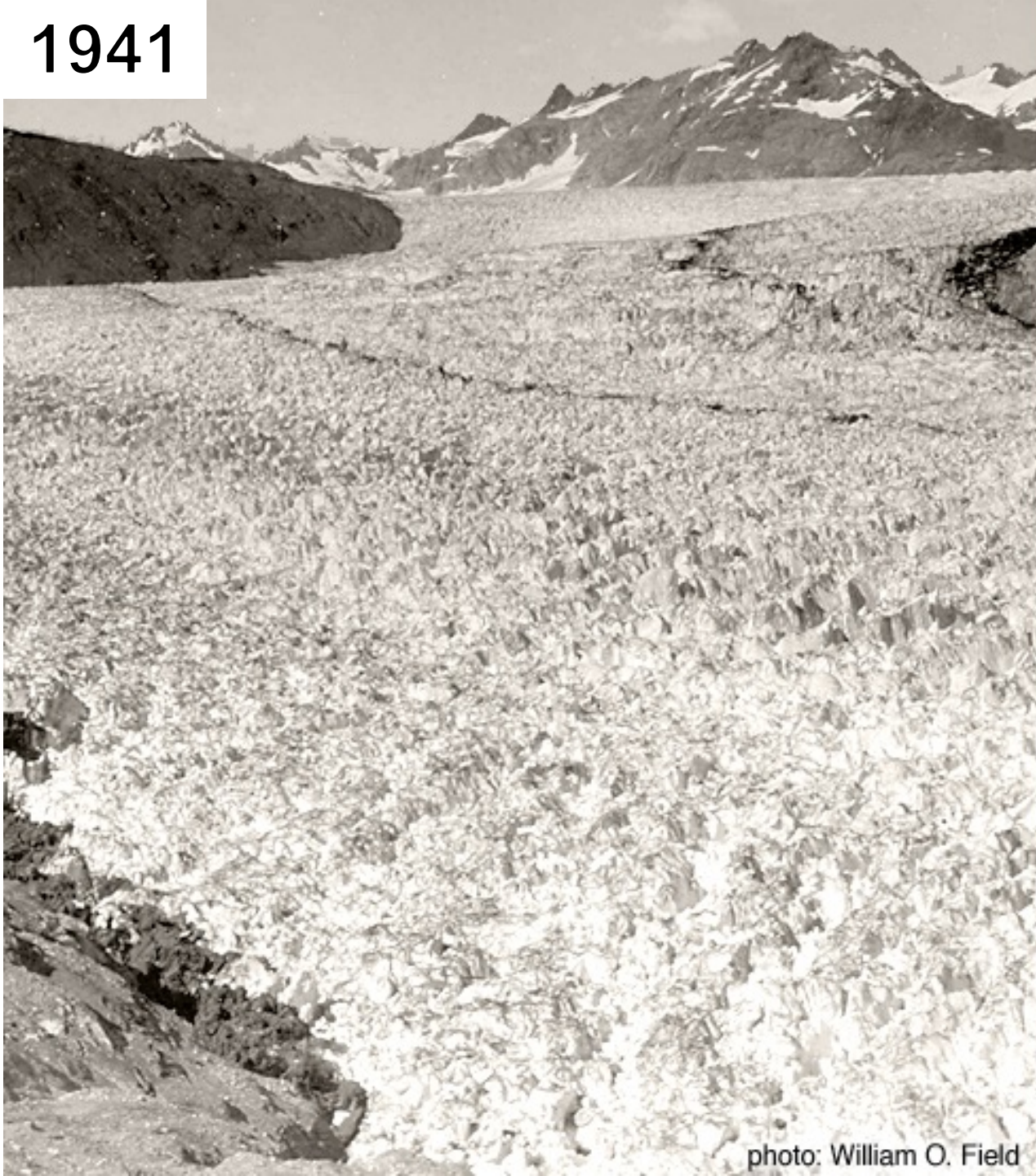


photo: William O. Field

2004



photo: Bruce F. Molnia

SEA LEVEL RISE

BY CENTURY

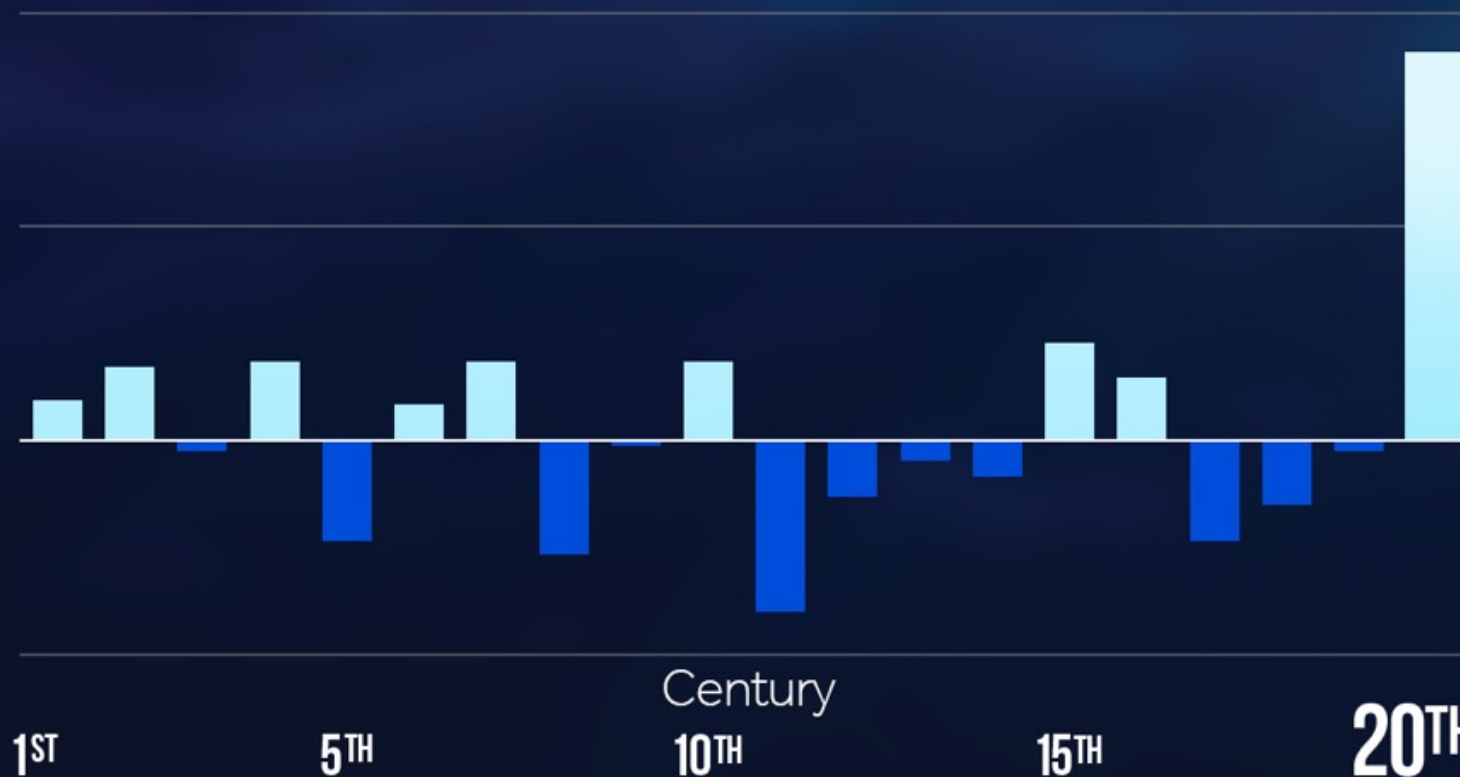
Inches:

+6

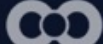
+3

0

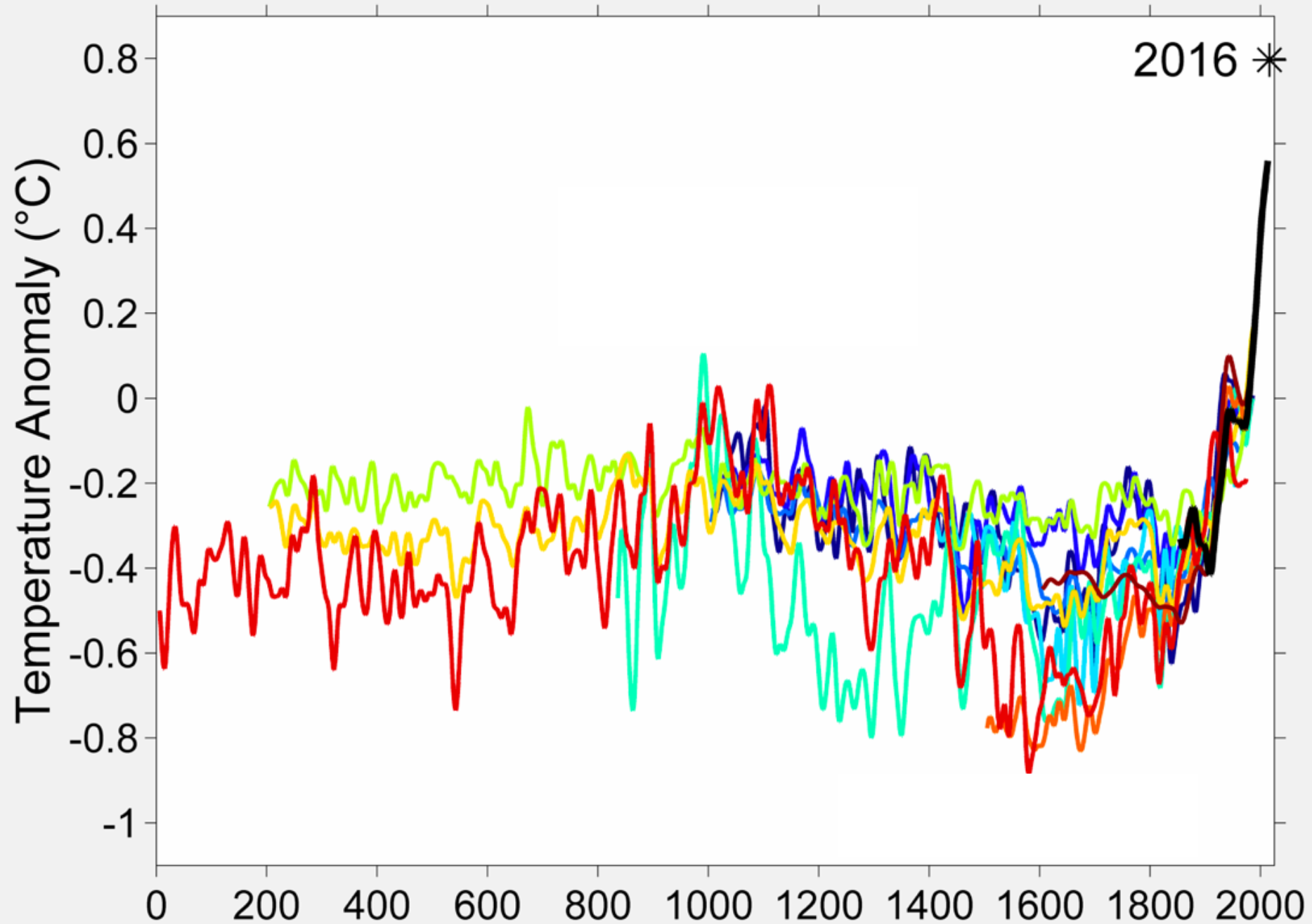
-3



Central reconstruction shown
Source: Kopp et al. 2016 (PNAS)

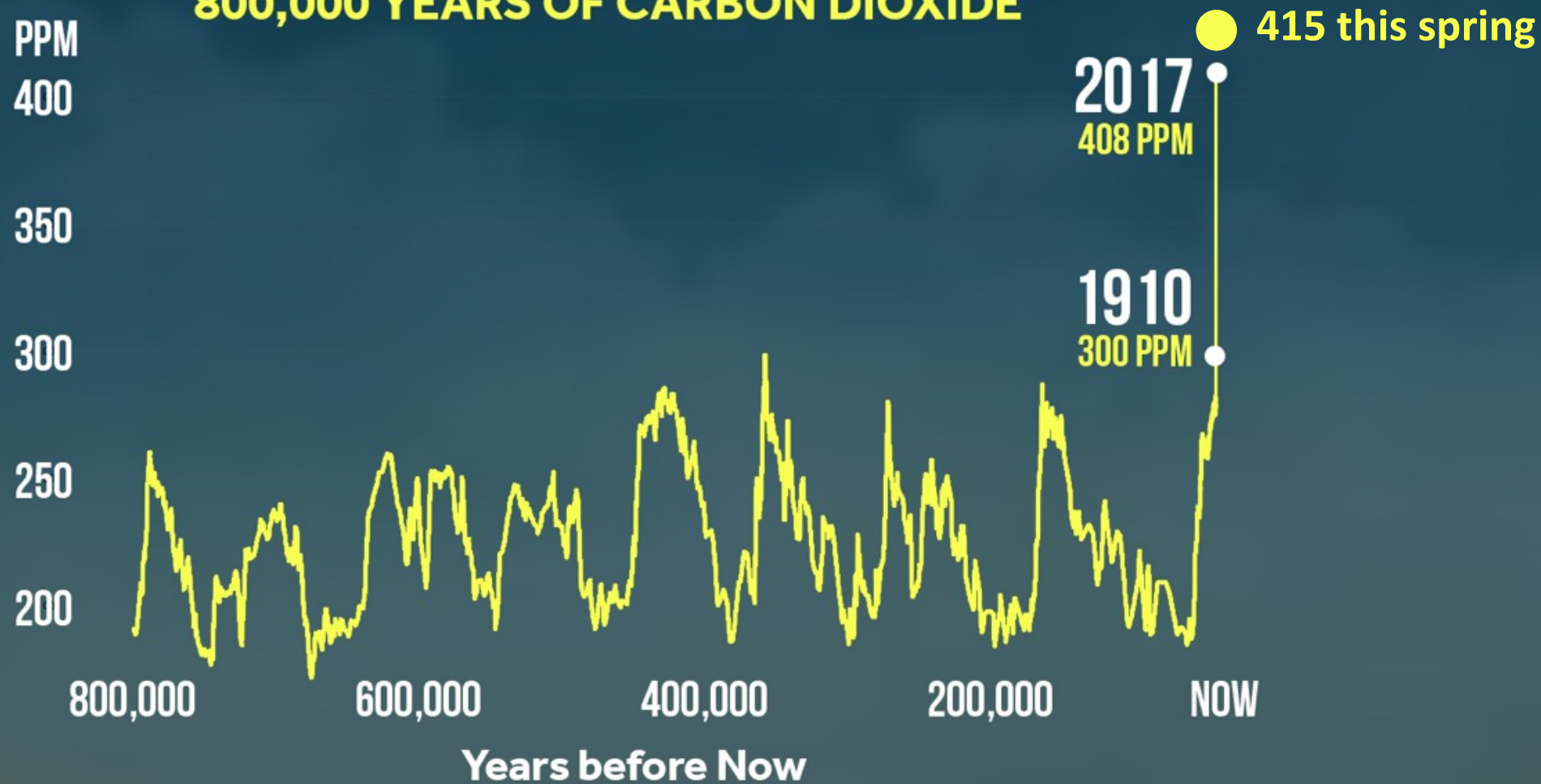
CLIMATE  CENTRAL

Reconstructed Temperature



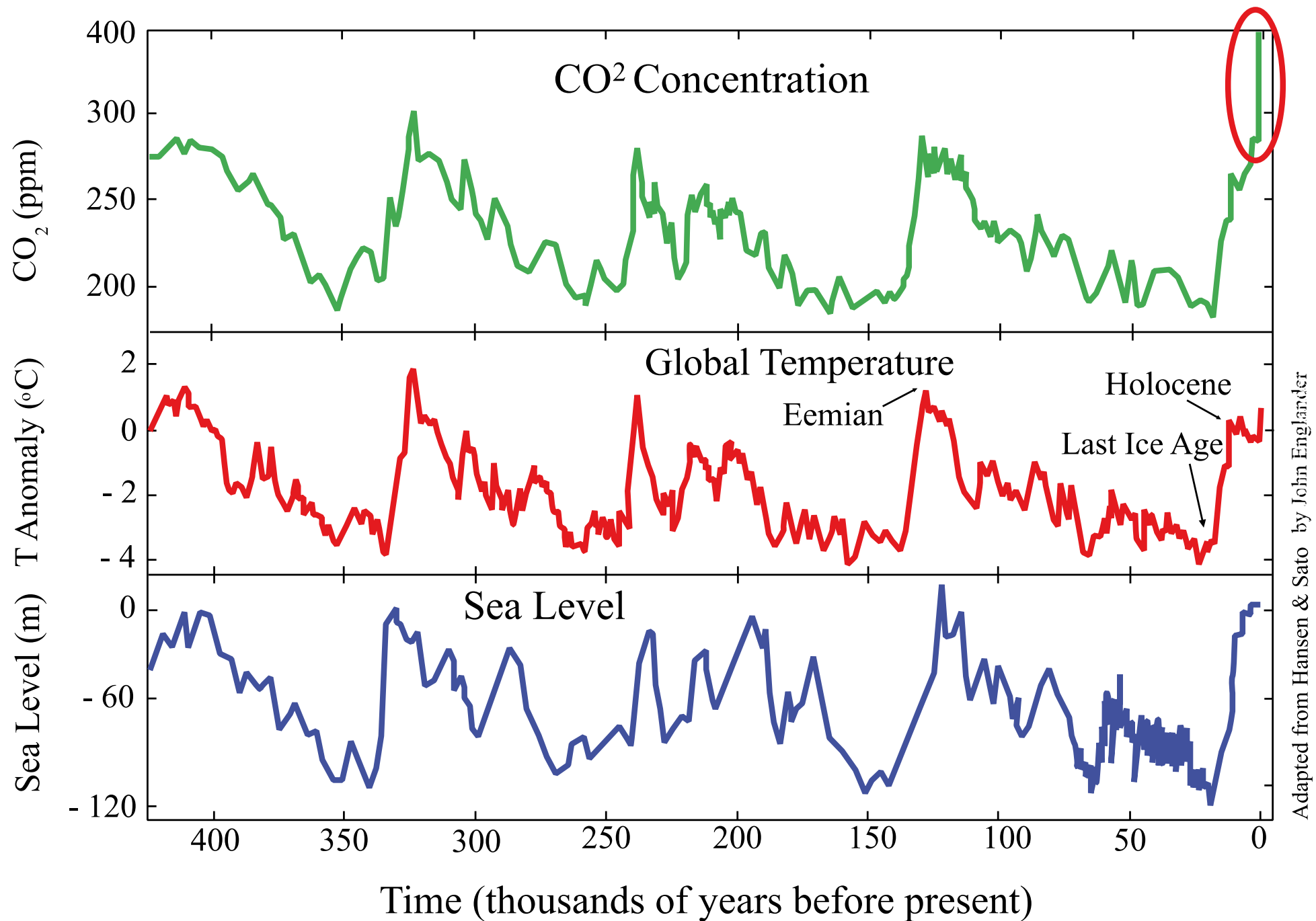
CHANGING OUR ATMOSPHERE

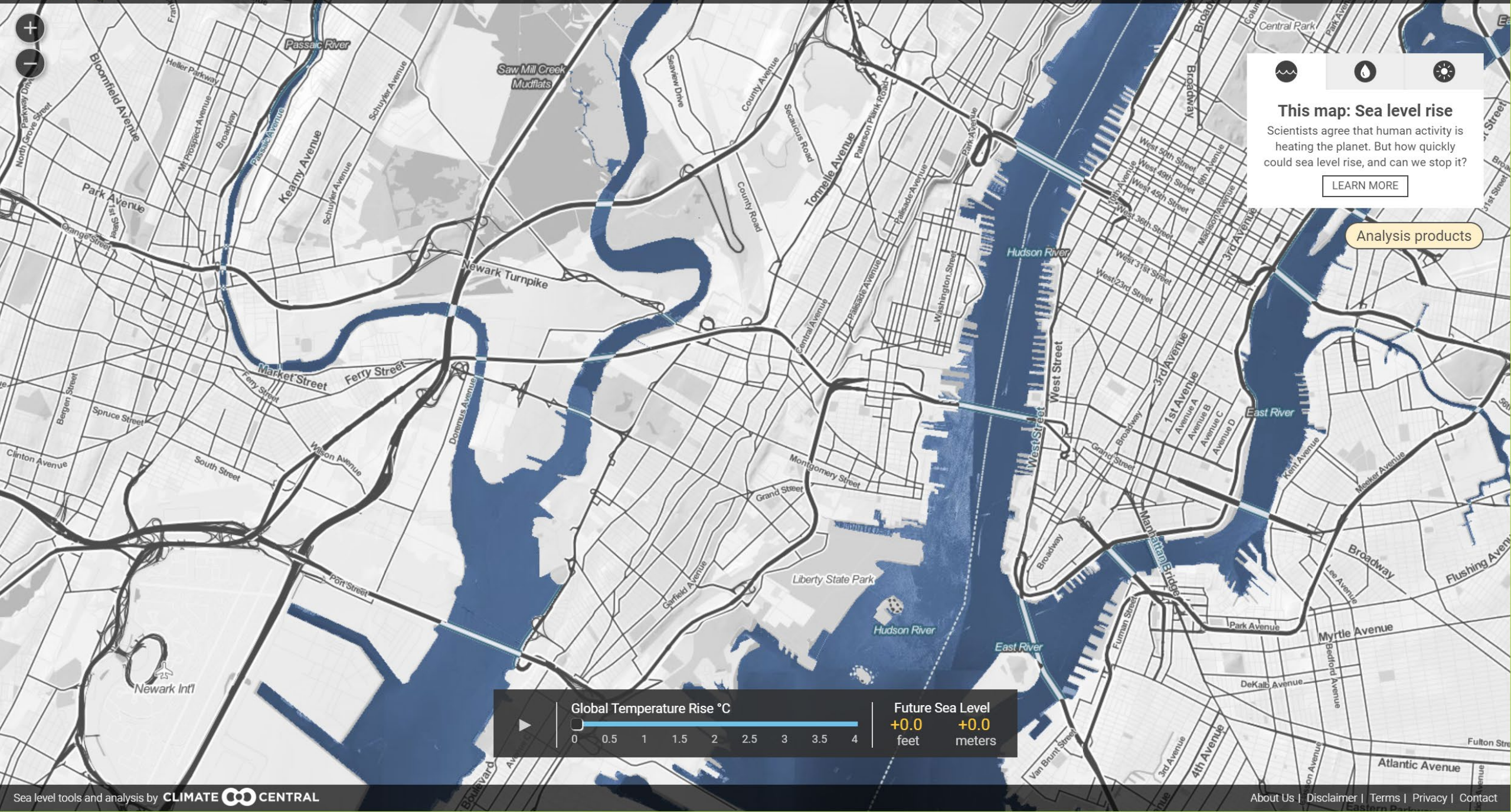
800,000 YEARS OF CARBON DIOXIDE



Source: Luthi et al (2008) (cdiac.ornl.gov) & Keeling et al (Scripps.ucsd.edu)

CLIMATE  CENTRAL





This map: Sea level rise
Scientists agree that human activity is heating the planet. But how quickly could sea level rise, and can we stop it?
[LEARN MORE](#)

[Analysis products](#)



This map: Sea level rise
Scientists agree that human activity is heating the planet. But how quickly could sea level rise, and can we stop it?
[LEARN MORE](#)

Analysis products

Global Temperature Rise °C

Future Sea Level
+7.0 feet
+2.1 meters



This map: Sea level rise
Scientists agree that human activity is heating the planet. But how quickly could sea level rise, and can we stop it?

[LEARN MORE](#)

Analysis products

▶ Global Temperature Rise °C

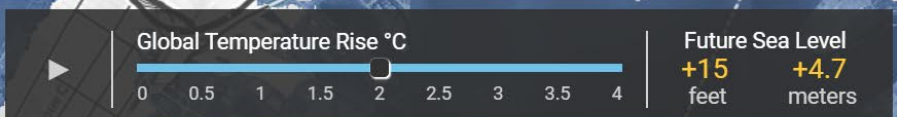
0 0.5 1 1.5 2 2.5 3 3.5 4

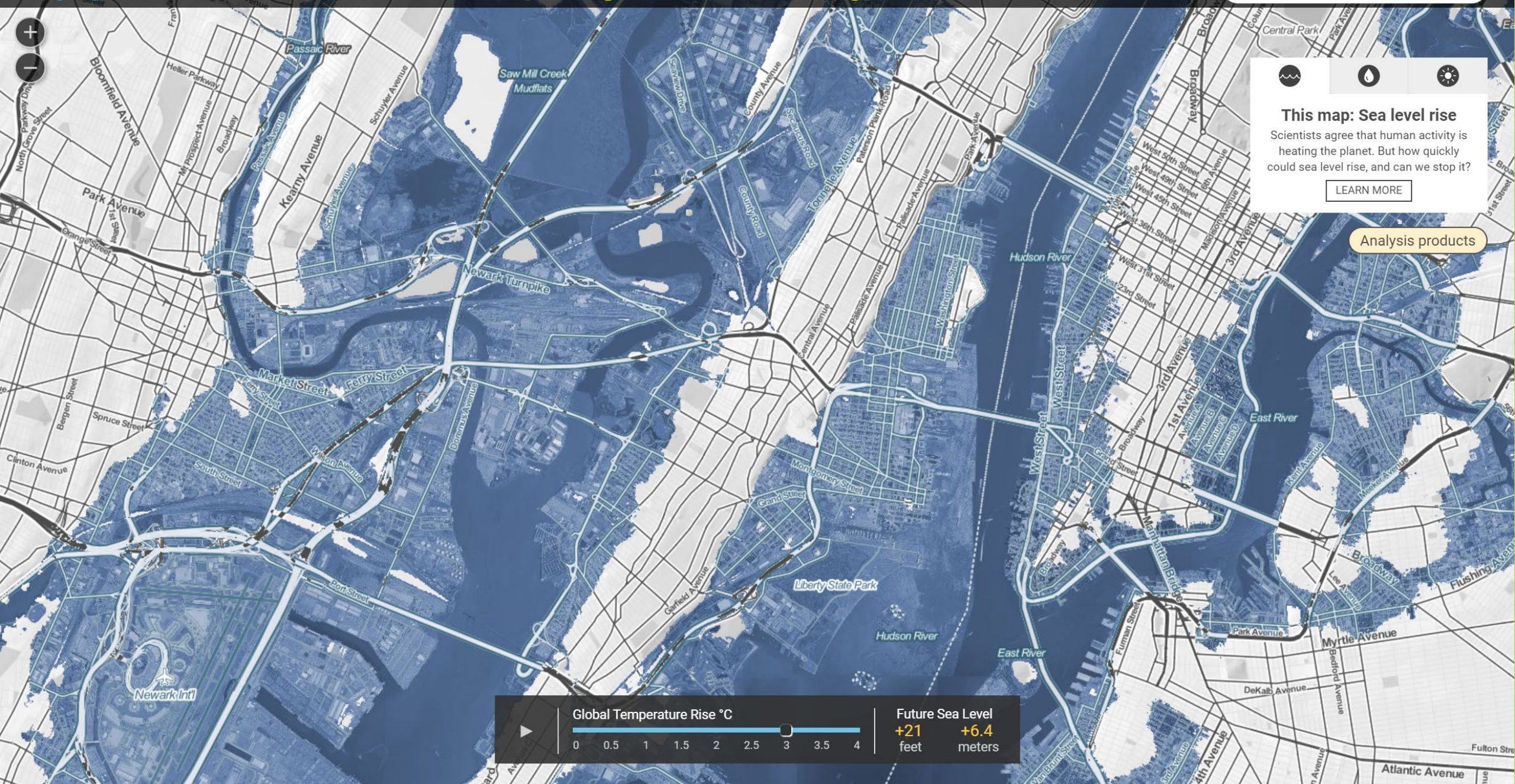
Future Sea Level
+9.4 feet
+2.9 meters



This map: Sea level rise
Scientists agree that human activity is heating the planet. But how quickly could sea level rise, and can we stop it?
[LEARN MORE](#)

[Analysis products](#)



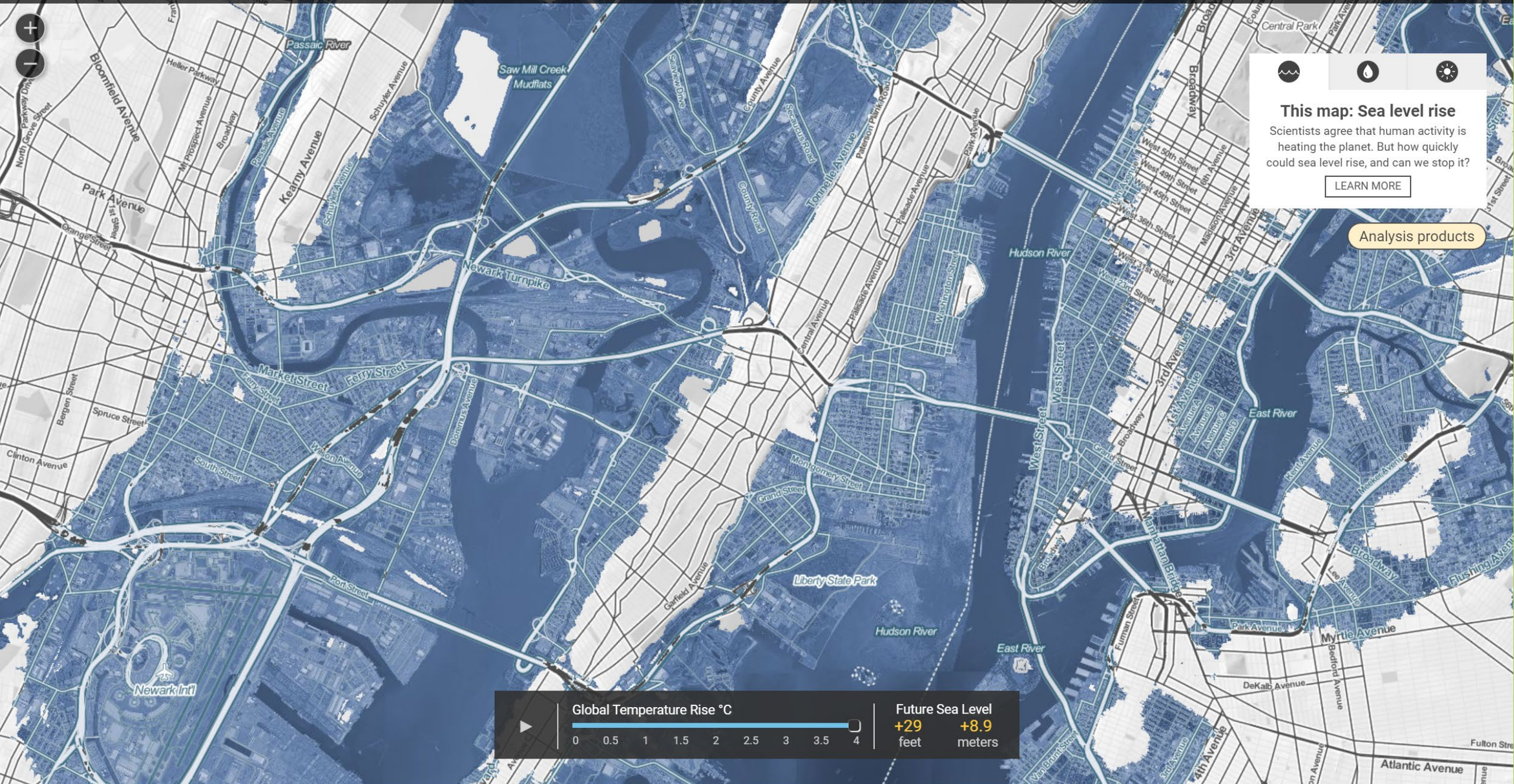


This map: Sea level rise
Scientists agree that human activity is heating the planet. But how quickly could sea level rise, and can we stop it?
[LEARN MORE](#)

Analysis products

Global Temperature Rise °C

Future Sea Level
+21 feet +6.4 meters



This map: Sea level rise

Scientists agree that human activity is heating the planet. But how quickly could sea level rise, and can we stop it?

[LEARN MORE](#)

Analysis products

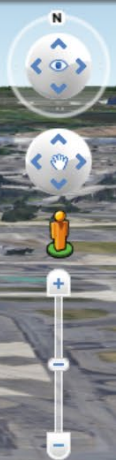
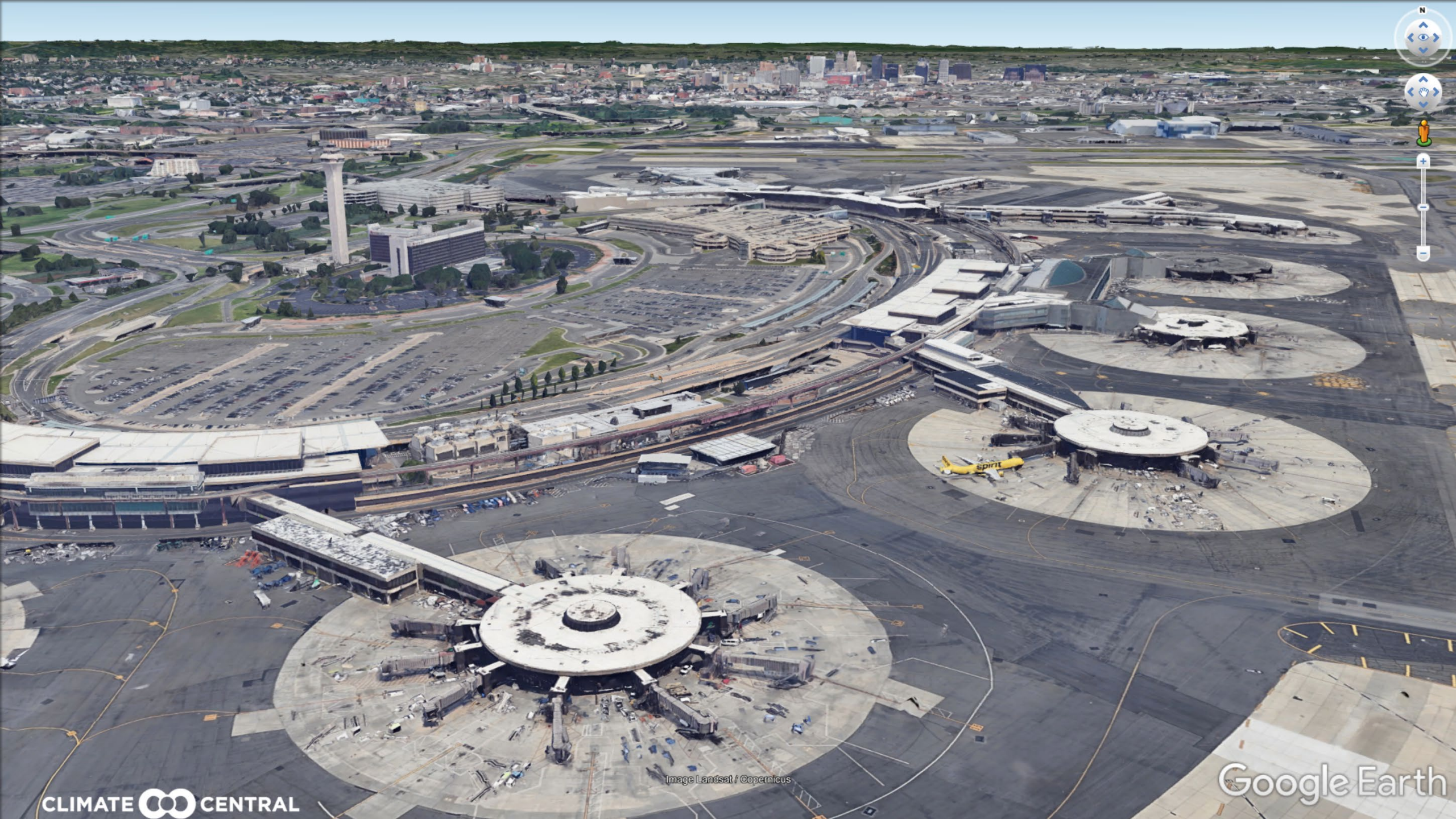


Image Landsat / Copernicus

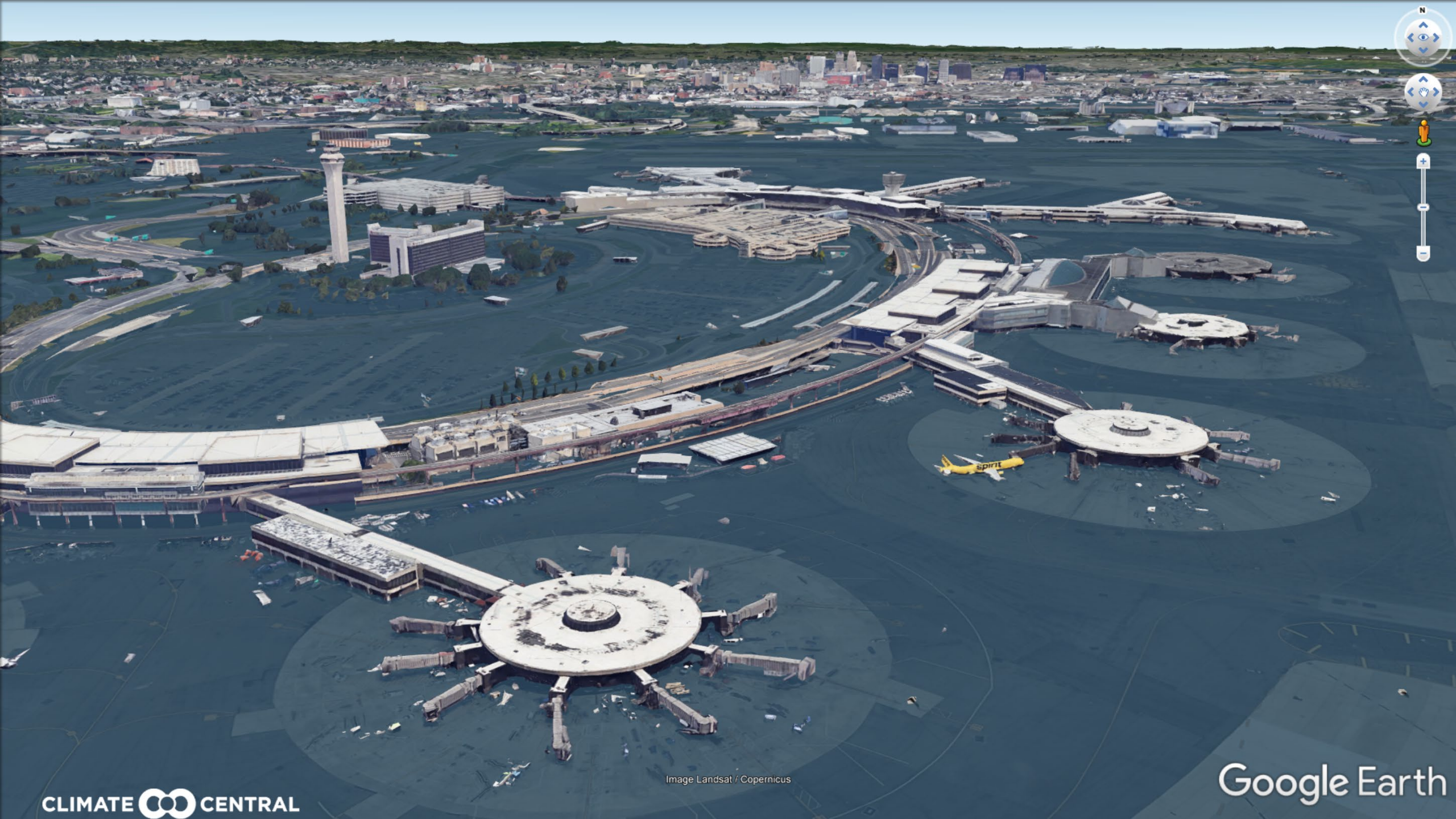


Image Landsat / Copernicus

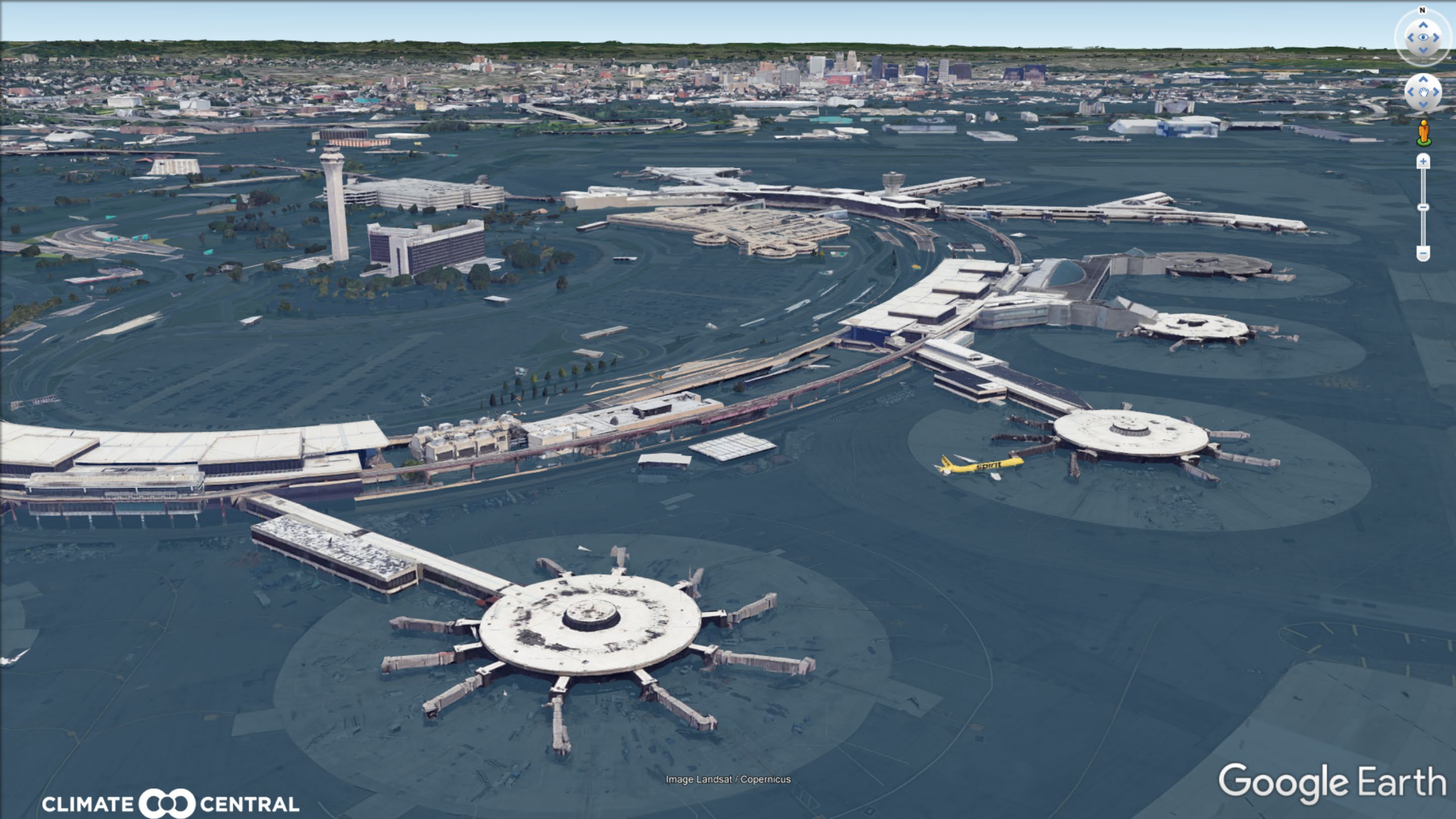


Image Landsat / Copernicus

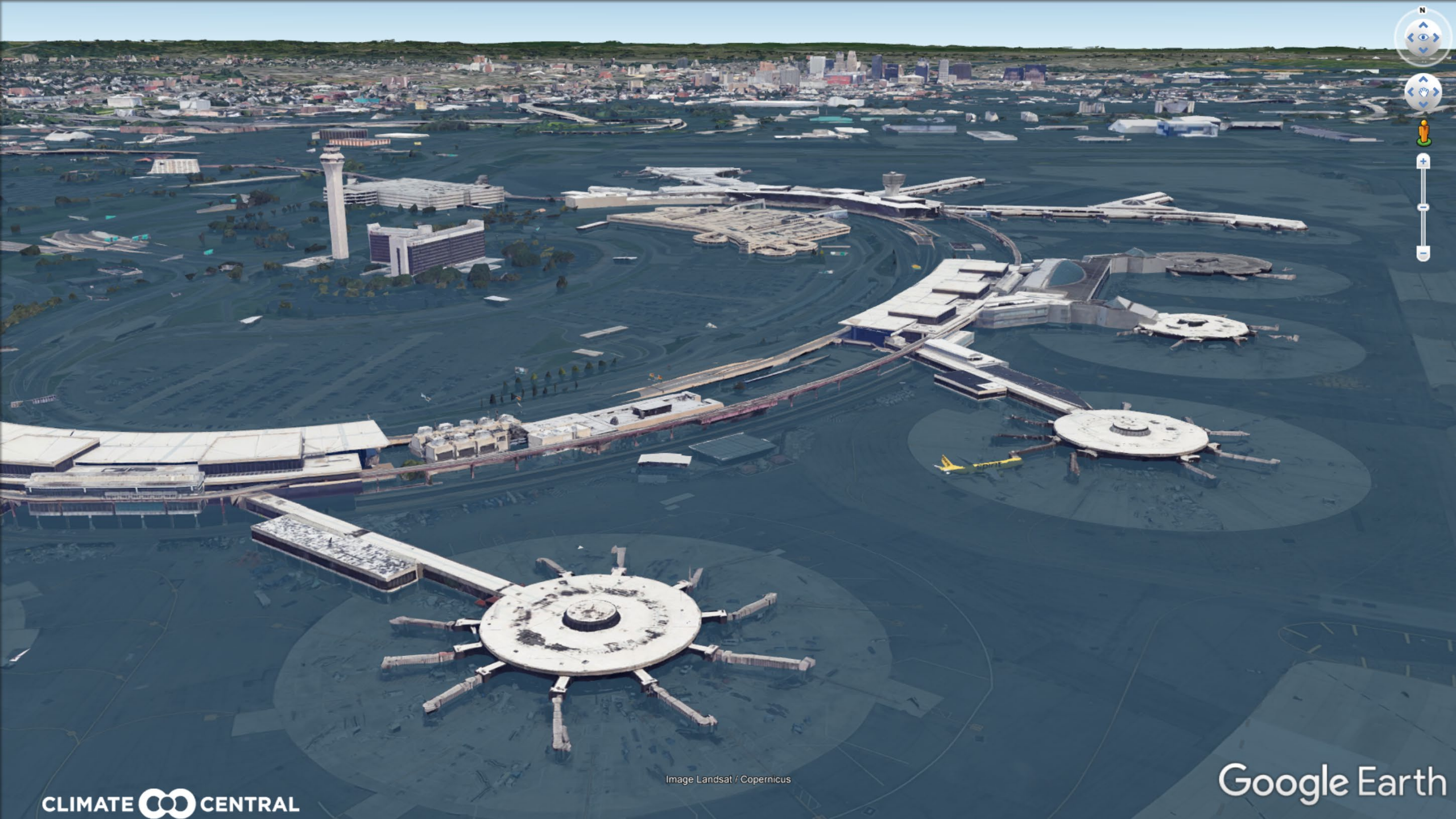
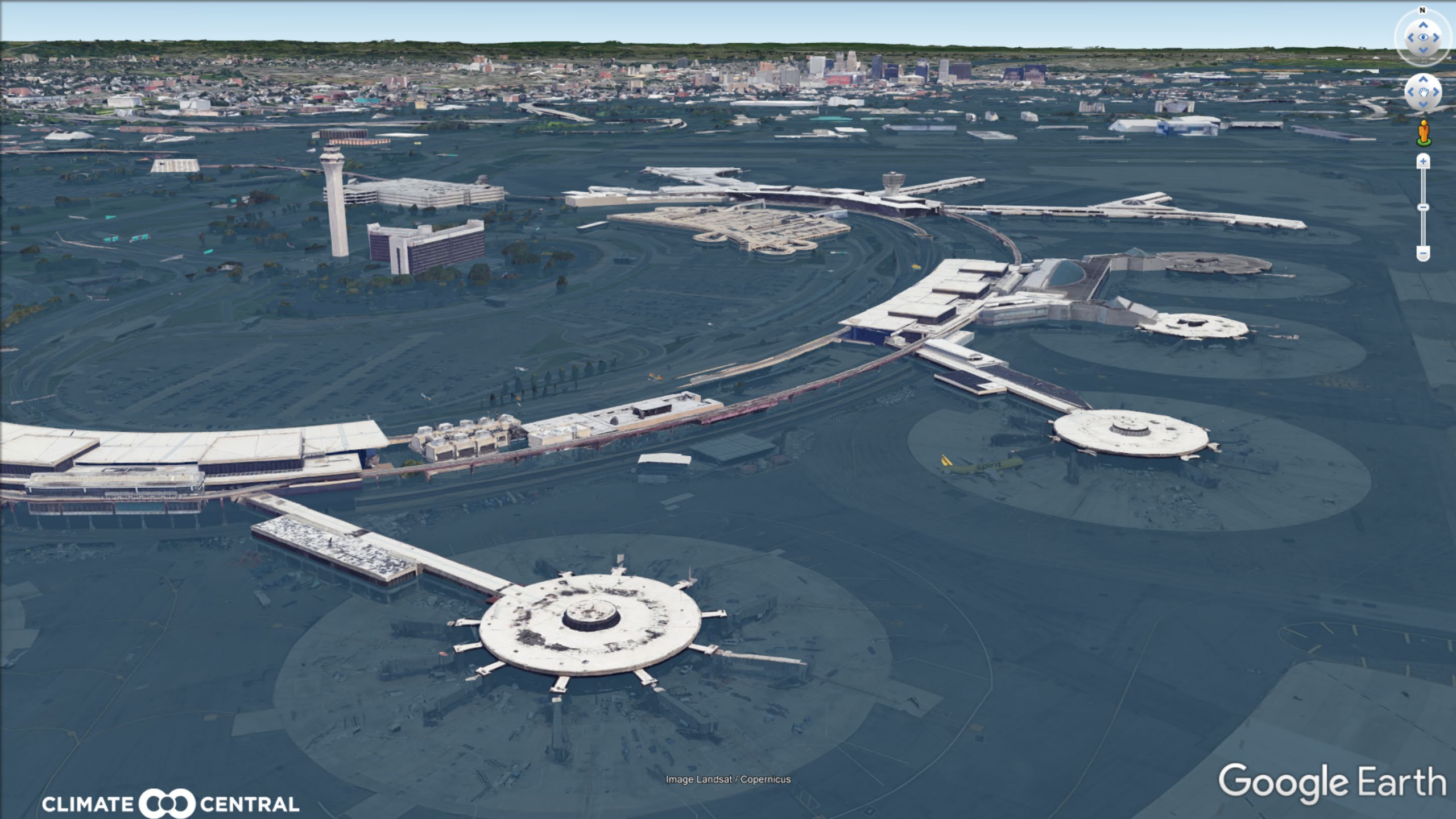


Image Landsat / Copernicus



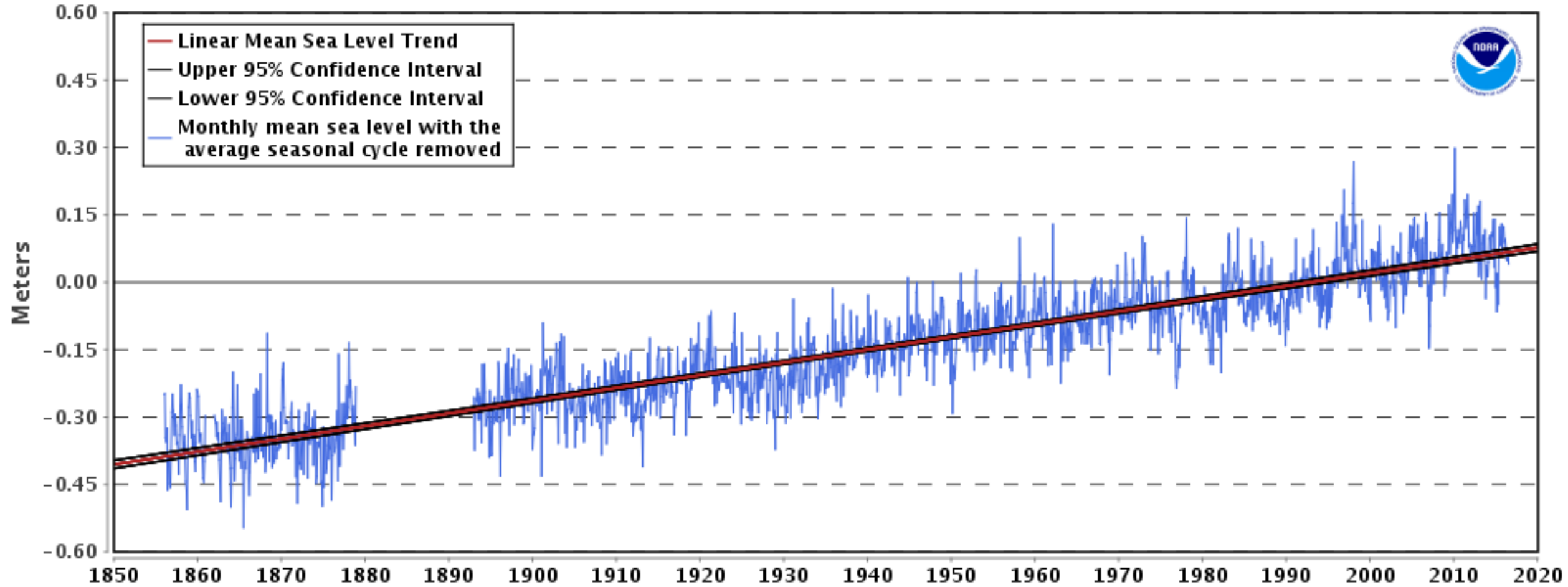
1. Higher

2. Faster

3. More

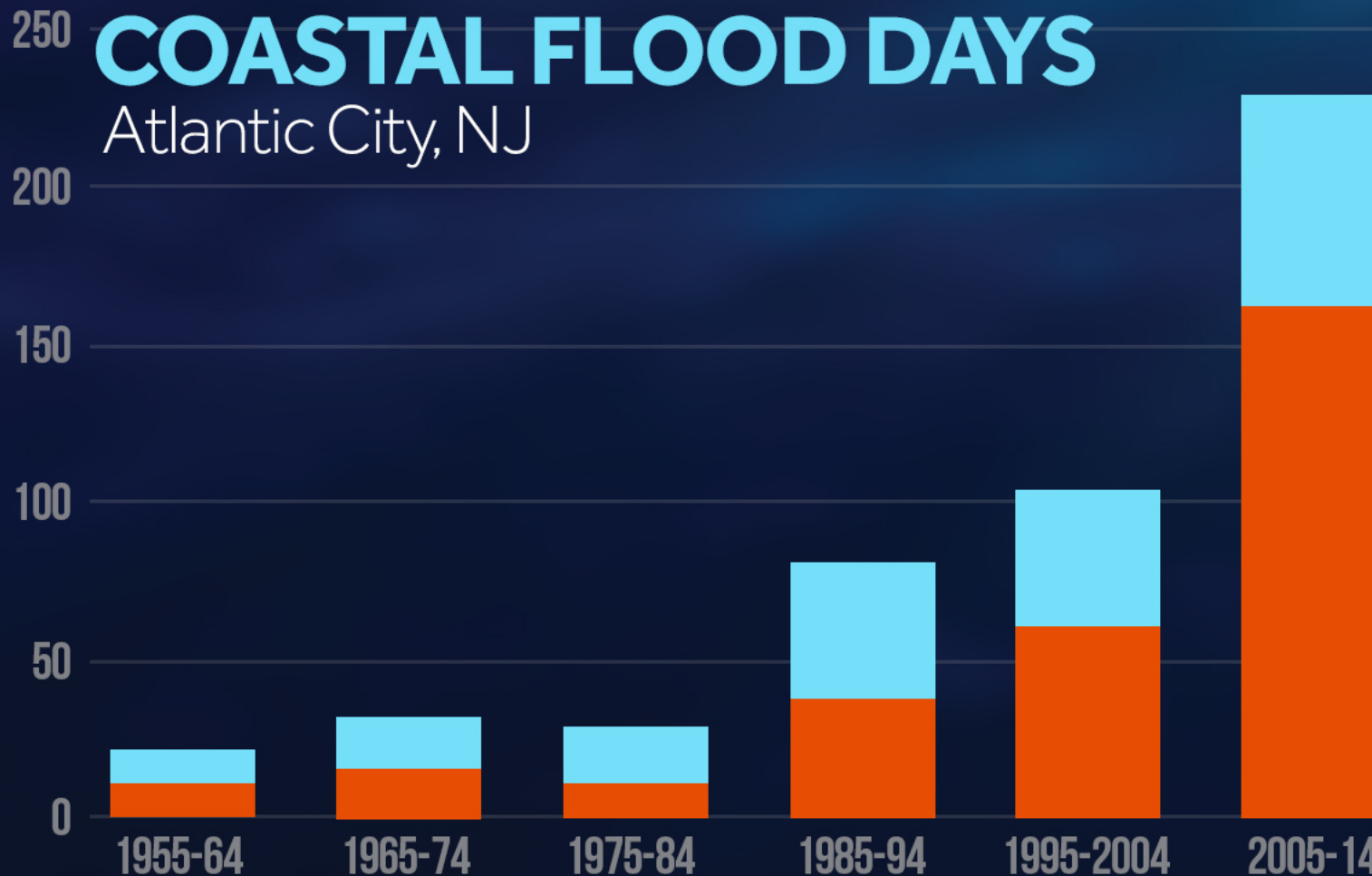
8518750 The Battery, New York

2.84 +/- 0.09 mm/yr



NATURAL + HUMAN-CAUSED COASTAL FLOOD DAYS

Atlantic City, NJ



Orange shows human-caused global sea level rise effects

Must top NWS 'nuisance' thresholds

Source: Kopp et al. 2016 (PNAS), NOAA, & Climate Central

Water level (ft)

When Are the Risks?

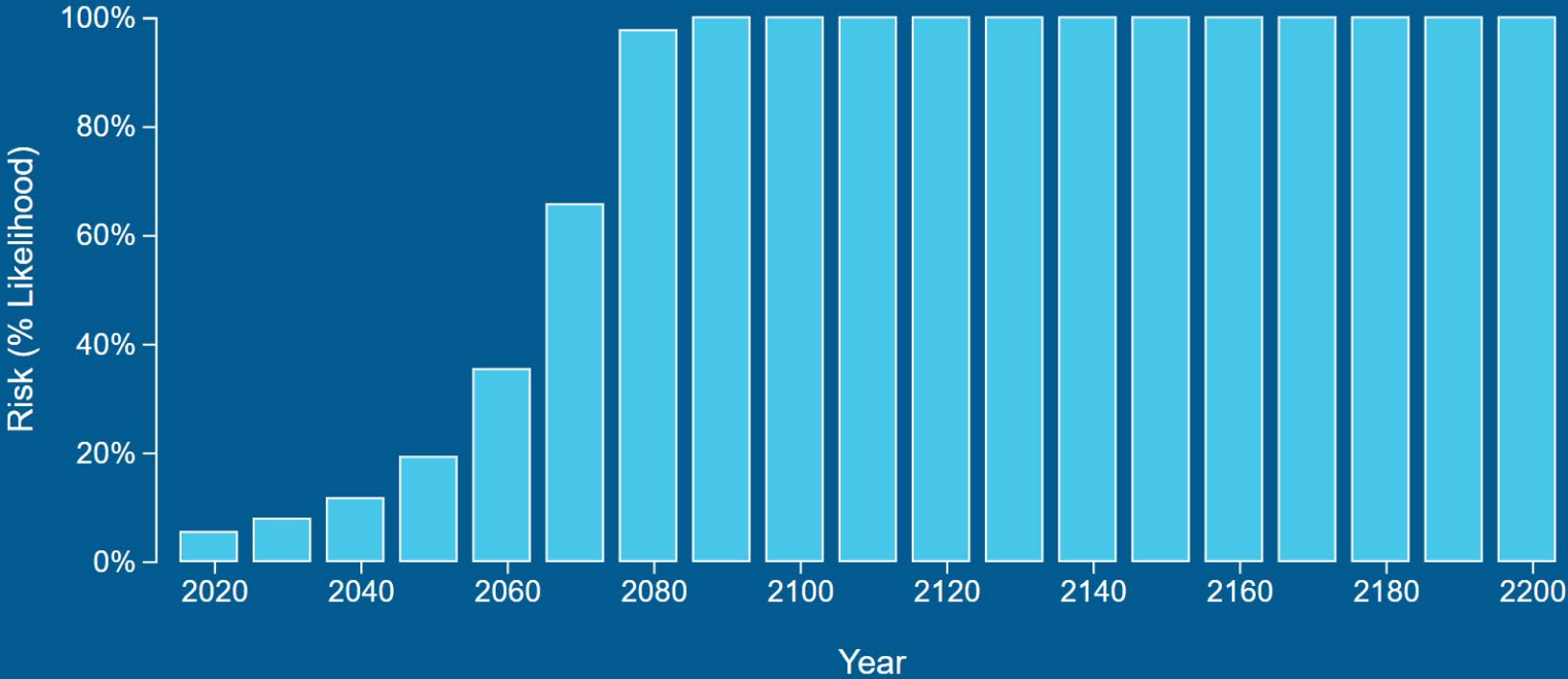
[Tutorial video](#)

HUDSON COUNTY AREA*

Single-year risk of flooding above 5 ft ▾



Risk of at least one flood within each year shown



Sea level scenario

Extreme

Fast rise

Medium

Slow rise

[Advanced](#)

*At The Battery water level station, 4 miles from Hudson County

Analysis uses median local sea level projections based on the intermediate scenario from NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment. [Key notes](#)

English

Water level (ft) ?

When Are the Risks?

[Tutorial video](#)

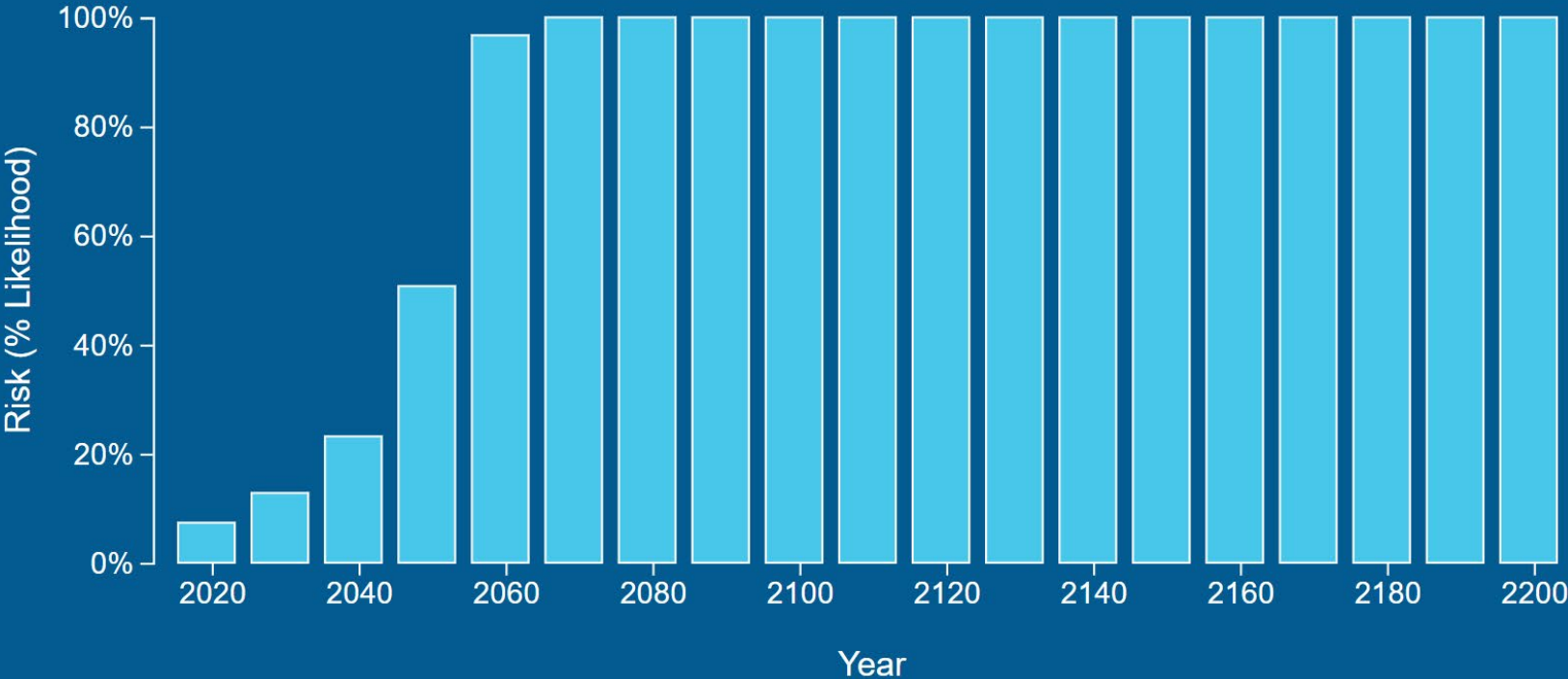


HUDSON COUNTY AREA*

Single-year risk of flooding above 5 ft ▾



Risk of at least one flood within each year shown



Sea level scenario

Extreme

Fast rise

Medium

Slow rise

[Advanced](#)

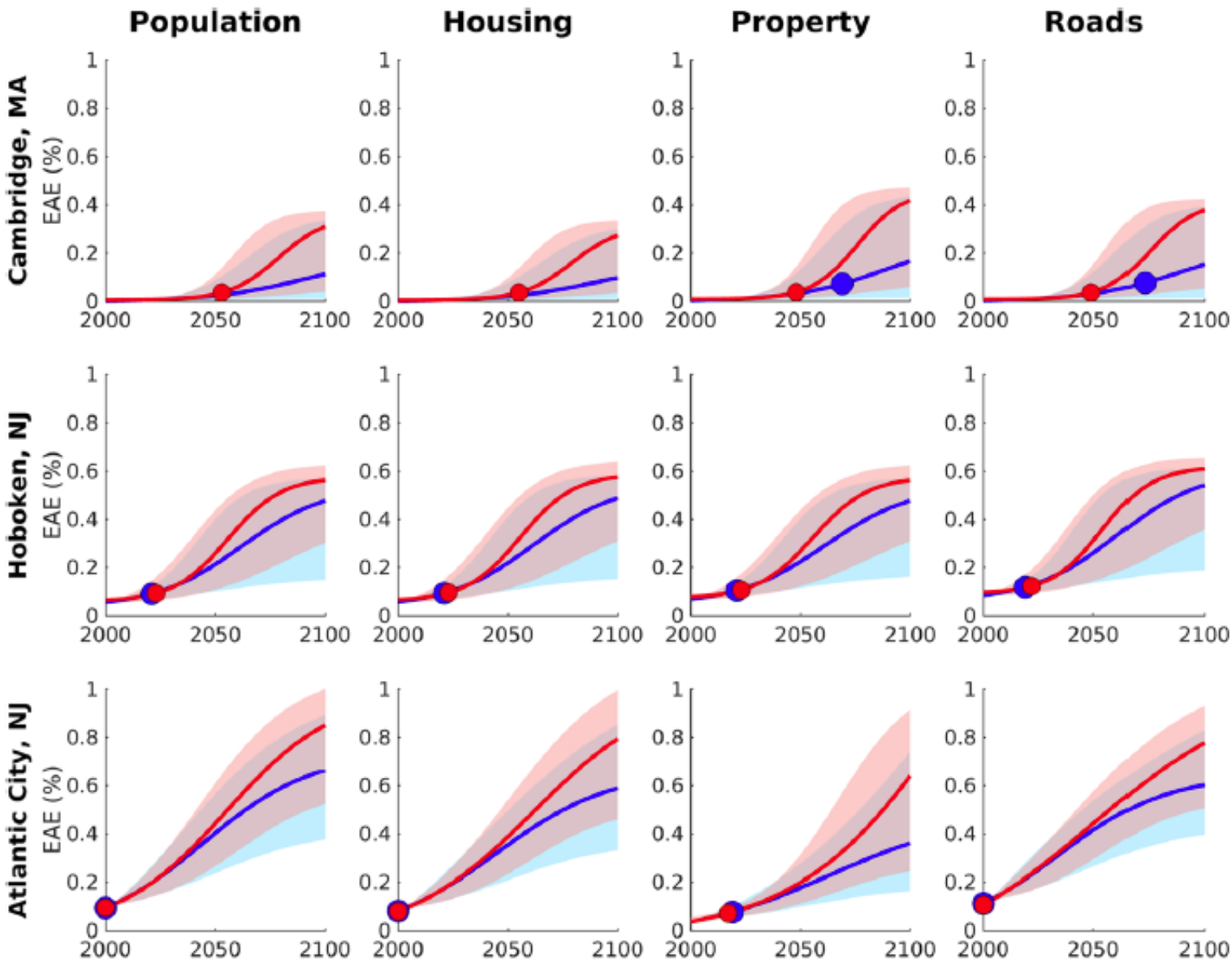
*At The Battery water level station, 4 miles from Hudson County ? ⚙

Analysis uses median local sea level projections based on the intermediate high scenario from NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment. ? ⚙ [Key notes](#)

English

Rapid escalation of coastal flood exposure in US municipalities from sea level rise

Scott Kulp¹ • Benjamin H. Strauss¹



1. Higher
2. Faster
3. More

English (US) ▾

- Download map image
- New York City stats
- Analysis products

Water level ? >>



Show current coast

- See projections
- Legend
- Social vulnerability
- Population
- Ethnicity
- Income
- Property
- Landmarks

 Elevation data courtesy of NOAA ?

What Is at Risk?

- Population
- Buildings
- Infrastructure
- Contamination Risks
- Land

Total infrastructure below 5 ft in New Jersey

Infrastructure: All ▾	Total
Roads	2,012 miles
Local roads	1,762 miles
County roads	135 miles
Railroads	128
Secondary roads	114 miles
State roads	72 miles
Mainline rail	71 miles

Sources: Raw roads data, [Census 2012](#); elevation data, [lidar](#); administrative boundaries, [US Census](#). [Details](#)

Values exclude sub-5ft areas potentially protected by levees or other features. ⓘ

Choose a threat to map using the scrollable list above

Total roads below 5 ft in New Jersey by county ▾



Miles of road

Water level (ft) ⓘ



English

Water level (ft) ?

Choose a threat to map using the scrollable list above

Total roads below 5 ft in New Jersey by county ▼



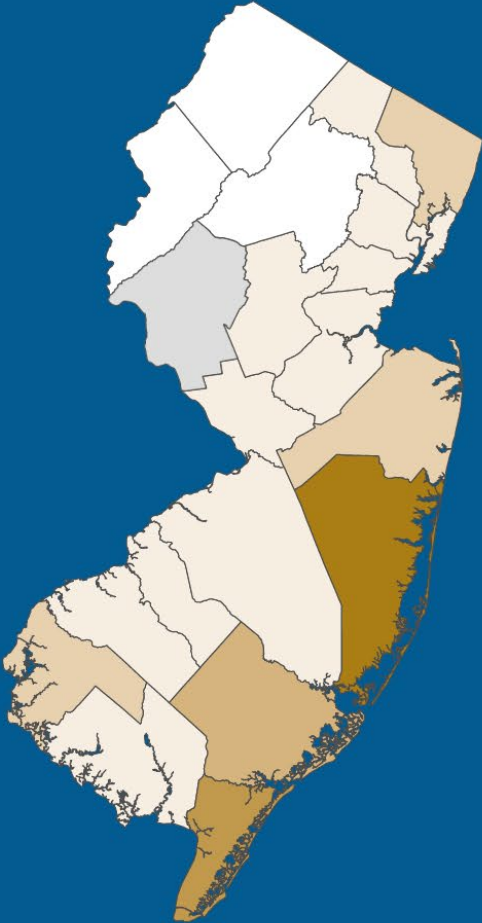
Miles of road



Legend values are bin upper limits

Top threats on map

Ocean Co.	536 miles
Cape May Co.	386 miles
Atlantic Co.	303 miles
Salem Co.	145 miles
Bergen Co.	114 miles



Sources: Raw roads data, [Census 2012](#); elevation data, [lidar](#); administrative boundaries, [US Census](#). [Details](#)

Values exclude sub-5ft areas potentially protected by levees or other features. ?

English

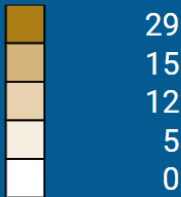
Water level (ft) ?

Choose a threat to map using the scrollable list above

Total railroads below 5 ft in New Jersey by county ▼



Railroads



Legend values are bin upper limits

Top threats on map

Hudson Co.	29
Bergen Co.	15
Essex Co.	13
Salem Co.	12
Camden Co.	11

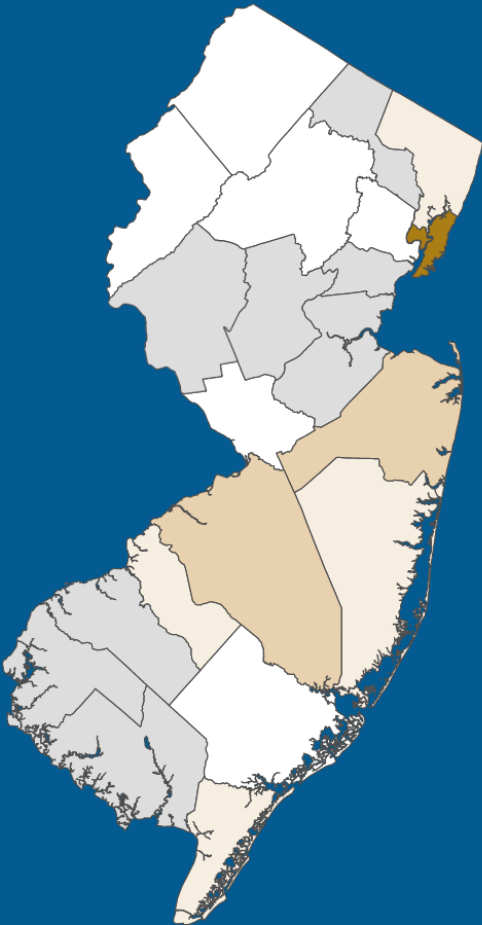
Sources: Raw railroads data, [RITA/BTS 2013](#); elevation data, [lidar](#); administrative boundaries, [US Census](#). [Details](#)

Values exclude sub-5ft areas potentially protected by levees or other features. ?

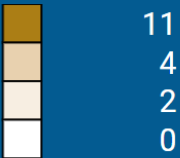
Water level (ft) ?

Choose a threat to map using the scrollable list above

Total passenger stations below 5 ft in New Jersey by county ▼



Passenger stations



Legend values are bin upper limits

Top threats on map

Hudson Co.	11
Burlington Co.	4
Monmouth Co.	3
Bergen Co.	2
Camden Co.	1

Sources: Raw passenger stations data, [RITA/BTS 2013](#); elevation data, [lidar](#); administrative boundaries, [US Census](#). [Details](#)

Values exclude sub-5ft areas potentially protected by levees or other features. ?

English

What Is at Risk?

[Tutorial video](#) ⓘ ⚙

- Population
- Buildings
- Infrastructure
- Contamination Risks
- Land

Total infrastructure below 5 ft in Hudson County

Infrastructure: All ▾	Total
Roads	104 miles
Local roads	81 miles
Railroads	29
Mainline rail	16 miles
Non-mainline rail	13 miles
Passenger stations	11
County roads	11 miles

Sources: Raw roads data, [Census 2012](#); elevation data, [lidar](#); administrative boundaries, [US Census](#). [Details](#)

Values exclude sub-5ft areas potentially protected by levees or other features. ⓘ

Choose a threat to map using the scrollable list above

Total roads below 5 ft in counties in New Jersey ▾



Miles of road

Water level (ft) ⓘ

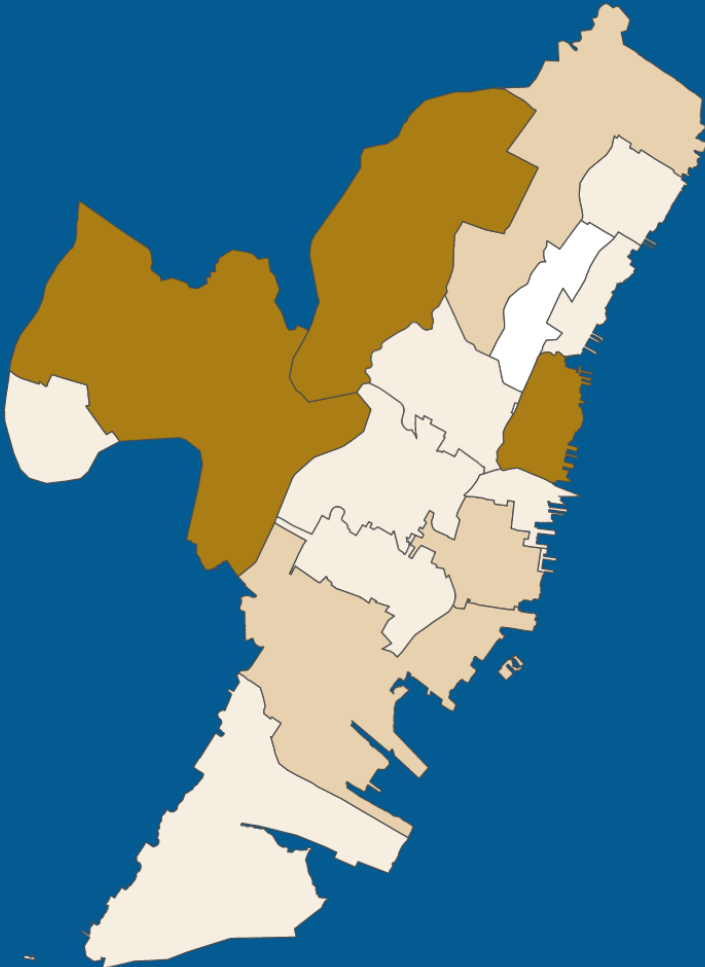


English

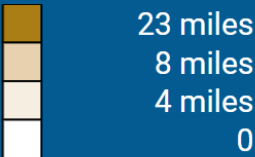
Water level (ft) ?

Choose a threat to map using the scrollable list above

Total roads below 5 ft in Hudson County by zip code ▼



Miles of road



Legend values are bin upper limits

Top threats on map

- 07094 23 miles
- 07032 21 miles
- 07030 20 miles
- 07302 8 miles
- 07047 7 miles

Sources: Raw roads data, [Census 2012](#); elevation data, [lidar](#); administrative boundaries, [US Census](#). [Details](#)

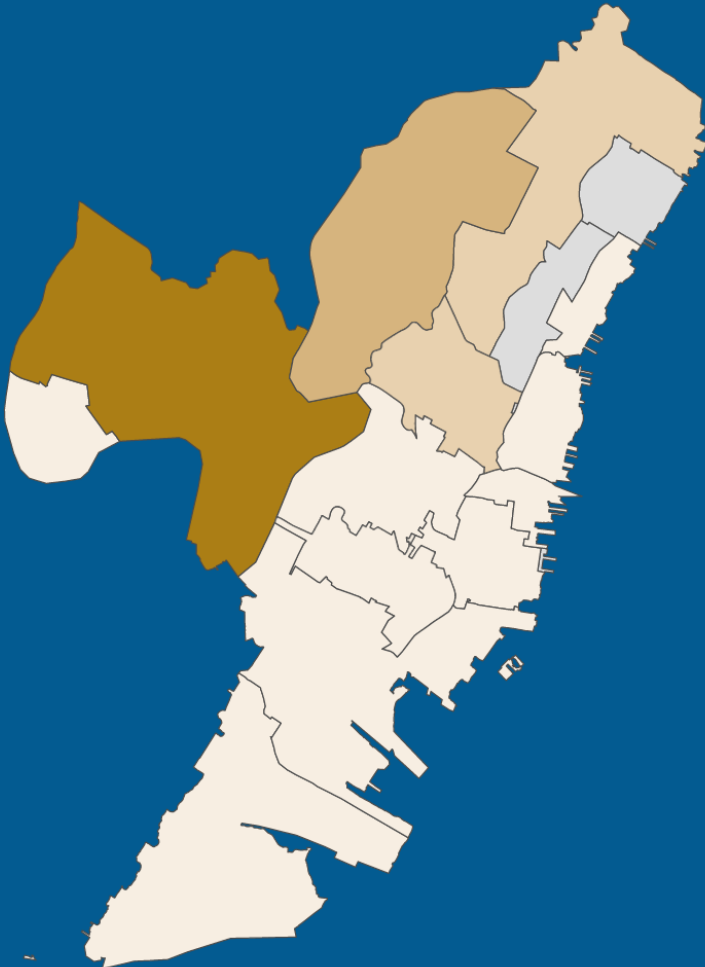
Values exclude sub-5ft areas potentially protected by levees or other features. ?

English

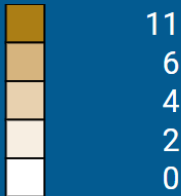
Water level (ft) ?

Choose a threat to map using the scrollable list above

Total railroads below 5 ft in Hudson County by zip code ▼



Railroads



Legend values are bin upper limits

Top threats on map

07032	11
07094	6
07047	4
07307	4
07002	2

Sources: Raw railroads data, [RITA/BTS 2013](#); elevation data, [lidar](#); administrative boundaries, [US Census](#). [Details](#)

Values exclude sub-5ft areas potentially protected by levees or other features. ?

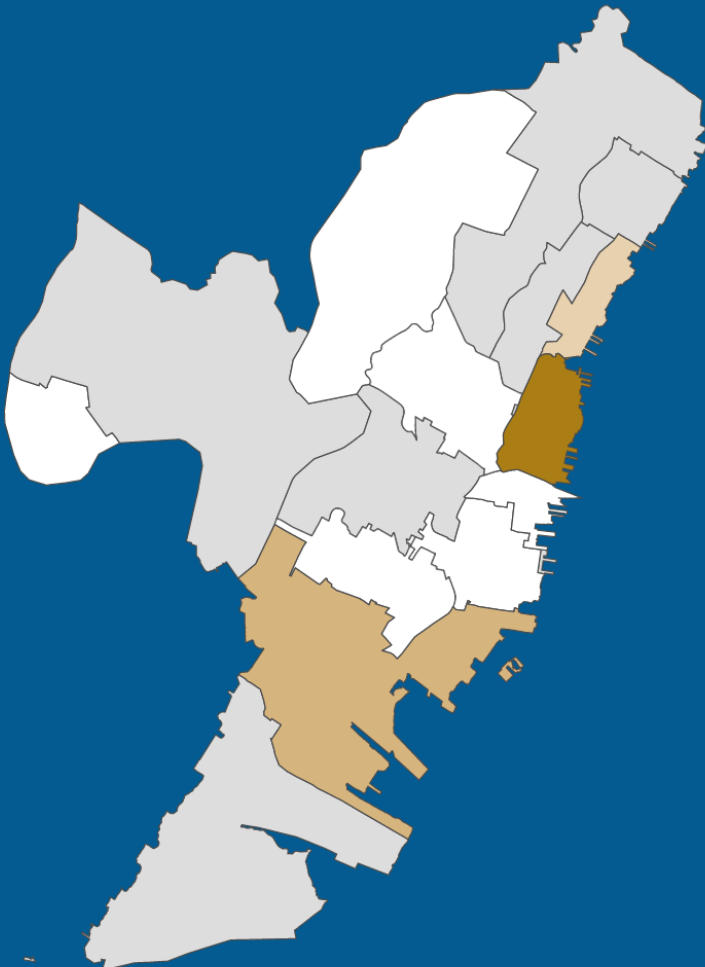
English

Choose a threat to map using the scrollable list above

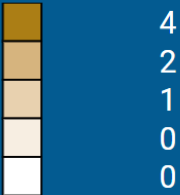
Total transit passenger stations below 5 ft in Hudson County by zip code ▼



Water level (ft) ?



Transit passenger stations



Legend values are bin upper limits

Top threats on map

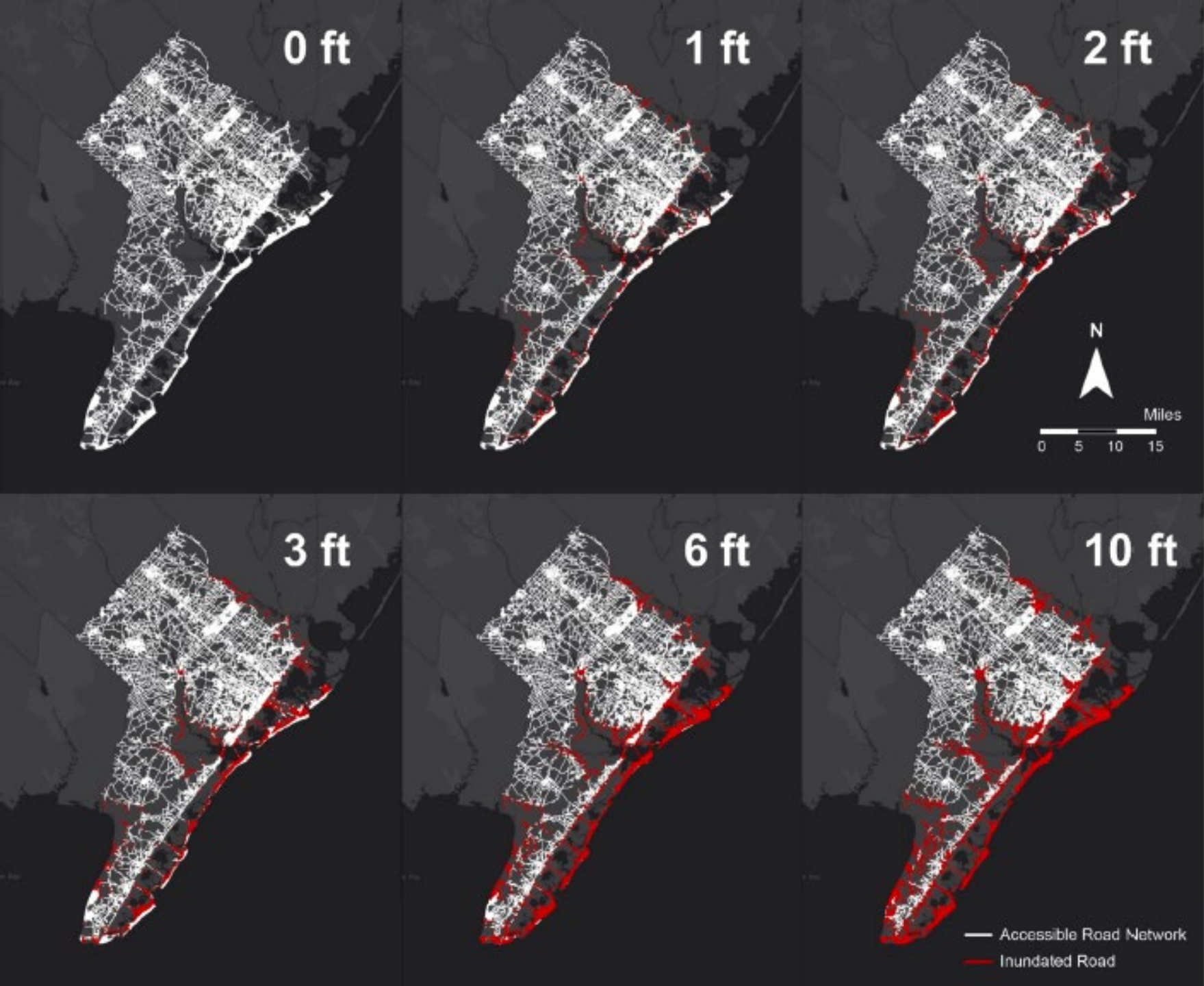
07030	4
07305	2
07086	1
07029	0
07304	0

Sources: Raw transit passenger stations data, [RITA/BTS 2013](#); elevation data, [lidar](#); administrative boundaries, [US Census](#). [Details](#)

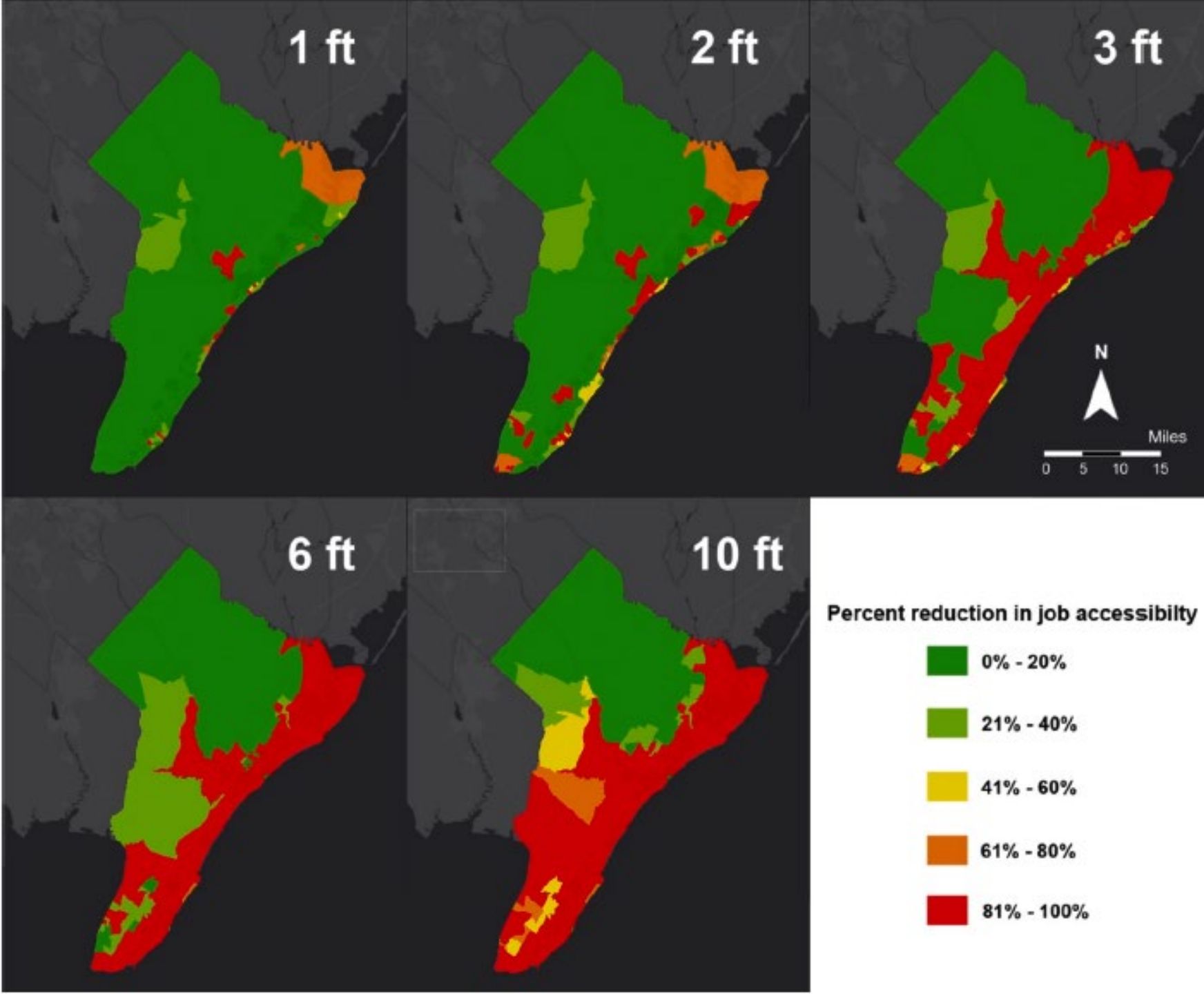
Values exclude sub-5ft areas potentially protected by levees or other features. ?

English

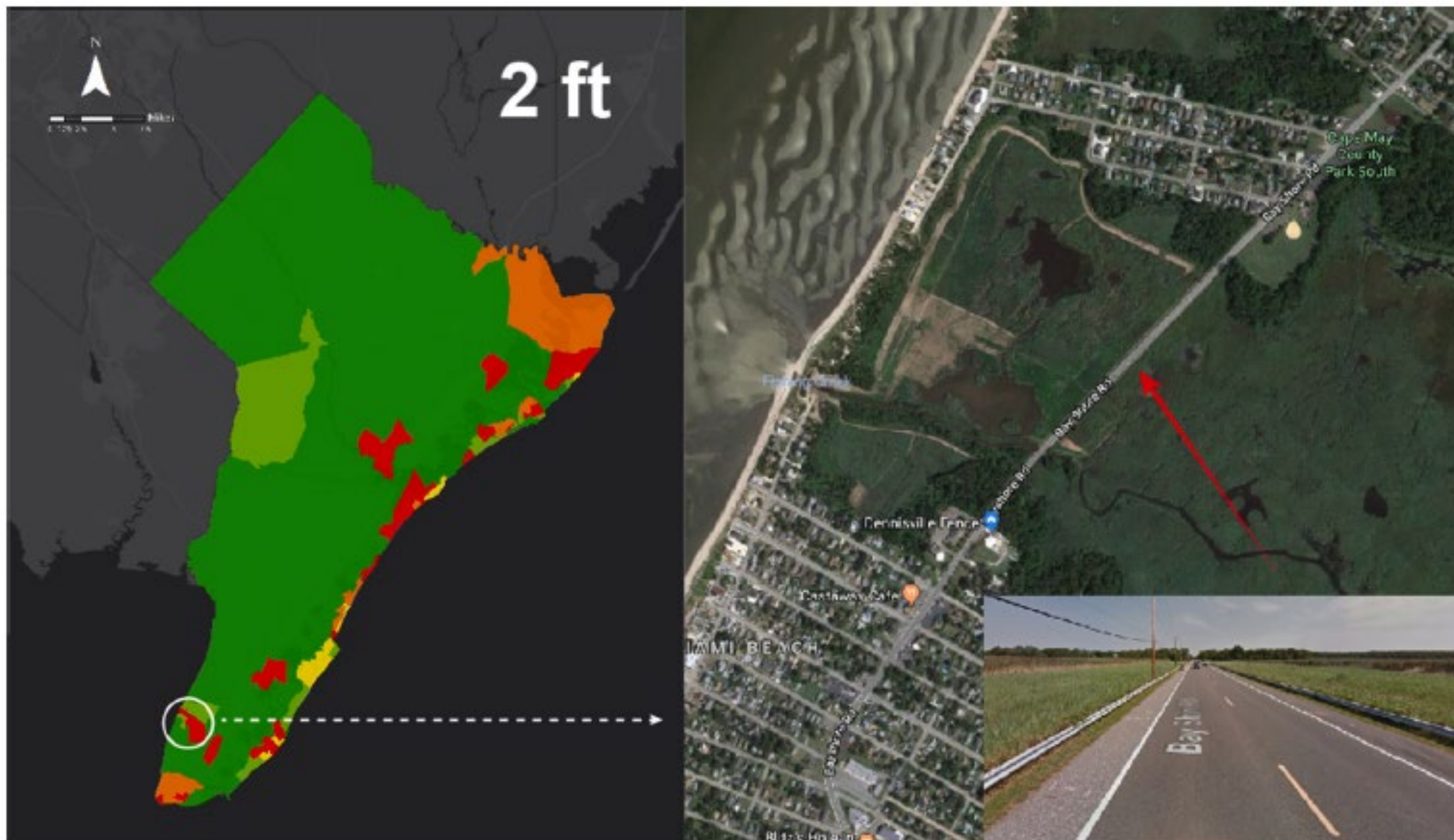
SEA LEVEL RISE AND COASTAL FLOOD EXPOSURE OF TRANSIT PASSENGER STATIONS IN HUDSON COUNTY, NJ ON LAND BELOW 10FT: LIST											
LEVEL	ID	NAME	LAT	LON							
0f	NJ0730502	Port Liberte	40.68703	-74.0741							
0f	NJ0708702	Port Imperial	40.7718	-74.012							
0f	NJ0708701	Lincoln Harbor	40.7593	-74.02072							
0f	NJ0731001	Newport Ferry Terminal	40.72793	-74.02818							
0f	NJ0703002	14th Street Terminal	40.75206	-74.02262							
0f	NJ0730201	Colgate Pier/Paulus Hook	40.71616	-74.03256							
2f	NJ0730401	Liberty Landing Marina	40.70694	-74.0343							
2f	NJ0703005	Hoboken	40.7356	-74.0277							
2f	NJ0703004	Hoboken	40.7356	-74.0277							
2f	NJ0703003	Hoboken	40.73485	-74.02804							
3f	NJ0703001	Hoboken Terminal	40.73526	-74.02715							
4f	NJ0702901	Harrison	40.7382	-74.1557							
5f	NJ0703007	2nd Street	40.7418	-74.0428							
6f	NJ0731002	Pavonia-Newport	40.7267	-74.0347							
6f	NJ0709401	Secaucus Jct.	40.76119	-74.07582							
6f	NJ0731003	Pavonia/Newport	40.7267	-74.0347							
6f	NJ0730205	Exchange Place	40.716	-74.0342							
6f	NJ0730207	Exchange Place	40.7192	-74.0417							
7f	NJ0708602	Port Imperial	40.7758	-74.0128							
7f	NJ0731004	Harsimus Cove	40.7225	-74.0373							
7f	NJ0708601	Lincoln Harbor	40.7617	-74.0239							
7f	NJ0730206	Harborside	40.7195	-74.0341							
8f	NJ0730501	Greenville Piers	40.6776	-74.07566							
8f	NJ0730202	Jersey Avenue	40.7151	-74.0487							
9f	NJ0730403	Marin Boulevard	40.7145	-74.0434							
10f	NJ0730402	Liberty State Park	40.7103	-74.056							
10f	NJ0730203	Grove Street	40.7198	-74.043							



From Noland et al. 2019
(Transportation Research Part D)



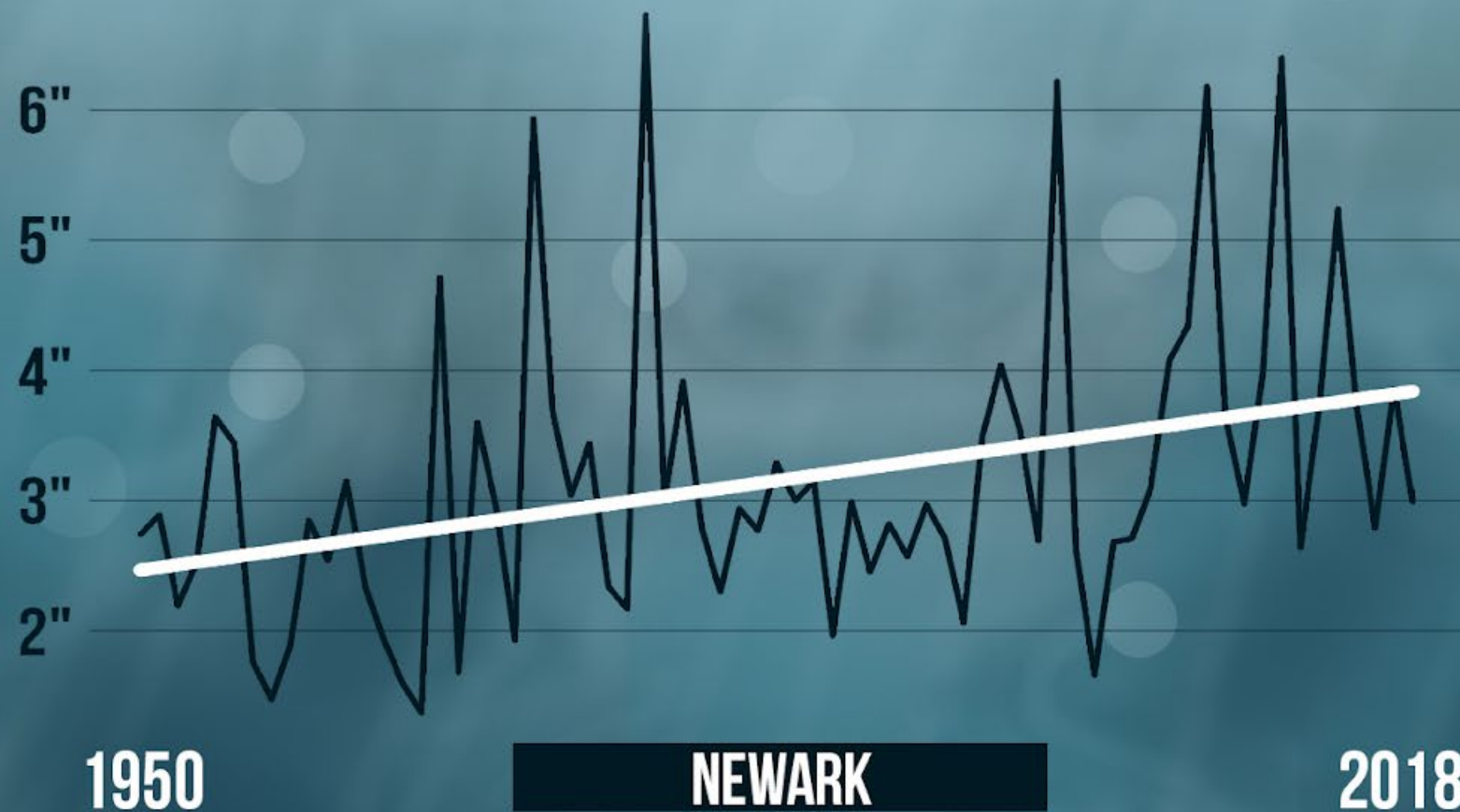
From Noland et al. 2019
(Transportation Research Part D)



From Noland et al. 2019 (Transportation Research Part D)

DAILY DELUGE

RAIN ON THE WETTEST DAY EACH YEAR

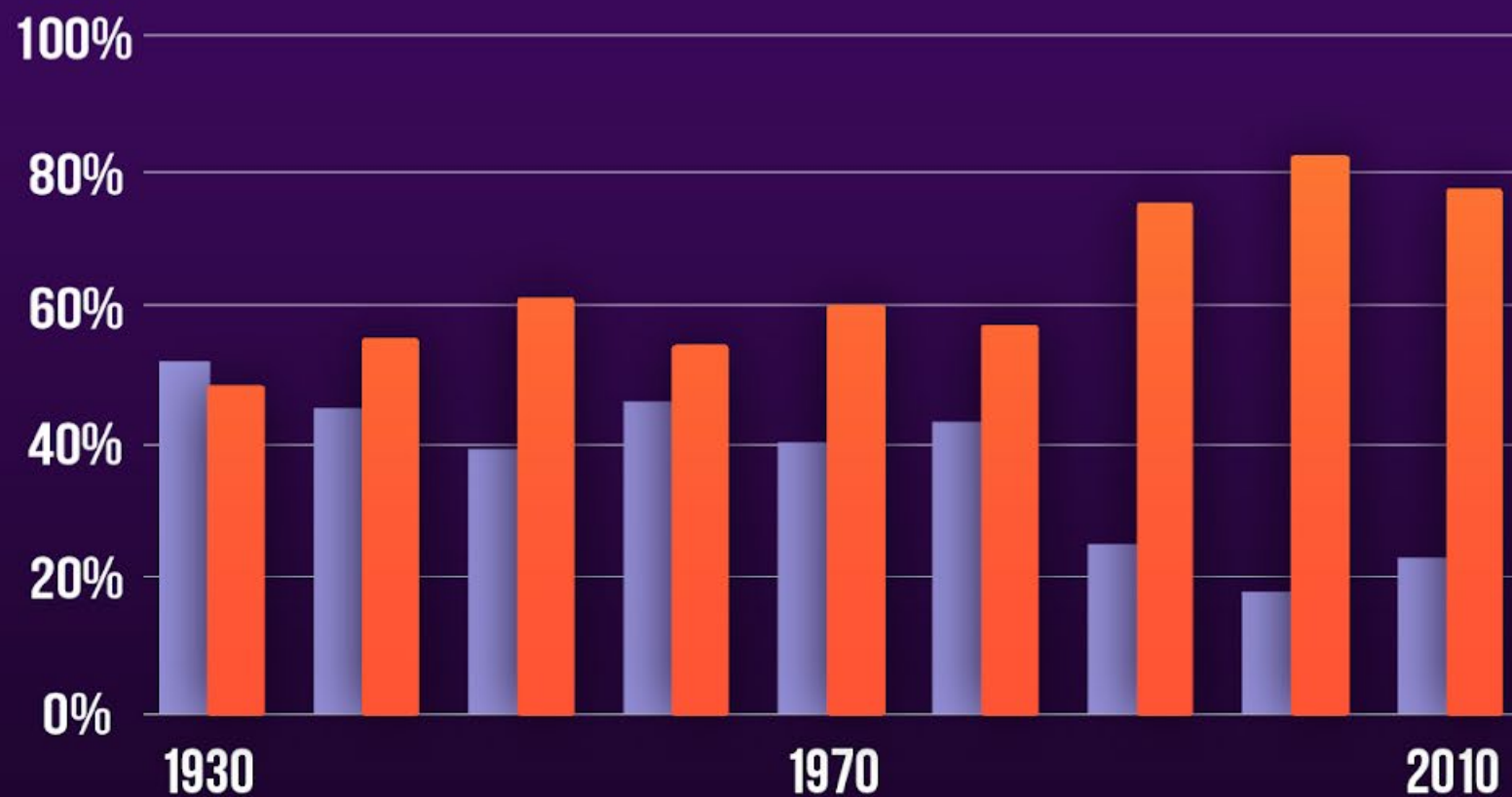


Amount of precipitation on the wettest calendar day observed each year
Source: RCC-ACIS.org

CLIMATE  CENTRAL

NEWARK RECORDS SET BY DECADE

■ HOT ■ COLD



% maximum & minimum daily temperature records by decade for POR through 2018
Source: RCC-ACIS.org

CLIMATE  CENTRAL

**DAYS
ABOVE 95°**

**6.4 MORE
DAYS**



Day count based on rate of change since 1970.
Source: RCC-ACIS.org

CLIMATE  CENTRAL

Unless

Thank you

RiskFinder.org

bstrauss@climatecentral.org