



Photo: Hodgejr/Dreamstime.com

Underwater:

Rising Seas, Chronic Floods, and the Implications for U.S. Coastal Real Estate

[Union of
Concerned Scientists

Science for a
and healthier planet
safer world.



Encroaching Tides

How Sea Level Rise and Tidal Flooding Threaten U.S. East and Gulf Coast Communities over the Next 30 Years



Union of Concerned Scientists

Union of Concerned Scientists

EXECUTIVE SUMMARY

The US Military on the Front Lines of Rising Seas

Growing Exposure to Coastal Flooding at East and Gulf Coast Military Bases

HIGHLIGHTS
The US Armed Forces depend on safe and functional bases to carry out their stated mission to provide the military forces needed to deter war and to protect the security of the country. The US military and defense budget in fiscal year 2012 was just under \$500 billion. Of that total, about one-third was earmarked for the maintenance and operation of bases, many of which are in the United States. Given growing exposure to rising seas and storm surge, this analysis finds the military is at risk of losing land where vital infrastructure, training and testing grounds, and housing for thousands of its personnel currently exist.

The Department of Defense (DOD) maintains more than 1,200 military installations in the United States—sites where the military tests weaponry, conducts training exercises, builds and launches ships, comprises intelligence, develops new technology, and houses critical military commands (Hall et al. 2016). Many of these sites are also where officers, enlisted men and women, and their families live.

Given their central role in national security, such installations have historically been well protected. But sea level rise, increased tidal flooding, and heightened storm surges do not stop for checkpoints. These climate-driven trends are already complicating operations at certain coastal installations (NAS 2011). A roughly three-foot increase in sea level¹ would threaten the second 100 installations in the United States (43 percent \$500 billion) and the tens of thousands—who depend on them—to enable decision makers around this century, and who Union of Concerned Scientists (UCS) focus along the East and Gulf coasts in the armed forces, sea level rise, and because they of size, geographic distribution



Ships docked in 2011 at Naval Station Parris Camp, NC. As of 2016, this area is at risk of flooding.

When Rising Seas Hit Home

Hard Choices Ahead for Hundreds of US Coastal Communities



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Underwater

Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate



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Photo: Will Brown

[Defining Chronic Inundation



Photo: Emily Michot/The Miami Herald via AP

[Mapping Chronic Inundation

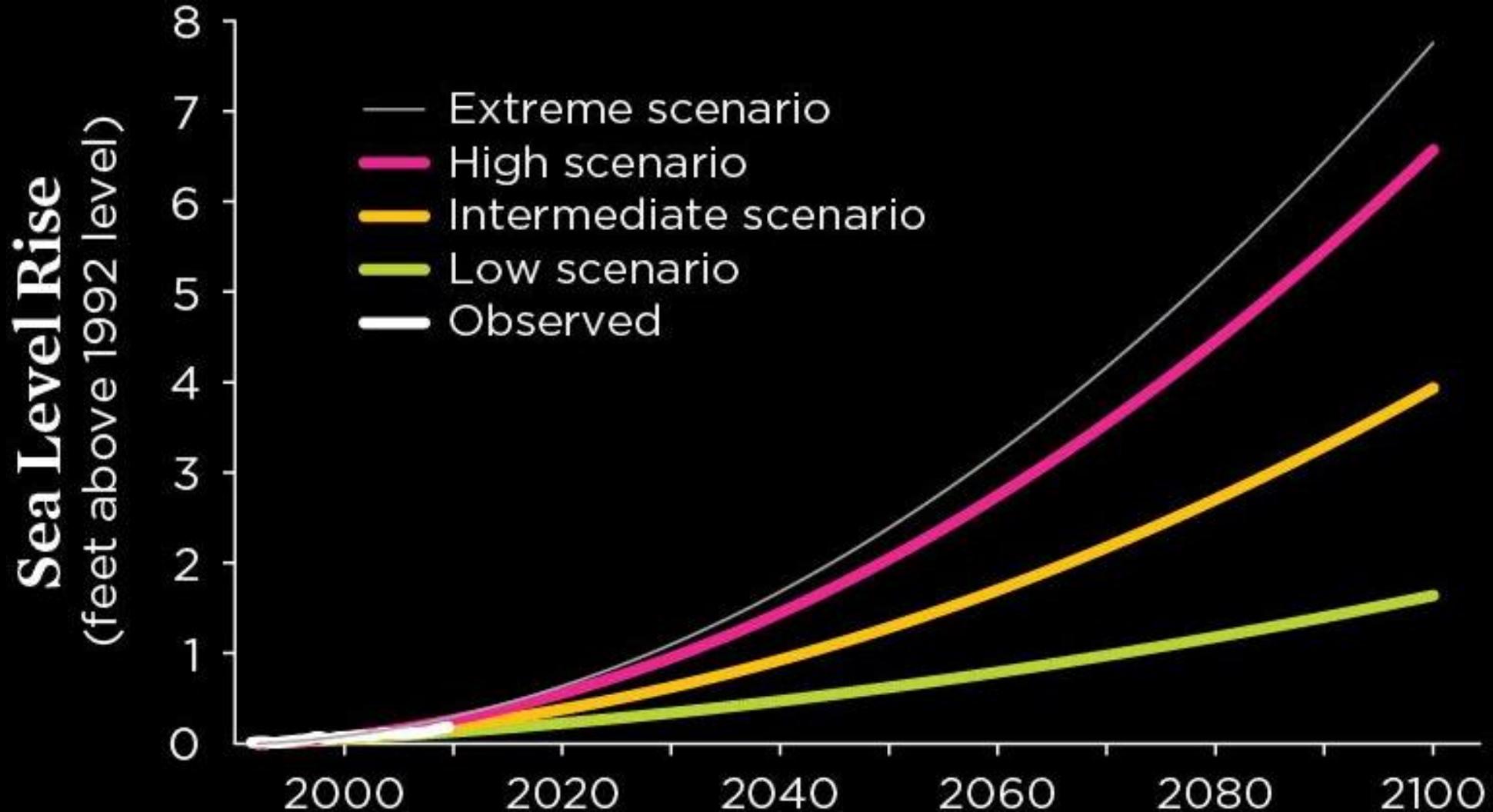
1. Tide gauge records



Photo: NOAA

Mapping Chronic Inundation

2. Sea level rise projections

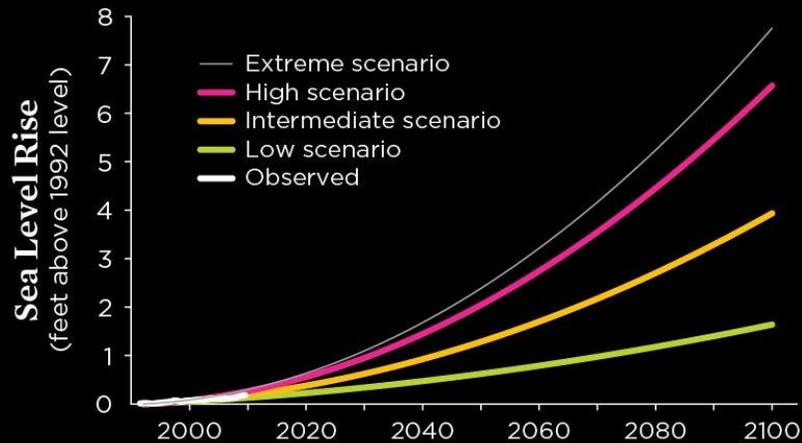


[Mapping Chronic Inundation

1. Tide gauge records



2. Sea level rise projections



3. Digital Elevation Models



4. Property data from Zillow

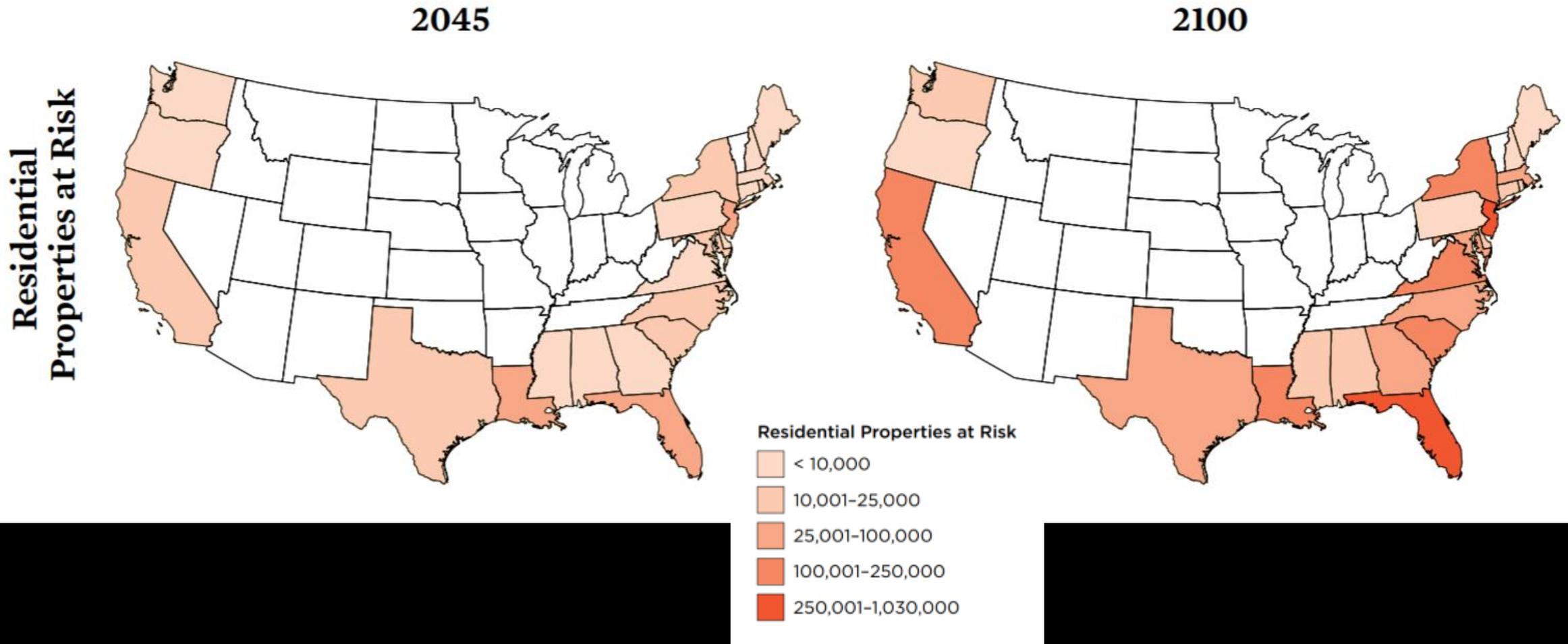




[What does this mean for coastal property?]

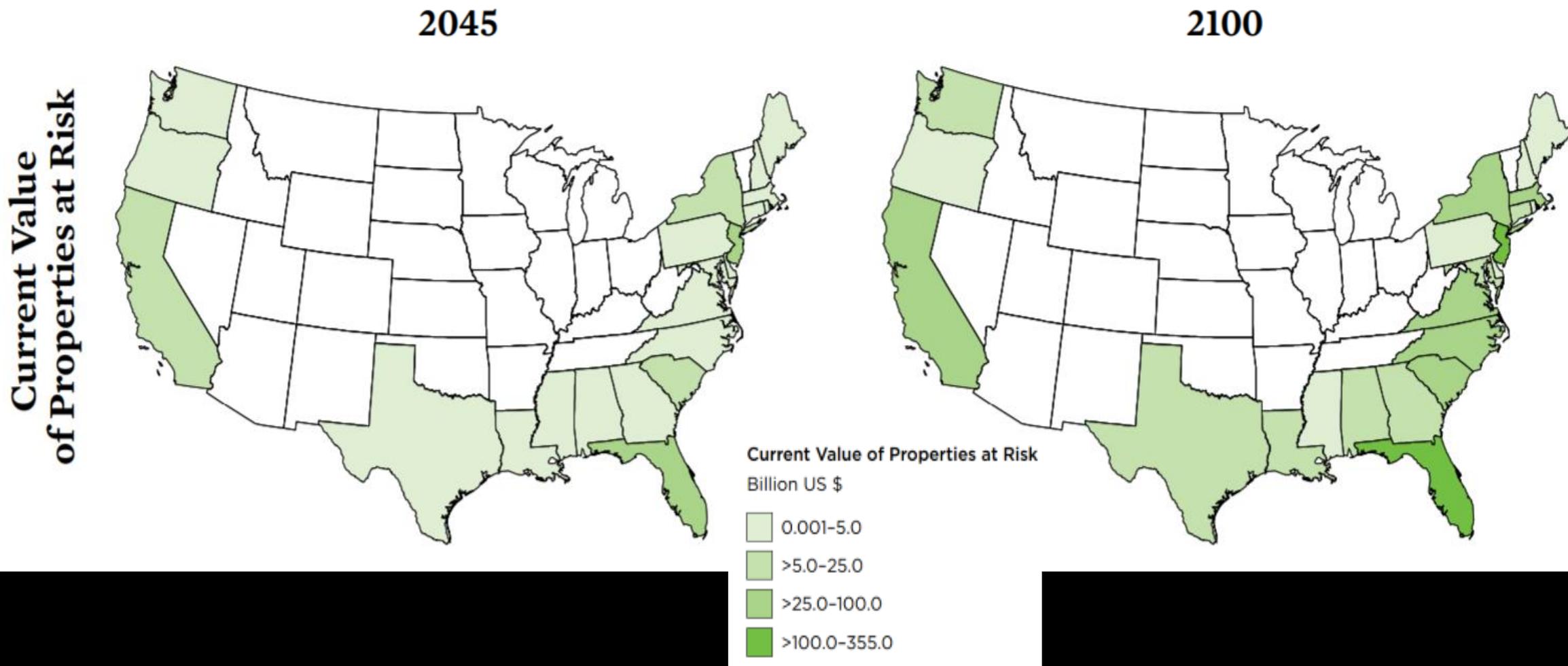
[Homes at risk

A National Overview



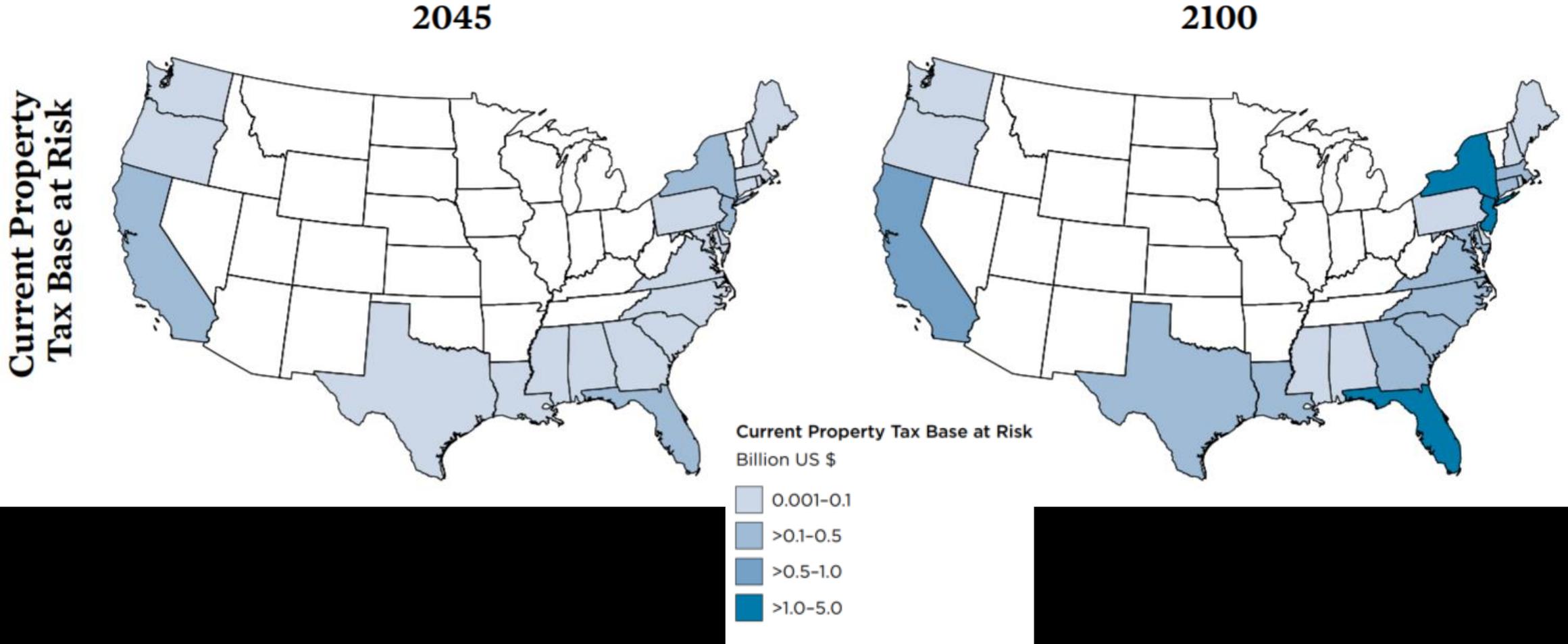
[Value at risk

A National Overview

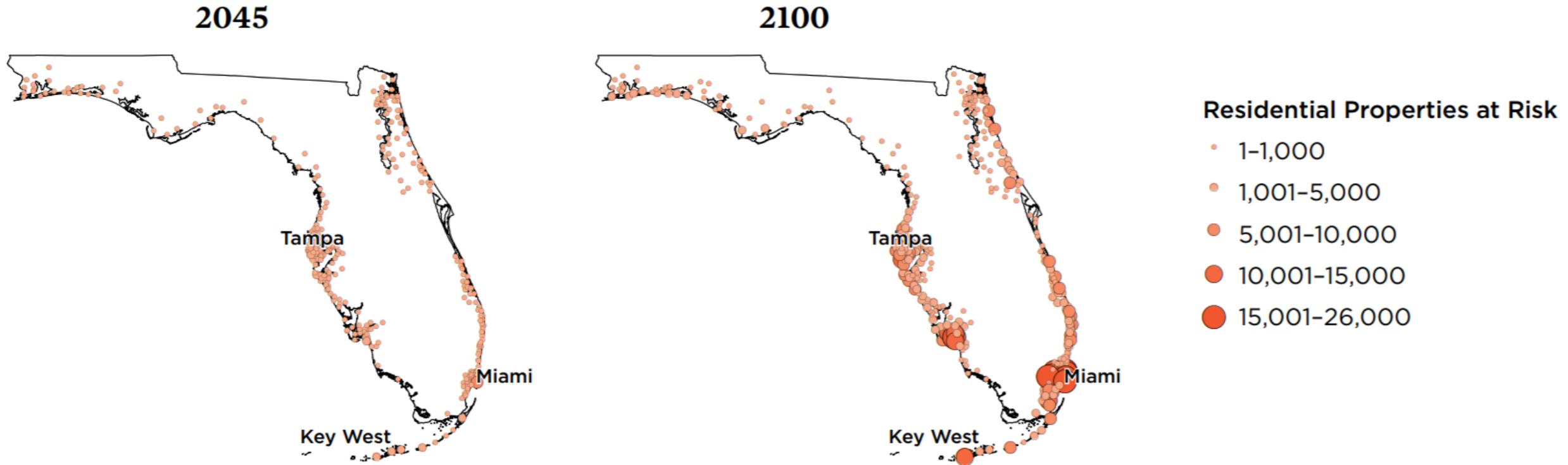


[Tax base at risk

A National Overview



[Acute exposure in Florida: Homes at risk



[Acute exposure in Florida: Value at risk

2045

2100

Current Value of Properties
at Risk

Billion US \$

● 0.001-1.0

● >1.0-2.0

● >2.0-5.0

● >5.0-20.0

Tampa

Miami

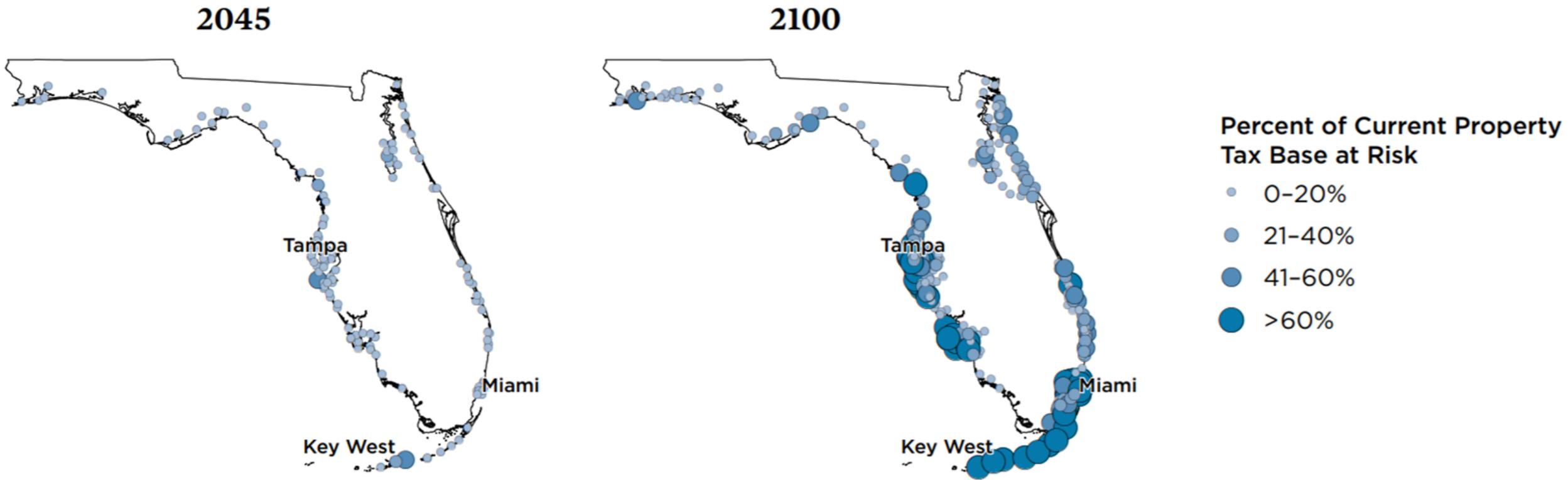
Key West

Tampa

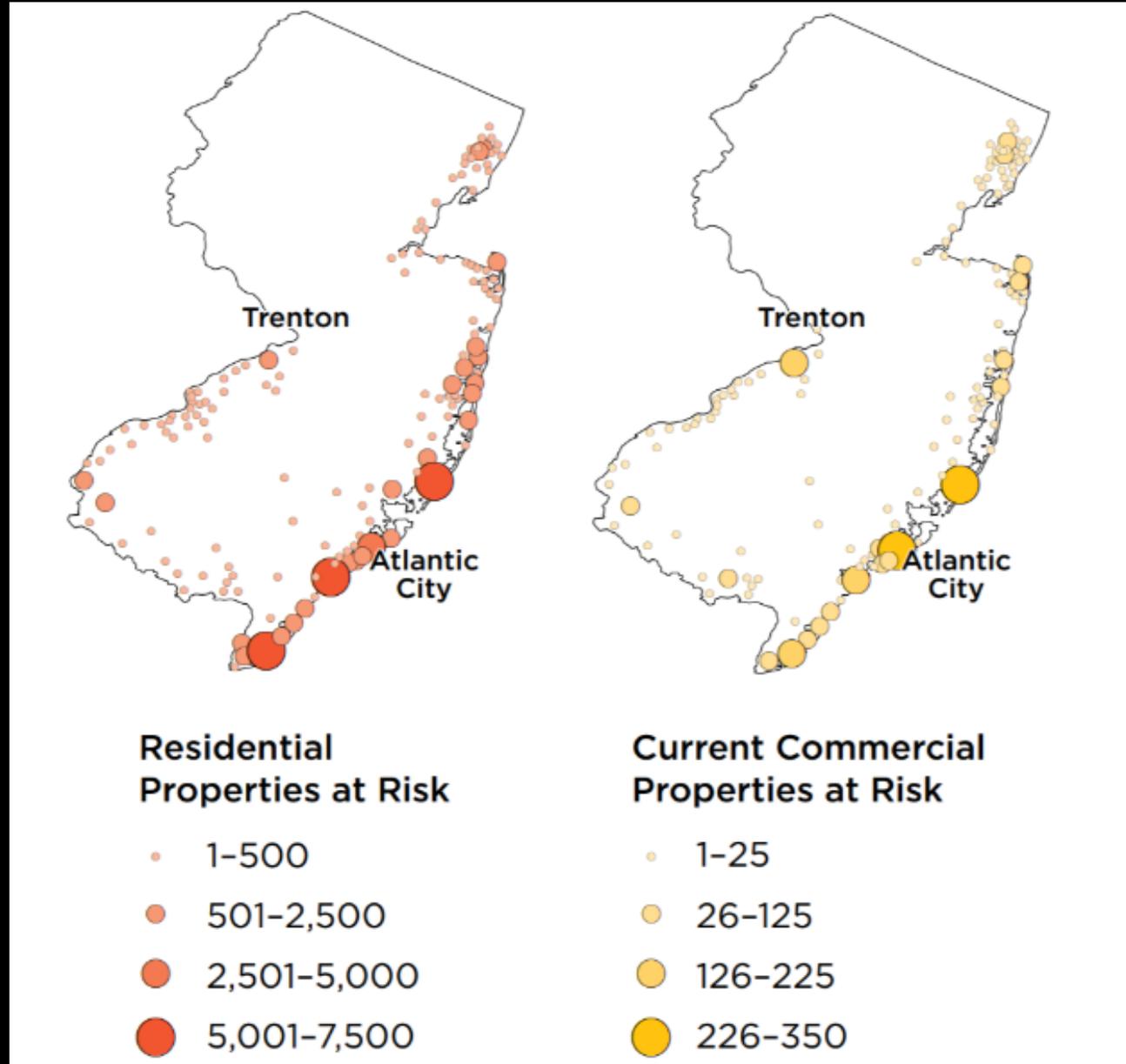
Miami

Key West

[Acute exposure in Florida: Tax base at risk



[Snapshot of homes and businesses at risk (2045)



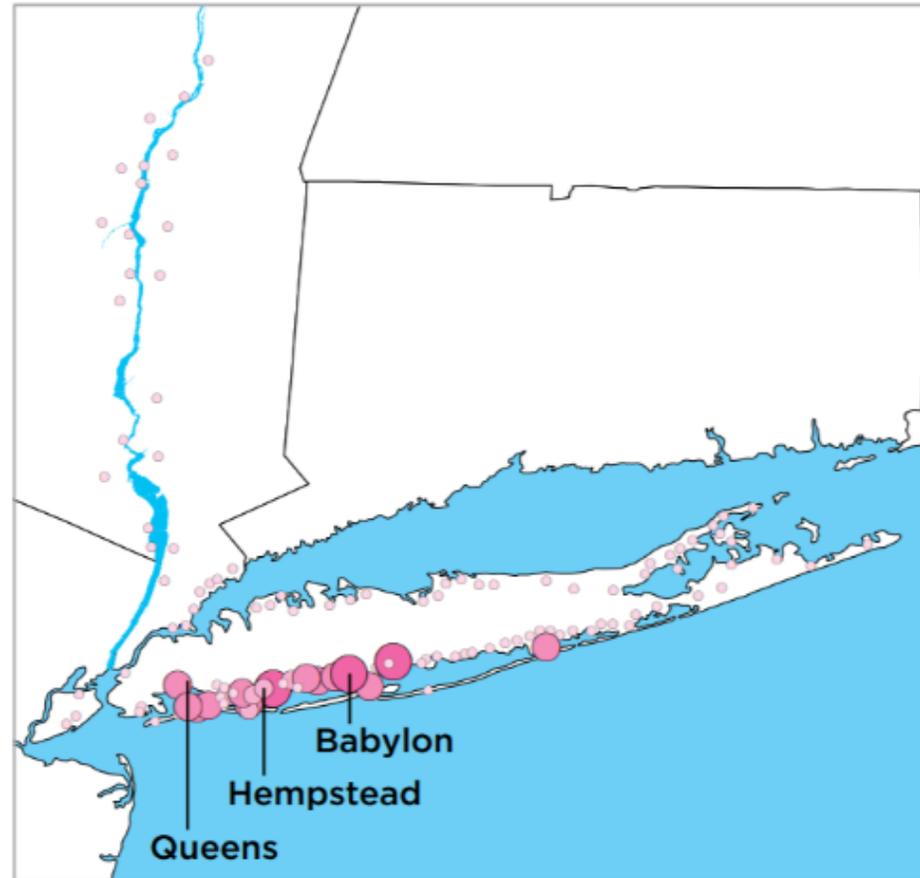
Data provided by third parties through the Zillow Transaction and Assessment Dataset (ZTRAX). More information on accessing the data can be found at <https://www.zillow.com/ztrax>.

[Snapshot of densely populated places at risk (2045)

California



New York



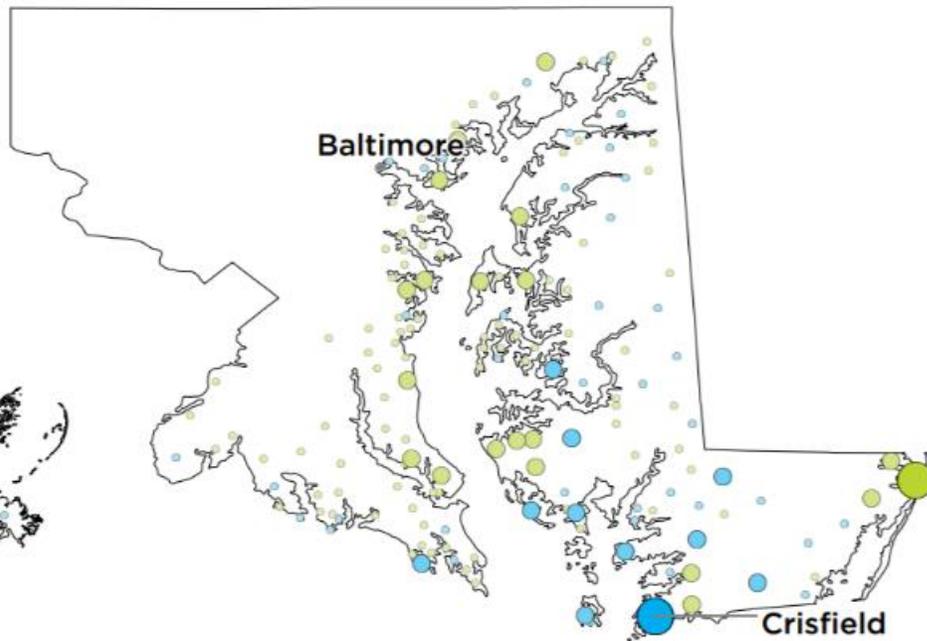
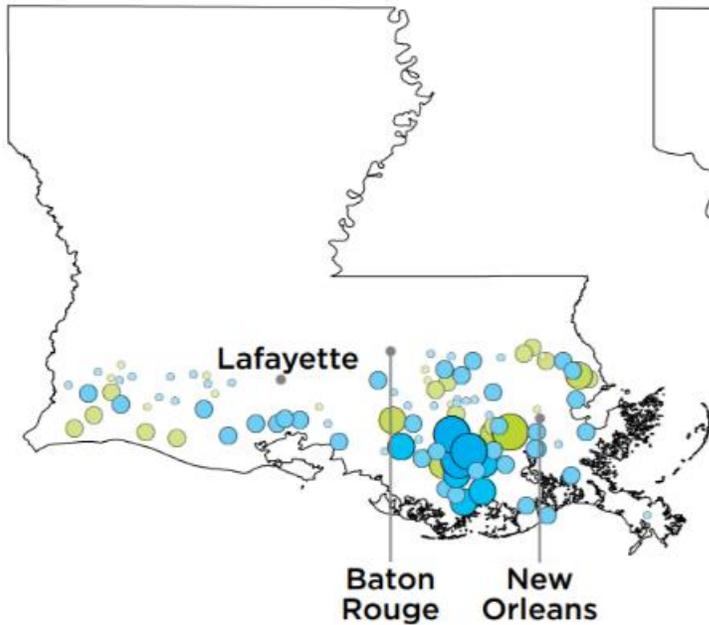
Current Population
Living in At-Risk
Properties

- 1-500
- 501-1,000
- 1,001-2,500
- 2,501-5,000
- 5,001-11,000

[Snapshot of the chronic flooding & poverty intersection (2045)]

Louisiana

Maryland



Poverty Rate
at or below
National
Average

Poverty Rate
above
National
Average

Residential
Properties
at Risk



1-100
101-1,000
1,001-2,000
2,001-3,100

Interactive map: Homes at risk in MD in 2045

US Coastal Property at Risk from Rising Seas

By the Union of Concerned Scientists  

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By State

By Community

By ZIP Code

Homes in the Balance

Challenges and Choices

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A Story Map   

State by state

AT RISK FROM RISING SEAS

Click the buttons to see what's at risk from chronic inundation (high-tide flooding that occurs 26 or more times per year).

In 2045

Homes

Value

Population

Tax Base

In 2100

Homes

Value

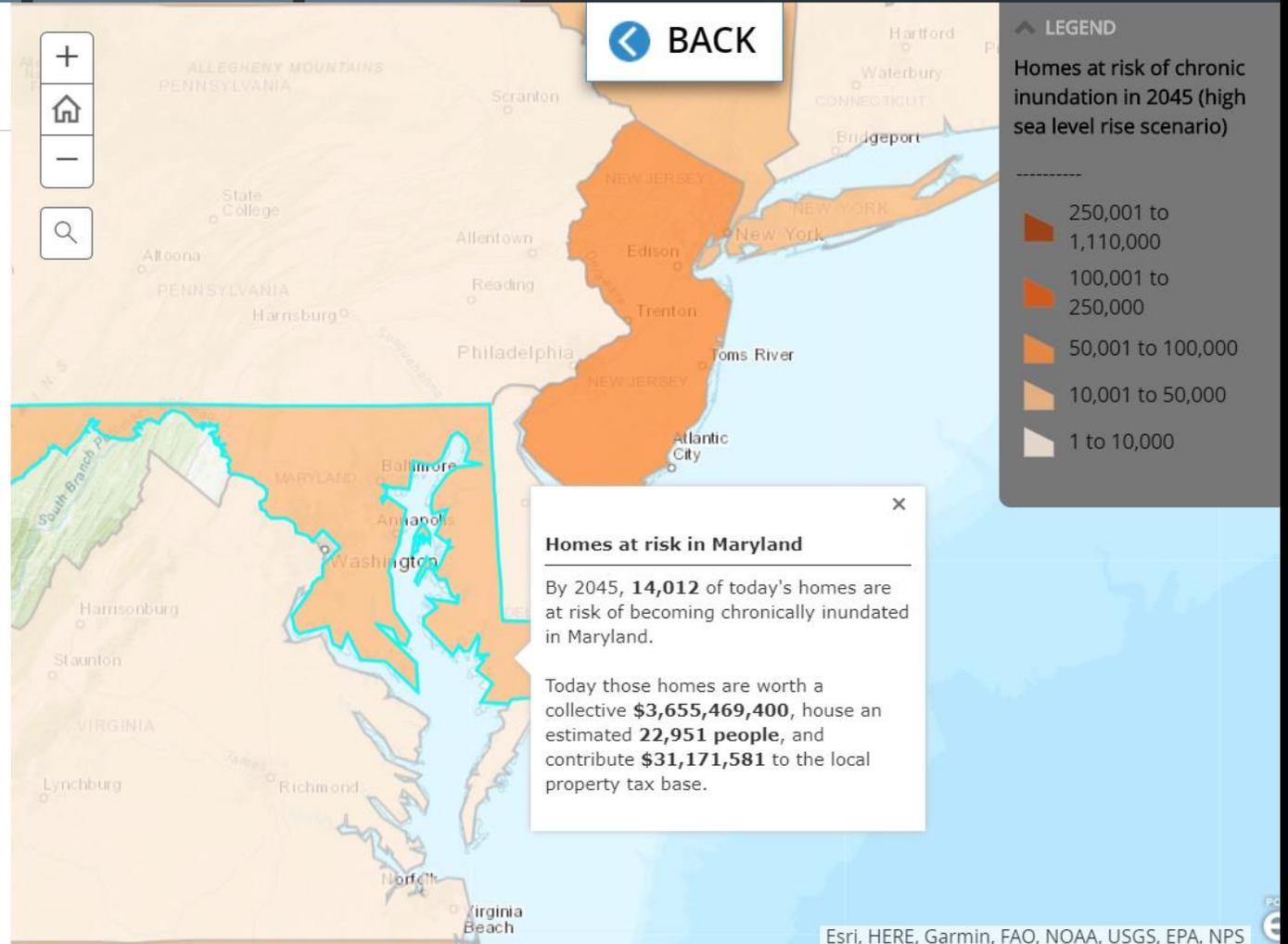
Population

Tax Base

This scenario assumes a high rate of sea level rise caused by a continued rise in global carbon emissions and an increasing loss of land ice. In this scenario, global average sea level is projected to rise about 2 feet by 2045 and about 6.5 feet by 2100.

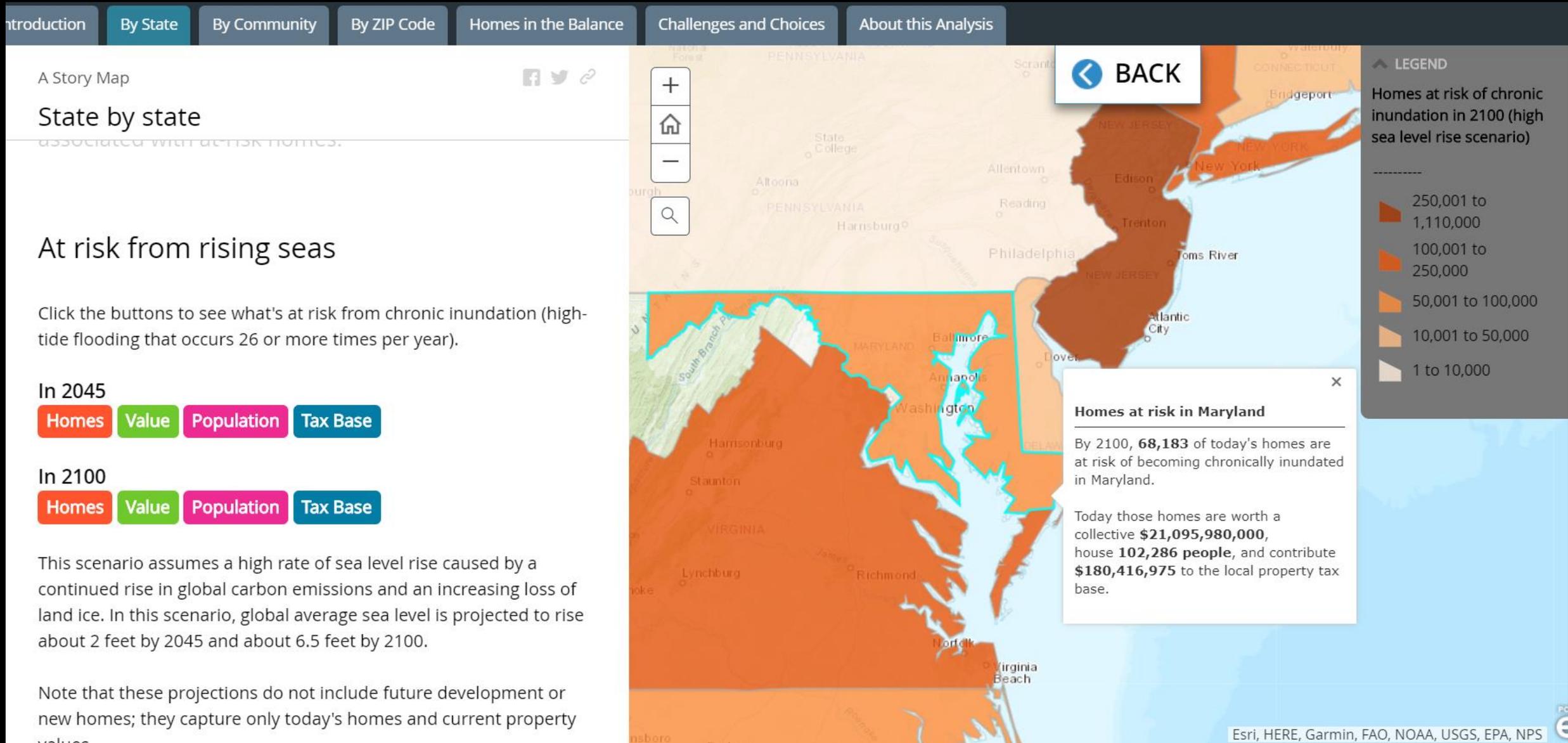
Note that these projections do not include future development or new homes; they capture only today's homes and current property values.

With a moderate rate of sea level rise



Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS

[Interactive map: Homes at risk in MD in 2100



Data provided by third parties through the Zillow Transaction and Assessment Dataset (ZTRAX). More information on accessing the data can be found

[Interactive map: community-level results: Baltimore

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Town by town

Click the buttons to see what's at risk from chronic inundation (high-tide flooding that occurs 26 or more times per year).

In 2045

Homes Value Population Tax Base

In 2100

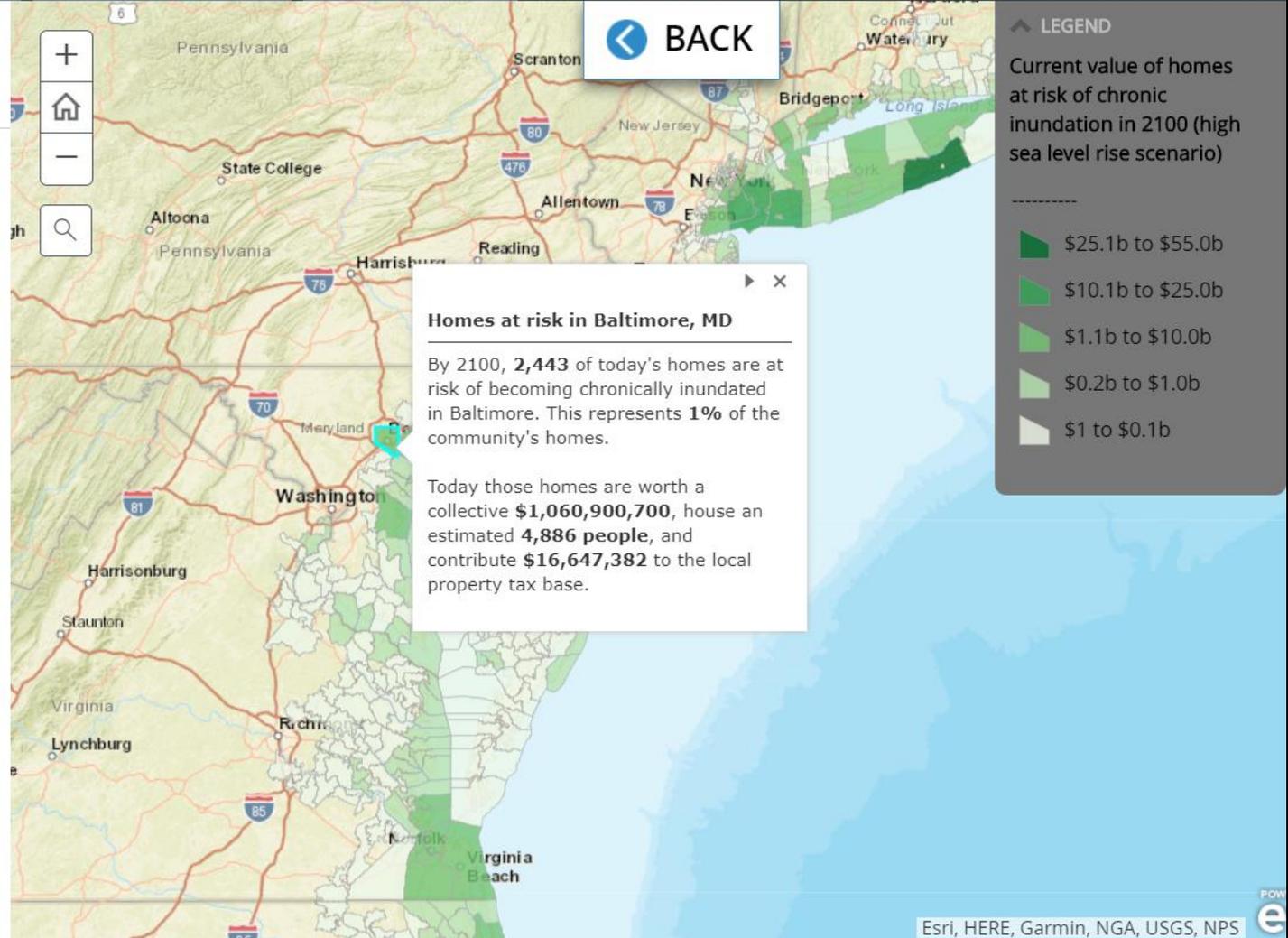
Homes Value Population Tax Base

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With a moderate rate of sea level rise

With a more moderate rate of sea level rise, nearly 140,000 homes



Esri, HERE, Garmin, NGA, USGS, NPS

[Interactive map: ZIP code-level results

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What's at Risk by ZIP Code

What's at risk from rising seas

Click the buttons to see what's at risk from chronic inundation (high-tide flooding that occurs 26 or more times per year).

In 2045

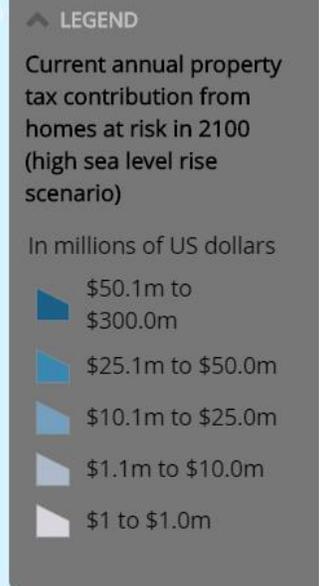
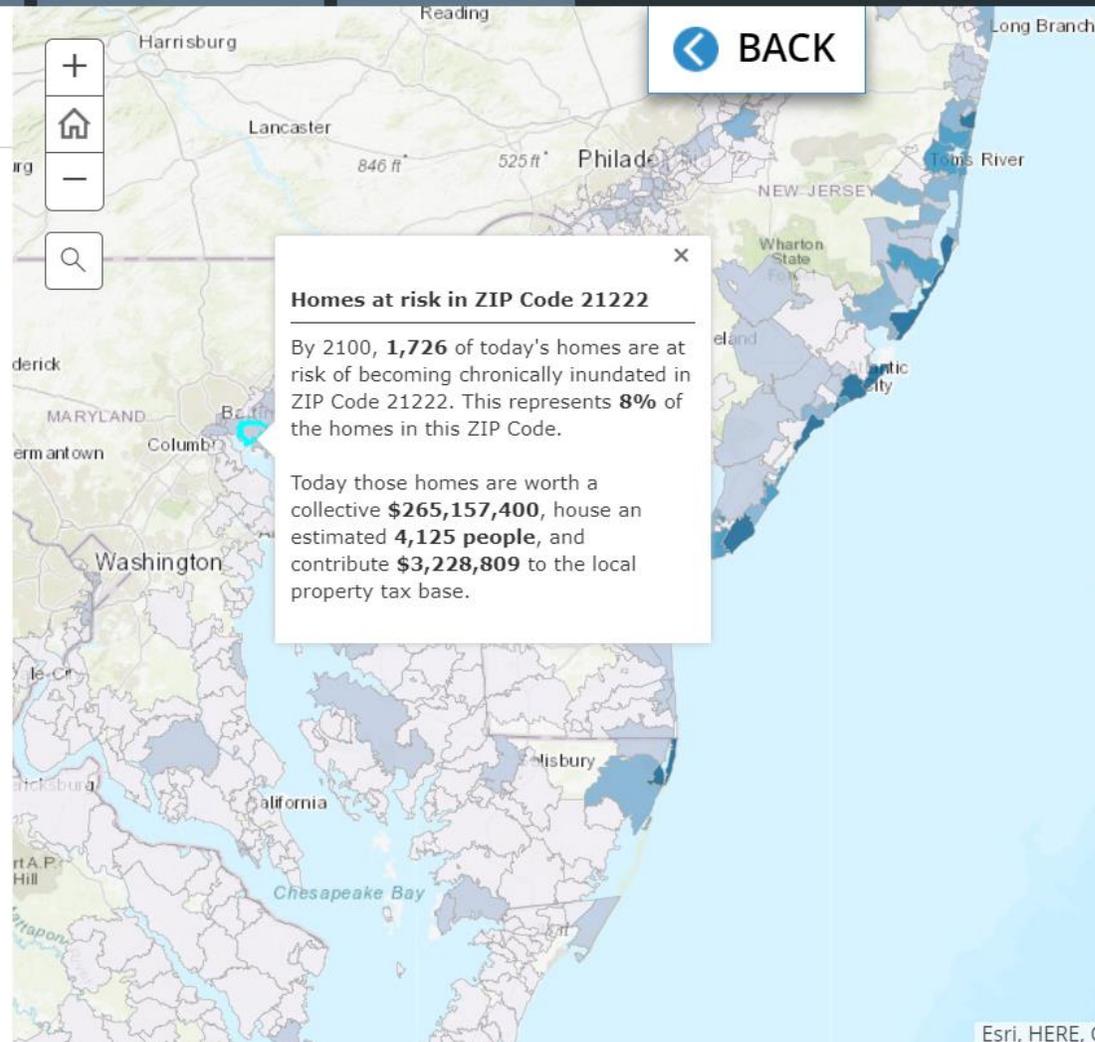
[Homes](#) [Value](#) [Population](#) [Tax Base](#)

In 2100

[Homes](#) [Value](#) [Population](#) [Tax Base](#)

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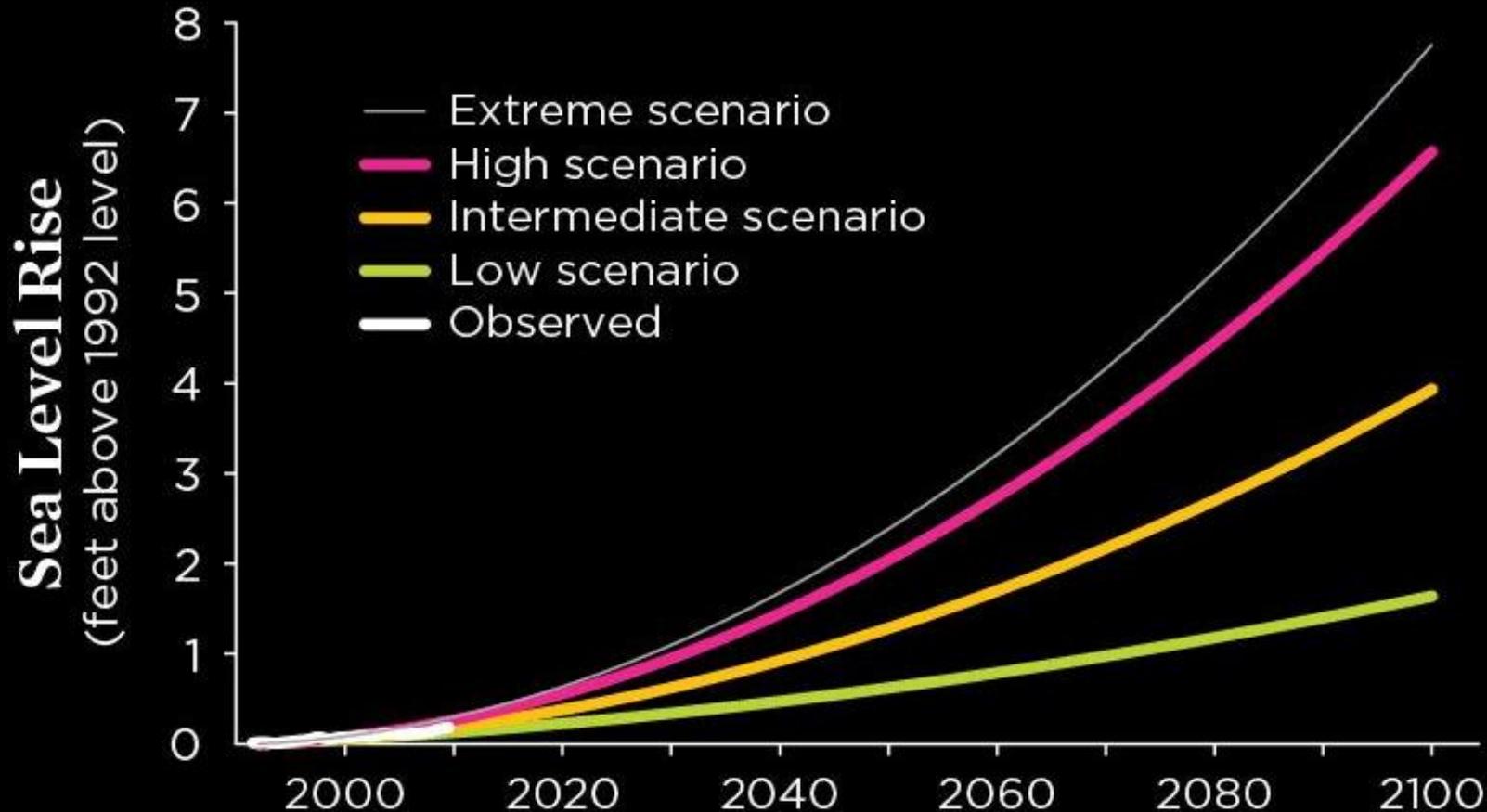


Esri, HERE, Garmin, FAO, USGS, EPA, NPS

[Sea Level Rise Projections & Our Choices

Low Sea Level Rise Scenario (2 ft for MD): Real Estate Risks Drastically Reduced

- Nationwide: 85% of homes (worth \$782 billion)
- Maryland: 70% of homes



[Sea Level Rise Projections & Our Choices

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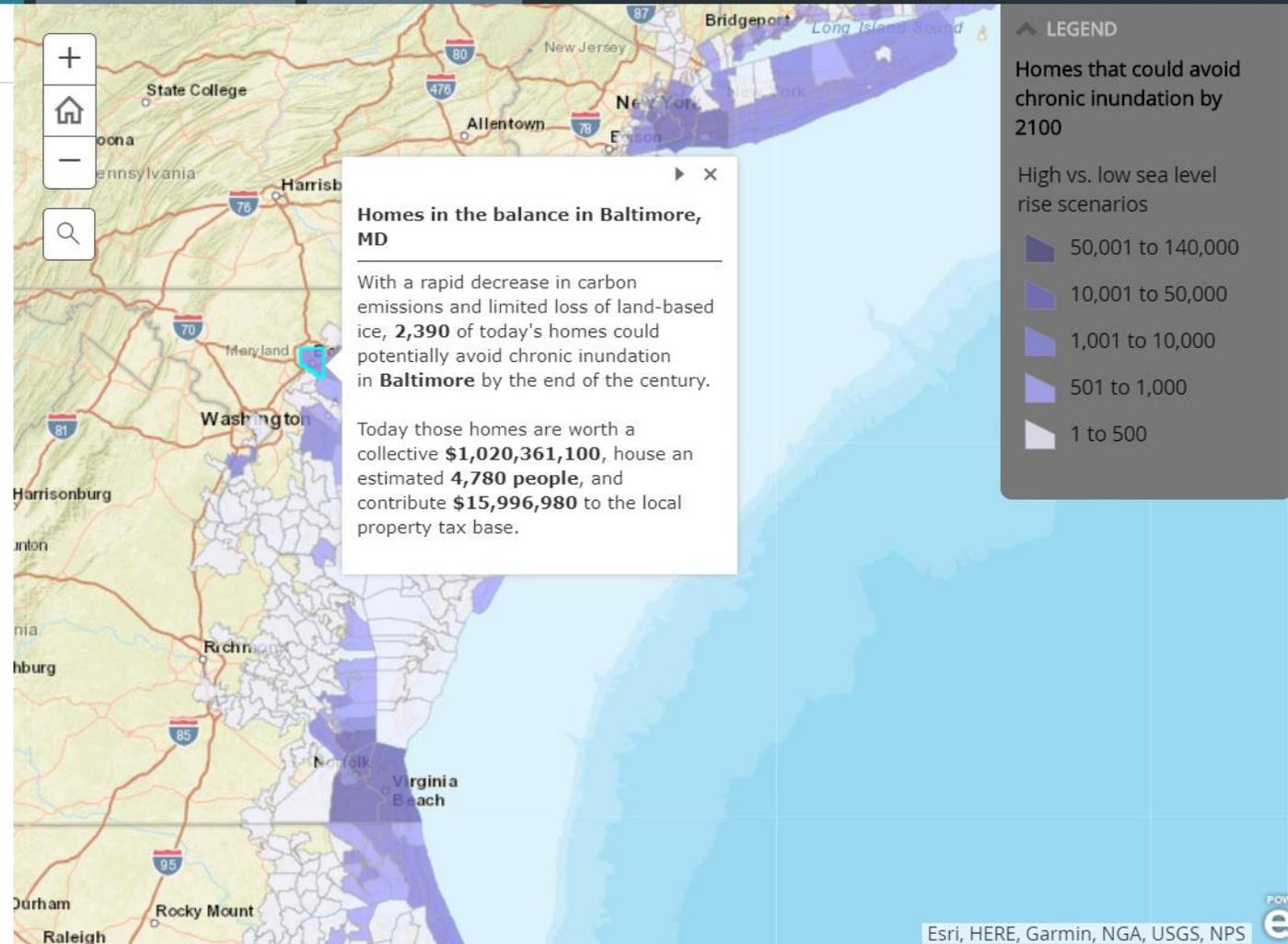


Homes in the Balance

This map shows the number of homes in coastal communities that could avoid chronic inundation by the end of the century if the world takes aggressive action on climate change and the loss of land-based ice is limited.

It shows that more than two million of today's homes—collectively worth \$782 billion today—could potentially be spared from frequent and disruptive high-tide flooding if we act quickly to reduce the carbon emissions that cause global warming.

The map shows the difference between a high rate of sea level rise, associated with a continued increase in carbon emissions and ice melt; and a low rate of sea level rise, which is possible if nations successfully limit future warming to less than 2 degrees Celsius (the goal set by the Paris Climate Agreement) and ice loss is limited. By 2100



Economic Reverberations of Chronic Flooding



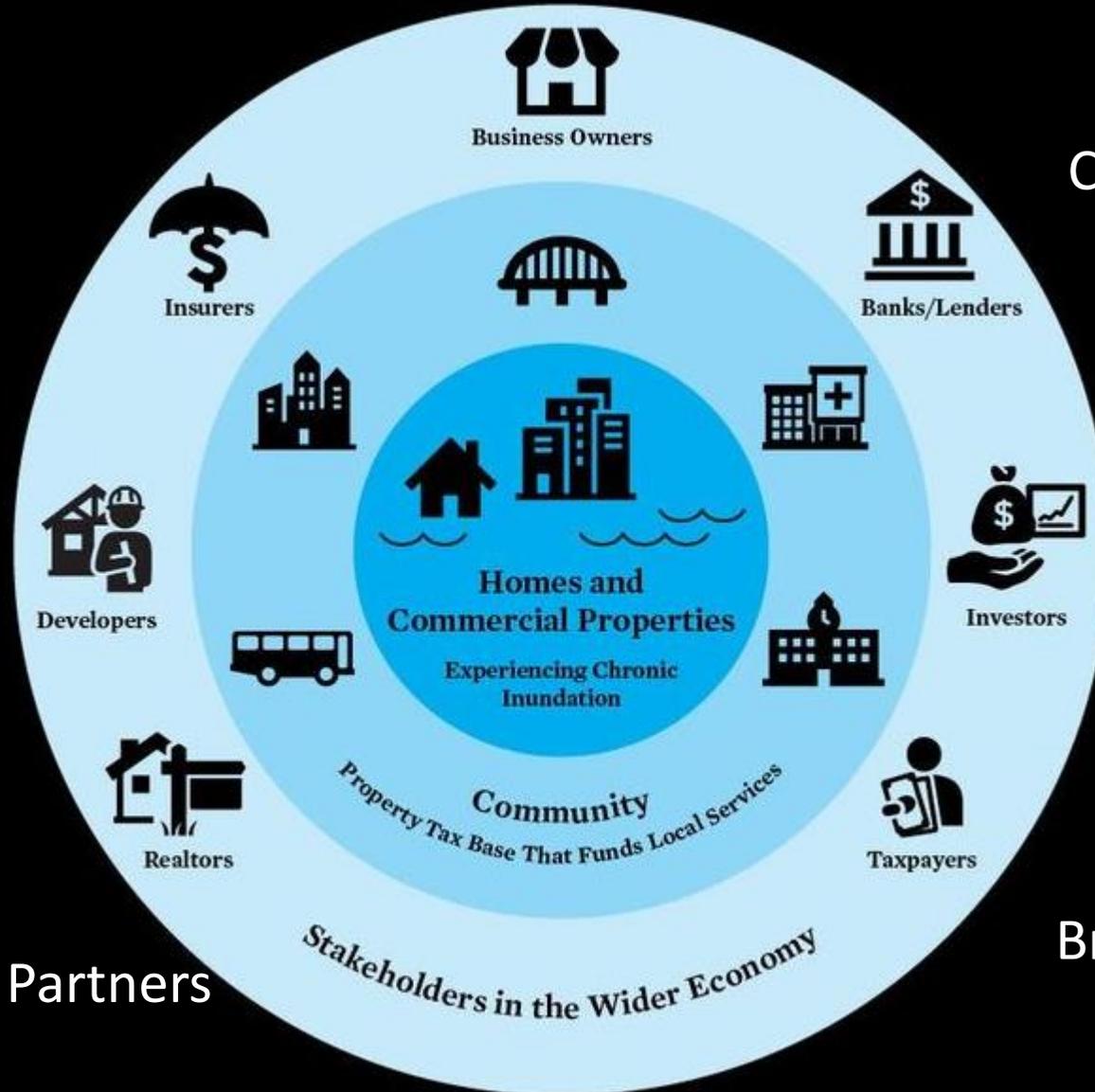
[Market experts: “Matrix of Voices”

CERES

AIR Worldwide

Bentall Kennedy

Enterprise Community Partners



Consumer Mortgage Coalition

S&P Global Ratings

Wharton Risk Center

Breckenridge Capital Advisors

“As an investment manager, one of the biggest challenges is the disconnect between time horizons for investments in bonds— sometimes they can be as short as three to five years—and the time frame for significant tipping points when, say, 50 to 70 percent of a city’s tax base is at risk of flooding.”

**- Andrew Teras, Vice-President and Senior Analyst,
Breckinridge Capital Advisors**

“S&P Global Ratings see the uniform and transparent disclosure by governments of the potential effects of gradual environmental change and extreme weather events as both an important input into our assessment of management's ability to respond to the risks and one of the largest challenges to the market.”

**- Kurt Forsgren, Managing Director , Infrastructure Sector Lead
S&P Global Ratings**

[Realign policies & market incentives to reflect risk



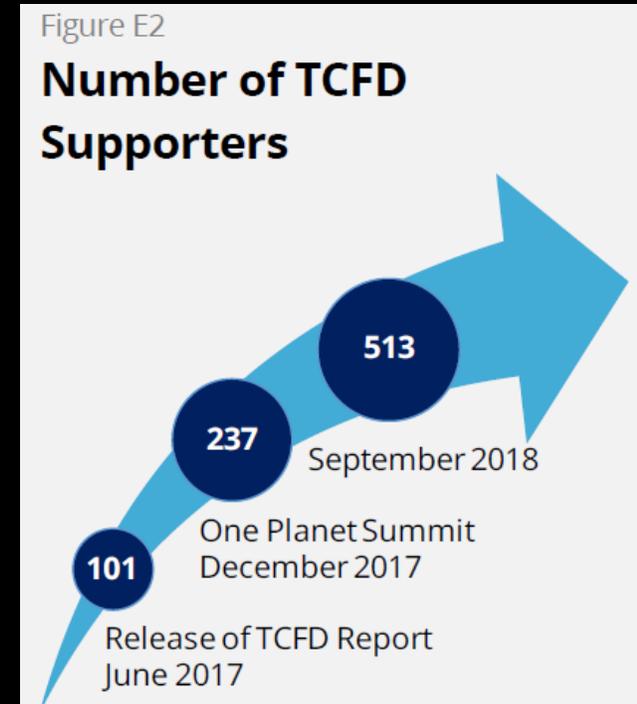
ACTUARIES CLIMATE INDEX
INDICE ACTUARIEL CLIMATIQUE

ActuariesClimateIndex.org

TCFD | TASK FORCE ON
CLIMATE-RELATED
FINANCIAL
DISCLOSURES



- ✓ Extreme high & low temps
- ✓ high winds
- ✓ heavy precipitation
- ✓ drought
- ✓ sea level



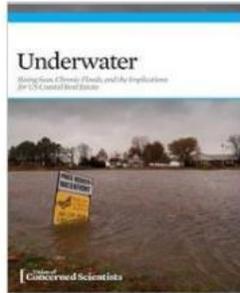
[Planning for a Resilient Future for all



Photo credit: Matt Green

[Suite of Products

Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate (2018)



Hundreds of thousands of homes are at risk of chronic flooding due to sea level rise over the coming decades. The implications for coastal residents, communities, and the economy are profound.

[DOWNLOAD]

[Full report >](#)
[Technical backgrounder >](#)
[Insights from market experts >](#)
[Complete data by state >](#)
[Complete data by community >](#)
[Complete data by ZIP Code >](#)

[Información disponible en español](#)



If you or somebody you know is looking at coastal real estate, here are some smart questions to ask about tidal flooding. Read the brochure online or print it using this printer-friendly layout.

Explore interactive maps of the analysis



Interactive maps show how many homes are at risk by state, community, and ZIP Code. The maps also show the current property value, estimated population, and the property tax base at risk.

State-specific information (press releases)

[California \(English | Spanish\)](#) -- [Delaware](#) -- [Florida \(English | Spanish\)](#) -- [Georgia](#) -- [Louisiana](#) -- [Maryland](#) -- [Massachusetts](#) -- [New Hampshire](#) -- [New Jersey \(English | Spanish\)](#) -- [New York \(English | Spanish\)](#) -- [North Carolina](#) -- [Pennsylvania](#) -- [South Carolina](#) -- [Texas \(English | Spanish\)](#) -- [Virginia](#) -- [Washington](#)

[Download data for all years and sea level rise scenarios included in this analysis \(Excel\)](#)
[By state](#) -- [By community](#) -- [By ZIP Code](#)

Property at Risk from Rising Seas, by Congressional District

<https://www.ucsusa.org/coastaldistricts>



Property at Risk from Rising Seas, by Congressional District

Data is drawn from the analyses [Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate \(2018\)](#) and [When Rising Seas Hit Home: Hard Choices Ahead for Hundreds of US Coastal Communities \(2017\)](#).

At risk from rising seas

Click the buttons to see what's at risk from chronic inundation (high-tide flooding that occurs 26 or more times per year).

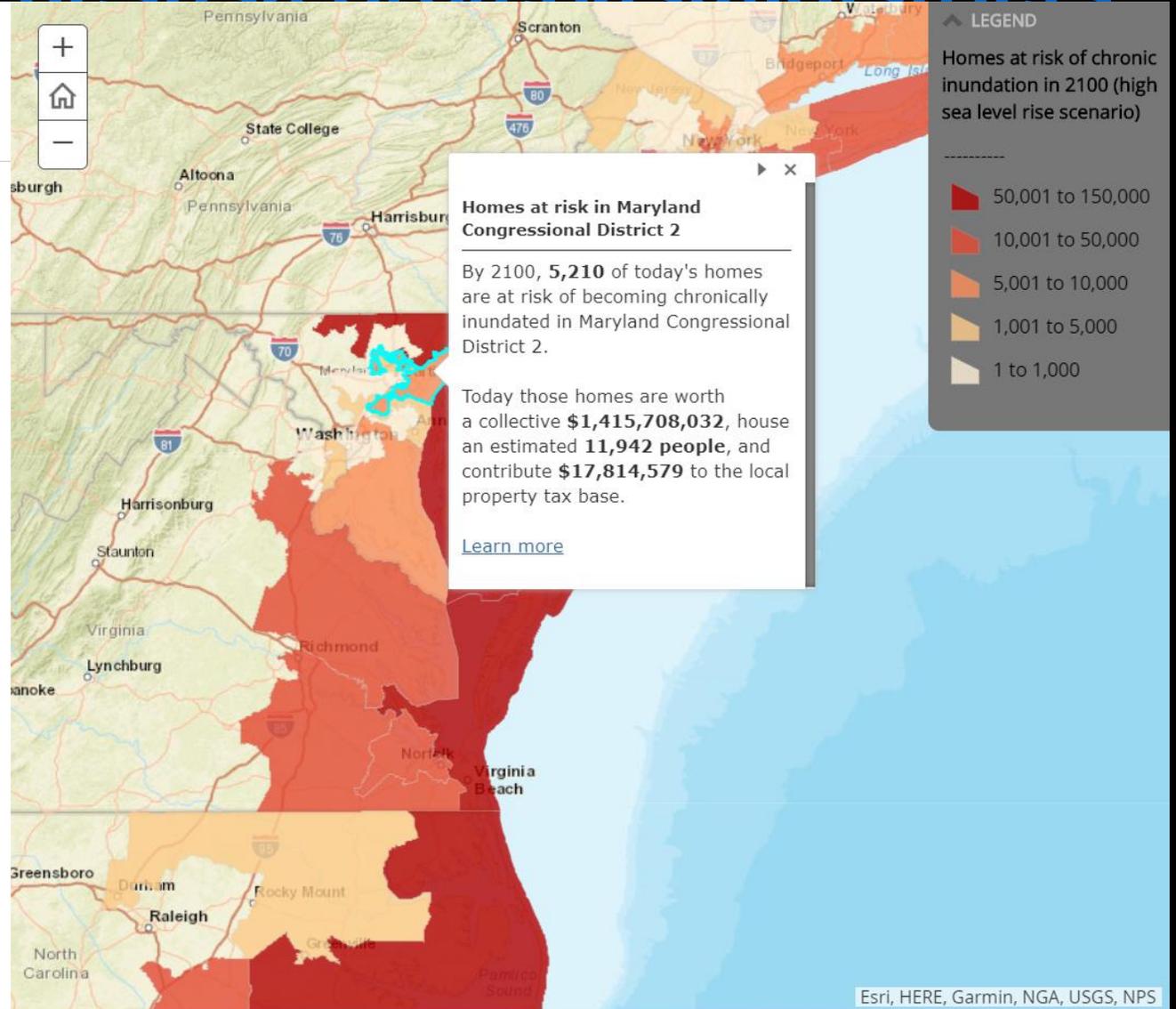
In 2045



In 2100



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Thank you. Any questions?

Shana Udvardy, sudvardy@ucsusa.org

Report available at <http://ucsusa.org/underwater>

Photo: Maureen Drennan