Can Removing Development Subsidies Promote Adaptation? Evidence from the Coastal Barrier Resources System

TWEEDS October 2022

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with Yanjun (Penny) Liao, Sophie Pesek, Margaret Walls, and Shan Zhang

Motivation

Natural disasters are expected to become more frequent and severe with climate change.

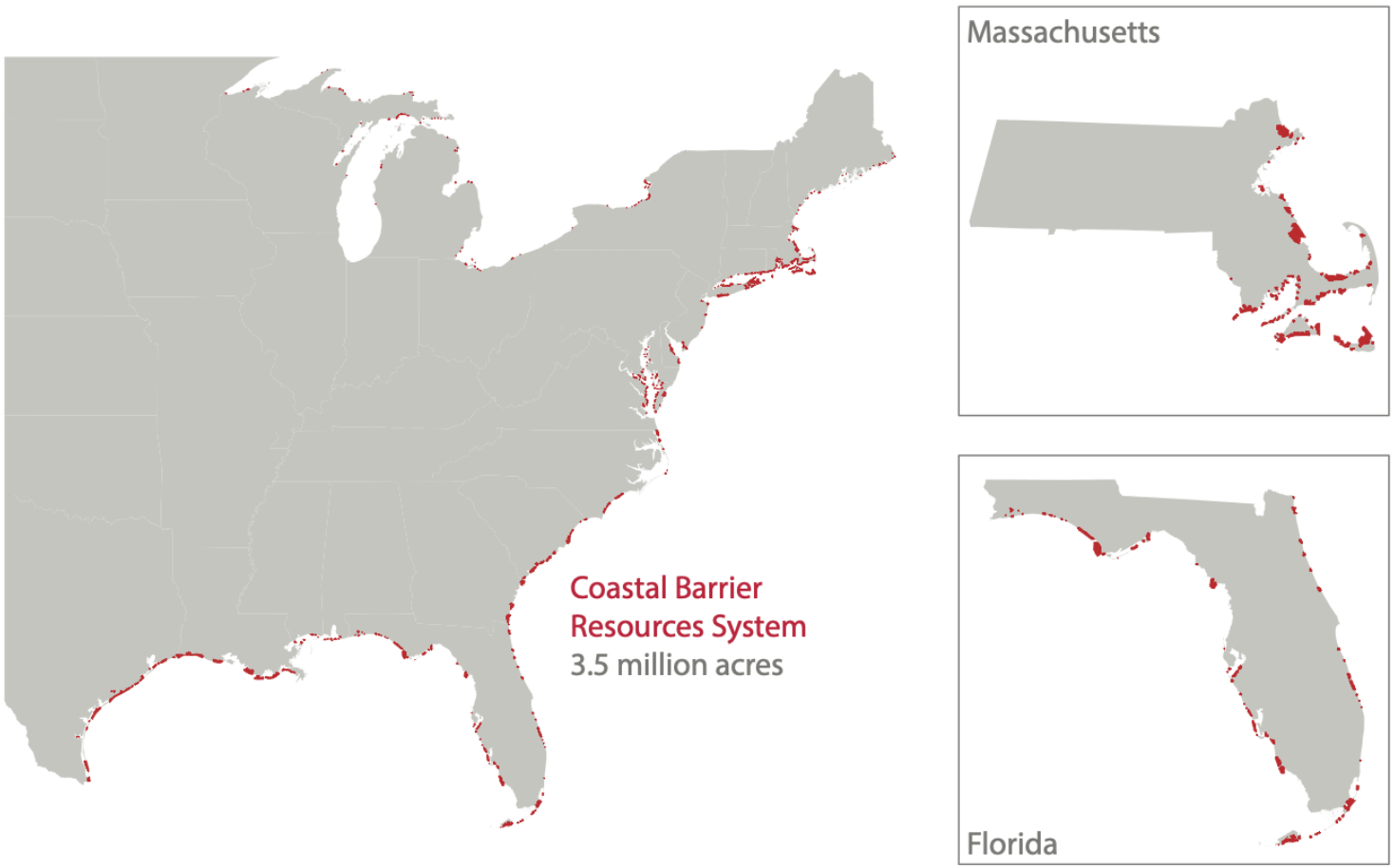
Limiting the number of people and properties in harm's way will be key to adaptation.

One policy option is **removing government incentives for development in risky areas**, such as

- Infrastructure investments
- Disaster assistance
- Subsidized flood insurance

Coastal Barrier Resources Act of 1982

Withdrew federal incentives for development in designated coastal areas



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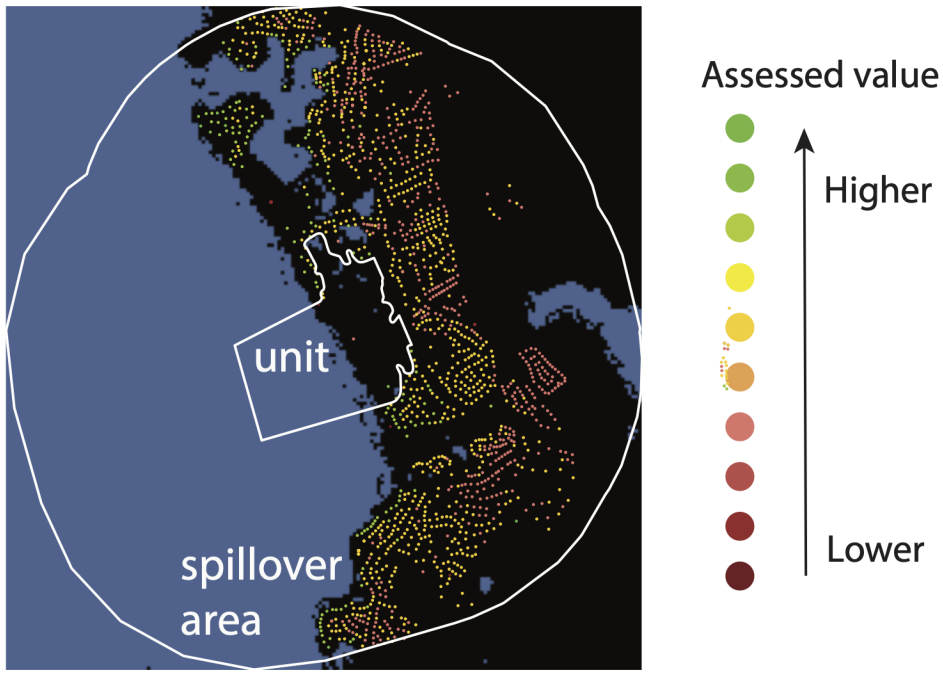
Research questions

1. Has CoBRA been effective in discouraging development?
2. Does the policy have spillover effects on neighboring communities?
3. What is the impact on local municipal finances?



Empirical challenge

Prior studies have compared CBRS lands to all other coastal areas

But there is a strong form of **selection bias** into which lands are designated as part of the CBRS.

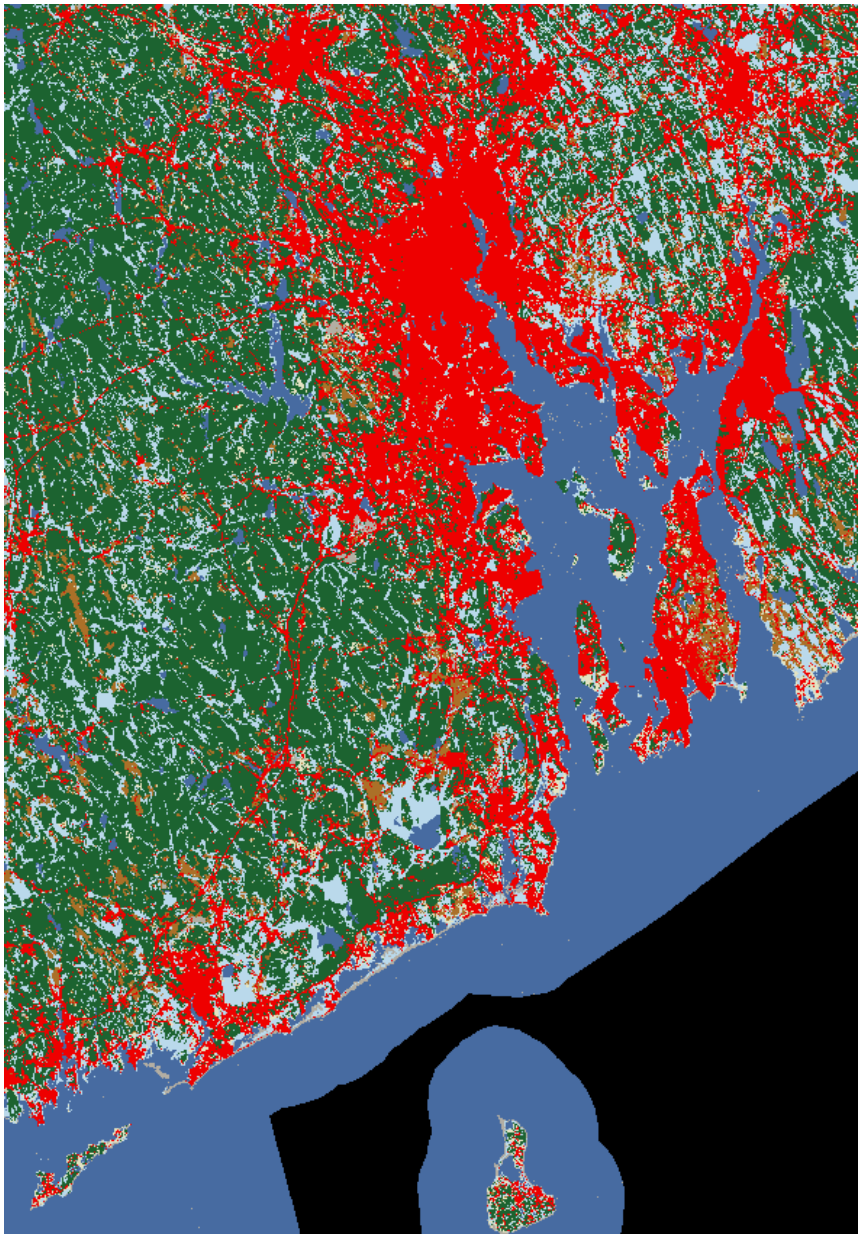
Goal: Identify plausible control areas to compare with CBRS lands

Empirical approach

We mimic the process by which land use planners determined CBRS boundaries based on geomorphic and development features.

1. Obtain data on historical land use and development pressures
2. Spatial clustering algorithm to outline potential controls
3. Propensity score matching to identify controls that met the basic criteria for inclusion into the CBRS at the time of designation
4. Overlap weighting to balance covariates across treatment and controls

Step 1: Data



Inputs:

- Land cover
- Elevation
- Distance to coast
- Road network

Land cover, 1985

- Developed
- Cropland
- Grass/shrub
- Tree cover
- Water
- Wetland
- Barren

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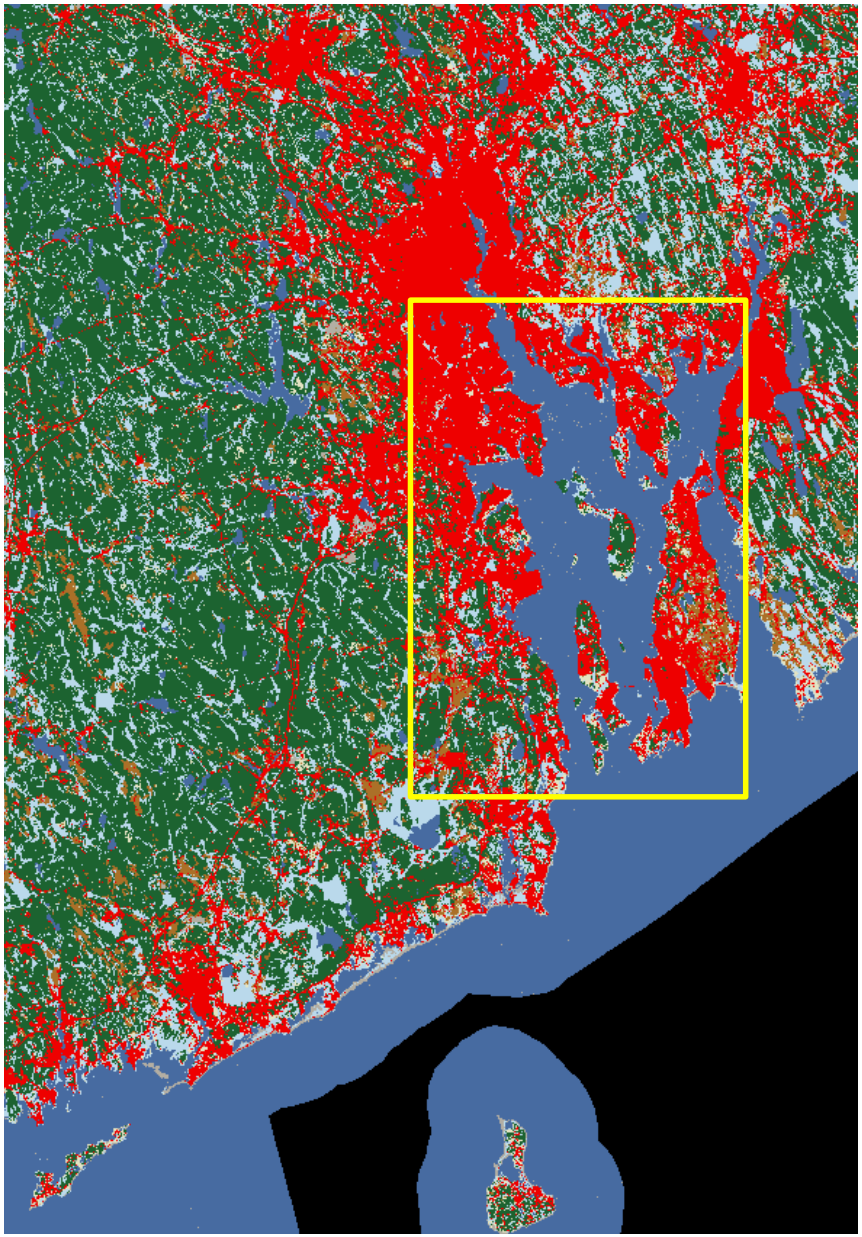

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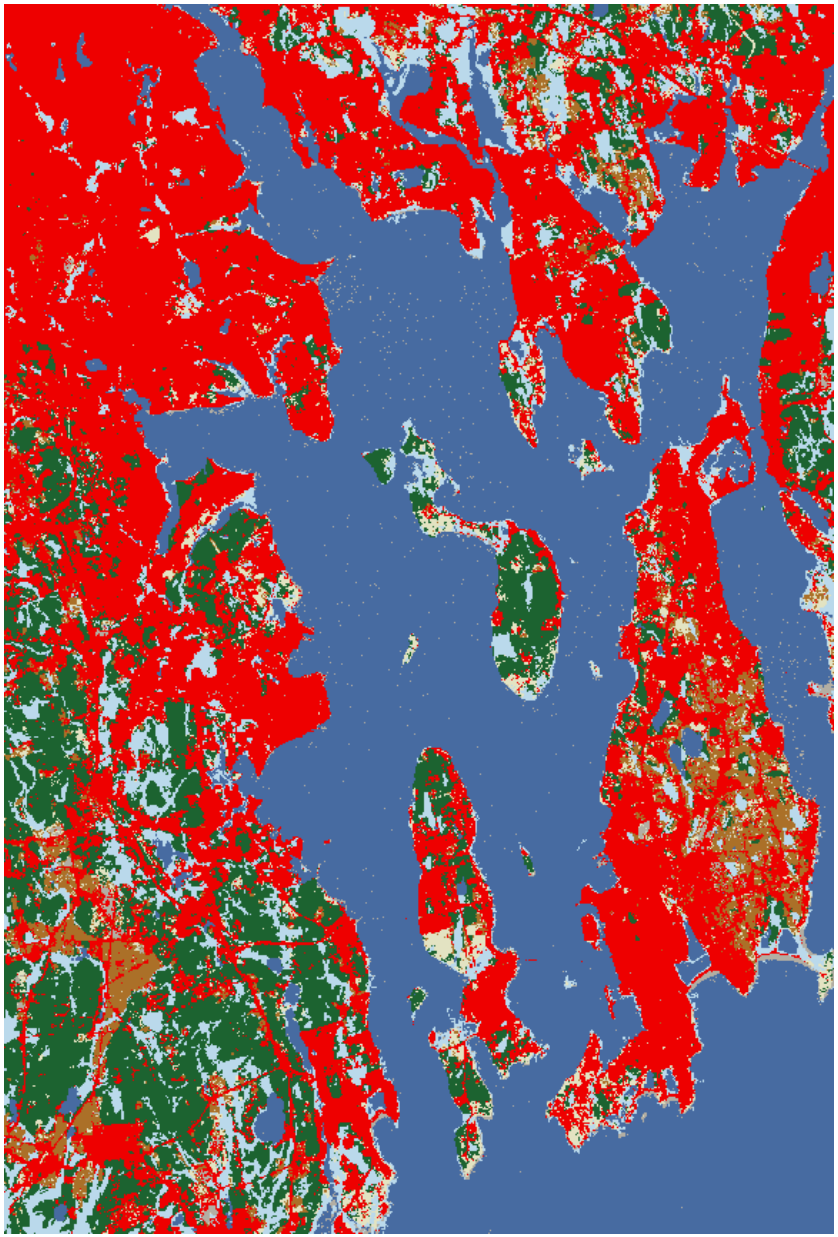

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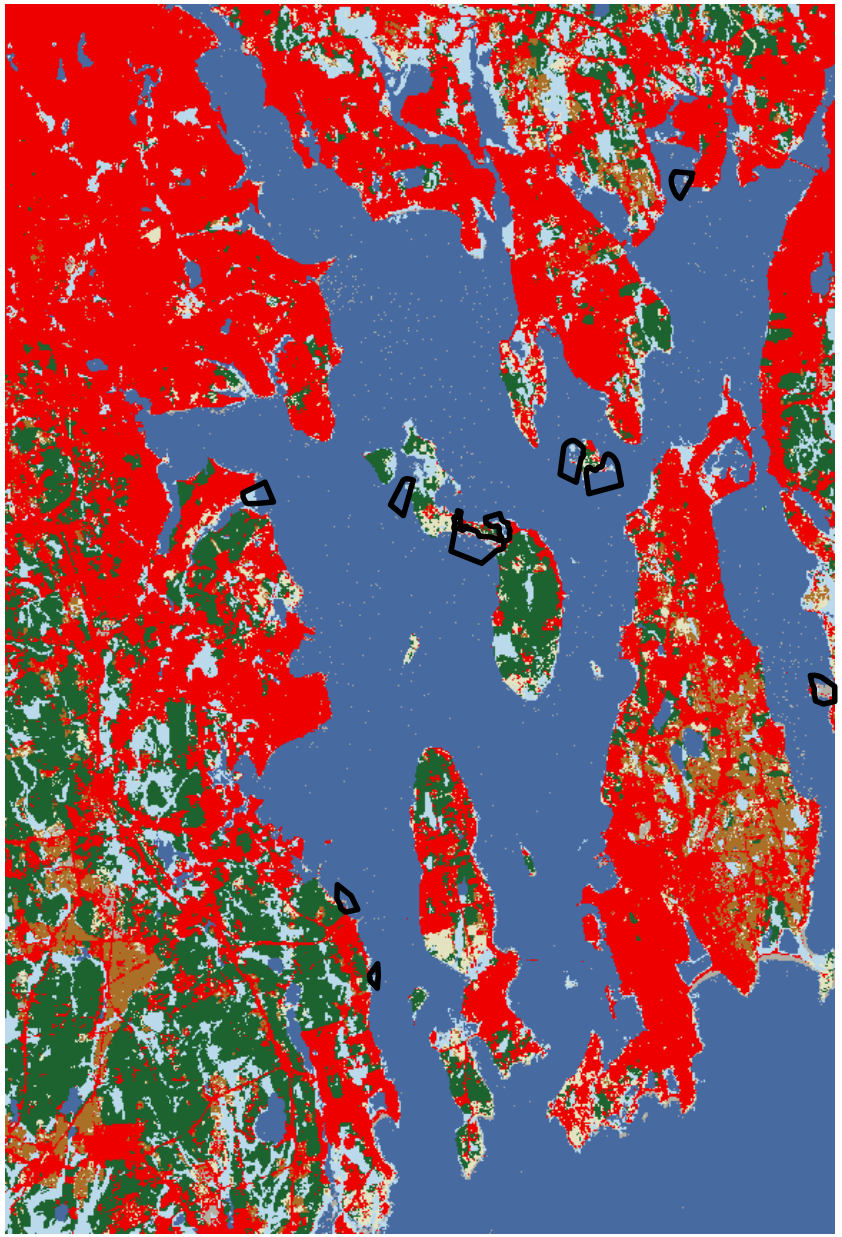

CBRS unit

Land cover, 1985

- Developed
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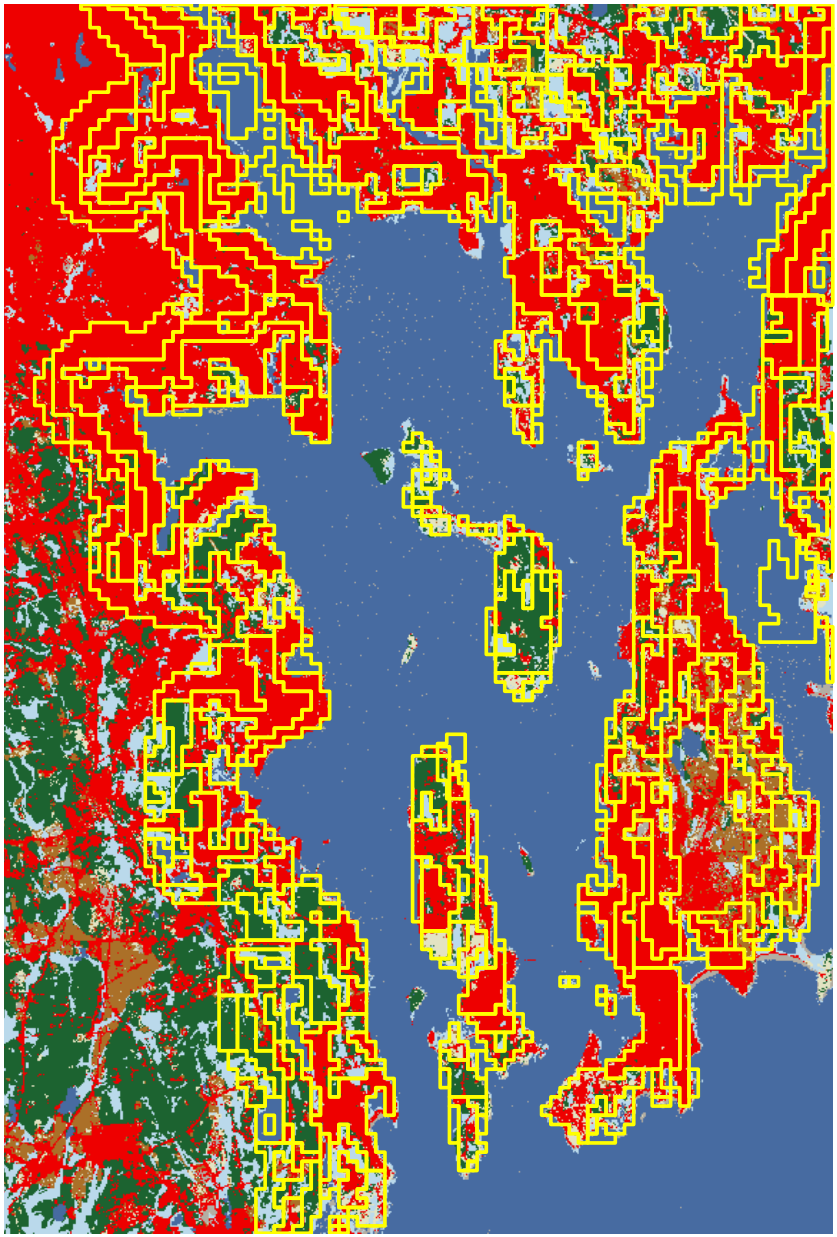
Step 2: Regionalization



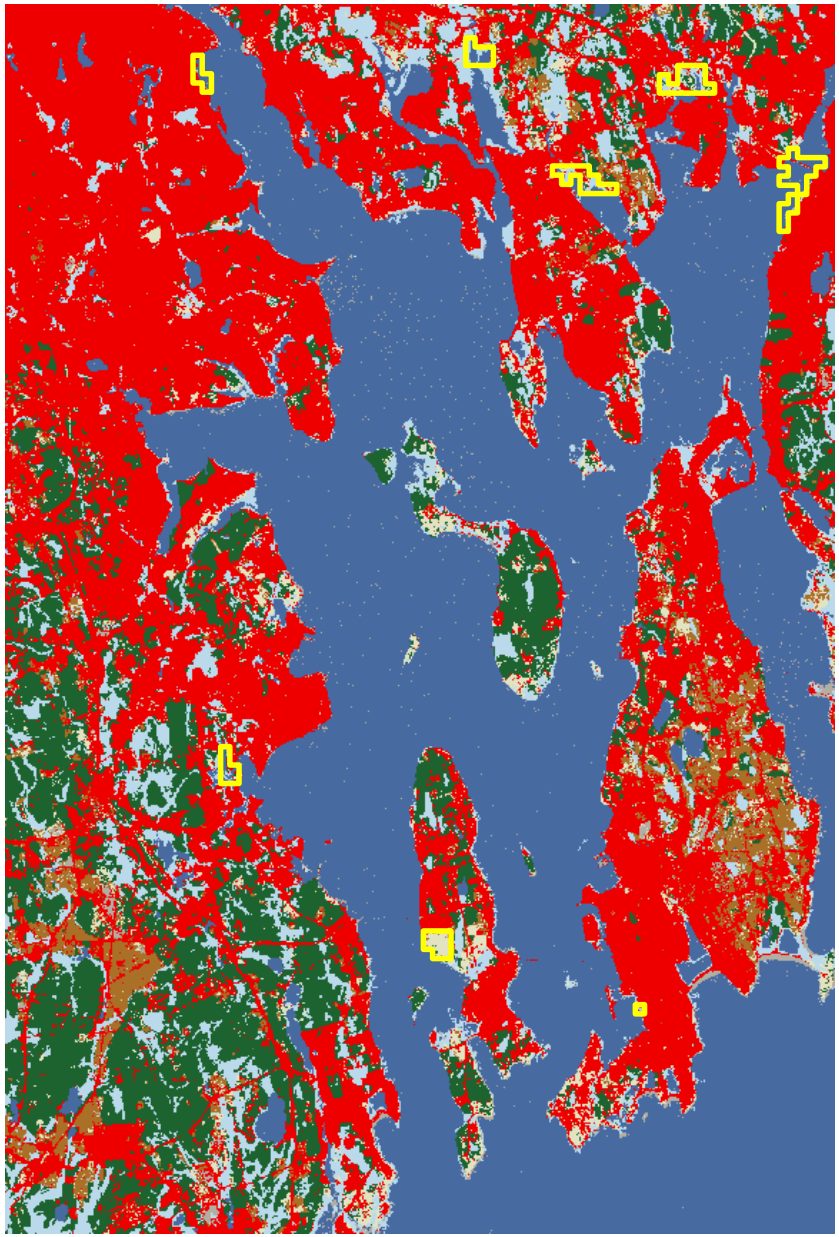
Inputs:

- Land cover
- Elevation
- Distance to coast
- Road network

Outputs:

 "regions"

Step 3: Matching



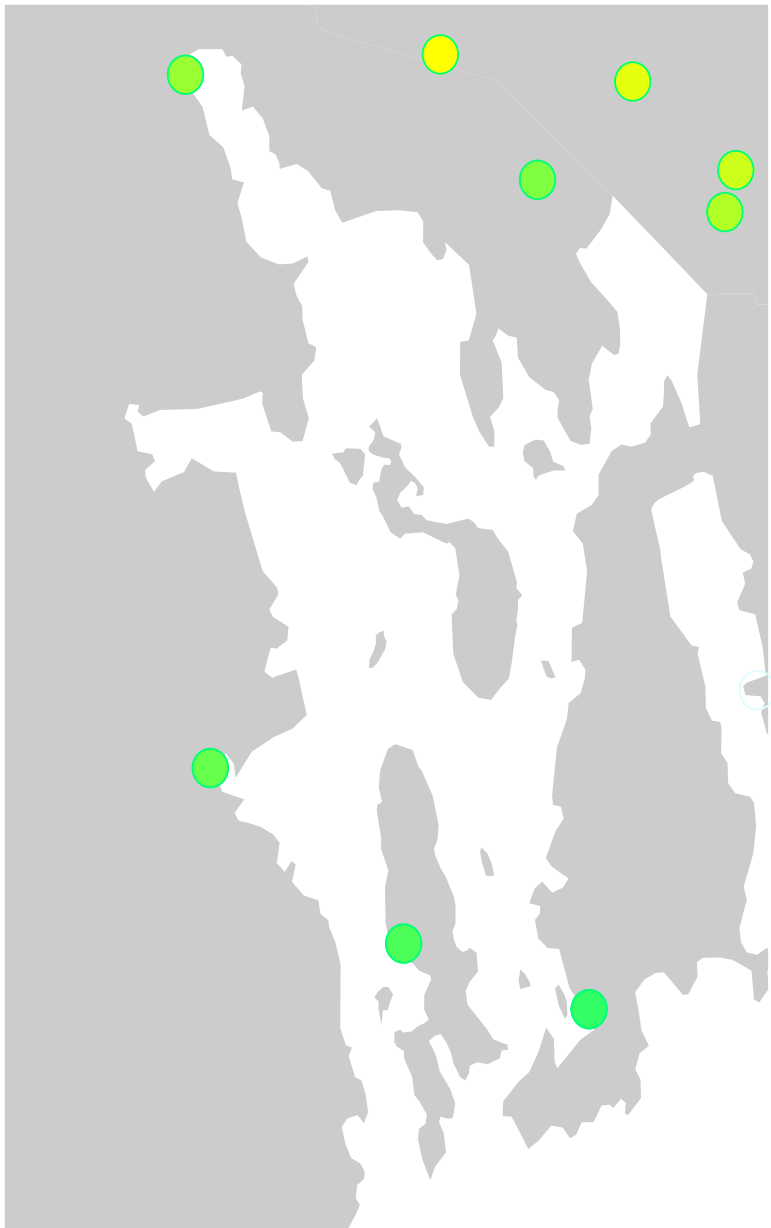
Inputs:

- Land cover
- Elevation
- Distance to coast
- Road network

Outputs:

 control areas

Step 4: Overlap weighting



Inputs:

- Land cover
- Elevation
- Distance to coast
- Road network
- Population density
- Proximity to urban
- Protect areas
- Income
- Education
- Employment
- Demographics

Outputs:

higher weight

lower weight

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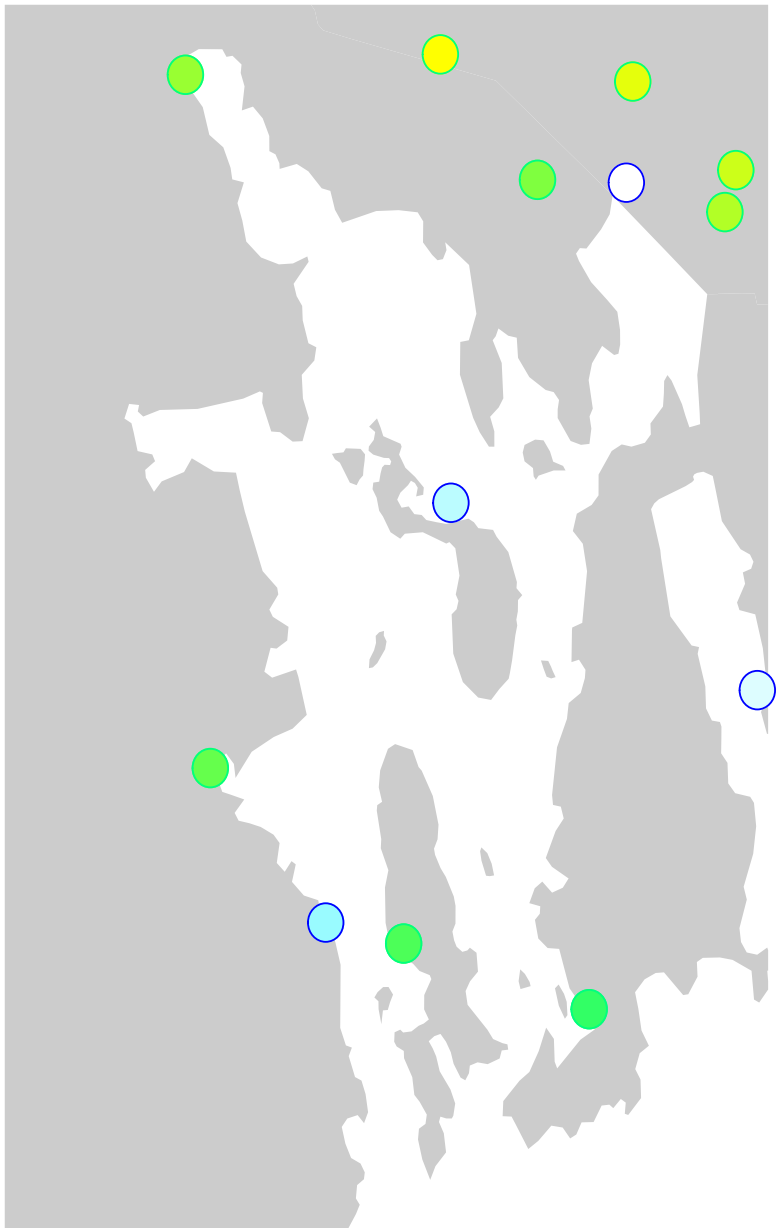
Treatment and control areas



Control areas

higher weight

↑

lower weight

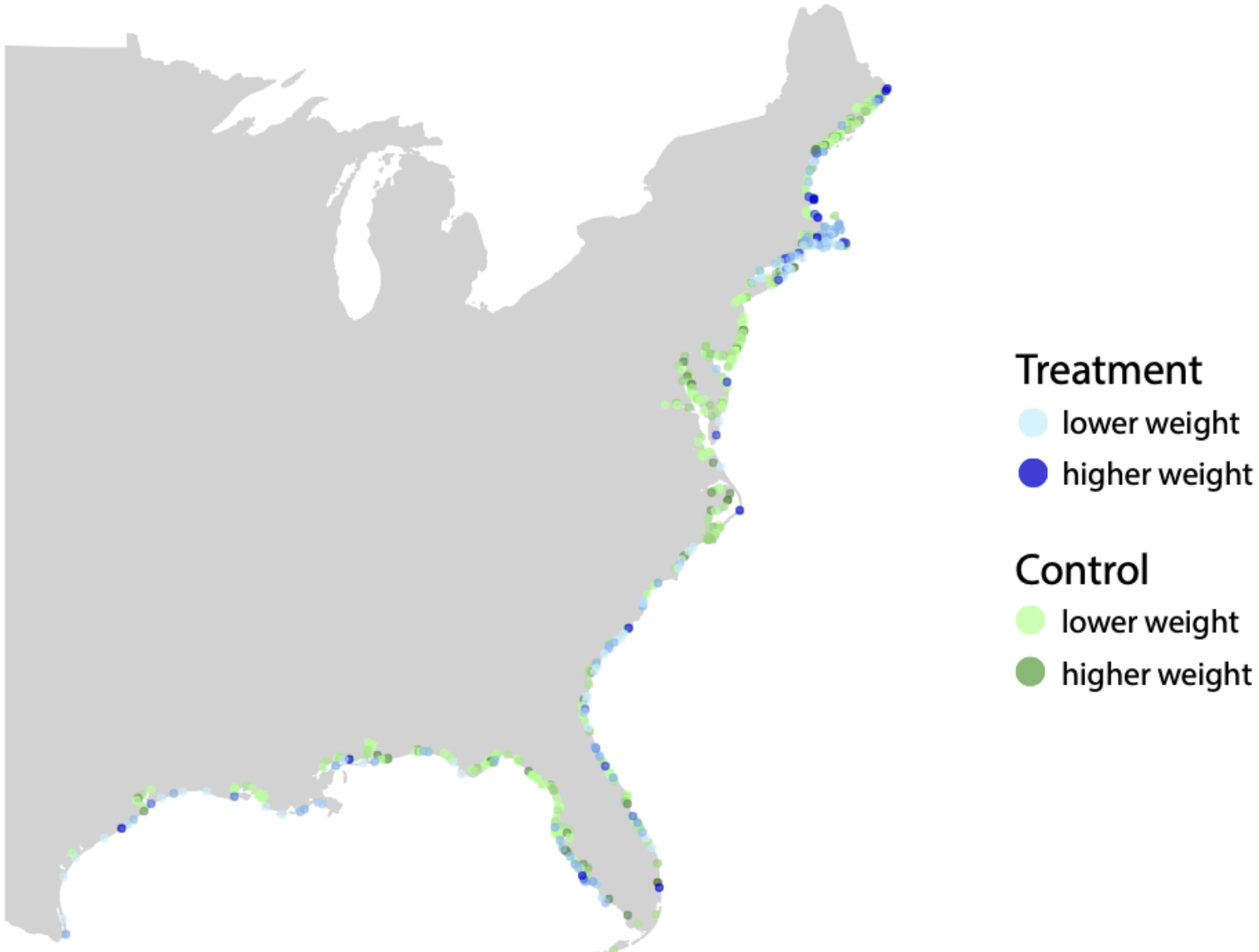
Treatment areas

higher weight

↑

lower weight

Treatment and control areas



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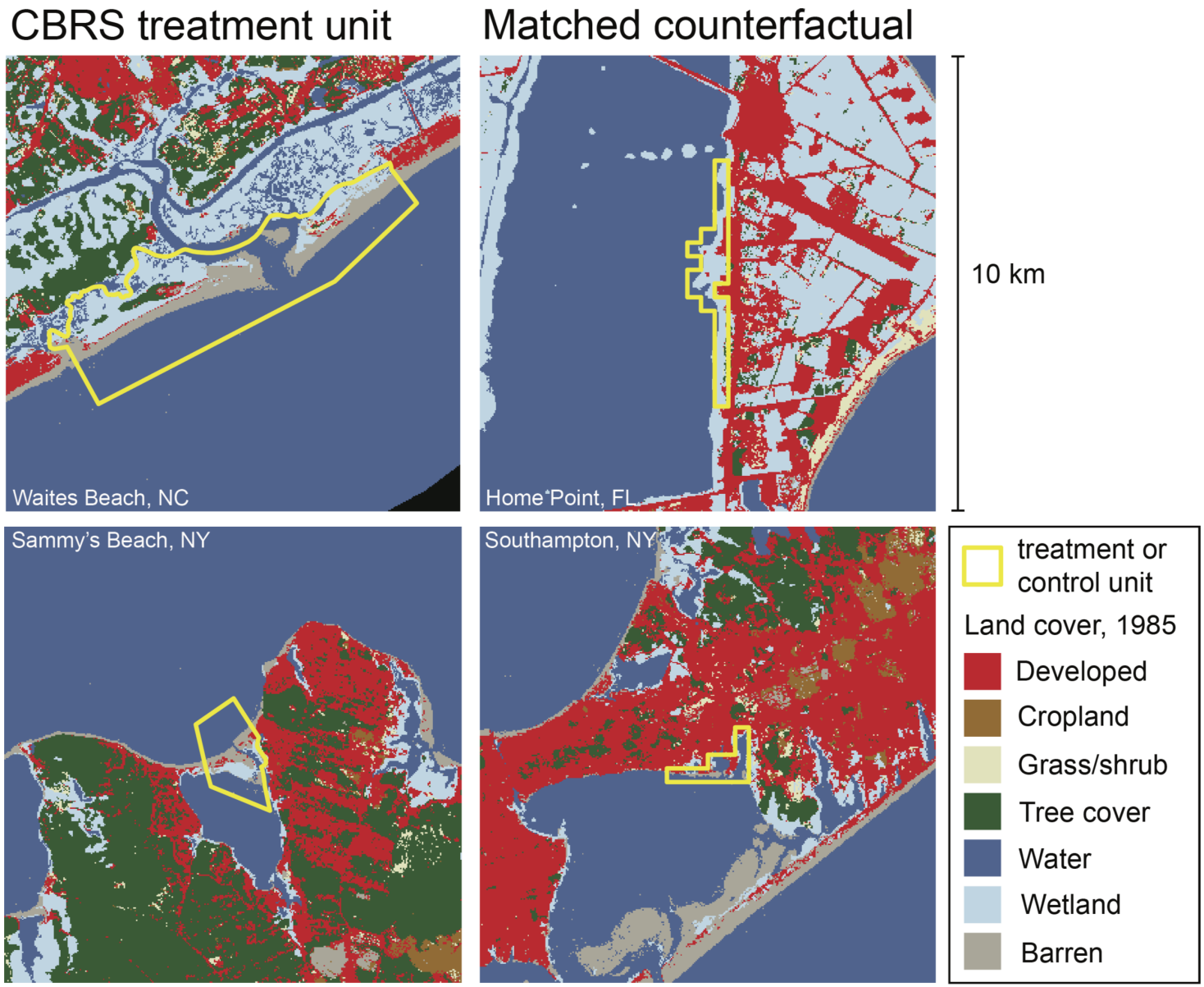
Treatment and control areas: Examples

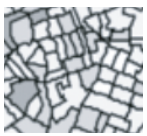


Treatment and control areas: Covariate balance

	CBRS	Controls	Coastal	SMD
Elevation (m)	1.8	1.8	6.3	0.029
Distance to coast (m)	46	56	1002	0.005
Beach/barren (%)	22.3	30.1	1.4	0.062
Cropland (%)	0.4	0.5	10.6	0.034
Developed (%)	6.8	7.2	18.4	0.147
Grass/shrub (%)	3.0	3.0	2.8	0.013
Tree cover (%)	3.6	3.4	14.4	0.019
Water (%)	28.6	24.9	11.2	0.028
Wetland (%)	35.2	30.9	41.3	0.014
Population density (persons/km2)	0.19	6.30	1.16	0.005
Commuting-distance urban population (millions)	1.7	1.7	1.4	0.060
Road density (km/acre)	0.11	0.12	0.89	0.100
Protected area (%)	11.2	18.3	12.5	0.020
Median household income (thousand USD)	35.4	27.8	29.1	0.056
Female (%)	48.2	49.3	51.4	0.006
White (%)	89.5	91.2	59.7	0.040
Black (%)	4.1	5.6	22.5	0.045
Hispanic (%)	2.5	1.6	24.8	0.021
College degree (%)	21.0	12.5	15.5	0.044
Employed (%)	44.0	43.8	44.7	0.032
Unemployed (%)	2.3	2.8	4.3	0.004
Observations (effective sample size)	167 (106)	448 (192)		

Outcome measures

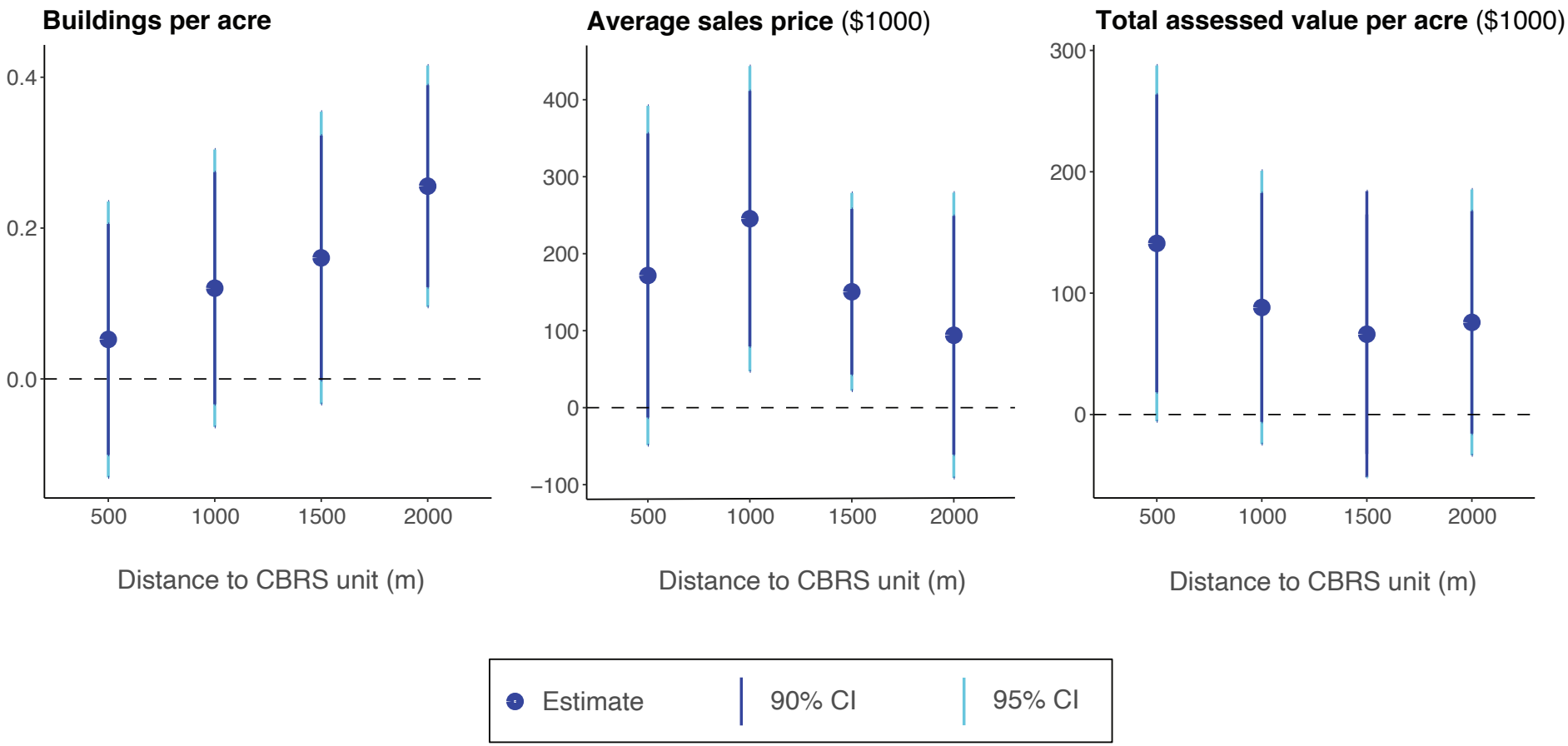
Goal is to measure long-term changes: outcomes measured 2010-2020

Outcome	Data Source	Geometry		Aggregation to unit
Development densities	Microsoft building footprints	Polygons		Number of buildings per acre
Property values & charactersitics	ZTRAX	Points		Assessed value per acre, mean property characteristics
Demographics	2010 Census	Census tracts		Area weighted means
Flood damages	NFIP claims	Census tracts		Weighted by number of buildings in SFHA

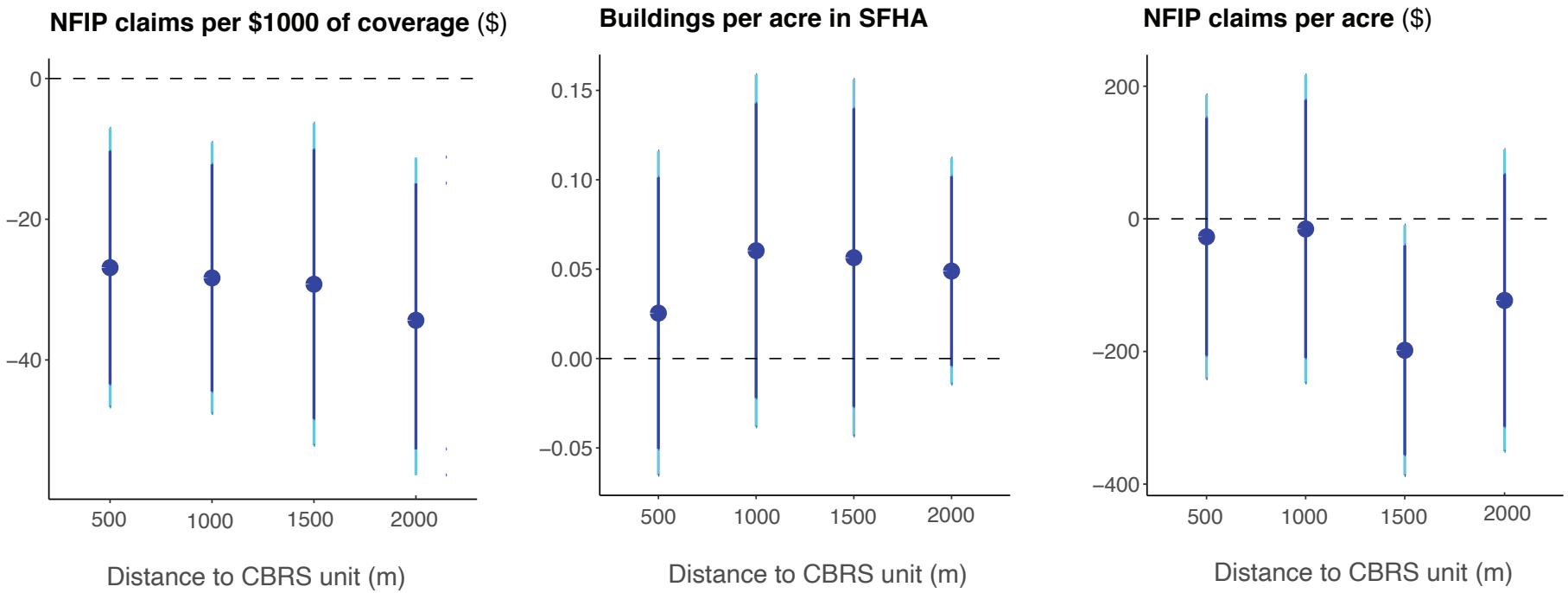
Direct effects of CBRS

	Estimate	Standard error	Control mean
Development density:			
Buildings per acre	-0.109^{***}	0.032	0.128
Property sales:			
Property sales per acre	-0.066^{**}	0.029	0.099
Average property sales price	211,861	248,806	790,169
Assessed values:			
Total assessed value per acre	$-187,033^{**}$	80,783	340,546
Land assessed value per acre	$-66,141^{*}$	33,822	111,552
Improvement value per acre	$-64,852^{***}$	15,893	78143
Home characteristics:			
Average lot size	-1.57	7.15	11.6
Average year built	2.75	4.85	1979
Average squared footage	676.0	442.8	3,104
Average bedrooms	0.392^{**}	0.18	3.01
Demographics:			
Median household income	$11,173^{**}$	4,555	75,878
Median rent	201.6^{***}	76.5	1,197.5
Percent owner occupied	-7.5^{***}	2.8	65.7
Percent renter occupied	-4.4^{***}	0.1	14
Percent white	2.7	1.8	84.2

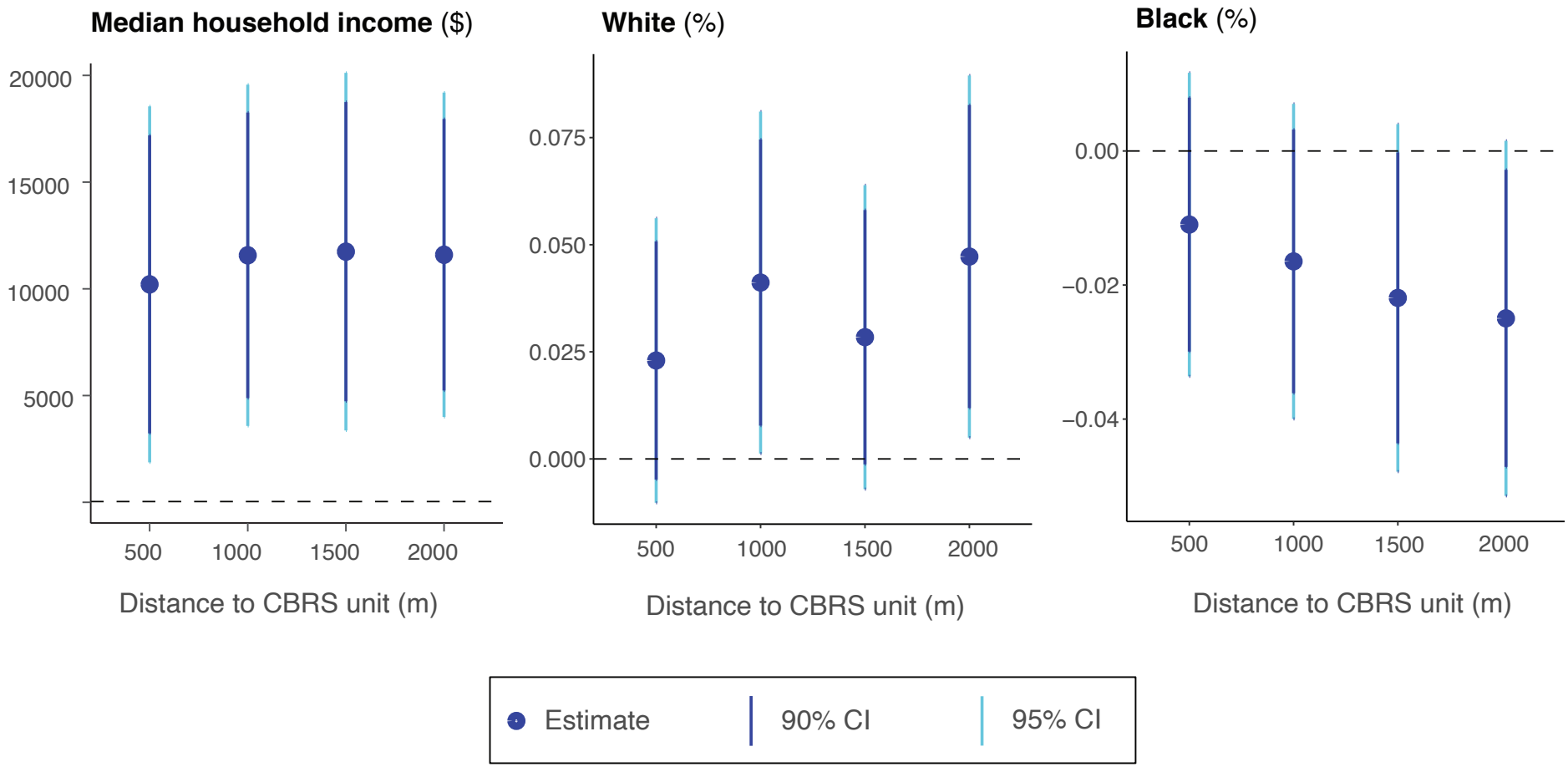
Spillover effects: Development and property values



Spillover effects: Flood damages



Spillover effects: Demographics



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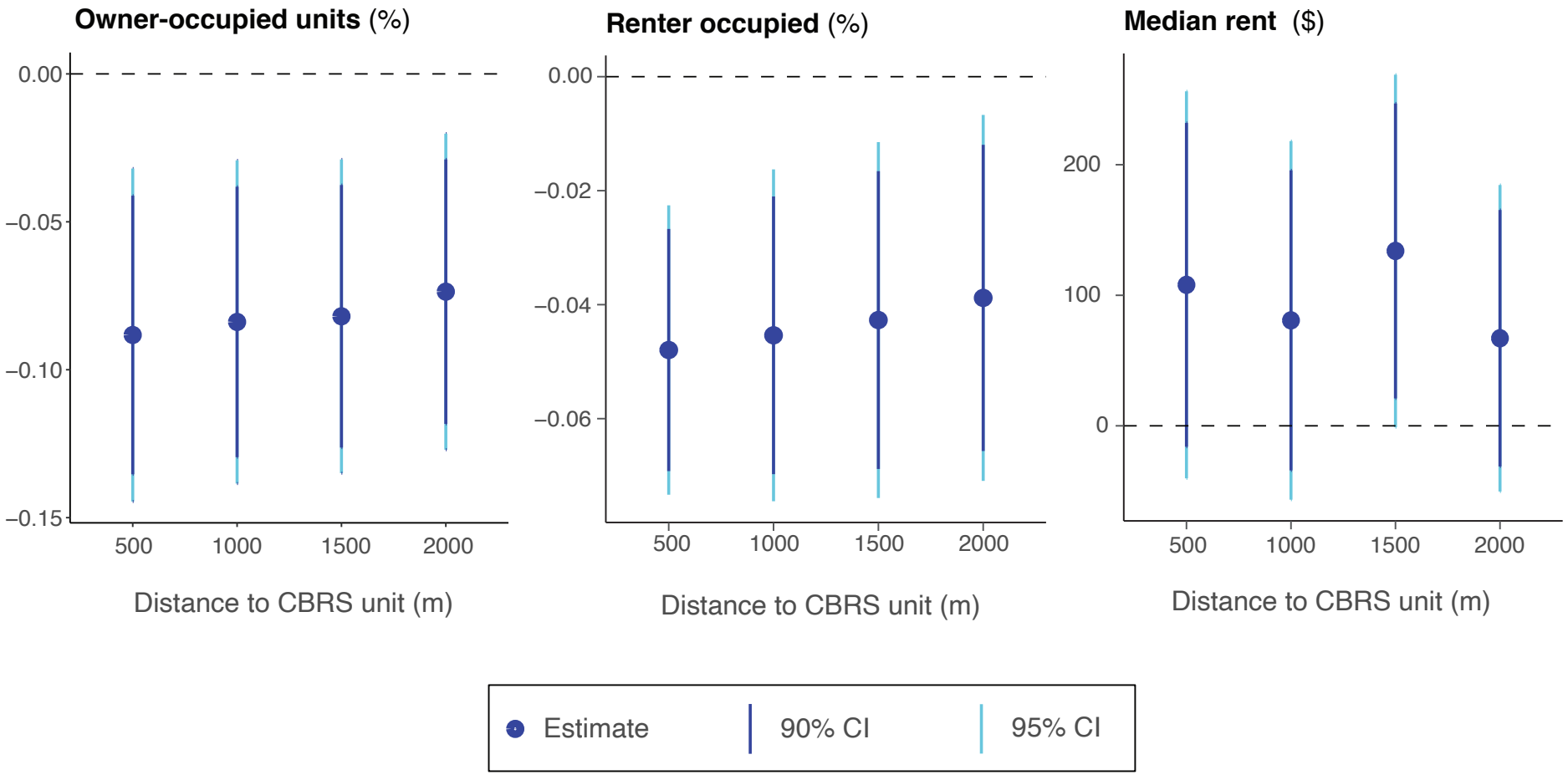

Fiscal impacts

Flood insurance payouts:

- $\downarrow$ \$68 million per year
- $>$90% of the reduction is in spillover areas

Property tax revenues:

- $\downarrow$ \$500 million per year in CBRS lands
- $\uparrow$ \$558 million per year in spillover areas
- 71% of counties have positive impact on property tax revenue

Summary

Context: Coastal communities face significant threats from climate change and human development.

This study: We evaluate one approach to limiting development in risky coastal areas: the removal of financial incentives for development.

- CBRS has been highly effective in limiting development
- Large spillover benefits effects in surrounding communities
- Evidence of demographic change
- Fiscal impacts: reduced flood damages and higher property tax bases

Methodological contribution: Propose a new approach for identifying the causal effect of place-based policies.

Thank you!

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