

Special Flood Hazard Effects on Coastal and Interior Home Values: One Size does not fit all



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- Impact on home values of being located in $\geq 1\%$ annual flood risk Special Flood Hazard Areas (SFHAs)
- lack of knowledge on spatial dimension of SFHA effects
- Existing lit:
coastal only, interior only, or mixed with a single effect
- coarse coastal buffers
- This study:
Refined coastal buffers, comparison coastal vs. interior
- Balanced matching with Bayesian regression adjustment

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Intro ○	Data ●○○○○○○○○○	Methodology ○○○	Matching ○○○○○○○	Results ○○○○	Robustness ○○	Conclusion ○○
data						
• 5 CT counties (Fairfield, Hartford, Middlesex, New Haven, New London) • residential home sales 1991 - 2014 • single family, private owner-occupied • drop missing addresses, sale date, price • drop distressed, non-arms-length sales • drop flips-sales (sold > once w/in 1 year) • drop gross outliers for price (2nd, 98th pctile) • drop if substantial improvements recorded • drop 0 bedrooms, >10 bedrooms, other nonsensical • drop missing GIS information • drop hurricane days • 426,440 sales, 291,129 properties						
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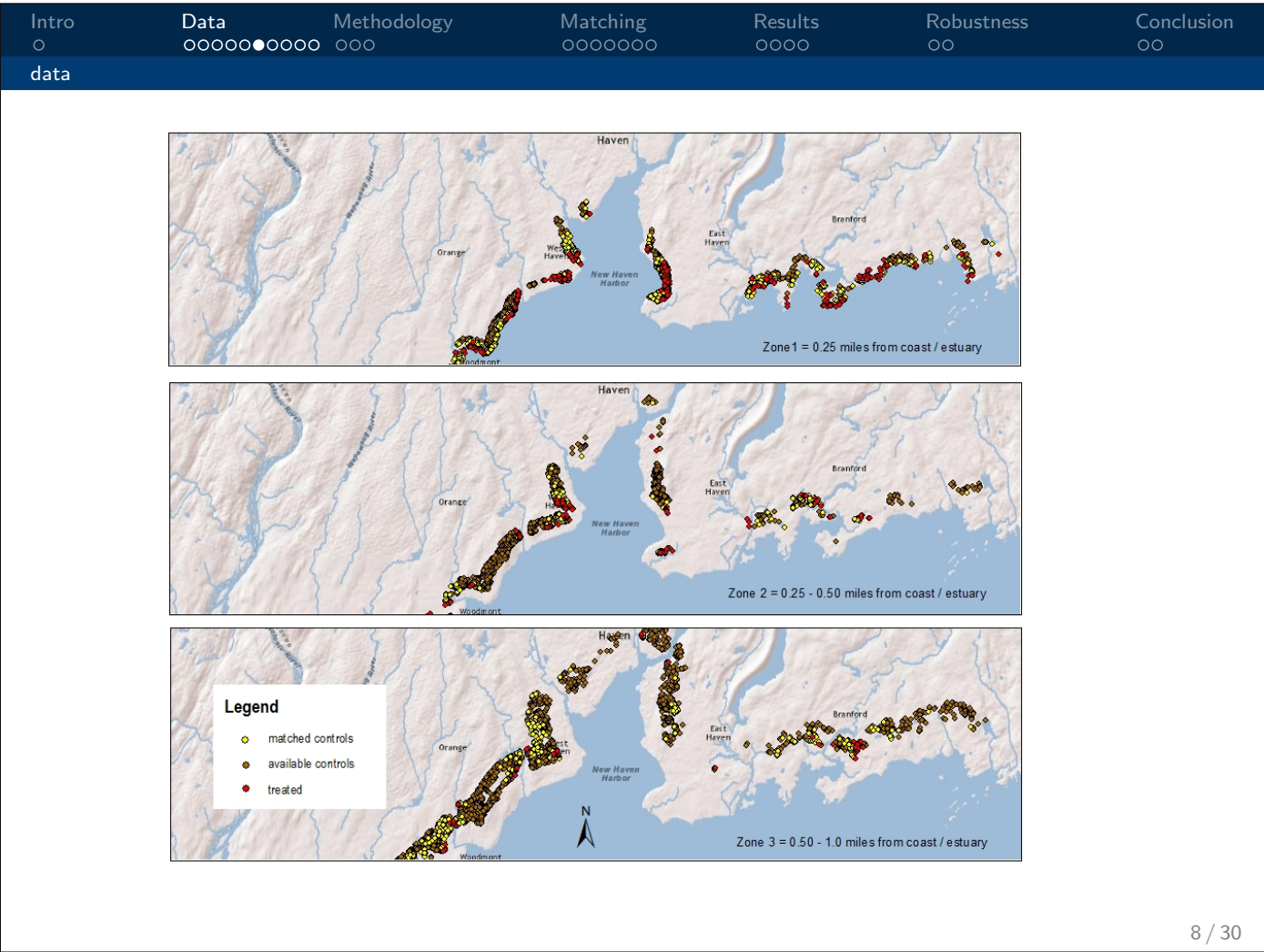
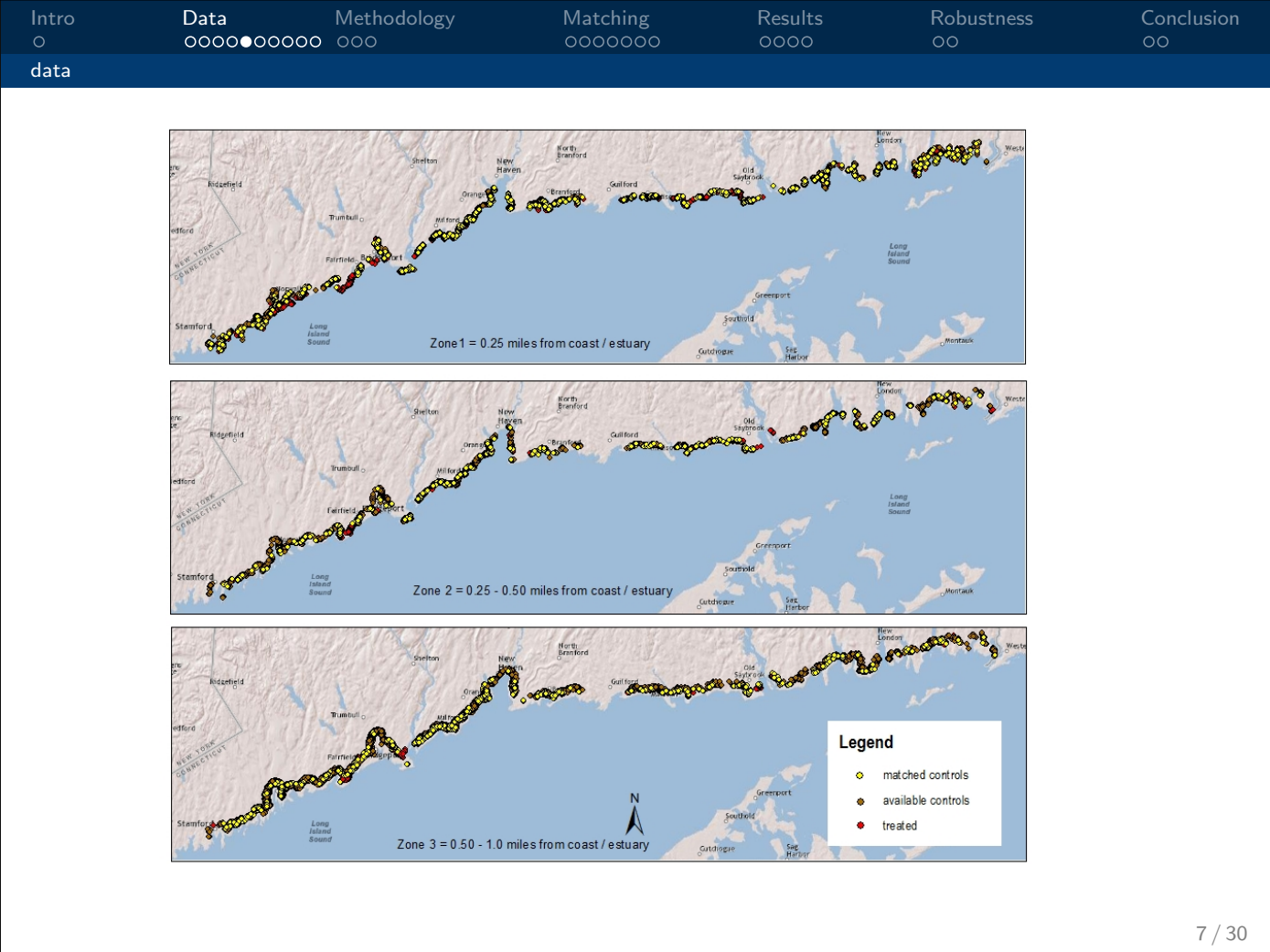
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Variables for analysis <table border="1"> <thead> <tr> <th>nature</th> <th>urban</th> <th>hazards/NFIP</th> </tr> </thead> <tbody> <tr> <td>elevation</td> <td>interstate (miles)</td> <td>1 = SFHA</td> </tr> <tr> <td>beach (miles)</td> <td>principal artery (miles)</td> <td>1 = HS</td> </tr> <tr> <td>coast, estuary (miles)</td> <td>high-density development (miles)</td> <td>1 = CRS</td> </tr> <tr> <td>reservoir, lake (miles)</td> <td>acres of industrial land w/in perimeter</td> <td></td> </tr> <tr> <td>river (miles)</td> <td>acres of agricultural land w/in perimeter</td> <td></td> </tr> <tr> <td></td> <td>acres of open land w/in perimeter</td> <td></td> </tr> <tr> <td></td> <td>school zone indicators (122)</td> <td></td> </tr> </tbody> </table>							nature	urban	hazards/NFIP	elevation	interstate (miles)	1 = SFHA	beach (miles)	principal artery (miles)	1 = HS	coast, estuary (miles)	high-density development (miles)	1 = CRS	reservoir, lake (miles)	acres of industrial land w/in perimeter		river (miles)	acres of agricultural land w/in perimeter			acres of open land w/in perimeter			school zone indicators (122)	
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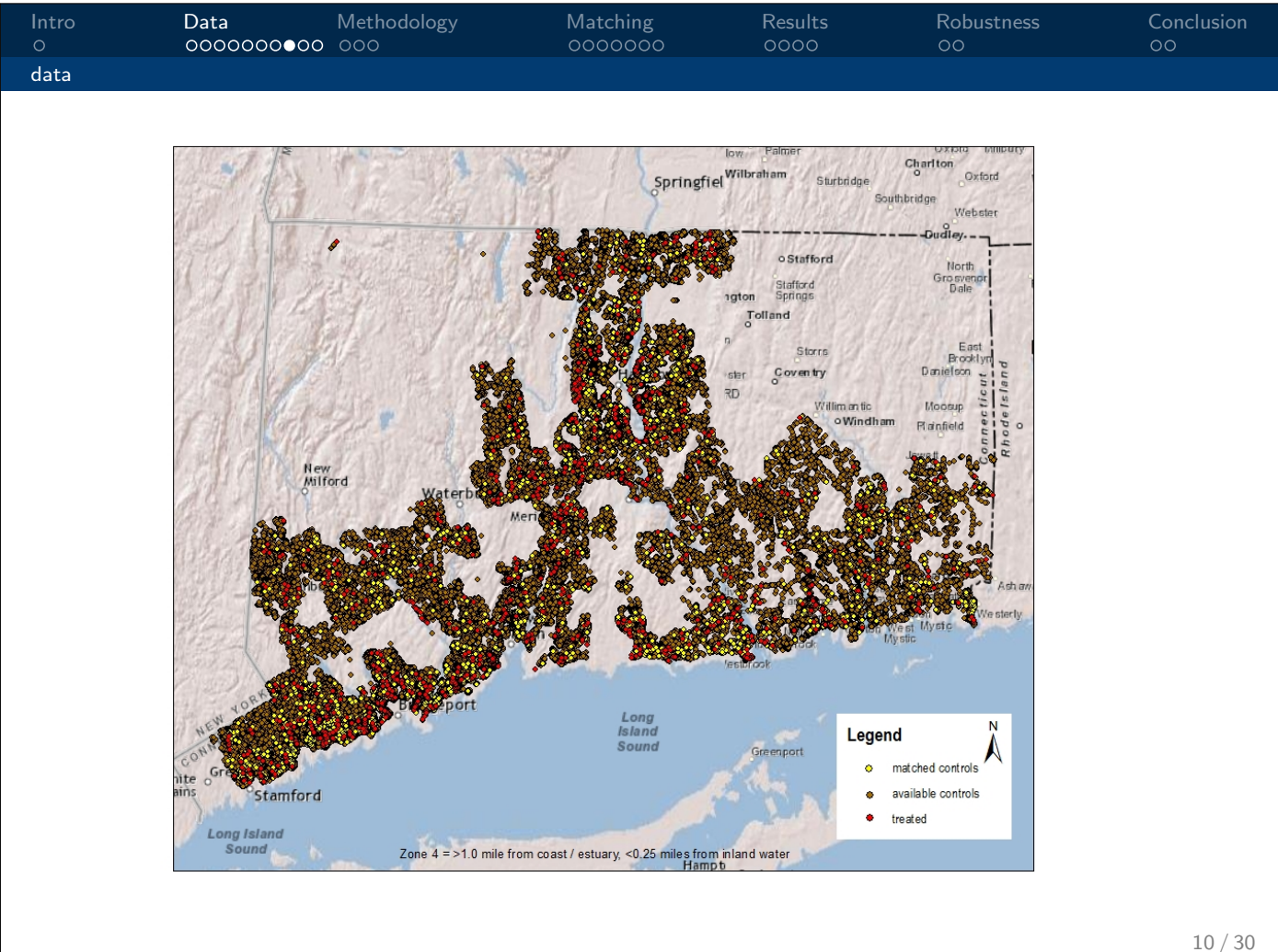
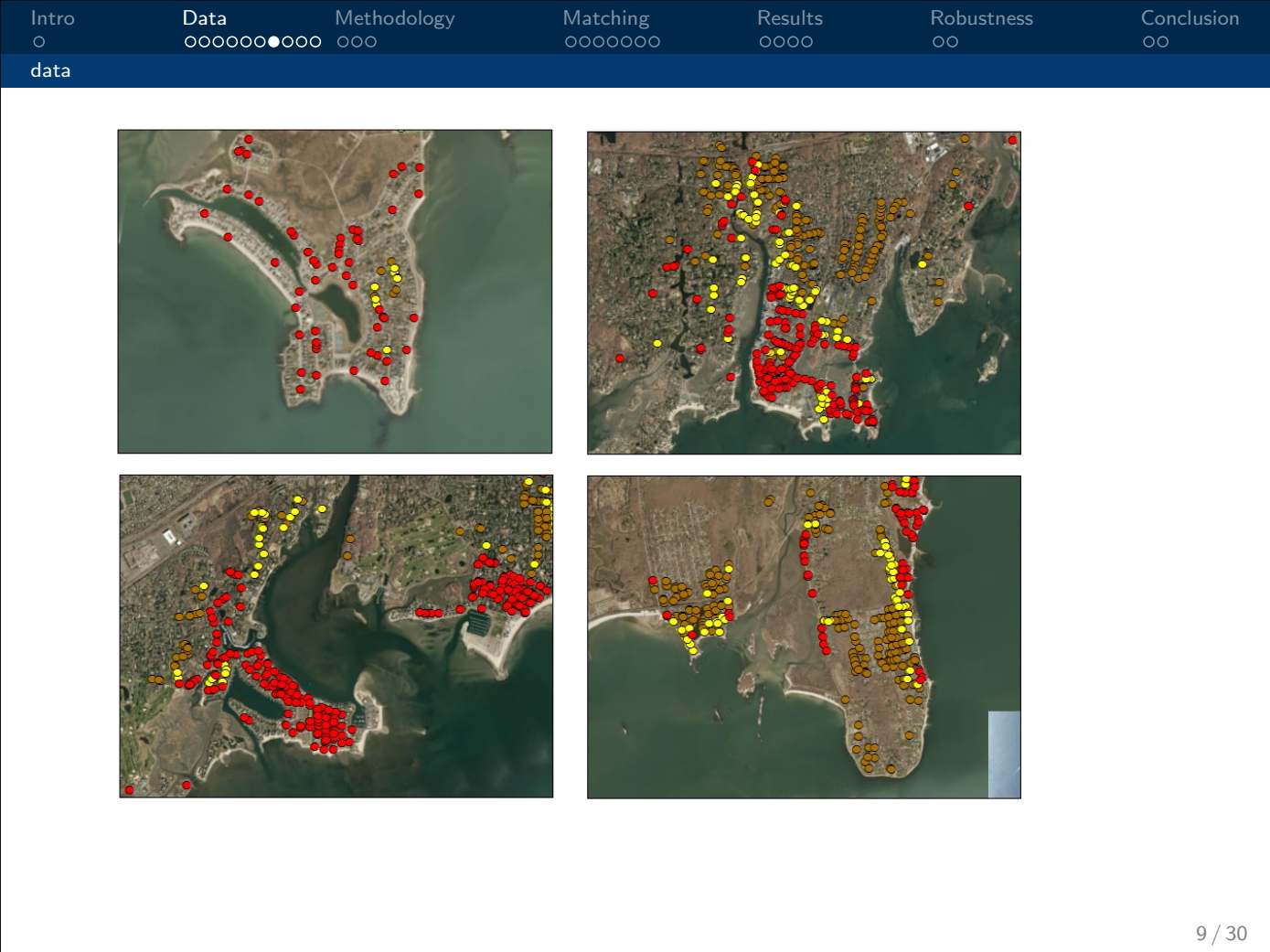
FIRM categories

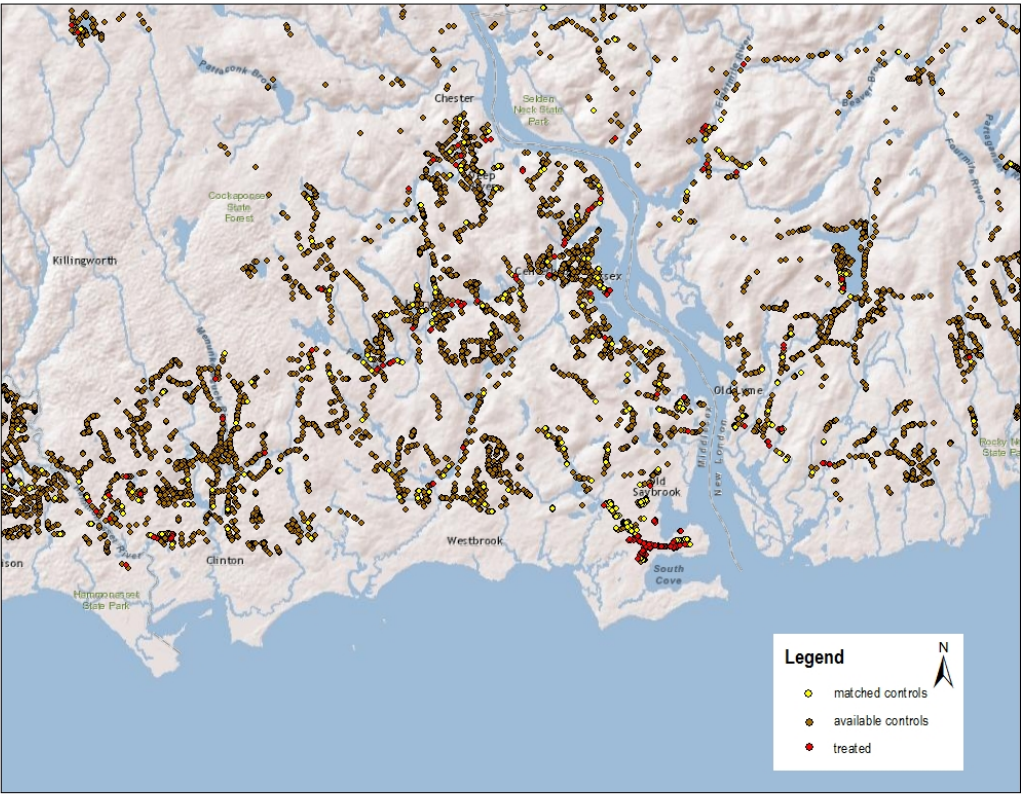
FEMA designation	label	count	percent
A	1%, no BFE	935	0.22%
AE	1%, BFE	14,217	3.33%
AO	1%, river	17	0.00%
VE	1% plus waves	495	0.12%
total SFHA		15,664	3.67%
X	0.2% risk		1.68%
X	minimal risk		94.61%
total		426,440	100.00%
NFIP member at time of sale		426,440	100.00%
CRS member at time of sale		49,801	11.68%
pre-FIRM (count, % of SFHA)		12,227	78.06%

Zones for analysis

zone	miles from:	miles from:	SFHA		total	% SFHA
	coast or estuary	river, lake, reservoir	yes	no		
coastal						
1	<0.25	-	5,553	9,428	14,981	37.07%
2	0.25 - 0.5	-	1,731	9,701	11,432	15.14%
3	0.5 - 1.0	-	2,383	19,285	21,668	11.00%
	total		9,667	38,414	48,081	20.11%
interior						
4	>1.0	<0.25	5,195	282,742	287,937	1.80%
5	>5.0	<0.25	2,864	205,433	208,297	1.37%







Estimation risks and responses

- Mis-specified hedonic price function /
Use non-parametric matching instead
- Space-invariant temporal shocks /
Force matches to be within 1 calendar year
Include year-FEs in aux. regression
- Hurricane “jitters” /
Force matches to be within same inter-hurricane period
- Time-invariant spatial confounders /
Include SZ effects in aux. regression
- Risky reliance on asymptotics for standard errors /
Use Bayesian framework for regression adjustment

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$$T_i = E(y_1(\mathbf{x}_i)) - E(y_0(\mathbf{x}_i))$$

basic estimate:

$$\hat{y}_0(\mathbf{x}_i) = y_0(\mathbf{x}_j)$$

$$\hat{T}_i = y_1(\mathbf{x}_i) - y_0(\mathbf{x}_j)$$

$$E(\hat{T}_i) = E(y_1(\mathbf{x}_i)) - E(y_0(\mathbf{x}_j))$$

biased if $E(y_0(\mathbf{x}_j)) \neq E(y_0(\mathbf{x}_i))$

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$$T_i = E(y_1(\mathbf{x}_i)) - E(y_0(\mathbf{x}_i))$$

regression-adjusted estimate:

$$\begin{aligned}\hat{y}_0(\mathbf{x}_i) &= y_0(\mathbf{x}_j) + \hat{\mu}_0(\mathbf{x}_i) - \hat{\mu}_0(\mathbf{x}_j) \\ \hat{T}_i &= \{y_1(\mathbf{x}_i) - y_0(\mathbf{x}_j)\} - \{\hat{\mu}_0(\mathbf{x}_i) - \hat{\mu}_0(\mathbf{x}_j)\} \\ E(\hat{T}_i) &= \{E(y_1(\mathbf{x}_i)) - E(y_0(\mathbf{x}_j))\} - \\ &\quad \{E(\hat{\mu}_0(\mathbf{x}_i)) - E(\hat{\mu}_0(\mathbf{x}_j))\}\end{aligned}$$

“double-robust”

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Balanced Matching

- Pick control homes such that
treatment becomes independent of observables
- Same / similar distribution of $\mathbf{x}$ for both groups
- Less specification burden for the auxiliary regression
- More likely for $\hat{\mu}_0(\mathbf{x}_i)$ to be an accurate predictor
(since aux. regression is run using only matched controls)

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Intro

Data

Methodology

Matching

Results

Robustness

Conclusion

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Matching

$$d_{ij} = \sqrt{(\mathbf{x}_i - \mathbf{x}_j)' \mathbf{V}^{-1/2} \mathbf{W} \mathbf{V}^{-1/2} (\mathbf{x}_i - \mathbf{x}_j)}$$

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Matching

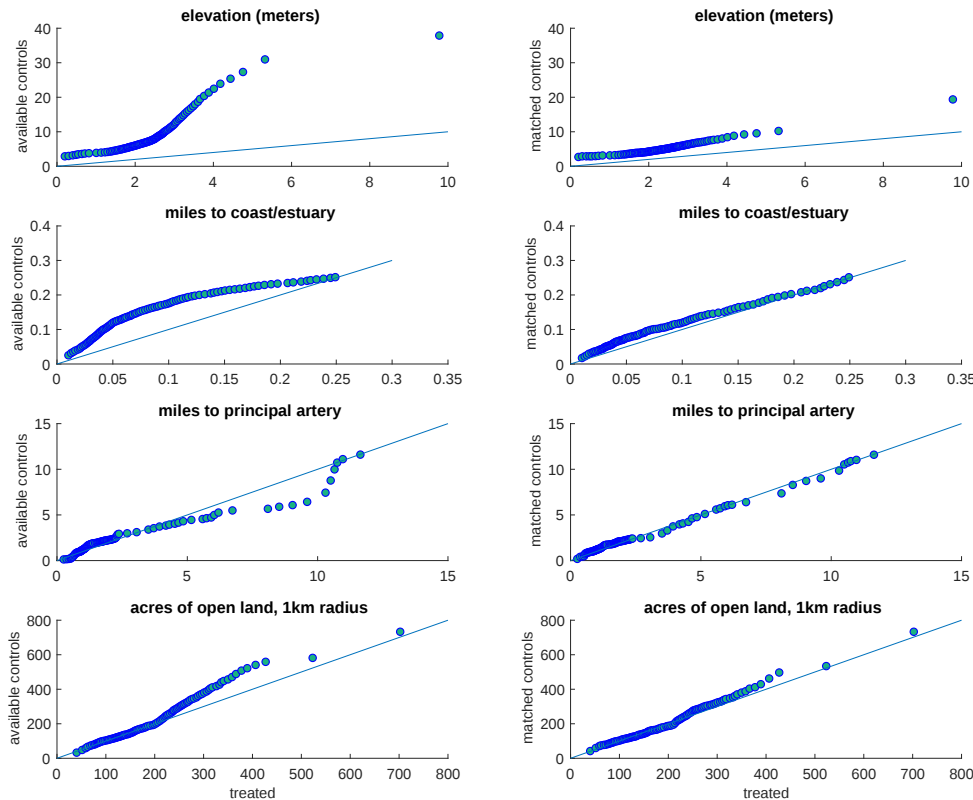
Matching Variables

structural	nature	urban
age	elevation	interstate (miles)
sqft00	beach (miles)	pricipal artery (miles)
lot000	coast, estuary (miles)	high-density development (miles)
bedrooms	reservoir, lake (miles)	acres of industrial land 1000m
bathrooms	river (miles)	acres of agricultural land 1000m
		acres of open land 1000m

sale year forced to be within 1 year on either side of treated,
in same inter-hurricane period

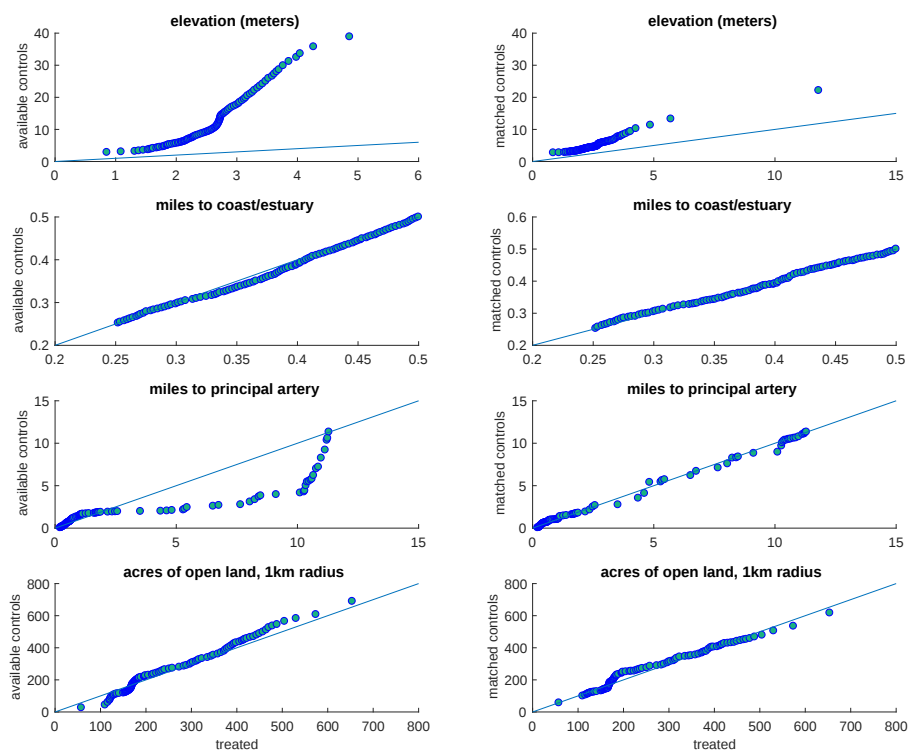
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Zone 1



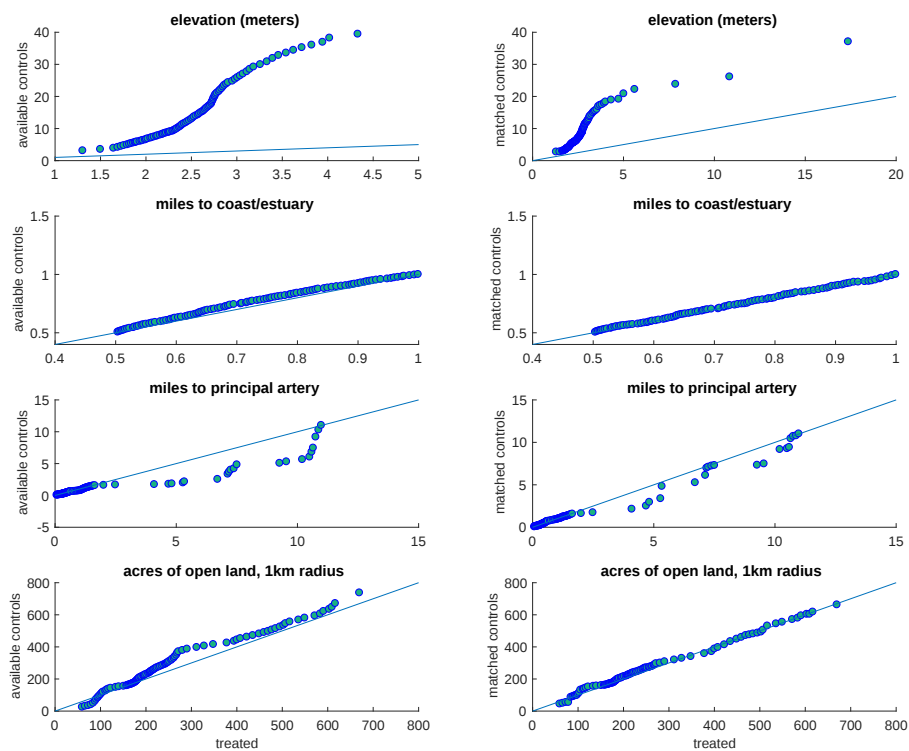
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Zone 2



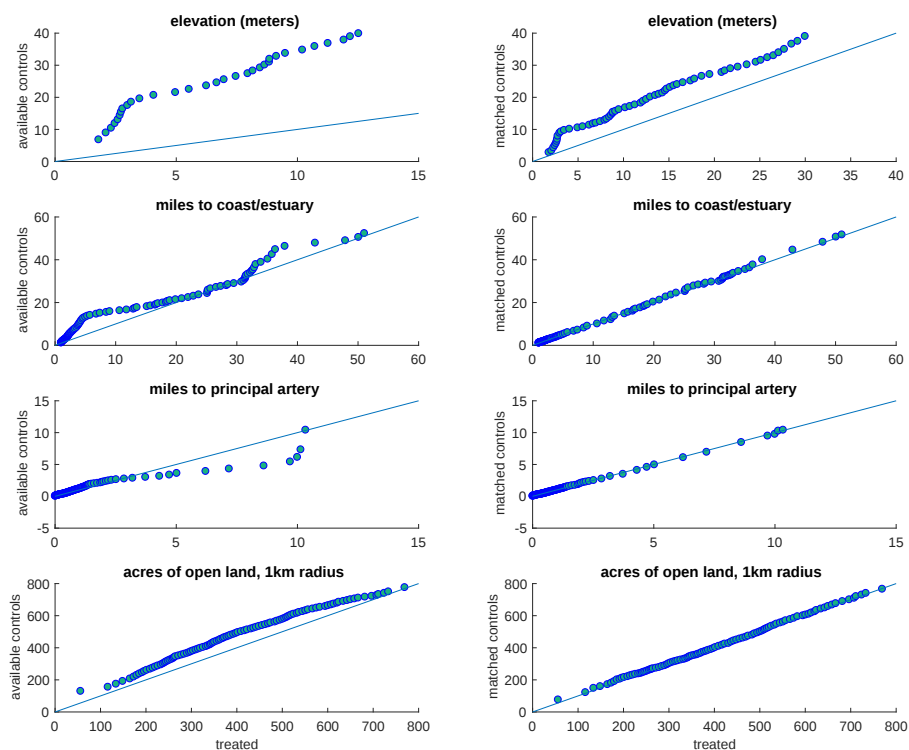
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Zone 3



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Zone 4



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zone	SFHA effect (\$000s)				SFHA effect (% of avg. price)		
	low	mean	high	(p>0)	low	mean	high
1	-58.98	-45.46	-30.92	0.00	-13.96%	-10.76%	-7.32%
2	-21.62	-5.62	10.35	0.24	-6.28%	-1.63%	3.00%
3	-12.98	0.75	14.67	0.54	-3.75%	0.22%	4.23%
4	-9.82	-6.46	-3.10	0.00	-2.83%	-1.86%	-0.90%
5	-6.08	-1.74	2.43	0.21	-1.93%	-0.55%	0.77%

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Robustness						

- Separate analysis for periods 1 and 2
- Exclusion of post-FIRM properties
- Exclusion of low (0.2%) risk properties
- Results remain qualitatively unchanged

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Robustness						

SFHA effects by period

zone	treated	controls available	chosen	SFHA effect (% of avg. price)		
				low	mean	high
Period 1 (08/21/91 - 09/15/99; Hurricane Bob to Floyd)						
1	2,439	3,888	1,080	-17.03%	-12.01%	-6.96%
2	688	3,804	419	-12.52%	-4.90%	2.46%
3	913	7,598	531	-7.65%	-1.52%	4.36%
4	1,938	111,596	1,504	-0.39%	0.85%	2.11%
5	1,004	79,397	835	-1.14%	1.21%	3.34%
Period 2 (09/18/99 - 08/26/11; Hurricane Floyd to Irene)						
1	2,629	4,783	1,135	-11.31%	-5.71%	-0.22%
2	904	5,088	581	-10.22%	-4.44%	0.93%
3	1,272	10,172	765	-0.72%	3.80%	8.21%
4	2,856	148,791	2,427	-3.45%	-2.46%	-1.51%
5	1,642	109,845	1,256	-1.50%	-0.17%	1.11%

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Conclusion						

- SFHA effects strongest near-coast taper off quickly
- interior near-water effects similar to coastal outside 0.25 mile buffer
- Buyers aware of elevated flood risk near-coast
- Calls for **location specific NFI premiums** to avoid:
 - Wrong risk signals
 - Inefficient cross-subsidies between A-zones

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Conclusion						



THANK YOU!

Photo shown in CT Post article of August 31, 2011 - Hurricane Irene hitting Milford, CT

<http://www.ctpost.com/local/article/Photographer-awestruck-after-catching-a-wave-2149831.php>

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