Coastal hazard zones and home values: The quest for an unbiased treatment effect

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- Impact of location in SFHA on home values (CT,RI,MA,NH,ME)
- Existing lit: -1% to -11% loss - not much known about New England
- Here: 2 Counties in MA - interesting case studies
- Residential sales 1991 - 2014
- Focus on 1% annual flood risk Special Flood Hazard Areas (SFHAs)
- Matching with Bayesian regression adjustment

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

basic estimate:

$$\hat{y}_0\left(\mathbf{x}_i\right) = y_0\left(\mathbf{x}_j\right)$$
$$\hat{T}_i = y_1\left(\mathbf{x}_i\right) - y_0\left(\mathbf{x}_j\right)$$
$$E\left(\hat{T}_i\right) = E\left(y_1\left(\mathbf{x}_i\right)\right) - E\left(y_0\left(\mathbf{x}_j\right)\right)$$

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

regression-adjusted estimate:

$$\hat{y}_0\left(\mathbf{x}_i\right) = y_0\left(\mathbf{x}_j\right) + \hat{\mu}_0\left(\mathbf{x}_i\right) - \hat{\mu}_0\left(\mathbf{x}_j\right)$$
$$\hat{T}_i = \left\{y_1\left(\mathbf{x}_i\right) - y_0\left(\mathbf{x}_j\right)\right\} - \left\{\hat{\mu}_0\left(\mathbf{x}_i\right) - \hat{\mu}_0\left(\mathbf{x}_j\right)\right\}$$
$$E\left(\hat{T}_i\right) = \left\{E\left(y_1\left(\mathbf{x}_i\right)\right) - E\left(y_0\left(\mathbf{x}_j\right)\right)\right\} - \left\{E\left(\hat{\mu}_0\left(\mathbf{x}_i\right)\right) - E\left(\hat{\mu}_0\left(\mathbf{x}_j\right)\right)\right\}$$

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
- Time-invariant spatial confounders /
  Include SZ effects in aux. regression
- Biased standard errors /
  Use Bayesian framework for regression adjustment

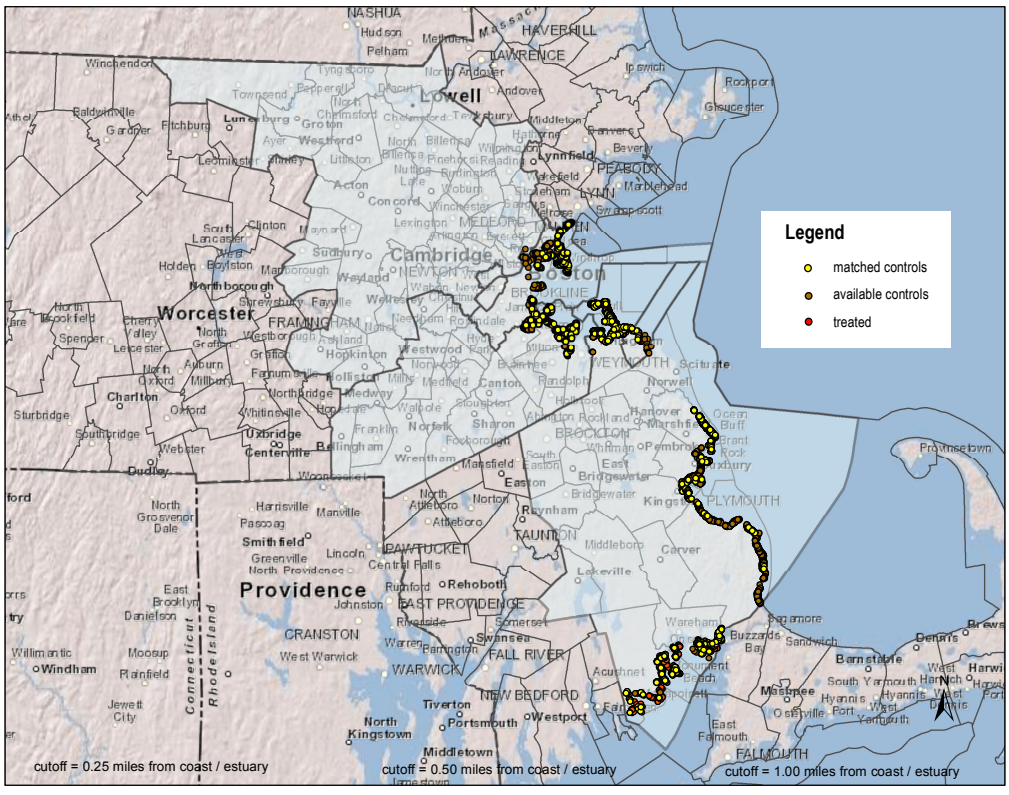
Balanced Matching

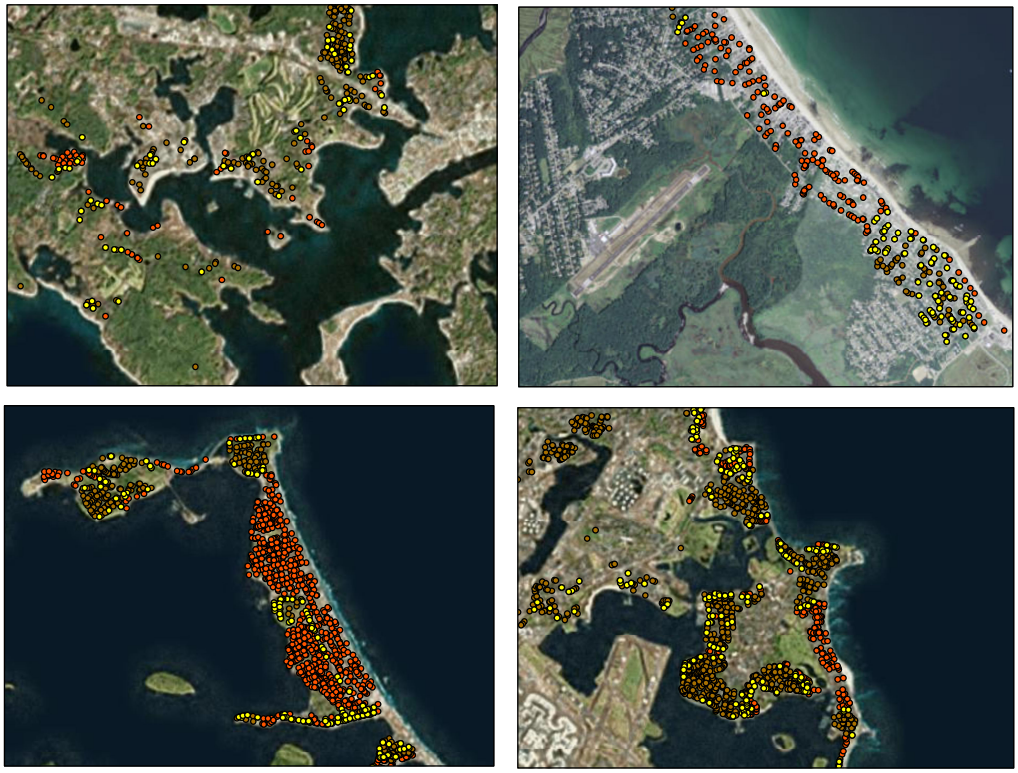
- Pick control homes such that
  treatment becomes independent of observables
- Same / similar distribution of **x** for both groups
- Less specification burden for the auxiliary regression

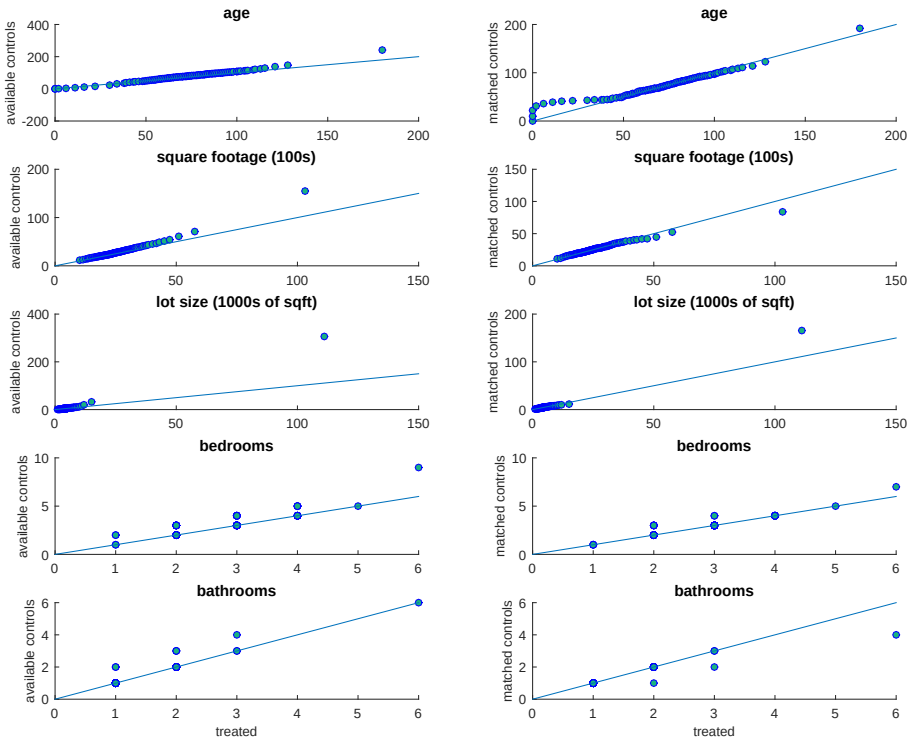
MatchingVariables

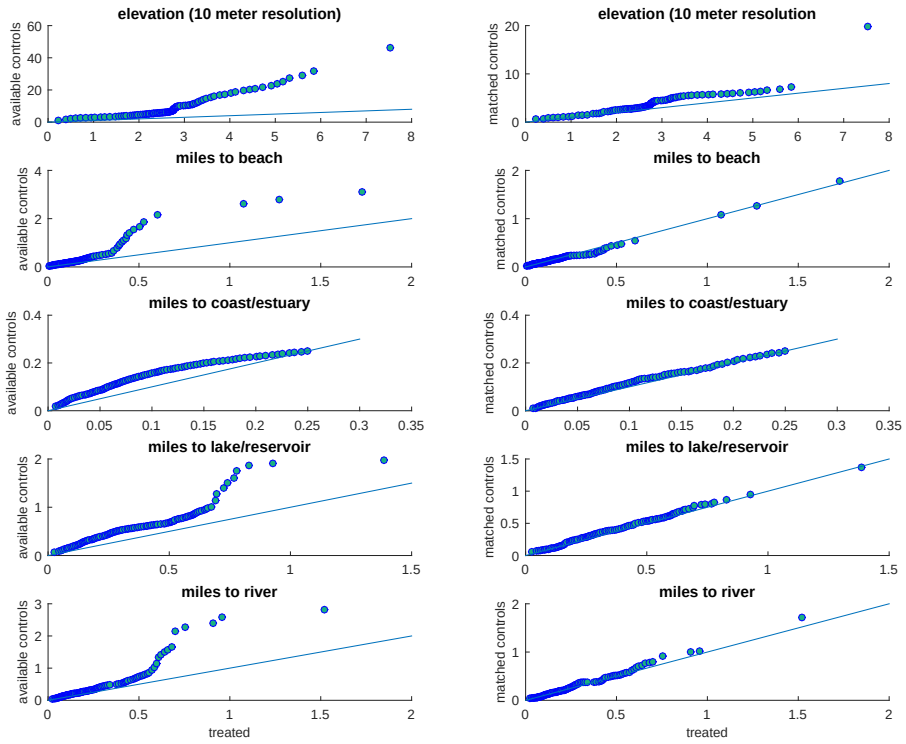
structural	nature	urban
age	elevation	interstate (miles)
sqft00	beach (miles)	pricipal artery (miles)
lot000	coast, estuary (miles)	high-density development (miles)
bedrooms	reservoir, lake (miles	acres of industrial land 1000m
bathrooms	river (miles)	acres of agricultural land 1000m
		acres of open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

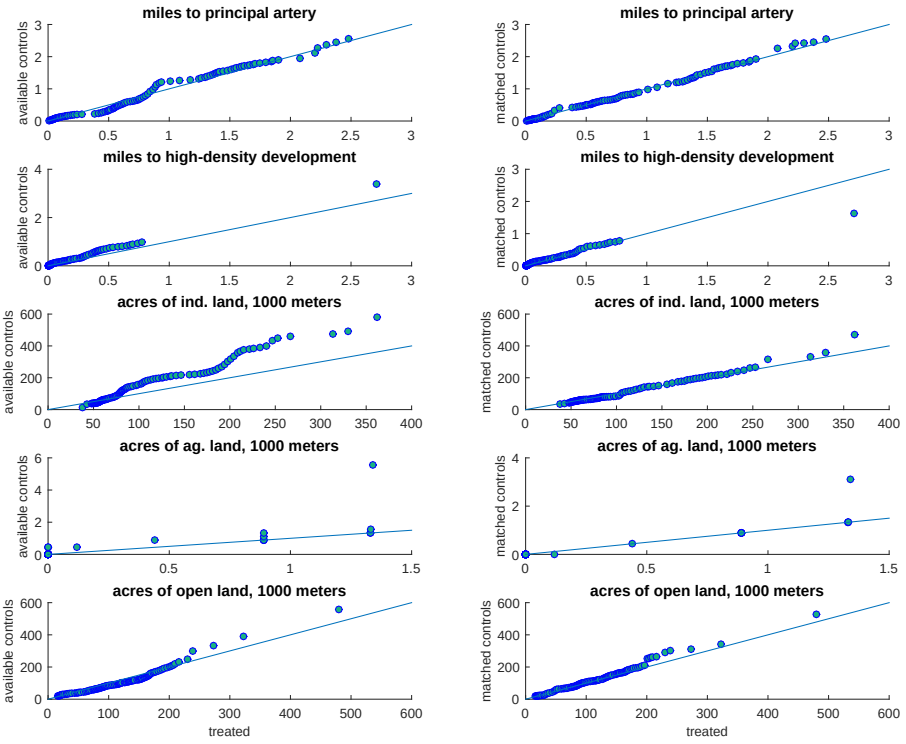
sale year forced to be within 1 year on either side of treated






age
available controls
matched controls
square footage (100s)
lot size (1000s of sqft)
bedrooms
bathrooms
treated


elevation (10 meter resolution)
available controls
elevation (10 meter resolution
matched controls
miles to beach
miles to coast/estuary
miles to lake/reservoir
miles to river
treated


miles to principal artery
available controls
matched controls
miles to high-density development
acres of ind. land, 1000 meters
acres of ag. land, 1000 meters
acres of open land, 1000 meters
treated

Regression Adjustment, Plymouth

variable	mean difference	coefficient estimates mean	$p > 0$	b*mean
age	2.124	-0.069	0.318	-0.147
sqft00	-0.128	4.665	1.000	-0.598
lot000	0.403	0.332	0.920	0.134
bedrooms	0.097	14.282	0.992	1.382
bathrooms	-0.018	13.731	0.947	-0.246
elev10	-4.753	4.998	1.000	-23.757
ISMi	-0.055	-10.579	0.064	0.584
PAMi	0.147	-2.389	0.427	-0.352
beaMi	-0.018	22.997	0.816	-0.414
hidMi	0.050	-2.082	0.439	-0.104
coaestMi	-0.005	-288.980	0.003	1.549
reslkMi	0.042	-53.107	0.010	-2.238
rivMi	0.004	3.979	0.568	0.017
ag10	0.458	-1.804	0.081	-0.826
ind10	0.674	-0.276	0.106	-0.186
op10	-7.082	-0.197	0.002	1.395
			total:	-23.807

Regression Adjustment, Suffolk & Norfolk

variable	mean difference	coefficient estimates mean	$p > 0$	b*mean
age	-1.678	-0.380	0.001	0.637
sqft00	-0.113	4.347	1.000	-0.492
lot000	0.075	2.385	0.999	0.180
bedrooms	-0.089	10.118	0.996	-0.900
bathrooms	0.011	6.338	0.869	0.067
elev10	-0.963	0.376	0.564	-0.362
ISMi	0.155	-26.875	0.000	-4.172
PAMi	0.001	-46.714	0.000	-0.058
beaMi	0.014	51.409	0.995	0.697
hidMi	-0.016	53.280	0.996	-0.851
coaestMi	-0.010	-67.039	0.141	0.681
reslkMi	-0.032	-100.150	0.000	3.215
rivMi	-0.020	-66.871	0.000	1.354
ag10	-0.001	25.846	0.996	-0.029
ind10	-0.469	-0.587	0.000	0.275
op10	-8.287	-0.697	0.000	5.776
			total:	6.020

PLYMOUTH:

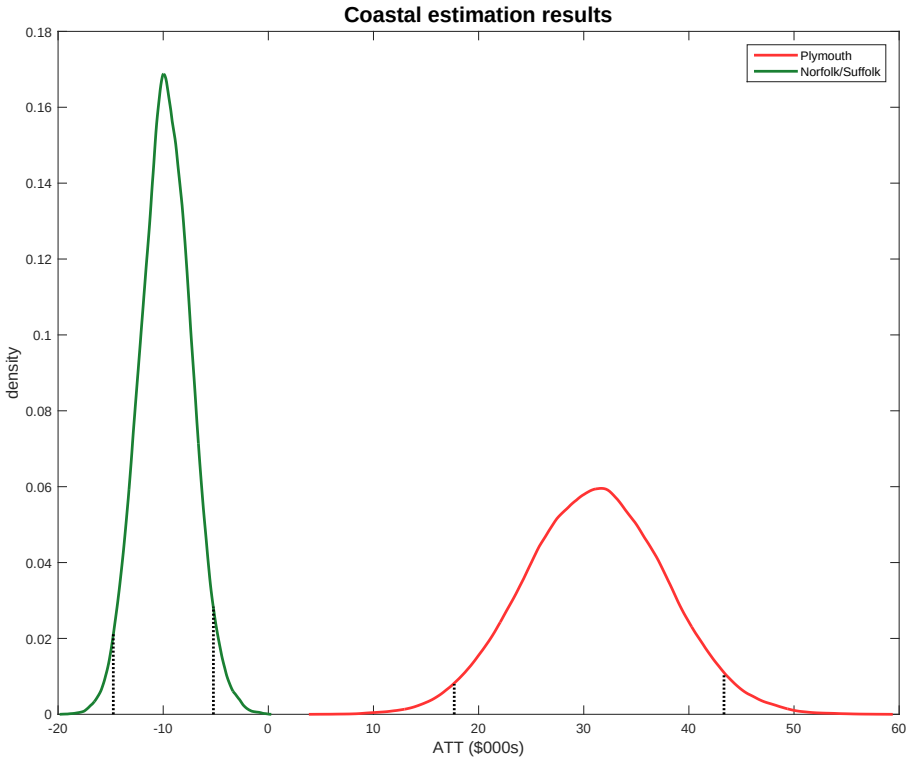
- 90% of matched pairs are in the same SZ
- average spatial distance between pairs = 2.49 miles

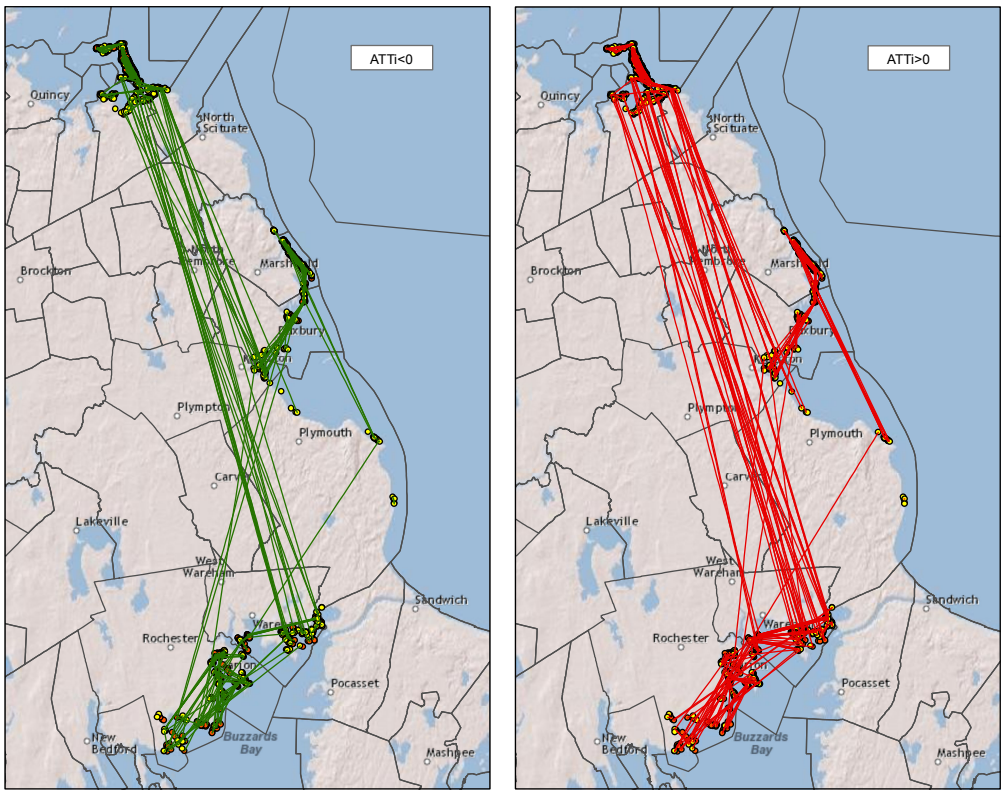
SUFFOLK / NORFOLK

- 89% of matched pairs are in the same SZ
- average spatial distance between pairs = 1.69 miles

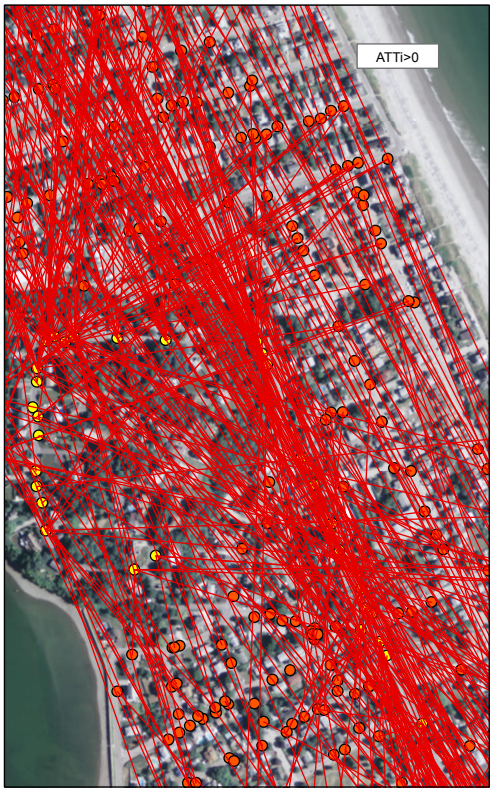
Coastal Results

hedonic		ATT	adjusted ATT mean	lo	hi	Ts	origCs	mCs
			PLYMOUTH					
10.631	**	8.724	31.074	17.681	43.339	2153	5058	766
			SUFFOLK & NORFOLK					
-3.557	ns	-6.787	-9.75	-14.747	-5.225	2036	5748	958

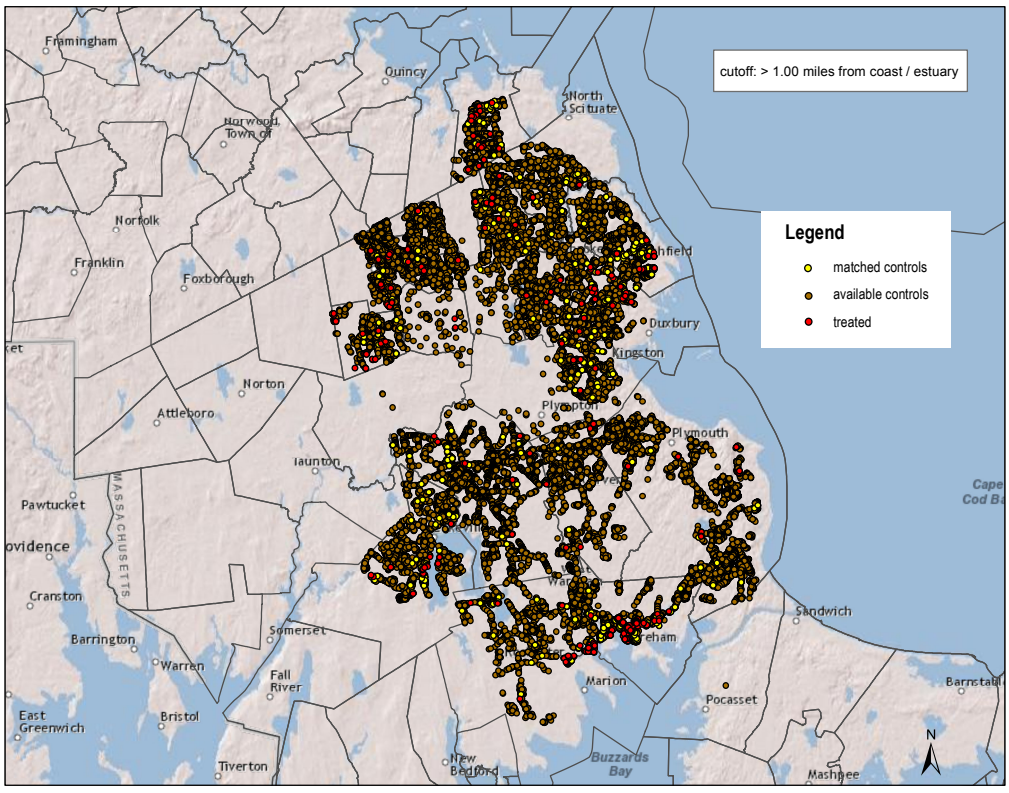

Coastal estimation results
Plymouth
Norfolk/Suffolk
density
ATT ($000s)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-20
-10
0
10
20
30
40
50
60

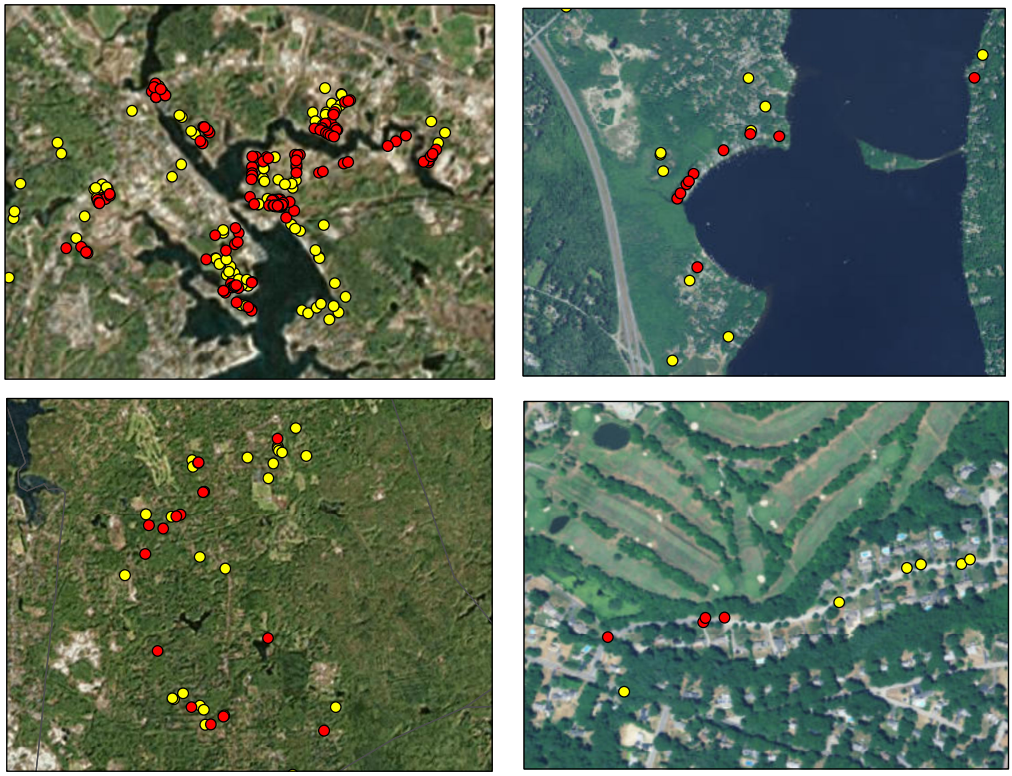

ATTi<0
ATTi>0
Quincy
North Scituate
Brockton
Marshfield
Plymouth
Lakeville
Rochester
Pocasset
Sandwich
Mashpee
Buzzards Bay
New Bedford

Results



Interior Analysis





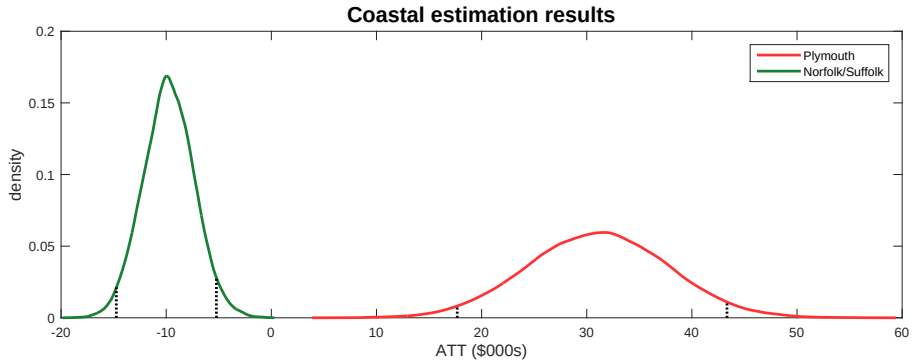
$$\hat{T}_{coast} = T_{coast} + A_{coast}, \qquad A_{coast} \geq 0$$
$$\hat{T}_{int} = T_{int} + A_{int}, \qquad A_{int} \geq 0$$
$$T_{coast} \leq T_{int} \qquad \text{(in real terms)}$$
$$A_{coast} \geq A_{int}, \quad \text{so}$$
$$T_{int} + A_{int} \geq T_{coast}$$

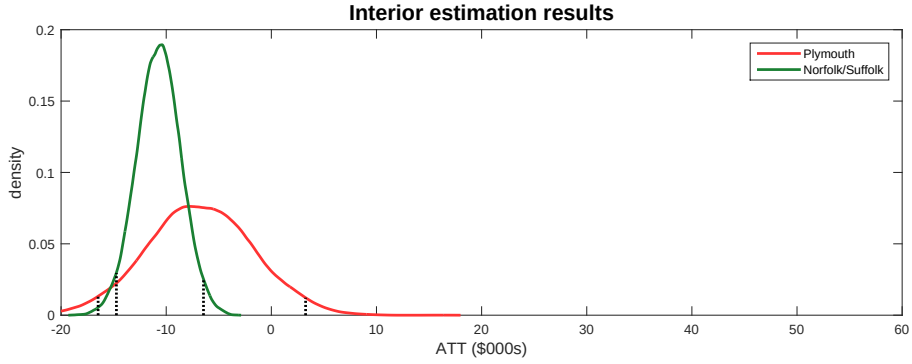
So $\hat{T}_{int}$ = upper bound for T_{coast}, in real terms.

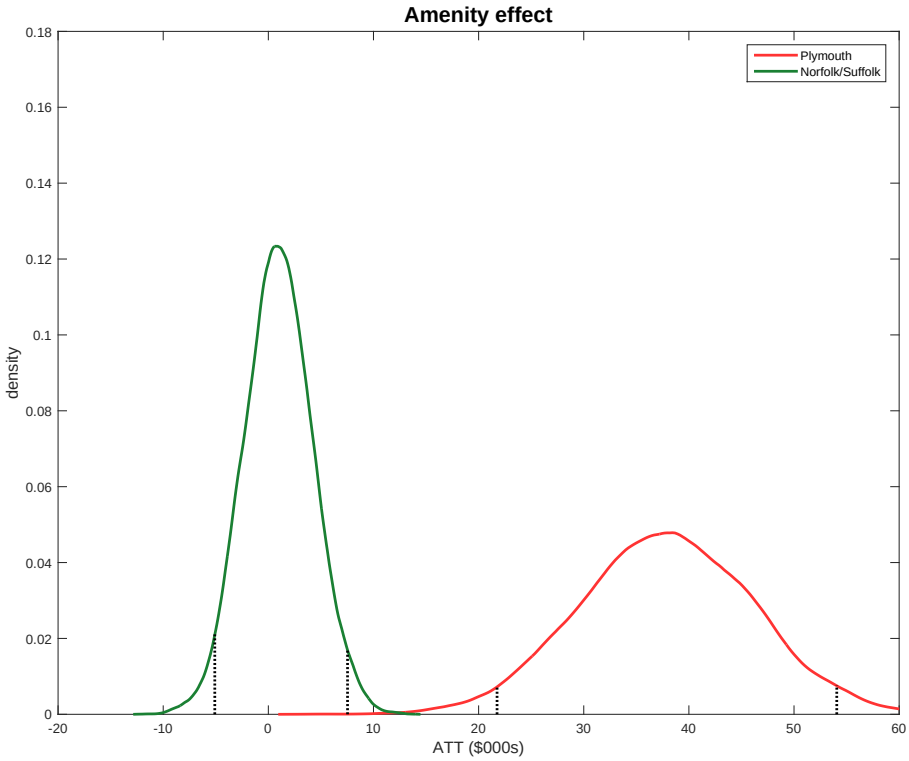
Also: $\hat{T}_{coast} - \hat{T}_{int}$ = lower bound for A_{coast}, in real terms.

Combined Results

adjusted ATT								
hedonic		ATT	mean	lo	hi	Ts	origCs	mCs
PLYMOUTH (row 1 = coastal, row 2 = interior)								
10.631	**	8.724	31.074	17.681	43.339	2153	5058	766
2.424	ns	-14.232	-6.787	-16.476	3.258	588	34843	488
SUFFOLK & NORFOLK (row 1 = coastal, row 2 = interior)								
-3.557	ns	-6.787	-9.75	-14.747	-5.225	2036	5748	958
-8.116	***	-11.1318	-10.17	-14.736	-6.454	2715	184922	2350



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Norfolk/Suffolk
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ATT ($000s)
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-10
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20
30
40
50
60