Downwind and Out: The Strategic Dispersion of Power Plants and Their Pollution

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Problem: Air pollution can travel long distances and not all counties are monitored

- Regulation & enforcement are complicated!

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Why? Air-pollution regulation and monitoring is fraught with complexity.

We shed light on additional challenges regulators face under the current, federalist system.

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Pervasiveness and problems with pollution transfer

- Sergi et. al (2020), Wang et. al (2020), Tessum et. al (2017)
    - Quantify extent of pollution transport in general + costs (health damages)

The Geography of US Power Plants

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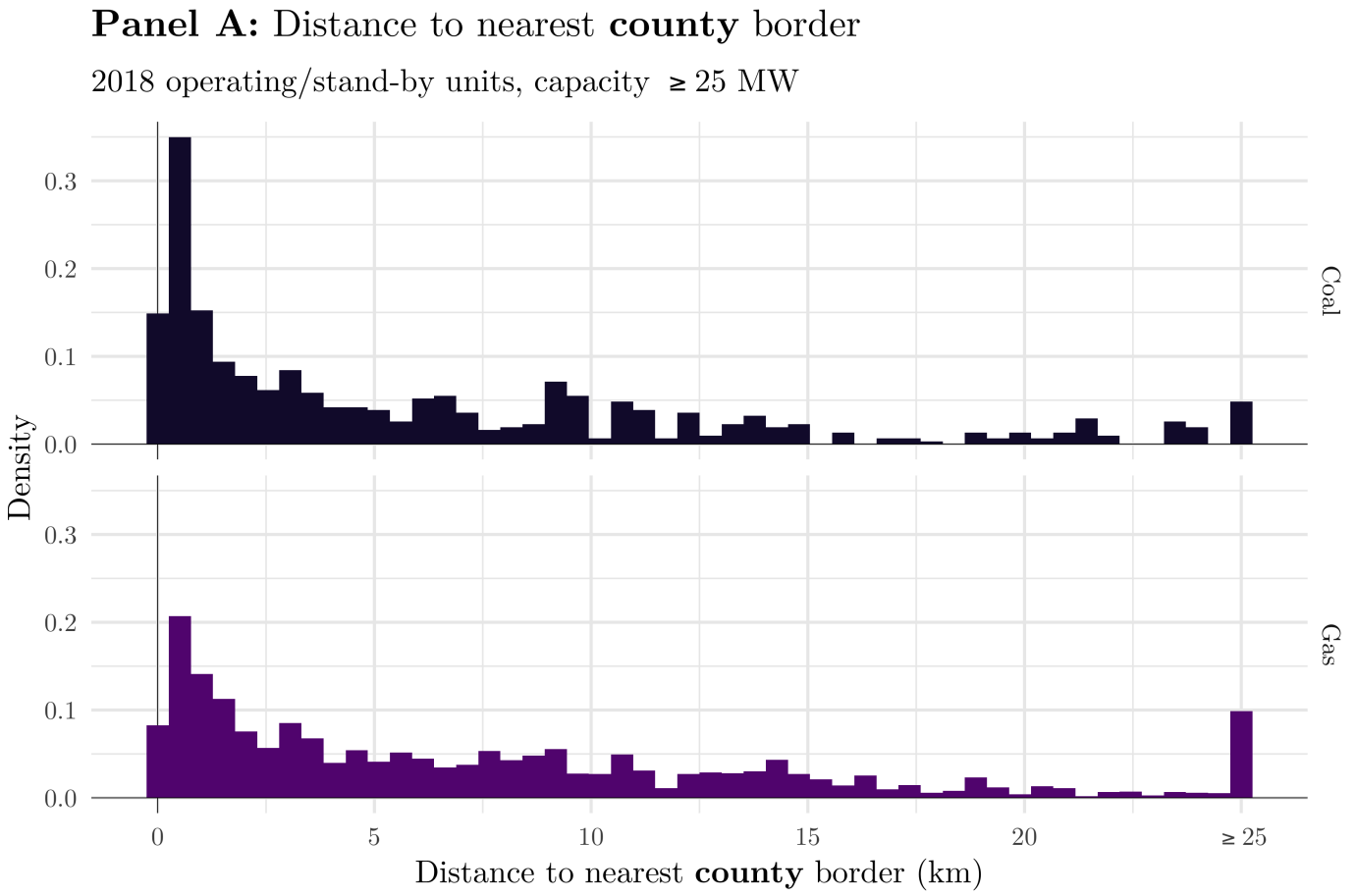
Meteorology: NOAA's North American Regional Reanalysis (NARR) daily data

Historic wind patterns at various pressure levels. 32km $\times$ 32km grid cells across contigous US

Distances to County Borders



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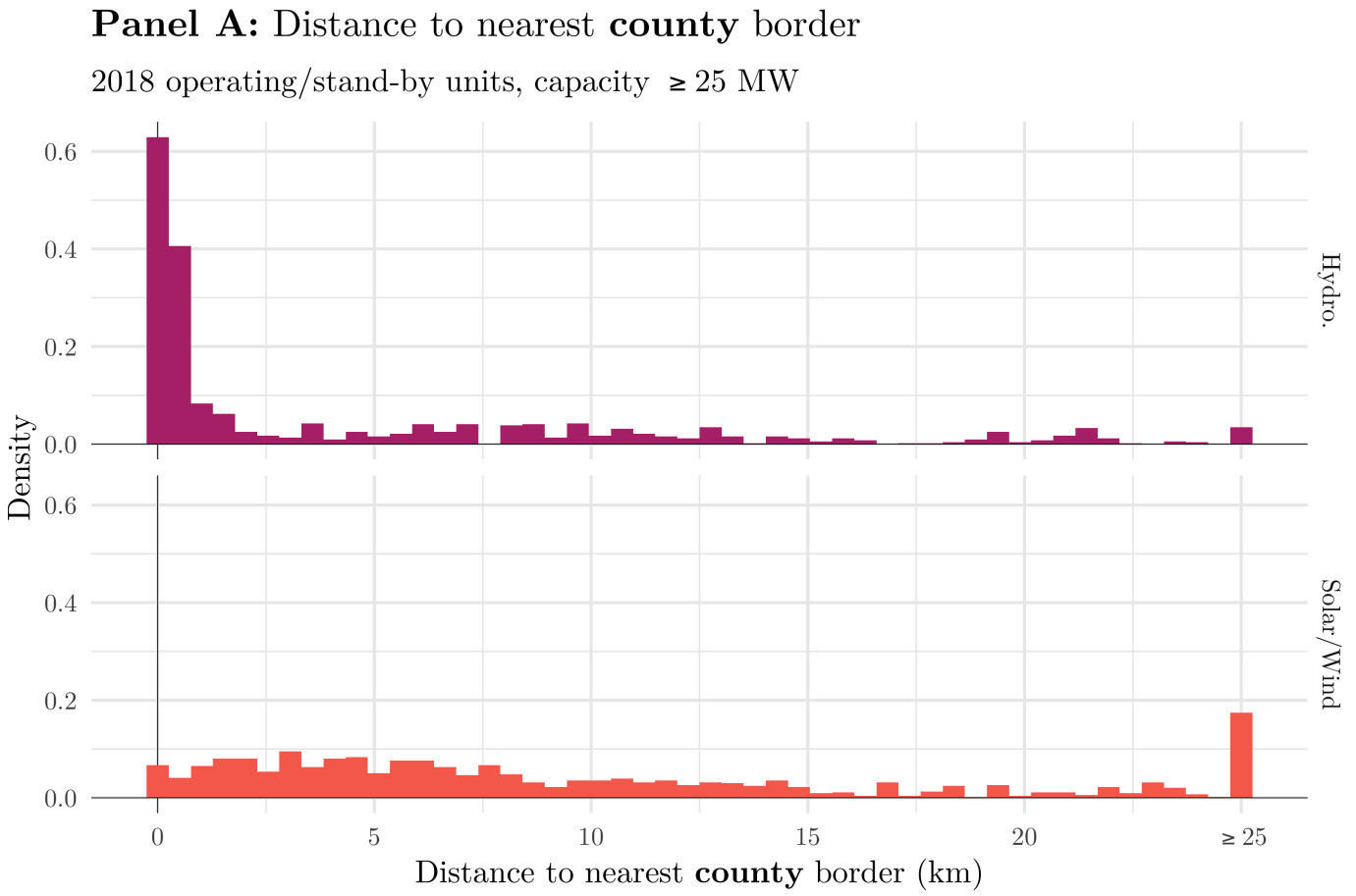
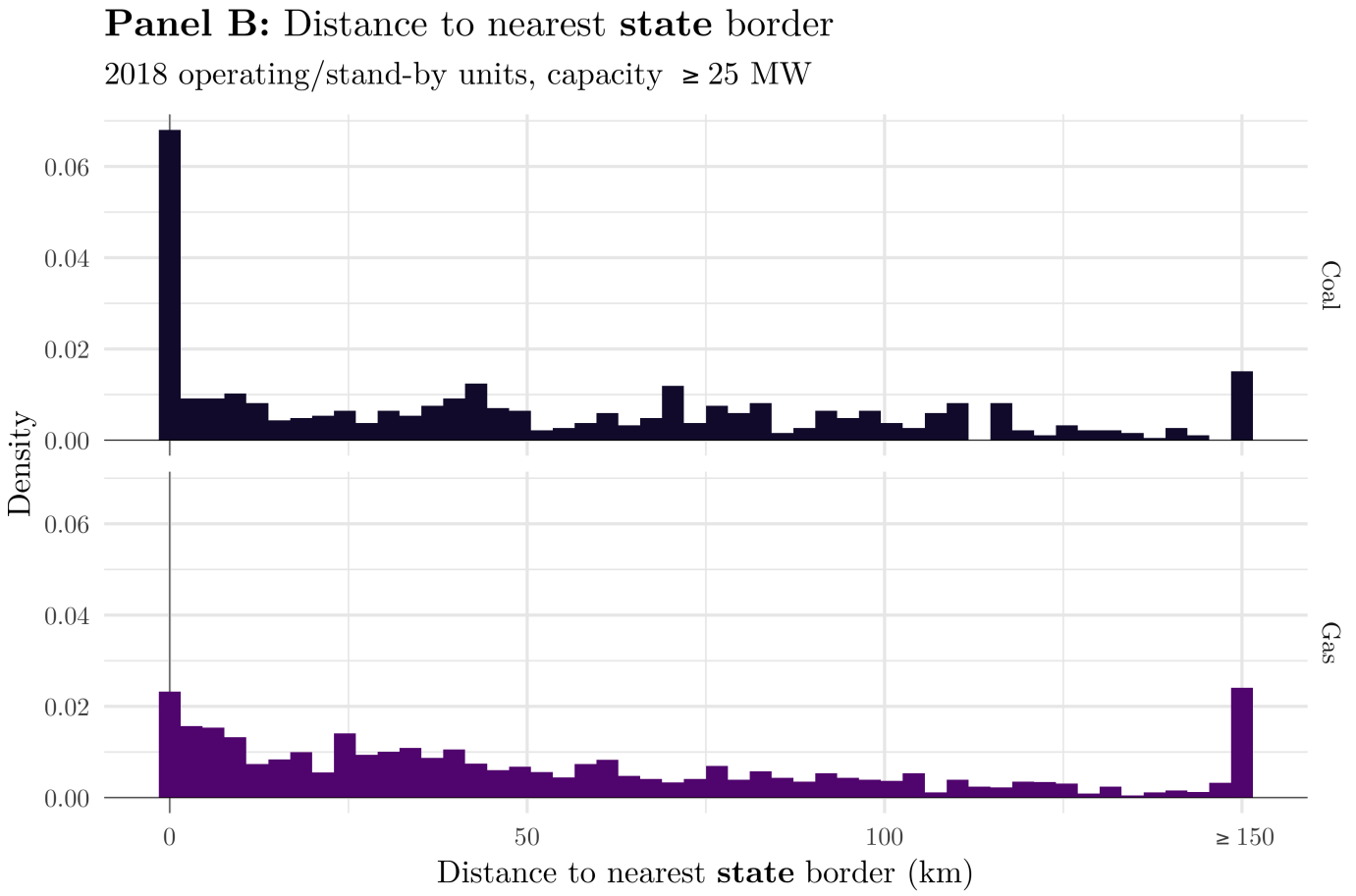


Distances to State Borders



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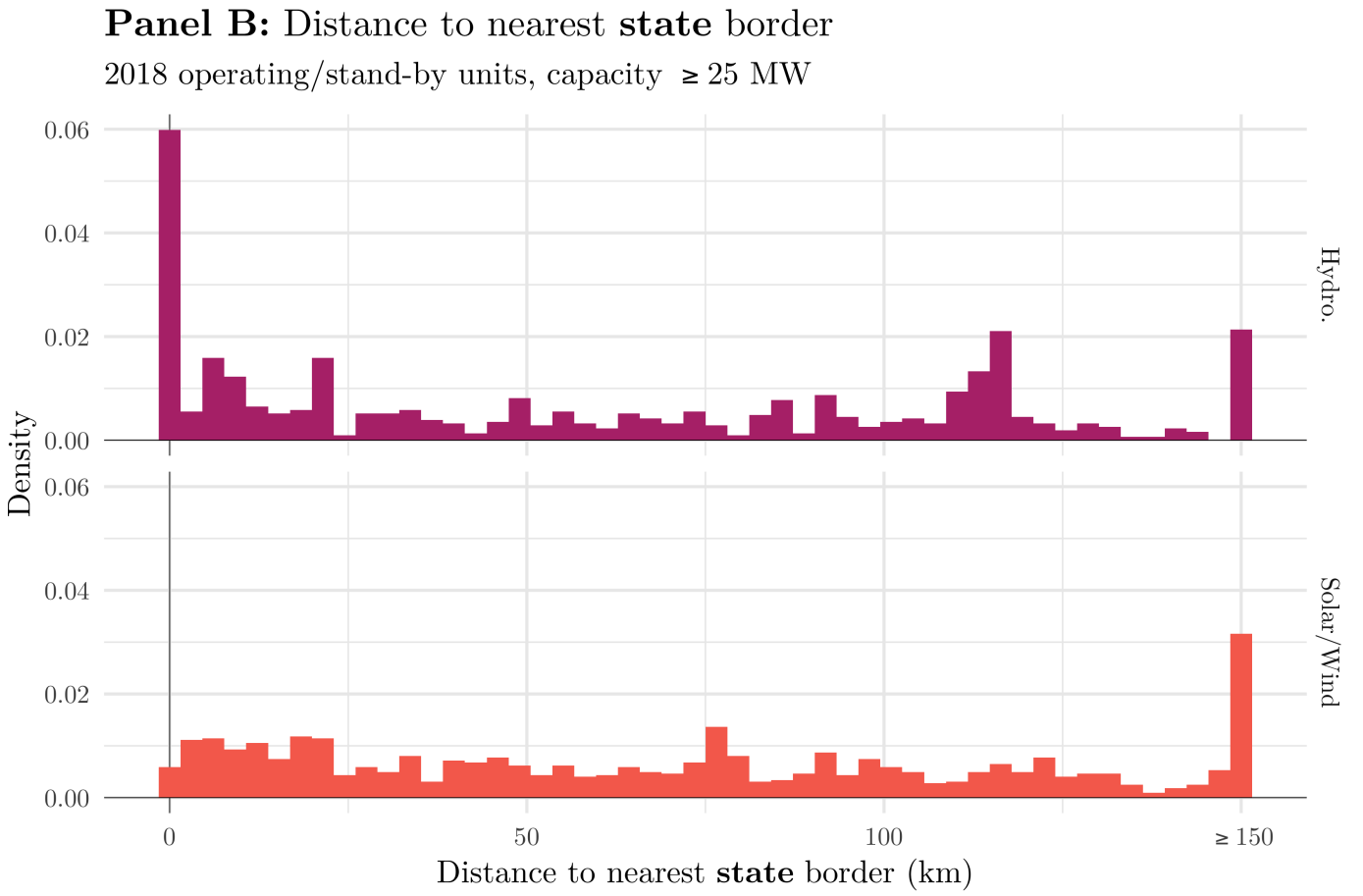
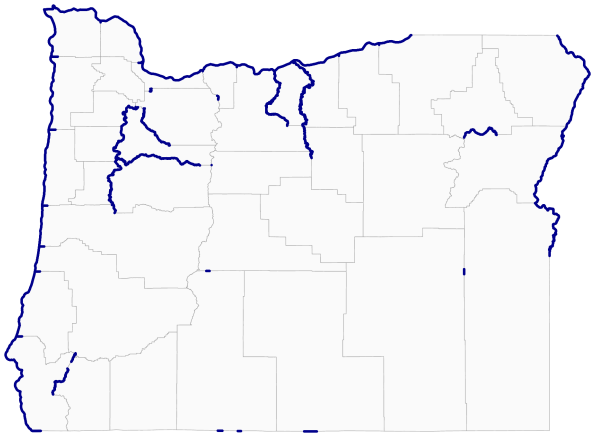
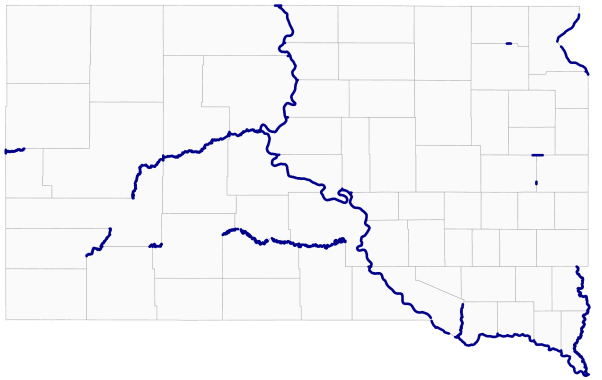
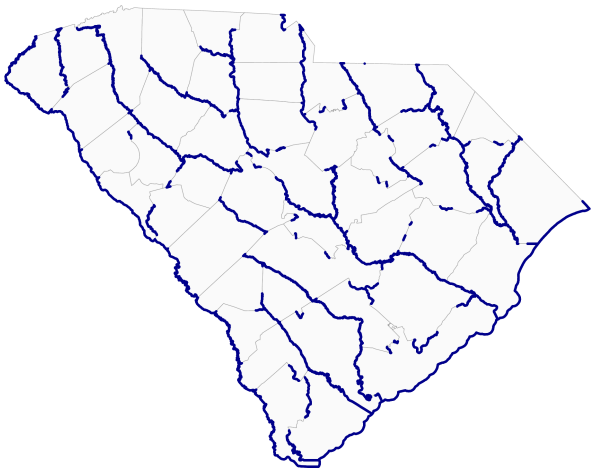


Water Borders: Example







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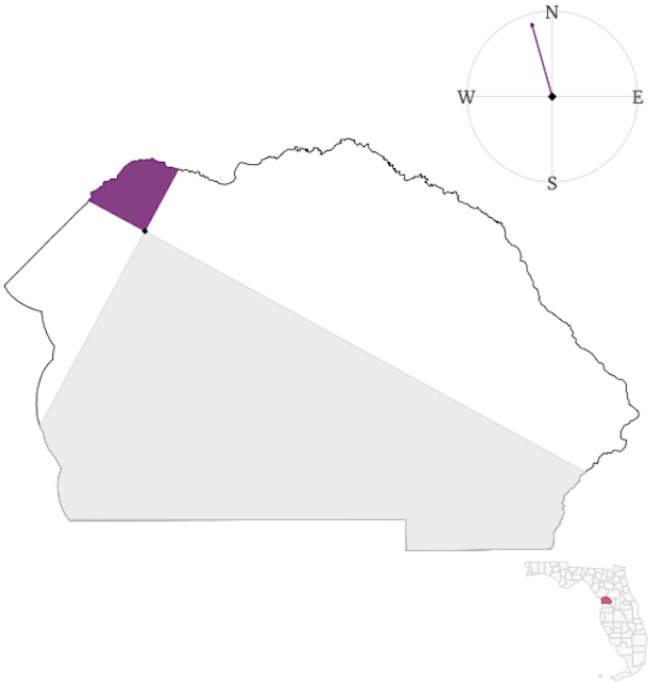
Main Idea: In the absence of regulatory avoidance, it should be a 50-50 flip whether the county's area downwind of the plant (in the EGU's county of residence) is larger or smaller than the area upwind.

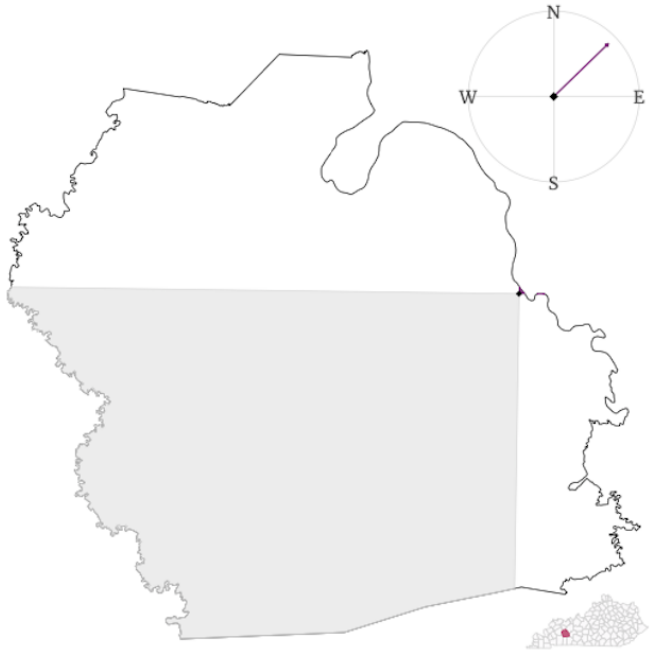
- **Focus**: coal. Strongest incentive to avoid regulation.
- **Placebo**: natural gas. Less incentive to avoid regulation.

Downwind vs. Upwind Area

(a) Plant 628



(b) Plant 1378



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− Major drawback: cannot capture more nuanced strategy

Strategic Siting: Main Results

	Coal-fueled plants			Natural-gas-fueled plants		
	(1) **All**	(2) Post-CAA	(3) Pre-CAA	(4) **All**	(5) Post-CAA	(6) Pre-CAA
Panel a: Siting strategically within **county**						
Count	515	286	229	1,258	995	263
Count *strategic*	297	165	132	612	482	130
Percent *strategic*	57.67%	57.69%	57.64%	48.65%	48.44%	49.43%
Fisher's exact test of H_o: In-**county** downwind area ≥ upwind area						
Under H_o: E[Percent strategic: County] = 50%						
P-value	0.0003	0.0054	0.0122	0.8381	0.8448	0.5974

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Panel b: Siting strategically within **state**						
Count	515	286	229	1,258	995	263
Count *strategic*	279	152	127	575	466	109
Percent *strategic*	54.17%	53.15%	55.46%	45.71%	46.83%	41.44%
Fisher's exact test of H_o: In-**county** downwind area ≥ upwind area						
Under H_o: E[Percent strategic: State] = 50%						
P-value	0.0321	0.1574	0.0563	0.9989	0.9788	0.9978

The Geography of US Coal Emissions

Overview

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- Atmospheric dispersion model. Heavily vetted by NOAA.
- Performs better than many other models (such as InMAP) for *long-distance* pollution transport modeling.
- Coal-based particles will travel much further than other sources of PM.

Hysplit: Goals

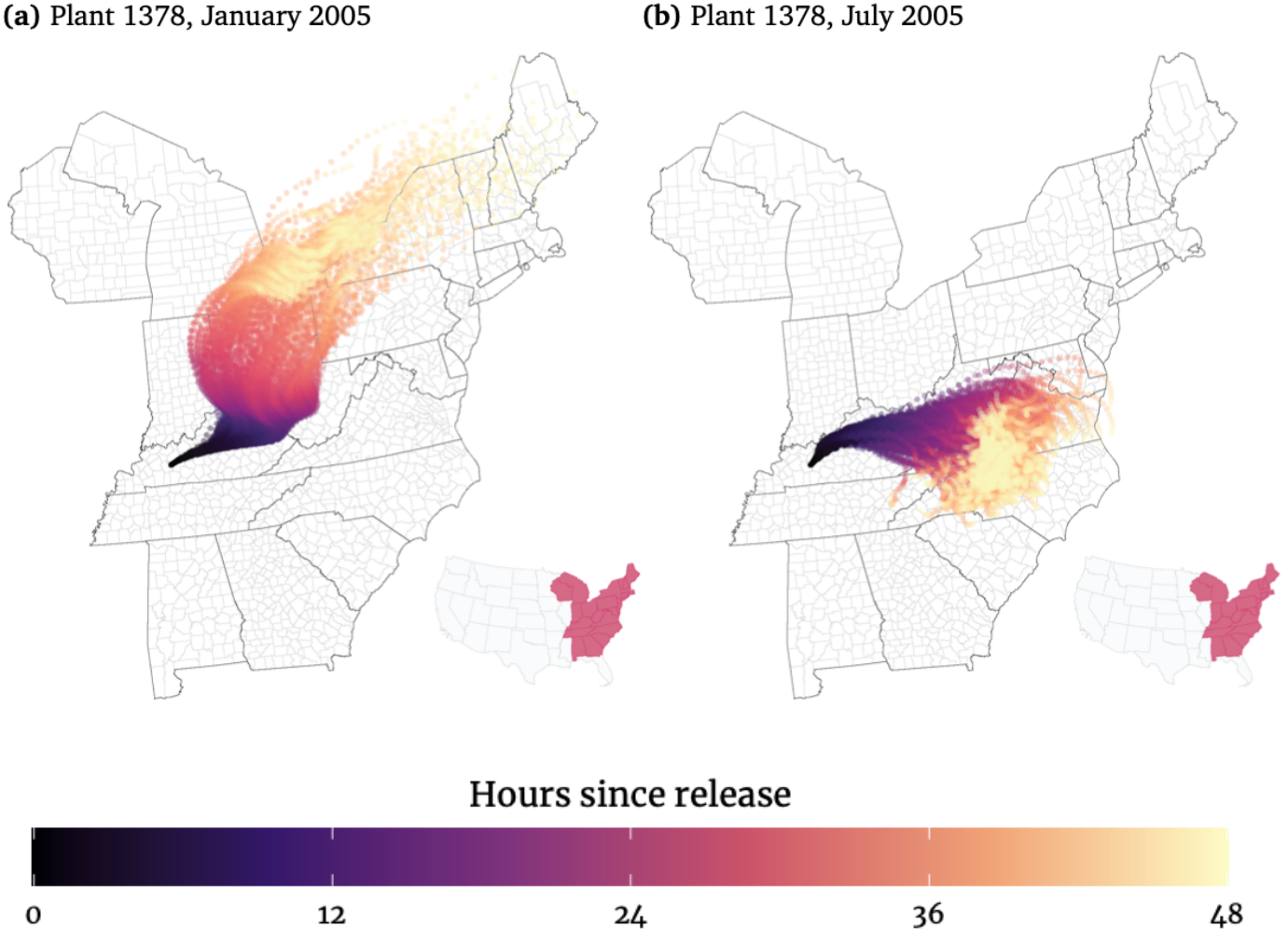
We do the following:

1) Quantify how quickly coal-based particles leave their own county and state (it's fast).

2) Quantify the proportion of coal-based emissions that are from other counties/states in any given county/state.

3) Illustrate the implications of 1) and 2) with case studies.

Example Plants



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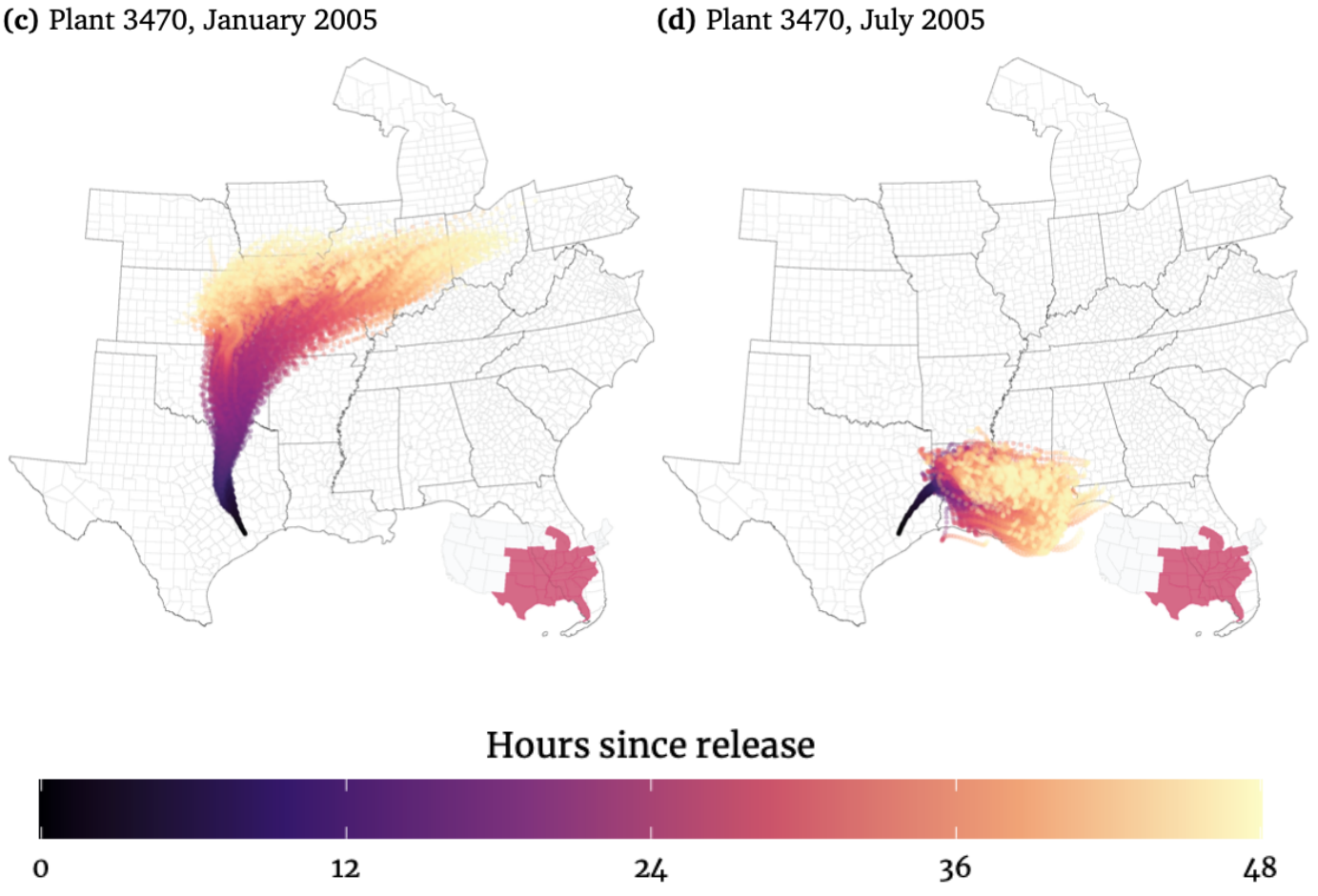
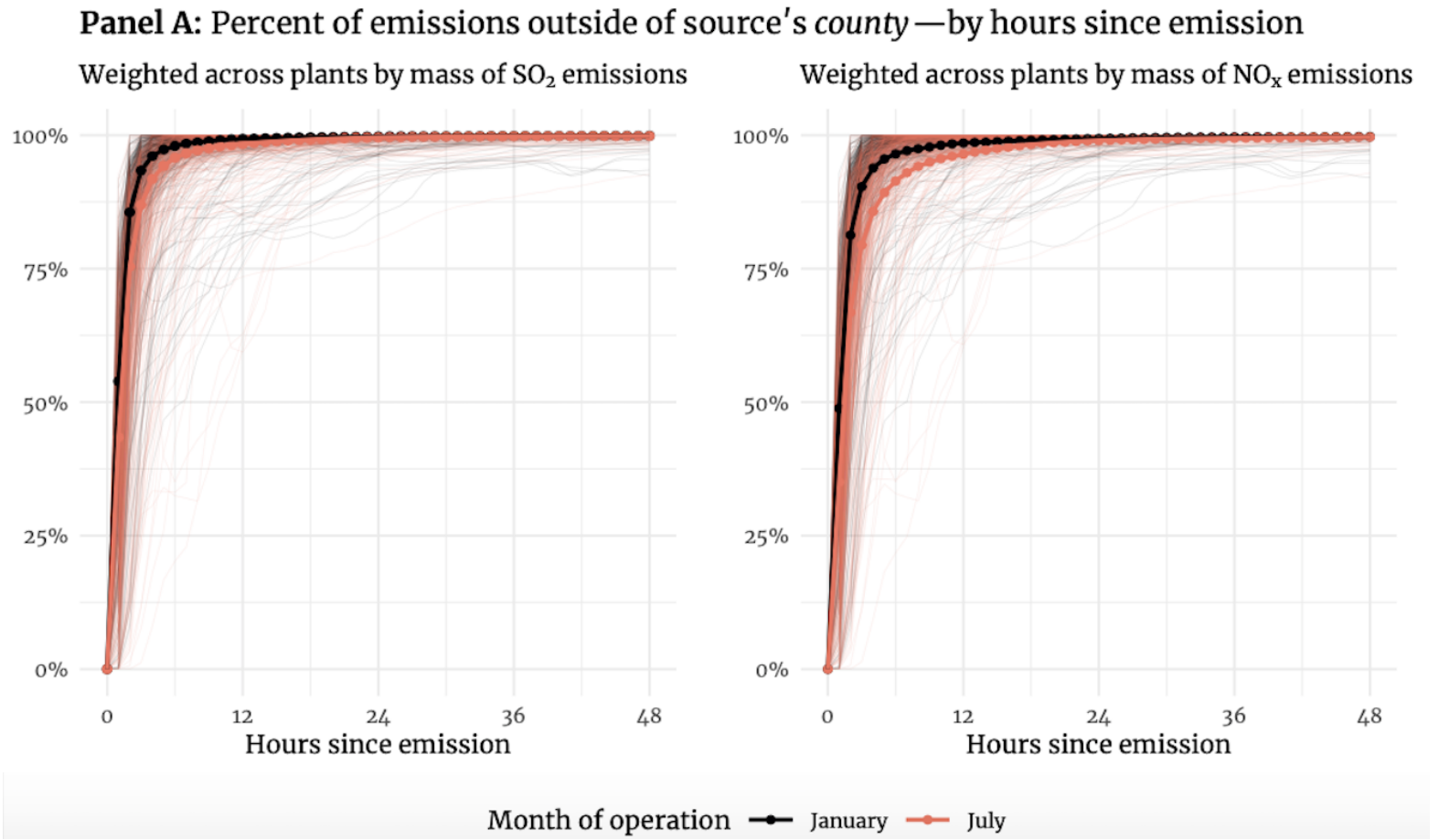


Emissions Transport: Speed



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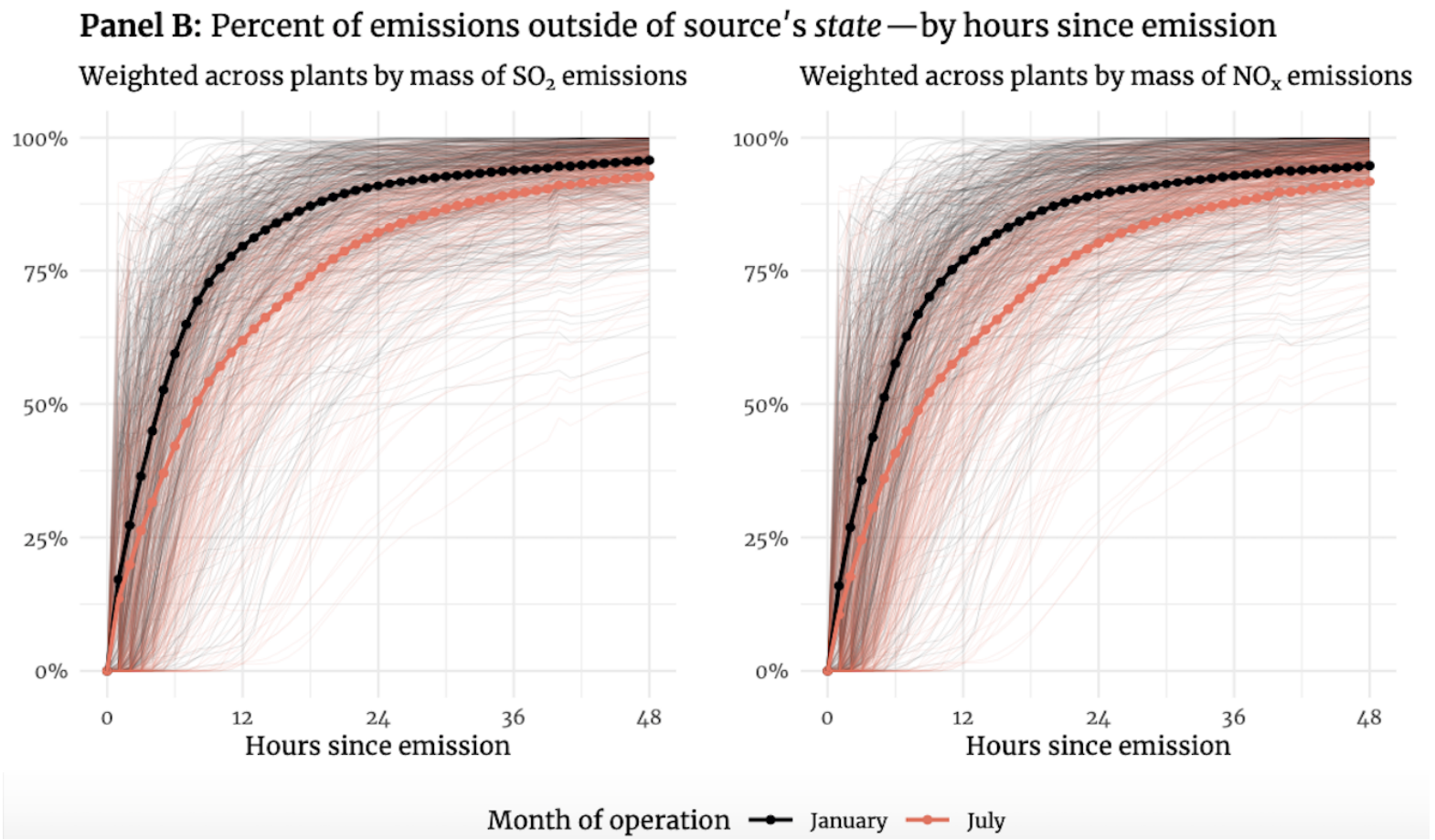
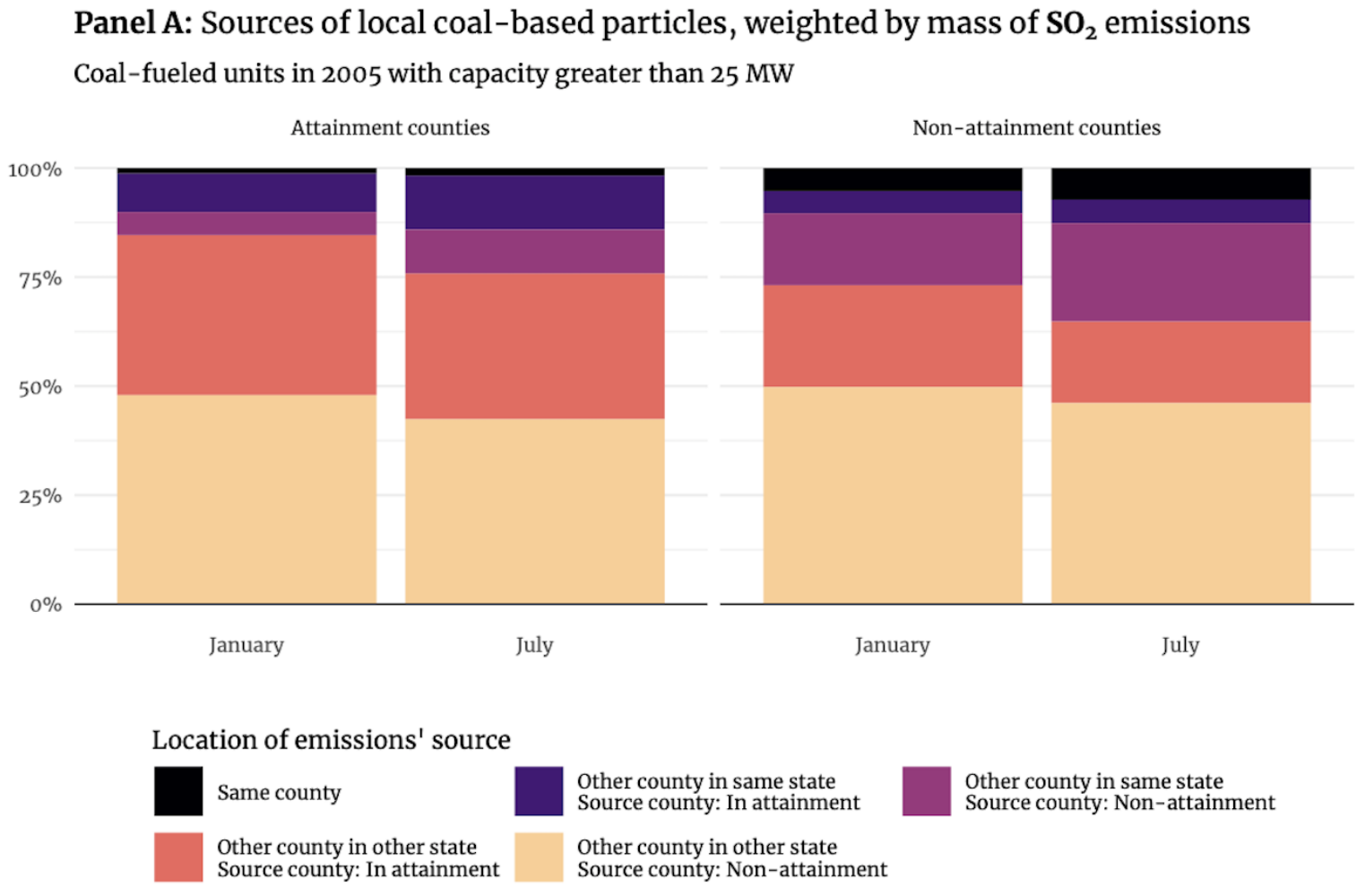


Emissions Transport: Shares



Discussion

What did we do?

Main contributions:

- Descriptive results on the geography of physical power plants *and* their emissions.
    - Causal evidence of coal plants strategically locating to minimize downwind area.
- Clean Air Act did not seem to impact strategic siting.
- Descriptive results on pervasiveness of pollution transport problem from coal powered plants.

Thank you!

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