Question C4:

What are the particular challenges to representing regulations that are not directly implemented through price in an economy-wide framework? Under what circumstances is it particularly challenging to accurately represent in these models versus alternative modeling frameworks?

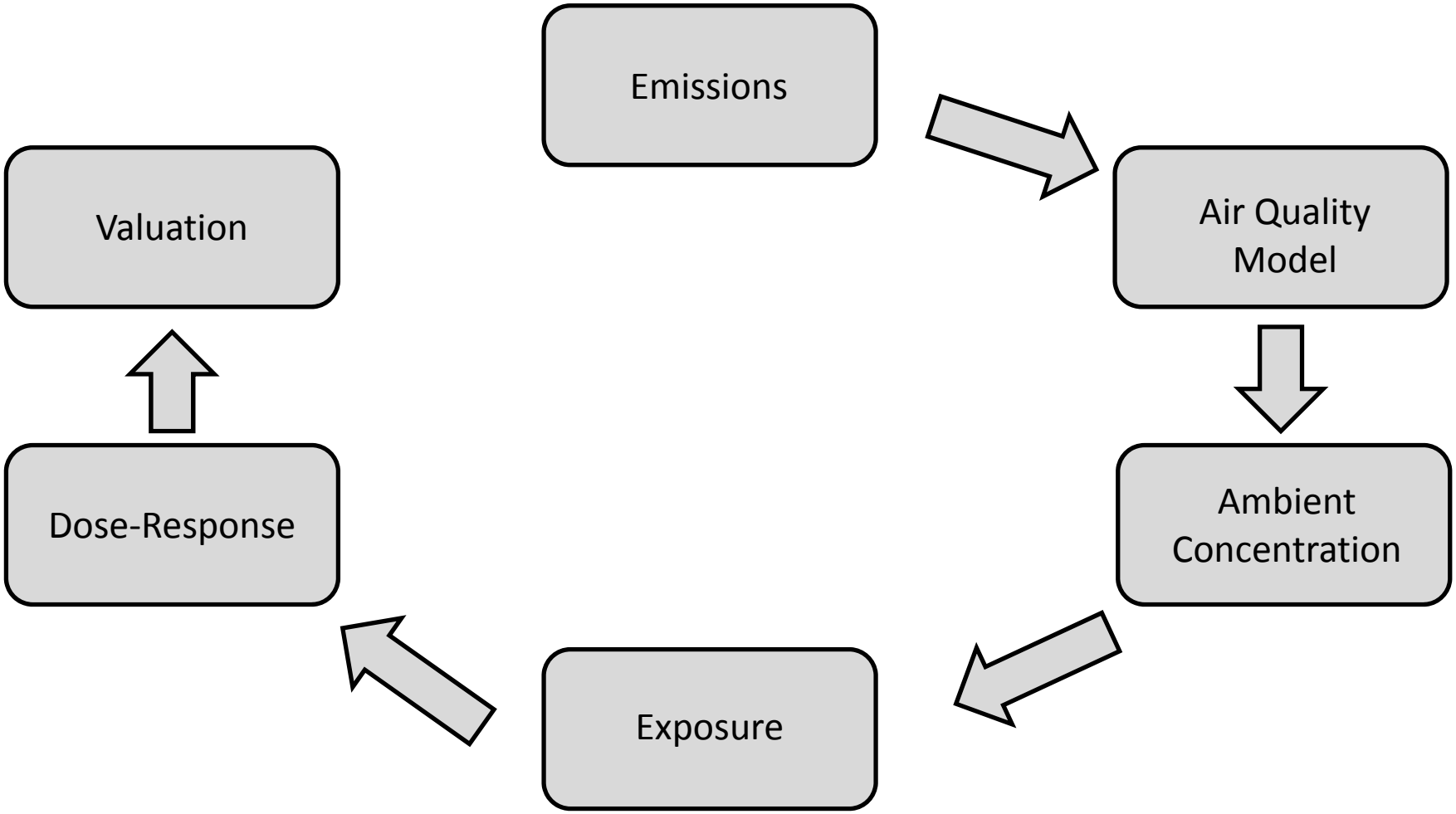
- The more spatially, sectorally, and/or temporally detailed the regulation is, the more challenging it is to represent in a modeling framework
  - E.g., standards determined at the national level, but implementation at the state or air basin level.
- Models that assume least-cost compliance strategies do not typically account for real-world rigidities.
  - Decision-making by regulated entities rarely strictly follows the economic model of cost-minimization.
- Technology-based or performance-based standards could led to market power issues that will be difficult to represent in models.
  - E.g., standards that have only one qualifying technology.

Question B1:

Conceptual and technical hurdles to representing the benefits of an air regulation in a general equilibrium framework? What would be required to overcome them?

- My perspective: Integrated Assessment.

Integrated Assessment Model



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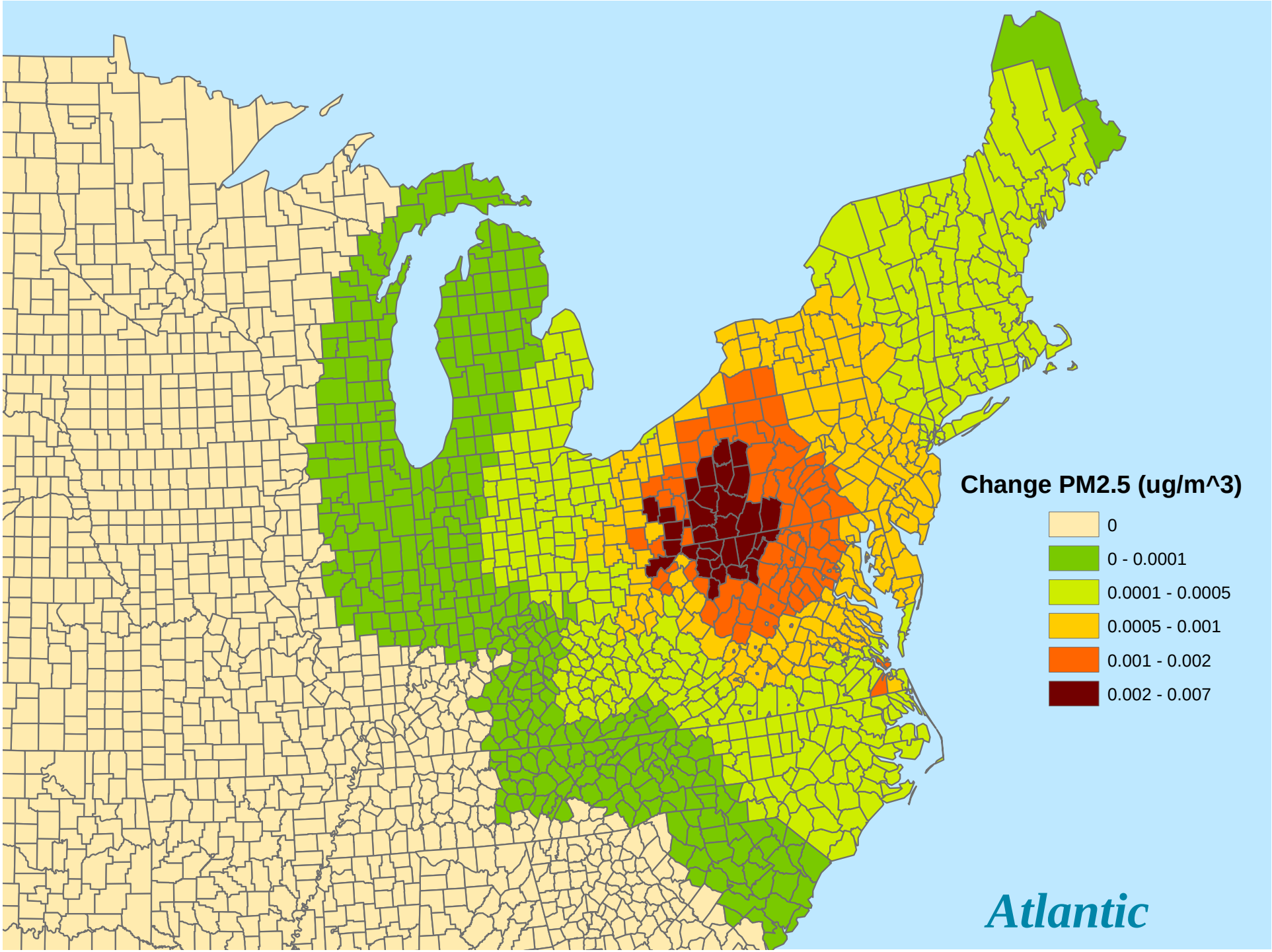
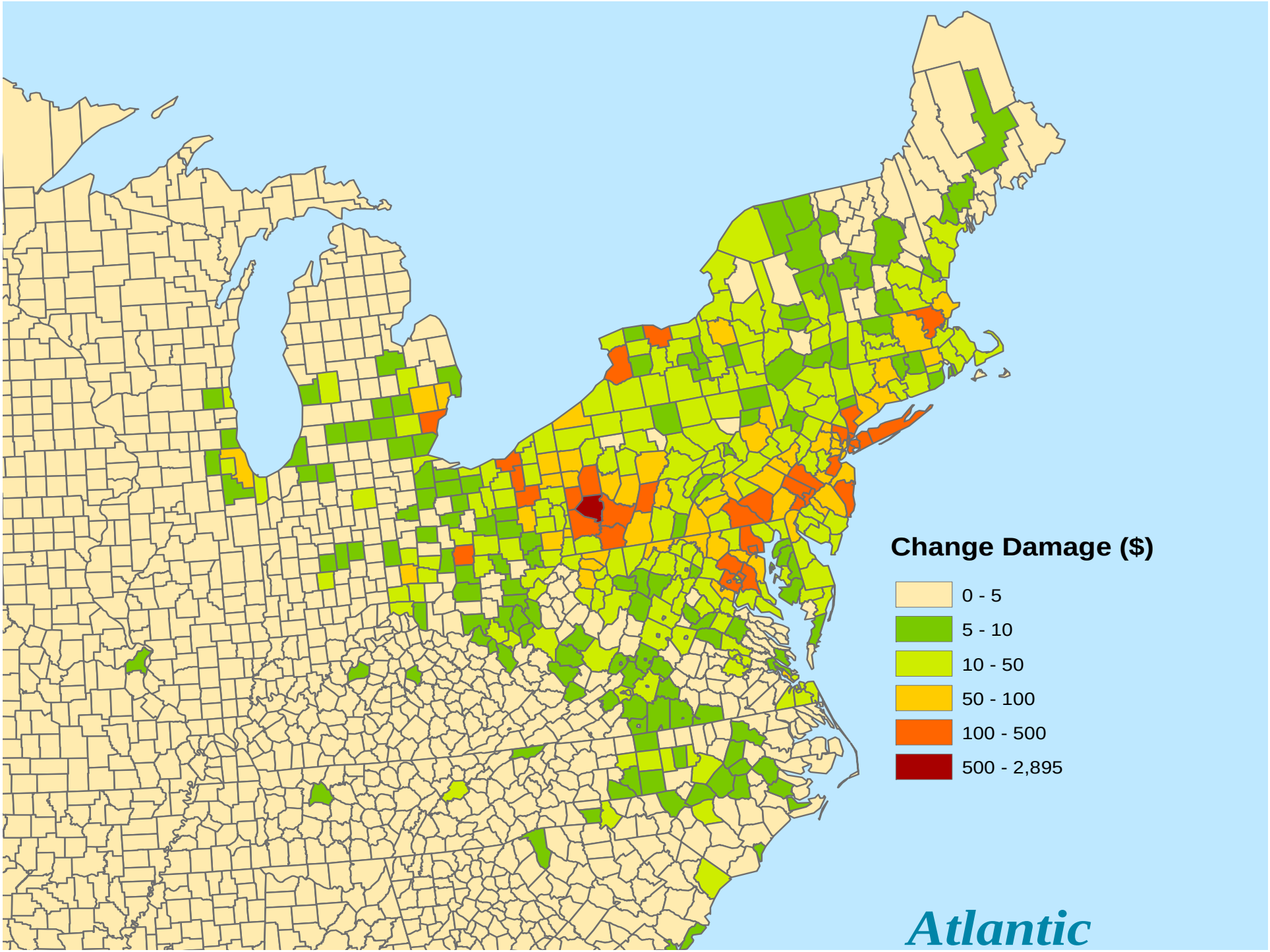
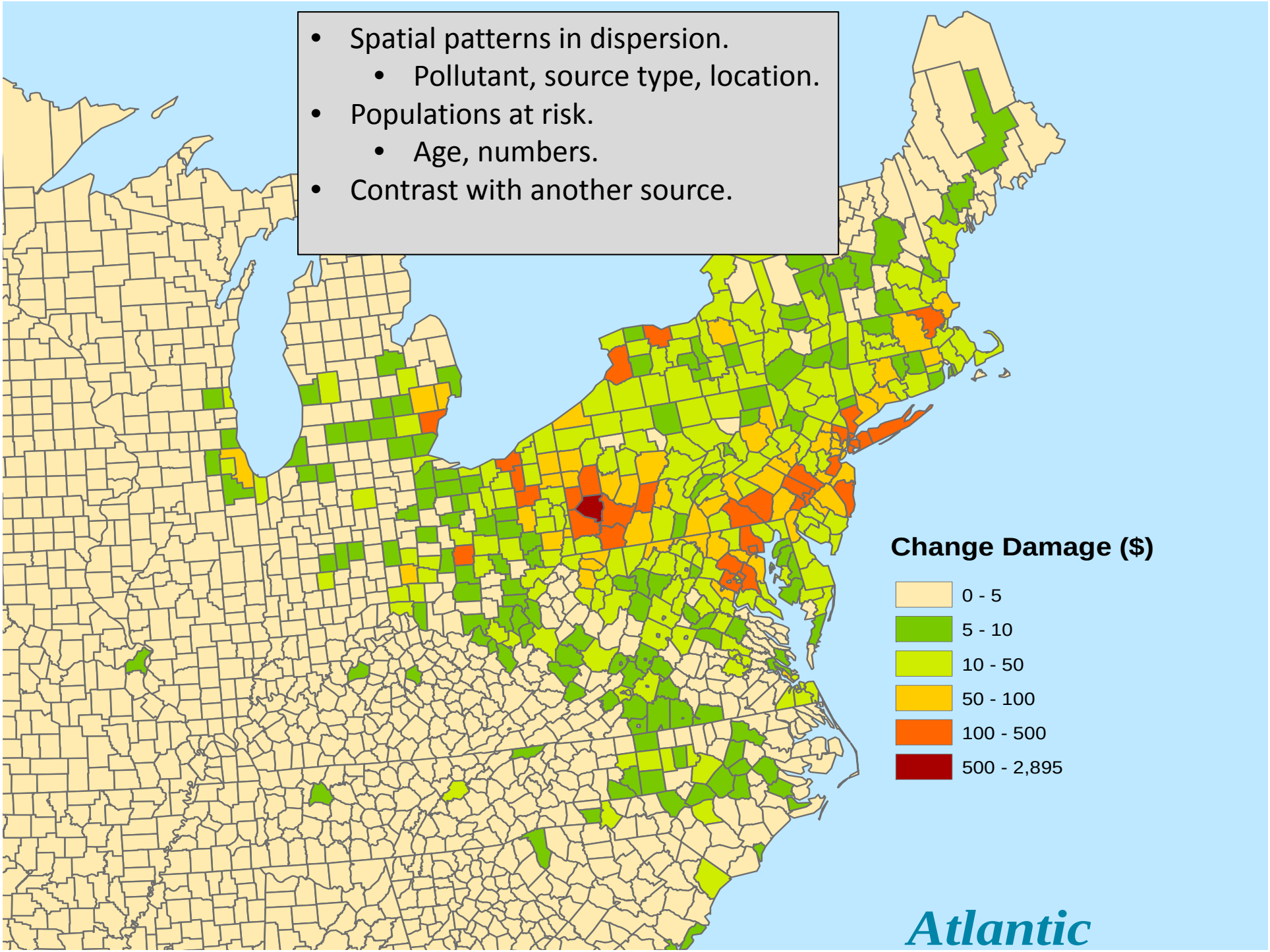
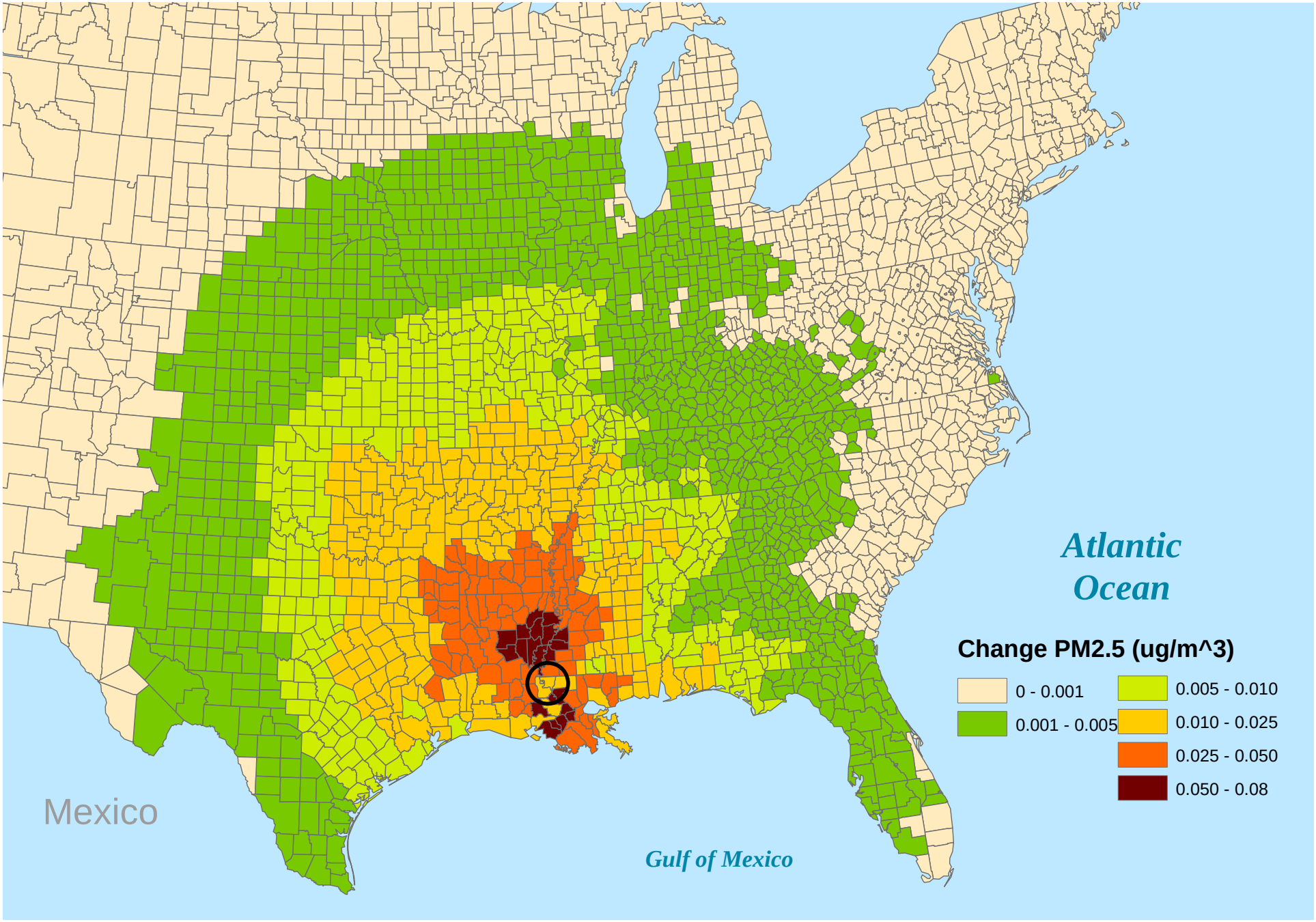
  - Why?

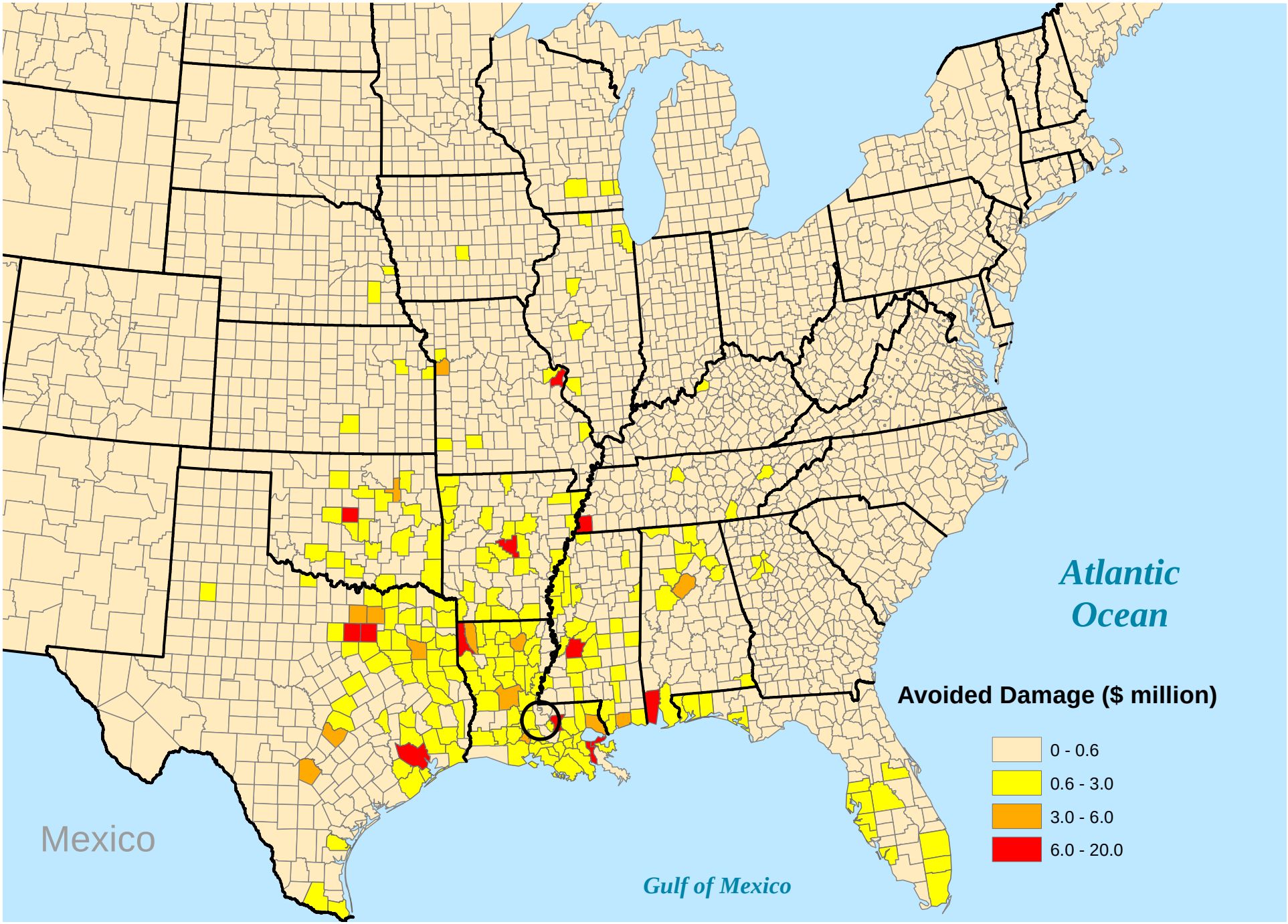

Change PM2.5 (ug/m^3)
0
0 - 0.0001
0.0001 - 0.0005
0.0005 - 0.001
0.001 - 0.002
0.002 - 0.007
Atlantic


Change Damage ($)
0 - 5
5 - 10
10 - 50
50 - 100
100 - 500
500 - 2,895
Atlantic

- Spatial patterns in dispersion.
  - Pollutant, source type, location.
- Populations at risk.
  - Age, numbers.
- Contrast with another source.




Atlantic Ocean
Change PM2.5 (ug/m^3)
0 - 0.001
0.001 - 0.005
0.005 - 0.010
0.010 - 0.025
0.025 - 0.050
0.050 - 0.08
Mexico
Gulf of Mexico


Atlantic Ocean
Avoided Damage ($ million)
0 - 0.6
0.6 - 3.0
3.0 - 6.0
6.0 - 20.0
Mexico
Gulf of Mexico

Question B1:

Conceptual and technical hurdles to representing the benefits of an air regulation in a general equilibrium framework? What would be required to overcome them?

- Modeling firm response to policy.
- Spatial heterogeneity.
  - Emission responses and dispersion.

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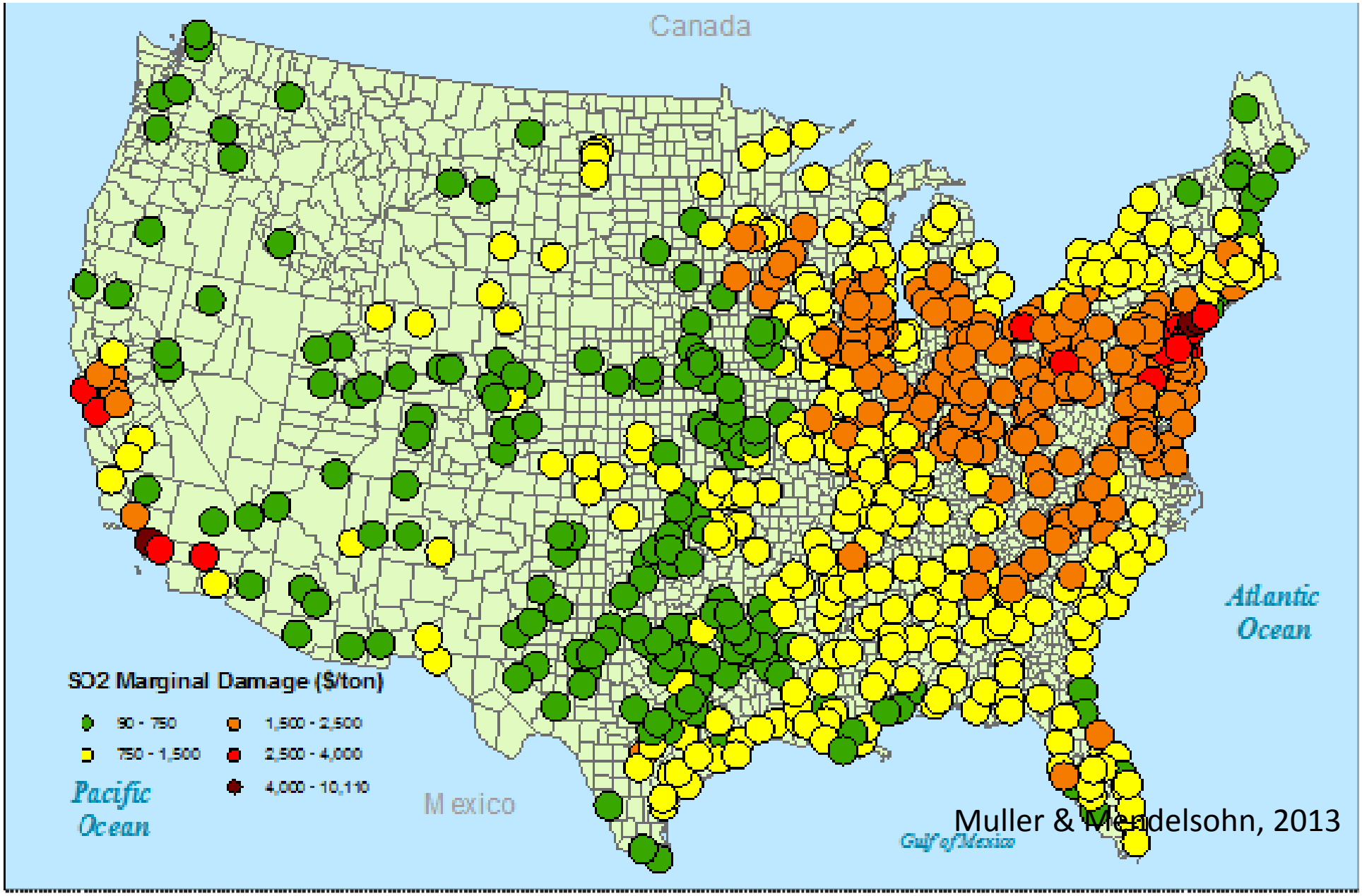
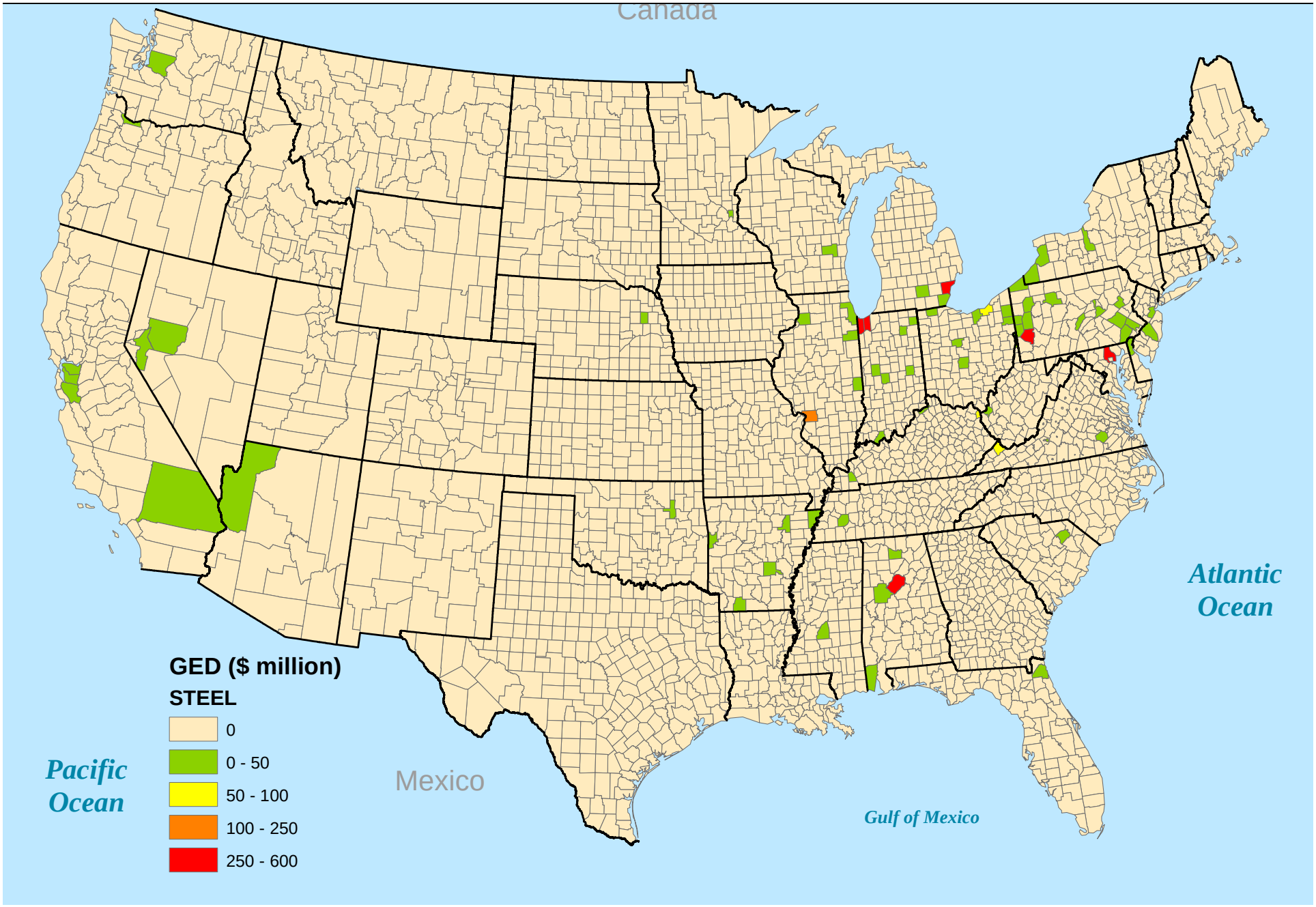
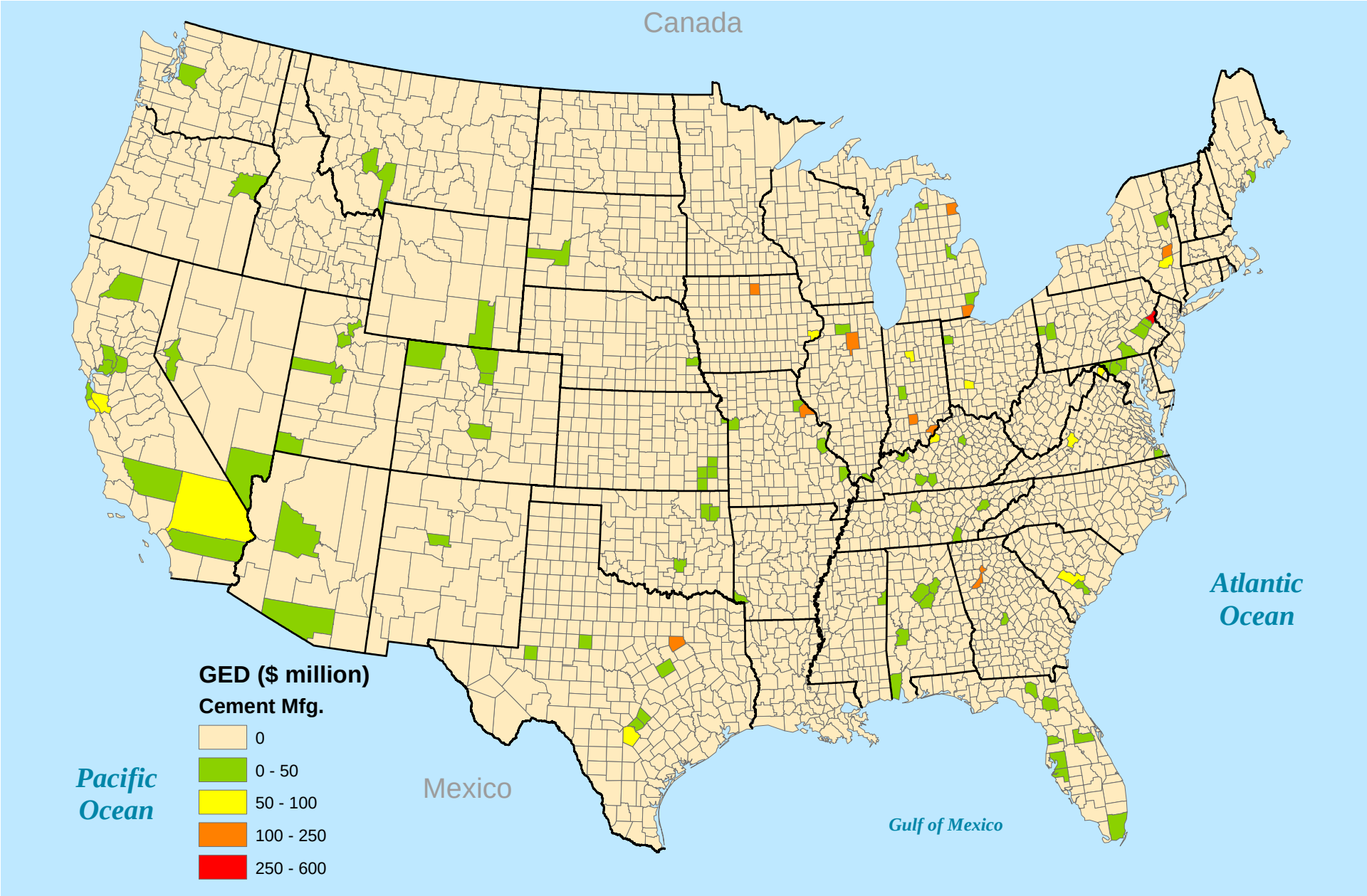
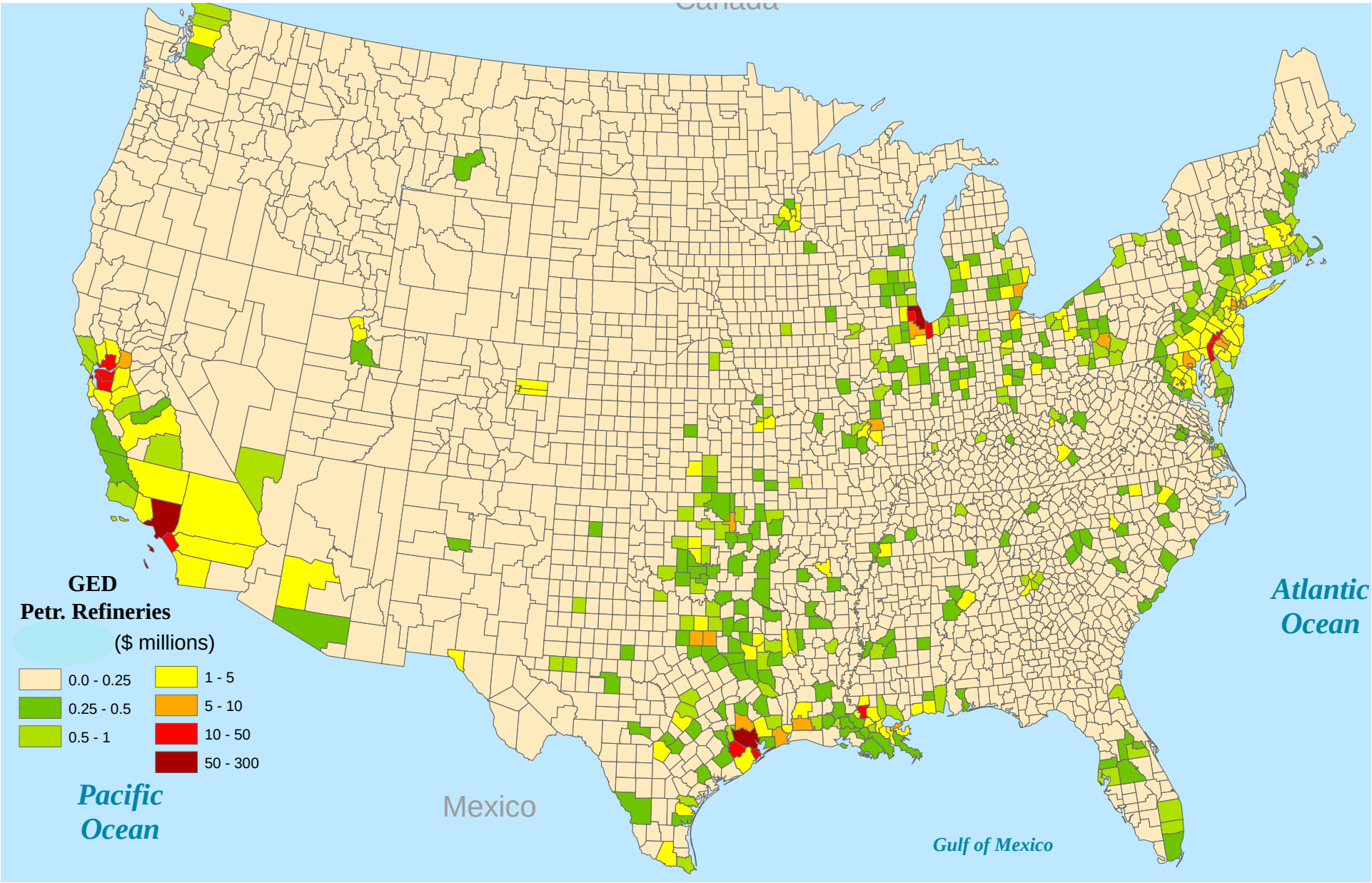
  - Demographics among exposed populations.
  - Location of major sources within and across industries.



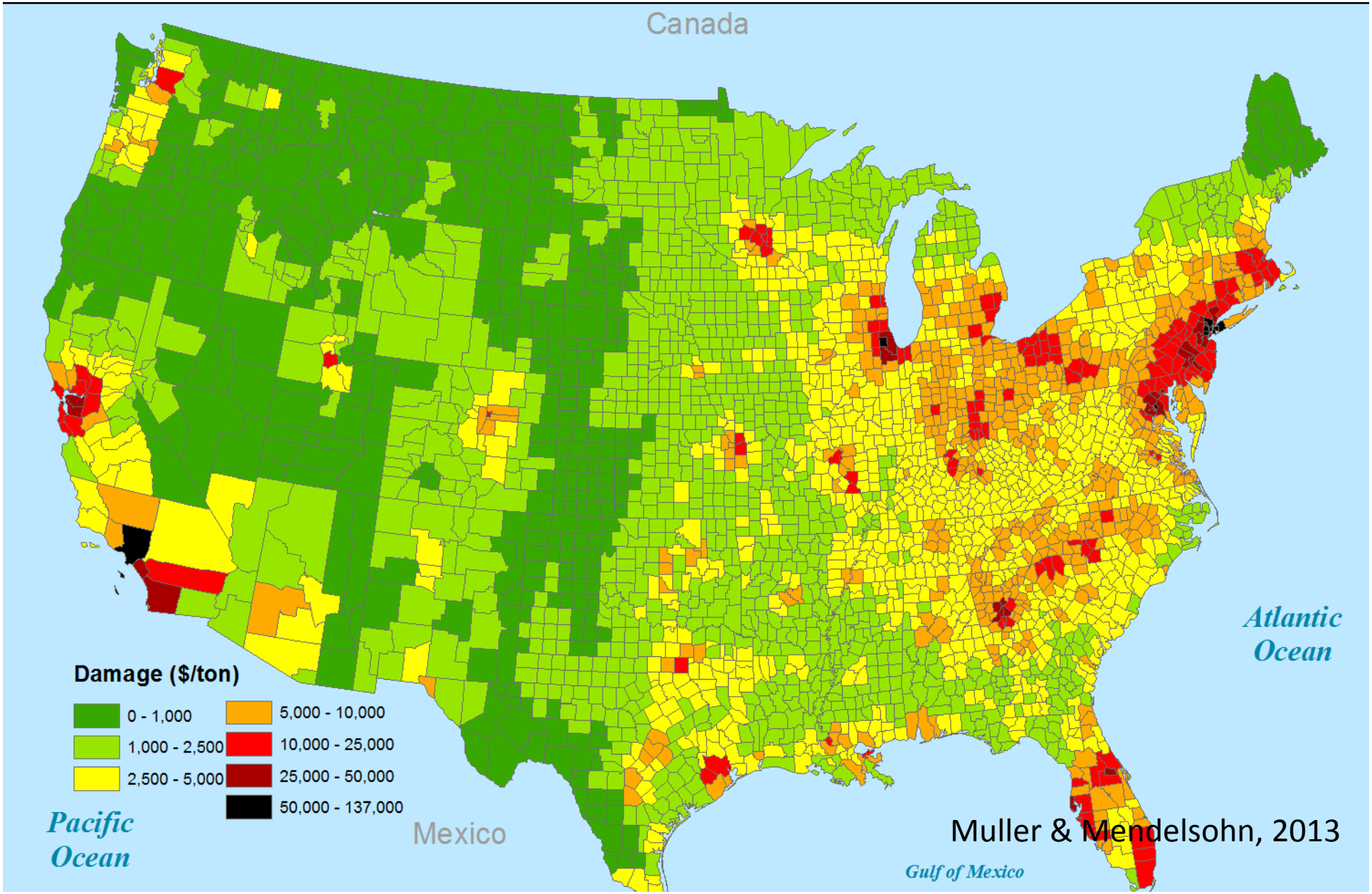
Muller & Mendelsohn, 2013


Canada
Mexico
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
GED ($ million)
STEEL
0
0 - 50
50 - 100
100 - 250
250 - 600


Canada
Mexico
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
GED ($ million)
Cement Mfg.
0
0 - 50
50 - 100
100 - 250
250 - 600


Canada
GED
Petr. Refineries
($ millions)
0.0 - 0.25
0.25 - 0.5
0.5 - 1
1 - 5
5 - 10
10 - 50
50 - 300
Pacific Ocean
Mexico
Gulf of Mexico
Atlantic Ocean

$PM_{2.5}$ Damage/ton by County of Emission



Muller & Mendelsohn, 2013

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- Valuation: WTP vs. Time endowment.

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- Valuation: WTP vs. Time endowment.
- Accounting for adaptive responses to changes in air quality.
  - Migration, exposure modification.
  - Again, spatial component.

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- Possible biases in underlying risk estimates.
  - Not unique to CGE.
  - Identify biases, characterize uncertainty, allow model choice.
  - How does this common hurdle relate to CGE?
    - Need for sensitivity speaks to model parsimony.

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Conceptual and technical hurdles to representing the benefits of an air regulation in a general equilibrium framework? What would be required to overcome them?

- Couple CGE with downstream benefits model.
- BENMAP won't work alone.
  - Emissions $\longrightarrow$ concentrations.
- Spatially-defined: regional.
- Industry-defined.
- Spatial/regional.

Question B7:

Can CGE models capture effects of increased income from reduced medical expenditures and changes in preferences resulting from reduced air pollution, as contemplated in the 2011 Section 812 Report?

- Price signal issues.
  - Relevant price signals are confounded by secular changes in technology, delivery systems and expectations. How to control?
  - Dominance of 3rd-party payment regimes (and now ACA) results in weak price signals. How to control?
  - Are relevant income effects distinguishable from noise?
- Preference change issues.
  - Relevant preference changes are confounded by secular preference changes due to temporal, cultural and technological factors, which have to be controlled.
- 2011 Sec. 812 Report.
  - Much more intensive review is required.