

Adapting national scale critical loads for lichens, trees, and herbaceous plants to local management of federal lands

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Critical Loads of Atmospheric Deposition (CLAD)

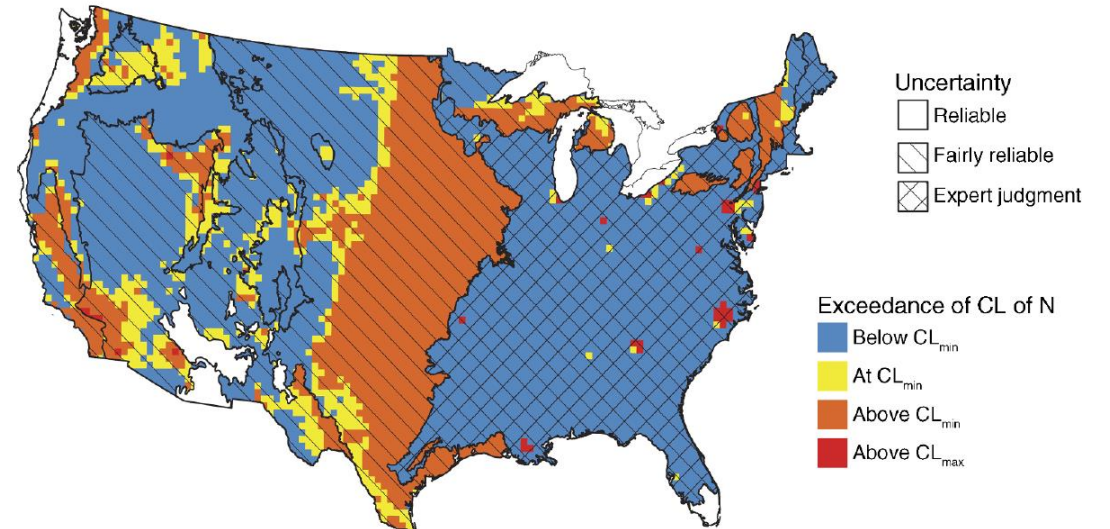
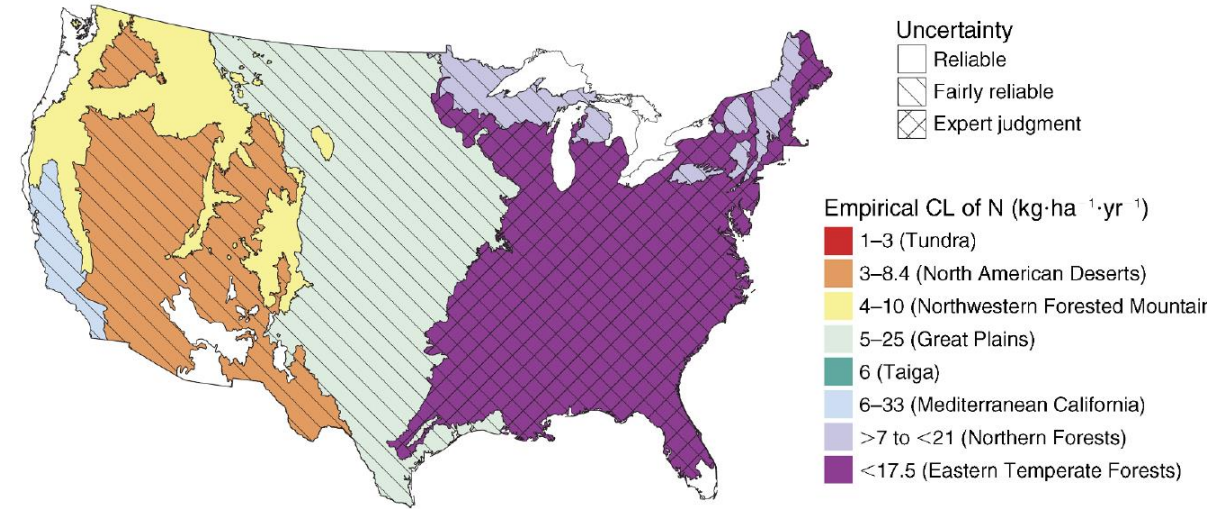


National Atmospheric
Deposition Program

- A science committee of the National Atmospheric Deposition Program
- Facilitate technical information sharing on critical loads topics within a broad multi-agency/entity audience;
- Fill gaps and provide consistency in critical loads development in the US;
- Promote understanding of critical loads approaches through development of outreach and communications materials.

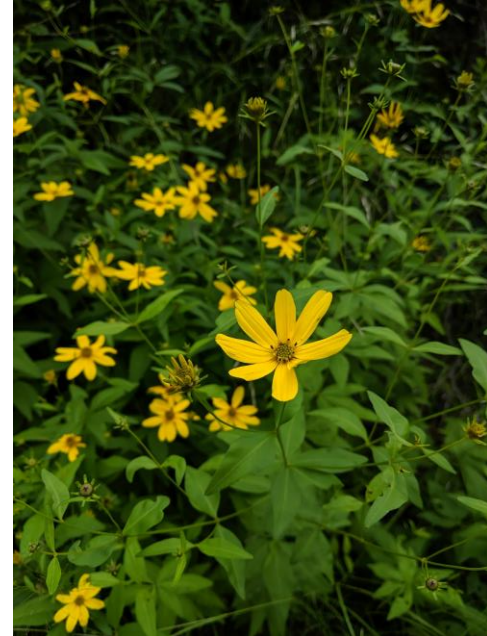
Initial US Terrestrial Critical Loads

- Most based at ecoregion or local level (Pardo et al. 2011).
- Synthesized species and community responses.
- Included local research where available.



New Critical Load data

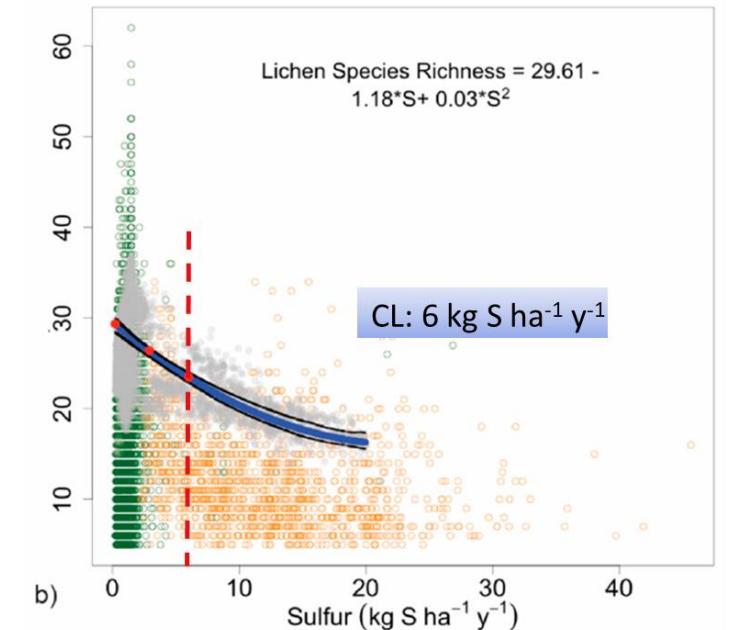
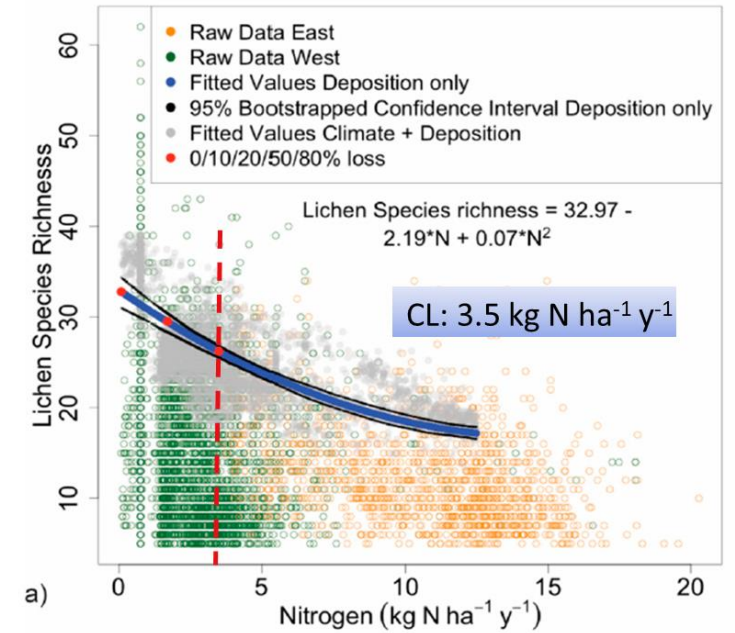
- Lichen community response
 - Decrease in species richness within increased N and S
- 71 forest tree species
 - Growth and survival response to N and S
- 348 Herbaceous species
 - Probability of occurrence with increasing N and S



Lichen Species Richness CLs

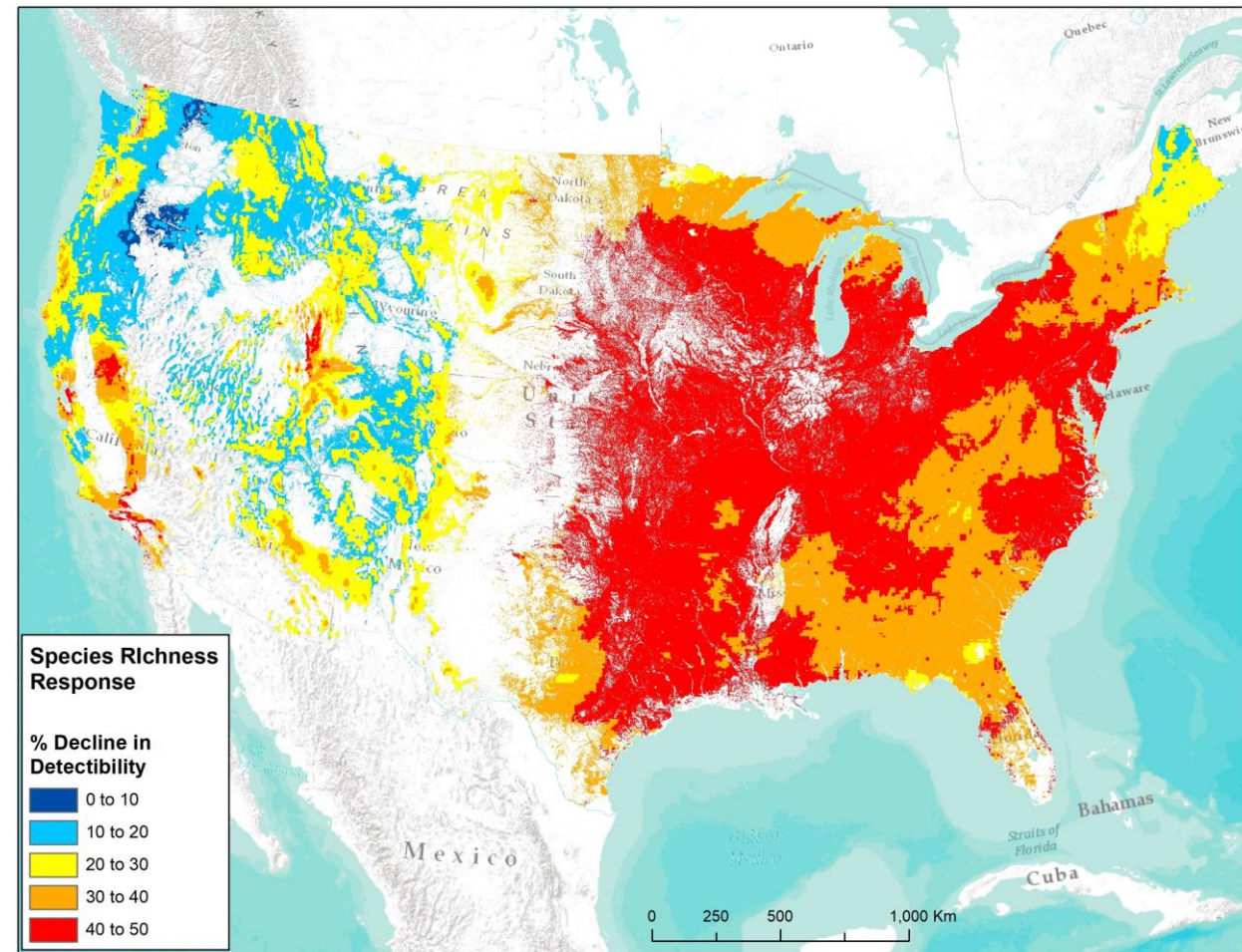
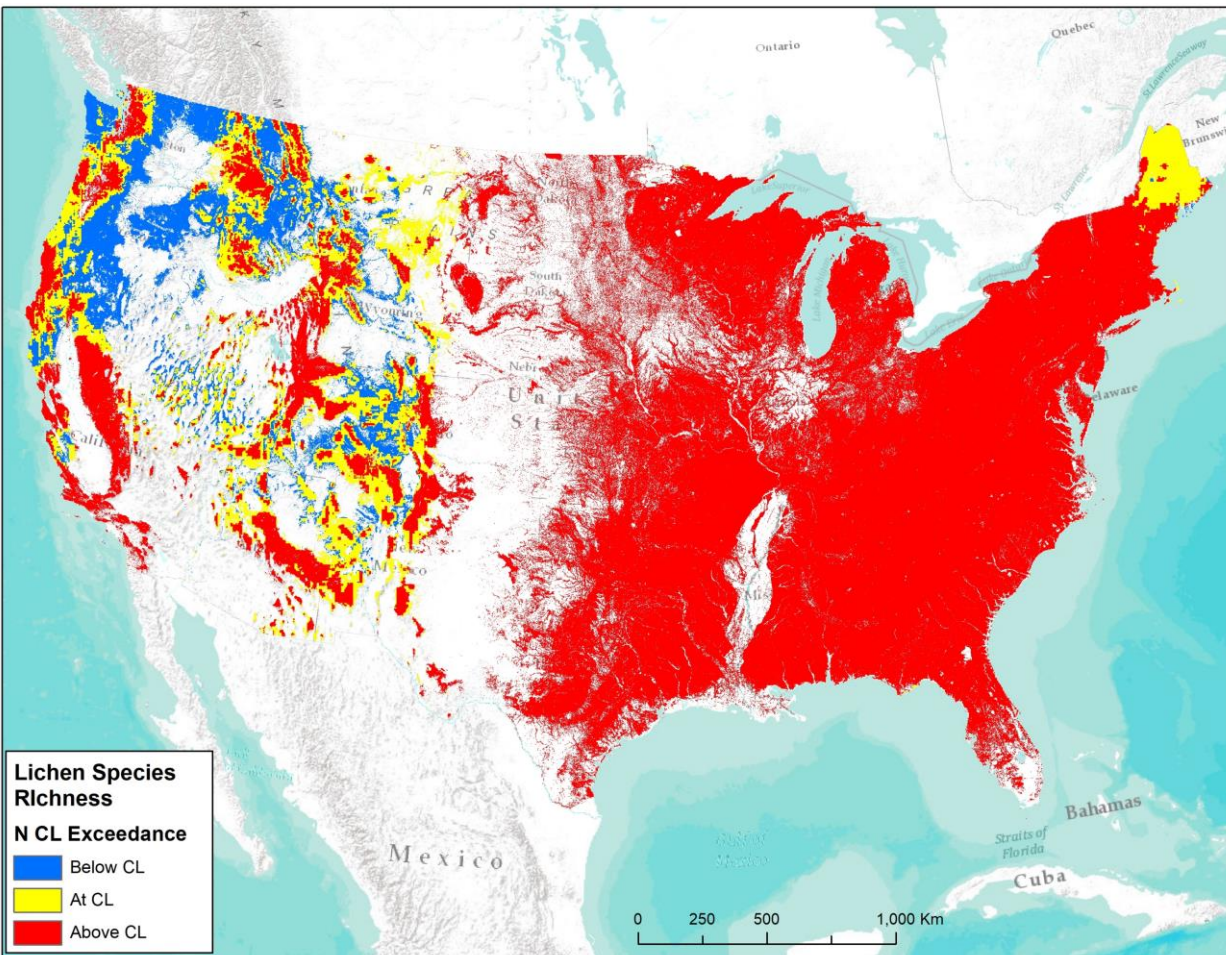
Geiser et al. 2019. *Assessing Ecological Risks from Atmospheric Deposition of Nitrogen and Sulfur to US Forests Using Epiphytic Macrolichens.*

- Used 8,855 data points to assess change in community structure with change in modeled N and S deposition.
- CLs for Total Species Richness, cyanolichen, forage lichen, and oligotrophic lichen



Extrapolating response curve to forested area

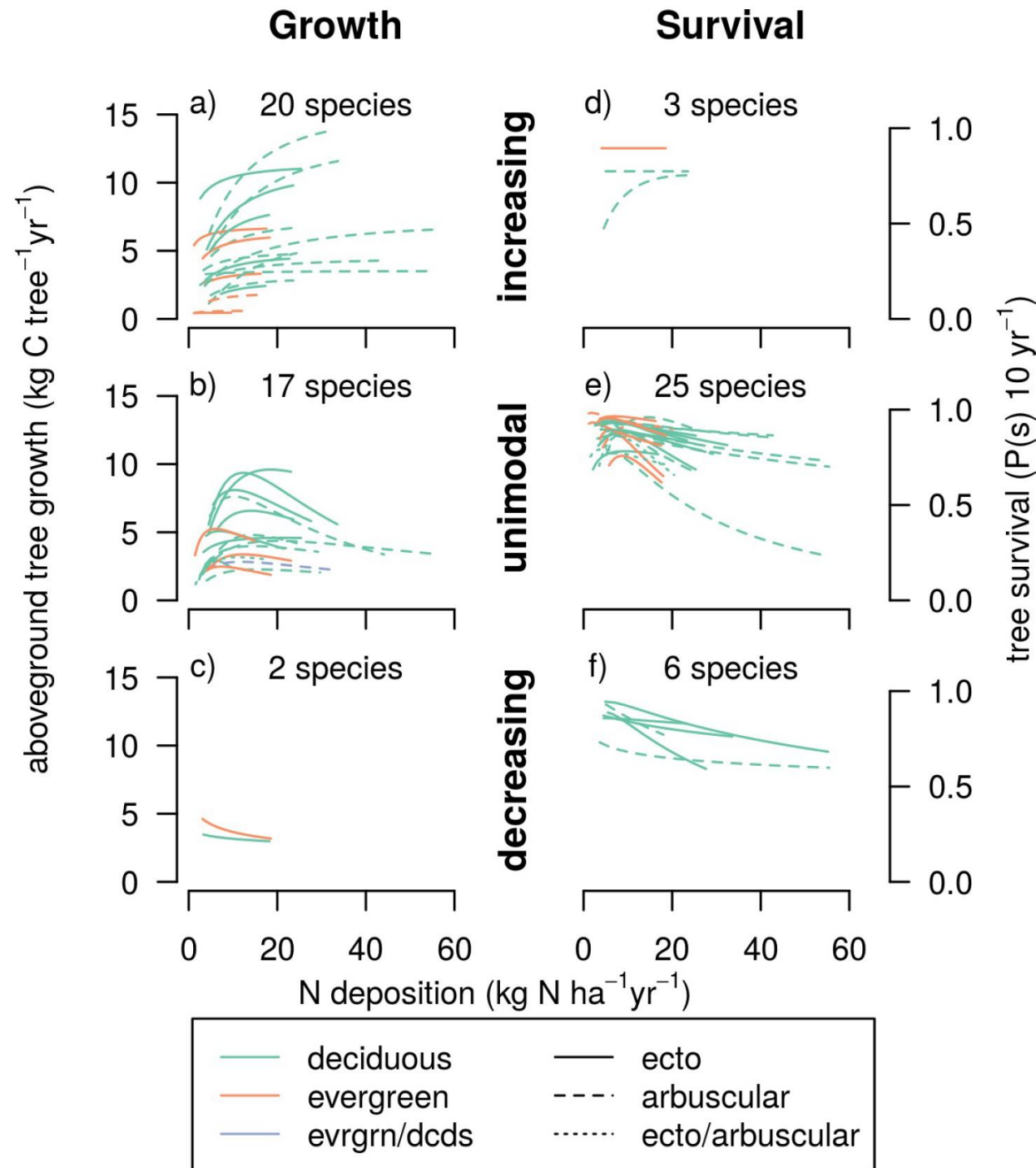
- Analysis based on TDep Total N deposition 2015-2017



Tree species critical loads

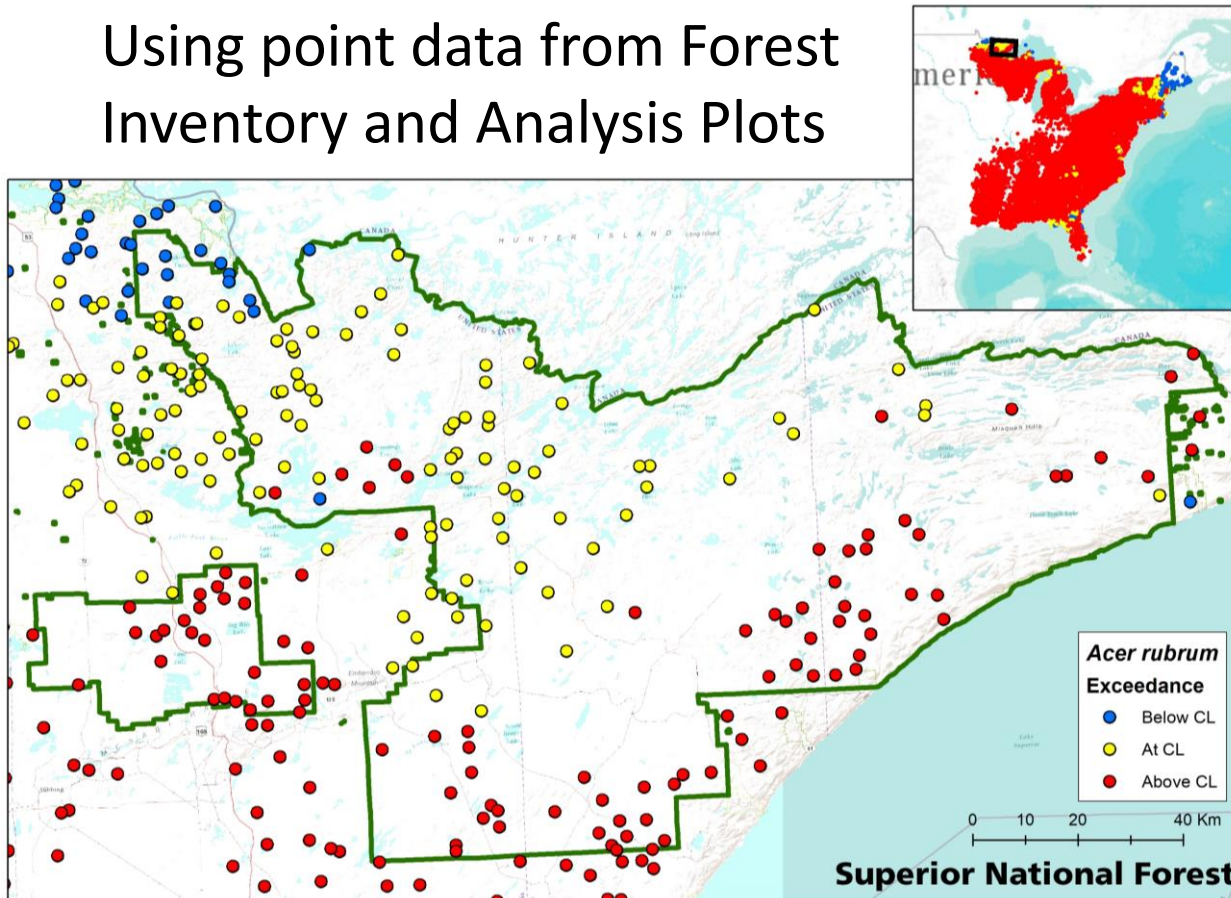
Horn et al. 2018. *Growth and survival relationships of 71 tree species with nitrogen and sulfur deposition across the conterminous U.S*

- 1,423,455 trees from >121,000 plots
- Types of response:
 - Increasing (N)
 - Threshold (N)
 - Decreasing (N/S)

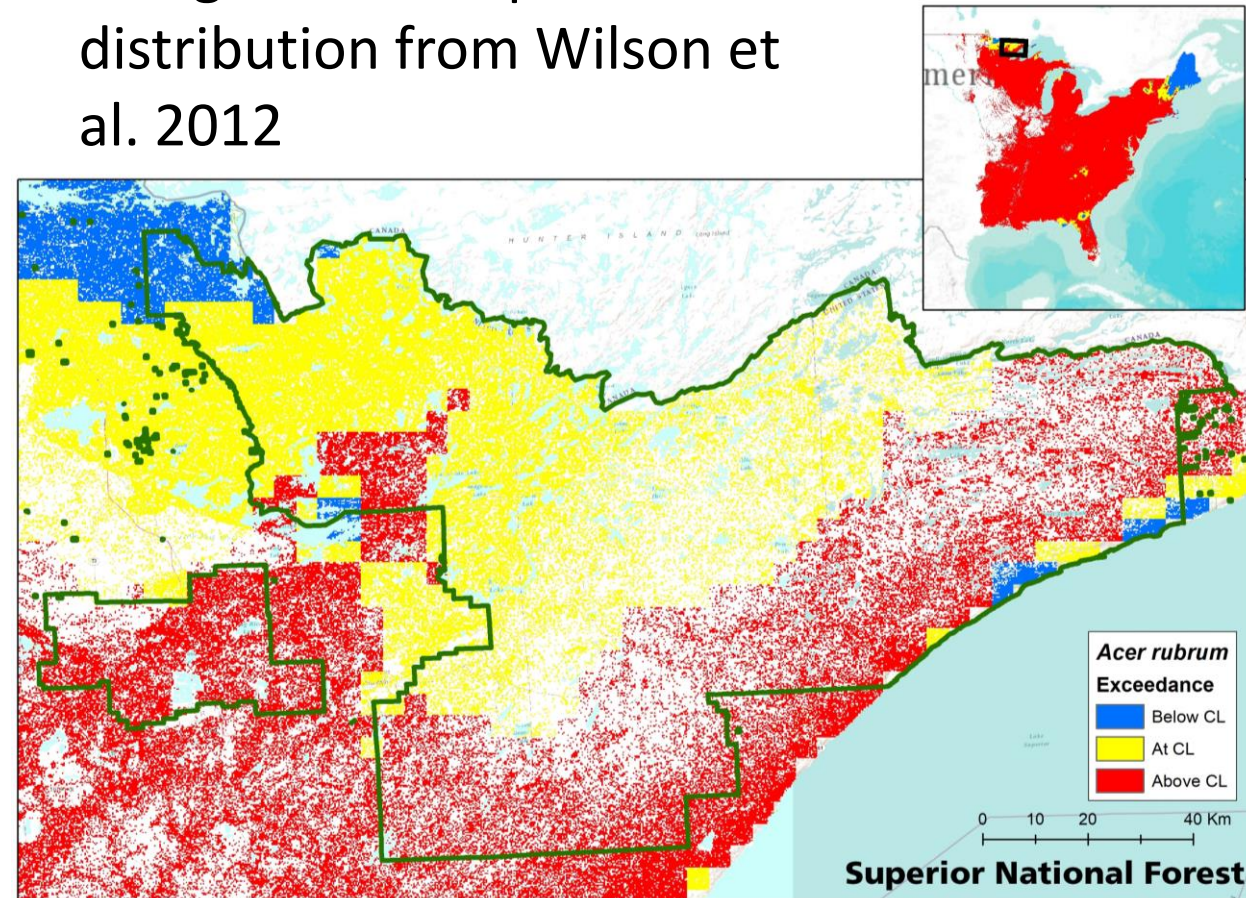


Application of Tree Species CLs: *Acer rubrum*

Using point data from Forest Inventory and Analysis Plots



Using modeled species distribution from Wilson et al. 2012



Limits of application

Using point data from Forest Inventory and Analysis Plots

	National Parks	National Forest
Total Units	265	115
Have FIA plots	105	114
>10 Plots	39	112
>50 Plots	8	103

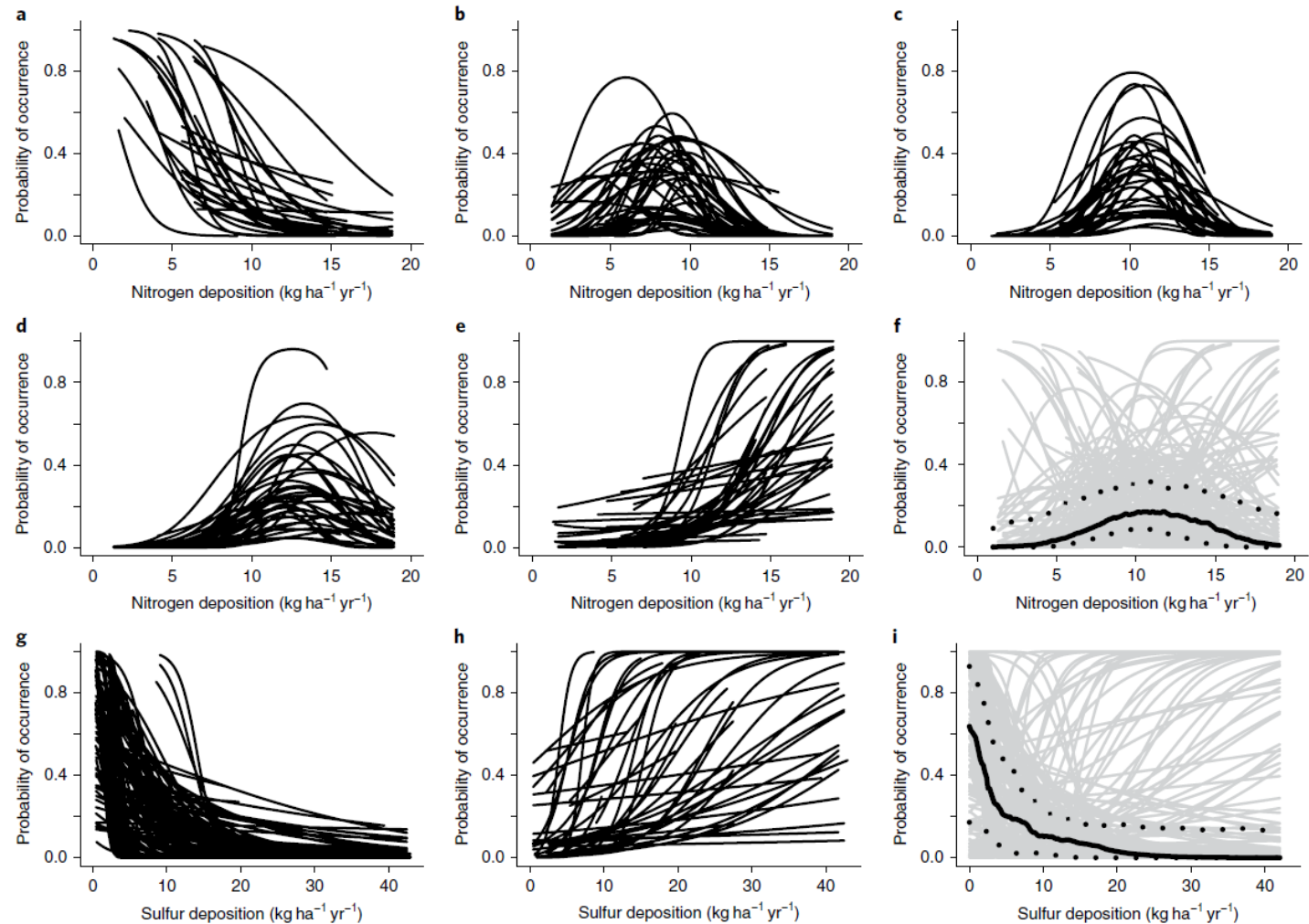
Using modeled species distribution from Wilson et al. 2012

	National Parks	National Forest
Total Units	265	115
Have modeled tree data	252	112

Herbaceous Species CLs

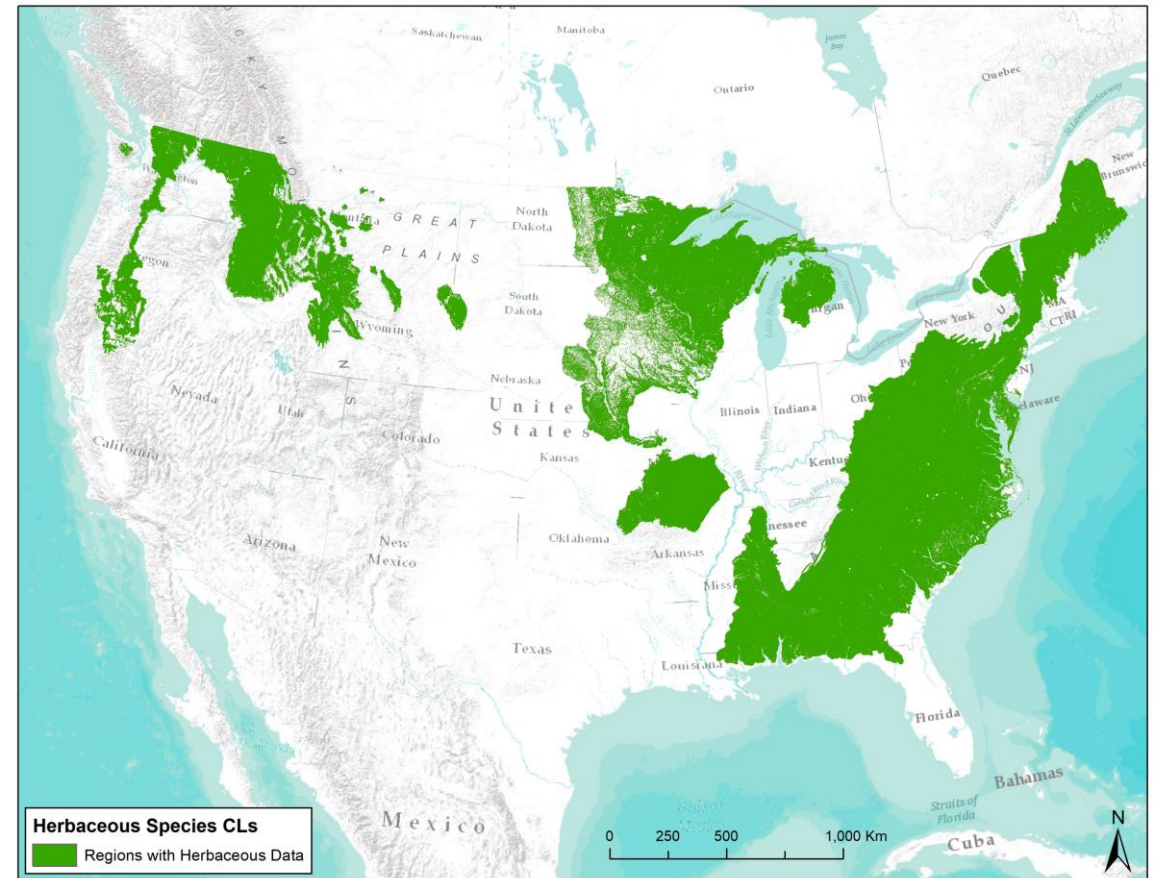
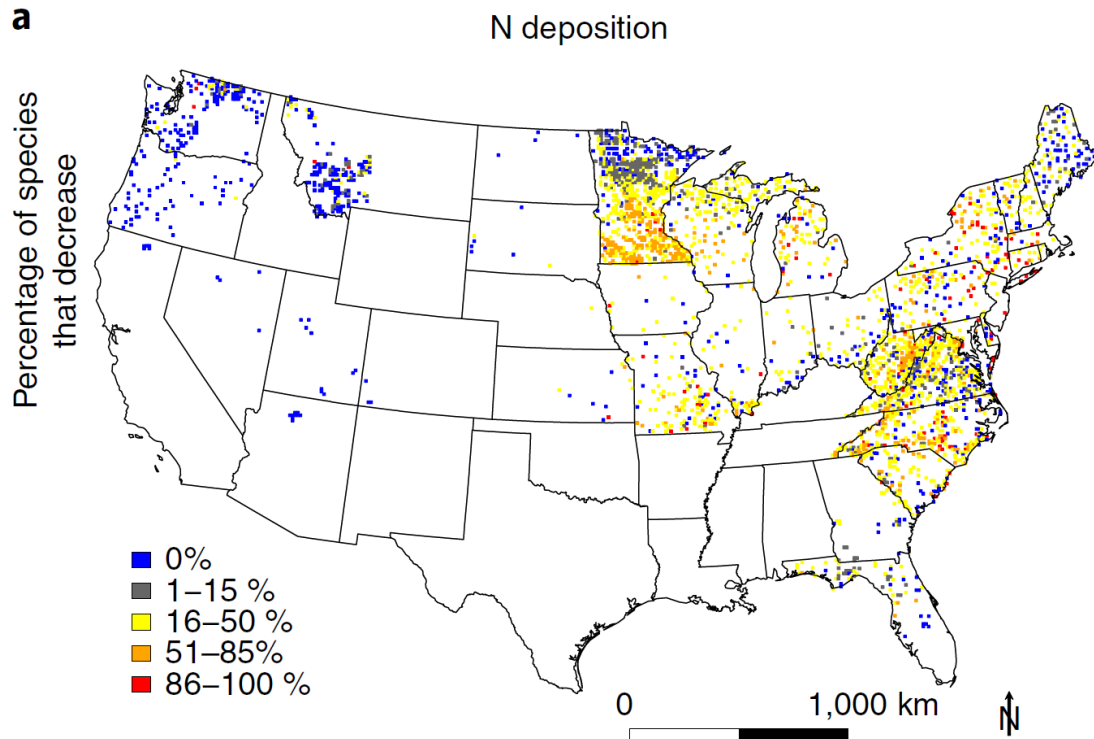
Clark et al. 2019. *Potential vulnerability of 348 herbaceous species to atmospheric deposition of nitrogen and sulfur in the United States.*

- >14,000 survey sites
- Types of response:
 - Increasing (N/S)
 - Threshold (N)
 - Decreasing (N/S)



Application of Herbaceous Species CLs

- Regional Distribution of herbaceous species with CLs



Application of Herbaceous Species CLs

- Fewer options for species distribution maps than trees
- Reliant on species lists from local areas
- Can link species to National Vegetation Classification Standard

	National Parks	National Forest
Total Units	265	115
Within regions with at least one species	102	63

Using CLs for federal lands management

- Having species specific responses can help connect managers to the science.
- Can tie species changes to ecosystem services from timber production, sensitive habitat, and species of cultural significance.
- Can guide active management in areas where multiple species or critical loads overlap.

Next Steps

- No plant is an island. We need to evaluate community dynamics.
- We need to get more systematic herbaceous species data to fill in gaps.
- For tree species with wide ranges, we are currently performing regional analyses to assess variation in response.
- Use lichen response curves to monitor for regeneration of lichen diversity in air where air quality improvements have occurred.

Questions?

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