

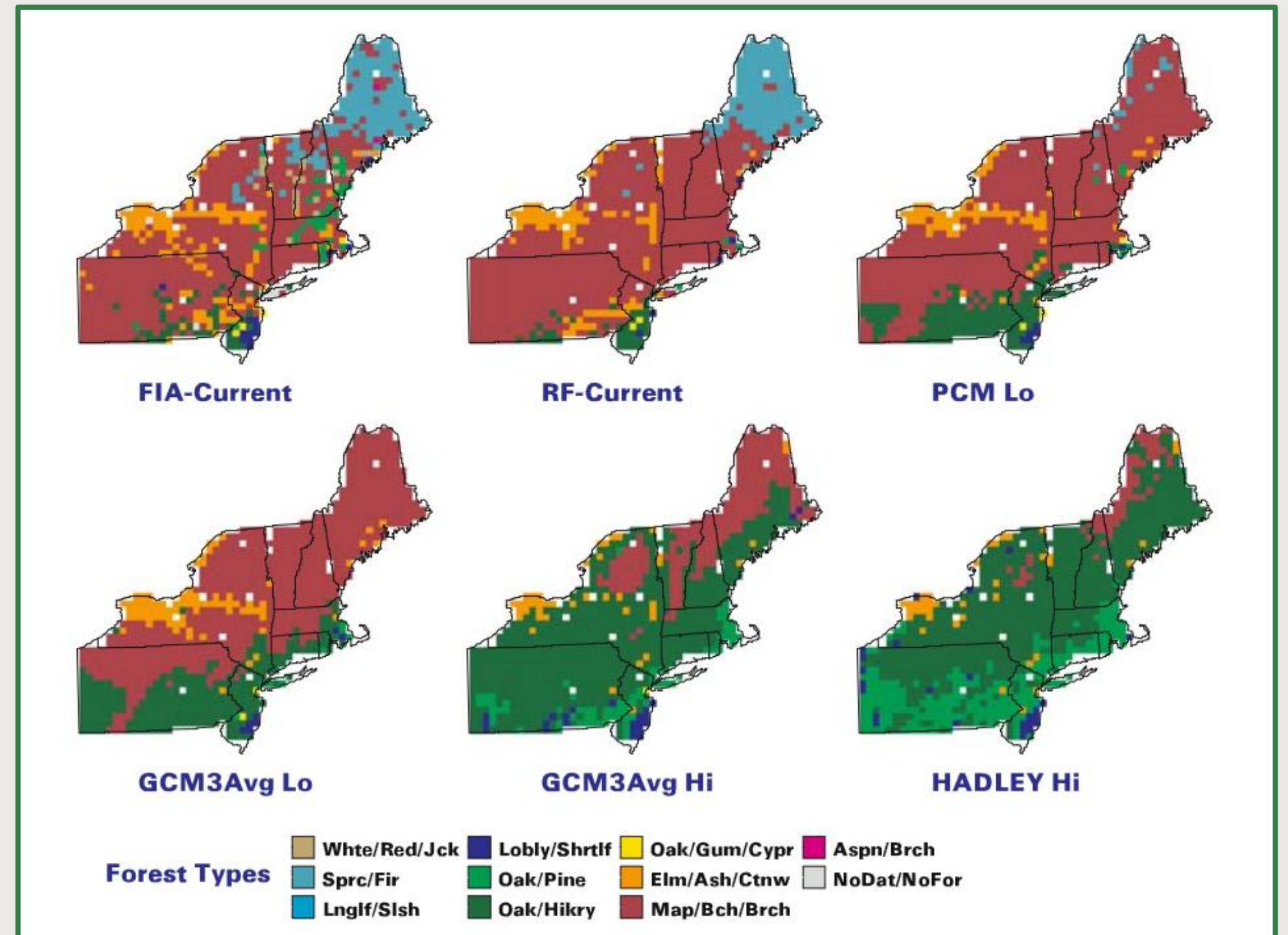
The background features a stylized landscape with rolling green hills, two large trees with light green foliage, and white clouds against a light grey sky. The text is centered in a dark green, serif font.

Reconstructing Cloud Cover from Tree Rings and Its Relationship with Tree Growth, Northeast United States

Mary Palmieri

Background

- ❖ The climate of the Northeast United States has been rapidly changing since the 1970s
- ❖ The suitable habitats for different tree species are predicted to shift
- ❖ Precipitation and temperature have been well studied, unlike cloud cover



Iverson et al., 2008, Fig. 2

Research Questions

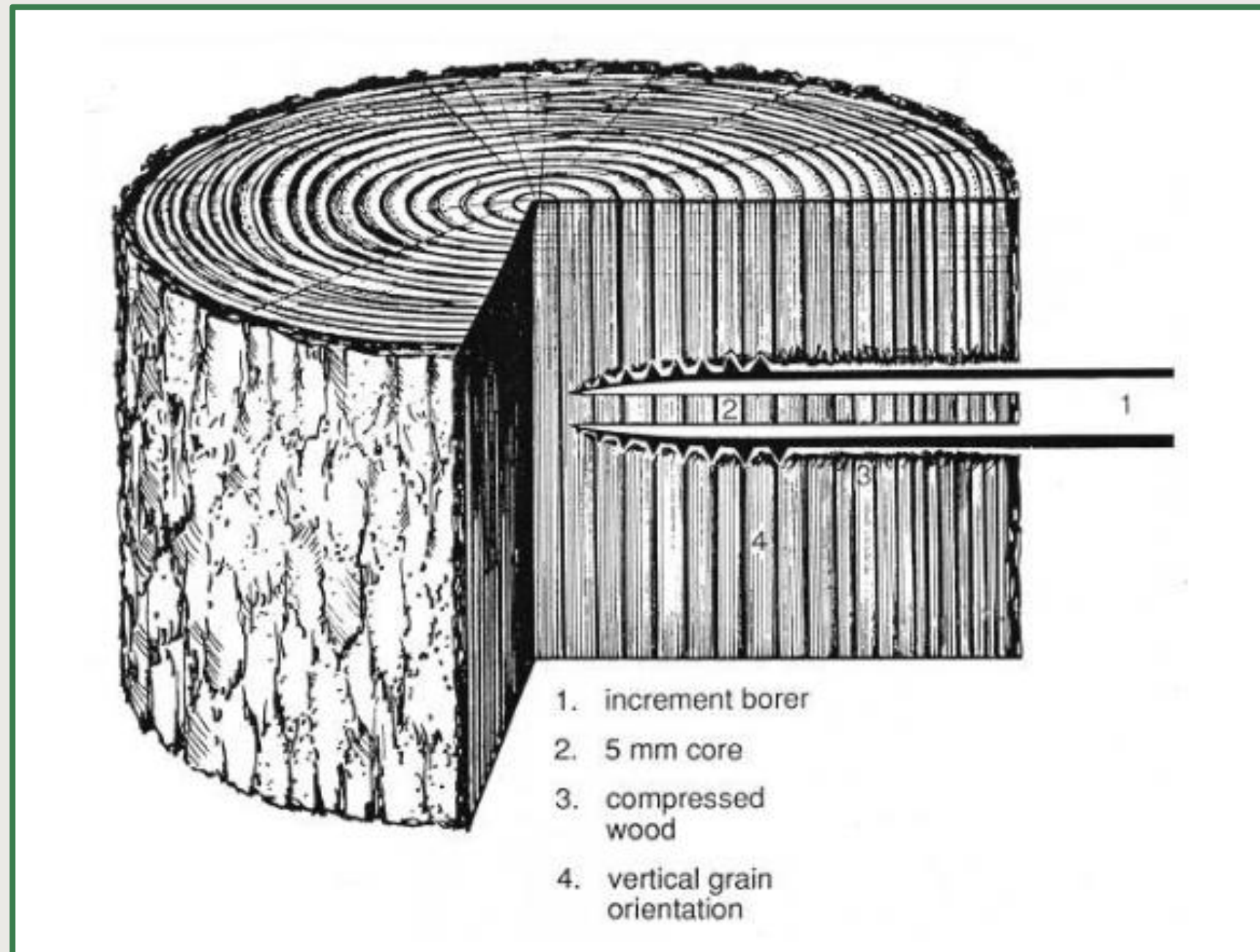
How has cloud cover in the Northeast United States changed over time?

What biological, natural, or anthropogenic factors forced the changes in cloud cover?

How do cloud cover changes impact tree growth?

Dendroclimatology

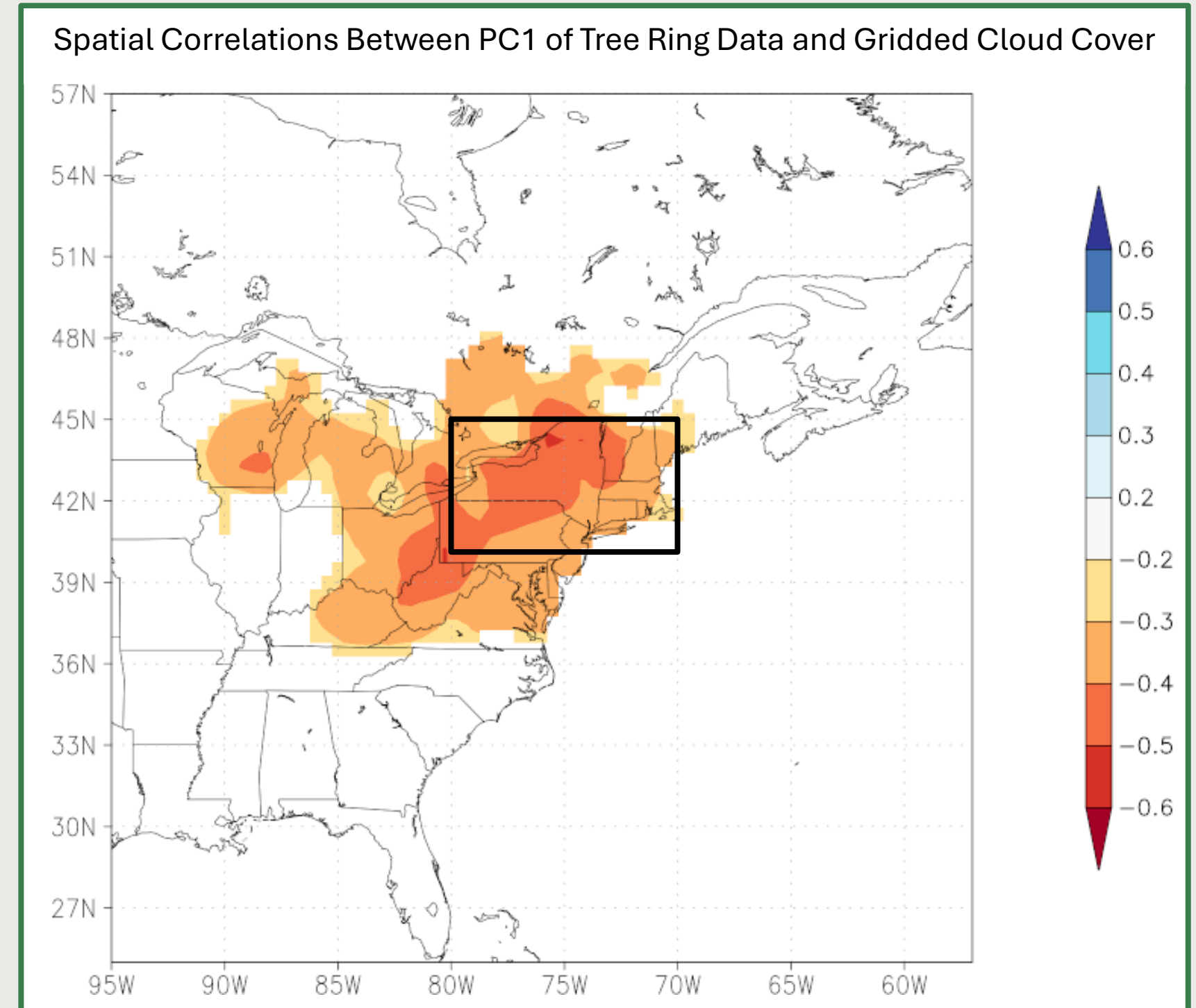
- ❖ Trees grow annual rings that record responses to climate
- ❖ Oak ring width and hemlock blue intensity
- ❖ Compare annual tree ring data with monthly climate data
- ❖ Standardized and averaged into site-level chronologies



Speer, 2010, Fig. 5.3

Climate Data

- ❖ Spatially correlate PC1 of 54 tree ring chronologies with cloud cover over calibration period (1906-1973)
- ❖ Ensures a relationship is present between variables
- ❖ Model will predict average June-September cloud cover in the boxed region



Tree Ring Data



Quercus rubra, *Q. alba*, *Q. velutina*, *Q. prinus*, *Q. stellata*

16 sites, 476 cores

Ring width

International Tree Ring Data Bank

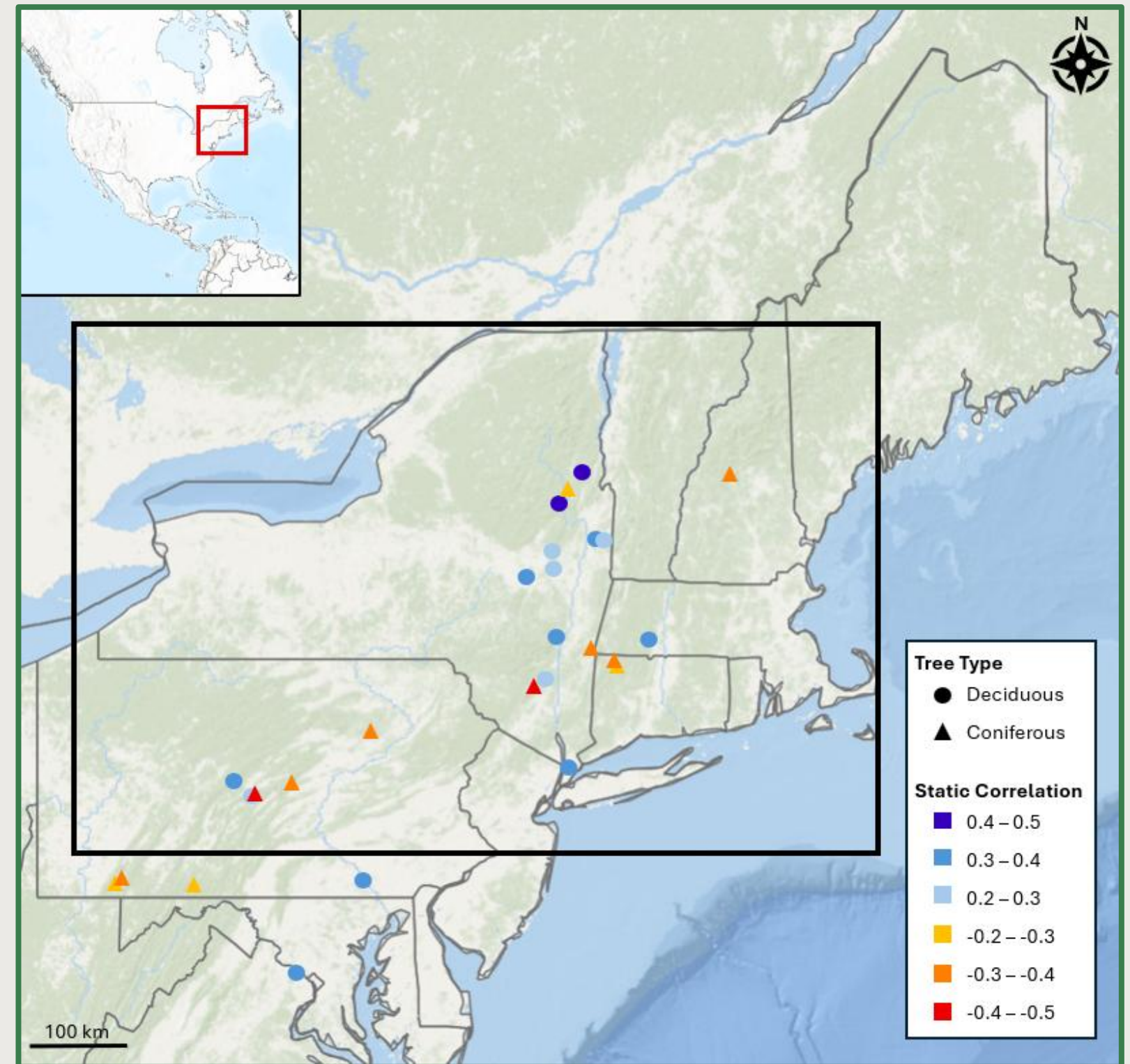


Tsuga canadensis

14 sites, 565 cores

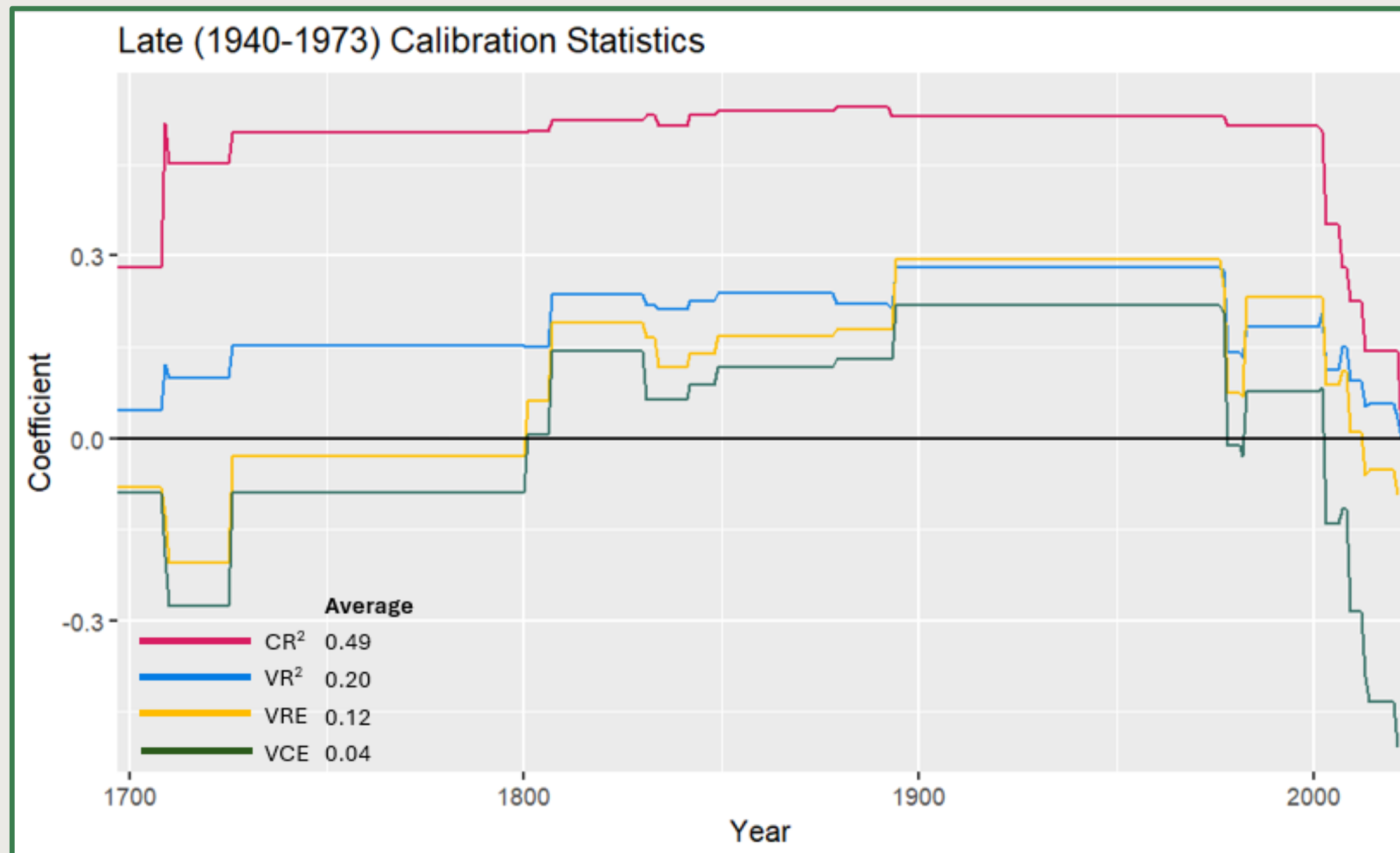
Blue intensity

Dr. Grant Harley, University of Idaho

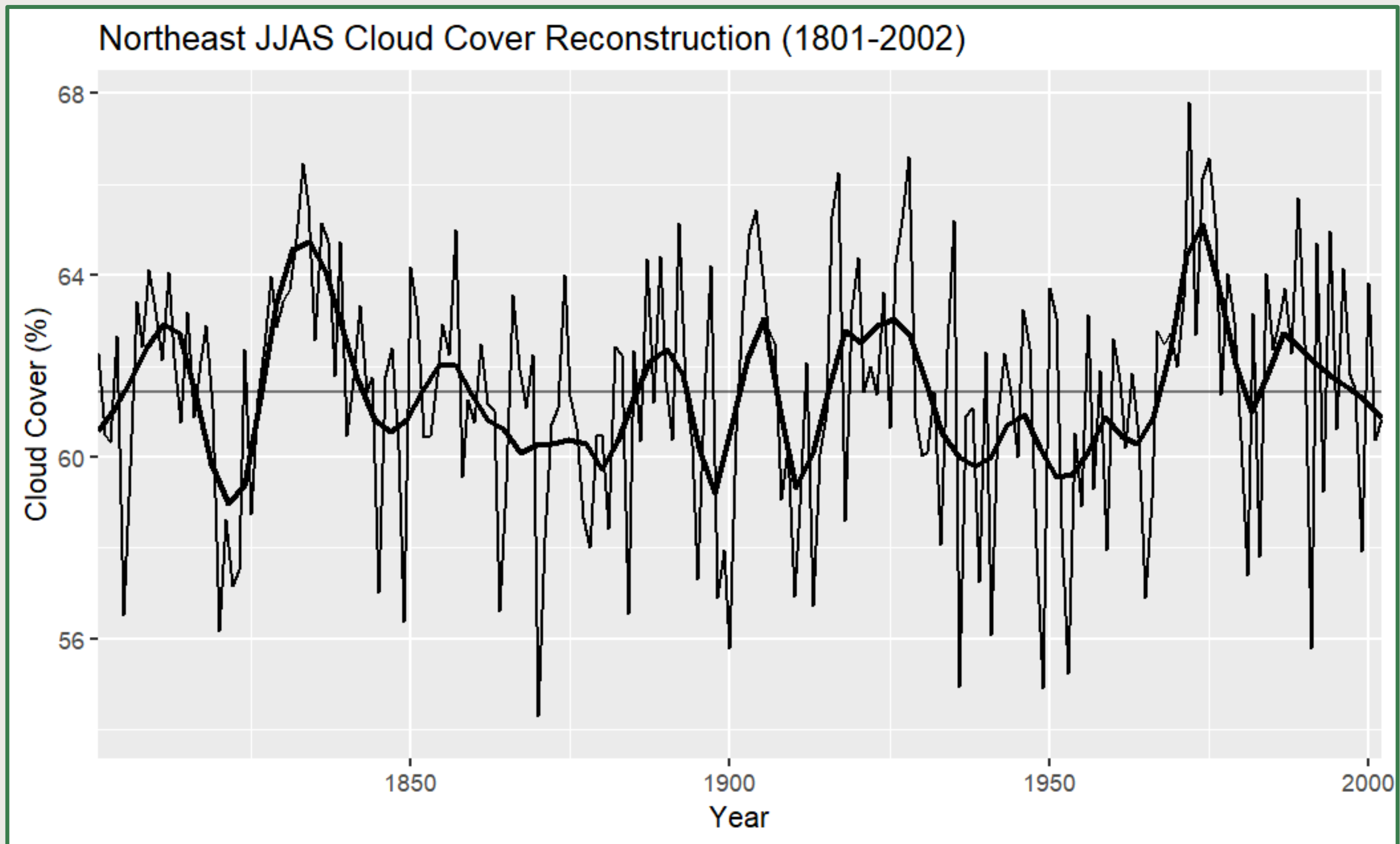


Modeling

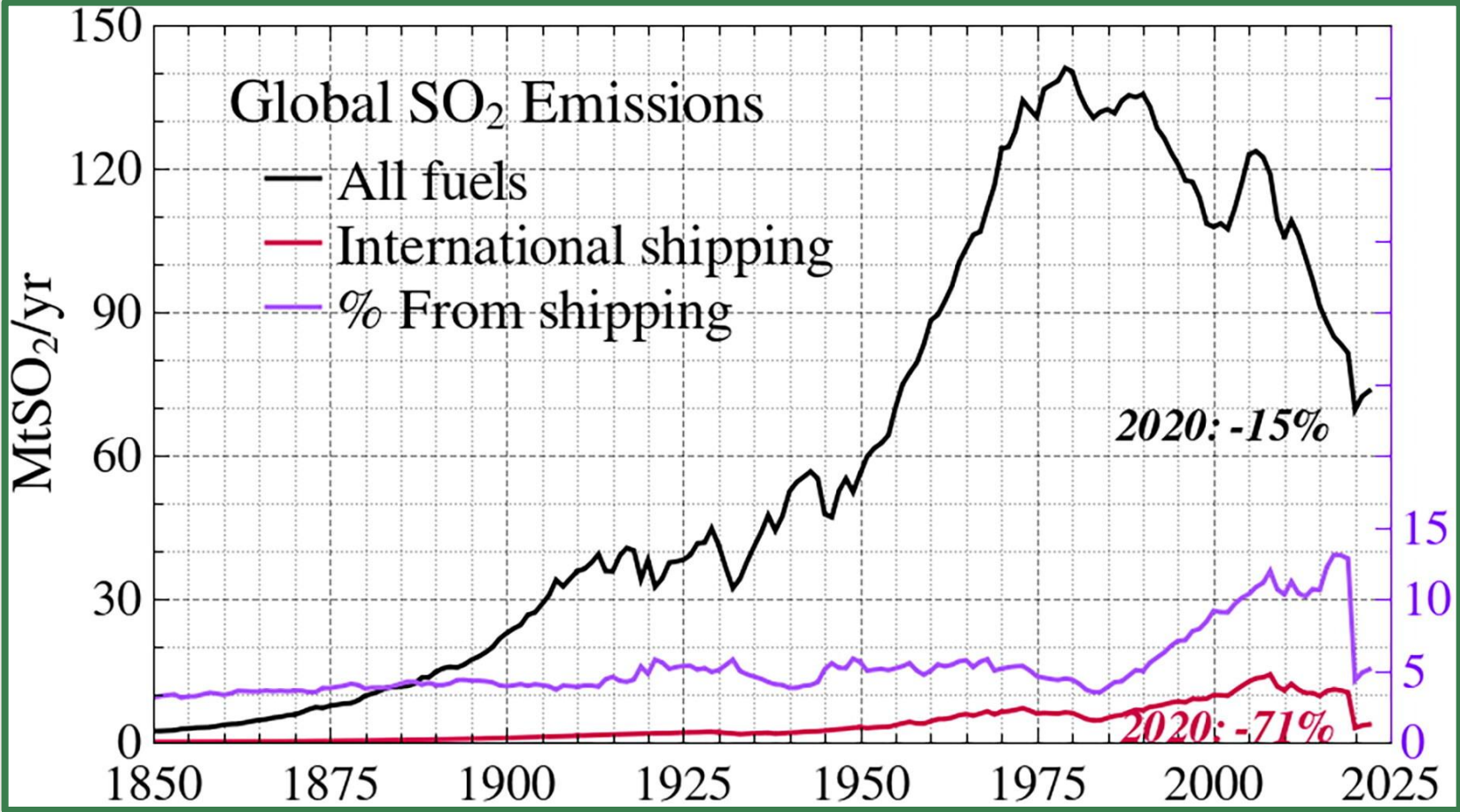
Nested principal component regression analysis was used to reconstruct Northeast June-September cloud cover from 1697 to 2022, but it is only reliable from 1801 to 2002



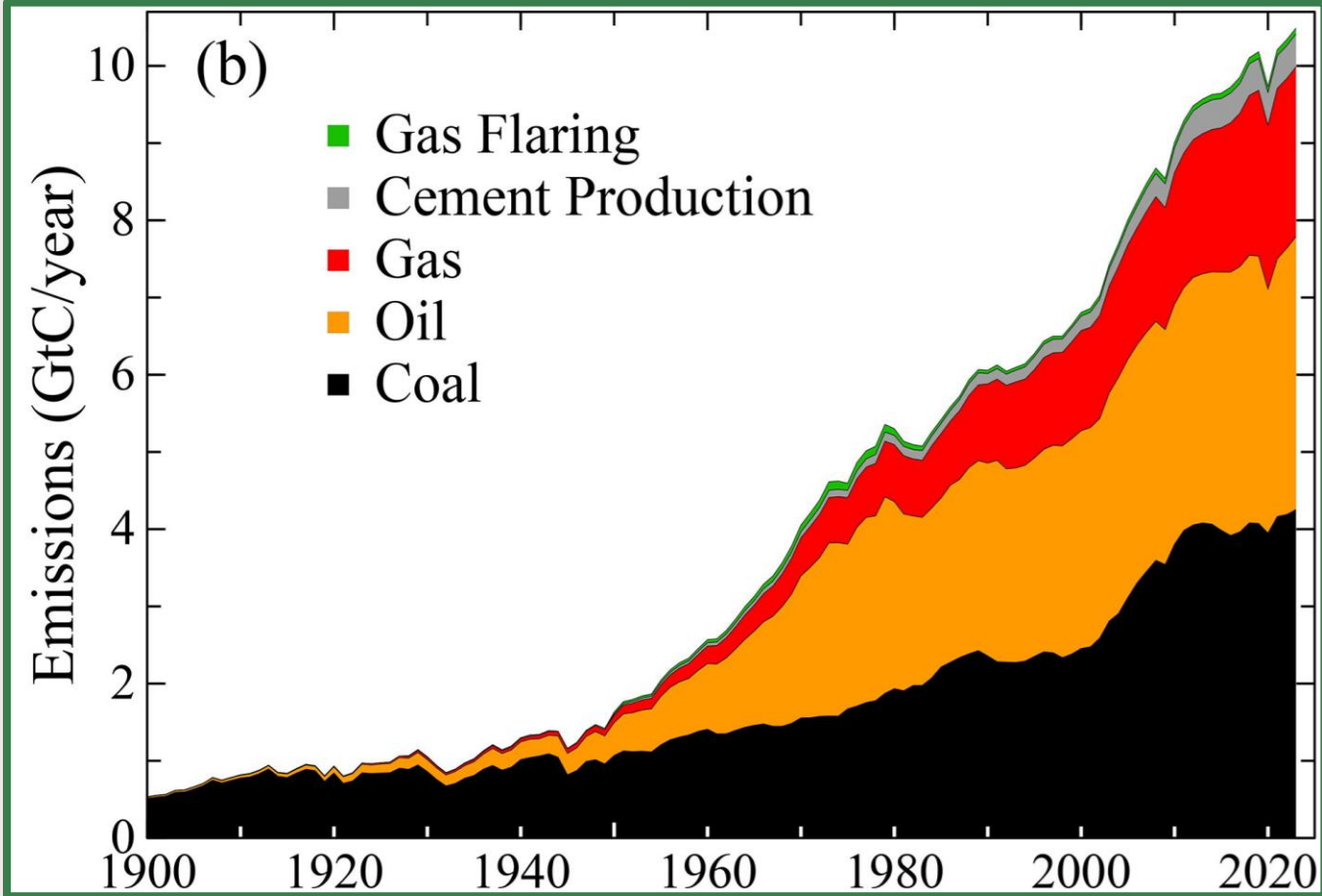
Reconstruction



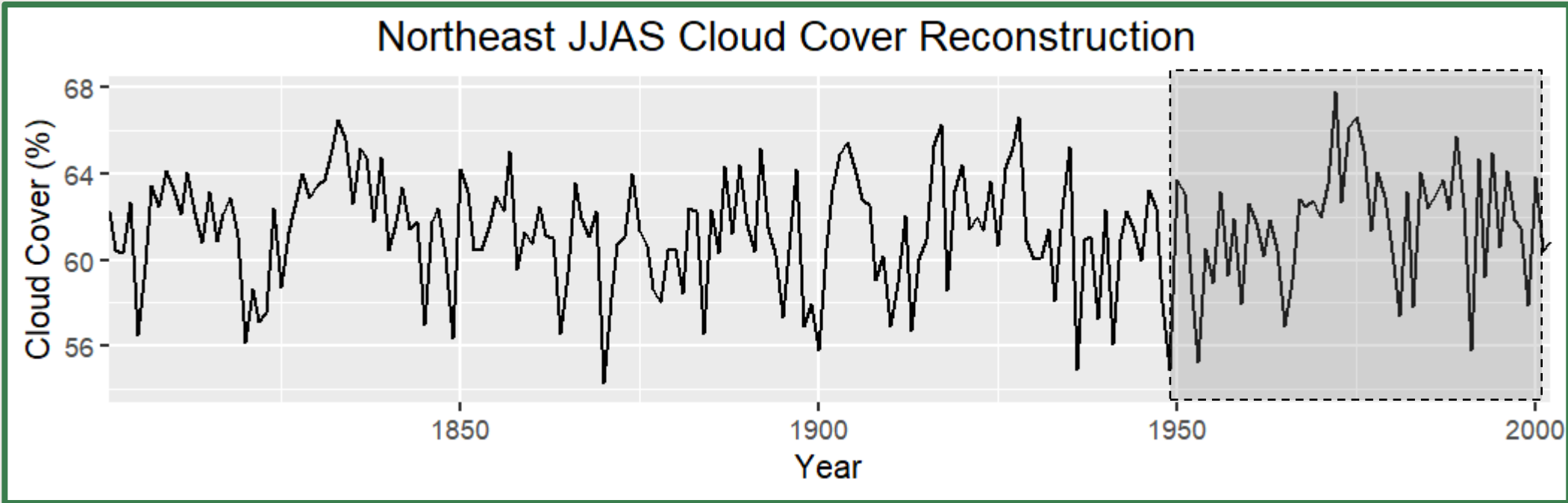
Human Emissions



Hansen et al., 2025, Fig. S8

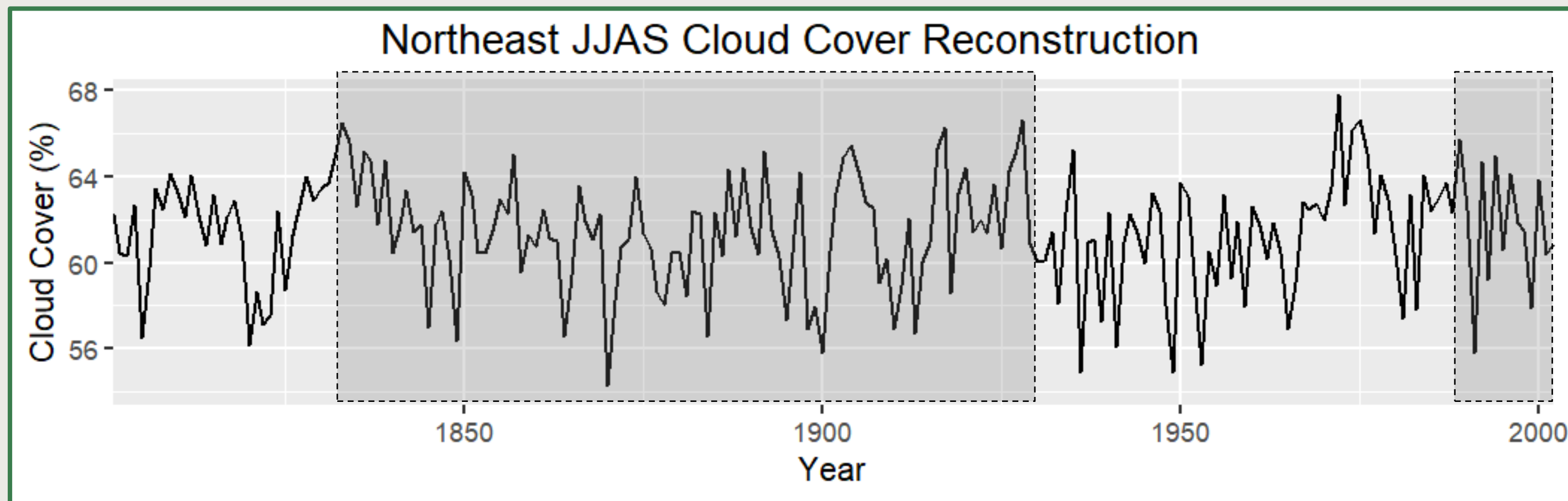


Hansen et al., 2025, Fig. 21b

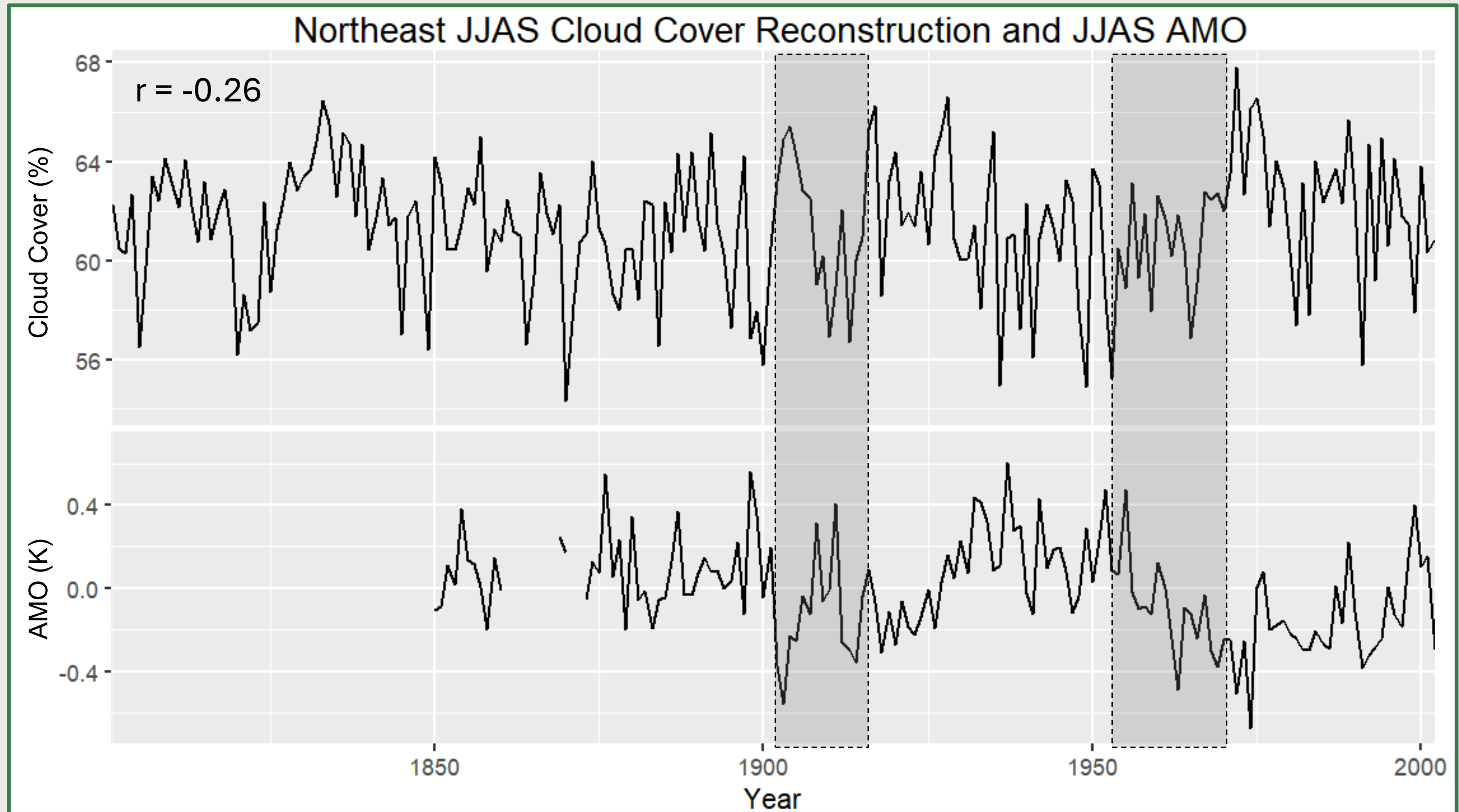


Land Use Changes

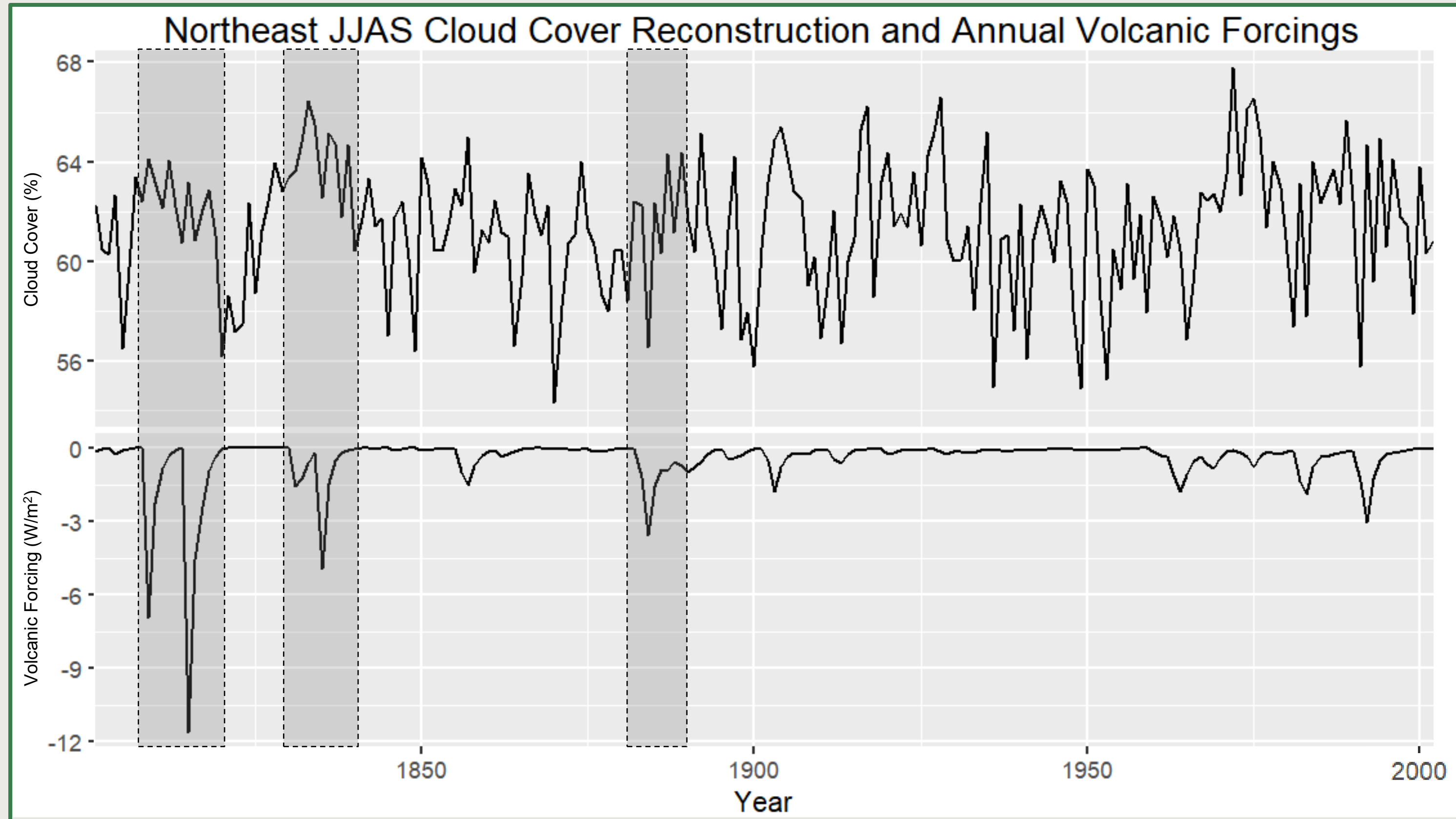
- ❖ Cloud cover tends to increase over forested areas and decrease with deforestation
- ❖ Deforestation began around 1650 with the arrival of European settlers, and reached a low in the late 1800s
- ❖ Forest cover has increased since, but has slowed down as of the 1990s



Atlantic Multidecadal Oscillation

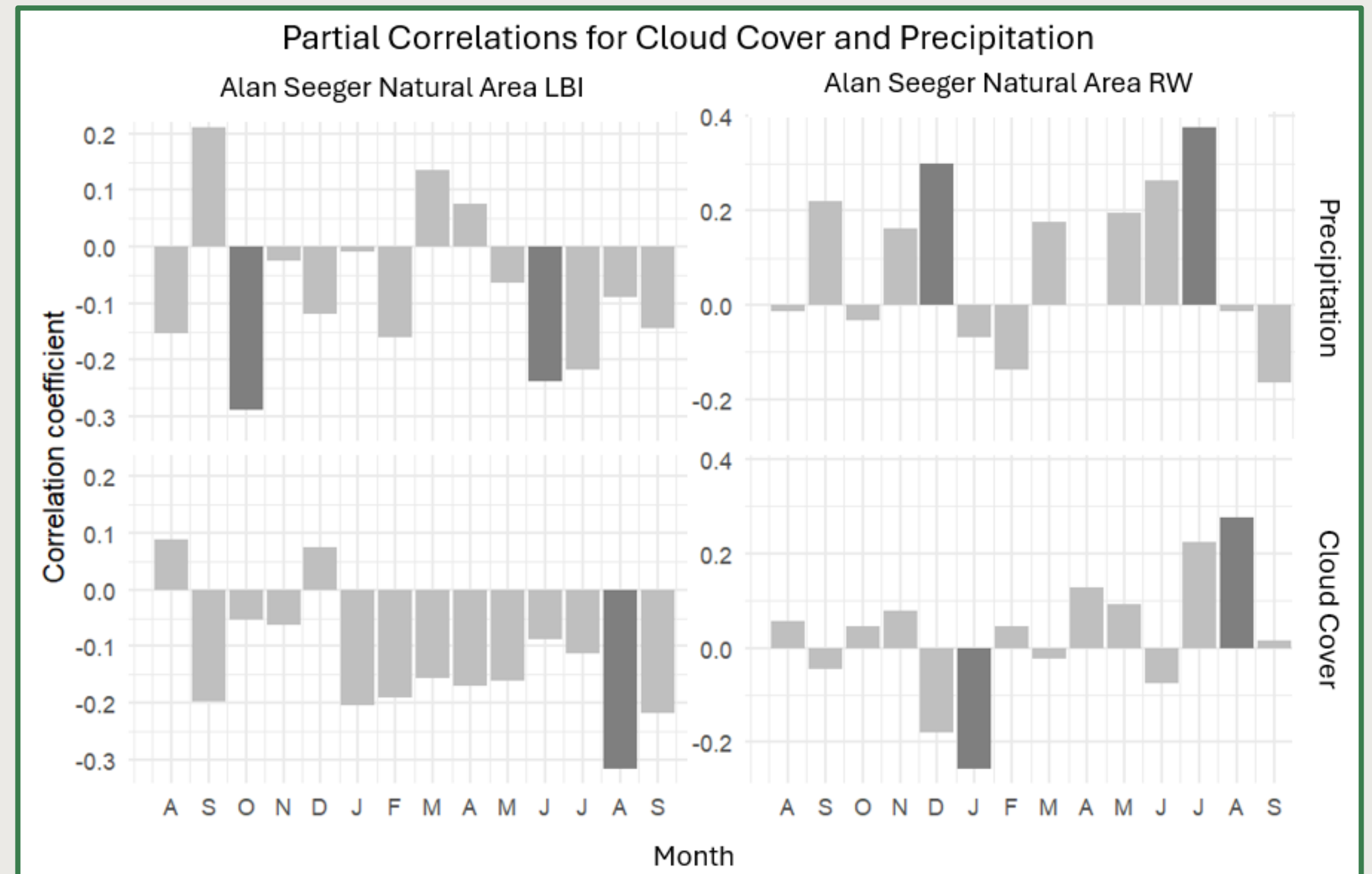


Volcanic Forcings



Cloud Cover Impact on Trees

- ❖ Negative relationship with hemlock latewood density and positive relationship with oak ring width
- ❖ Precipitation has a more direct impact, especially for oak ring width
- ❖ Hemlock latewood density is denser with higher temperature



Importance

- ❖ Cloud cover is rarely studied in relation to tree growth
- ❖ Involved in feedback loops regarding temperature, precipitation, aerosols, and light availability
- ❖ Complicated land use history in the Northeast
- ❖ More accurate predictions while the climate is rapidly changing



References

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- Iverson, L., Prasad, A., and Matthews, S., 2008, Modeling potential climate change impacts on the trees of the northeastern United States: *Mitigation and Adaptation Strategies for Global Change*, v. 13, no. 5-6, p. 487-516, doi:10.1007/S11027-007-9129-Y.
- Speer, J.H., 2010, *Fundamentals of Tree-ring Research*: University of Arizona Press.