Future Frost Regime Impacts on the Evergreen Bough Industry of the Pacific Northwest

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Background – Evergreen Bough Industry

- PNW Evergreen boughs:
  - Prized along the winter floral industry as top of the line
  - Especially noble fir – but also include silver fir, douglas-fir, and grand fir

- Evergreen boughs produce:
  - Millions in economic activity for the Pacific Northwest
    - Split between private and federal landowners alike
  - Hundreds of seasonal jobs for rural and foreign workers

Background – Evergreen Bough Ecology

- Evergreen boughs:
  - Only produced on trees between 15-30 years of age
  - Require a hard frost prior to harvest for hardening
  - Once hardened, boughs last up to 9 weeks or more

- Harvesters:
  - Must time harvests correctly for quality boughs
  - Identify and partner with local landowners to harvest
  - Contract with local industry to sell and process boughs
  - All prior to winter holidays

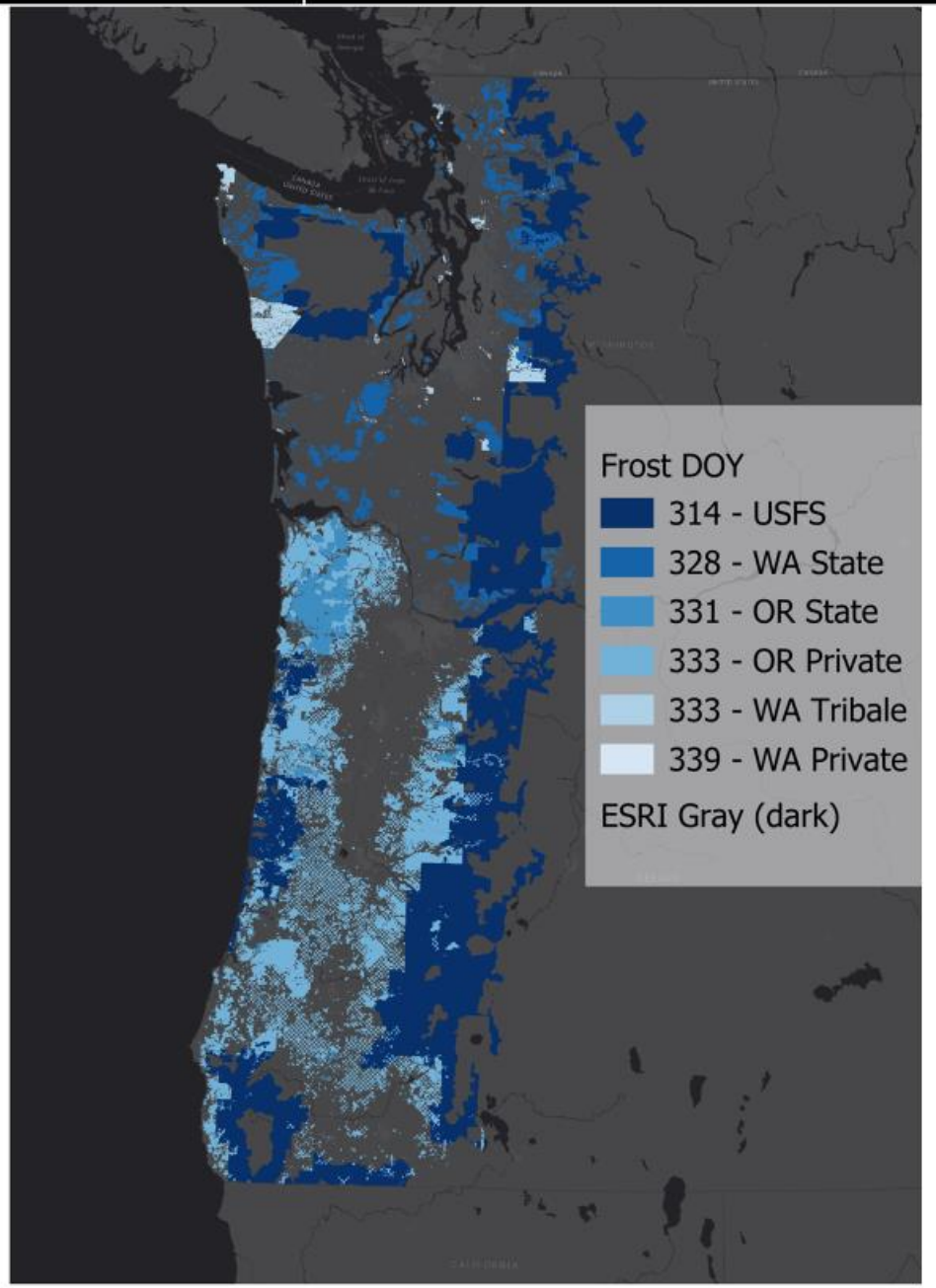
Research Question and Method Guide

- Research Question:
  - How will shifts in frost regimes on the landscape impact the bough industry?

- Methods:
  - Moderate climate socioeconomic scenario
    - Earth Veg-3 - ssp245
  - Compare historical and future periods
  - Calculate impact by:
    - Landownership
      - Mean frost change and probability change
    - Case study valuation
      - Gifford-Pinchot National Forest

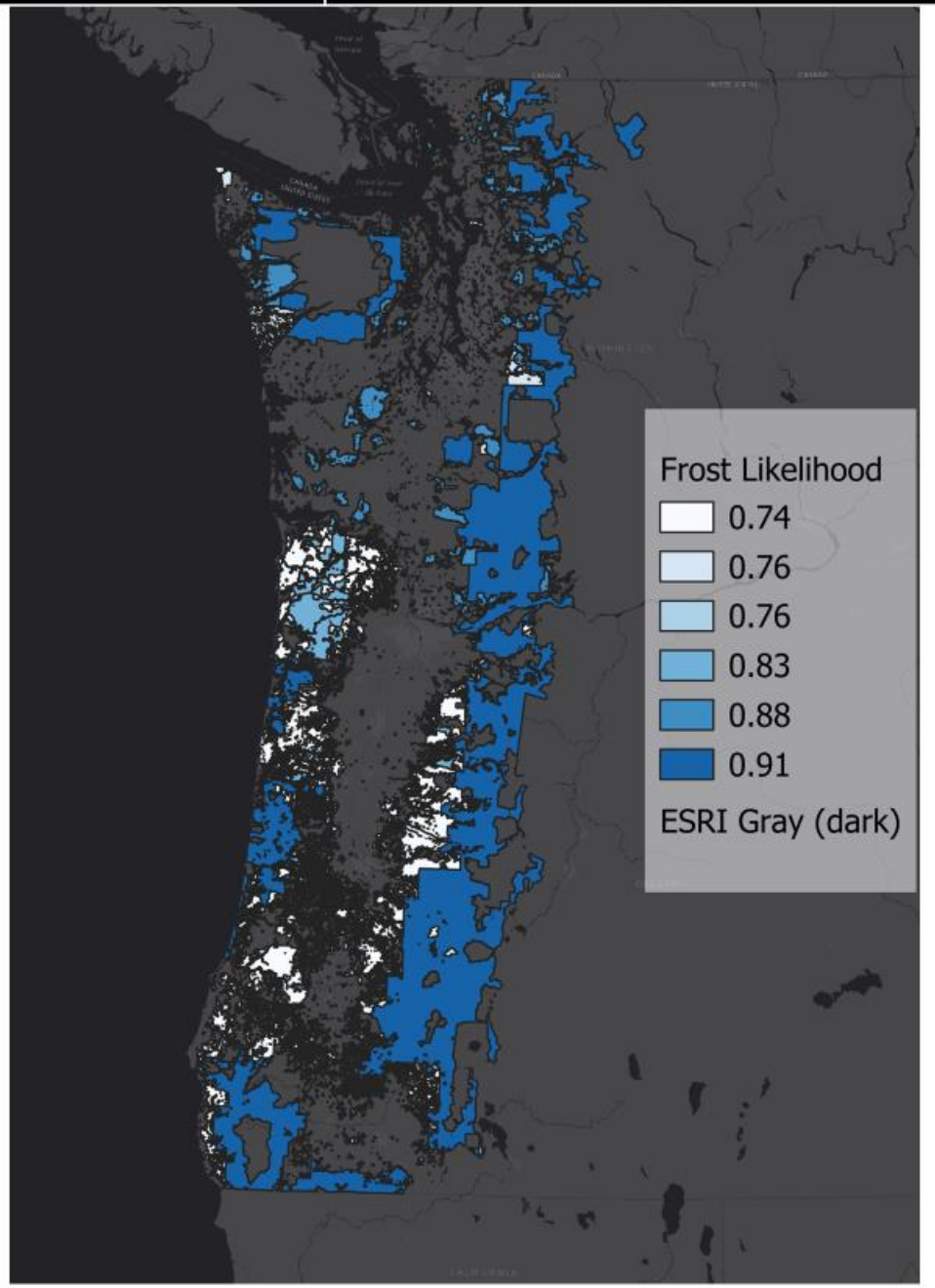
Frost Dates – Historic and Future

Owner	Historical	2015-2040	2041-2070	2071-2100
OR State	332	343	339	343
OR Private	333	344	340	343
USFS	314	326	323	328
WA State	329	340	334	339
WA Tribal	333	342	338	344
WA Private	339	350	347	342



Frost Probabilities – Historic and Future

Owner	Historical	2015-2040	2041-2070	2071-2100
OR State	0.83	0.59	0.42	0.33
OR Private	0.73	0.50	0.33	0.22
USFS	0.91	0.79	0.68	0.62
WA State	0.88	0.68	0.50	0.43
WA Tribal	0.76	0.51	0.36	0.27
WA Private	0.77	0.42	0.23	0.20



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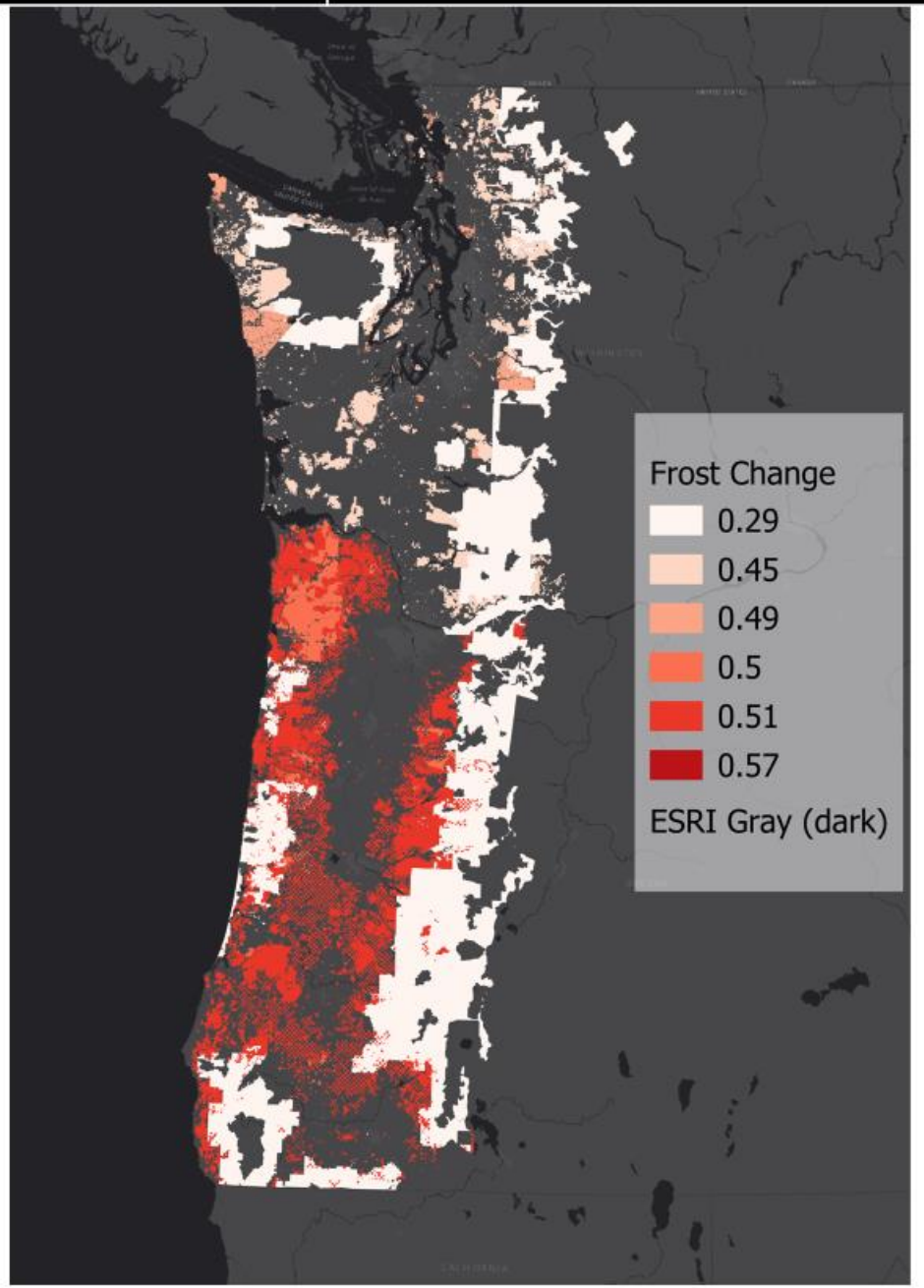
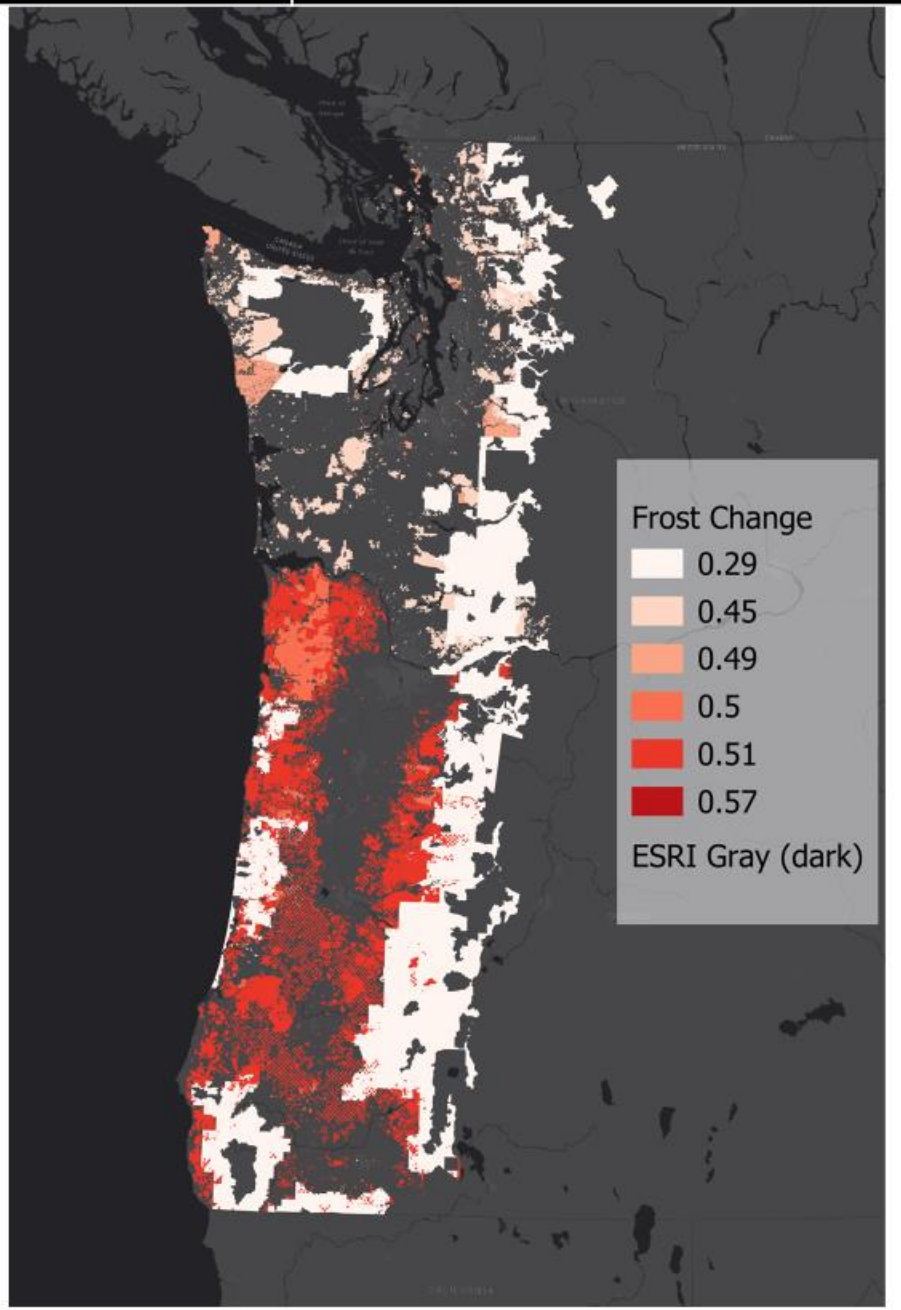


Initial Findings and Implications

- Frost dates are:
  - Getting later in the year across ownerships
  - Probability of a frost-free year before Dec. 25 is getting higher
- Private, especially Washington, ownerships will have much lower frost probabilities
- Federal ownerships are the least affected
- Federal ownerships keep a low frost-free year before Dec. 25 probability

- Bough harvests may shift to federal ownerships under shifting frost regimes



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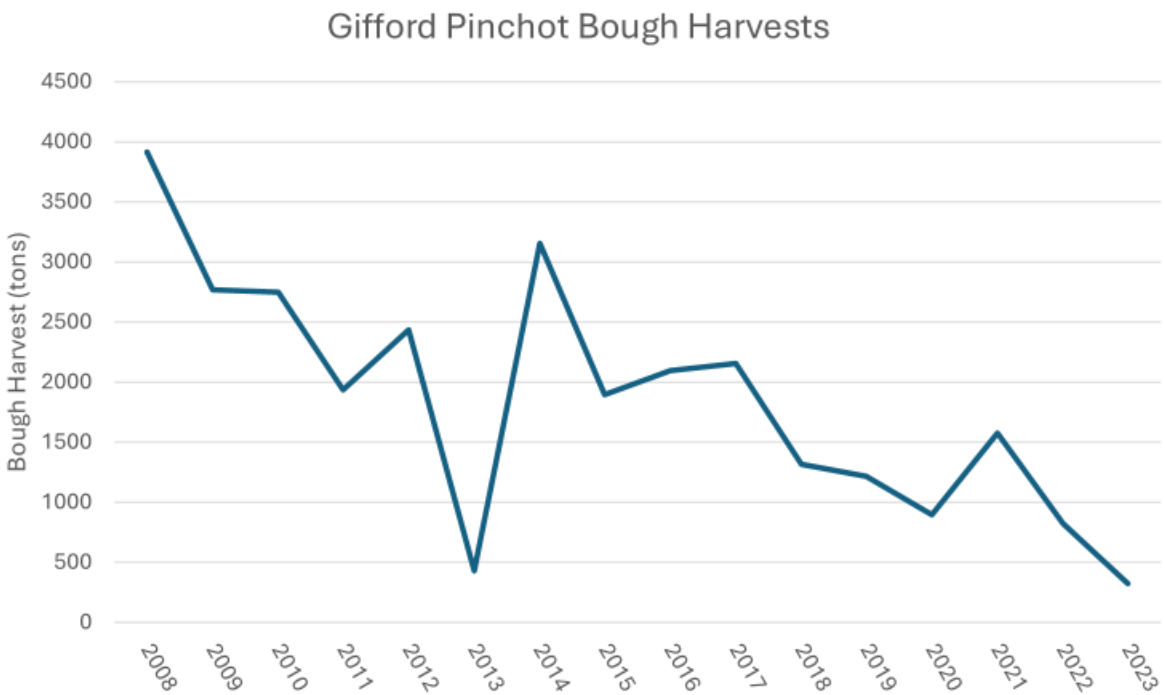

Next Steps

- Run pixel-based analysis for all of Washington and Oregon
- Compute for 16 other climate models for ensembled results
- Compute uncertainty and risk ranges
- Calculate valuation risk for the Gifford-Pinchot National Forest

Acknowledgements

- USDA McIntire-Stennis Grant
- Center for International Trade of Forest Products