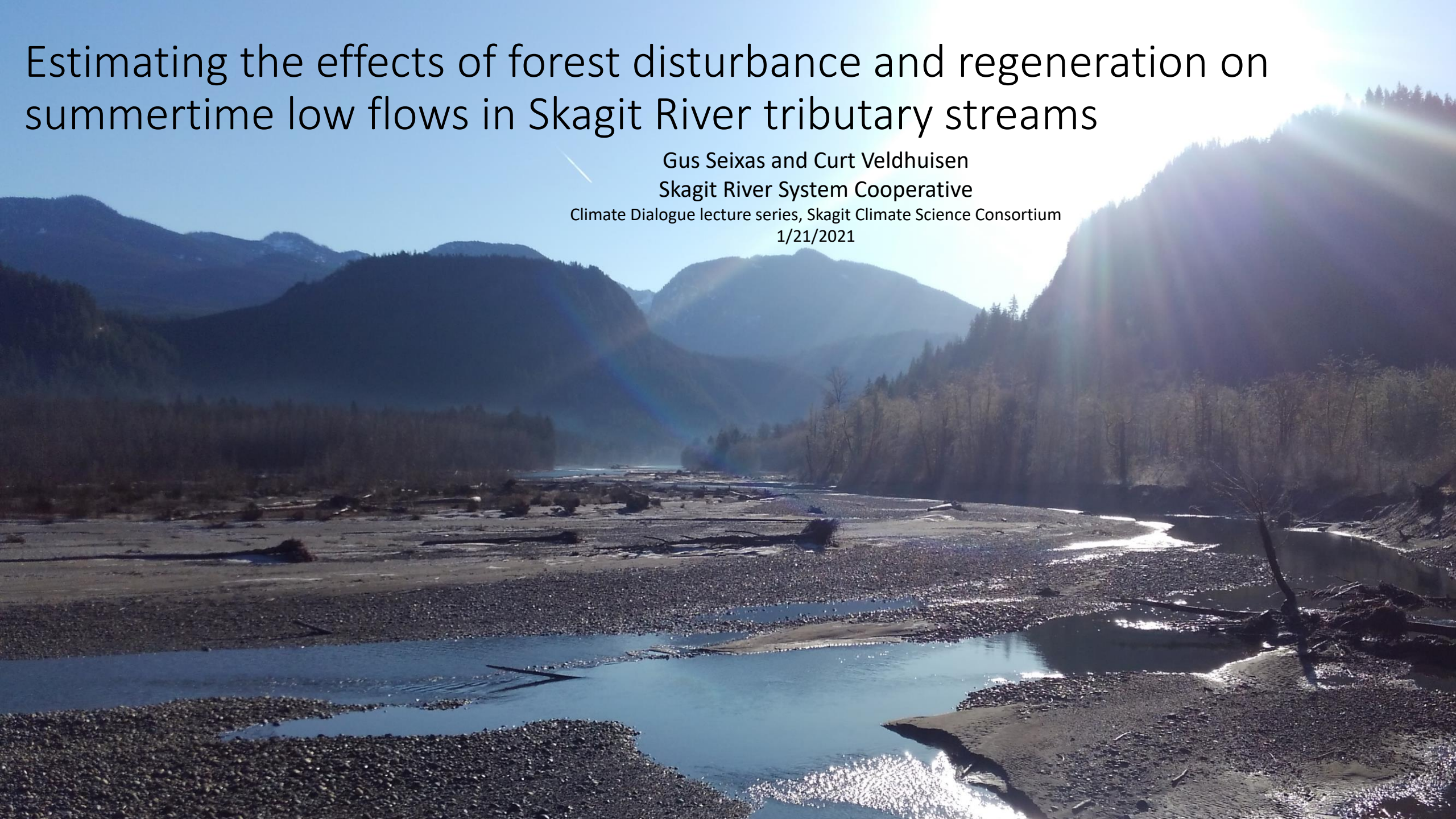
Estimating the effects of forest disturbance and regeneration on summertime low flows in Skagit River tributary streams

Gus Seixas and Curt Veldhuisen
Skagit River System Cooperative
Climate Dialogue lecture series, Skagit Climate Science Consortium
1/21/2021

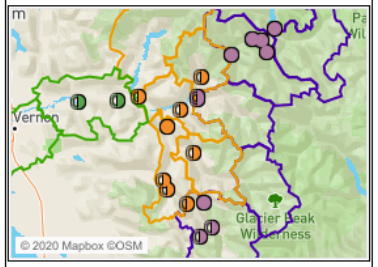


Monthly Average

Monthly Modeled Unregulated Streamfl..

Range in Modeled Unregulated Streamfl..

Select location from the map:
All



Basin Type
- Rain-Dominated
- Mixed
- Snow-Dominated

Bias Correction
- No
- Yes

Water Years
(30-year window recommended)
2038 to 2067

Global Greenhouse Gas Scenario
- [x] RCP 4.5 (Low)
- [x] RCP 8.5 (High)

Summary Flows
- Minimum
- Mean
- Maximum

Climate Model
- [x] Historical Average
- [x] ensemble
- [x] bcc-csm1-1-m
- [x] CanESM2
- [x] CNRM-CM5
- [x] CSIRO-Mk3-6-0
- [x] HadGEM2-CC365
- [x] HadGEM2-ES365
- [x] IPSL-CM5A-MR
- [x] MIROC5
- [x] NorESM1-M

Legend
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- CSIRO-Mk3-6-0
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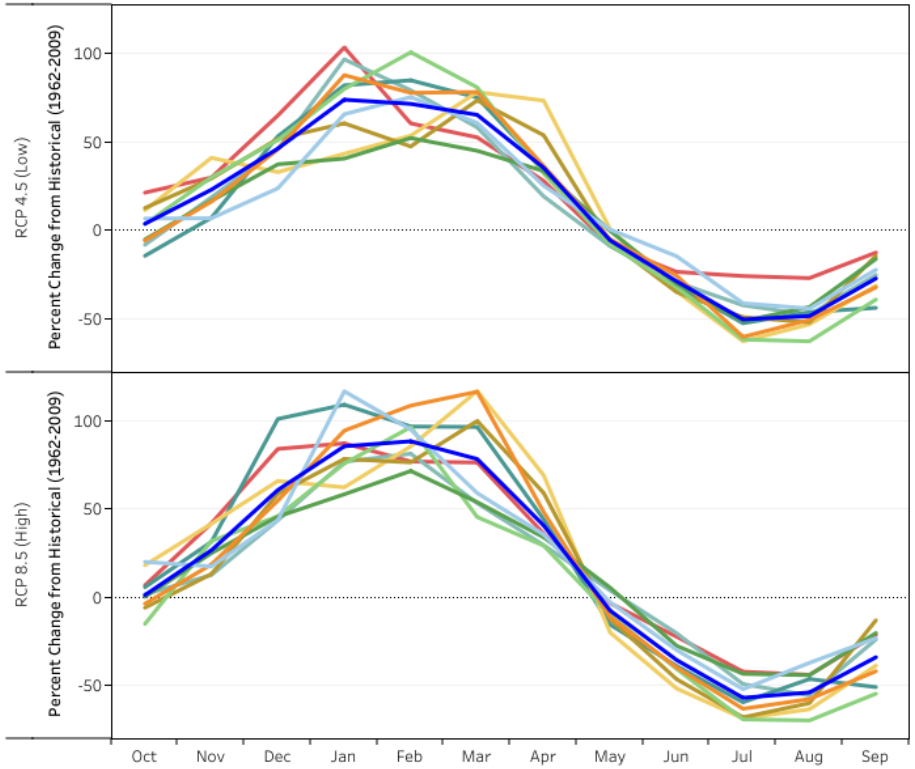
Location: All **Bias Corrected:** All

Unregulated Streamflow: Mean **Scenario:** RCP 4.5 (Low) & RCP 8.5 (High)

Select Model Output
(bias-corrected data only available for bias-corrected locations, see map)
Percent Change (no Bias Correction)



Water Years: 2038 to 2067

Predicted decreasing summertime low flows at locations throughout Skagit River watershed.

Monthly Average

Monthly Modeled Unregulated Streamfl..

Range in Modeled Unregulated Streamfl..

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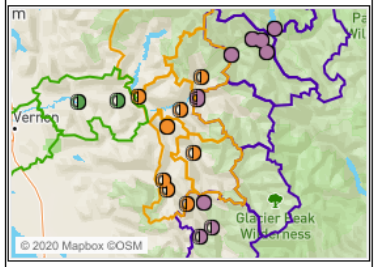

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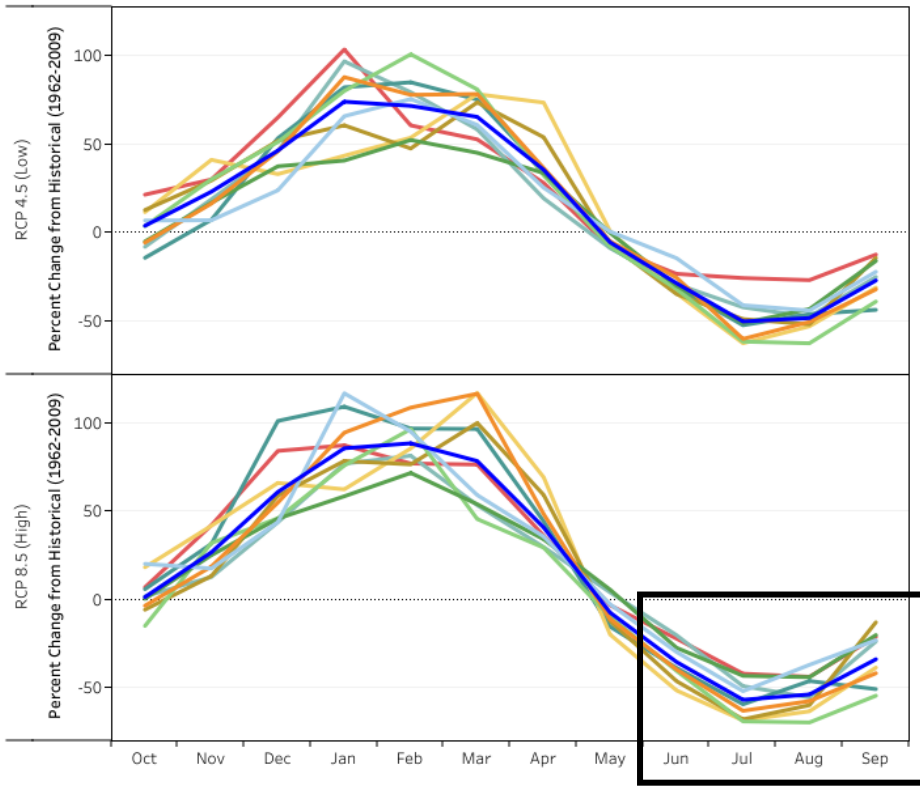

Water Years: 2038 to 2067

Predicted decreasing summertime flows

Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA

Timothy D. Perry | Julia A. Jones

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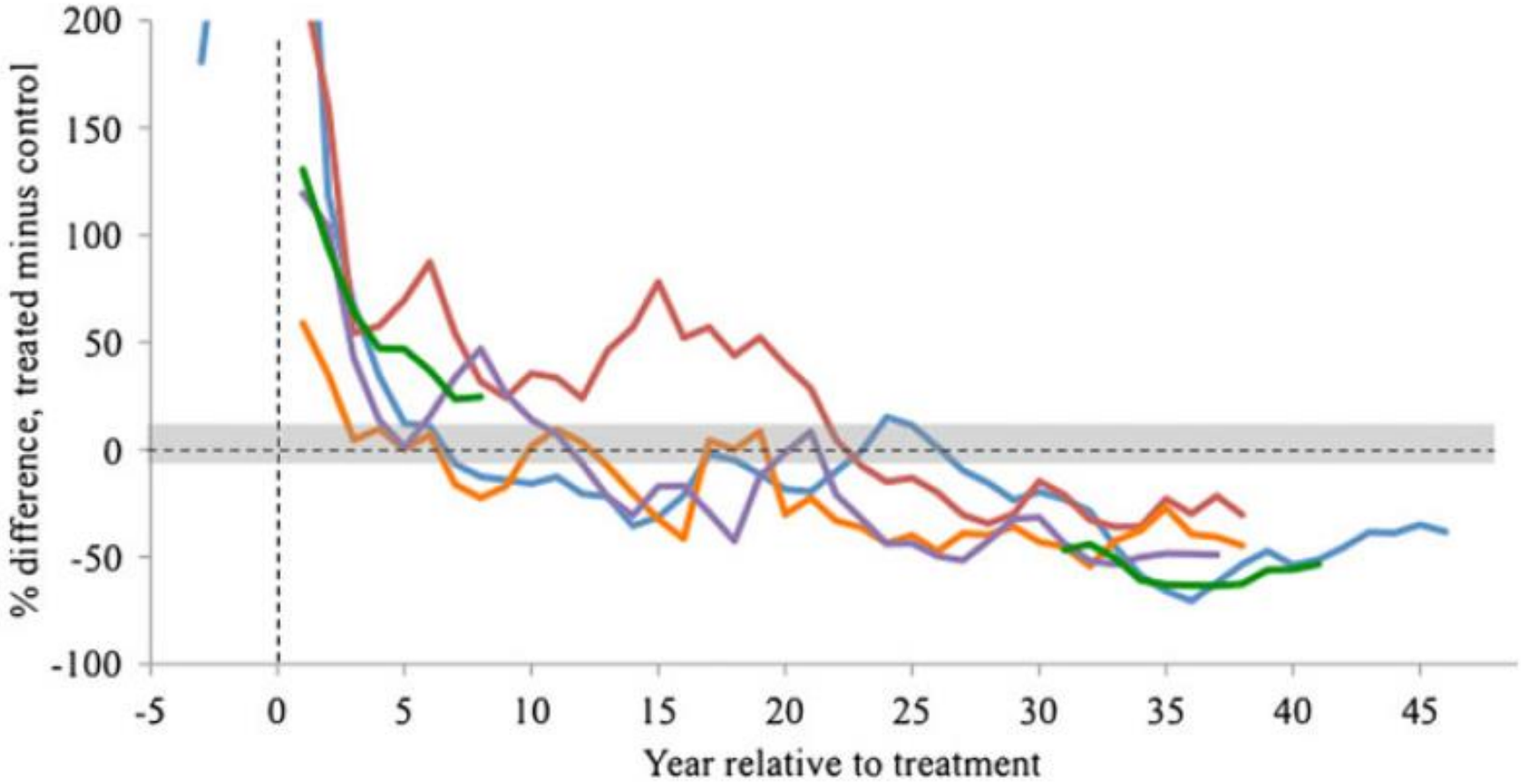
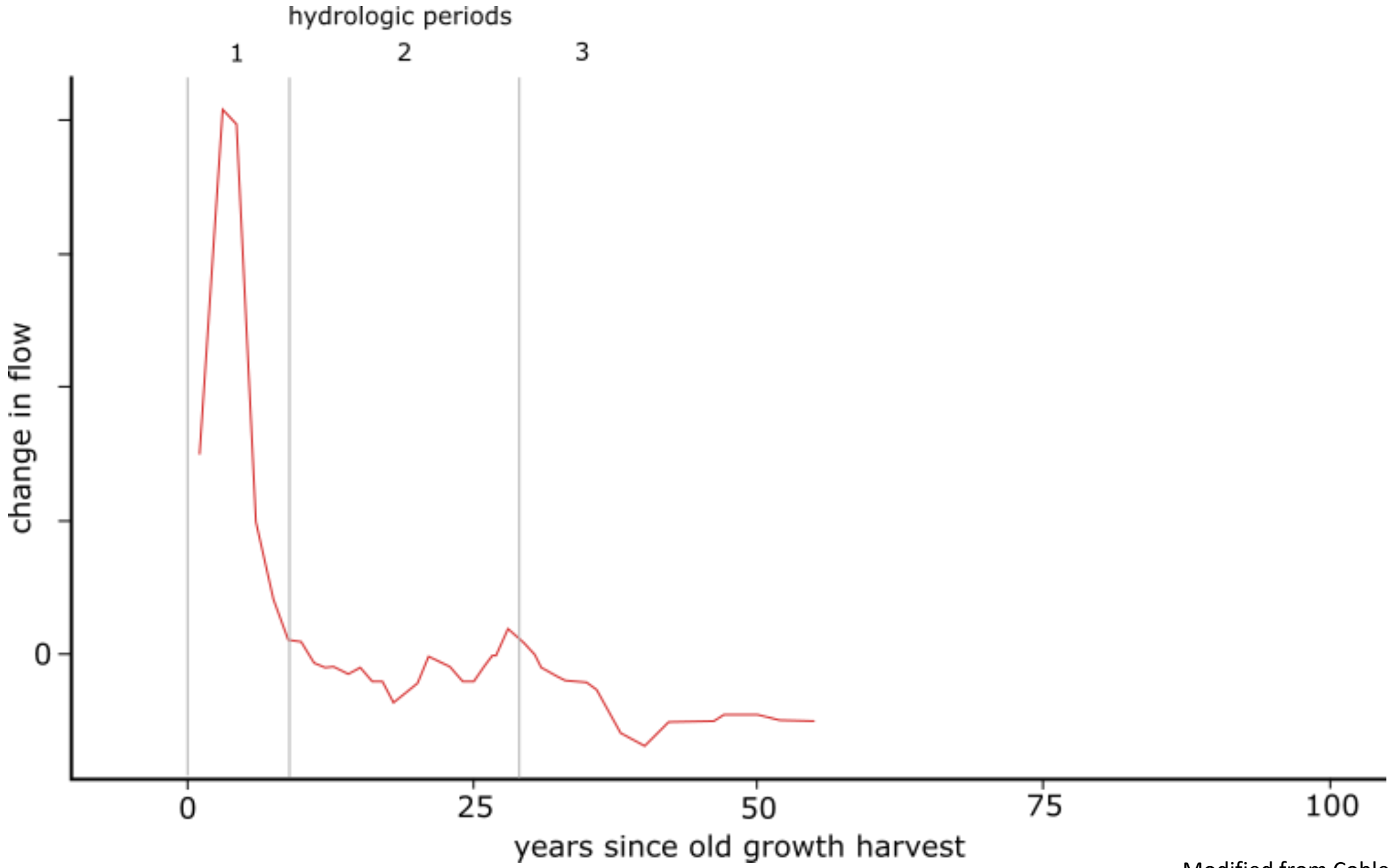


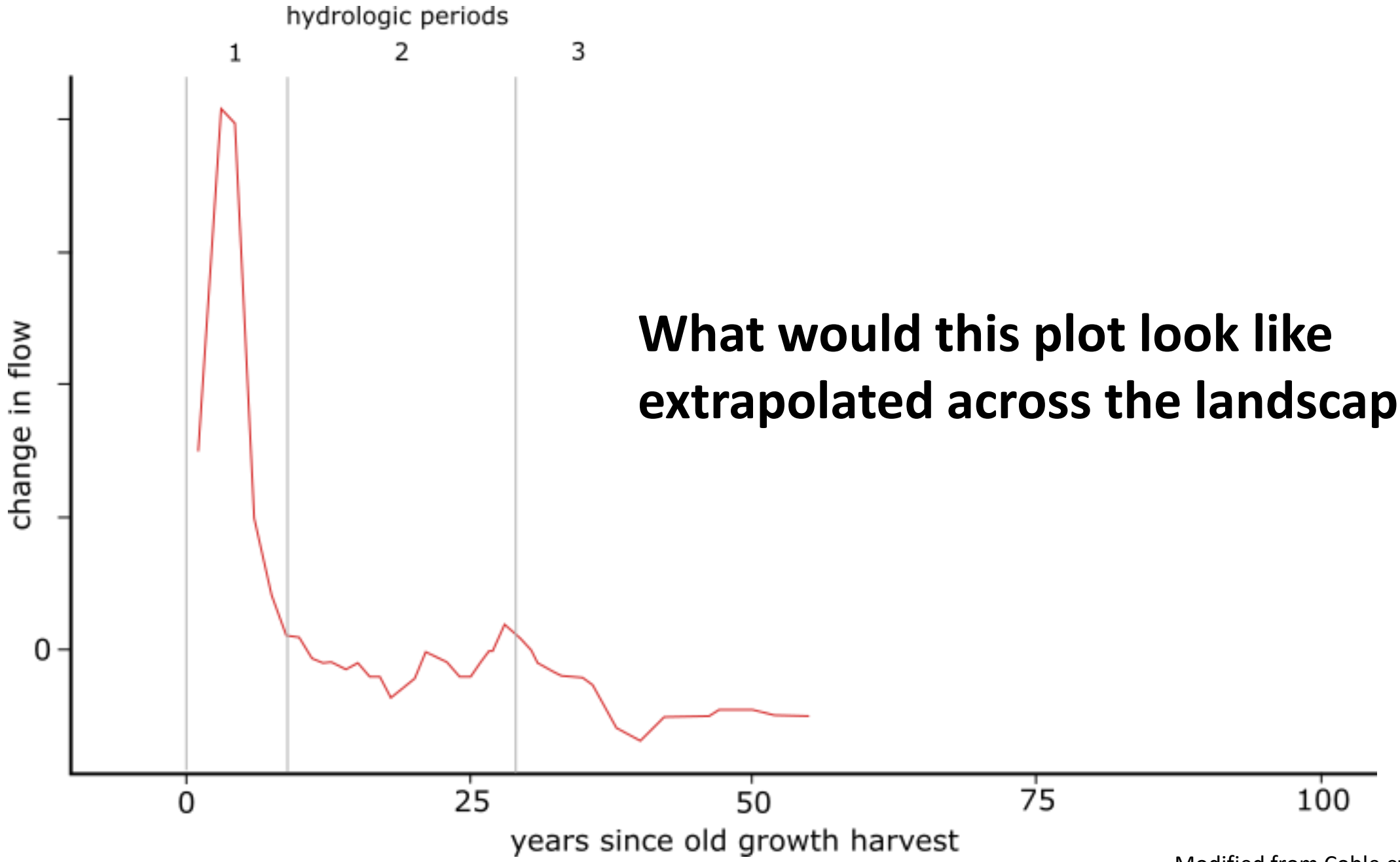


Modified from Coble et al., 2020


WESTERN RED CEDAR

Fisheries impacts of low flow deficits:

- Temporarily lost habitat
- Stream temperature hazards
- Temporarily inaccessible habitat
- Diminished food resources



What would this plot look like extrapolated across the landscape?

Modified from Coble et al., 2020

Goals:

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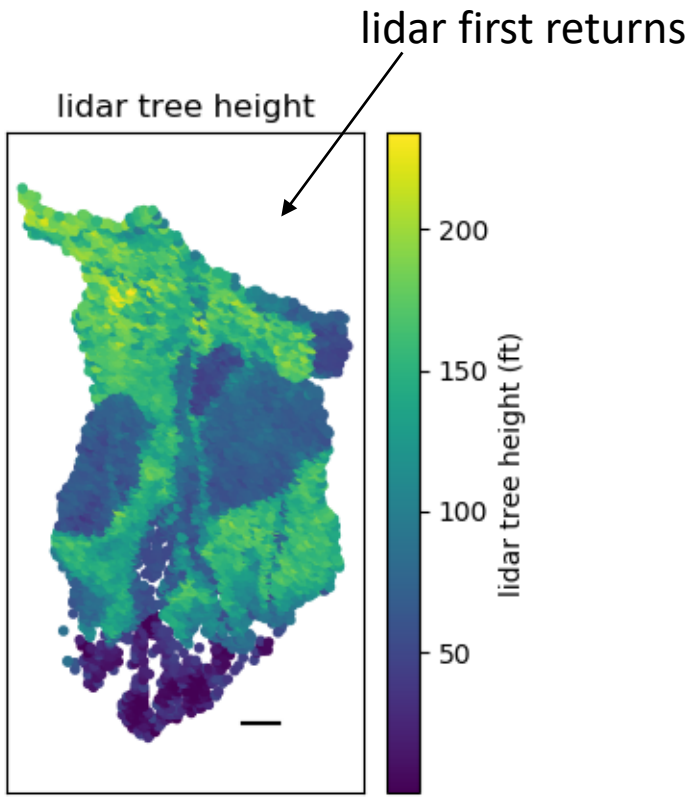
- Create an analysis tool that can be used to estimate forest age structure at the watershed scale
- Estimate summertime low flow changes in important salmon streams in the Skagit River basin

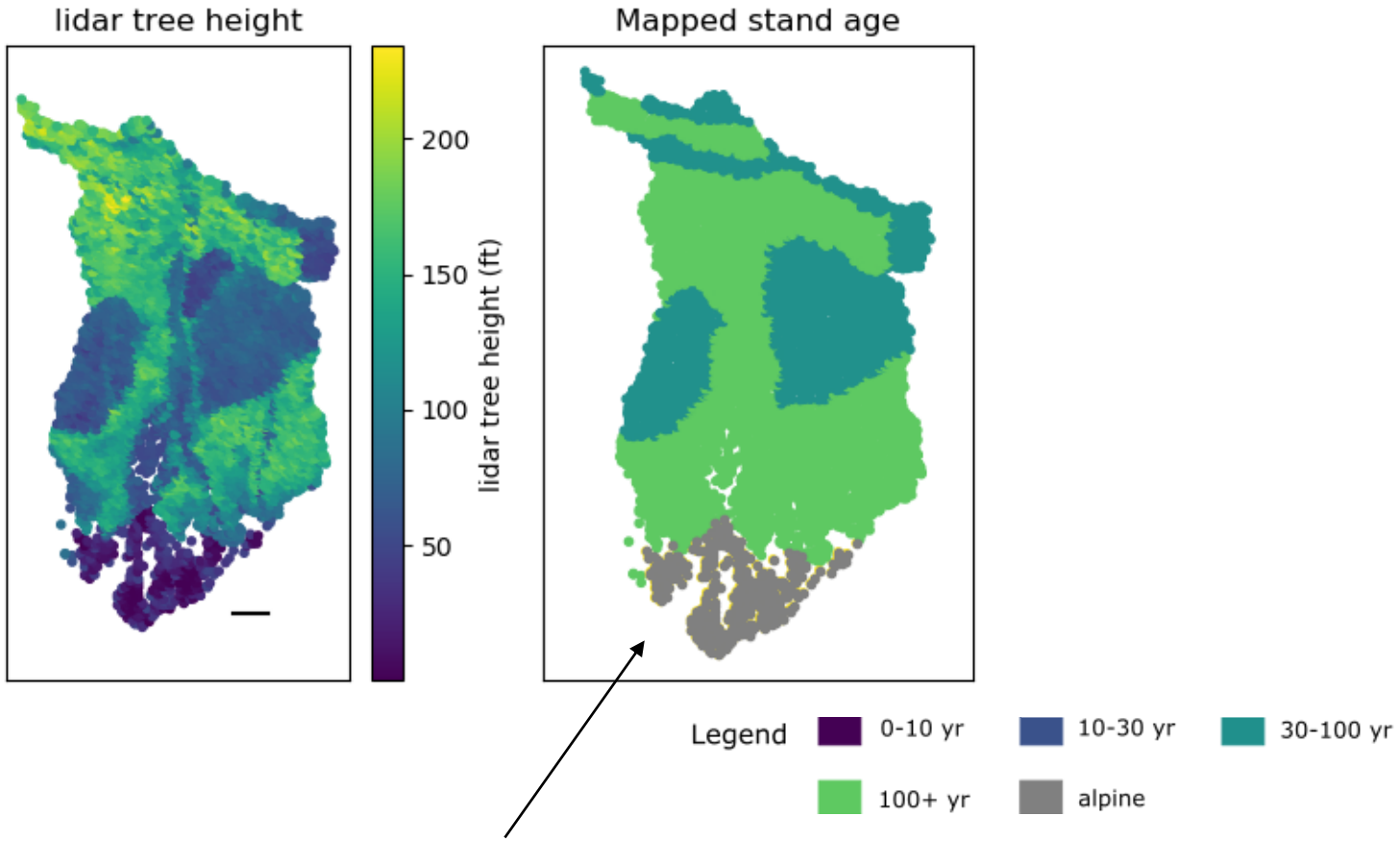
Low **F**low **H**azard **A**ssessment **T**ool

L.F.H.A.T.

Methods

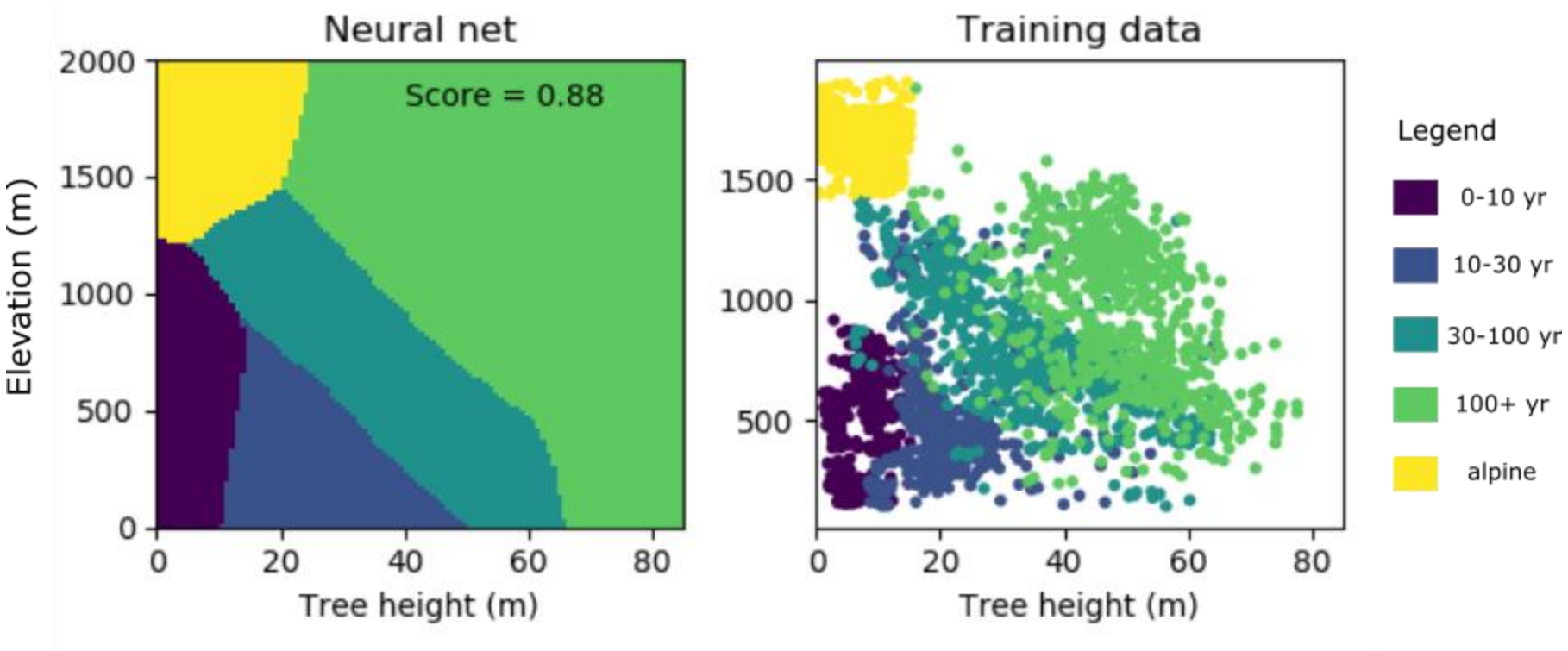

lidar first returns
lidar tree height
200
150
100
50
lidar tree height (ft)

Methods

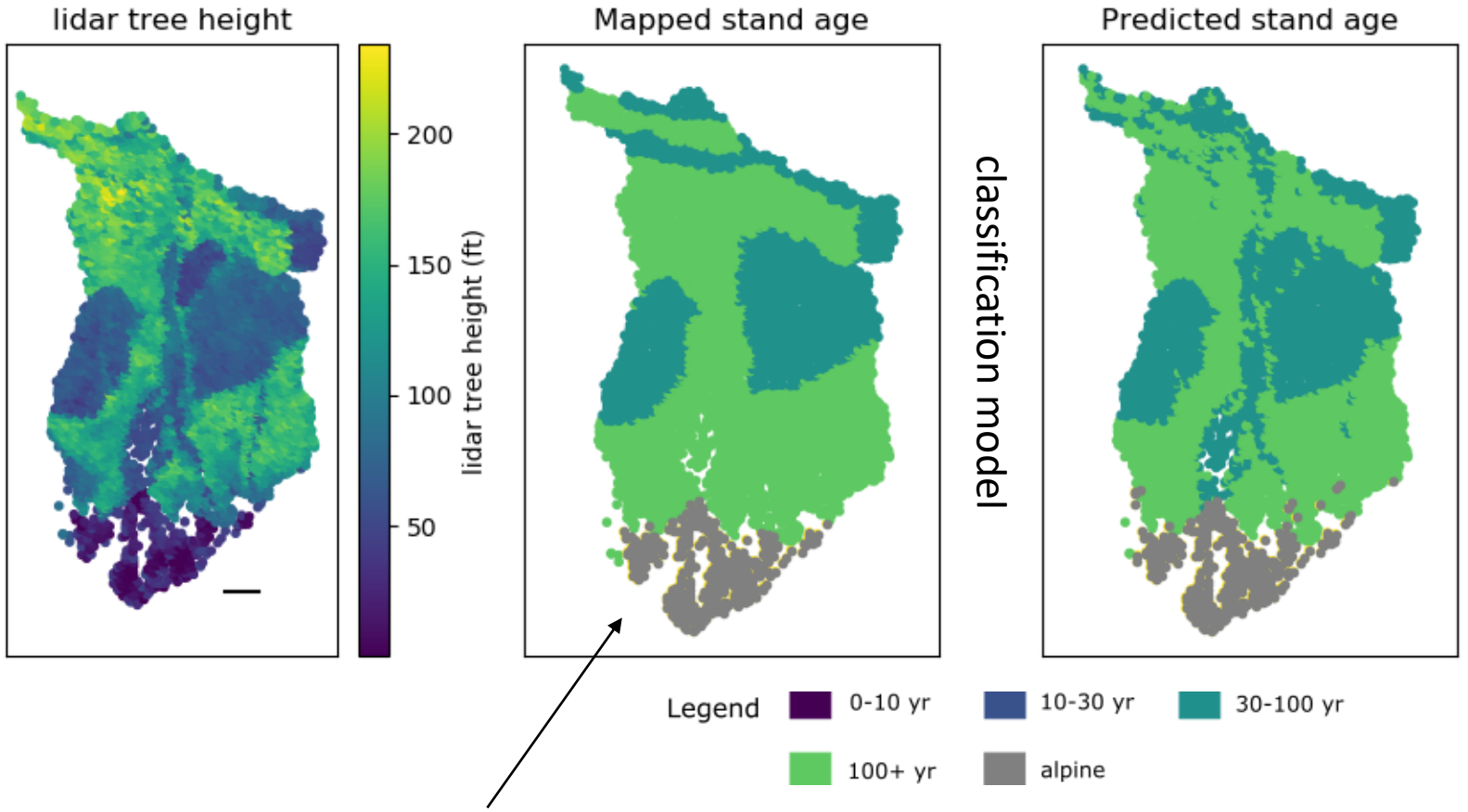


Stand year of origin data from Mount Baker Snoqualmie National Forest

Methods


Neural net
Score = 0.88
Elevation (m)
2000
1500
1000
500
0
0
20
40
60
80
Tree height (m)
Training data
1500
1000
500
0
20
40
60
80
Tree height (m)
Legend
0-10 yr
10-30 yr
30-100 yr
100+ yr
alpine

Methods



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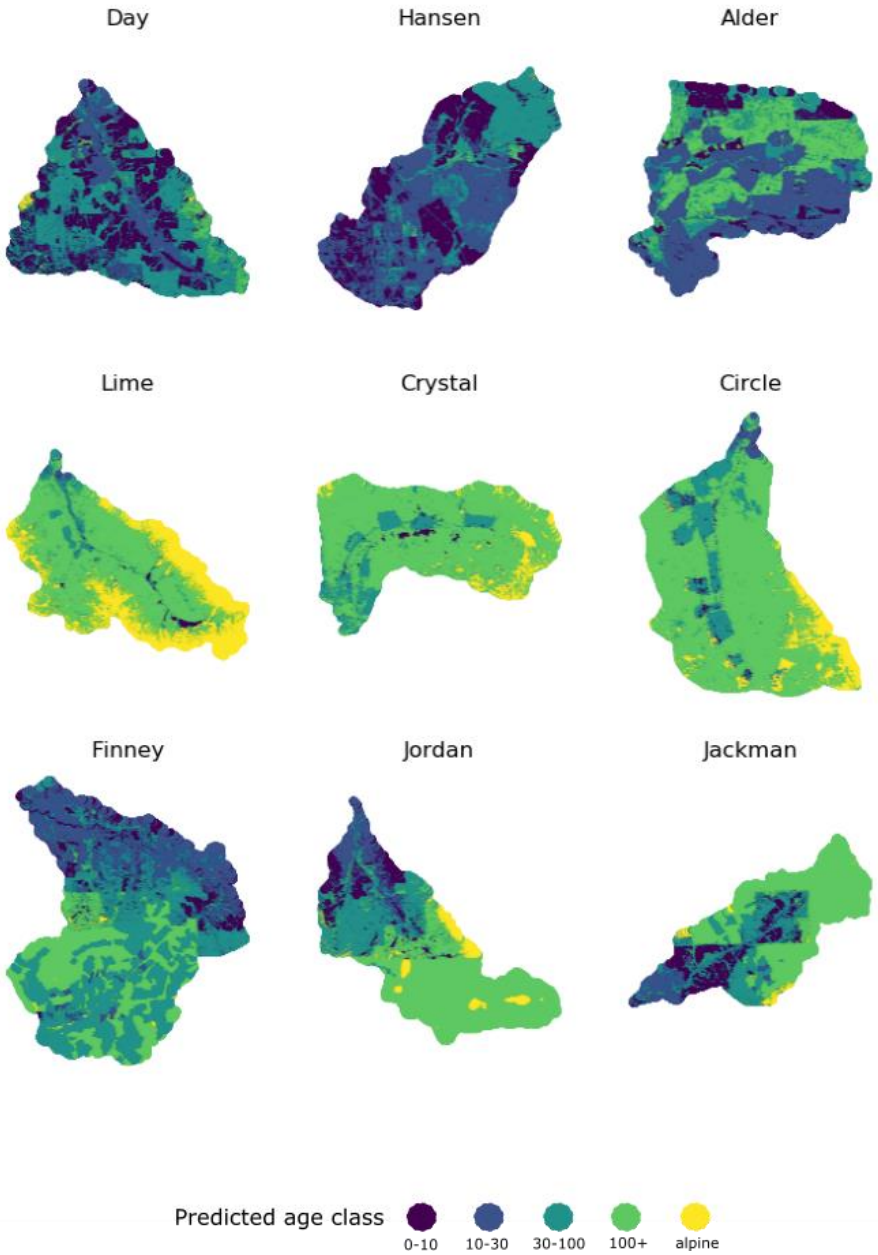
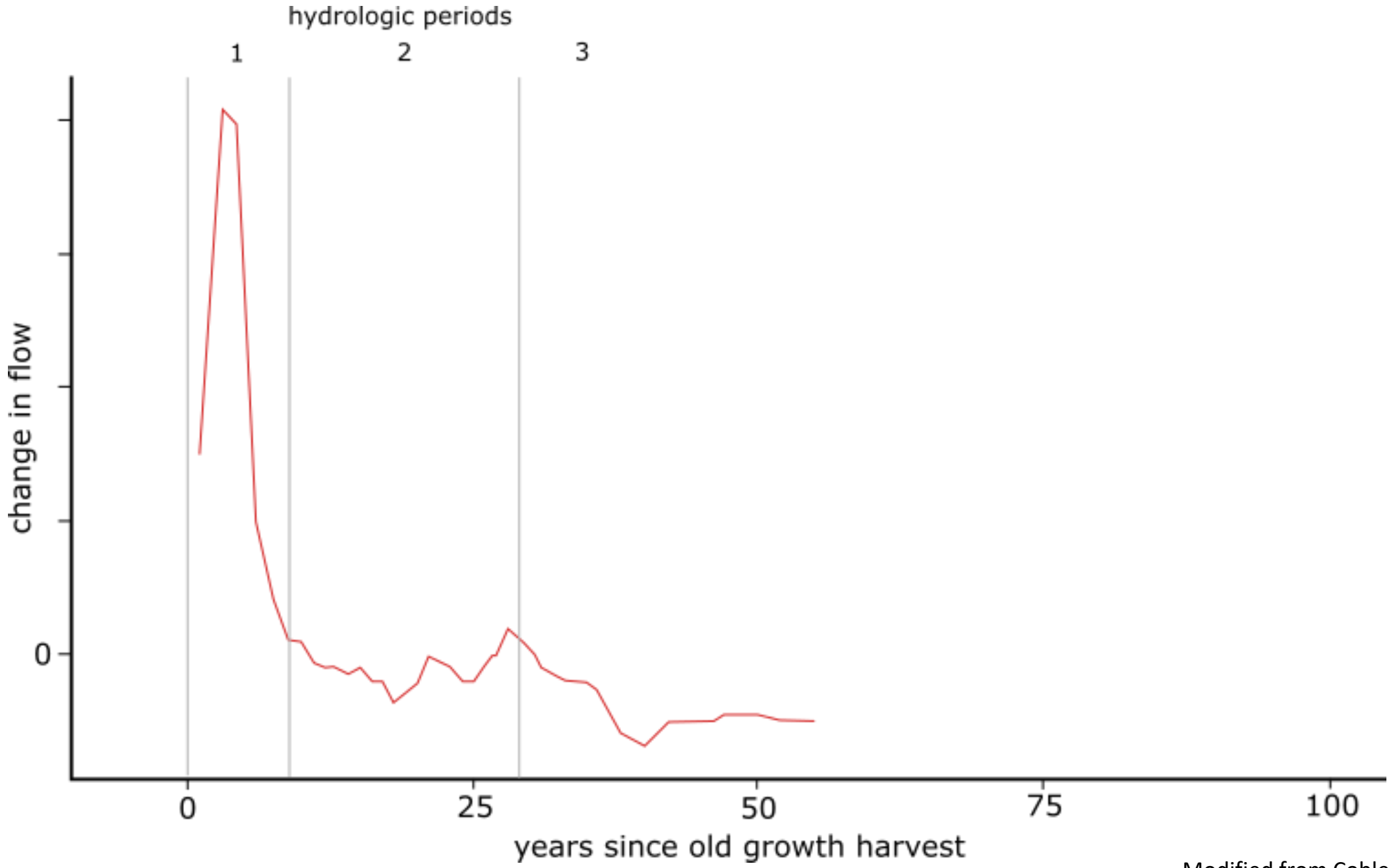
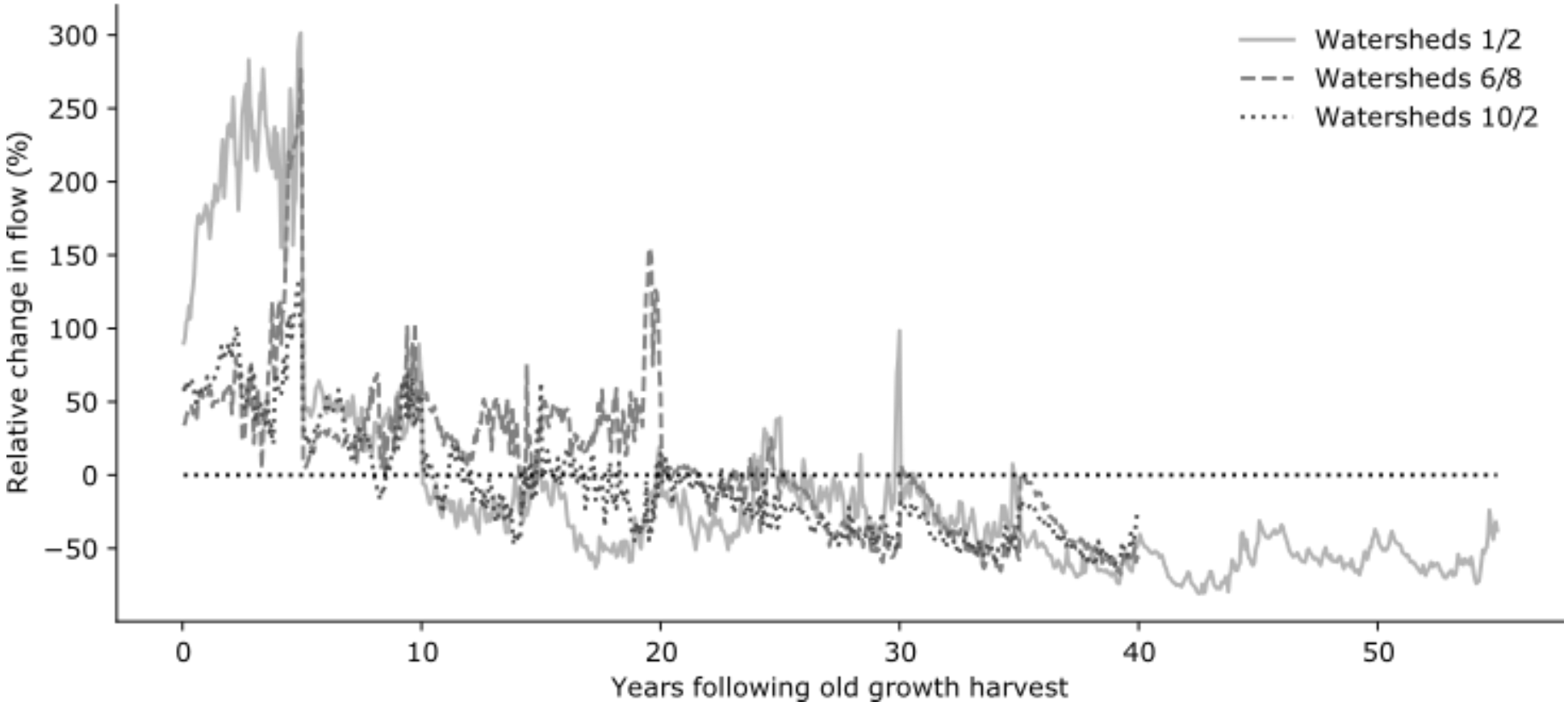
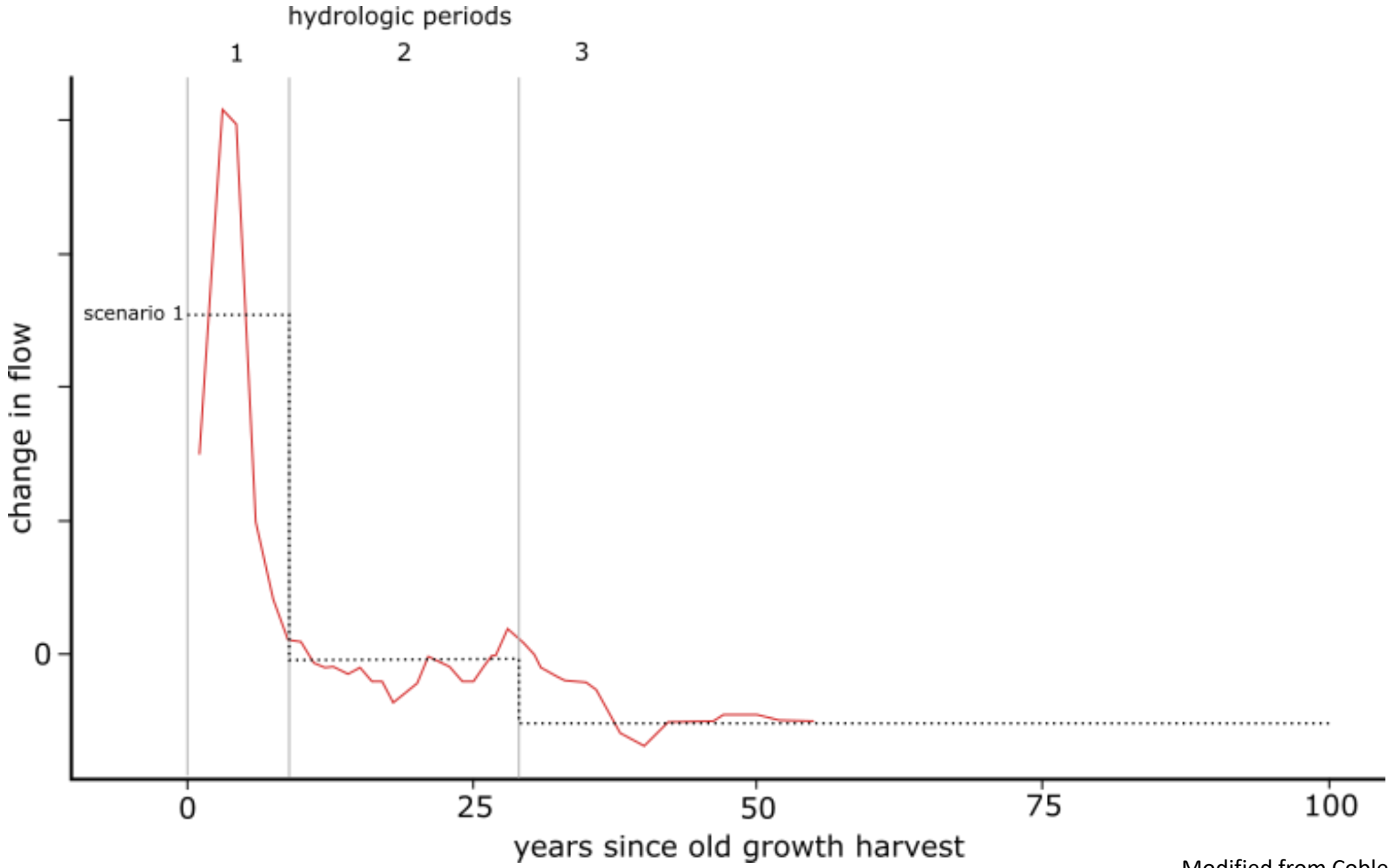

Day
Hansen
Alder
Lime
Crystal
Circle
Finney
Jordan
Jackman
Predicted age class
0-10
10-30
30-100
100+
alpine



Modified from Coble et al., 2020

Using the empirical record of flow change from the HJ Andrews Experimental Forest



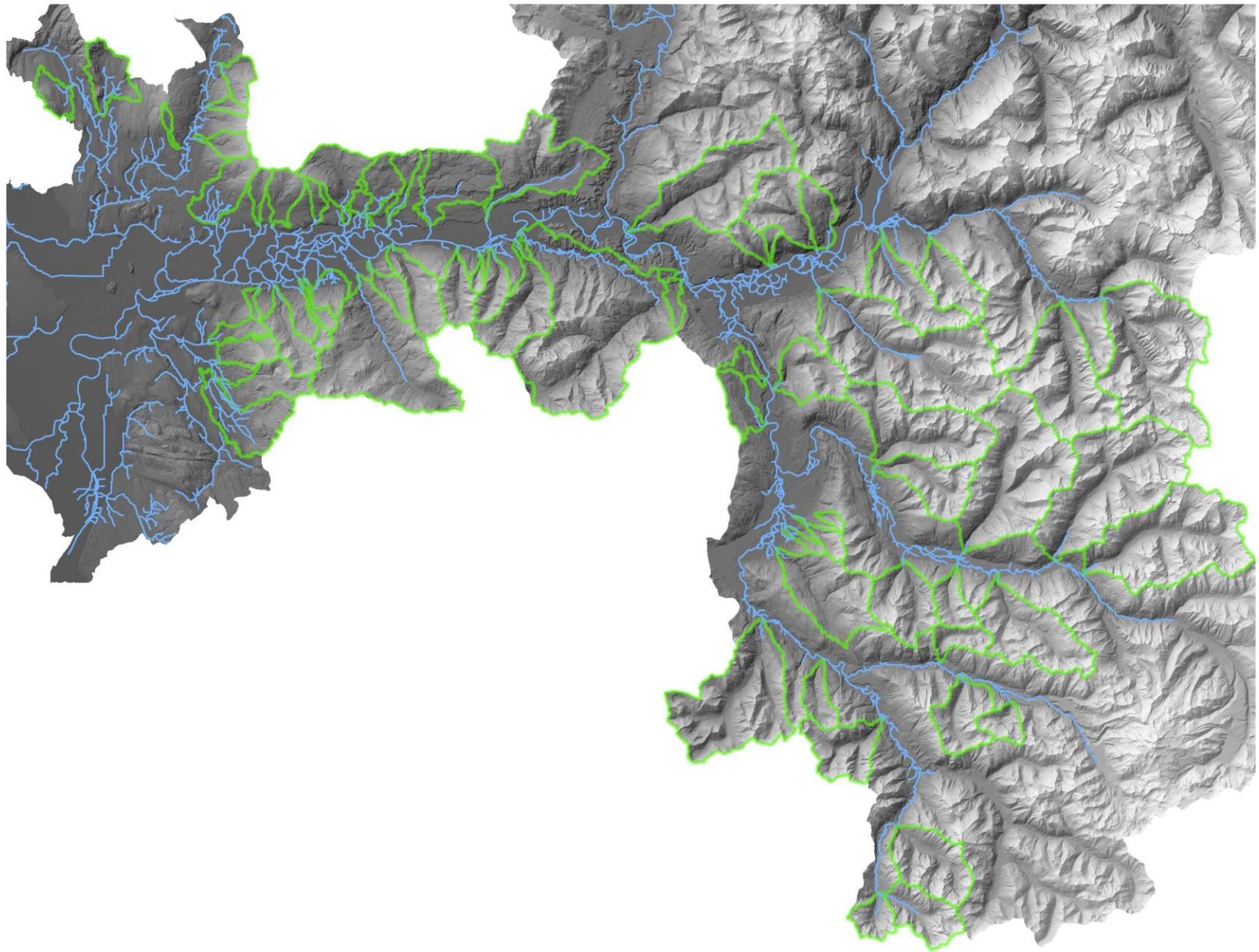


Modified from Coble et al., 2020

Application: Skagit River tributary streams

The Skagit River valley

Application: Skagit River tributary streams



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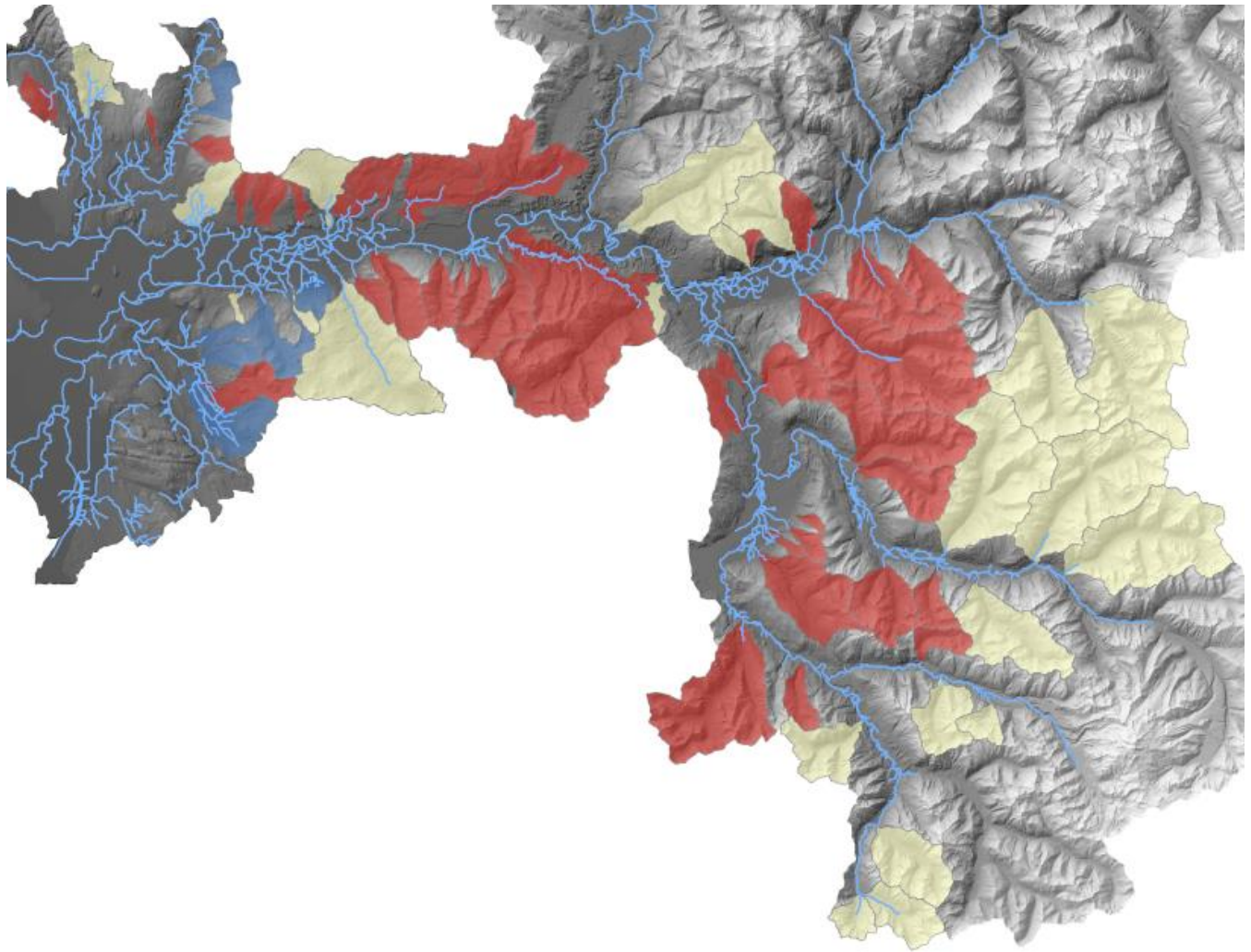
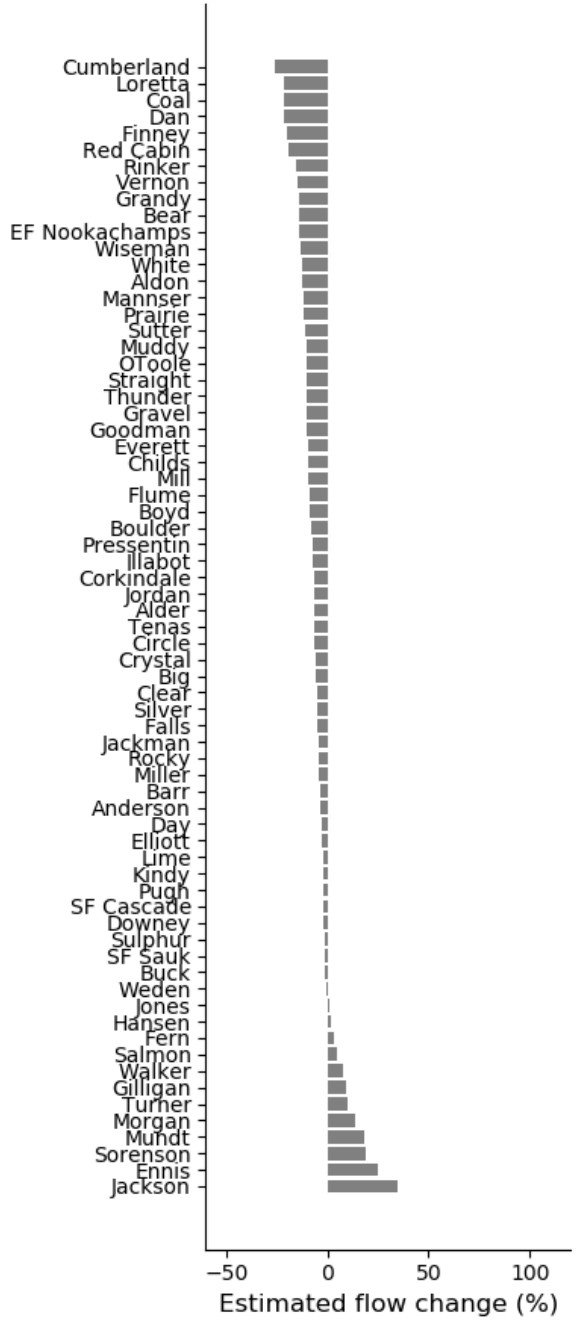


Estimated flow change (%)

-25 to -5

-5 to +5

5 to 35



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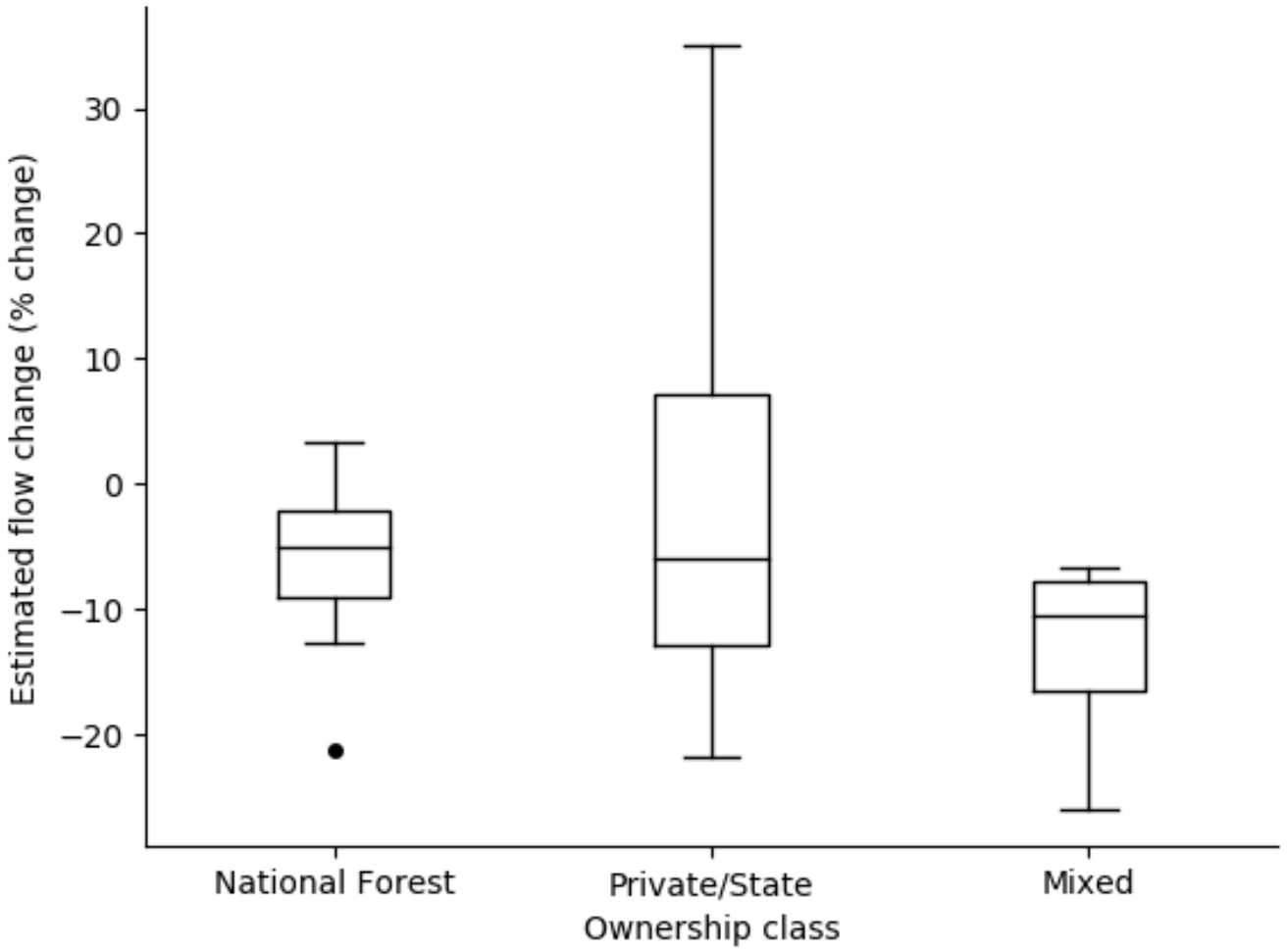

Estimated flow change in three land ownership classes

Summary

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    - Wide range of responses due to mix of stand conditions on the ground.
- Mixed ownership basins tend to have greater flow deficits due to history of extensive Forest Service harvest combined with little current harvest in the National Forest.
- Private and state forests have a wide range of forestry-related flow impacts due to diverse land use history.

Contact: gseixas@skagitcoop.org