



Modeling alternative future land use and climate change scenarios (1990–2100) for all major Puget Sound river basins (~30,000 km²)

Jonathan Halama¹

VELMA Team: Bob McKane¹, Allen Brookes¹, Sonali Chokshi¹, Kevin Djang²

¹US EPA, Corvallis, OR 97333; ²Inoventures LLC, c/o US EPA, Corvallis, OR 97333

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Puget Sound Integrated Modeling Framework (PSIMF)



<https://www.pugetsoundinstitute.org/about/pugetsoundmodeling/>

EPA PSIMF Team

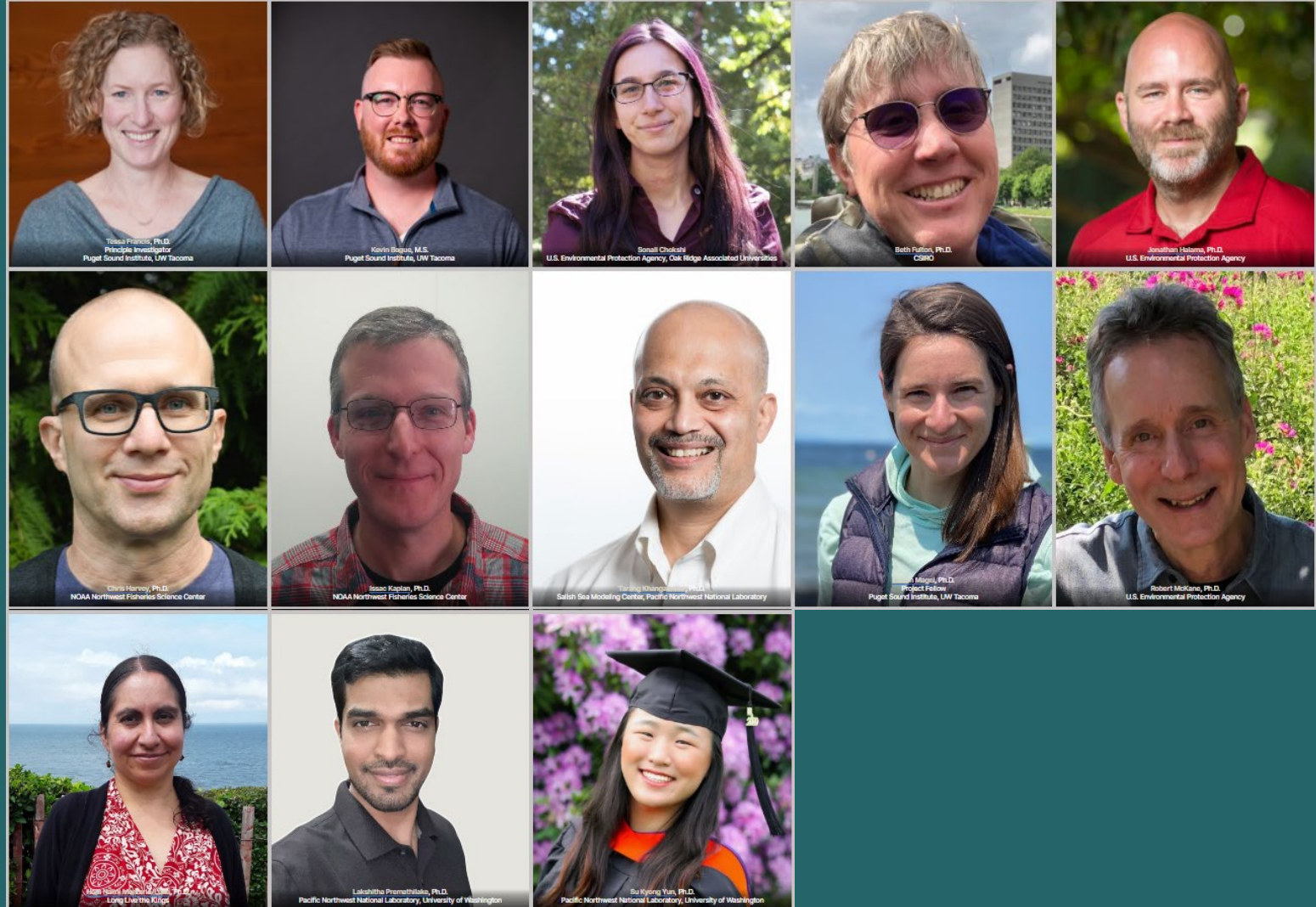
Puget Sound Institute
EPA Region 10 (Pacific Northwest)

CSIRO - Commonwealth Scientific and Industrial Research Organisation

NOAA Northwest Fisheries Science Center

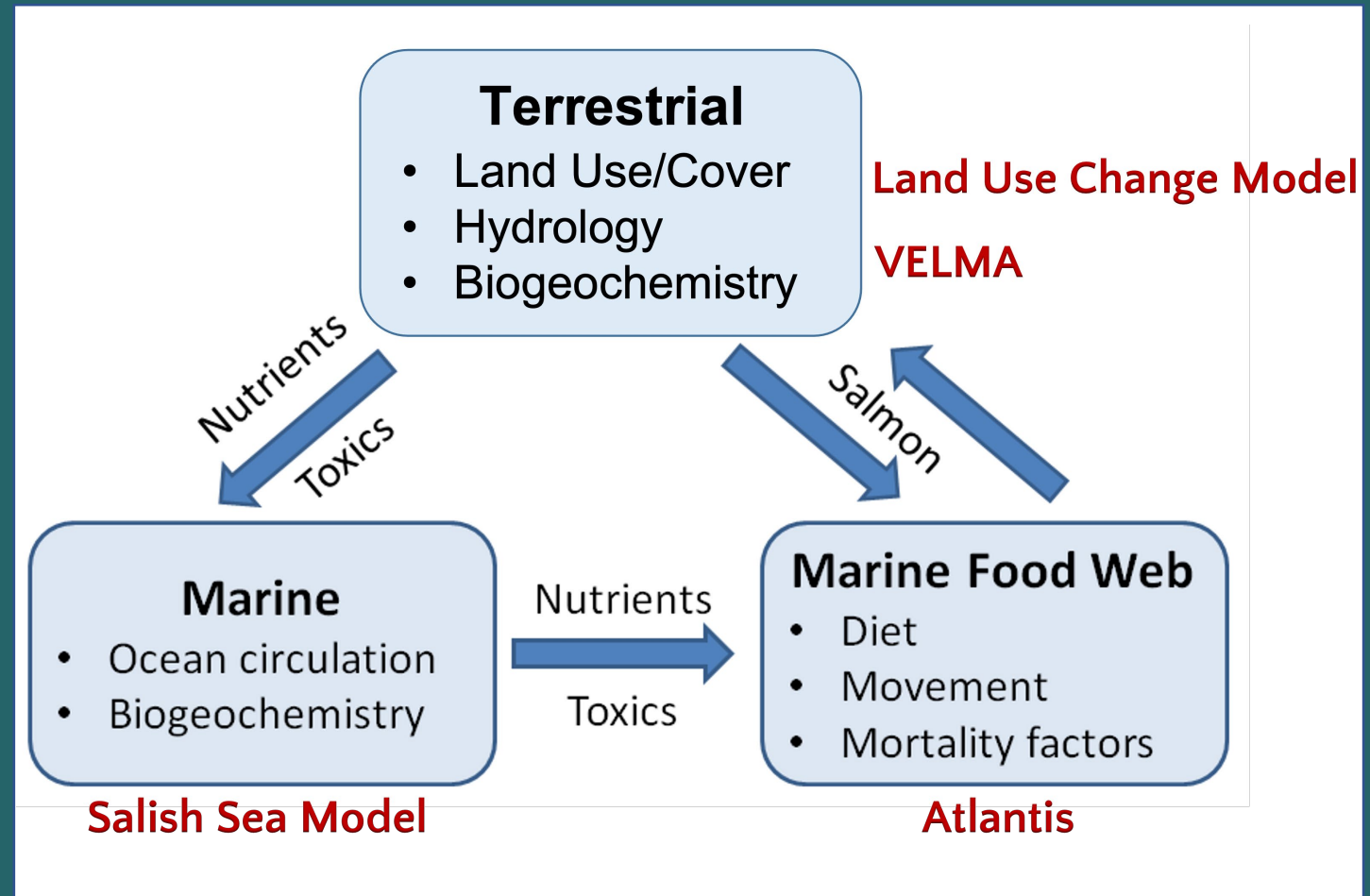
Salish Sea Modeling Center, Pacific Northwest National Laboratory

Long Live the Kings





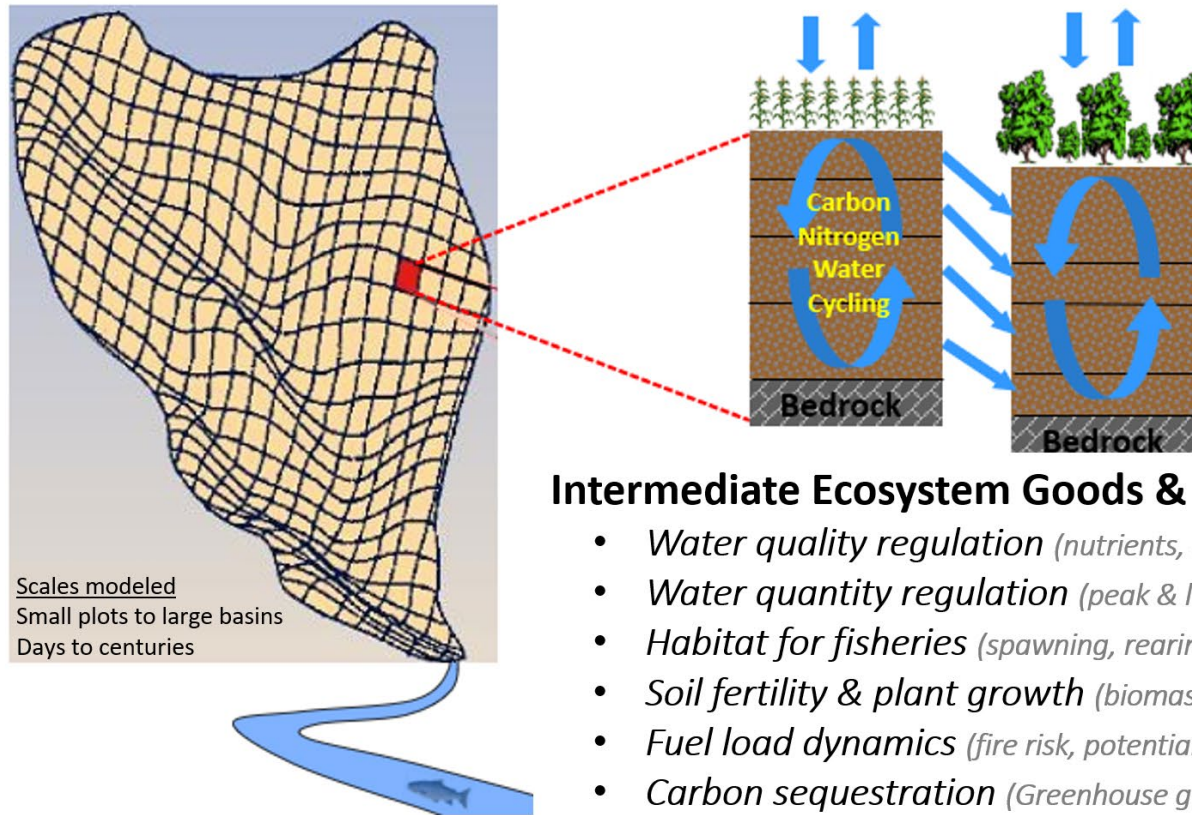
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VELMA Ecohydrological Model

Drivers of change: Climate, harvest, fire, nutrient & contaminant deposition, urbanization



Scales modeled
Small plots to large basins
Days to centuries

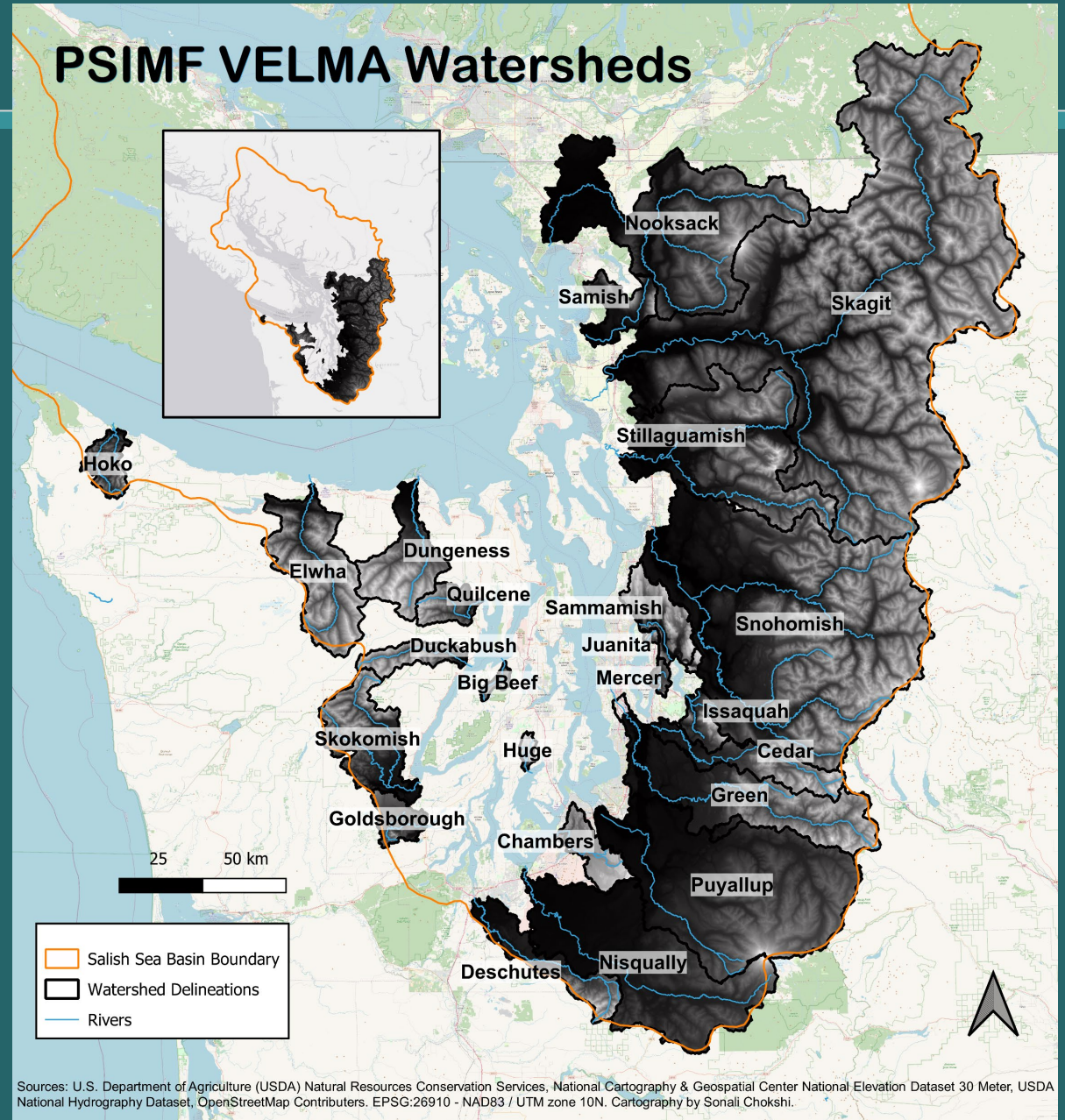
Intermediate Ecosystem Goods & Services

- *Water quality regulation (nutrients, contaminants, temperature)*
- *Water quantity regulation (peak & low flows, landscape aridity)*
- *Habitat for fisheries (spawning, rearing)*
- *Soil fertility & plant growth (biomass for food, fiber)*
- *Fuel load dynamics (fire risk, potential severity)*
- *Carbon sequestration (Greenhouse gas dynamics)*



Skagit
Snohomish
Puyallup
Nooksack
Nisqually
Deschutes
Elwha
Dungeness
Quilcene
Duckabush
Skokomish
Goldsborough

Big Beef
Huge
Issaquah
Duwamish/Green
Chambers
Juanita
Mercer
Sammamish
Hoko
Samish
Cedar
Stillaguamish

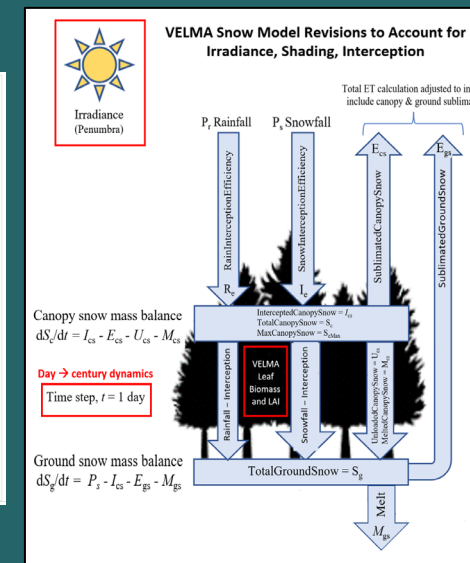
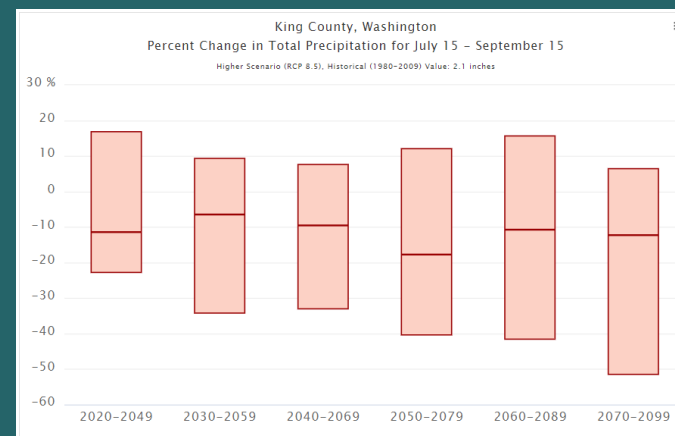
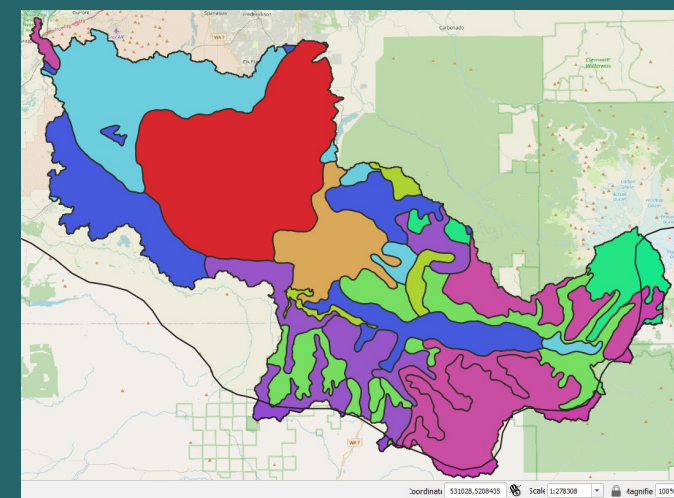
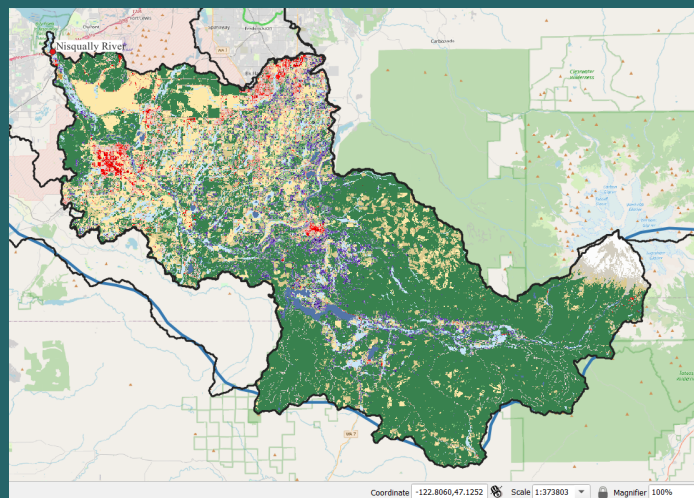


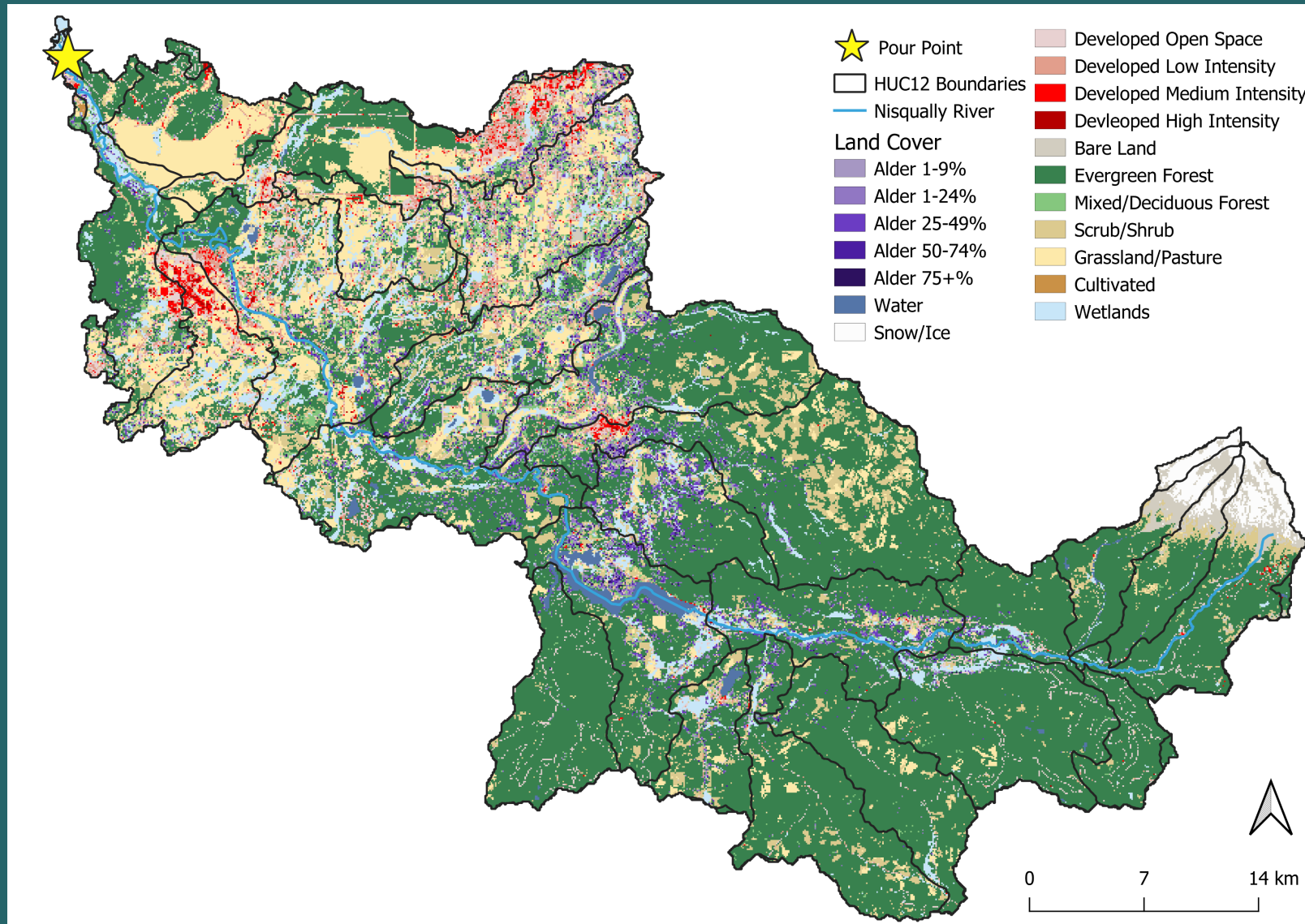
Coverage Data

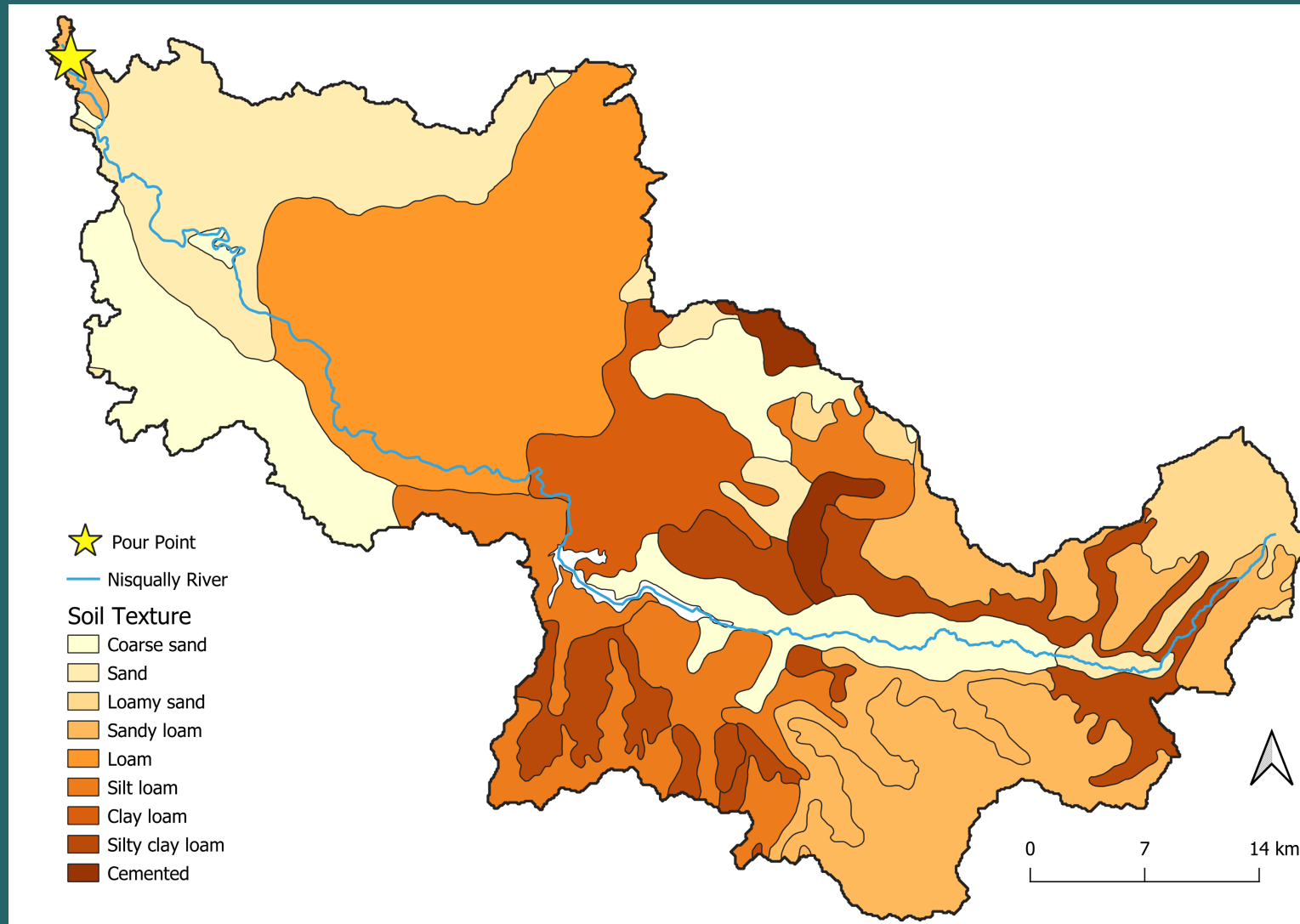
- NCLD categories
- Alder

Soils Data

- Textures
 - Effective Depth / Depth to bedrock
- ## Snow Model Enhancements

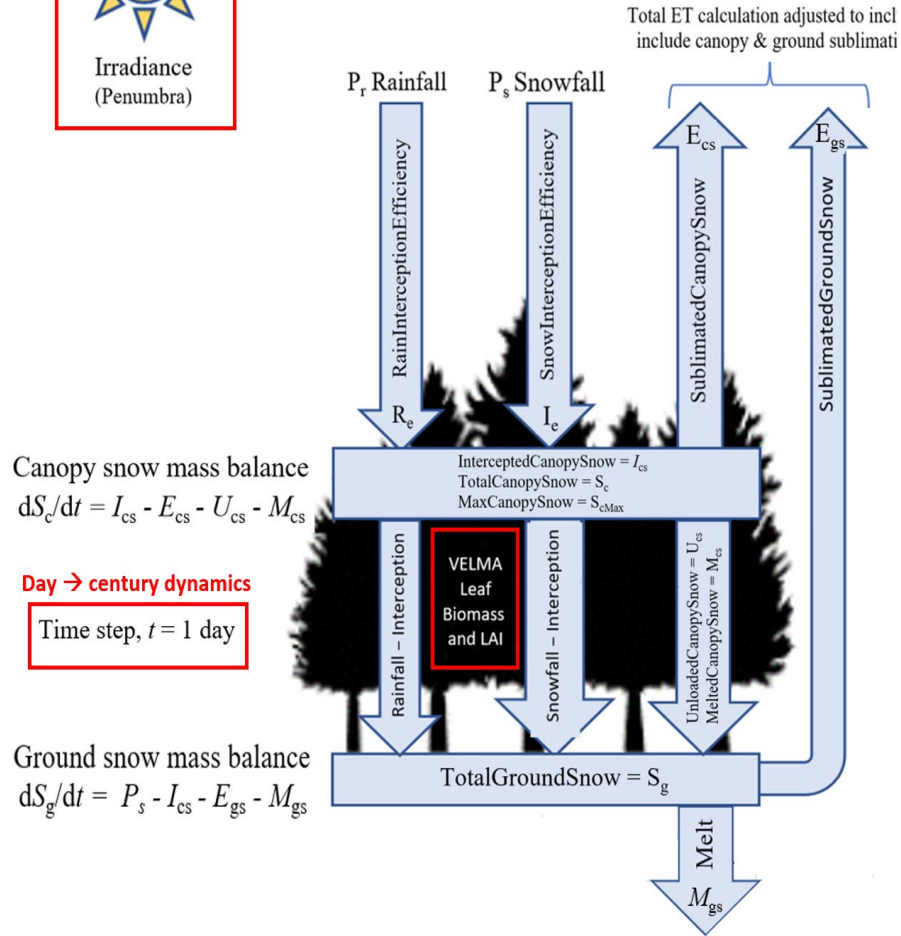








VELMA Snow Model Revisions to Account for Irradiance, Shading, Interception



Current Snow Model: Works well for open site locations; tested against SNOTEL sites.

Improvements:

- effects of canopy shading
- snow canopy interception

Land Cover Change impact on:

- Flow
- Nutrients
- Contaminants
- Stream Temperature

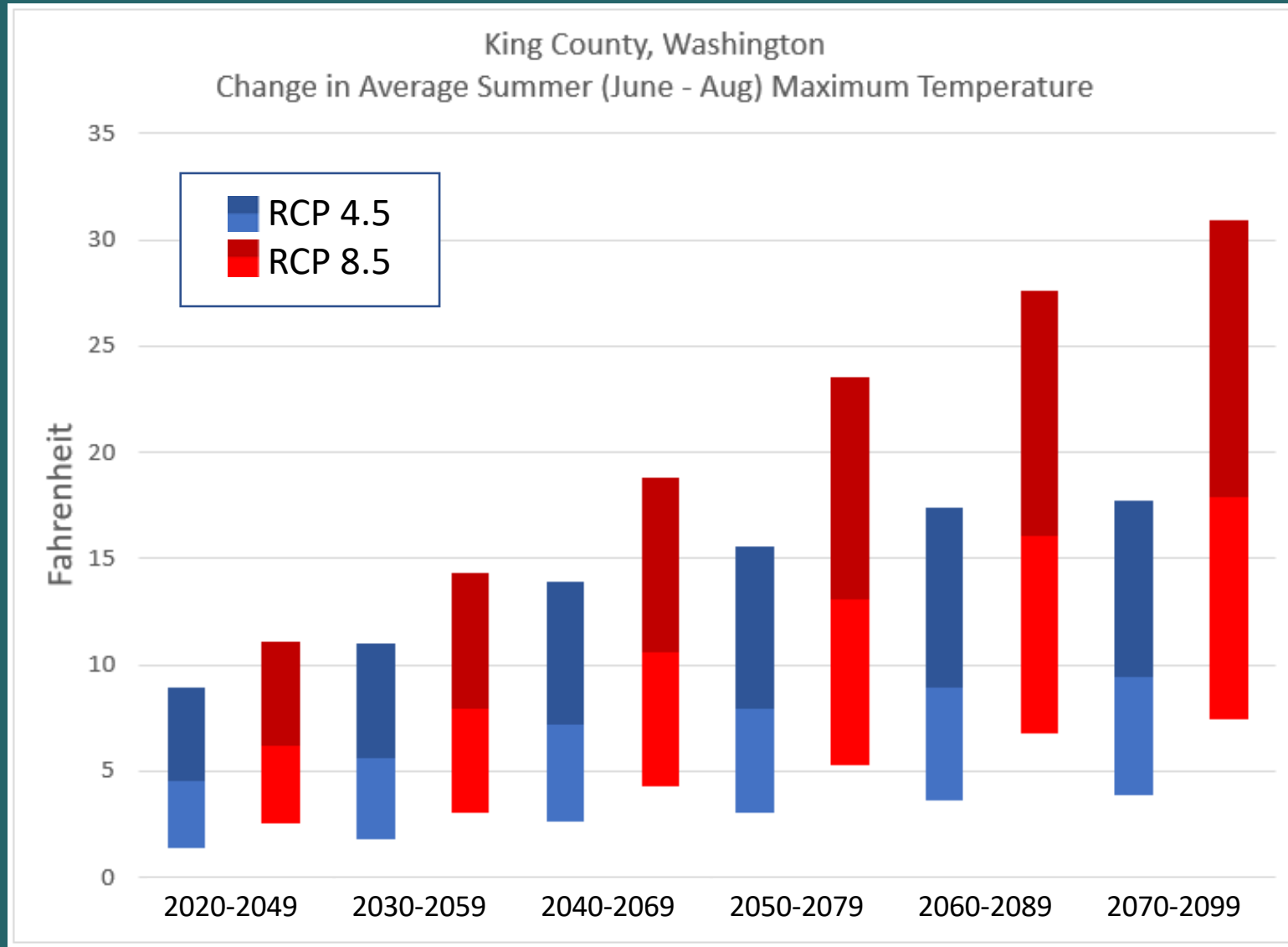
Climate Change impact on:

- Summer Low Flows
- Late Summer Stream Temperature



Climate Change Scenarios

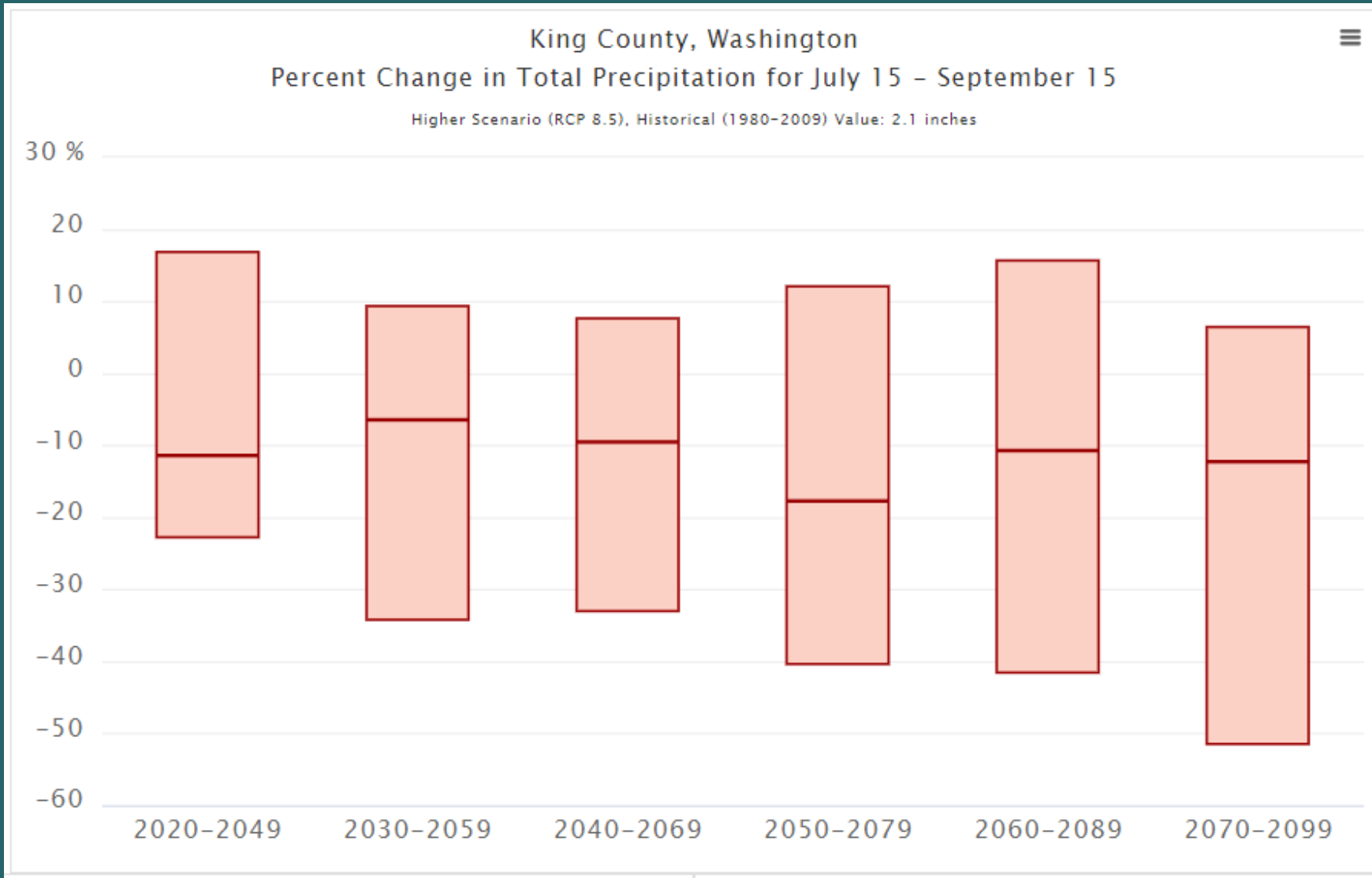
GUILLAUME MAUGER, PH.D.
<https://cig-wa-climate.nkn.uidaho.edu/>





Climate Change Scenarios

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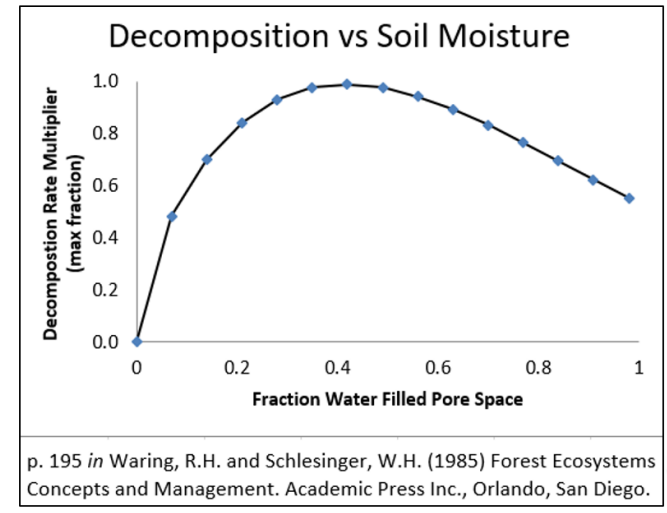
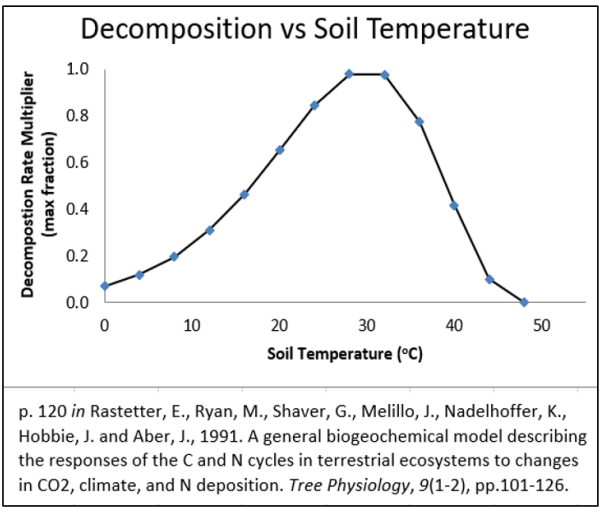
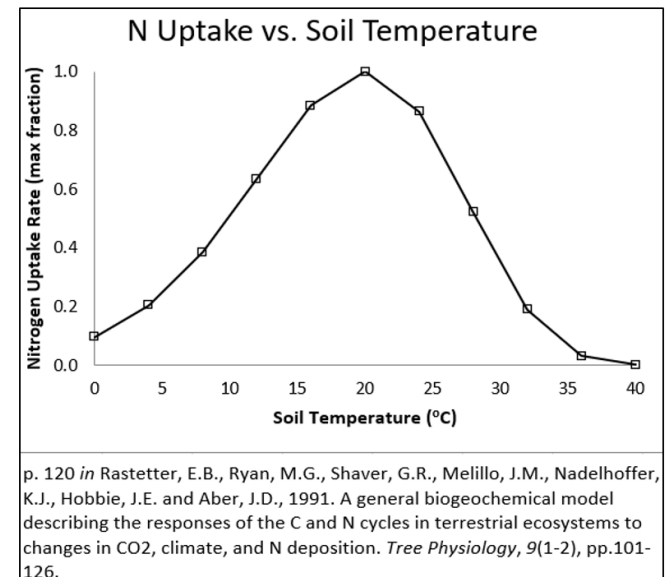
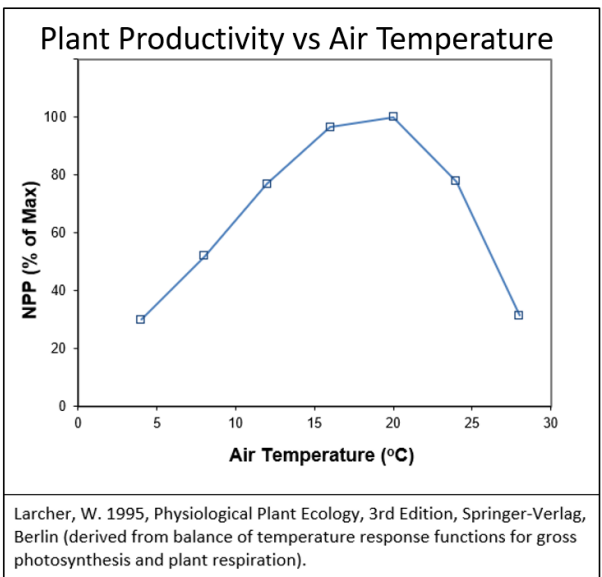
Climate Change Impact on VELMA

McKane et al.,

Climate change effects in VELMA are nonlinear



Thresholds, Tipping Points

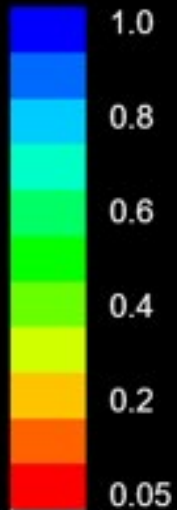




Climate Warming Impact on Soil Moisture

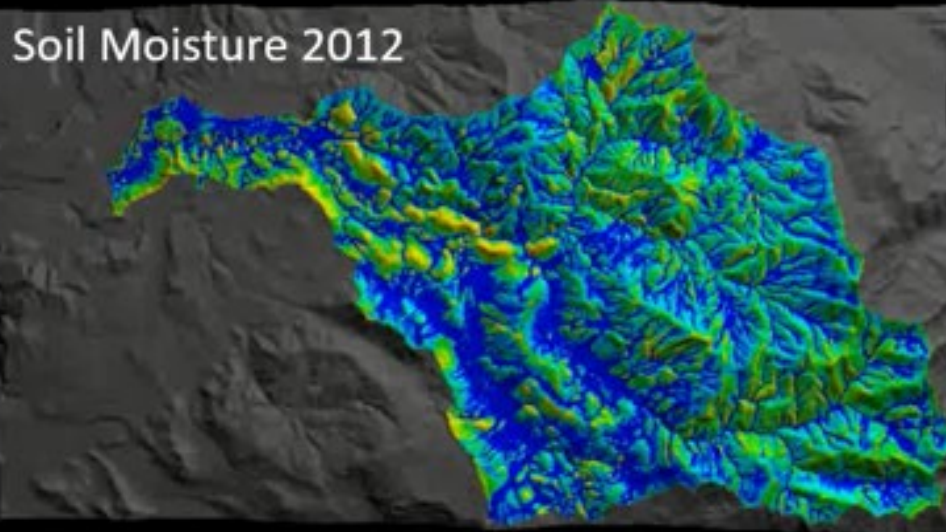
McKane et al.,

Soil Moisture
at 75 cm Depth
(% Saturation)



2012

MM-DD
10-09



Mashel River Watershed, WA
209 km²

2112

MM-DD
10-09



% Difference
in Streamflow,
2112 compared to 2012





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McKane et al.,

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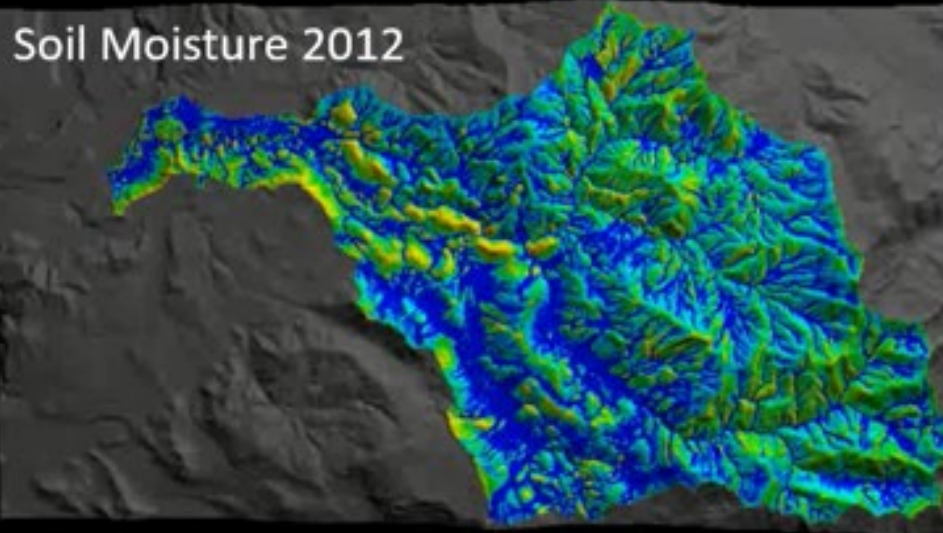
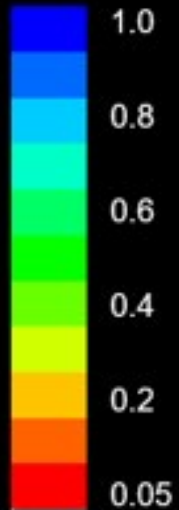
2012

MM-DD
10-09

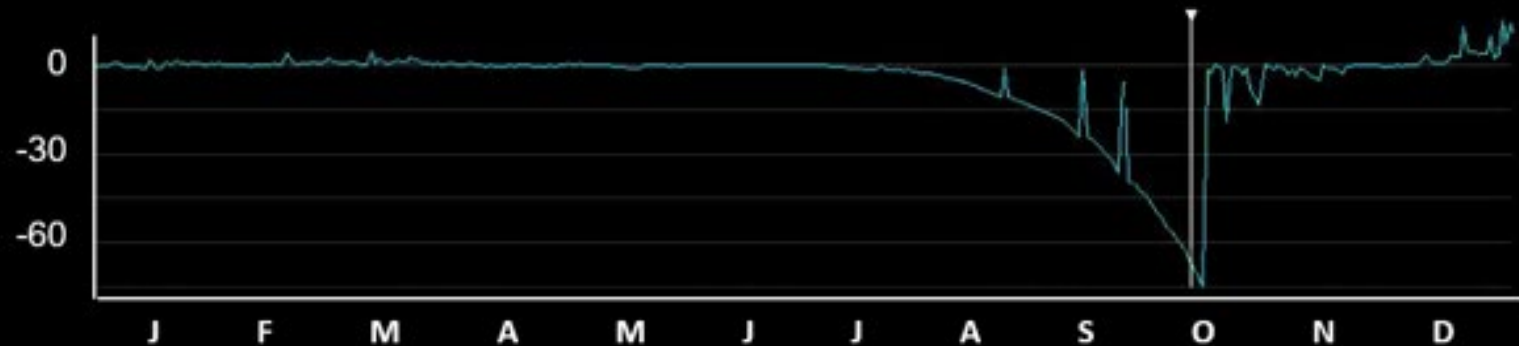
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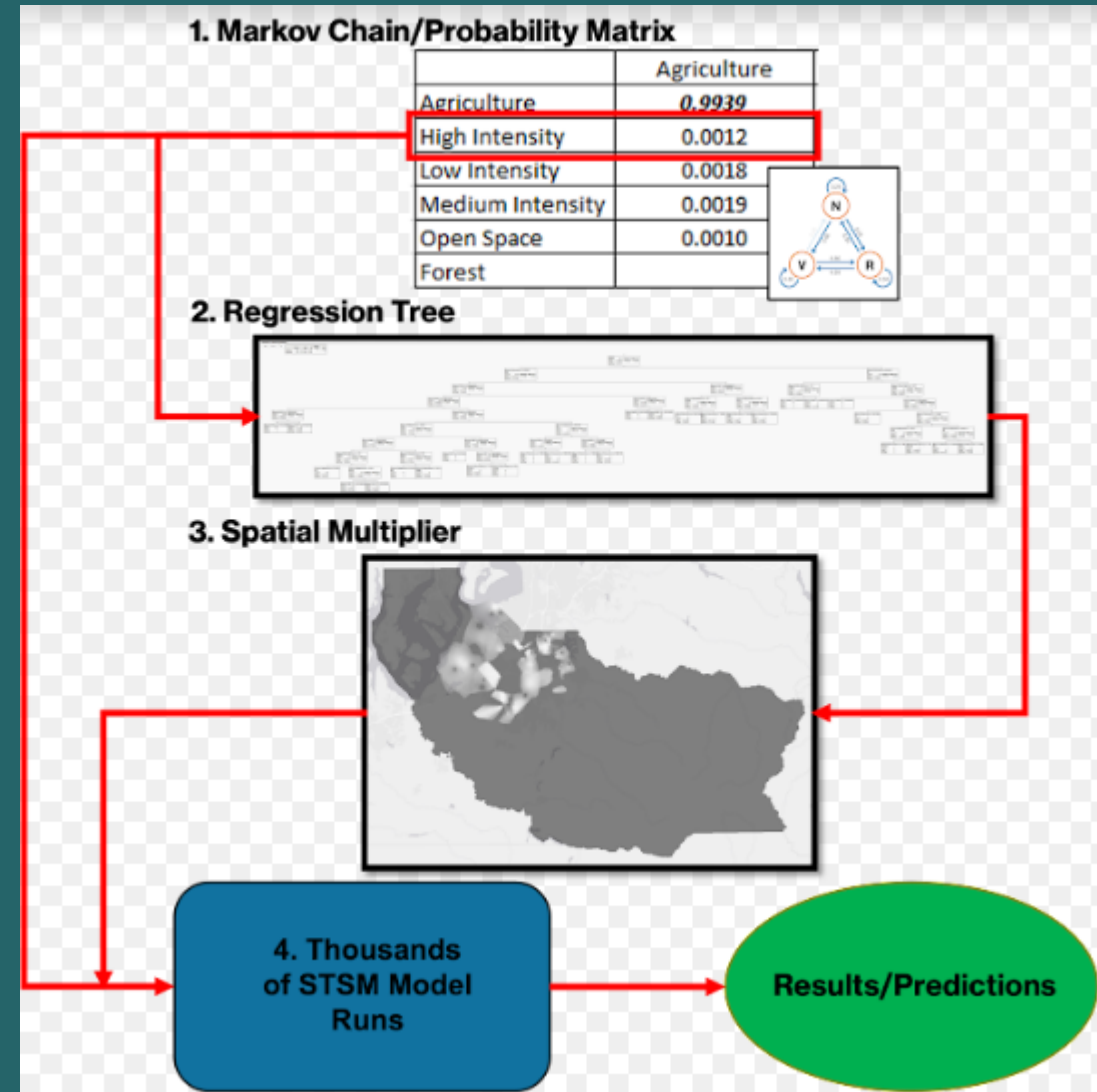
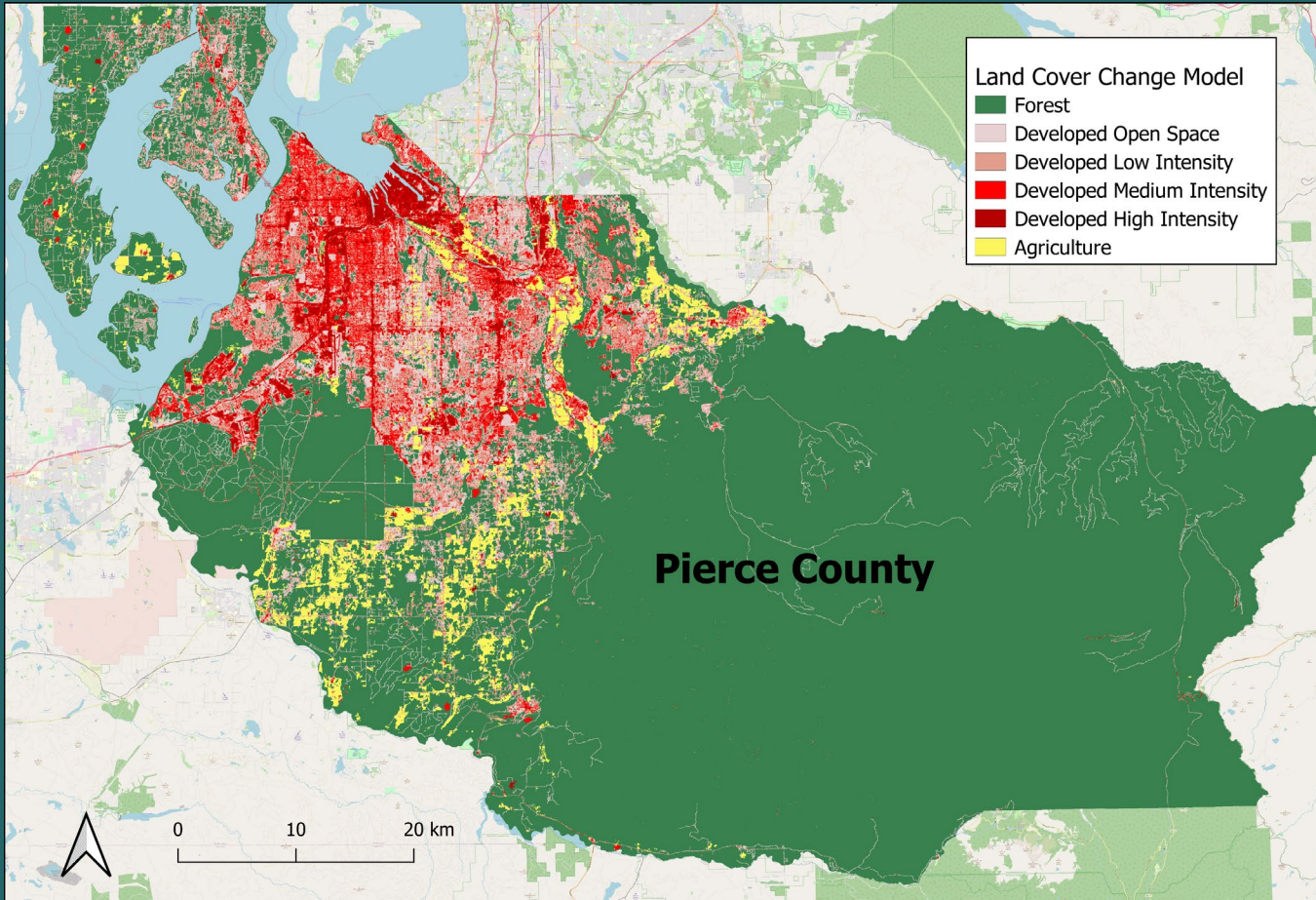
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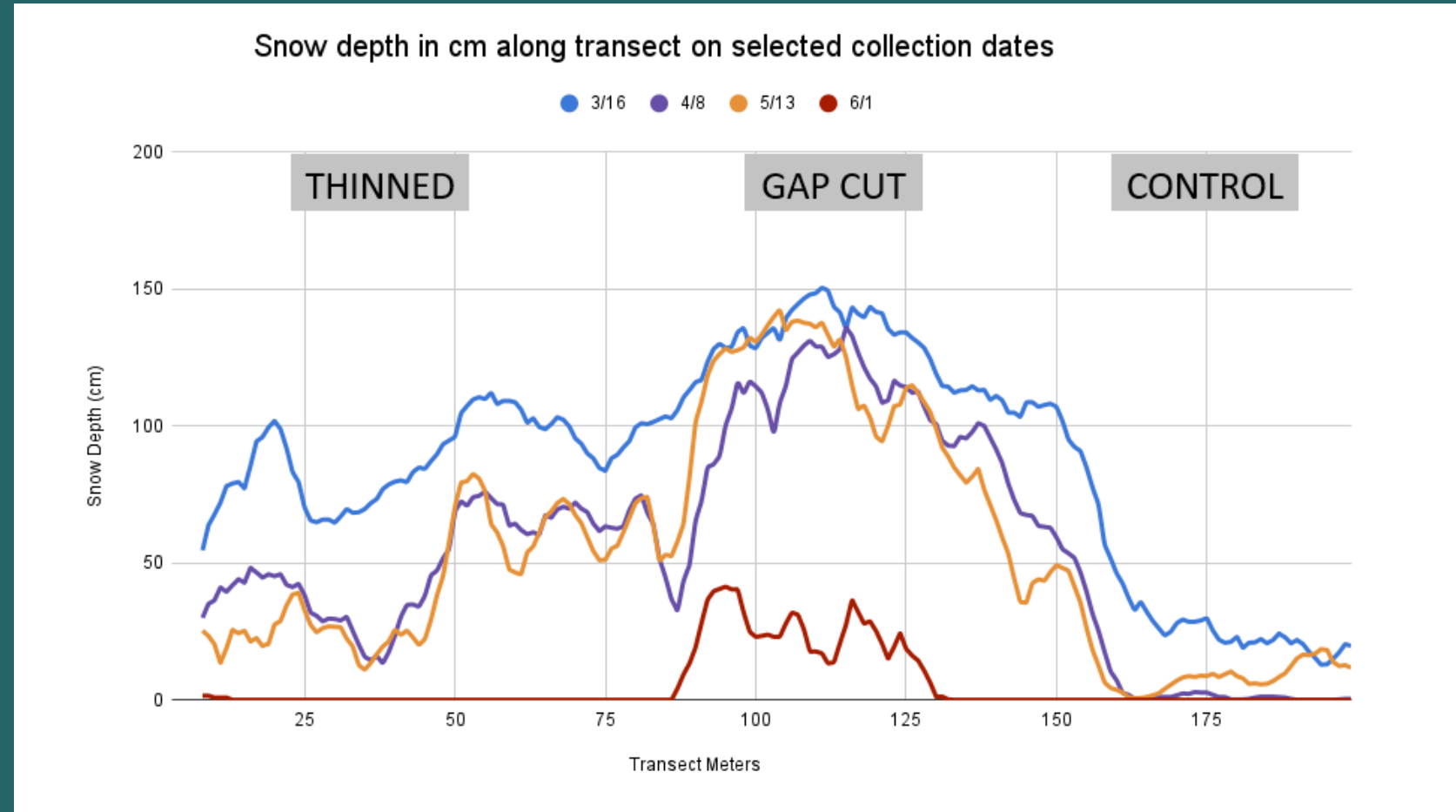
Land Cover Change Scenarios

Kevin Bogue
LCCM

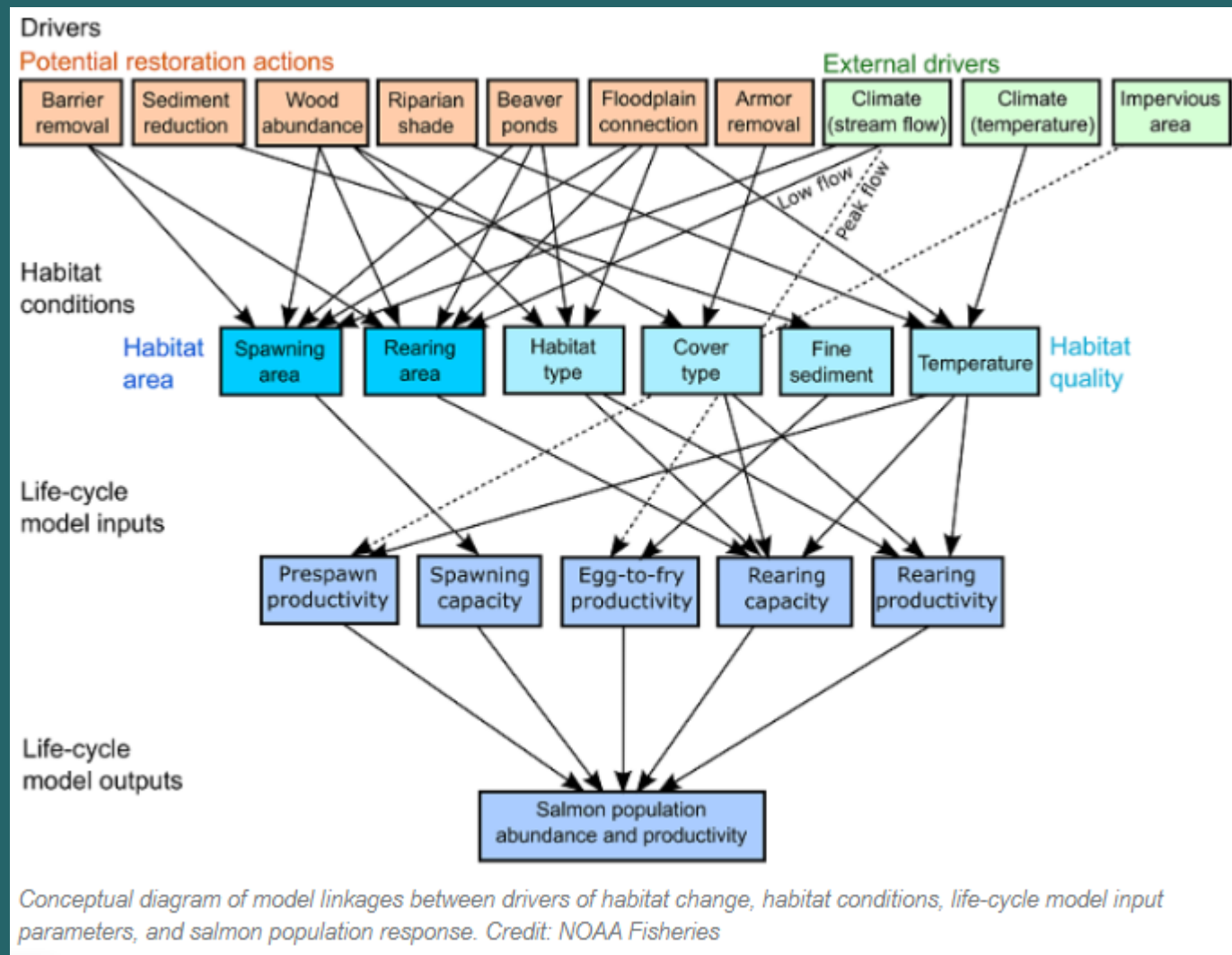


Ongoing climate adaption projects at Nisqually Community Forest

- 1) Thinning of young, thirsty forests**
 - Spreads available soil moisture among fewer trees & leaves more for runoff to streams
- 2) Snow gaps**
 - More snow accumulates and extends snowmelt season into dry summer months
- 3) Plant seedlings from warmer zones**
 - Provides a local seed source for adapted genetic traits

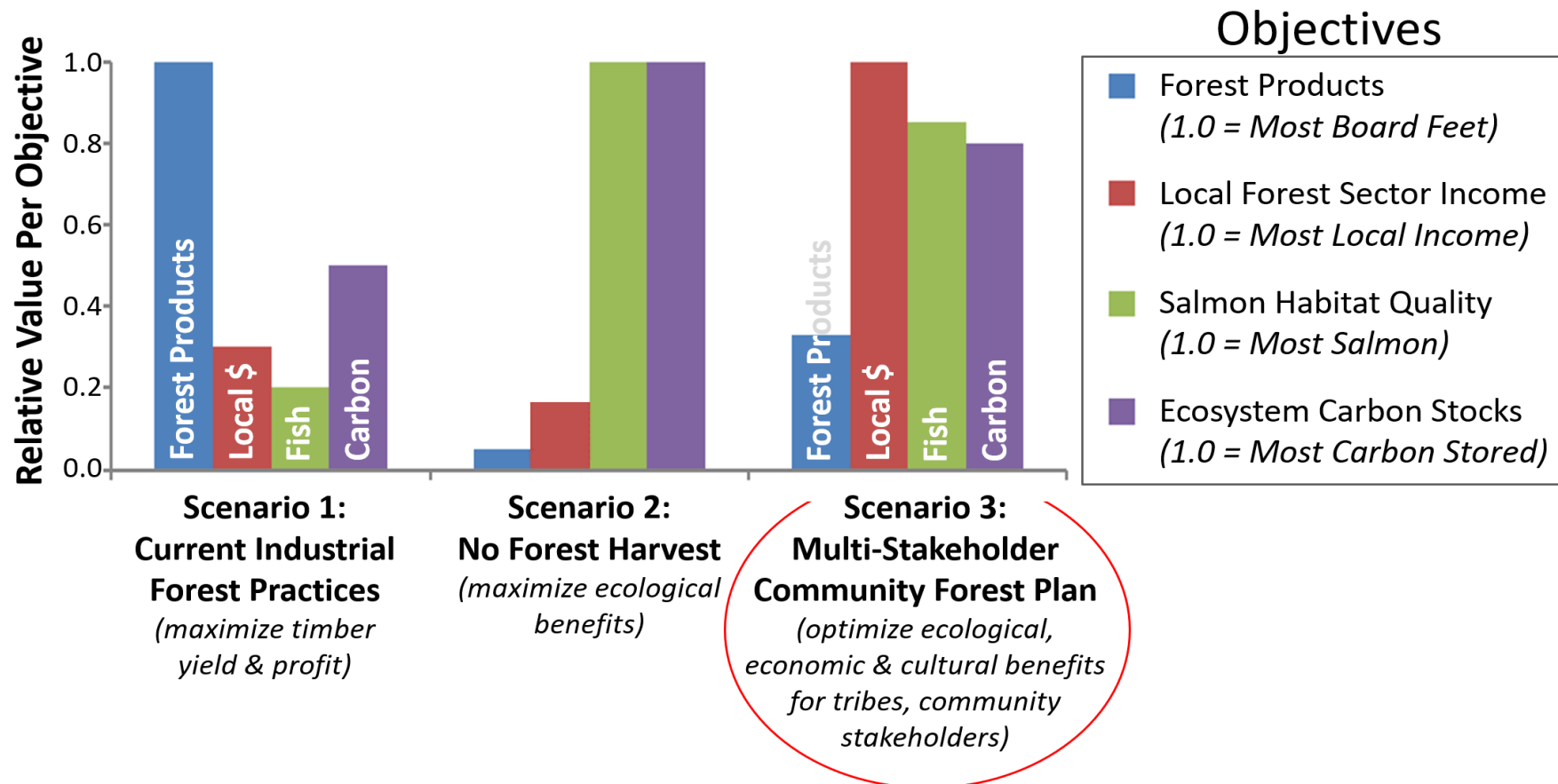


The Habitat Assessment and Restoration Planning (HARP) model is a process-based analysis for quantifying historical, current, and future habitat conditions, and modeling the potential benefit of alternative restoration actions to salmon populations. (NOAA)



Modeled Ecosystem Service Trade-offs for Alternative Forest Management Scenarios

Hypothesized (Informed by Work in Progress)





Thank You!

Puget Sound Tribes: Nisqually, Tulalip, Snoqualmie, Nooksack

Nisqually Community Forest partners: Land Trust, River Council, NNRG, & many others

University of Washington Puget Sound Institute / Salish Sea Modeling Center

EPA Region 10: Geographic Programs team

NOAA Northwest Fisheries Science Center

Washington Department of Ecology

ORD ACE.408.5.2 collaborators