Woodpecker: An interactive, scalable tool for characterizing hydrologic conditions to inform landscape and watershed planning

Raven Workshop: CWRA 2025

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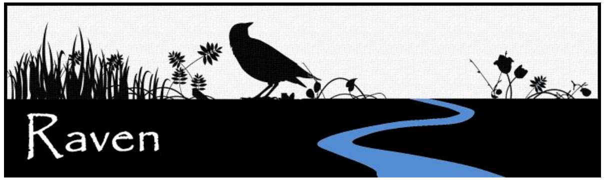
Overview

- Motivation
- Woodpecker
  - What it is?
  - Relation to Raven
- Practical example
  - Assessing forest disturbance
- Conclusion



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Motivation

- Risk based decision making frameworks are used for land management practices
- Need to understand hydrological regime of watershed to understand implications of land management practices
  - Etc. forestry, water withdrawals etc.
- Historically many of these decisions relied on qualitative observations, broad assumptions and expert judgement
- Quantitative outputs are needed to understand the hydrologic regime of watershed and support decisions
- **Raven hydrological modelling framework does this!**
  - **Learning curve to set up**

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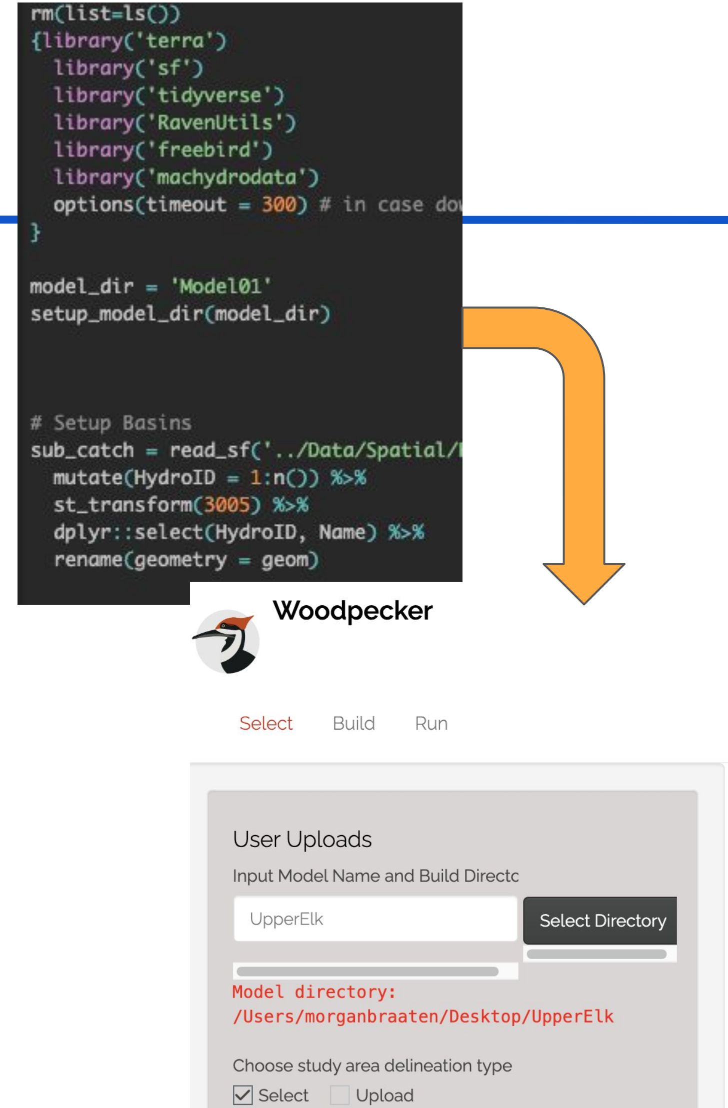
Woodpecker

- Woodpecker is an interactive scalable tool that applies Raven
- Builds hydrological model
  - Don’t need programming knowledge or software on computer
  - Regional to localized watersheds
- Automated parameterization useful for practitioners
  - Uses calibrated regional parameter sets
- Flexible incorporation of land use and climate scenarios



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Woodpecker cont.

- Generates outputs to inform decisions:
  - Generate serially complete streamflow record for gauged and ungauged locations
  - Spatial and temporal outputs

- Practical use cases:
  - Rapid evaluation of forest harvest plans
  - Climate change evaluation
  - Cumulative effects assessment
  - Watershed assessments

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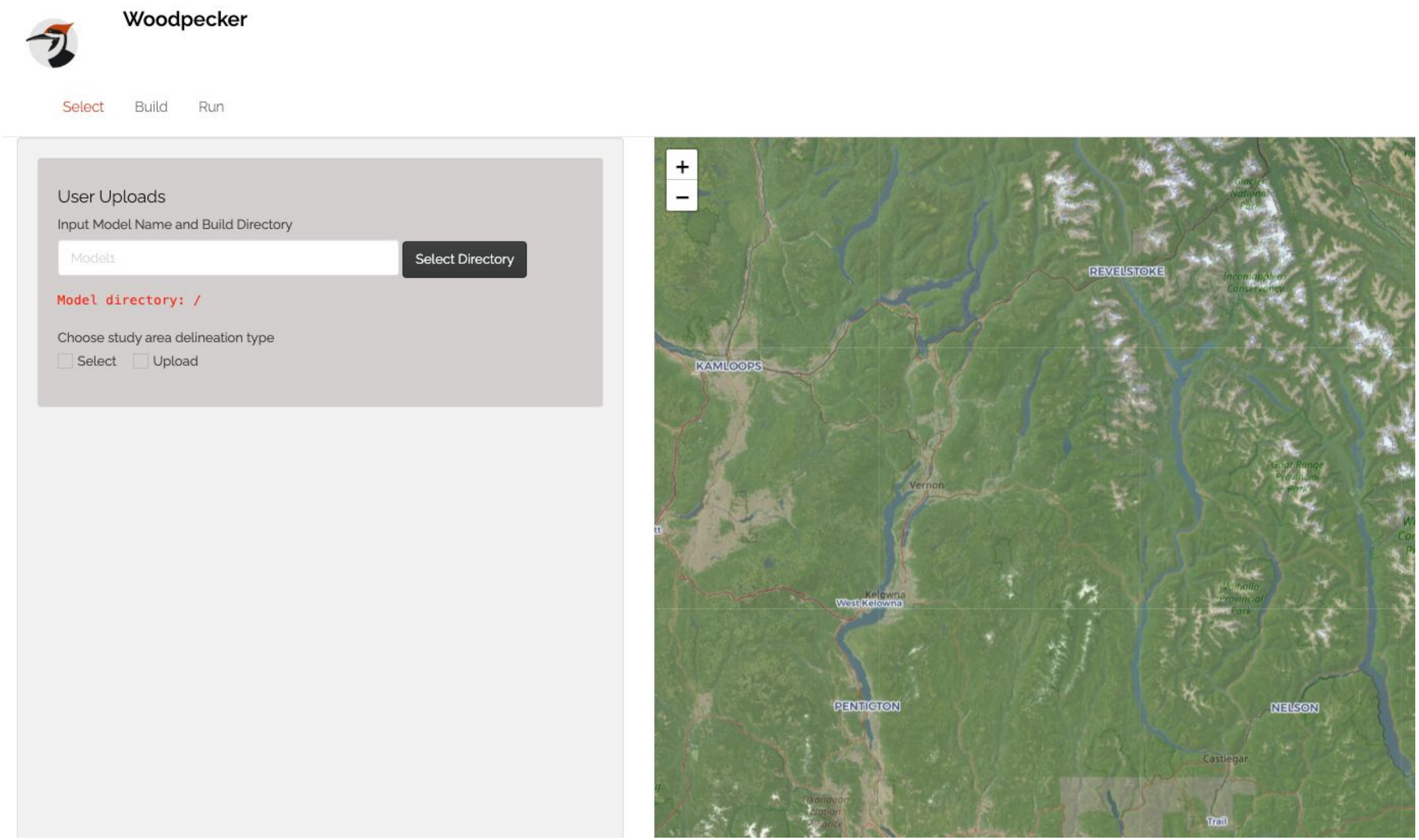
Woodpecker UI



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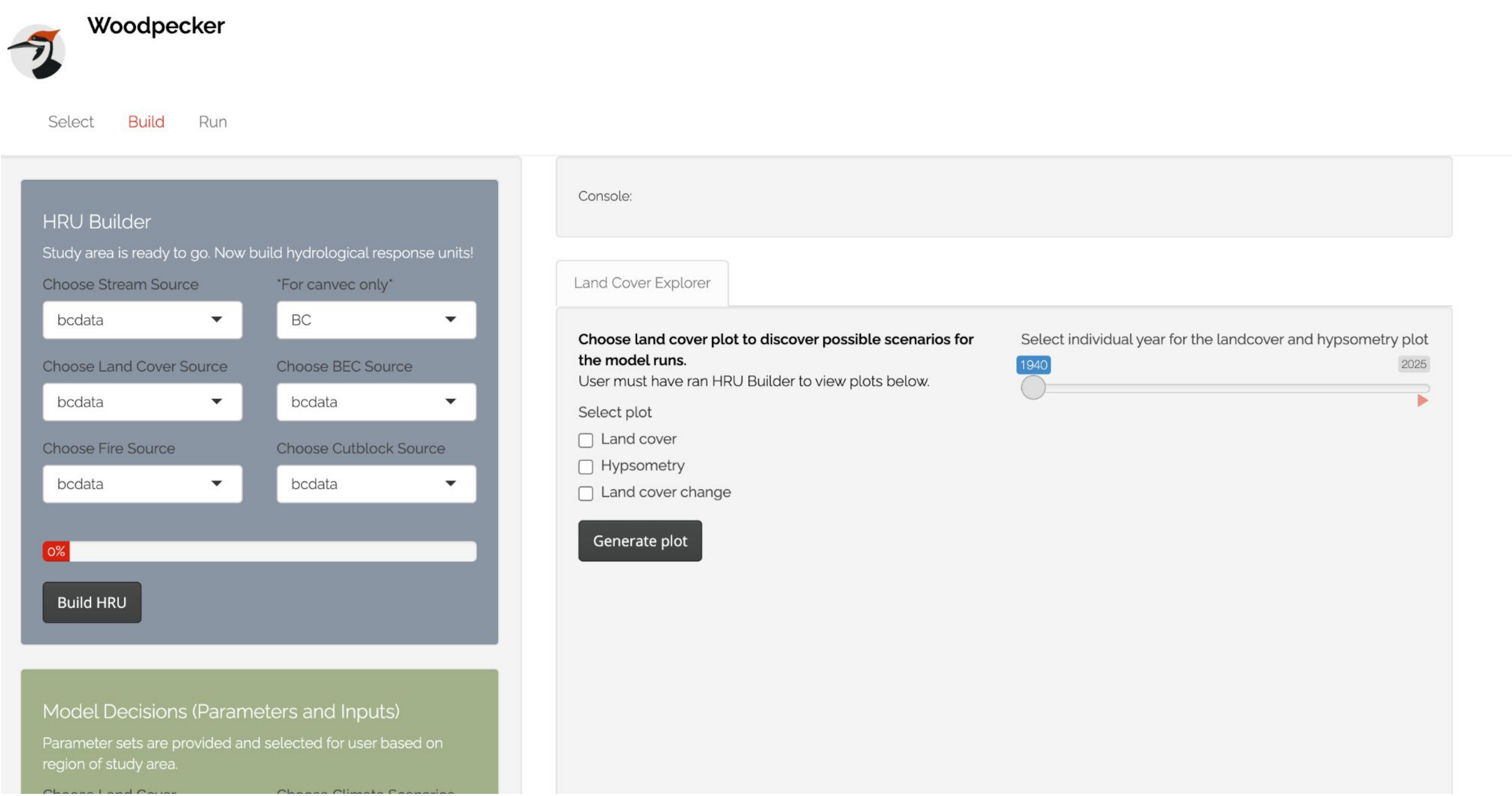
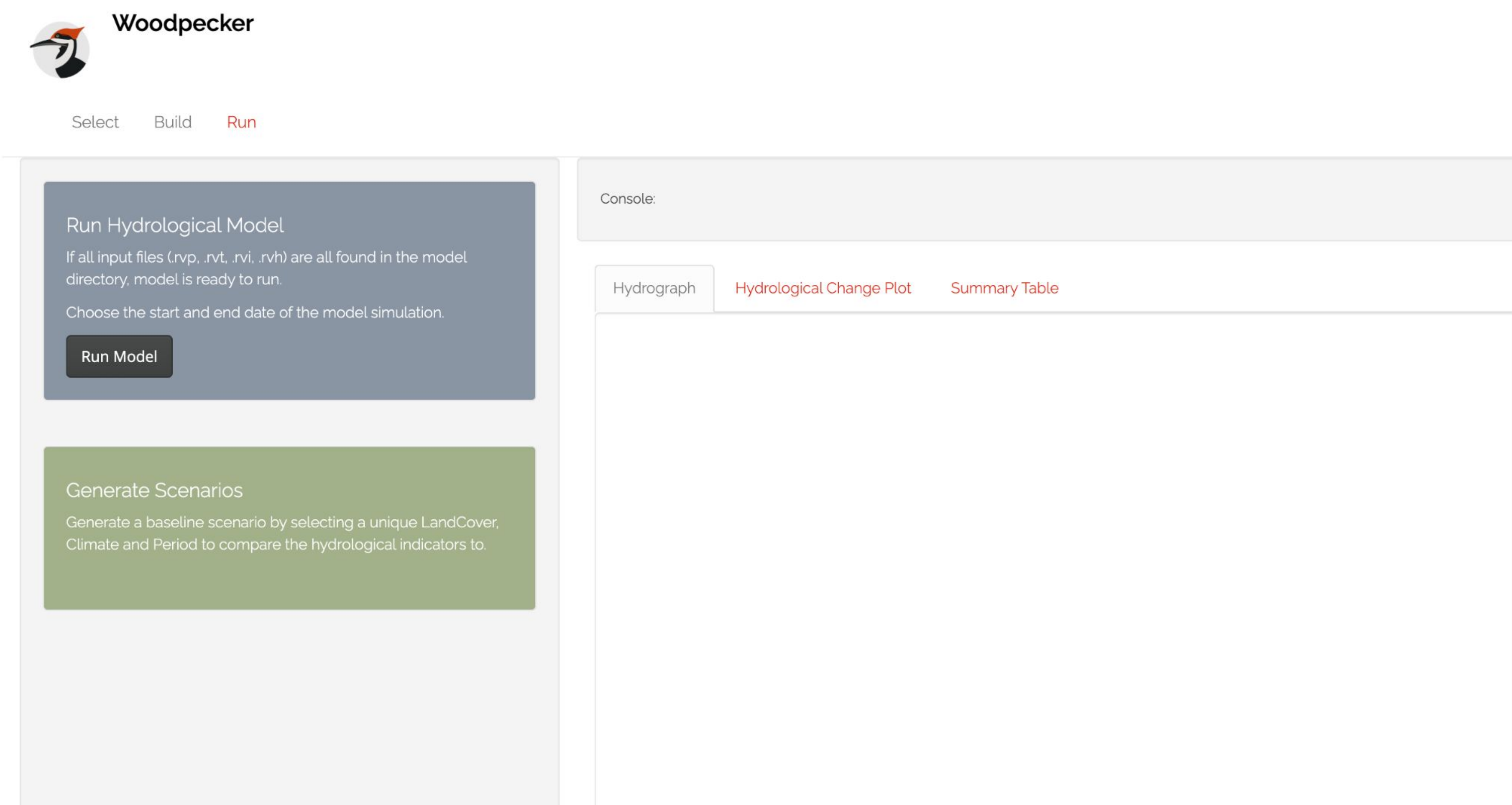


Woodpecker
Select
Build
Run
HRU Builder
Study area is ready to go. Now build hydrological response units!
Choose Stream Source
bcdata
For canvec only
BC
Choose Land Cover Source
bcdata
Choose BEC Source
bcdata
Choose Fire Source
bcdata
Choose Cutblock Source
bcdata
0%
Build HRU
Model Decisions (Parameters and Inputs)
Parameter sets are provided and selected for user based on region of study area.
Console:
Land Cover Explorer
Choose land cover plot to discover possible scenarios for the model runs.
User must have ran HRU Builder to view plots below.
Select plot
Land cover
Hypsometry
Land cover change
Generate plot
Select individual year for the landcover and hypsometry plot
1940
2025


Woodpecker
Select
Build
Run
Run Hydrological Model
If all input files (.rvp, .rvt, .rvi, .rvh) are all found in the model directory, model is ready to run.
Choose the start and end date of the model simulation.
Run Model
Generate Scenarios
Generate a baseline scenario by selecting a unique LandCover, Climate and Period to compare the hydrological indicators to.
Console:
Hydrograph
Hydrological Change Plot
Summary Table

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Watershed assessment example

- Forest managers rely on watershed assessments to understand how forest activities may affect water quality and quantity
- Rely on Equivalent Clearcut Area (ECA)
  - Proxy-type indicator relates a single calculated value based on disturbance accounting for forest recovery to the hydrological response of the entire watershed (Winkler & Boon, 2017).
- Caveats
  - Uses singular value for entire watershed
  - Doesn't account for partial retention
  - Scarce observations sometimes require expert judgement of forest recovery

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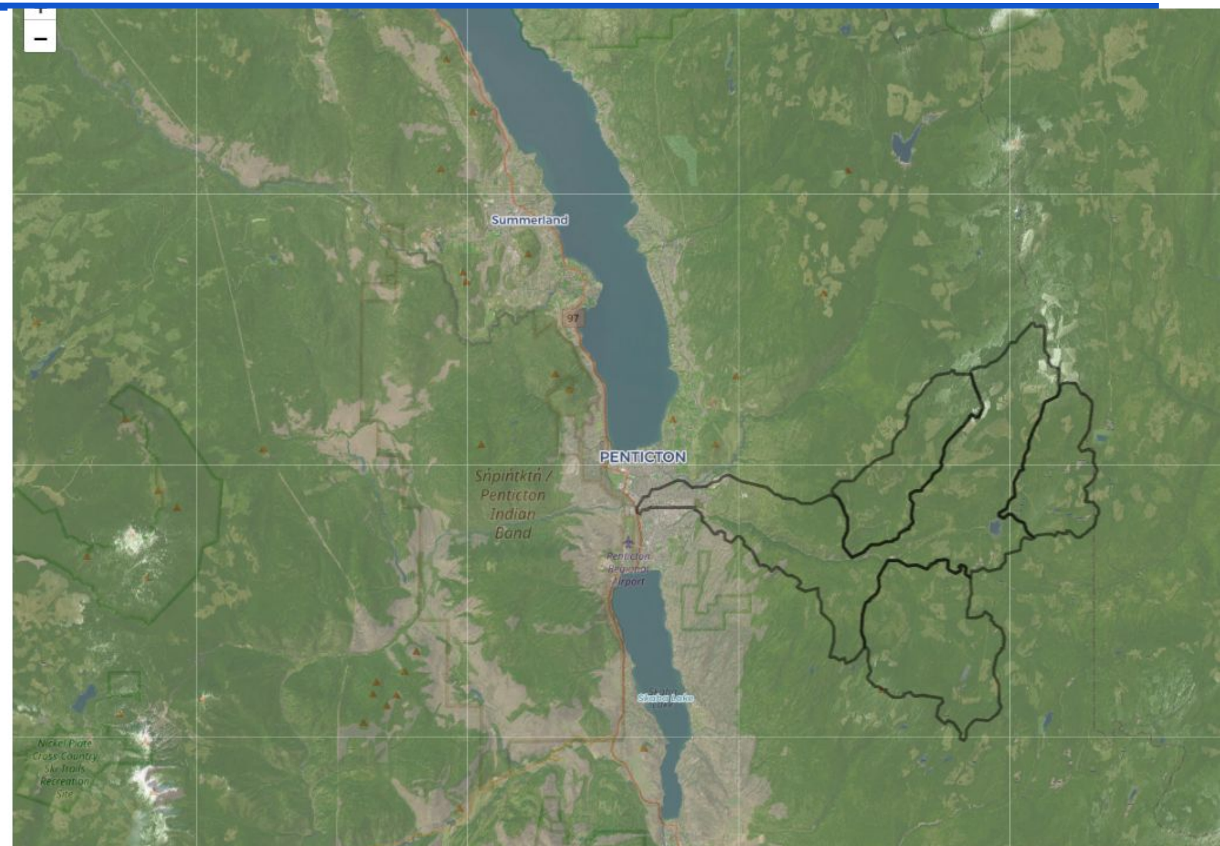
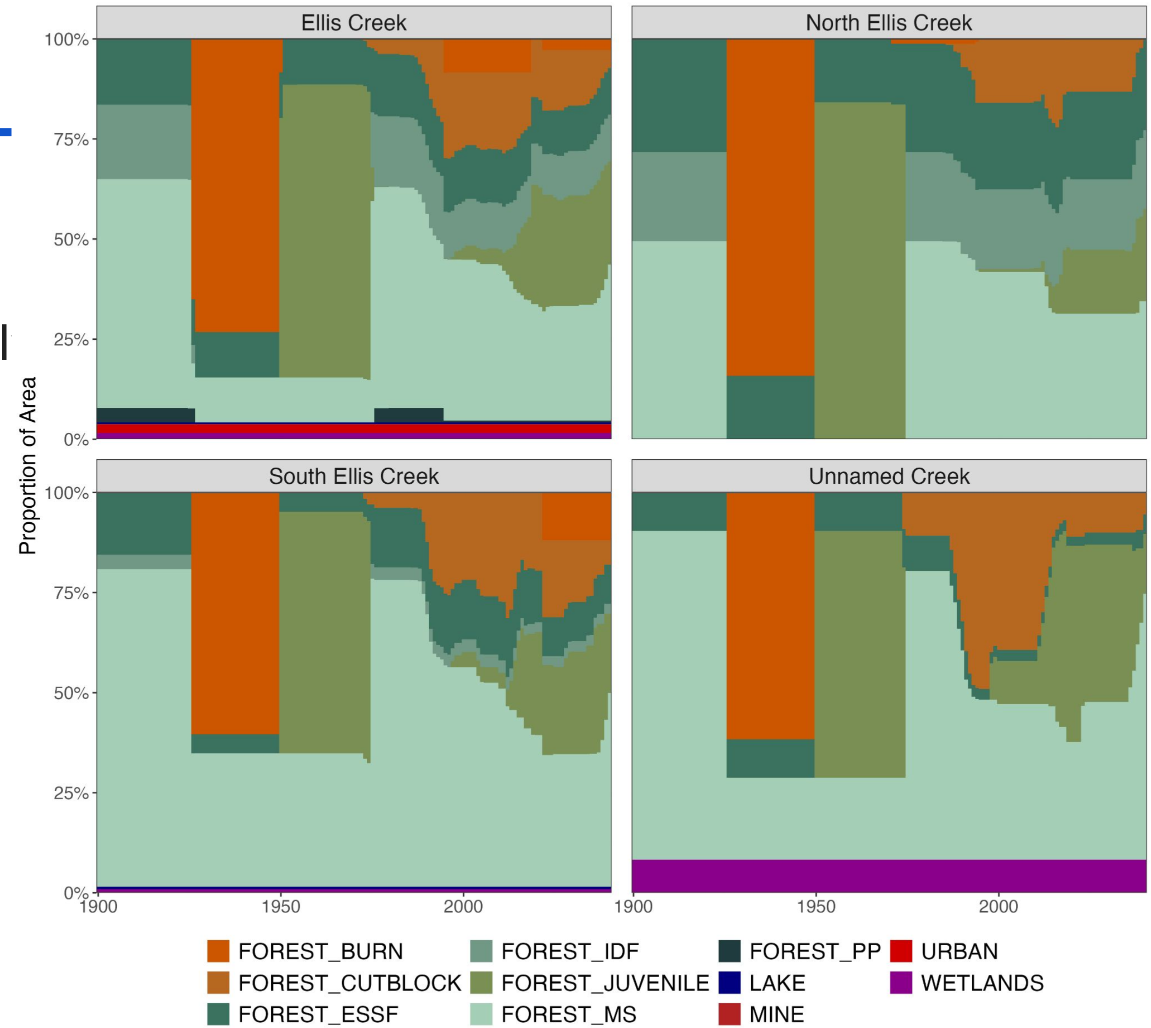
Watershed assessment example: Ellis Creek

- Value of concern is a community - could forest disturbance have implications downstream?



Land cover change

- Proportion of land cover change from 1900 to 2025
- Large burn occurred in earl 40's
- Juvenile regrowth high in the 50's
- Harvest started in 70's to current day



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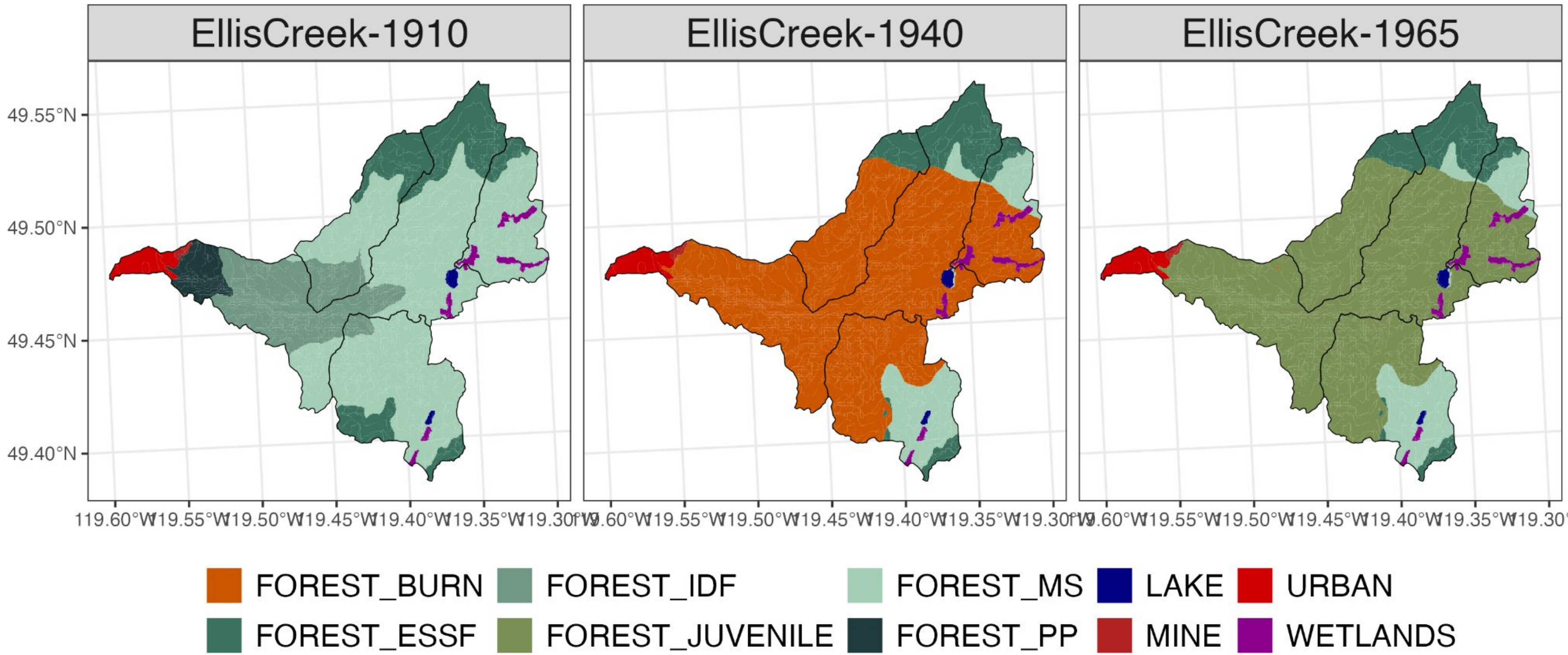
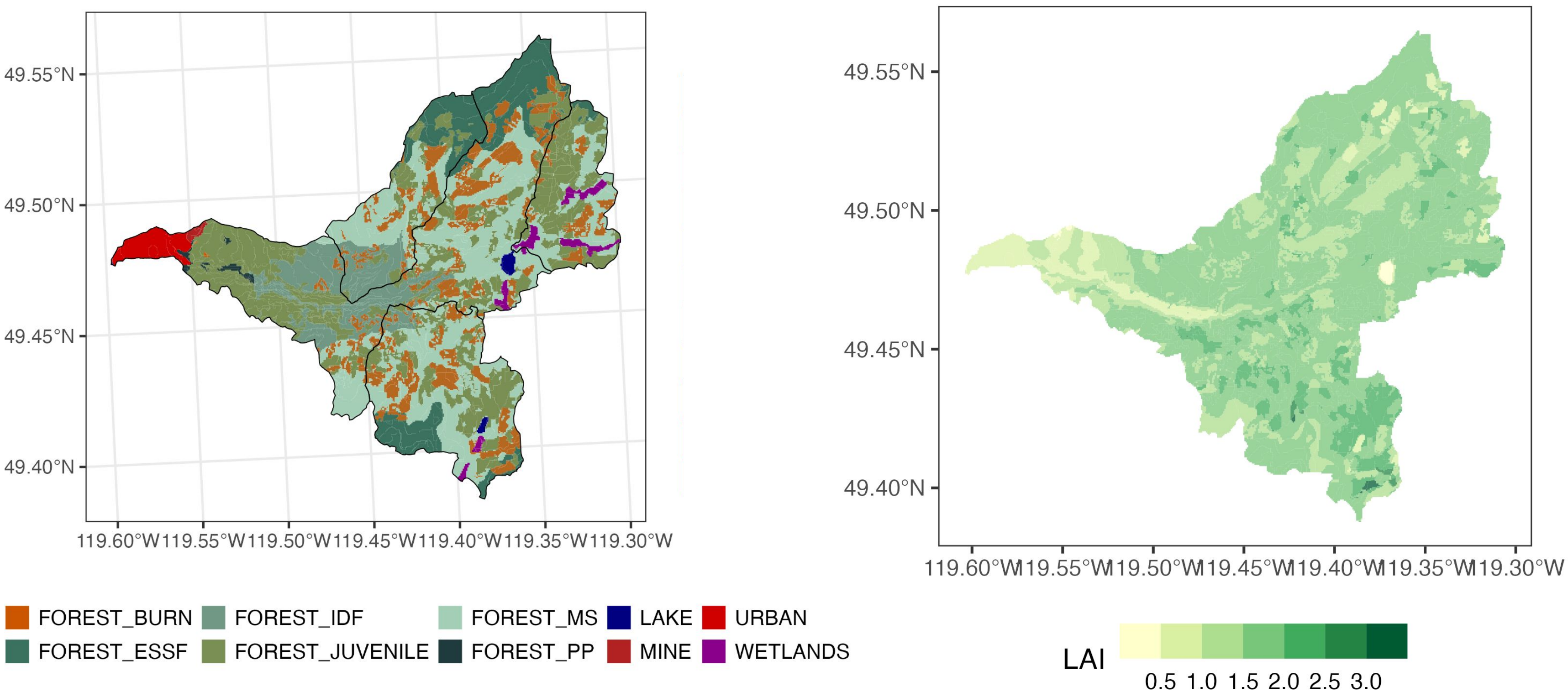
Land cover assessment

Forested → **Burned** → **Juvenile**



Vegetation parameterization



Vegetation is parameterized seasonal from monthly LAI remote sensing NRCAN

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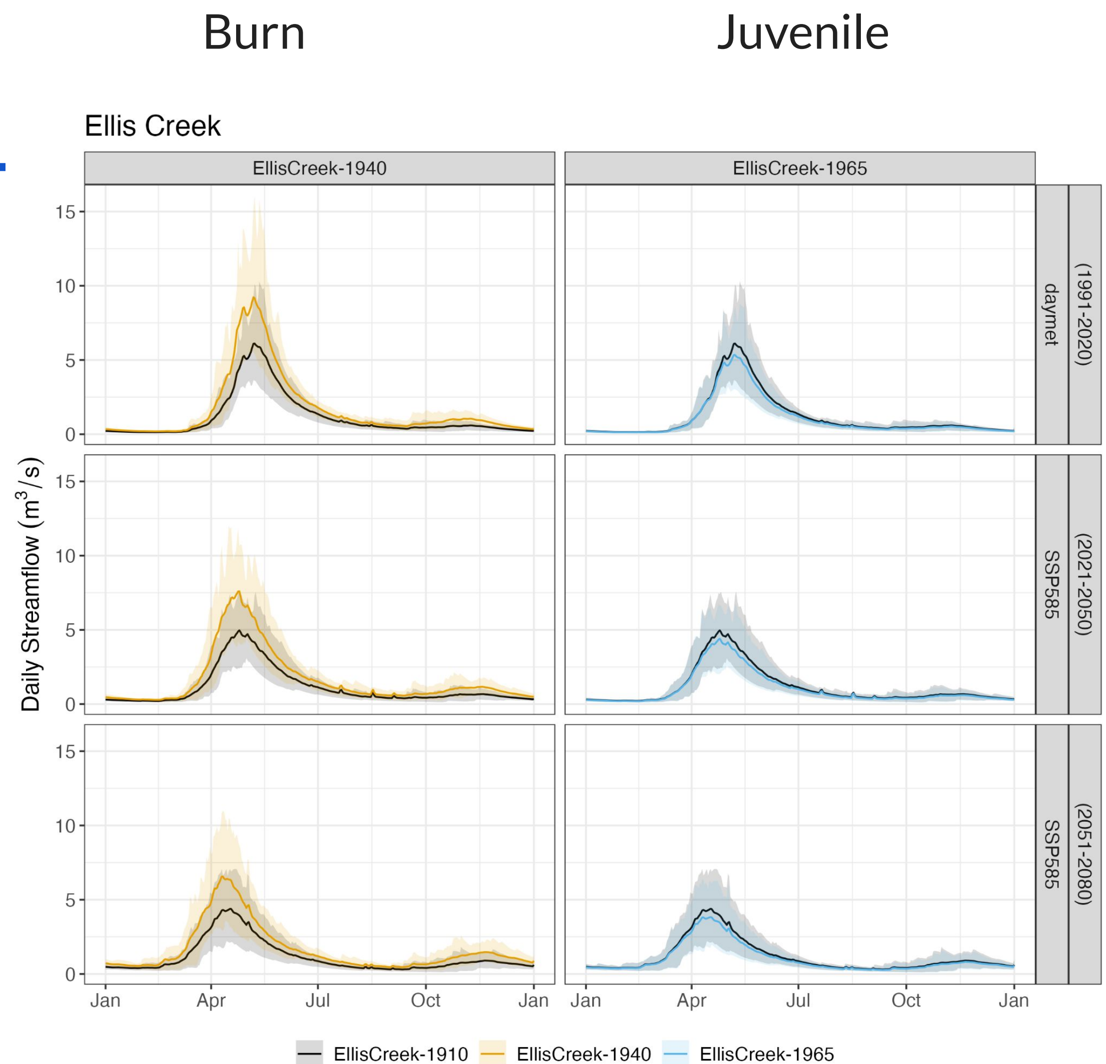
Annual Hydrograph

- Change in concert (temporally and spatially)
- Examples of how processes and parameterization of vegetation is working
- Model represents hydrological differences from land cover change



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Summary table

Ellis Creek

LandCover	Climate	Mean Annual Flow	Mean Aug-Sep Flow	2-Year Peak Flow	20-Year Peak Flow	Peak Flow Timing
1991-2020						
EllisCreek-1940	daymet	47%	39%	68%	50%	-3.9 days
EllisCreek-1965	daymet	−10%	−12%	−13%	−15%	-1.4 days
2021-2050						
EllisCreek-1910	SSP585	−2%	−4%	−15%	−29%	-4.9 days
EllisCreek-1940	SSP585	45%	36%	36%	1%	-11.3 days
EllisCreek-1965	SSP585	−12%	−14%	−25%	−35%	-5.7 days
2051-2080						
EllisCreek-1910	SSP585	−2%	−23%	−26%	−29%	-25.6 days
EllisCreek-1940	SSP585	43%	13%	17%	6%	-26.8 days
EllisCreek-1965	SSP585	−12%	−33%	−36%	−35%	-26.0 days

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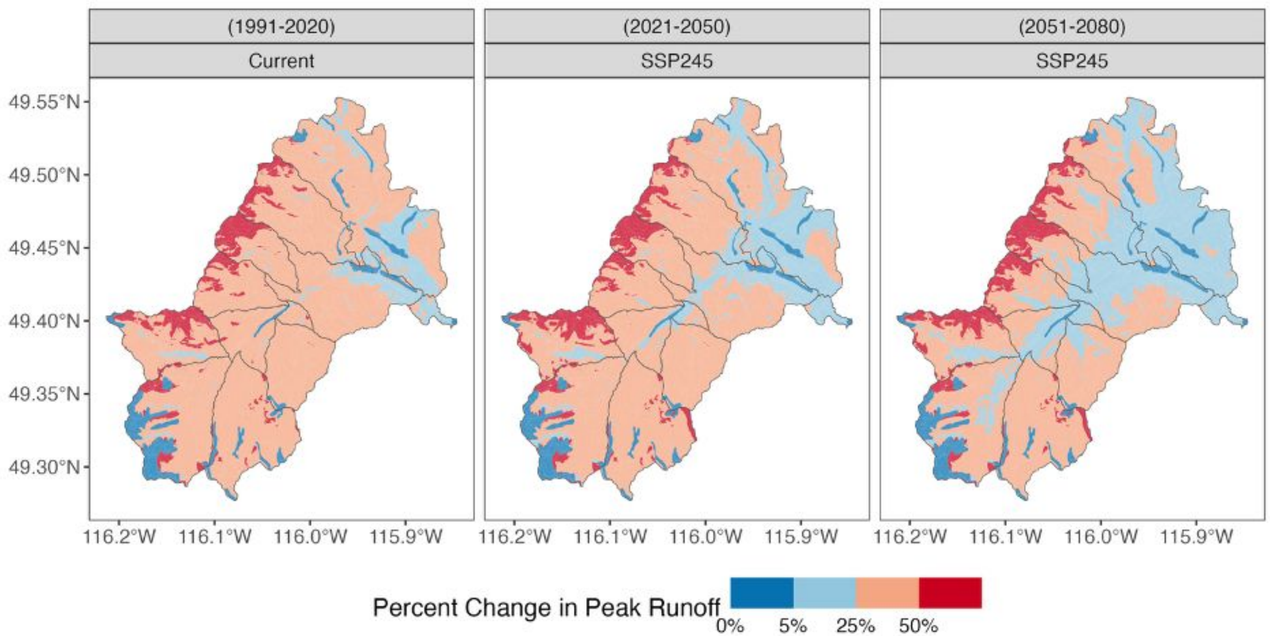
Future Woodpecker

- Integrate spatial outputs (i.e. runoff)
- Visually assess how fluxes change spatially



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Conclusion

- Raven supports proponents to make decisions on land use planning through our interactive tool Woodpecker
    - No software needed/programming experience required
    - Integrates reproducible workflow
- Allows users to assess dynamic land cover changes
- Incorporates climatic analysis
- Indicators to support decision and understand basin dynamics
    - Spatial and temporal outputs

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Acknowledgements

- Colleagues for support and discussion
- James Craig and team for Raven support
- Thank you for your time today

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