Forest Management Linkages to Snow, Wildfire, and Hydrology in the Oregon Cascades

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Hypothesis 1: Forest management strategies that address the combined effects of canopy density, gap size, winter temperature, and elevation can improve snowpack accumulation and retention, thereby increasing water yields for agriculture and decreasing the requirement for costly and energy-intensive forest fire suppression.

Main Question:
How does upland forest structure affect snowpack water yield and wildfire conditions?
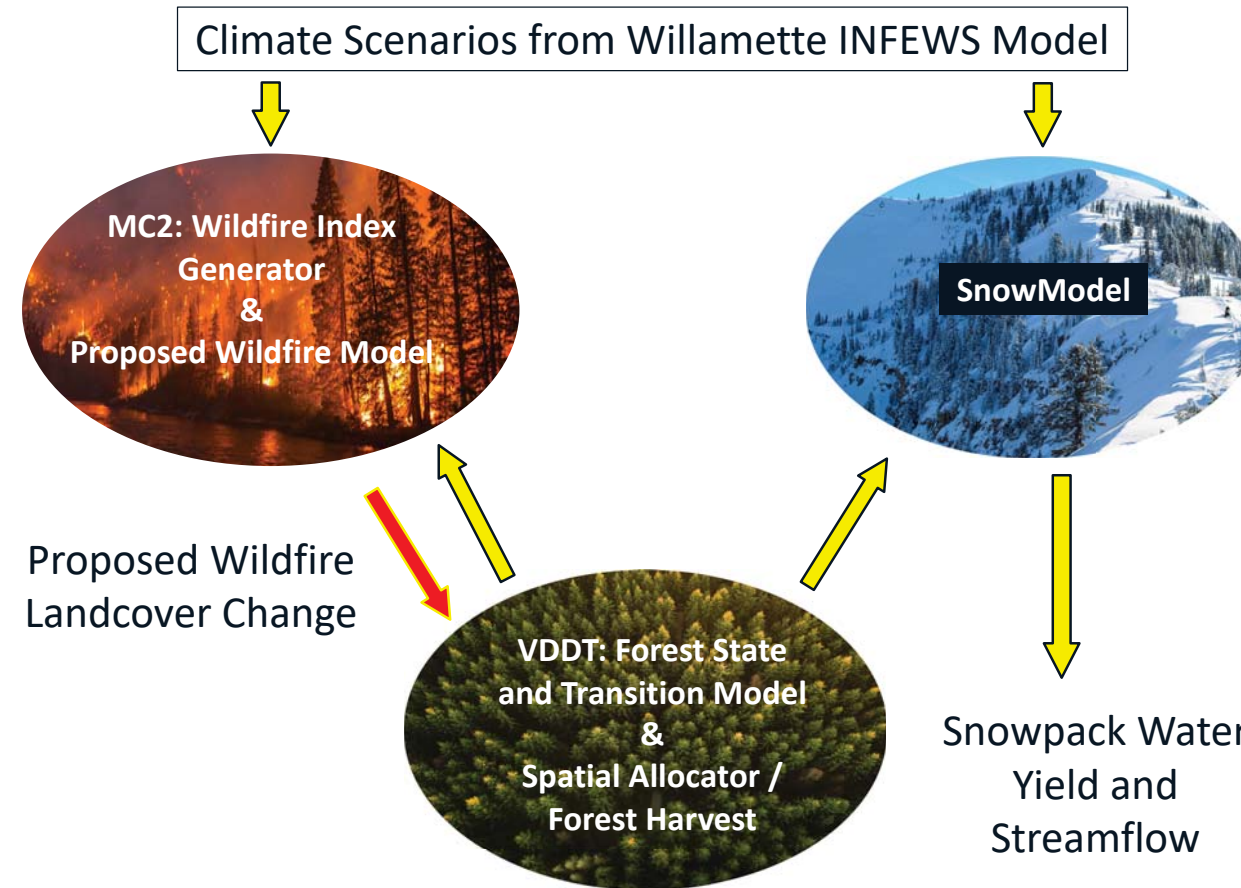
How We Examine This in the Willamette INFEWS Model:
We use four model plugins to explore changes in forest structure, snowpacks and wildfire:

1. **Spatial Allocator**: simulates forest harvest for both public and private land
2. **VDDT**: Forest growth and change model
3. **SnowModel**: Simulates seasonal snowpack accumulation and melt
4. **MC2**: Wildfire Model, Fire metrics are generated depending on forest structure and climate conditions. But fire is not generated by MC2

What We Have Found So Far:
- Thinning the forest increases maximum snow water equivalent
- Thinning and clearcut lead to faster melt and earlier snow disappearance
- After a wildfire, snowpacks have charred woody debris – so they melt faster than unburned forests

Climate Scenarios from Willamette INFEWS Model

MC2: Wildfire Index Generator & Proposed Wildfire Model

SnowModel

Proposed Wildfire Landcover Change

VDDT: Forest State and Transition Model & Spatial Allocator / Forest Harvest

Snowpack Water Yield and Streamflow

Here's What We Can Change in the Upland Snow/Forest Part of the Model for both Public and Private Land:
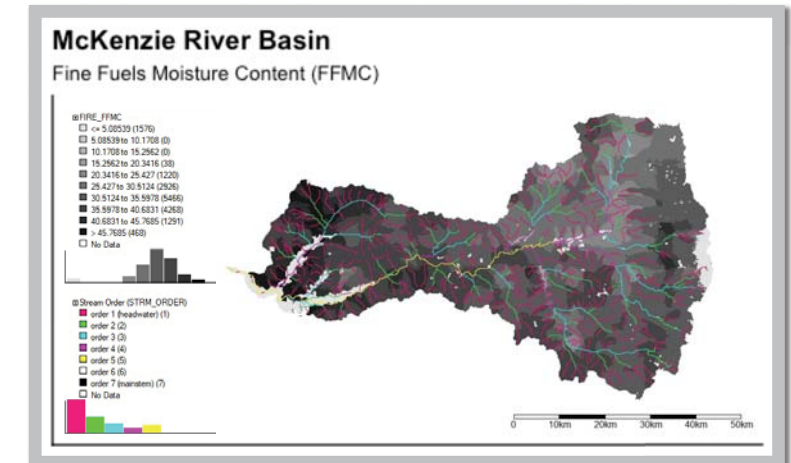- **Forest Harvest:** Removal of specified age stands for timber
- **Forest Thinning:** Reducing crown density and increasing forest gap fraction
- **Surface Fuels Treatment**: Removing the understory to decrease fire spread
- **Wildfire suppression**: When simulating wildfire we can adjust the suppression rate

We Listened and This is What We Heard From You :
- **Low flows in headwater catchments are important**
We will quantify effects of changing forest structure, wildfire and snow on 1st and 2nd order streams
- **Differences in private and public forest lands esp. for harvest/thinning**
We will quantify impacts of different forest harvest policies on snowpack and water yields
- **Drinking Water Quality**
We are not able to address water quality at this time

Simulated daily SWE using SnowModel
Hogg Pass Water Year 2003
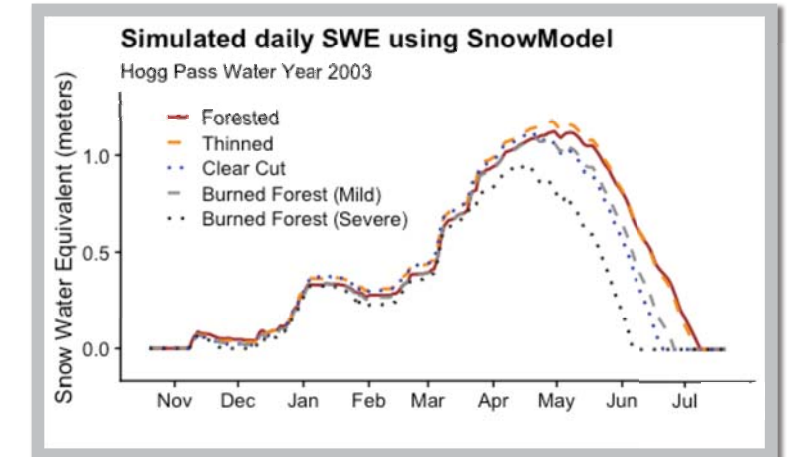
Forest structure and wildfire affect both peak SWE and snow disappearance date

McKenzie River Basin
Fine Fuels Moisture Content (FFMC)

Using both climate and forest structure MC2 has the capacity to track a wide variety of wildfire indices

Simulated Reservoir Inflows Under Varying Harvest Intensities
Cougar Reservoir
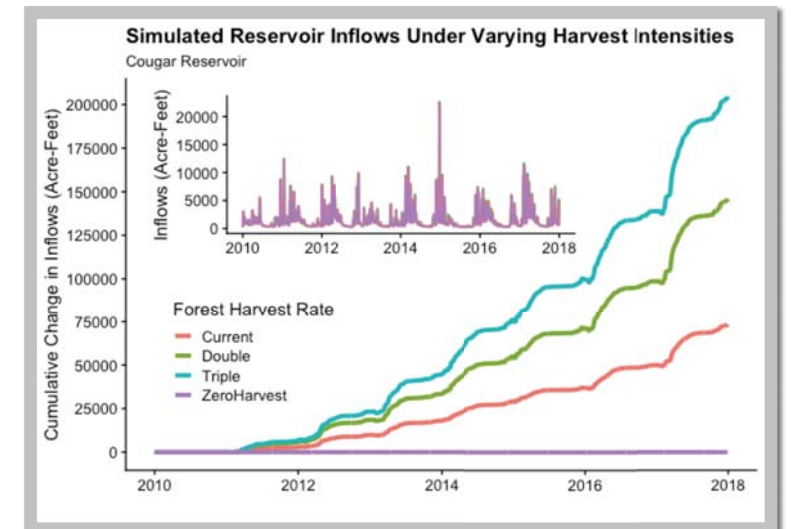
Cougar Reservoir has a storage capacity of 219,000 acre-feet