

An Integrated Model for Identifying Linkages Between the Management of Fuel Treatments, Fire and Ecosystem Services

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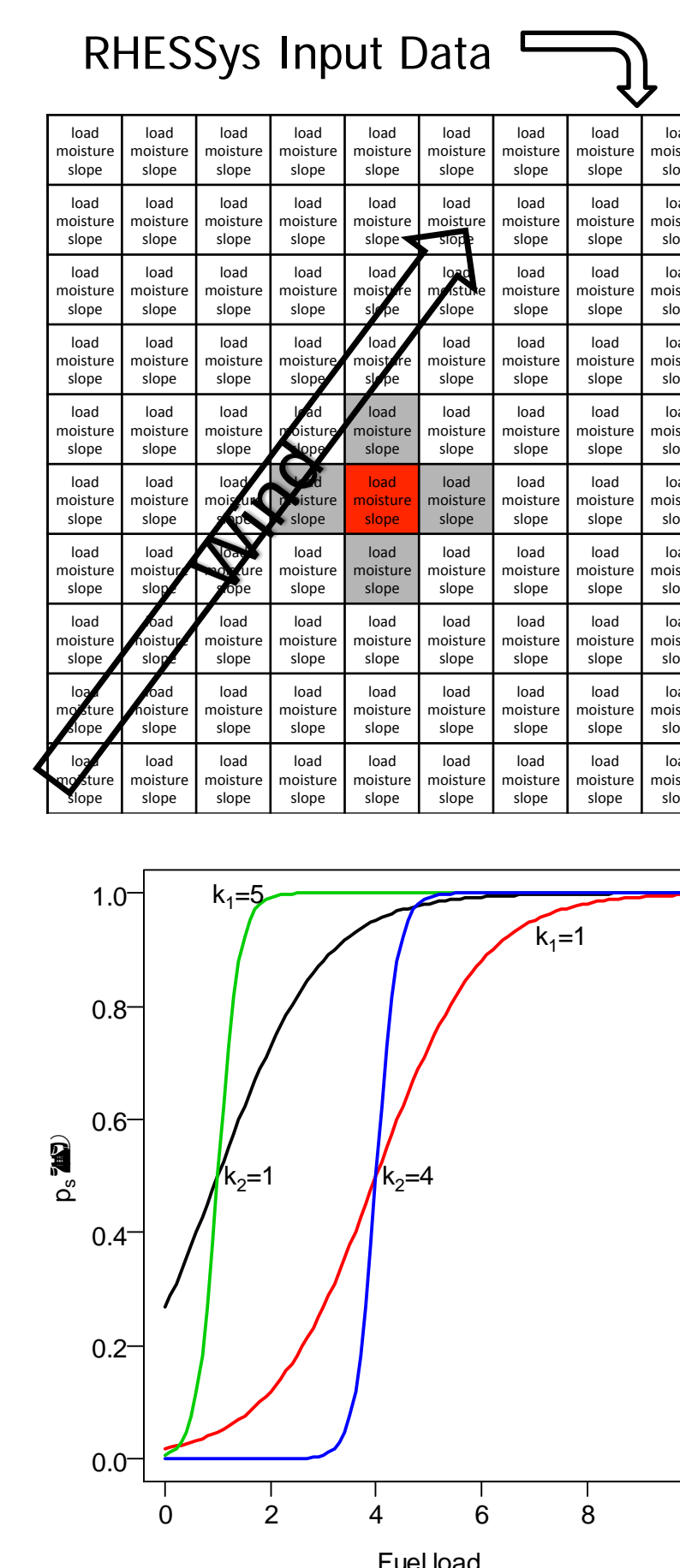
Rationale

- Predicting how vegetation fuel treatments (e.g. thinning, prescribed burning) may affect future wildfire risk and associated ecosystem services, such as forest water availability and streamflow, remains a challenge.
- There is insufficient understanding of how both ecological and social factors affect fuel management decisions.
- We present an integrated model that links a biophysical model that simulates vegetation and hydrology, a fire spread model and an empirical fuel treatment model that accounts for agency decision-making.

How do fuel treatments and subsequent biophysical states influence fire spread and fire severity?

Fire Spread Model

- WMFire is a stochastic model of fire spread developed to simulate *fire regimes*.
- Model complexity and process detail is commensurate with inputs from biophysical model.
- Probability of ignition is function of fuel load & moisture.
- Probability of spread is function of fuel load, moisture, wind & slope.



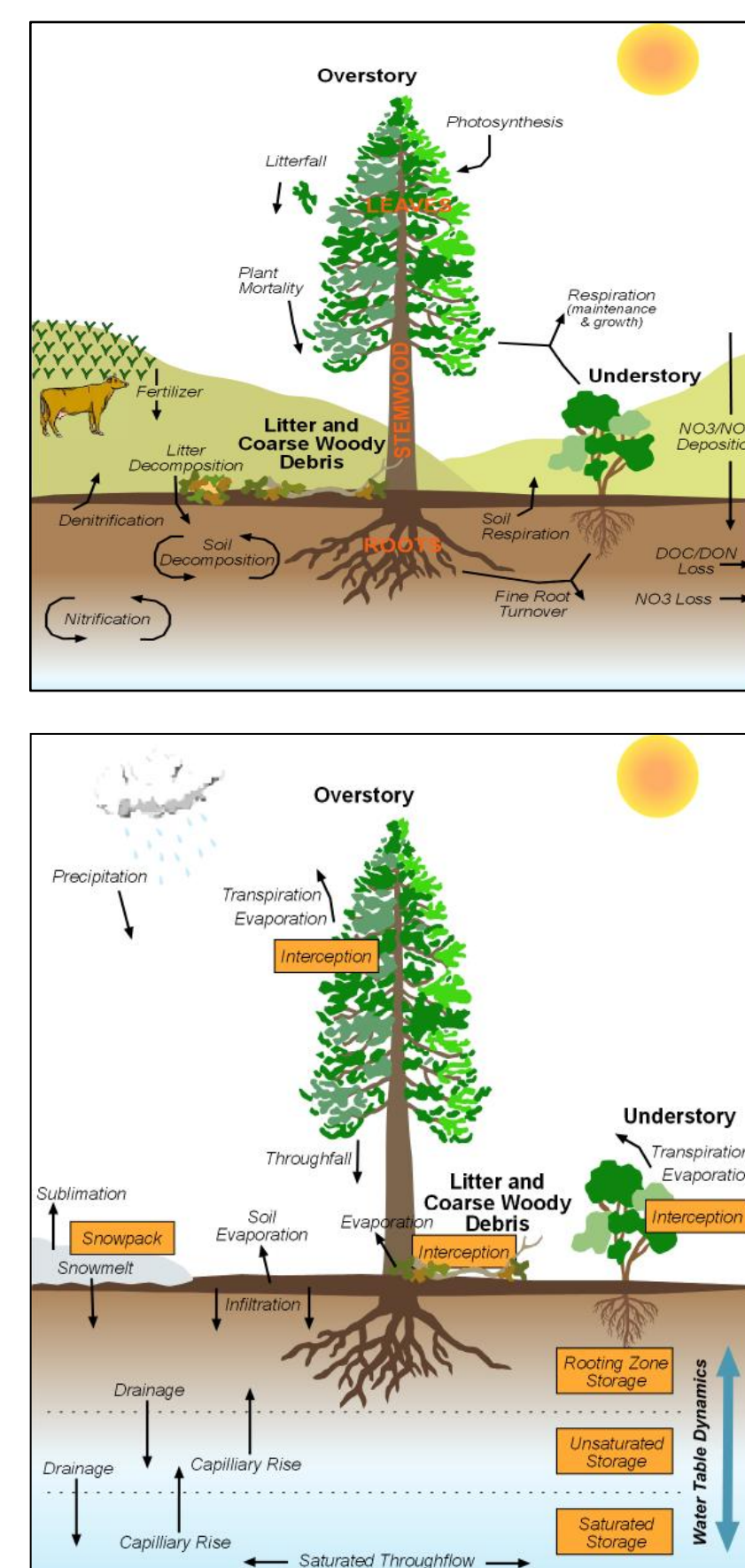
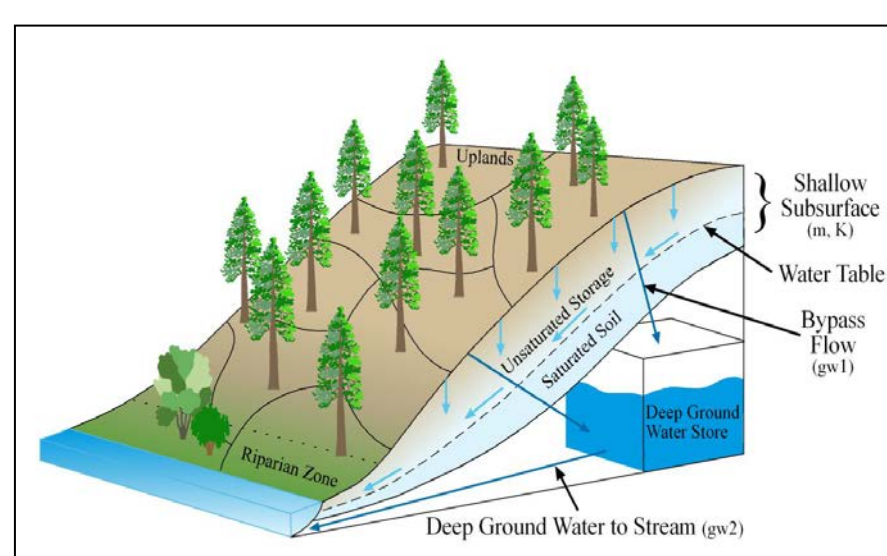
Do major fires increase public attention to wildfire and influence the timing and location of fuels management projects by federal agencies?

Applications

- The integrated model is used to investigate how management decisions affect landscape fuel loads, which in turn affect fire severity and ecosystem services, which feedback to management decisions on fuel treatments.
- The model provides a framework for answering novel questions about fuel treatments that span social and ecological domains, areas that have previously been treated separately.
- Model will be optimized based on multi-criteria objectives (e.g. fire risk, water, sediment, and forest health) developed from stakeholder input.

Biophysical Model

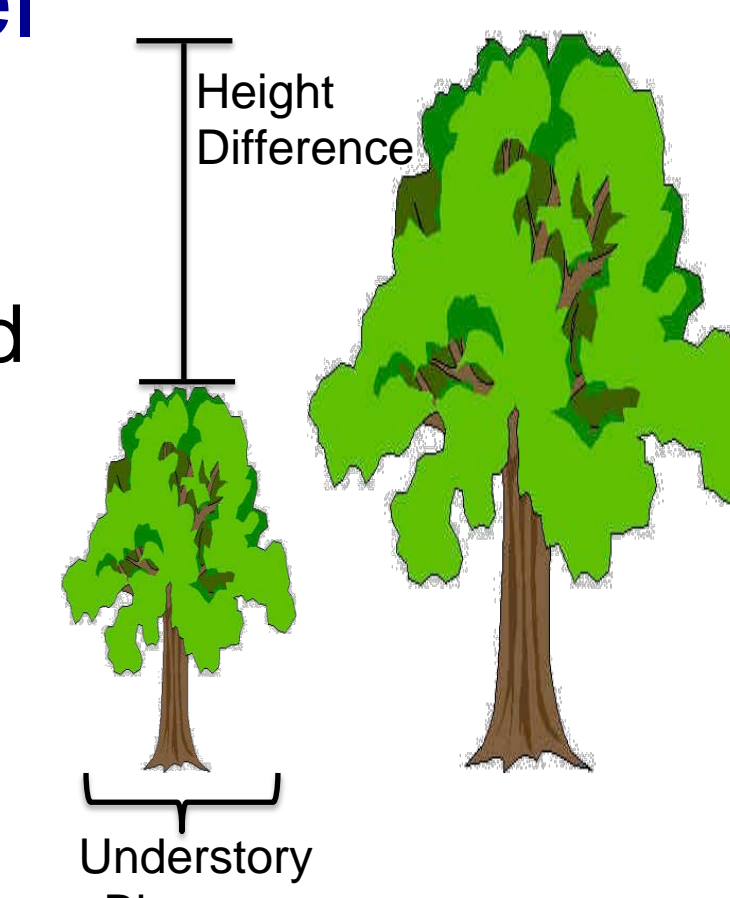
- Regional Hydro-Ecologic Simulation System (RHESys) is a spatially-distributed water and carbon-cycling model.
- Processes represented at patch to landscape scales.
- Multiple canopy layers.
- Live & dead fuel stores tracked.
- Ecosystem services: Water, carbon, nutrient, sediment.



How do the changes in fire regime alter carbon sequestration, streamflow, and sediment flux?

Fire Severity Sub-Model

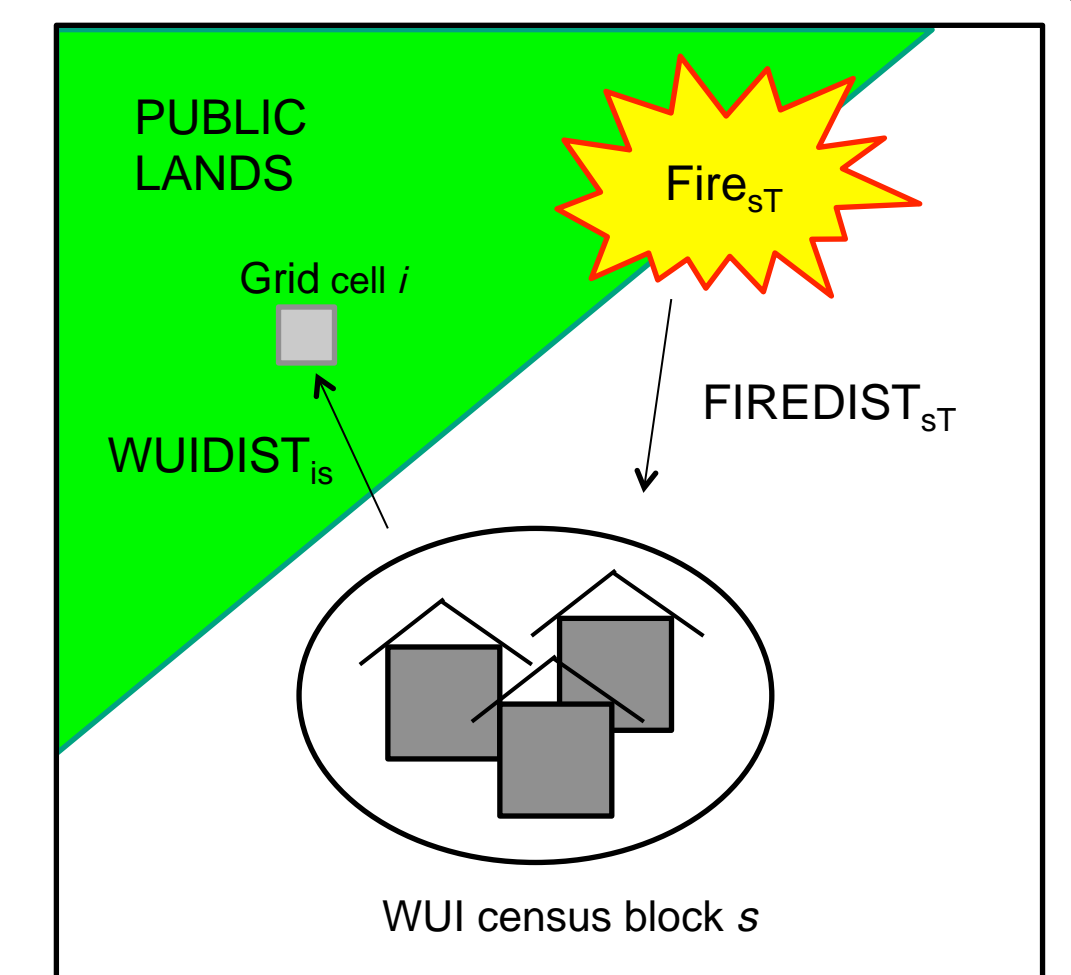
- Fire severity is a function of the probability of spread, the difference between over- and understory heights, and understory biomass.
- Fire effects on carbon stores in biophysical model derived from Ghimire et al. 2012 JGR.



How do biophysical states influence the timing, location and composition of various fuel treatment decisions? Are these optimal?

Fuel Treatment Model

- Empirical model assessing how previous fire events, landscape conditions, proximity to housing and roads, and other economic and political drivers affect federal fuel treatment decisions.
- Fuel treatment data for ~23 million land plots managed by federal agencies in Western U.S.



- Hypotheses:
- 1) A fire increases the probability of observing fuels management projects
 - 2) Fires closer to the wildland-urban interface (WUI) have a larger effect
 - 3) Federal lands close to the WUI are affected more.

Will fuel treatment outcomes differ as the climate warms?

Climate Variability/ Change

What are the consequences of fuels management decisions on ecosystem services? How can placement of fuels management projects be improved?

What are the key public, political, and economic drivers of current fuel management decisions?

Political / Economic Factors