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# Communicating why land surface heterogeneity matters

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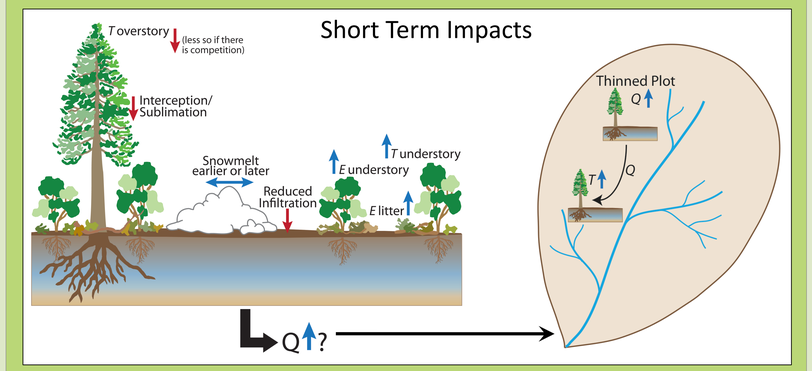
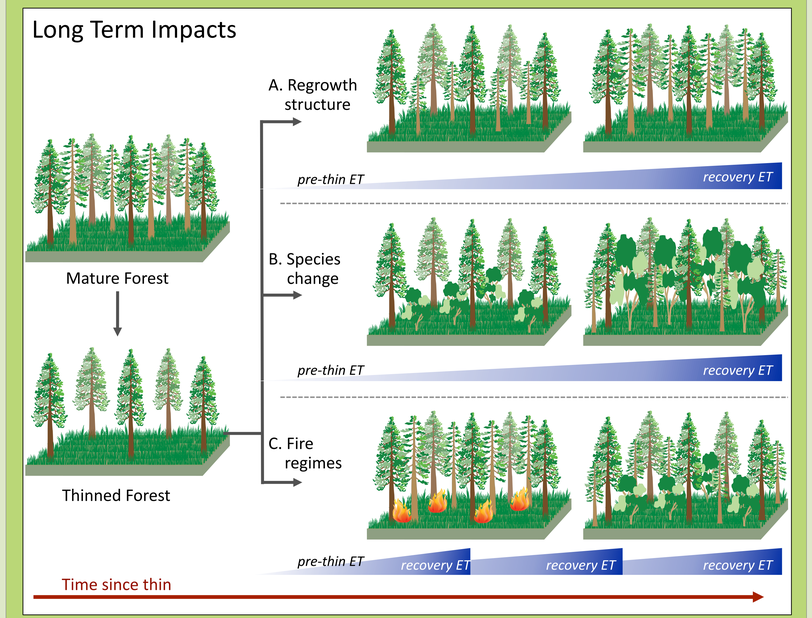
## Complex dynamics and eco-hydrology: the challenge of explaining responses

As hydrologic scientists, we know that land surface heterogeneity can have nuanced and sometimes dramatic impacts on the water cycle. For example, forest thinning (either by people, fire, or insects) impacts multiple hydrologic processes - some increase partitioning of precipitation towards evapotranspiration, some shift towards recharge and streamflow.

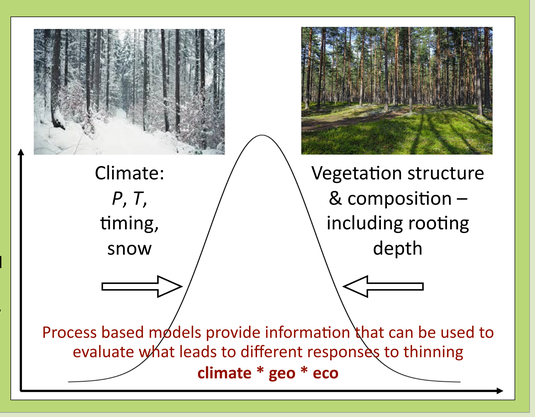



Land surface characteristics, including the structure and composition of vegetation, soil storage, and drainage properties, alter how incoming precipitation is translated into streamflow and evapotranspiration.

### *Multiple controls: signal/noise*

Land surface heterogeneity can explain why this partitioning of incoming precipitation cannot always be computed by a simple water budget calculation. We also know that land surface characteristics are dynamic - vegetation grows and changes with fire, disease, and human actions and these changes will alter the partitioning of water - how much so, however, depends itself on other site characteristics - soil water storage and the timing and magnitude of precipitation.

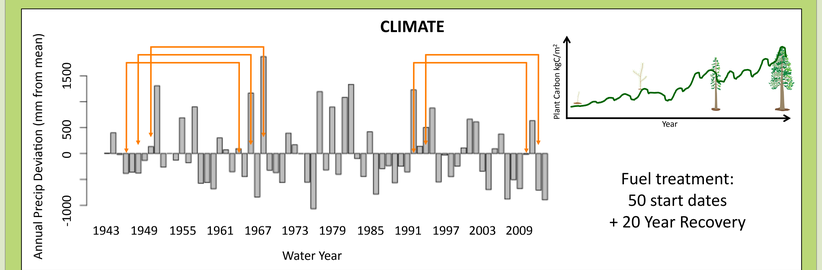


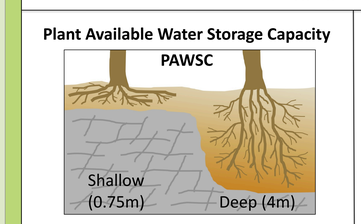

## Illustration of Land Surface Heterogeneity = Complexity

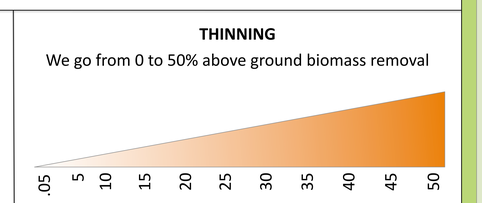
This complex impact of space/time dynamics on the water cycle is something we need to effectively communicate to non-experts. For example, we may want to explain why sometimes forest management practices increase water availability, but sometimes they don't - or why the impacts of urbanization or fire are location specific.

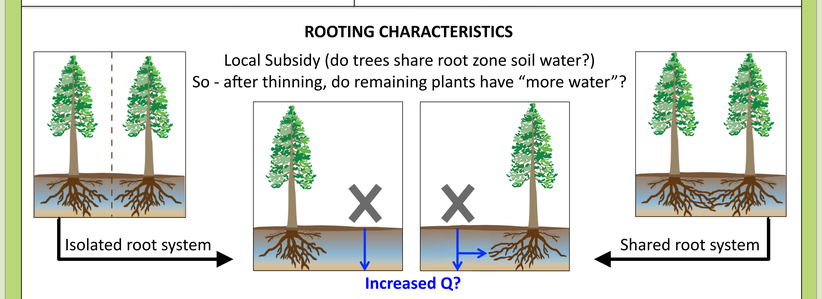
### *Example: Impacts of thinning on water use for mid elevation conifer*

We use a coupled model, the Regional Hydro-Ecologic Simulation System (RHESSys), validated with field measurements to show why spatial heterogeneity matters for understanding the impact of fuel treatments on the water cycle for the Sierra Critical Zone Observatory.



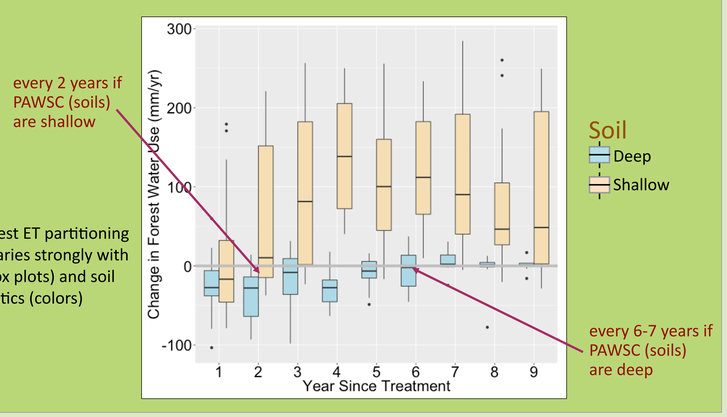




**Scenario:**
**Climate X PAWSC X Thinning X Rooting Characteristics**
**= 704 Scenarios**

RHESSys (a coupled eco-hydrologic model) was used to estimate how forest thinning impacts annual evapotranspiration for a mid-elevation snow dominated Sierra conifer site *(Tague & Moritz, in review)*

### *Results*

Rate of forest ET partitioning recovery varies strongly with climate (box plots) and soil characteristics (colors)

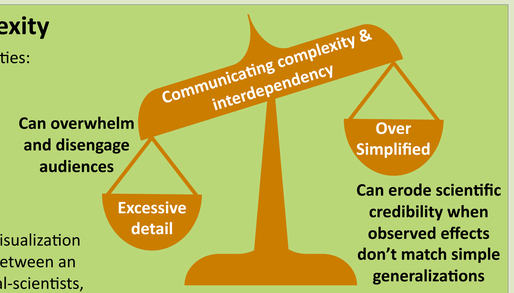



## Communicating Complexity

How do we help different communities:

- public
- private landowners
- other scientists
- NGO's
- governments

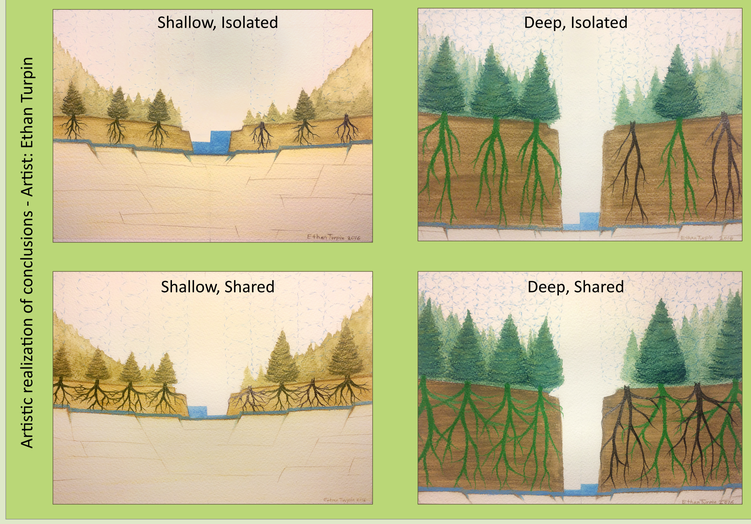
to better understand the role of space-time heterogeneity.




A solution - Better and interactive visualization of model outputs: a collaboration between an ecohydrologic modeling team, social-scientists, a visual artist, and computer graphics students.

### *One approach: collaboration with visual artists to come up with pictorial representations of different system states*

We summarize the previous example of model results in the following water colors



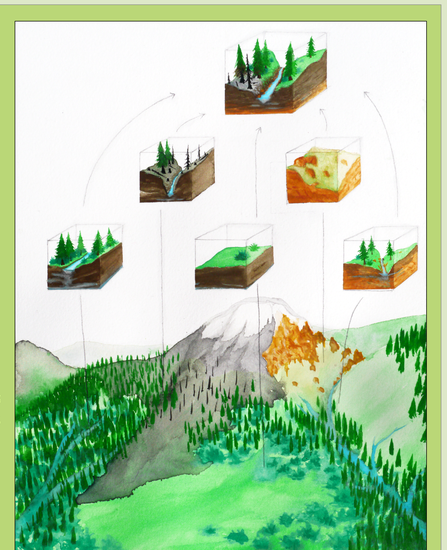

## Next Steps

### Translating these science based results into interactive visualization

This sketch presents the design of an interactive tool, under development, that allows users to explore how water and forest growth interact with climate - and how this interaction changes across space and through time - with and without climate warming.

Visualization is driven with output from the RHESSys model.

github.com/RHESSys/RHESSys
fiesta.bren.ucsb.edu/~rhessys



### Our goal - improving how we present results of process based models!

## Credits

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