Climate change impacts in forest ecosystems

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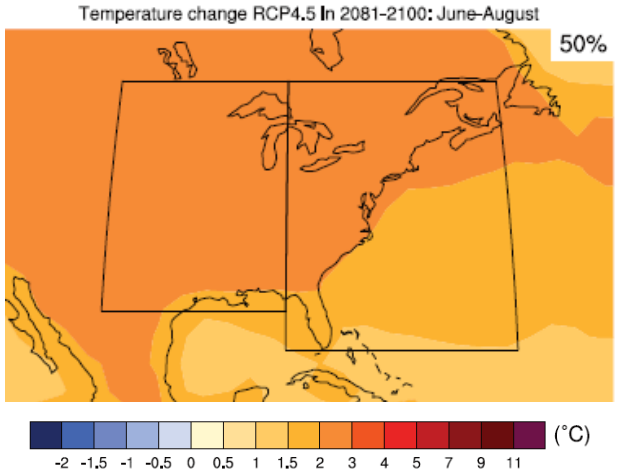
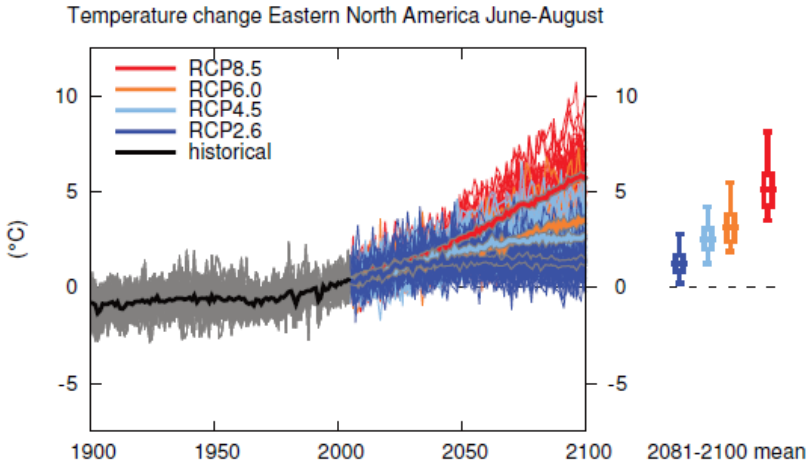
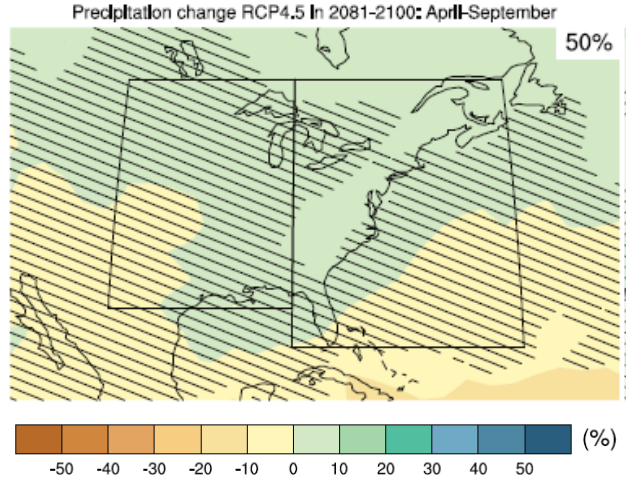
Overview

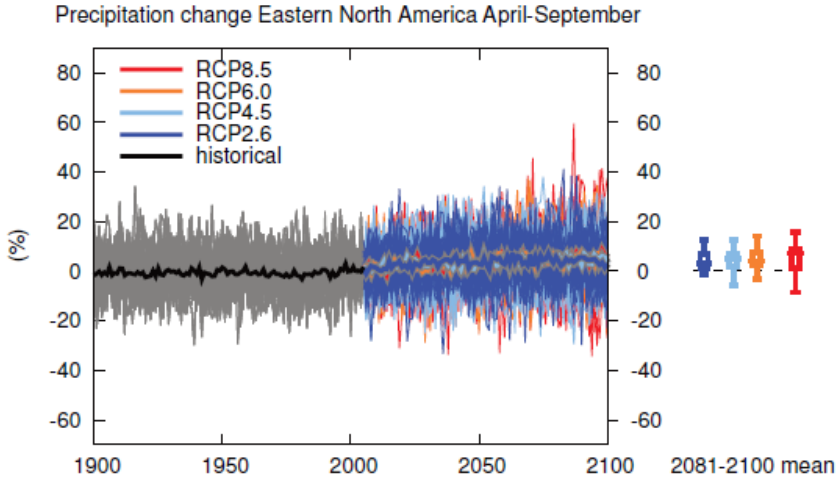
- Forest responses to climate change are complex
- Novel future climates include drought
- Good and bad of climate change
- We determine what our forests will look like in 100 years

2100: Hotter summers, slightly more annual precipitation





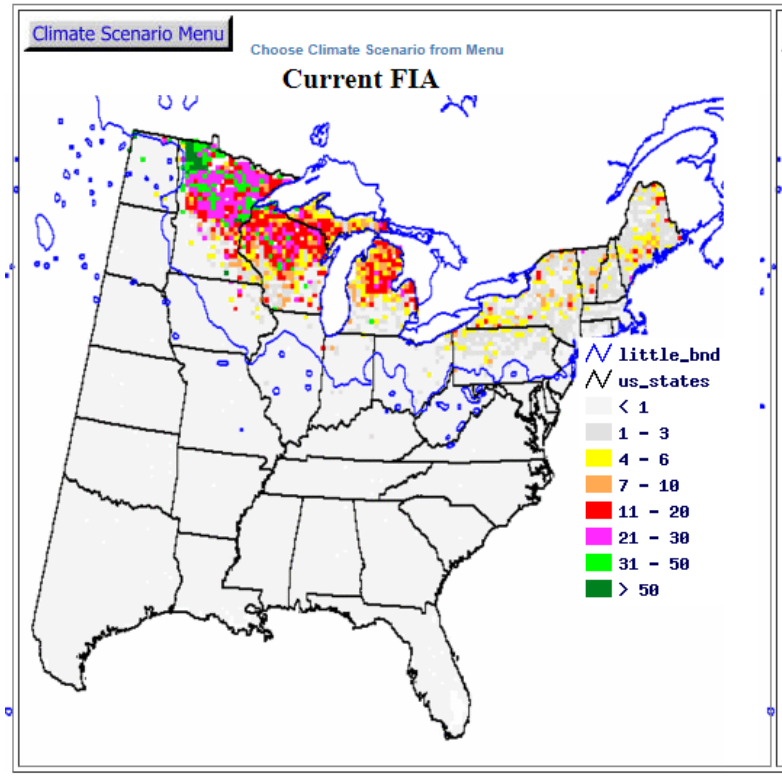




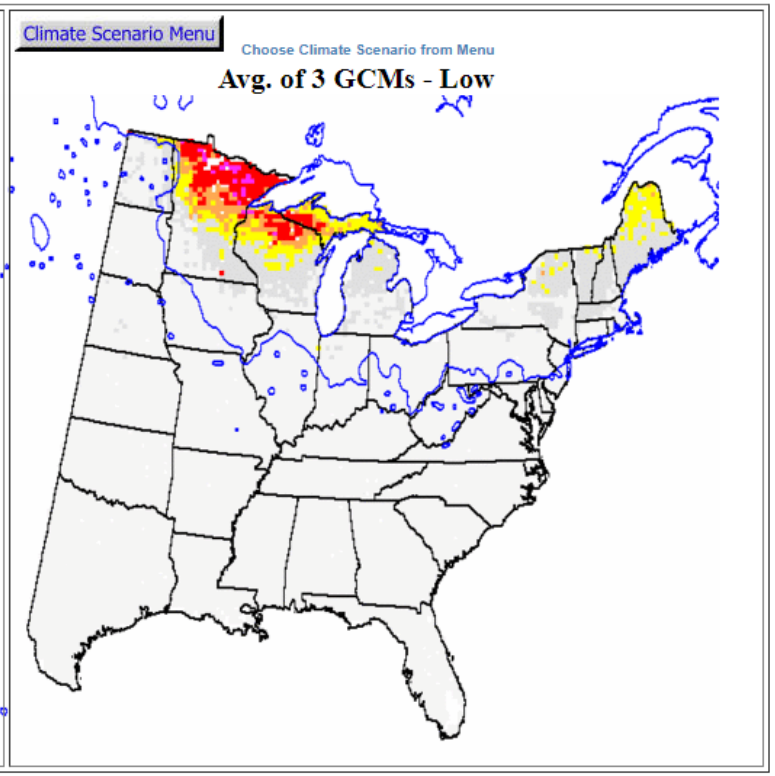
IPCC (2013)

Suitable habitats are shifting: trembling aspen (*Populus tremuloides*)

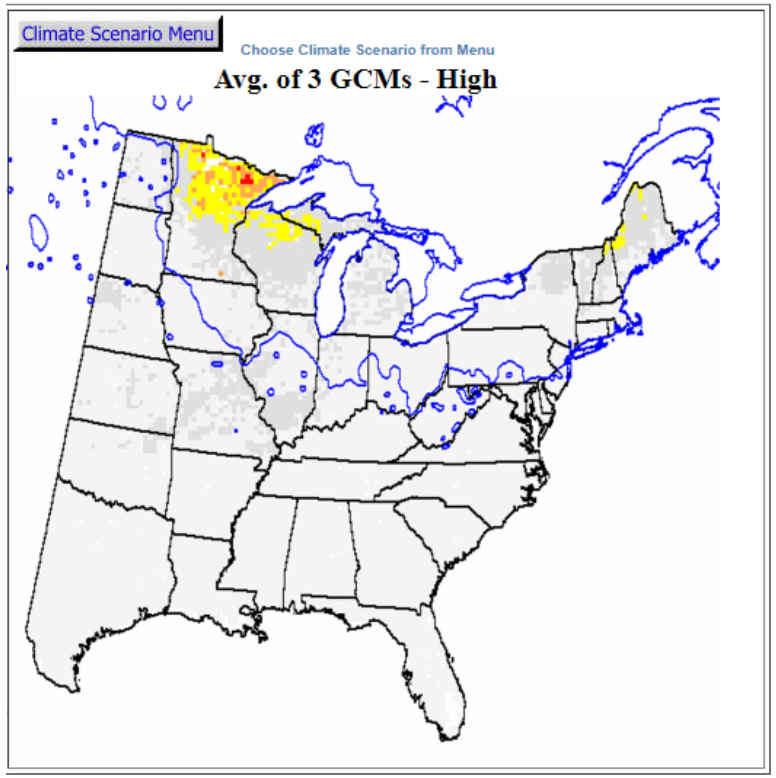
Current distribution



2100 suitable habitat with low amount of climate change

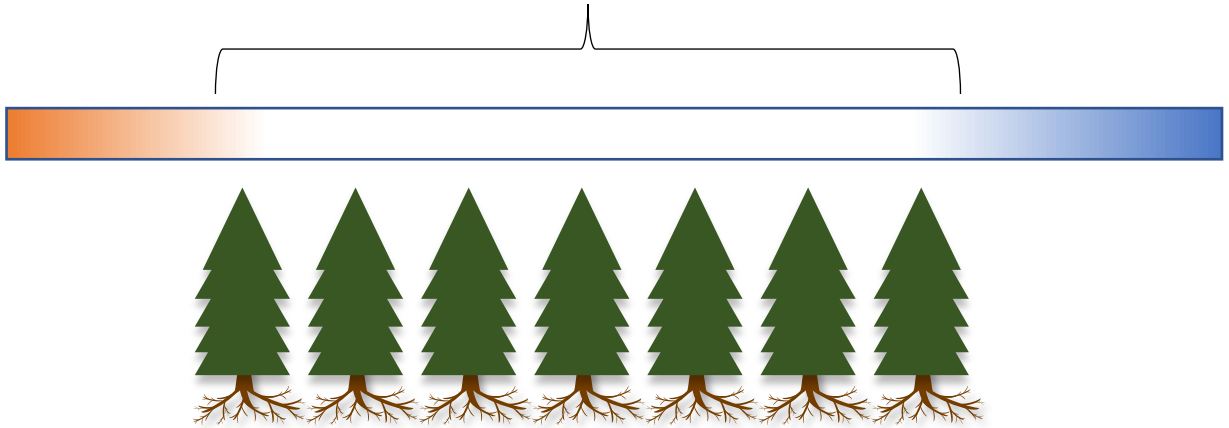


2100 suitable habitat with high amount of climate change



Suitable climate envelope

- Low latitude or elevation
- Warmer temperatures



- High latitude or elevation
- Cooler temperatures

Trees left behind experiencing novel climate conditions

Suitable climate envelope

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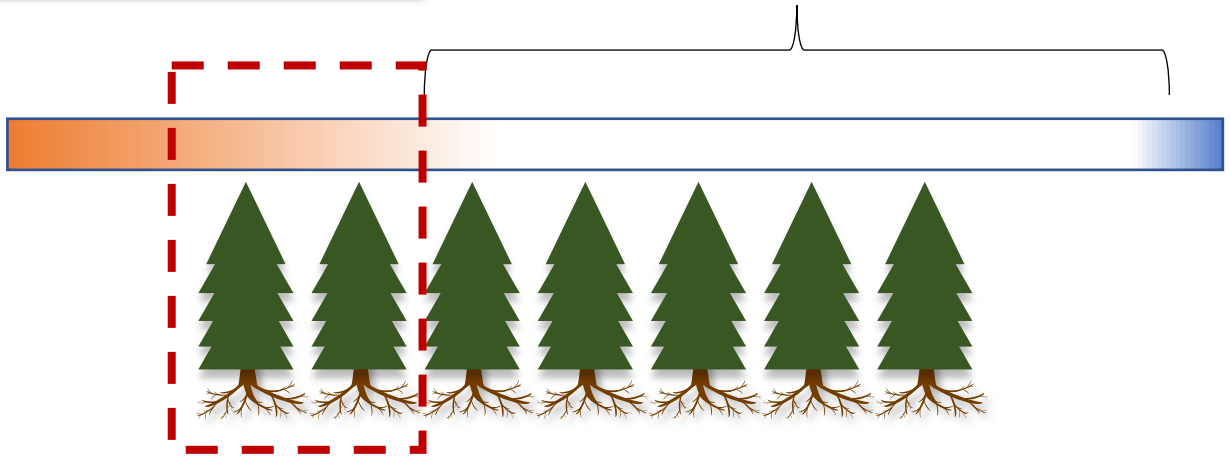
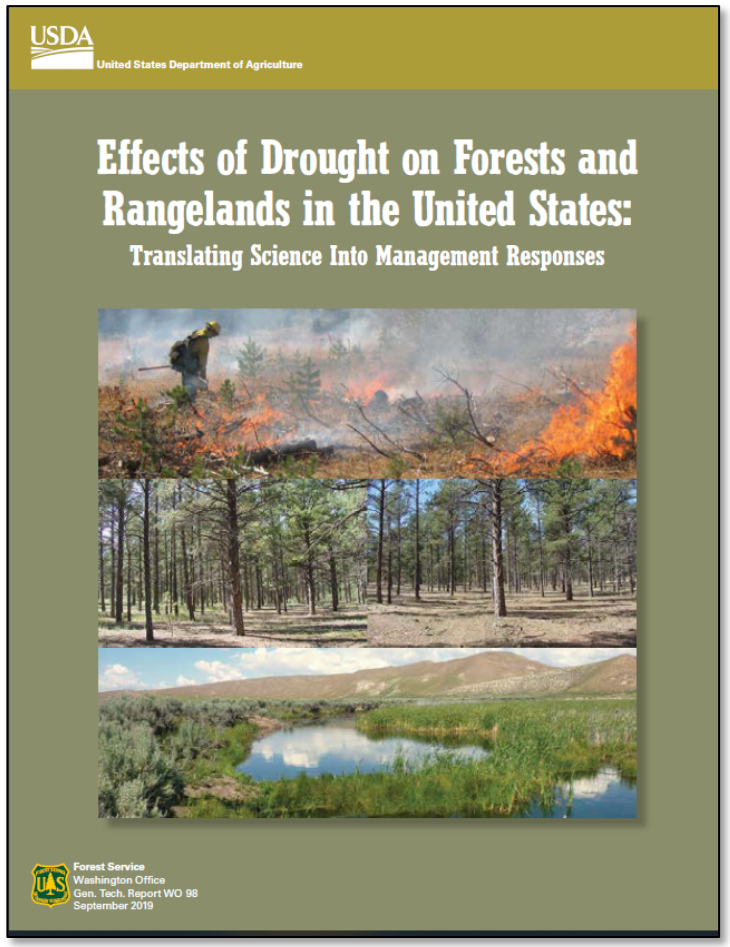
- Warmer temperatures



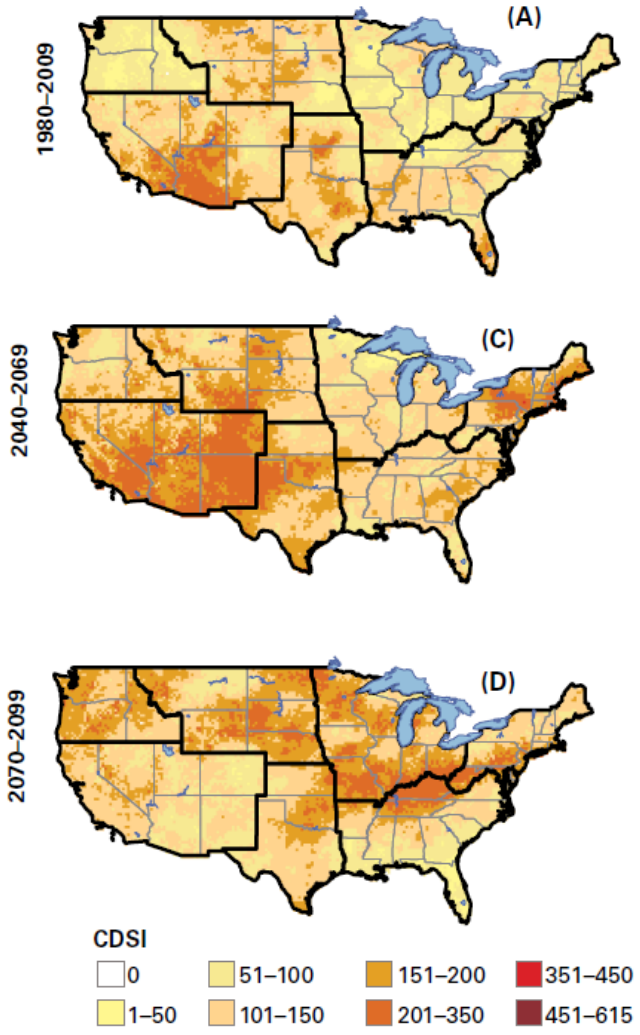
- High latitude or elevation
- Cooler temperatures

Drought

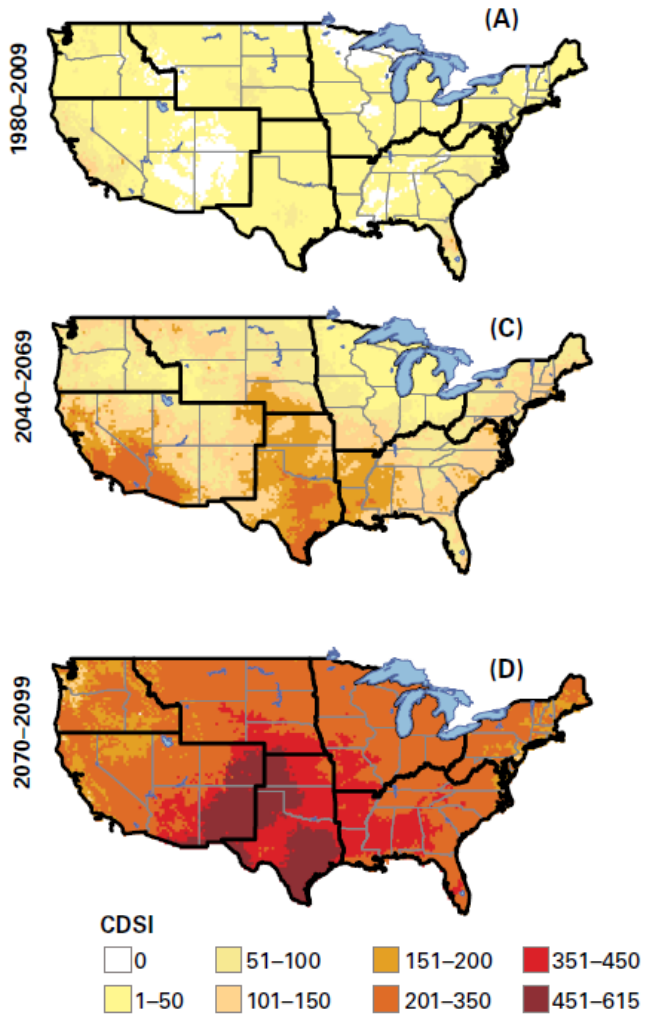


Vose et al 2019

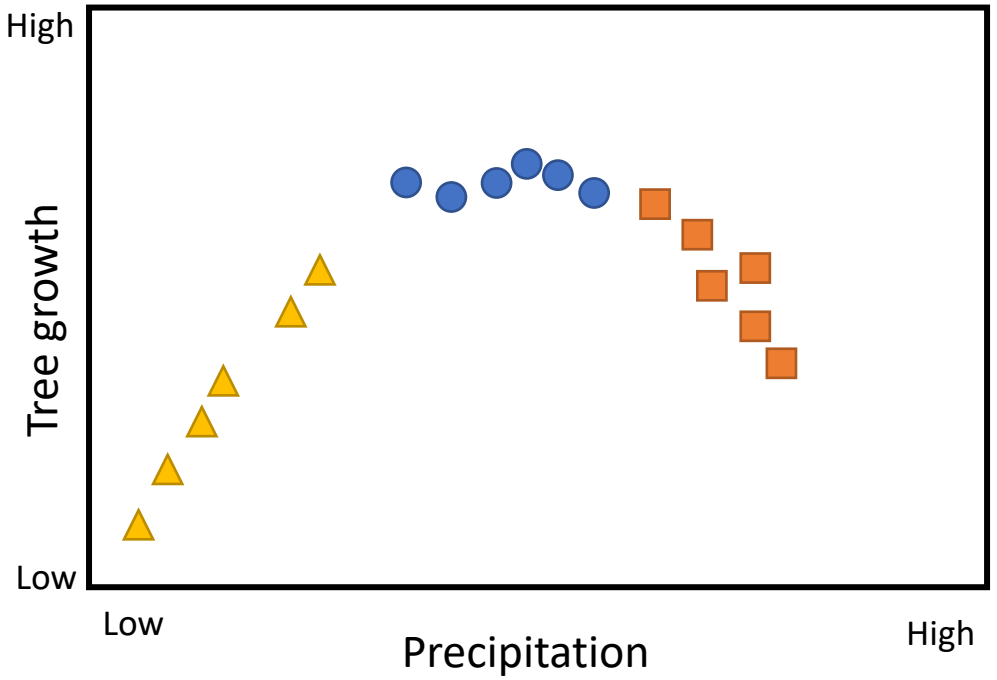
Warm-wet scenario

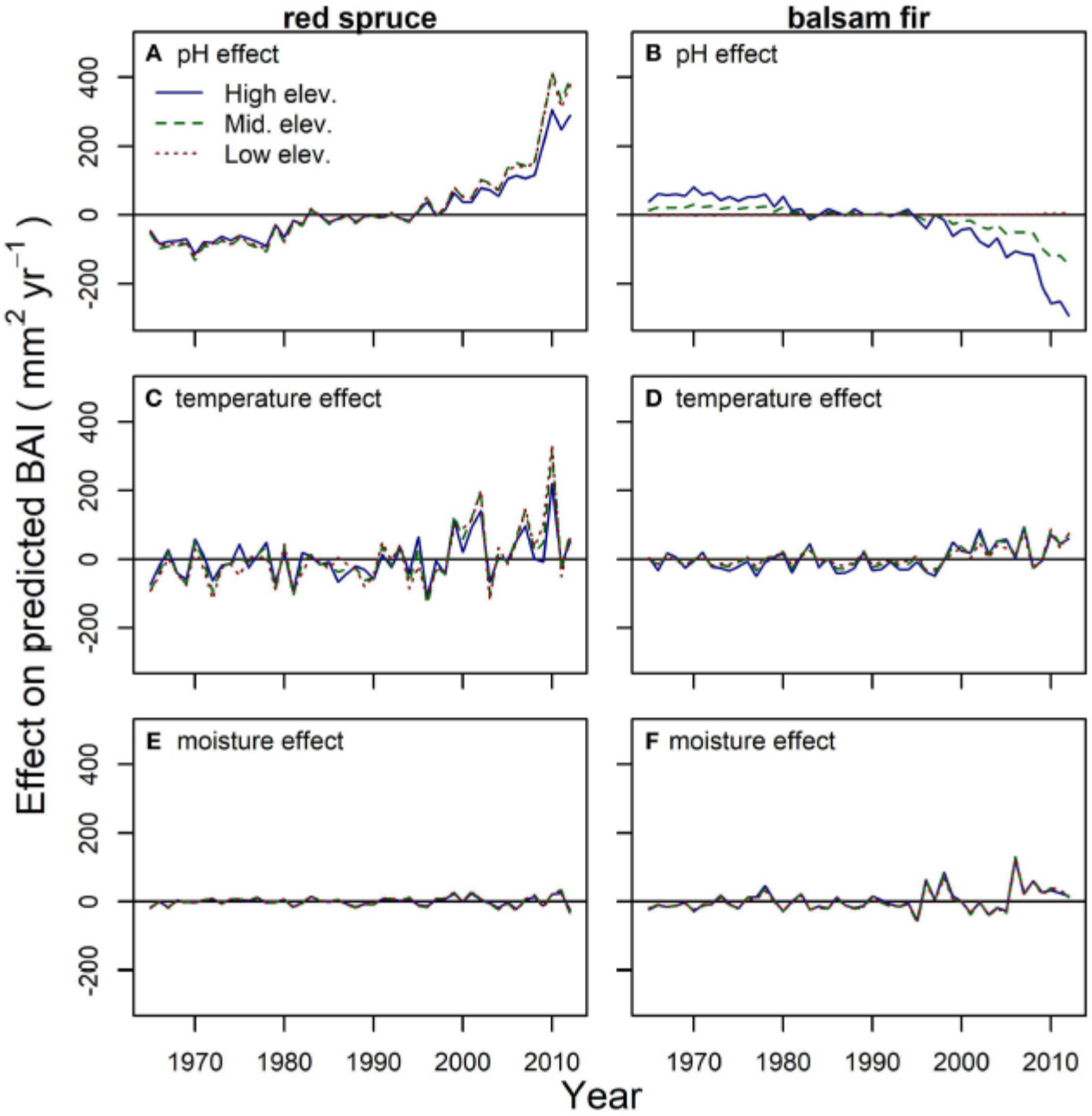


Hot-dry scenario



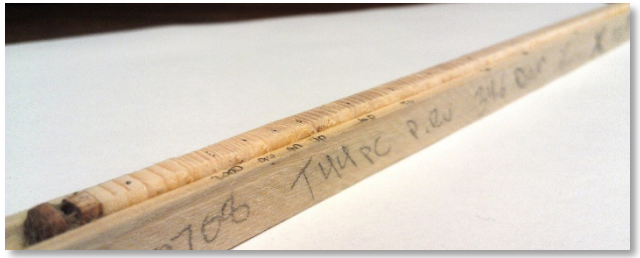
Tree rings

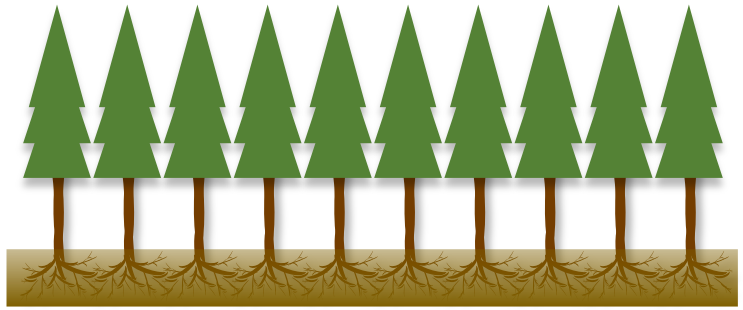




Wason et al (2019), *Frontiers in Ecology and Global Change*

Forest stand density effects on tree resistance and resilience to drought



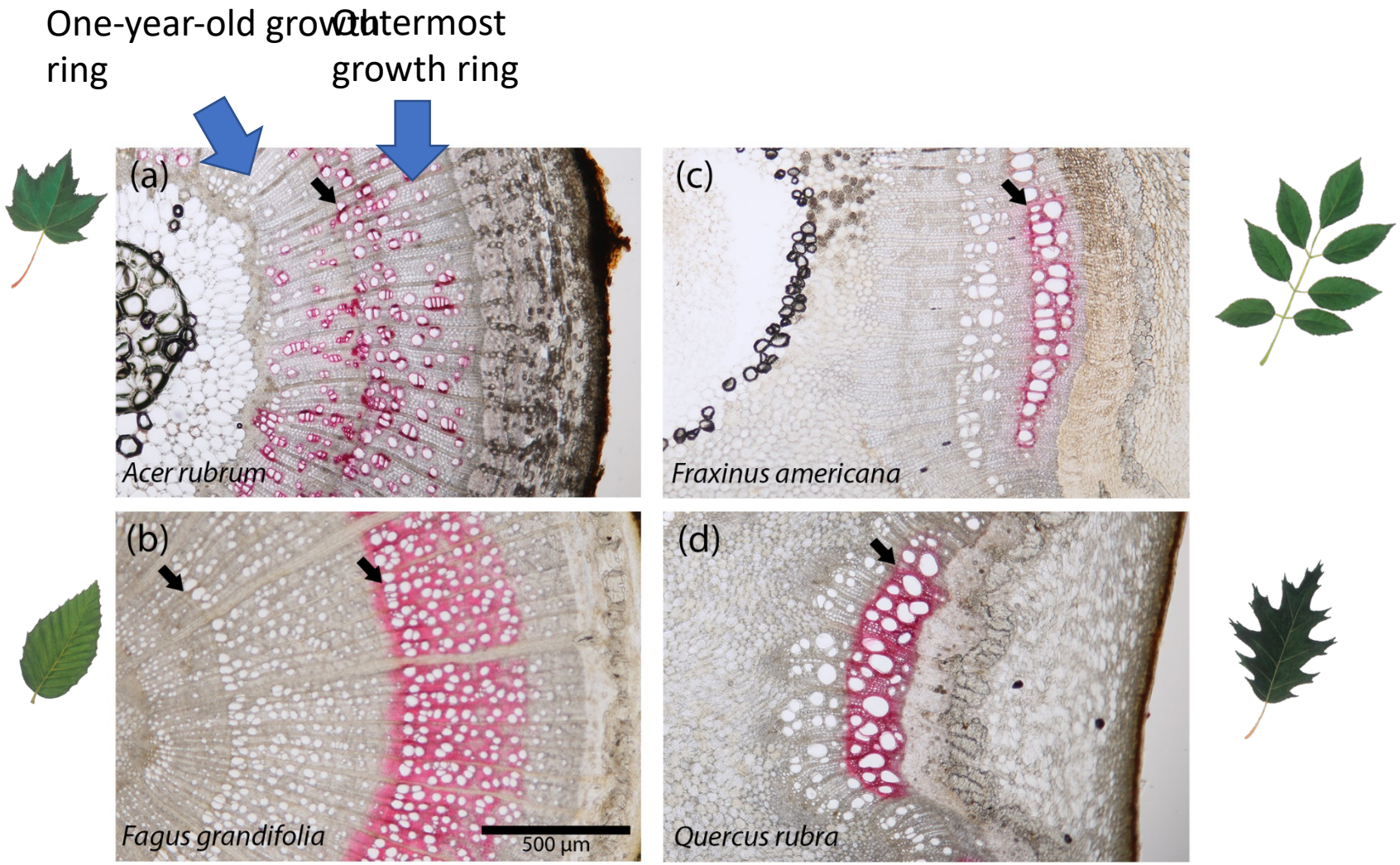


Red spruce

Balsam fir

Kelly French

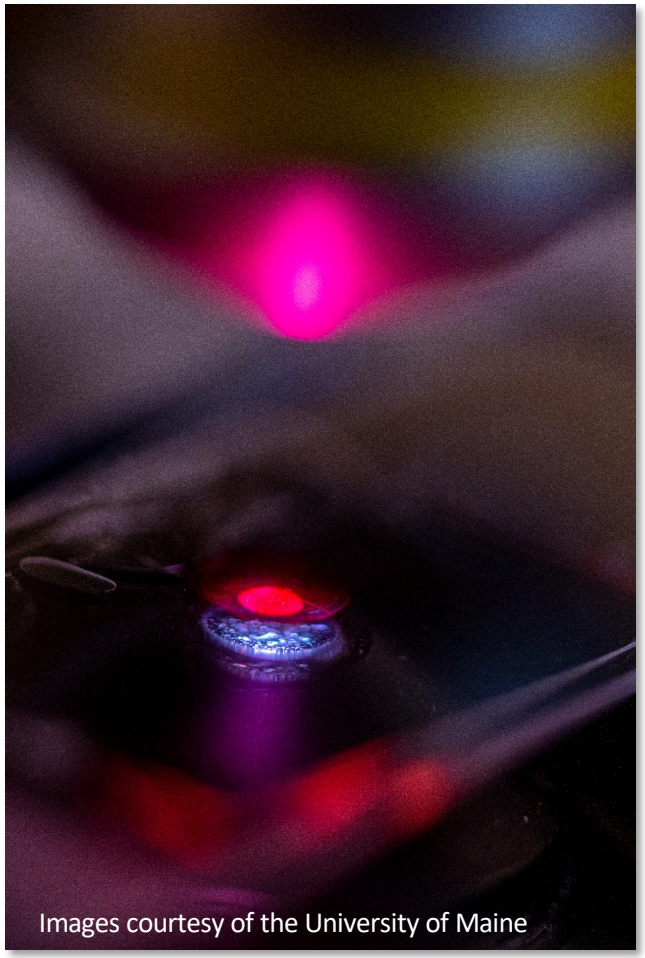
Tree ring structure and function

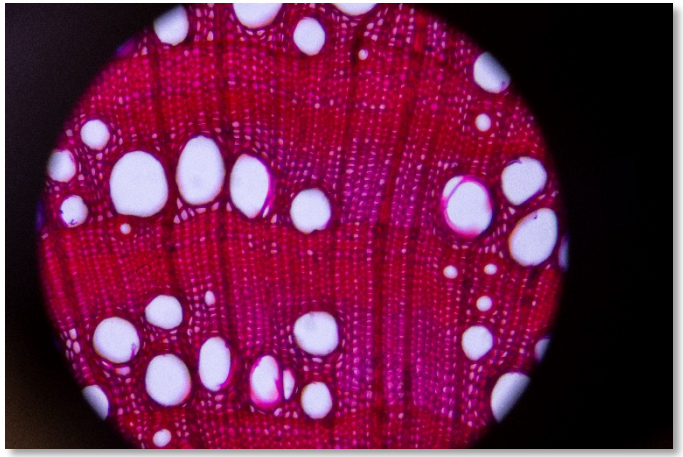


Black arrows indicate ring boundaries

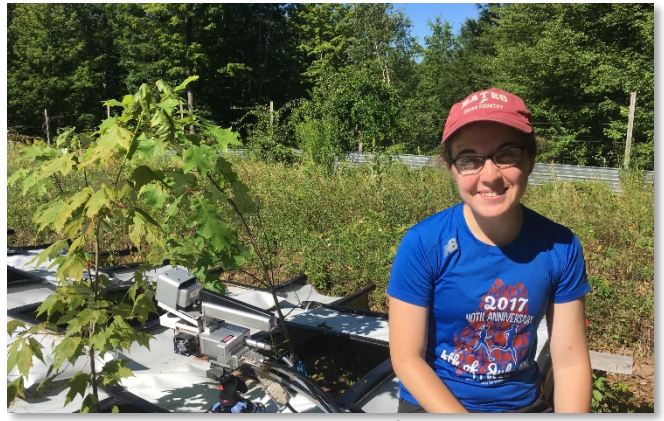
Wason et al. (2019), Annals of Botany

Tree adaptations to extreme drought

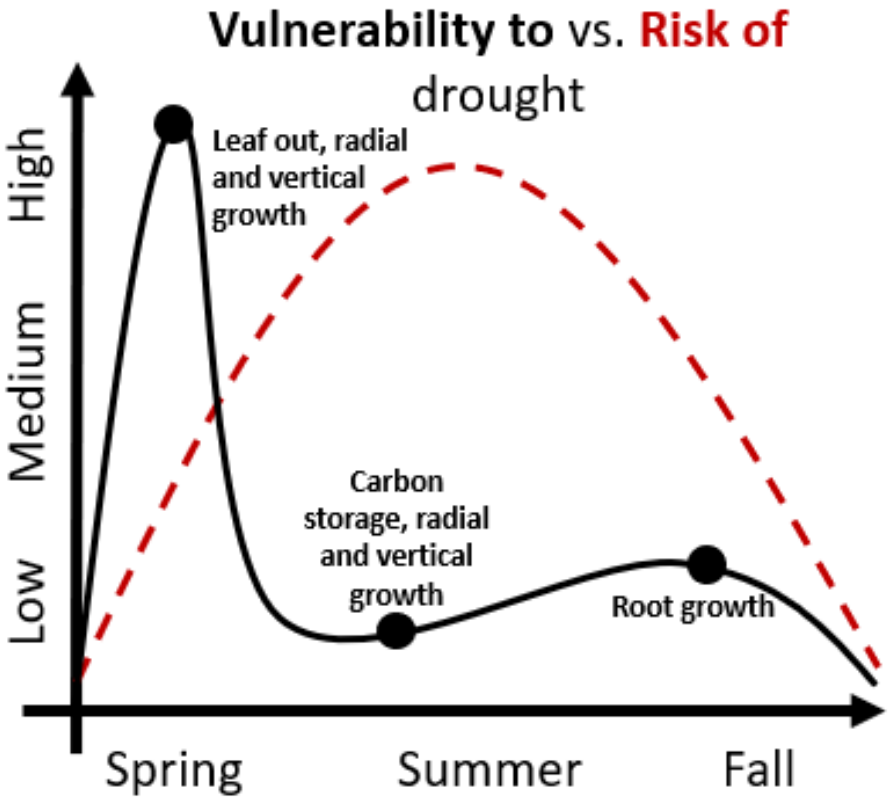




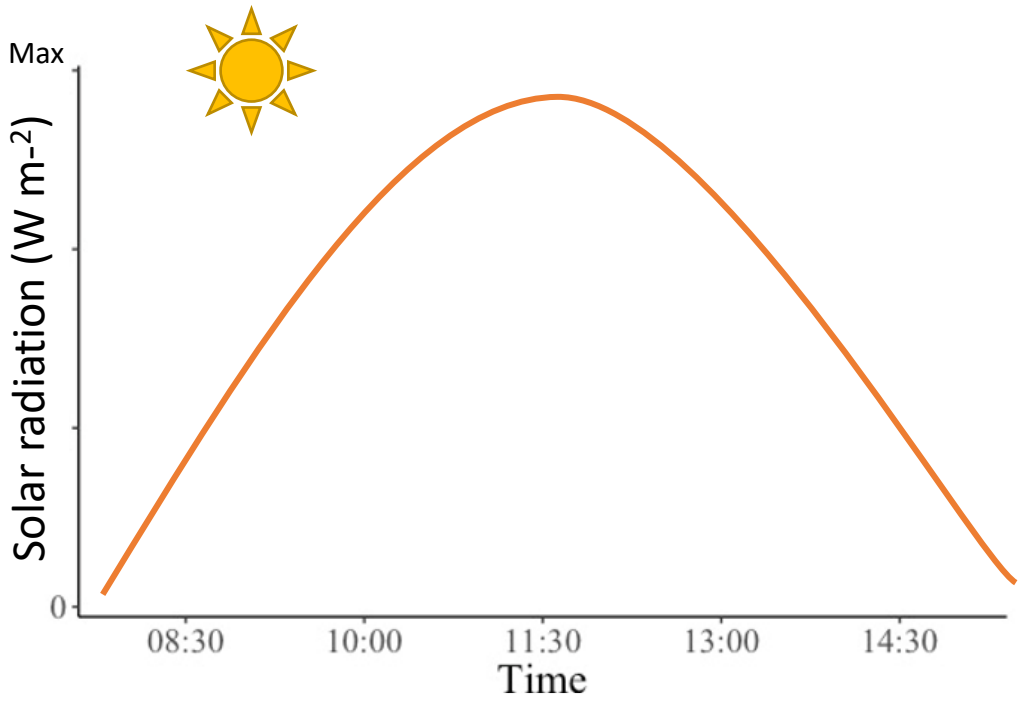
DroughtTIME: Drought Timing Impacts in Maine

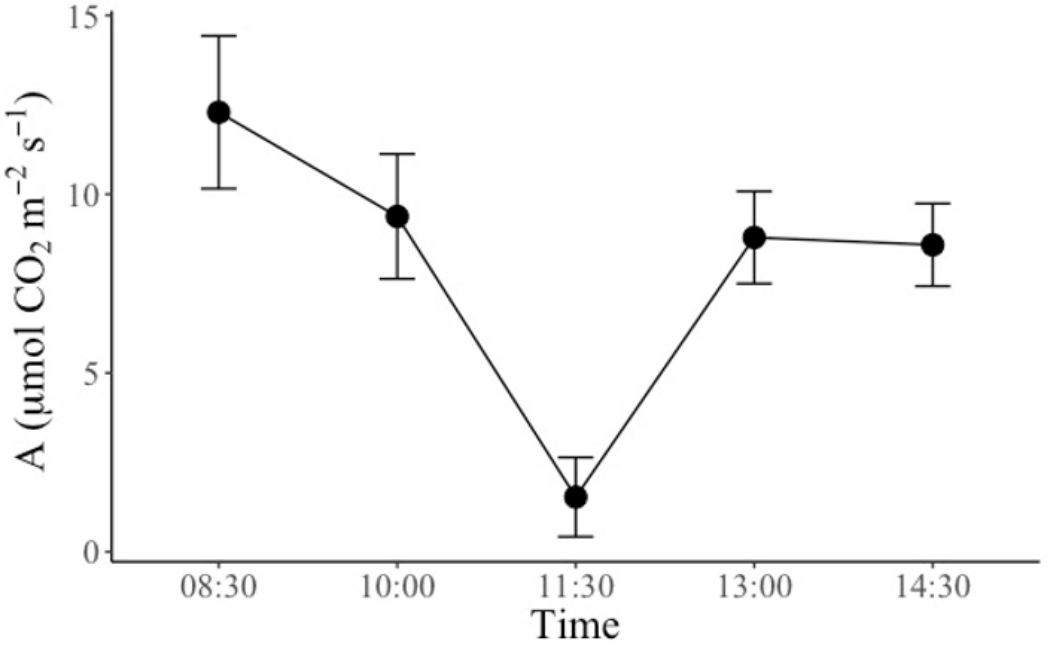


Ruth van Kampen



What is the best time of day for a plant to conduct photosynthesis?

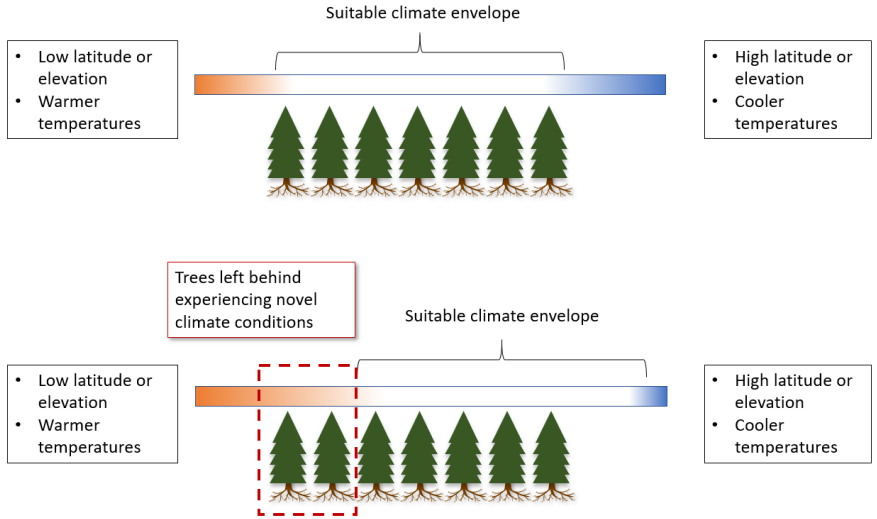




Midday declines in photosynthesis (A) for *Acer rubrum* leaves (n = 5) driven by high VPD and stomatal closure during a typical sunny day in Orono, ME (July 1, 2018).

Future directions

- Advantages and disadvantages of climate warming
- Climate change refugia



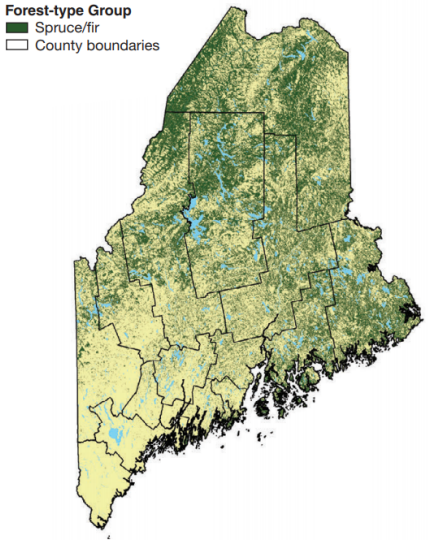


Figure 15.—Distribution of the spruce/fir forest-type group on forest land, Maine, 2013.

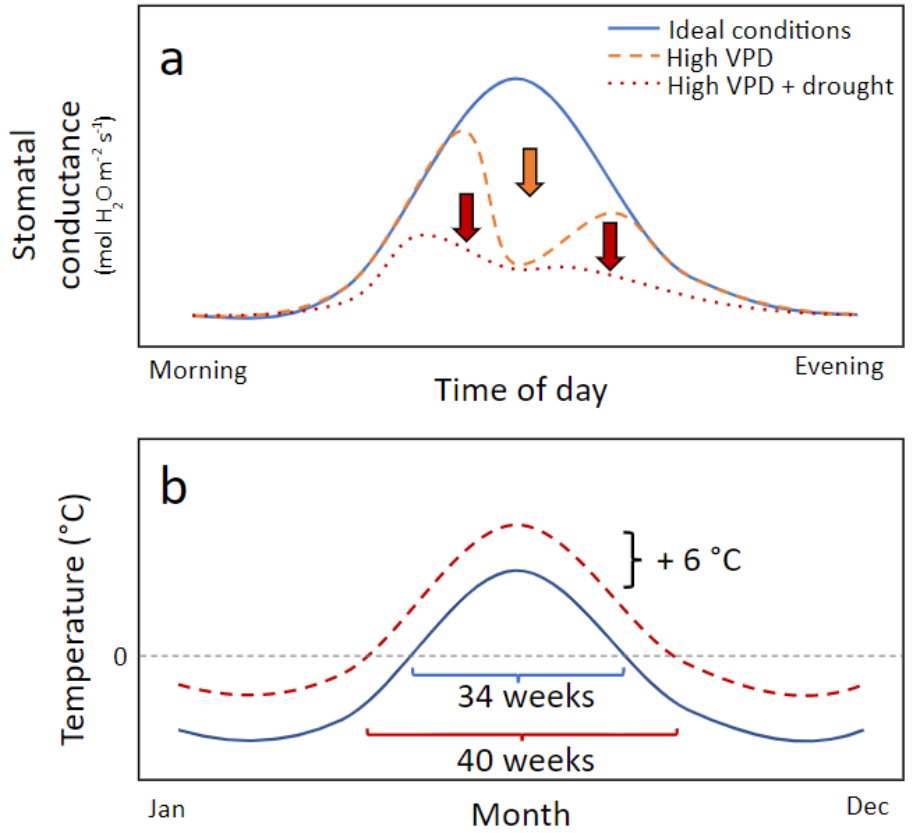
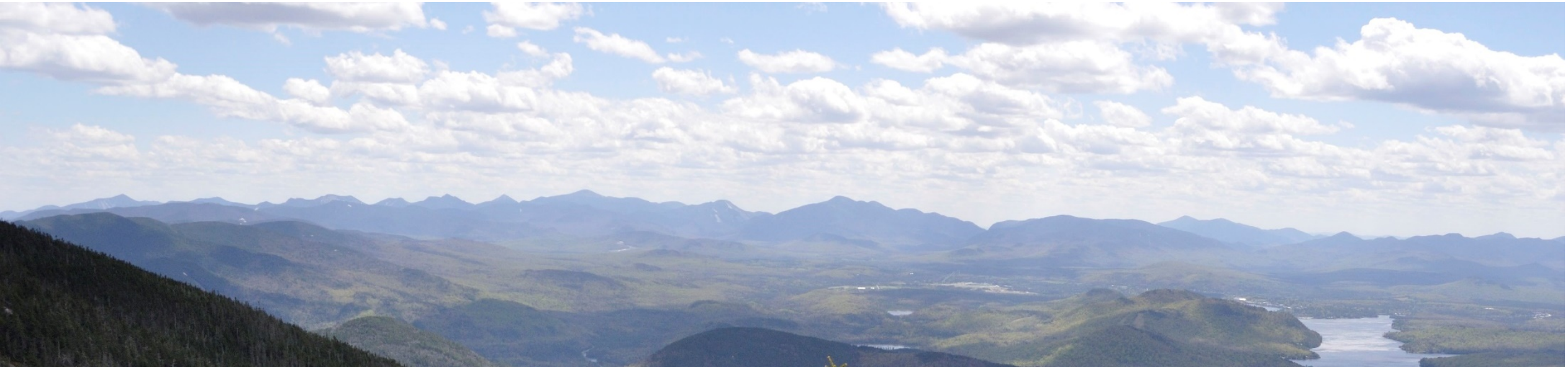


Figure 1. Conceptual figure depicting declines in midday stomatal conductance (a) driven by high vapor pressure deficits (VPD) and soil drought. Warming drives longer growing seasons (b) but also increases high temperatures leading to higher VPD and likelihood of soil drought.

Take-home message

- Forests will respond slowly – it will be up to forest managers to determine what our forests look like
- We need both observational and experimental research to understand the past and predict future responses to climate change




Thank you!
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