Fine-Root Production in a Boreal Bog Responds to Experimental Warming and Elevated CO_2 Differentially among Plant Functional Types

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OAK RIDGE National Laboratory

Fine roots are critical components of ombrotrophic peatlands

- Nutrient acquisition
- Proximity to carbon reserves
- Mycorrhizal symbioses
- Challenging to study

PFTs with contrasting traits comprise the vascular plant community in the SPRUCE experiment

shrubs

- shallowly distributed
- narrow fine-roots
- ericoid mycorrhizal (ErM)

evergreen ericaceous shrubs

- *Chamadaphne calyculata*
- *Kalmia polifolia*
- *Rhododendron groenlandicum*
- *Vaccinium oxycoccos*

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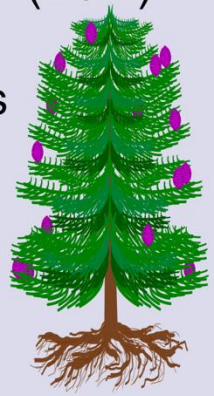
trees

- shallowly distributed
- thick fine roots
- ecto-mycorrhizal (EcM)

evergreen conifers

- *Picea mariana*



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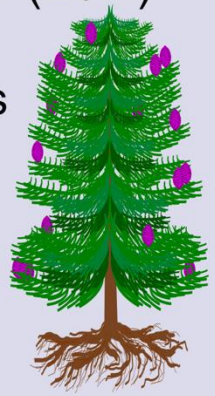

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deciduous conifers

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herbs

- deeply distributed
- thick fine-roots
- aerenchymous roots
- arbuscular (AMF) to non-mycorrhizal (NM)

graminoids

- *Carex magellanica*
- *Carex oligosperma*
- *Carex trisperma*
- *Eriophorum vaginatum*
- *Eriophorum virginicum*
- *Rhynchospora alba*

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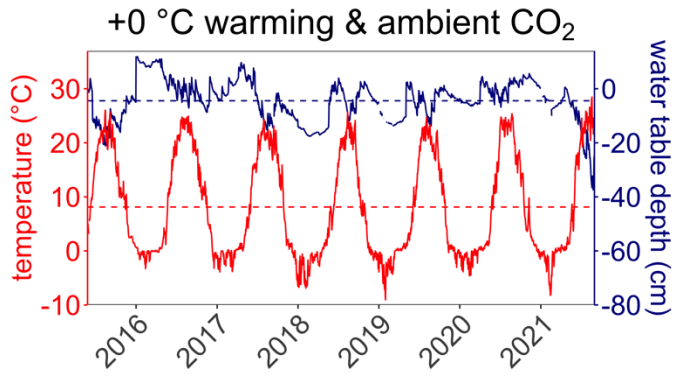
forbs

- *Maianthemum trifolium*

How will climate change impact the production and depth distribution of fine roots in boreal peat bogs?

PFTs will differentially respond to warming and elevated CO_2 directly, and indirectly via shifting summer water tables



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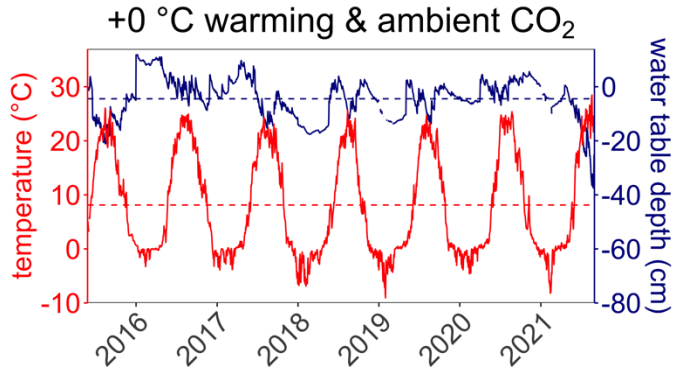

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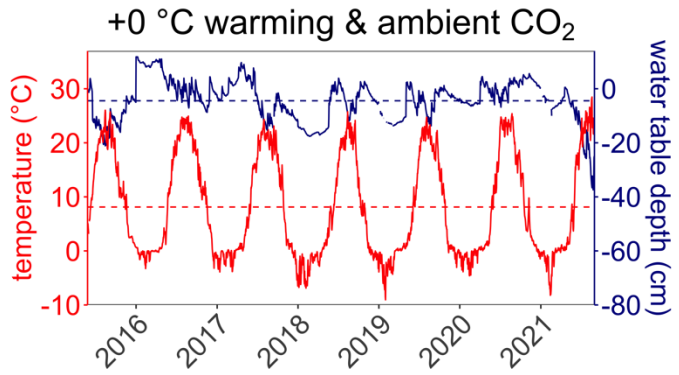
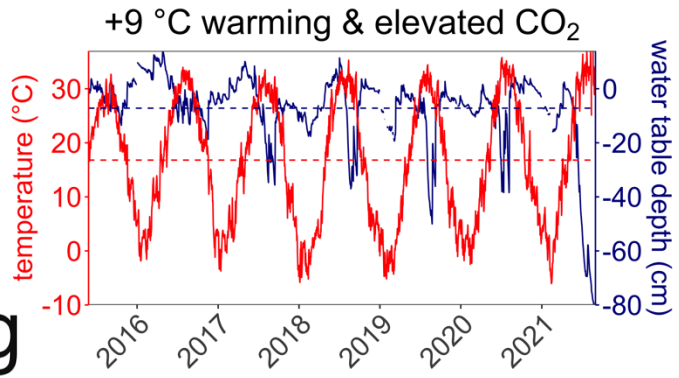


warming

e[CO2]



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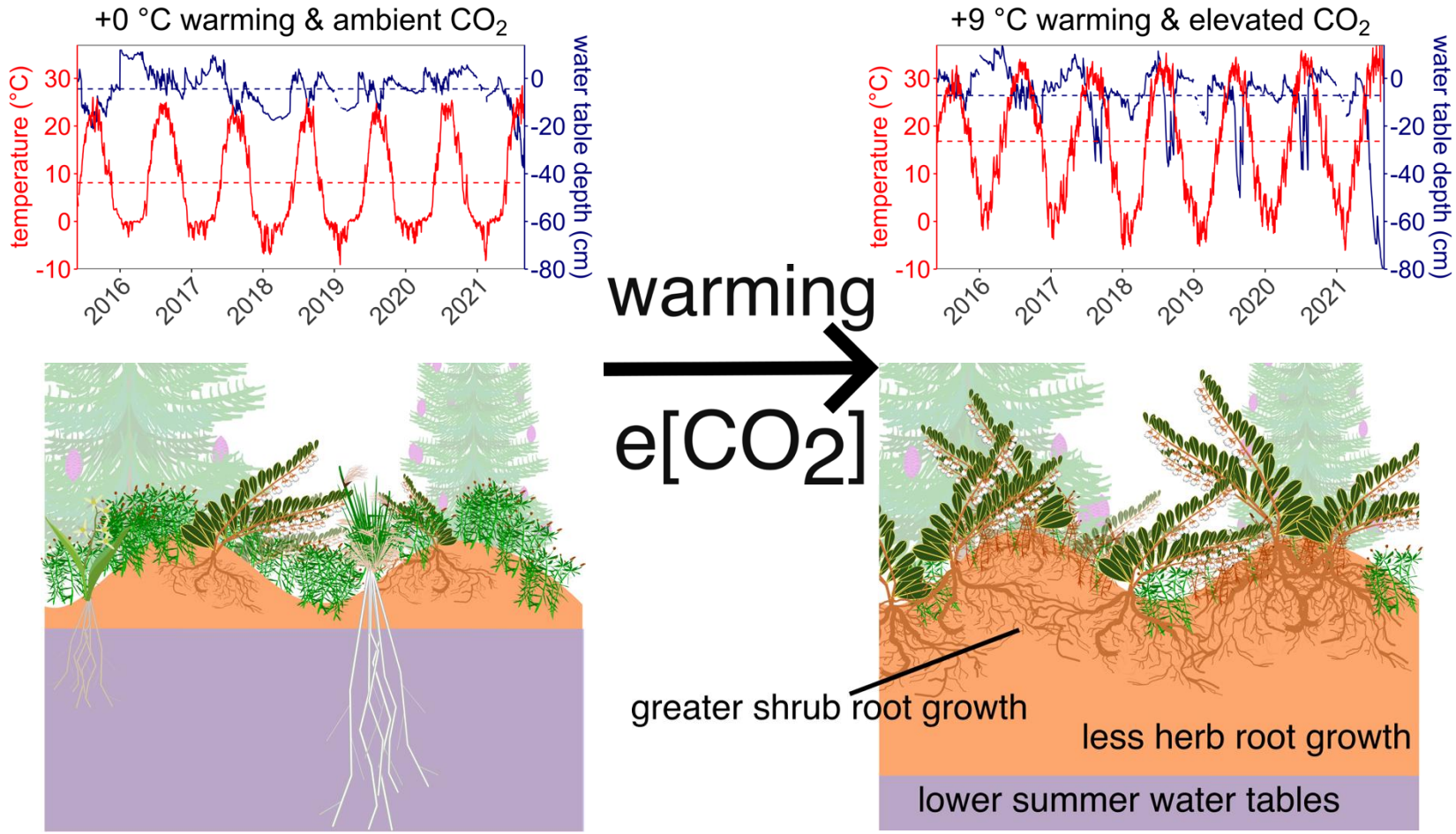

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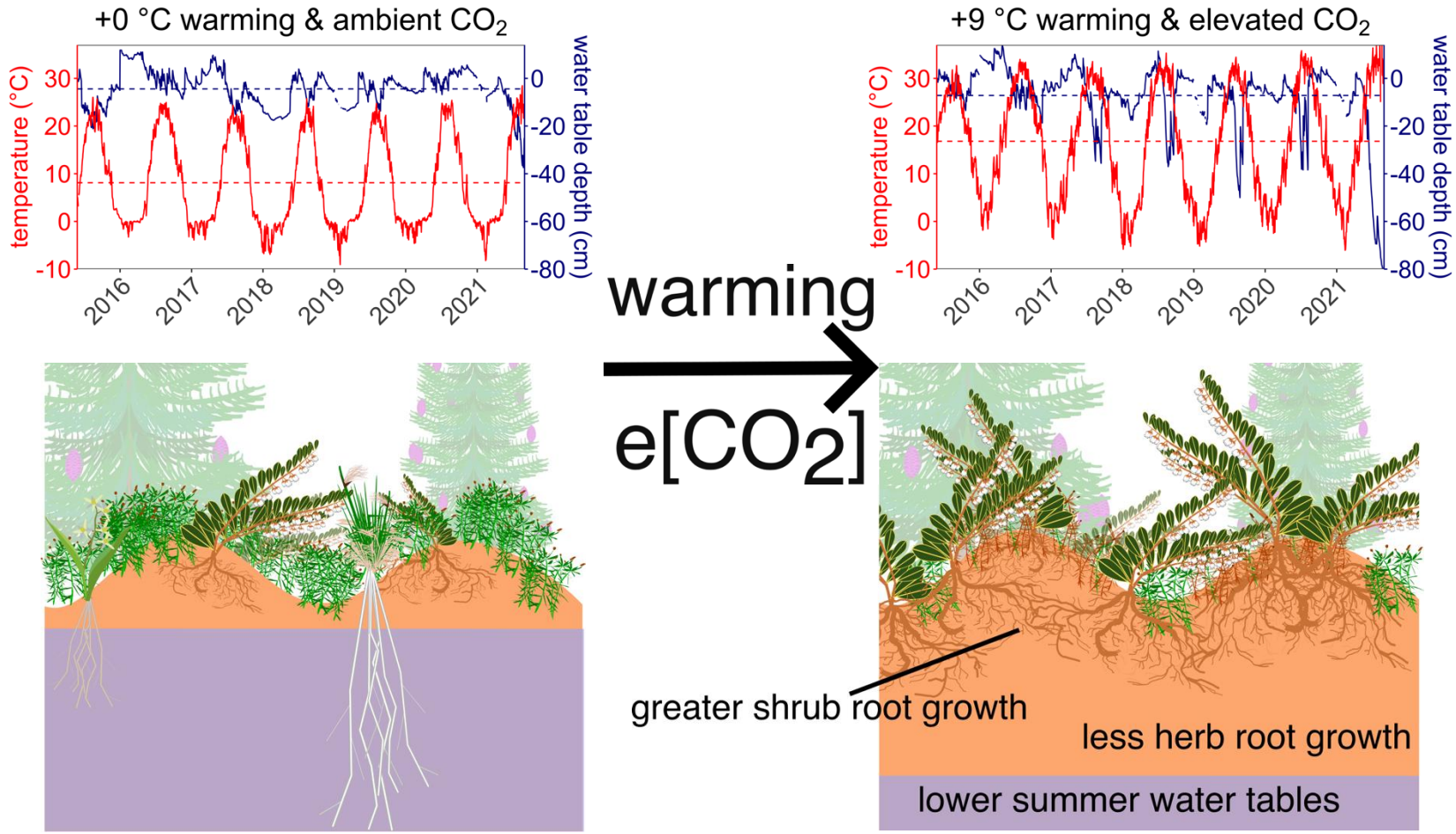
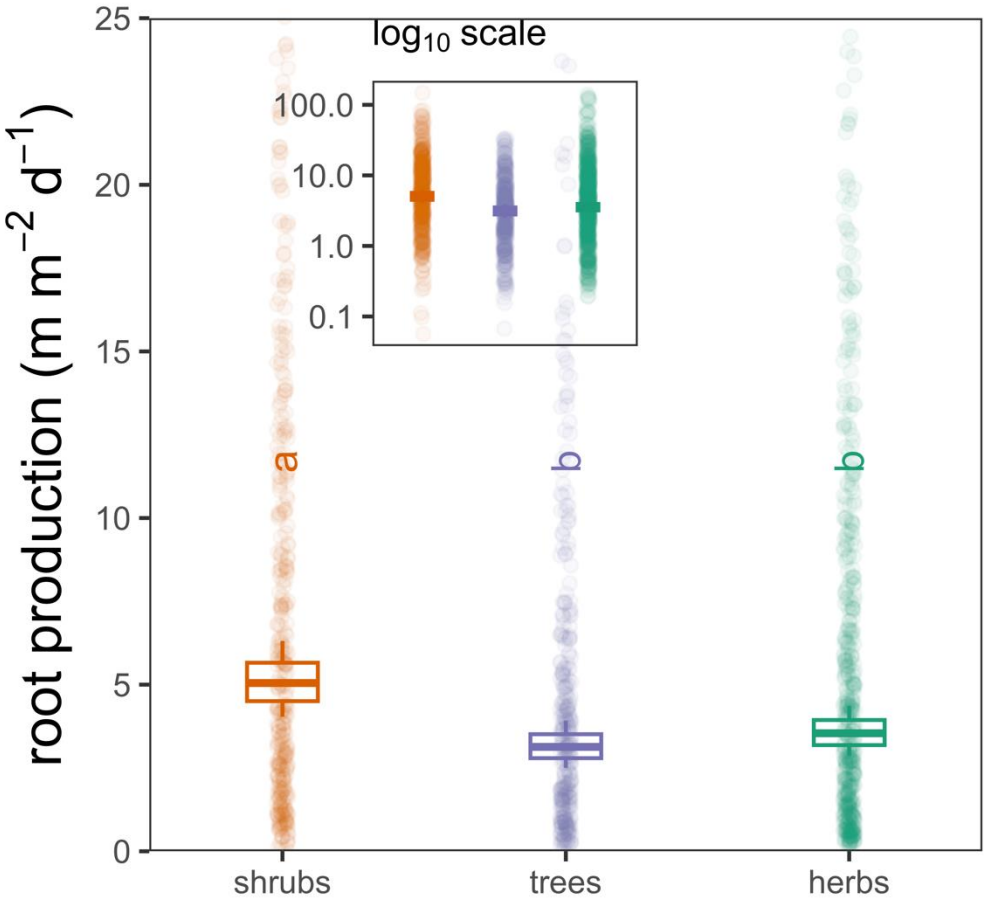
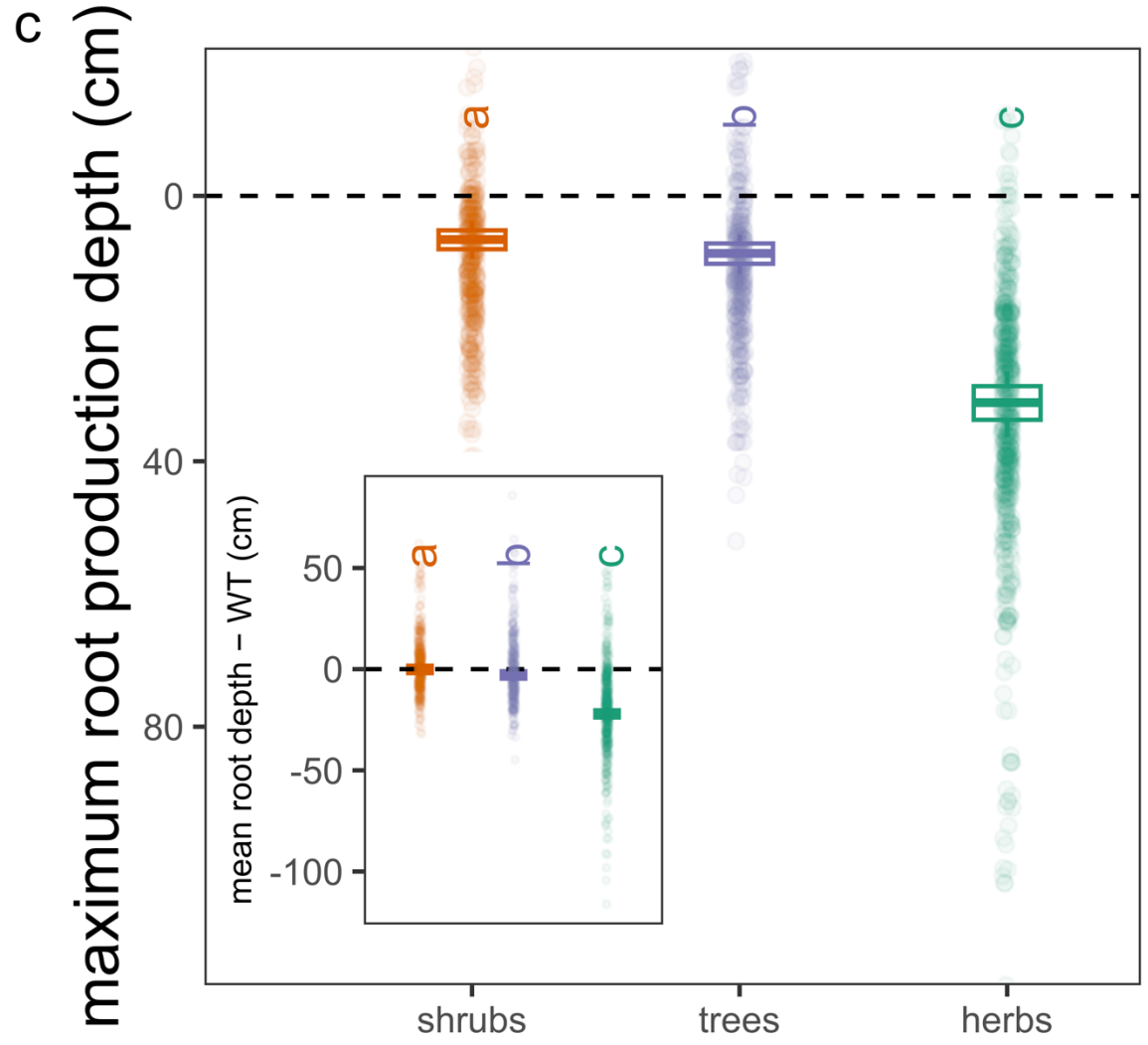


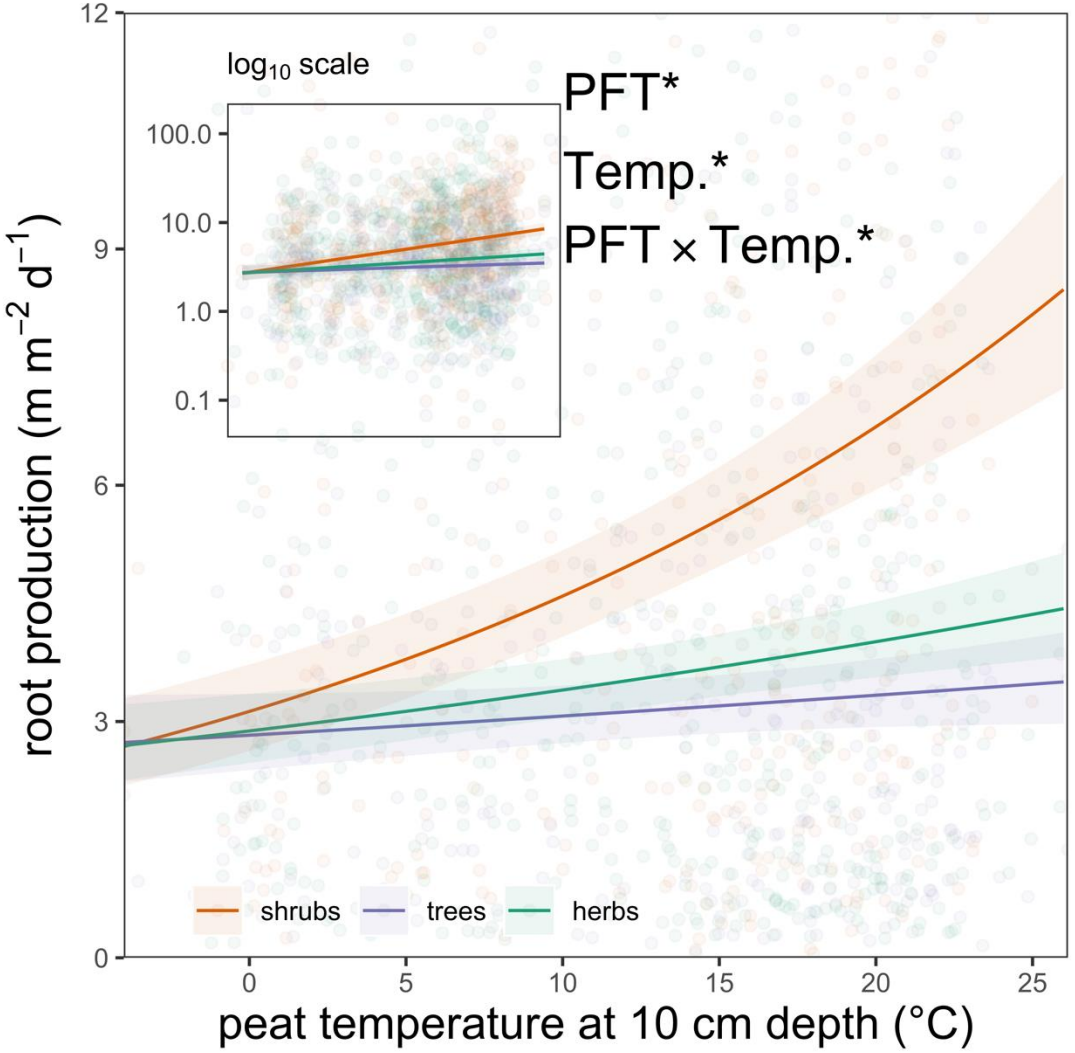
Shrubs produce more roots than trees or herbs



Root production depth varies among PFTs



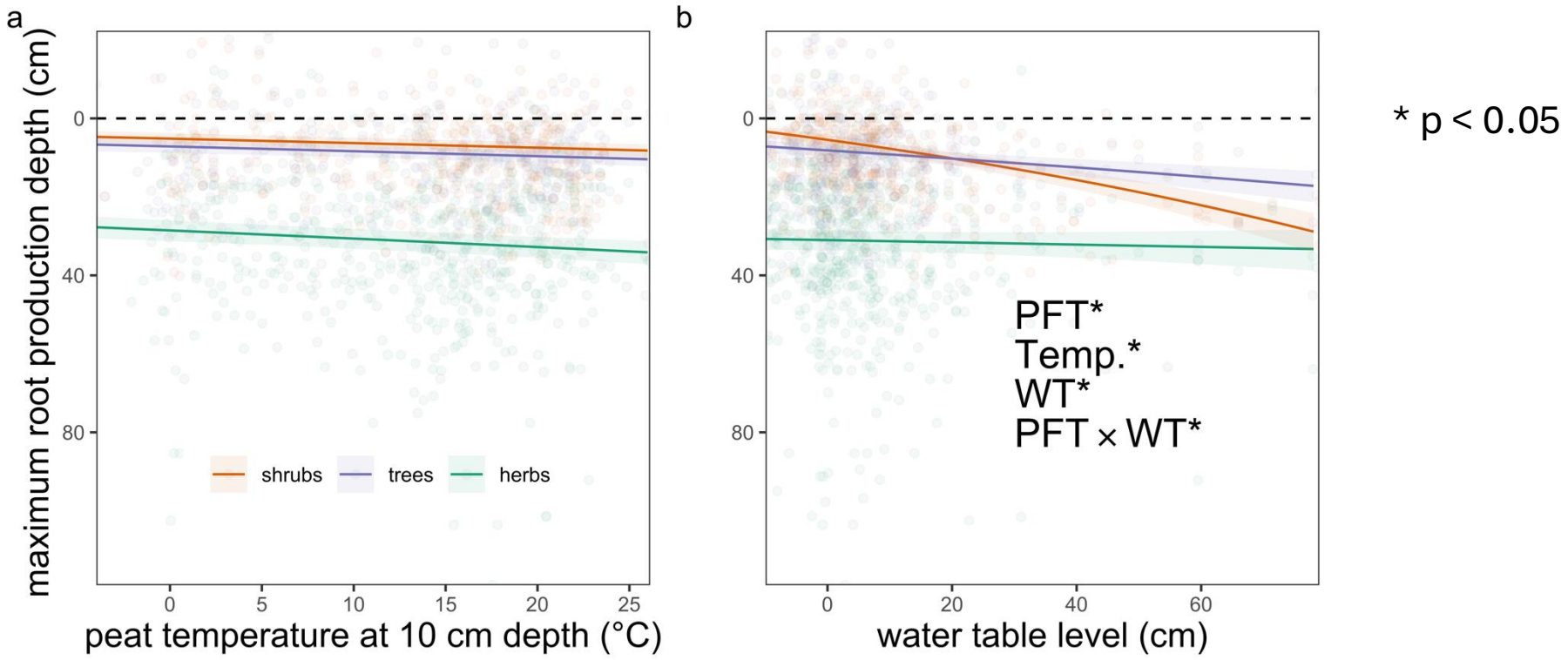
Root production increases with warming, strongest for shrubs



* $p < 0.05$

Roots are produced deeper with warming

Shrub and tree roots track lower water tables



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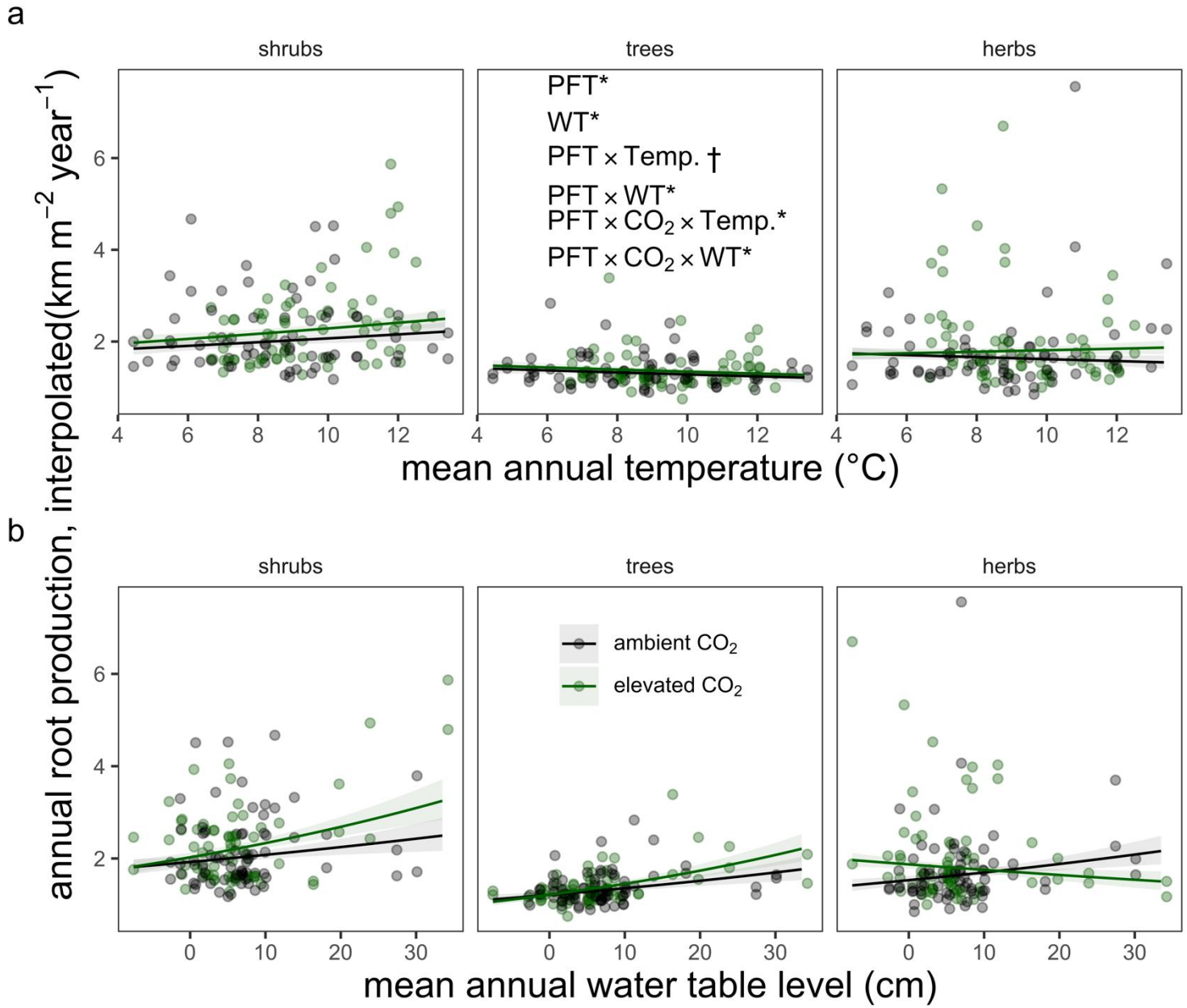
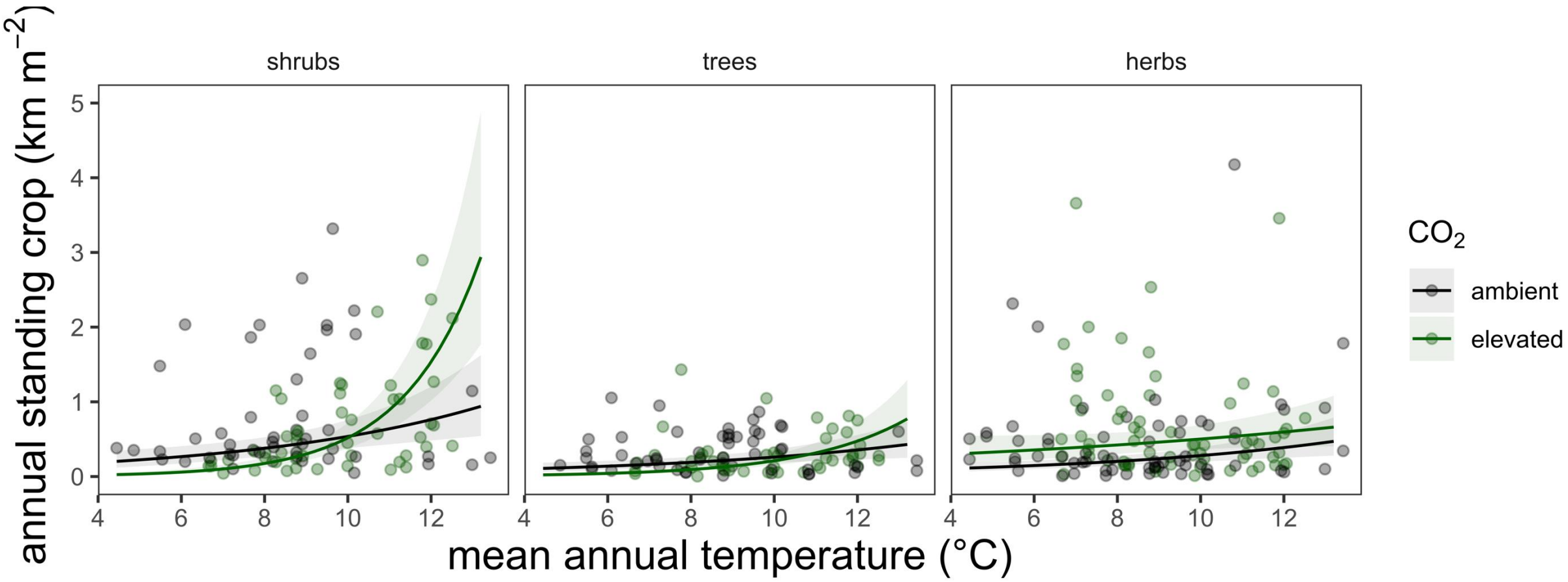

a
shrubs
trees
herbs
PFT*
WT*
PFT × Temp. †
PFT × WT*
PFT × CO2 × Temp.*
PFT × CO2 × WT*
annual root production, interpolated(km m−2 year−1)
mean annual temperature (°C)
b
shrubs
trees
herbs
ambient CO2
elevated CO2
mean annual water table level (cm)

* p < 0.05

† p < 0.10

Standing crop increases with warming, and this depends on CO_2 & PFT



I also looked at mass but there were already way too many plots, and it was *mostly* the same dynamics

Acknowledgements

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ESS Environmental System Science

SPRUCE

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Questions?

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