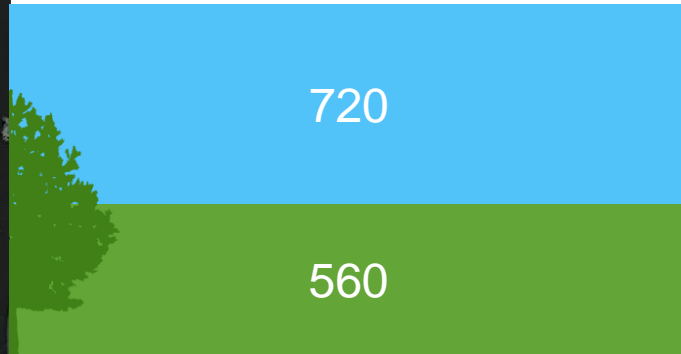


# Abiotic and biotic mediations of scale dependent tree trait effects on soil carbon concentrations

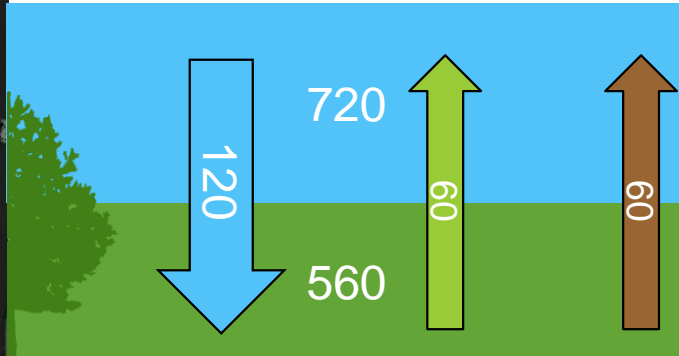
Rémy Beugnon

# Carbon on Earth is in earth



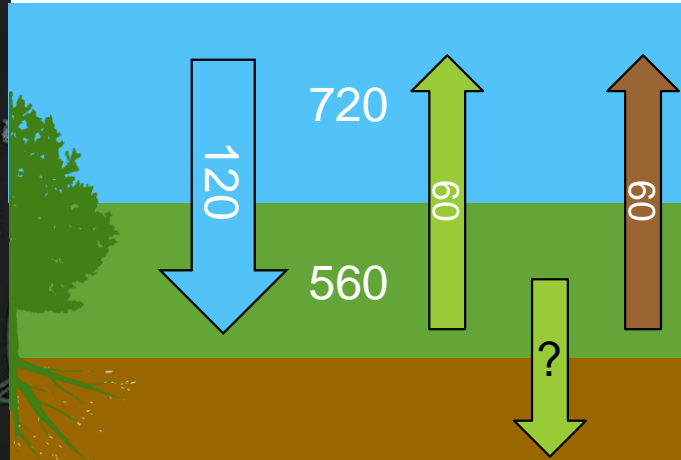
1'500

# Carbon on Earth is in earth



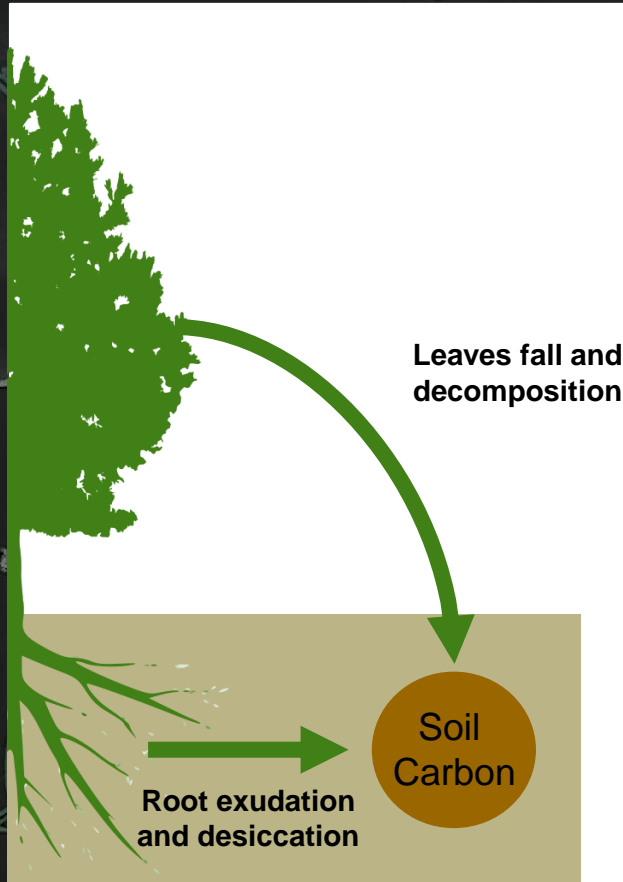
1'500

# Carbon on Earth is in earth

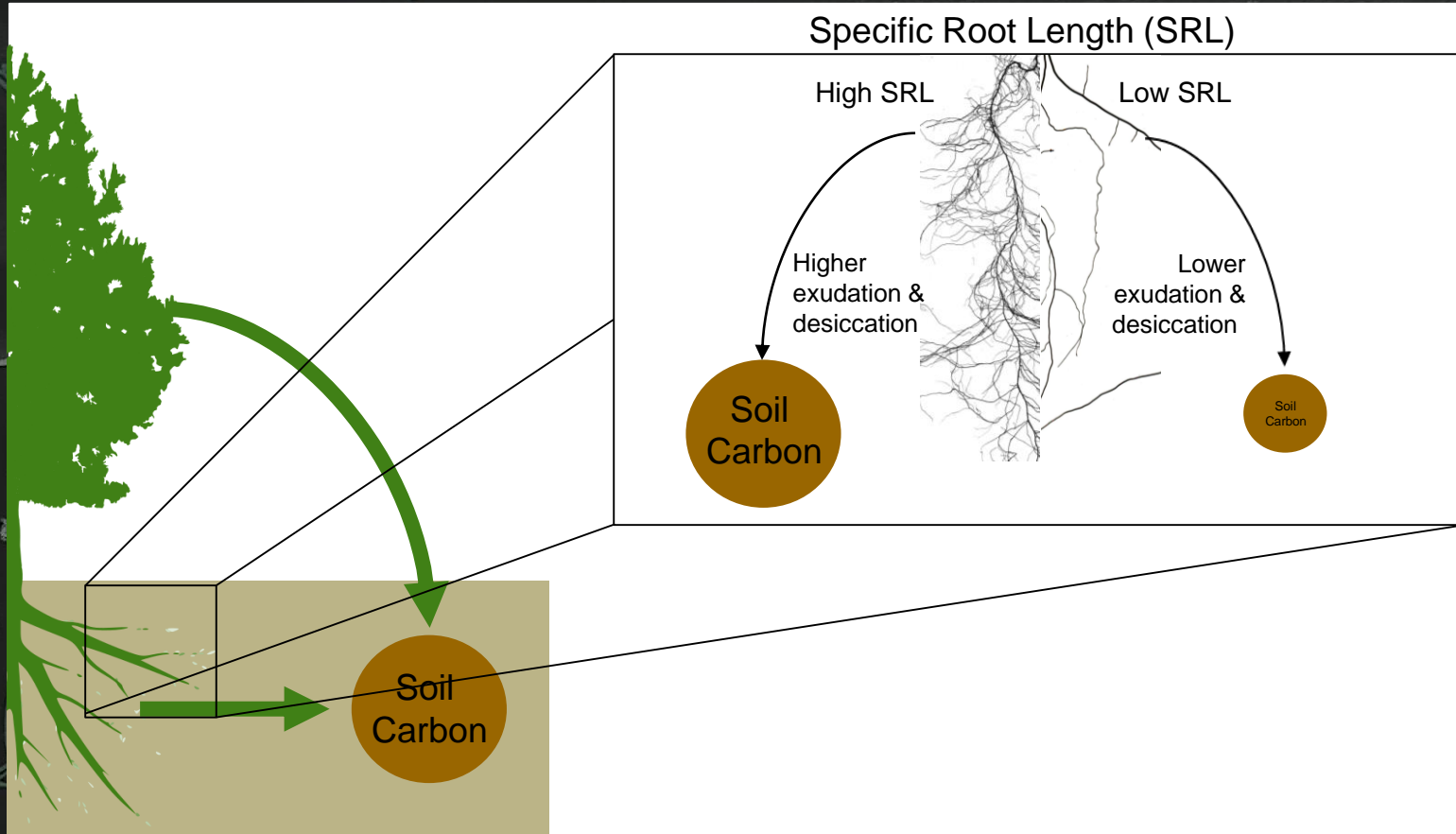


1'500

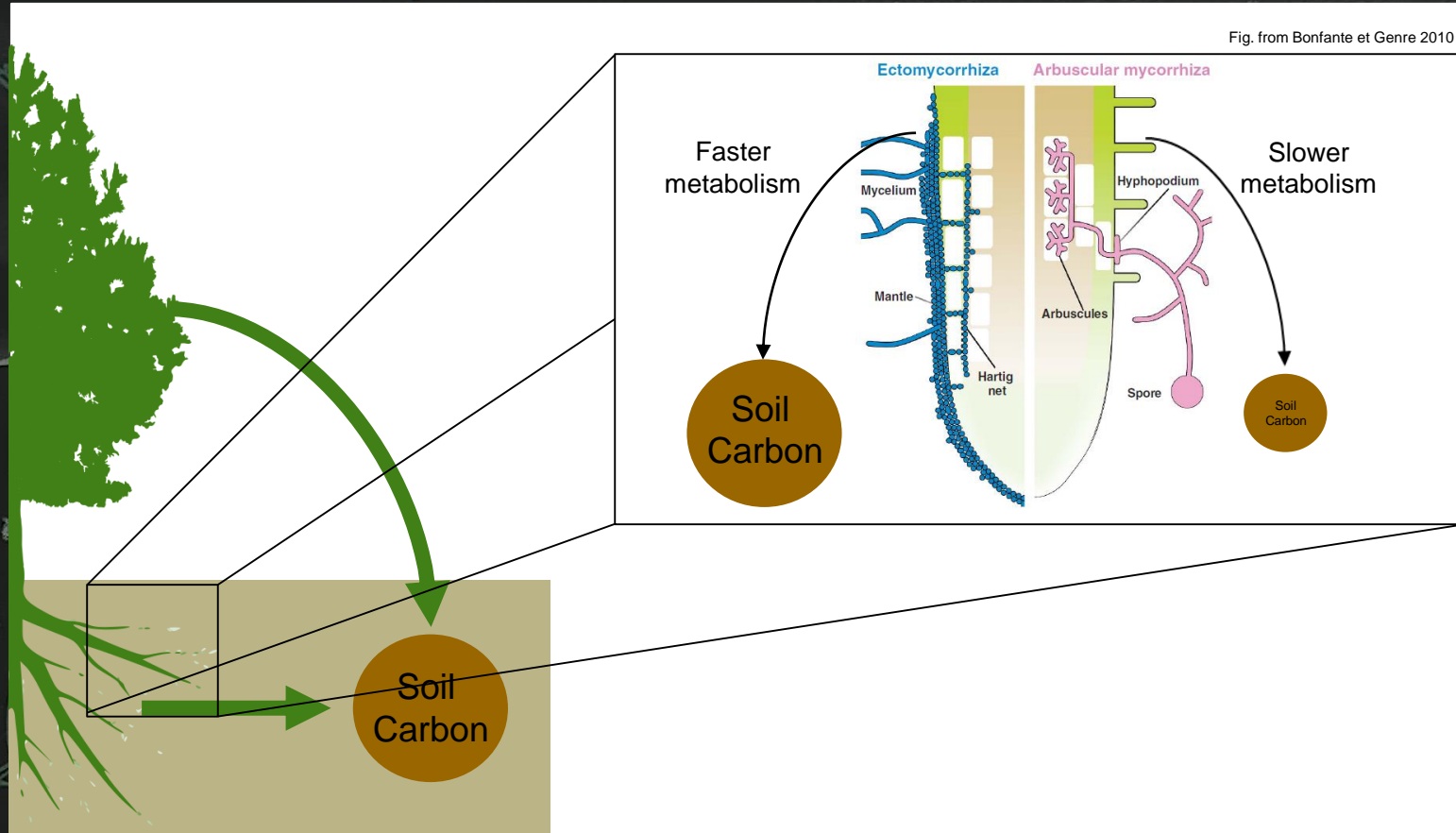
# What is the role of trees in soil carbon?



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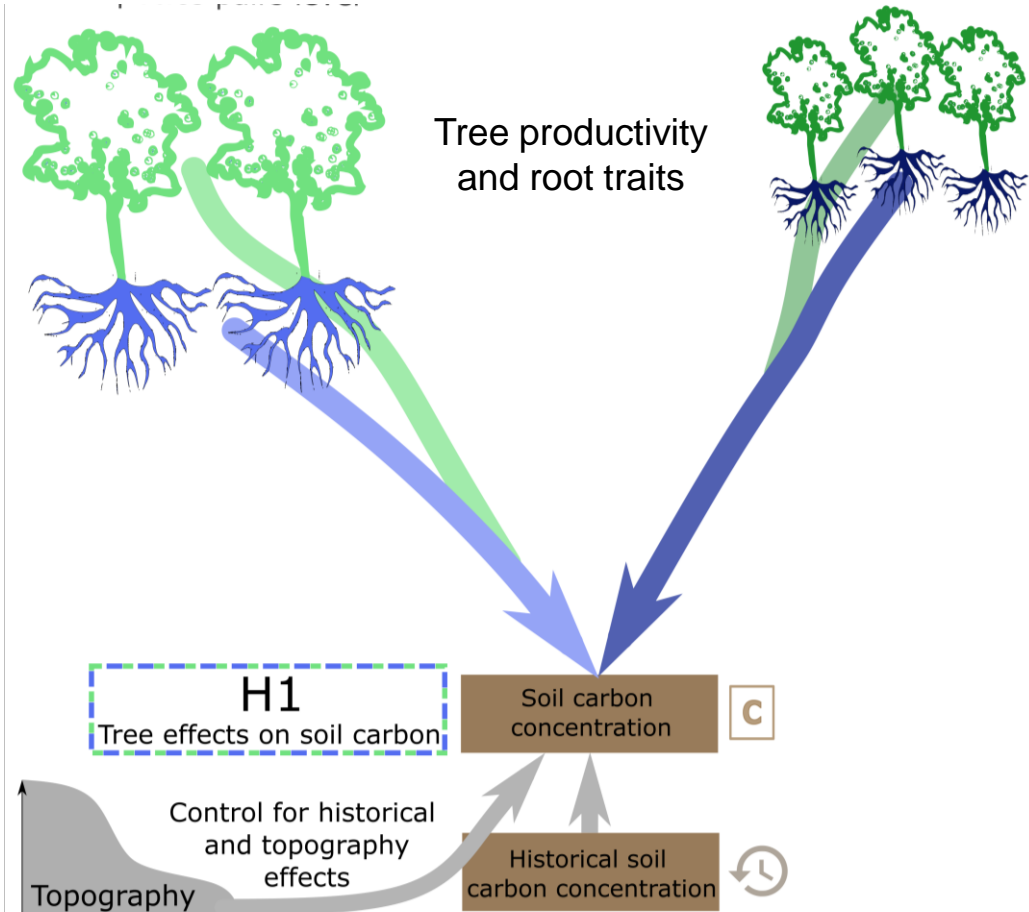


# What is the role of trees in soil carbon?



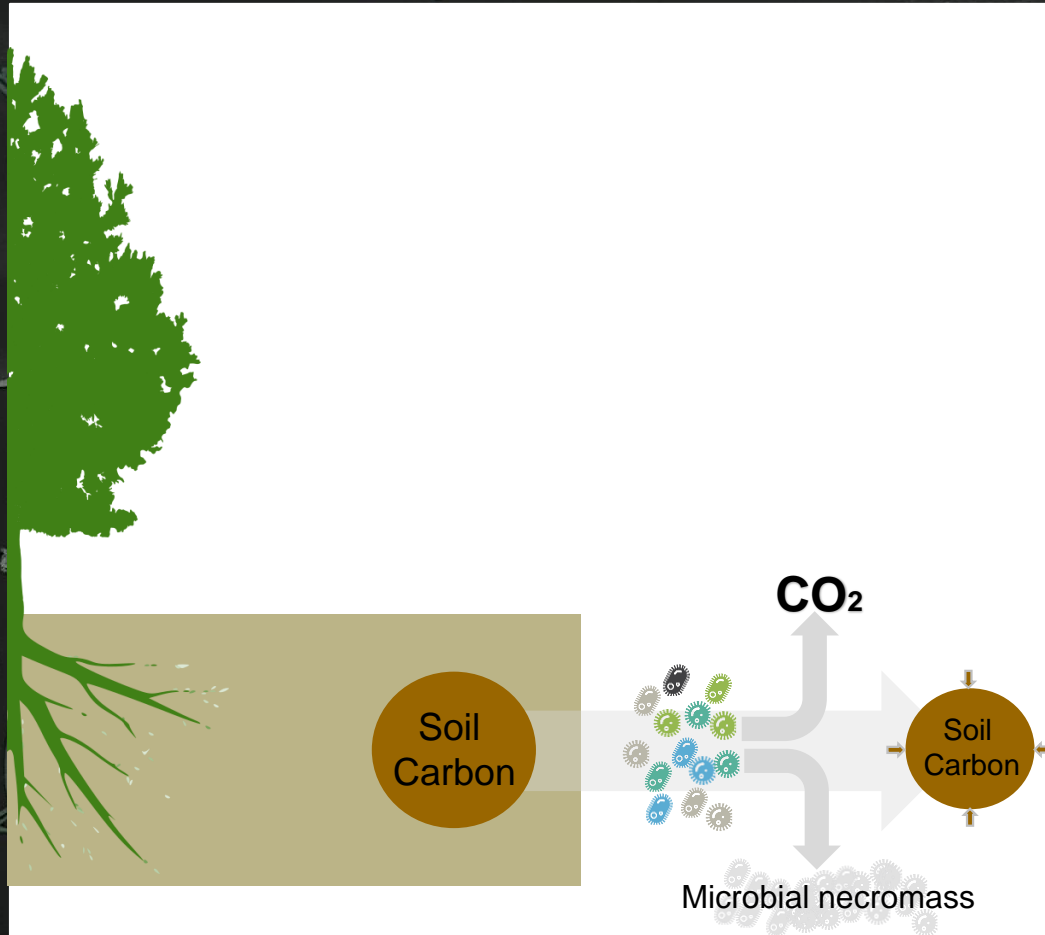
# Hypotheses:

- **Hypothesis 1:** tree productivity and root functional trait identity and dissimilarity drive soil carbon concentrations



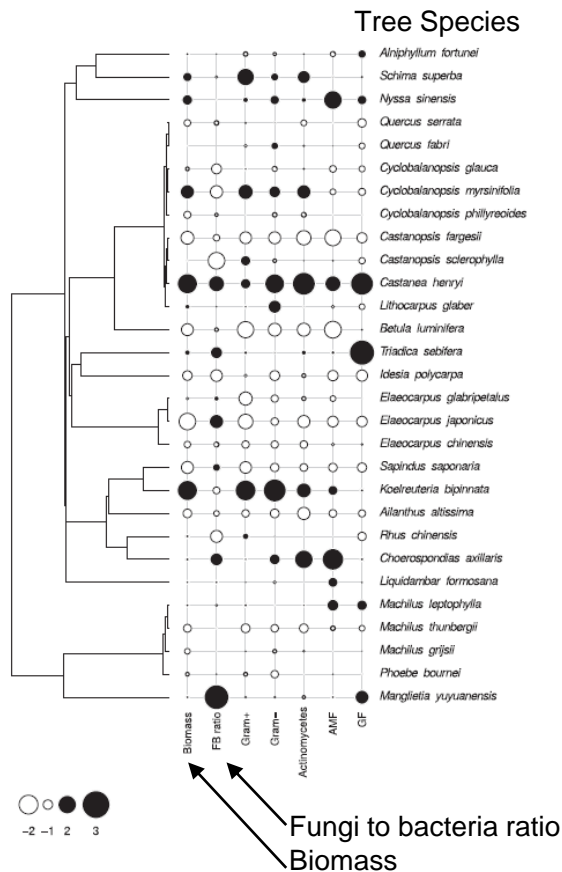


# Soil carbon and soil microbial communities



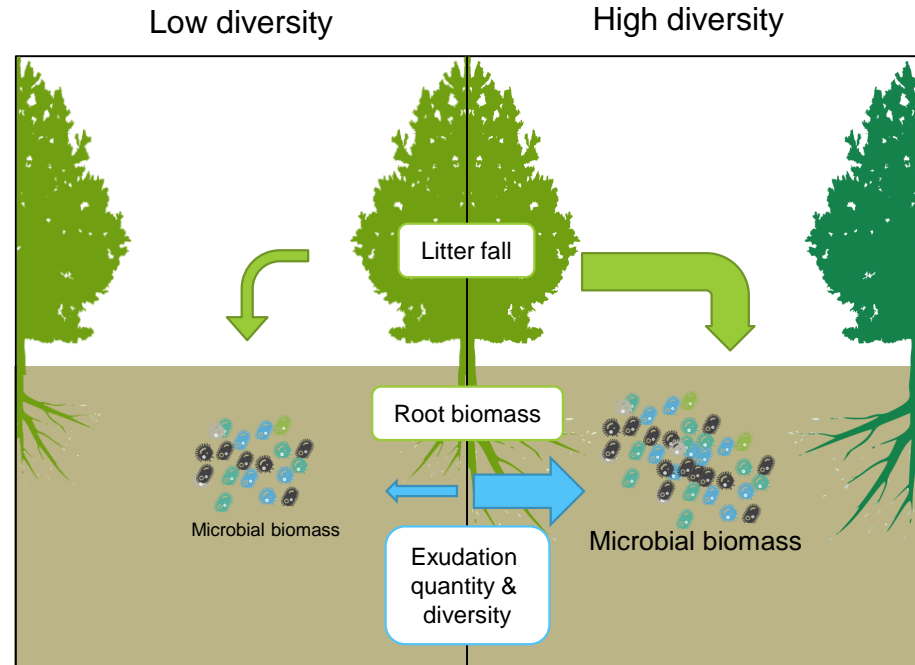
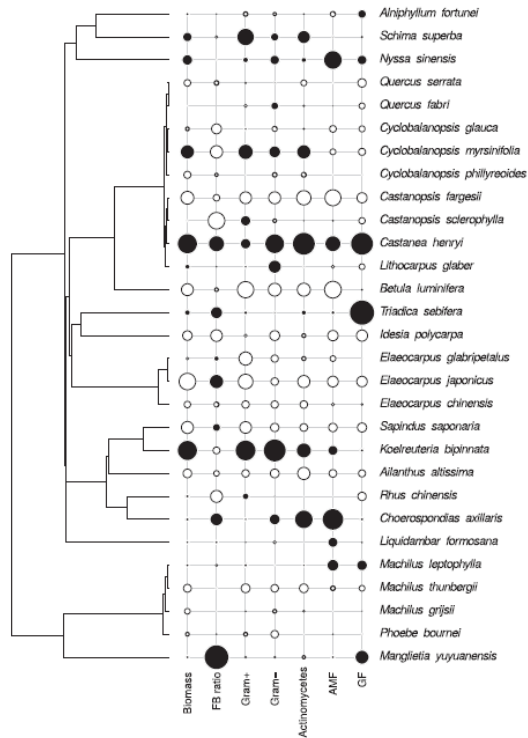


# Standing trees drive microbial communities



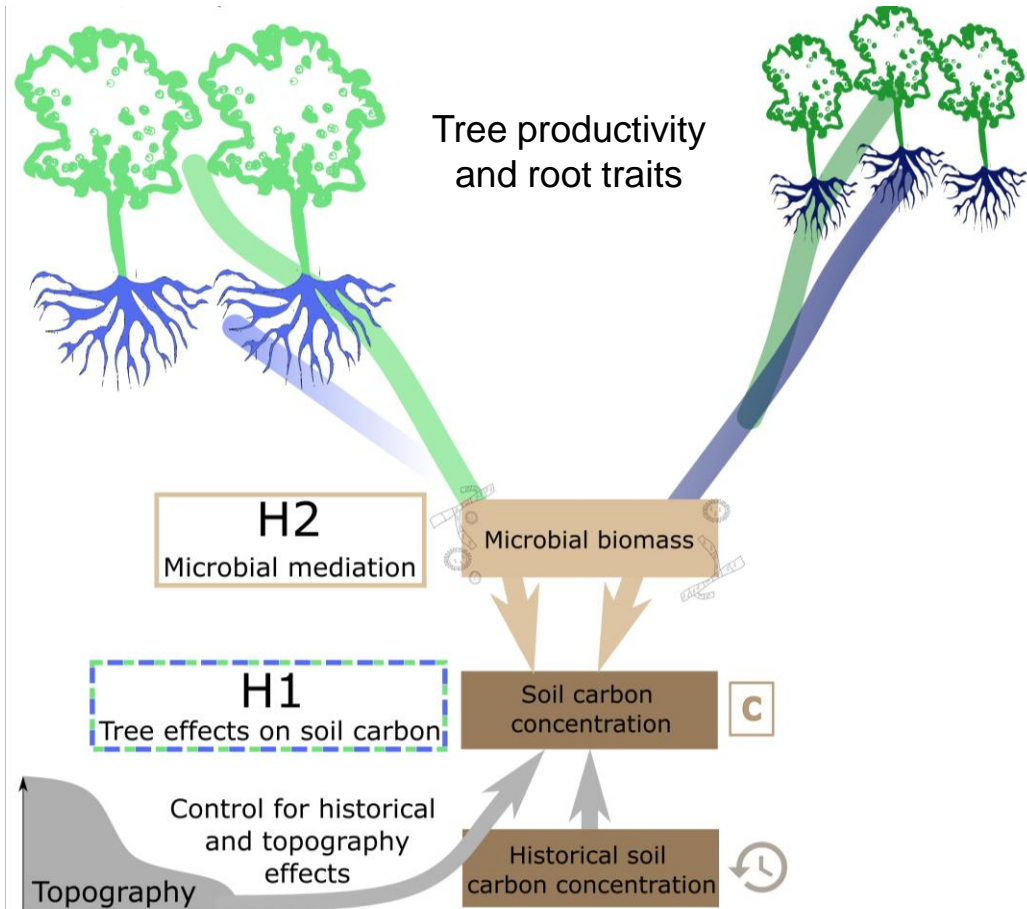
Microbial biomass and community composition are driven by tree species

# Standing trees drive microbial communities

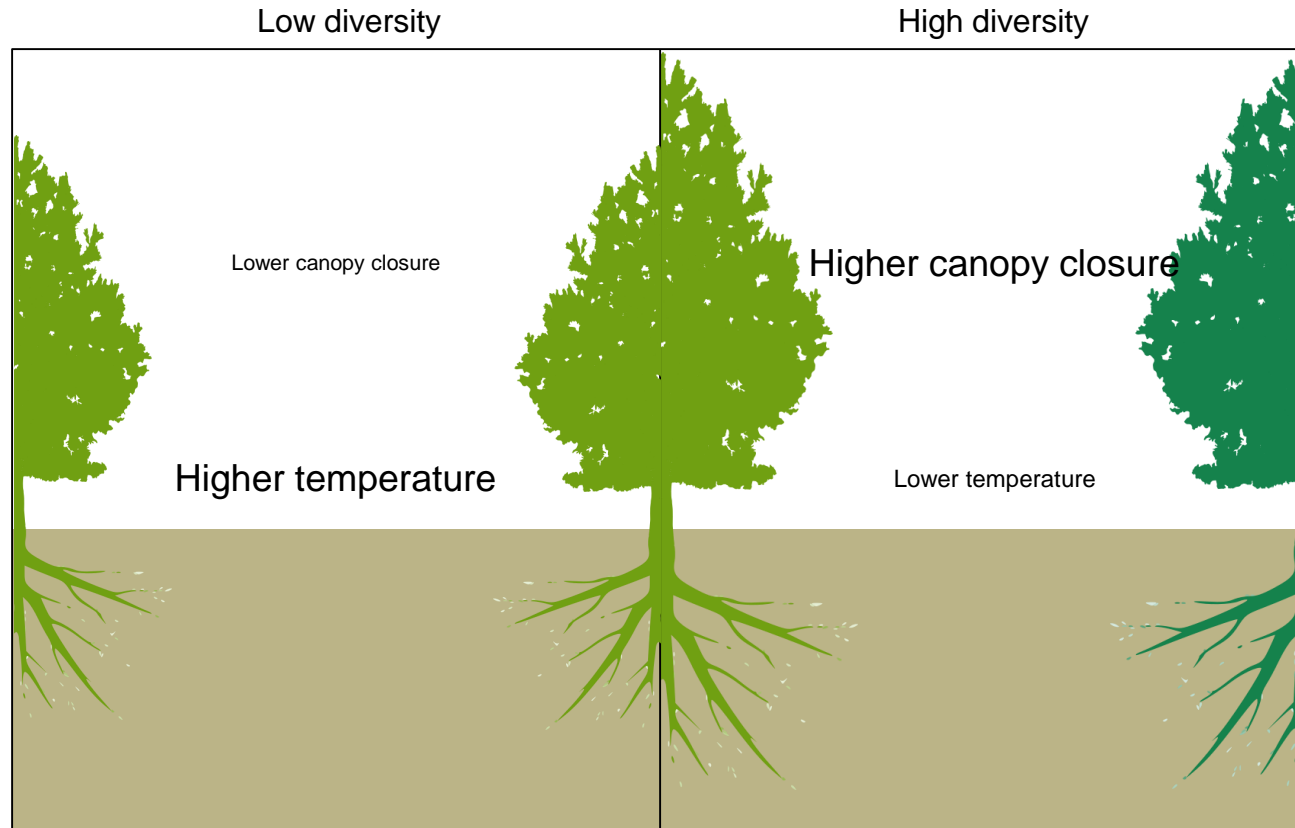


# Hypotheses:

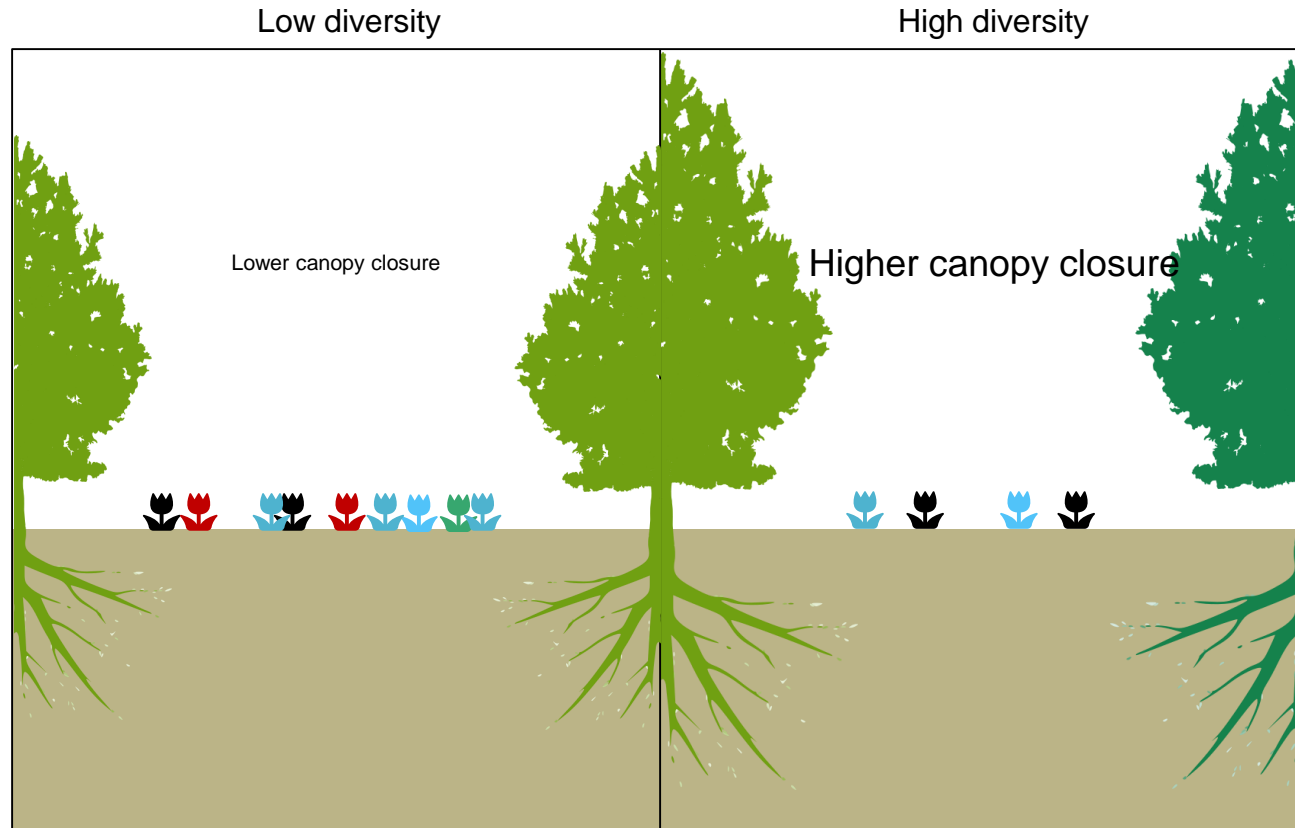
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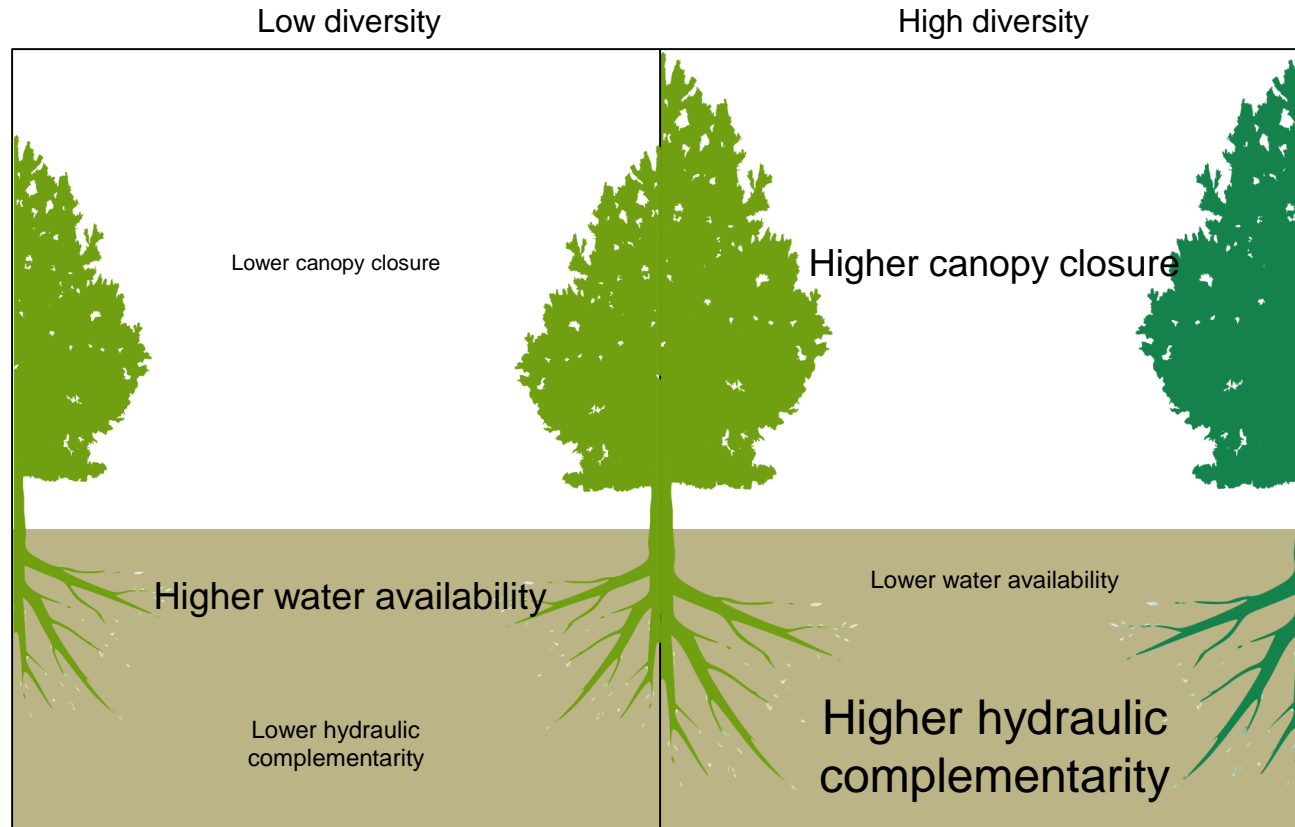
# Forest drive micro-environmental conditions: microclimate



# Forest drive micro-environmental conditions: understory plants

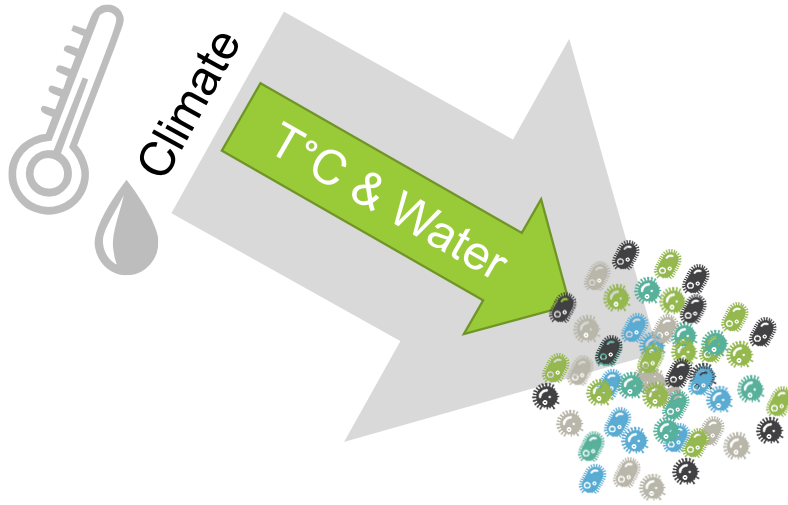


# Forest drive micro-environmental conditions: microclimate

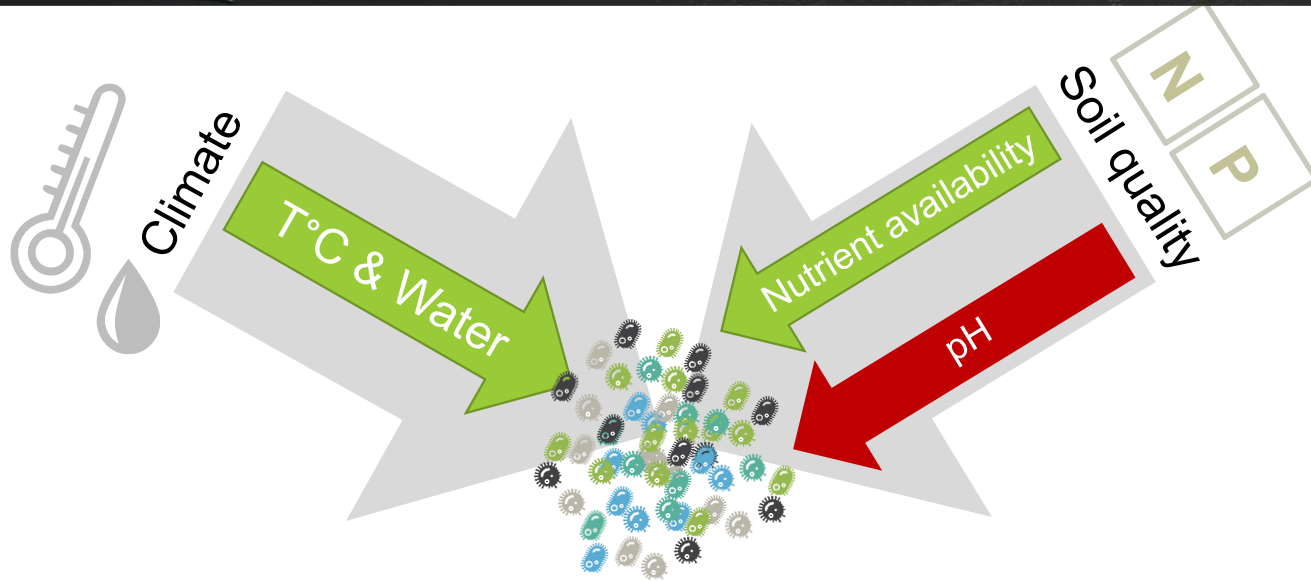




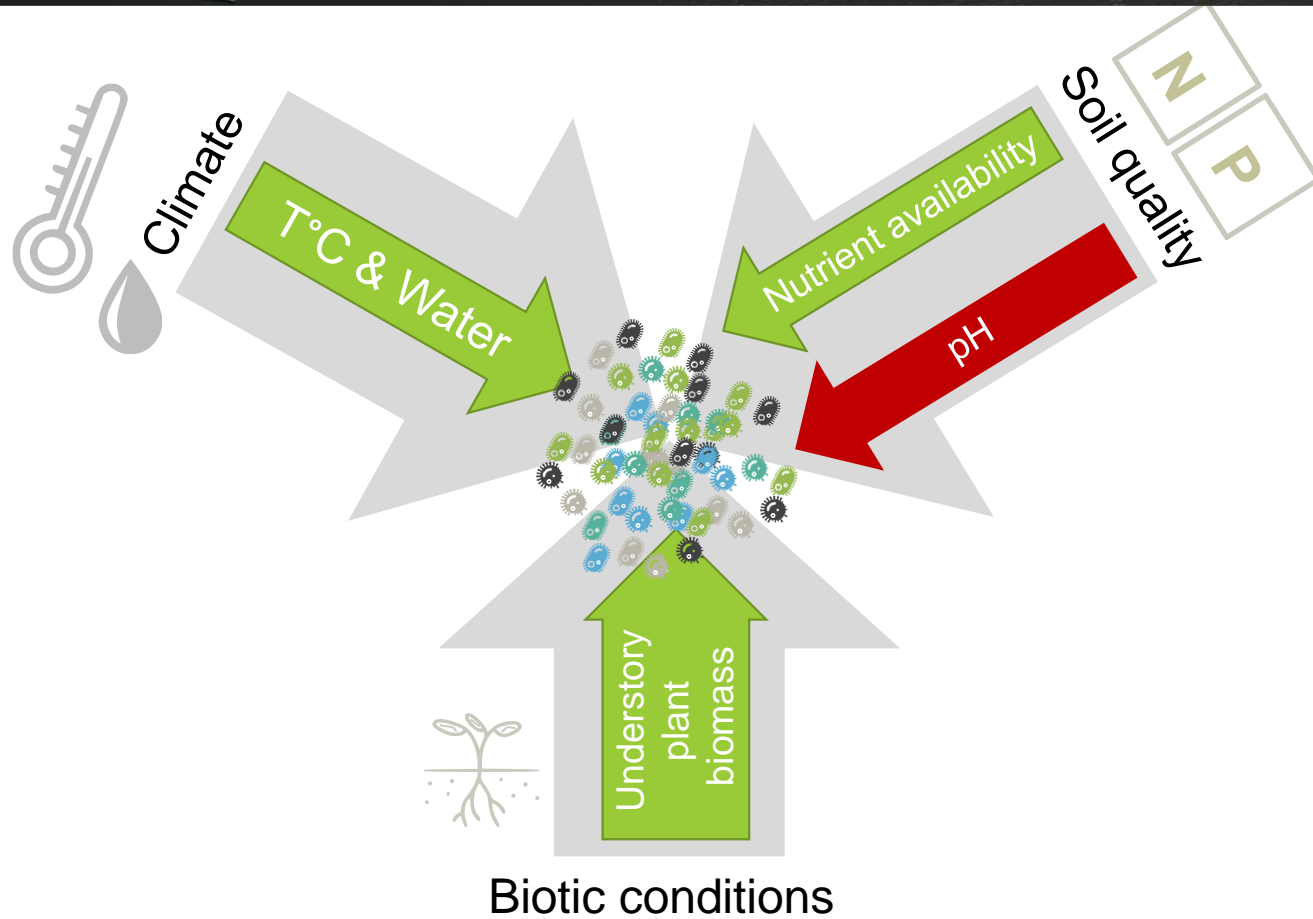
# High sensibility of the microbial community to environmental conditions



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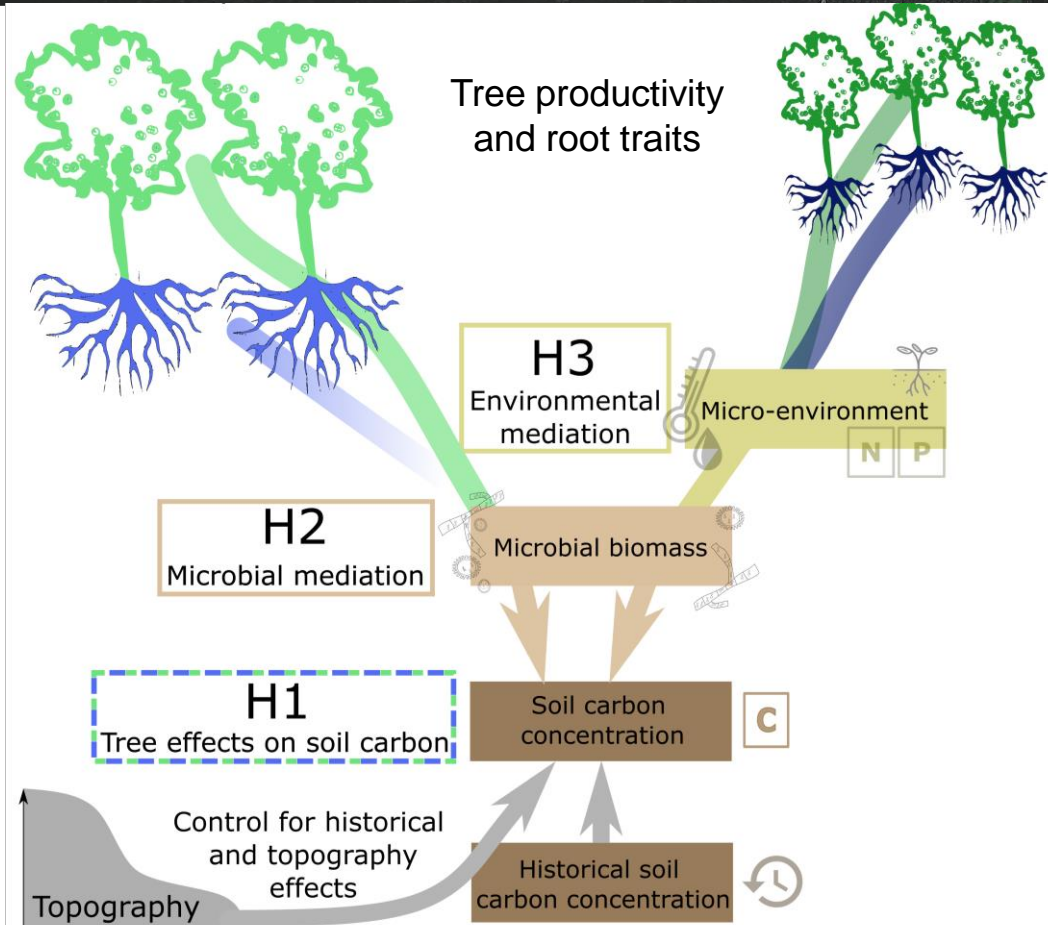


# High sensibility of the microbial community to environmental conditions

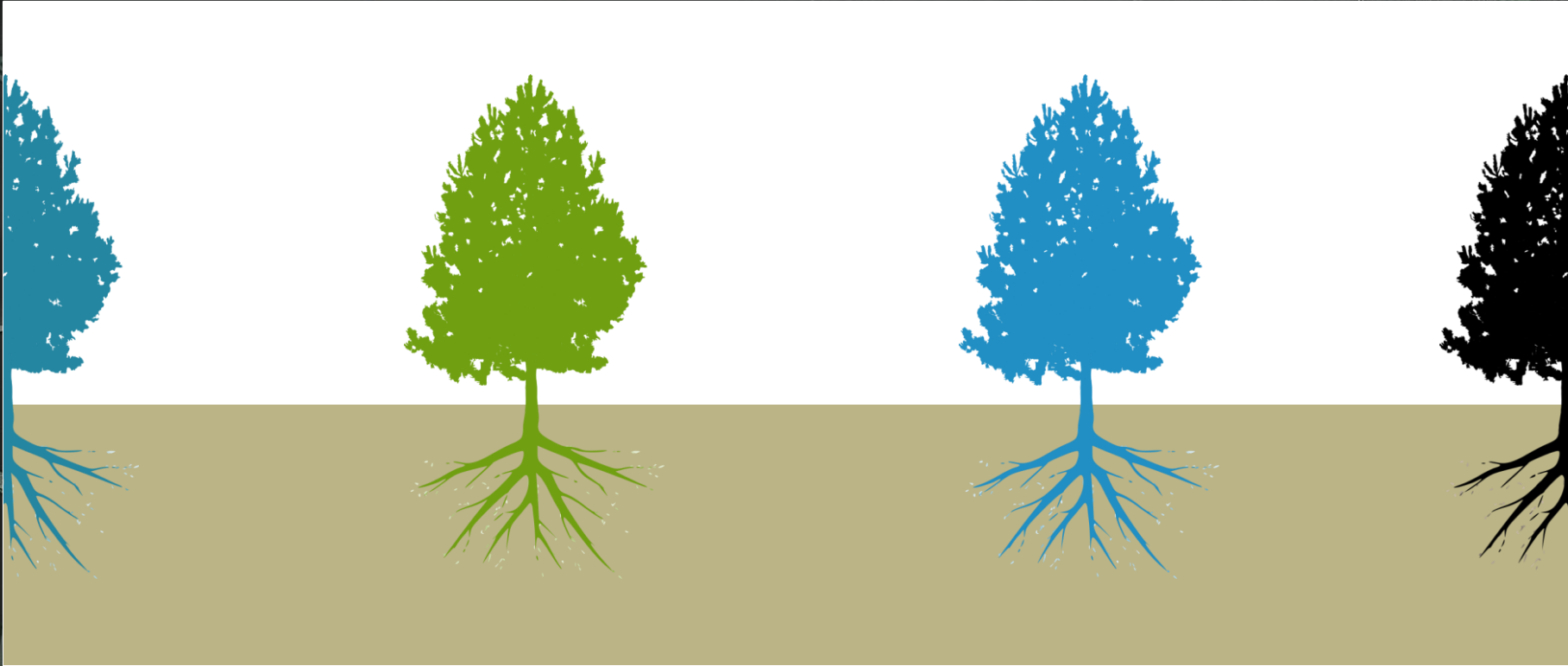


## Hypotheses:

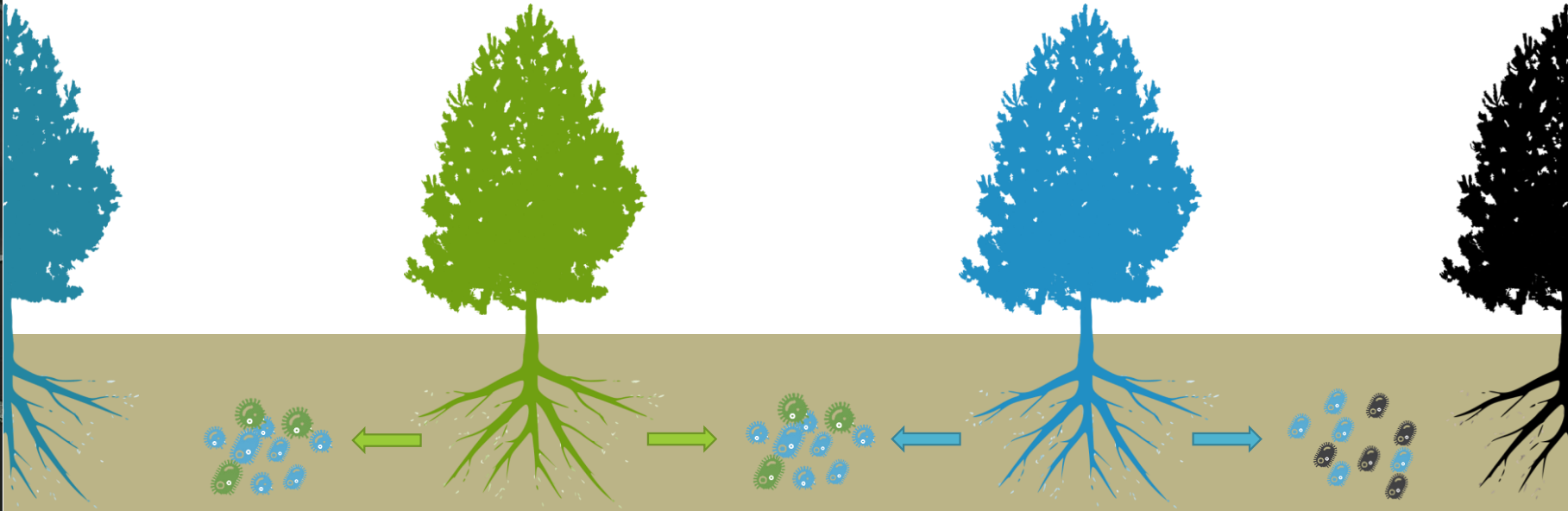
- **Hypothesis 1:** tree productivity and root functional trait identity and dissimilarity drive soil carbon concentrations
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- **Hypothesis 3:** tree community effects on microbial biomass are mediated by micro-environmental conditions (climate, soil quality, and biotic environment)



## Tree spatial distribution

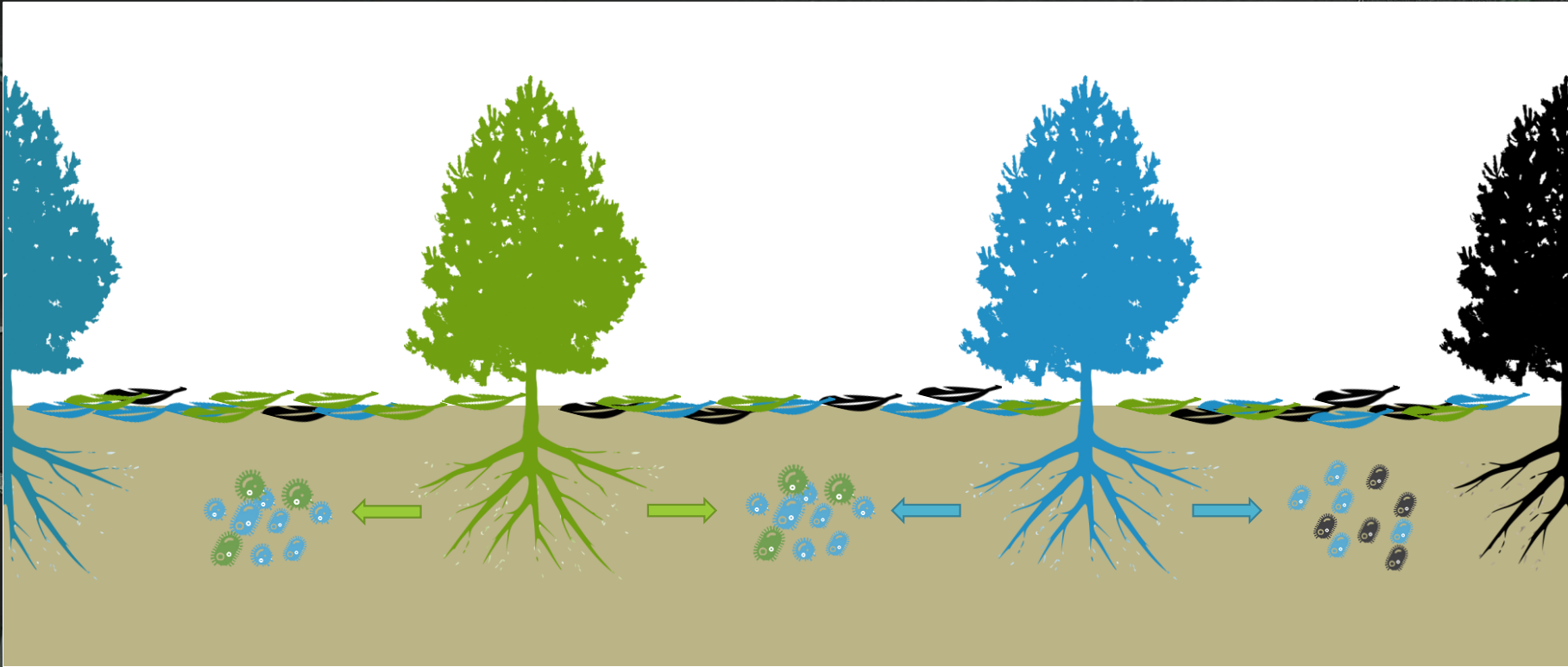


## Tree spatial distribution



e.g. Species-specific microbial association at tree level.

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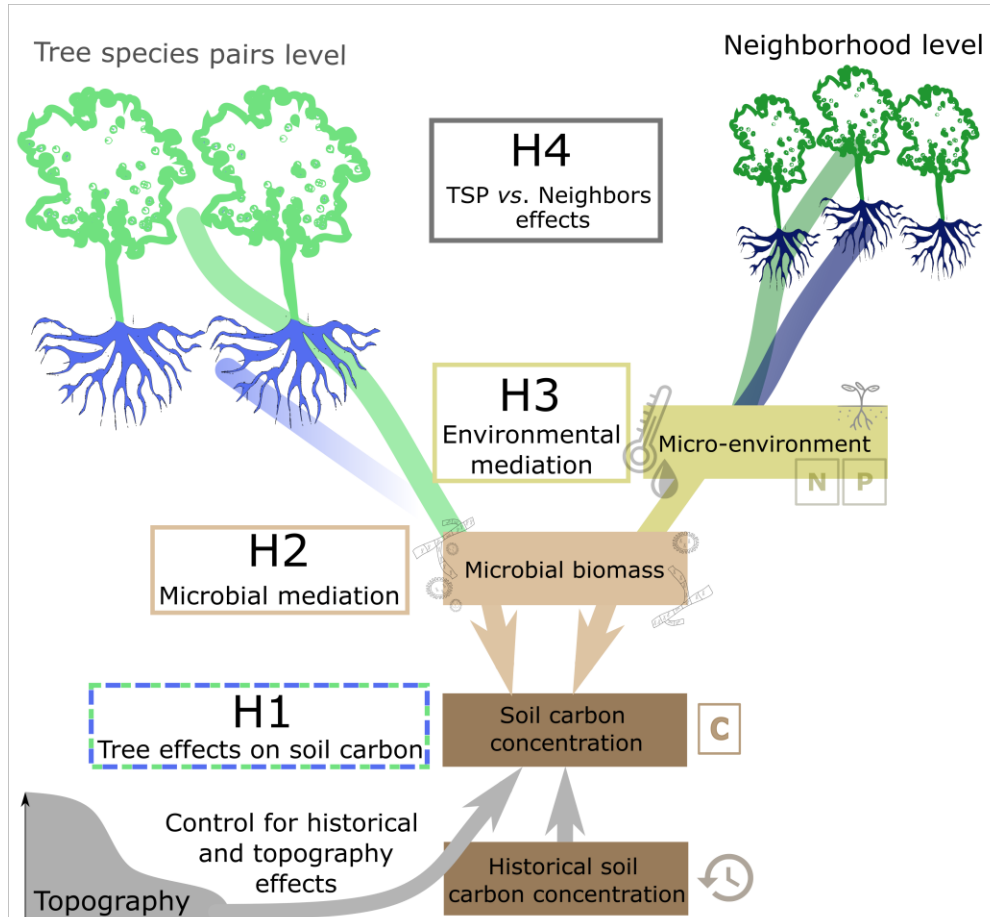


e.g. Species-specific microbial association at tree level.  
Litter homogenization at neighborhood level



# Hypotheses:

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- **Hypothesis 4:** we expected tree effects on soil microbial biomass to be scale-dependent





# Sampling design

## South-East China

Subtropical climate: warm, rainy summers & cool, dry winters

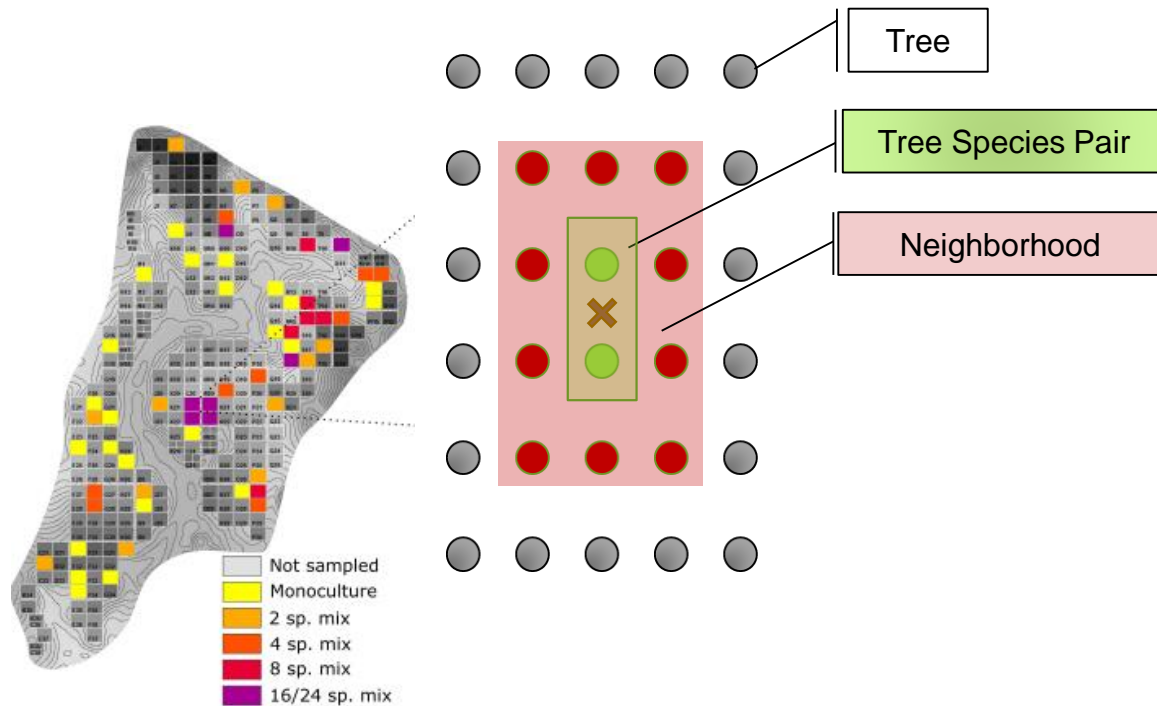
## BEF China platform:

Tree diversity experiment (since 2009)

Species richness manipulated from 1 to 16, planted in a random scenario



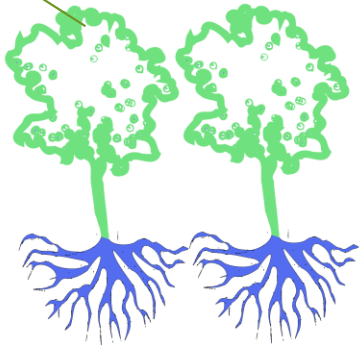
# Tree species pairs design



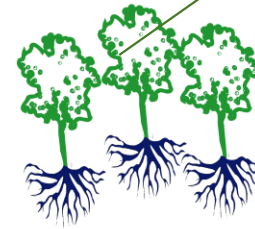
# Sampling design: BEF China

TSP biomass

Tree species pairs level



Neighborhood level



Neighborhood biomass

Canopy structure (ENL)

Litterfall biomass

Litterfall CN ratio

Micro-environment



Microbial biomass

Soil carbon concentration

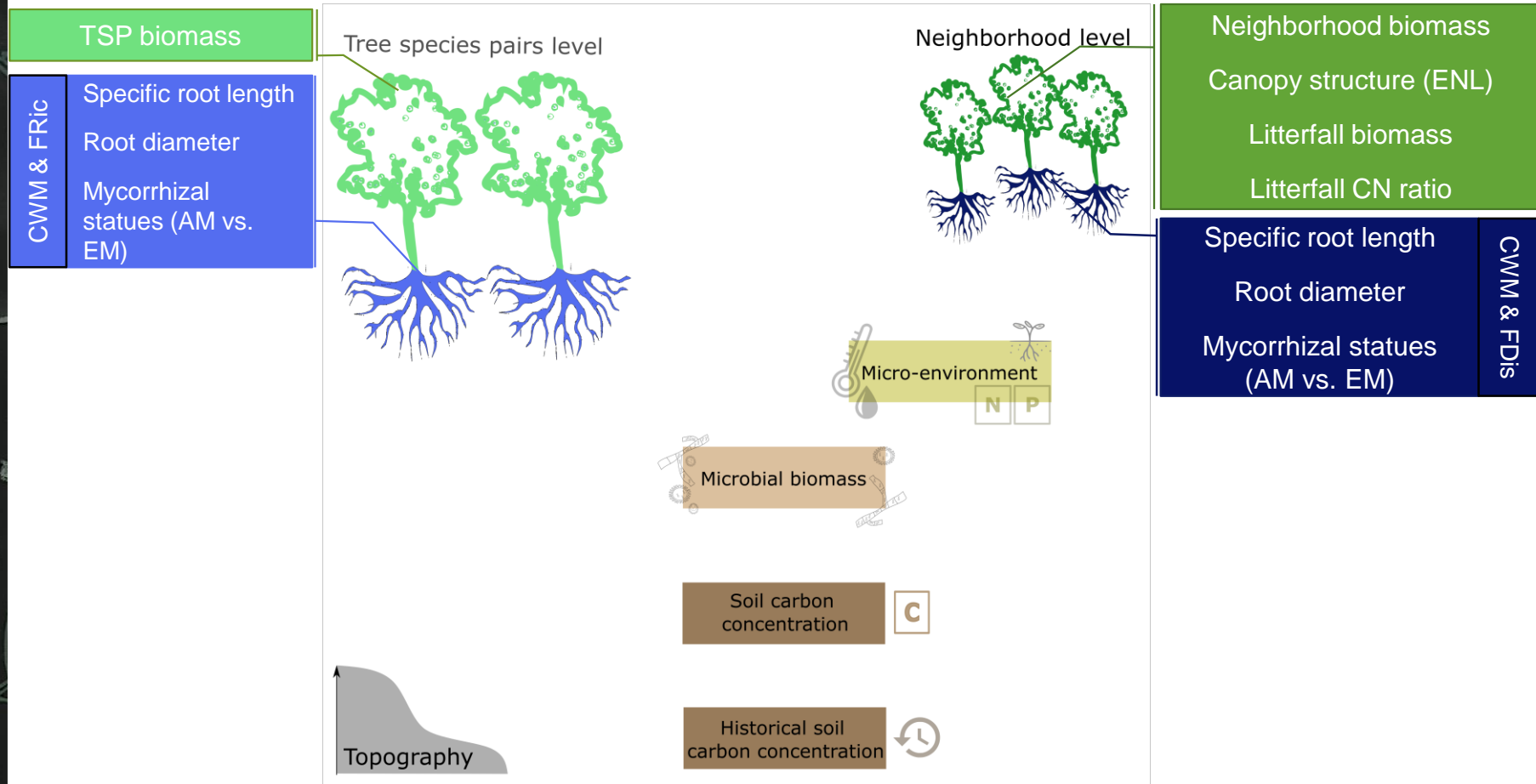
C

Historical soil carbon concentration

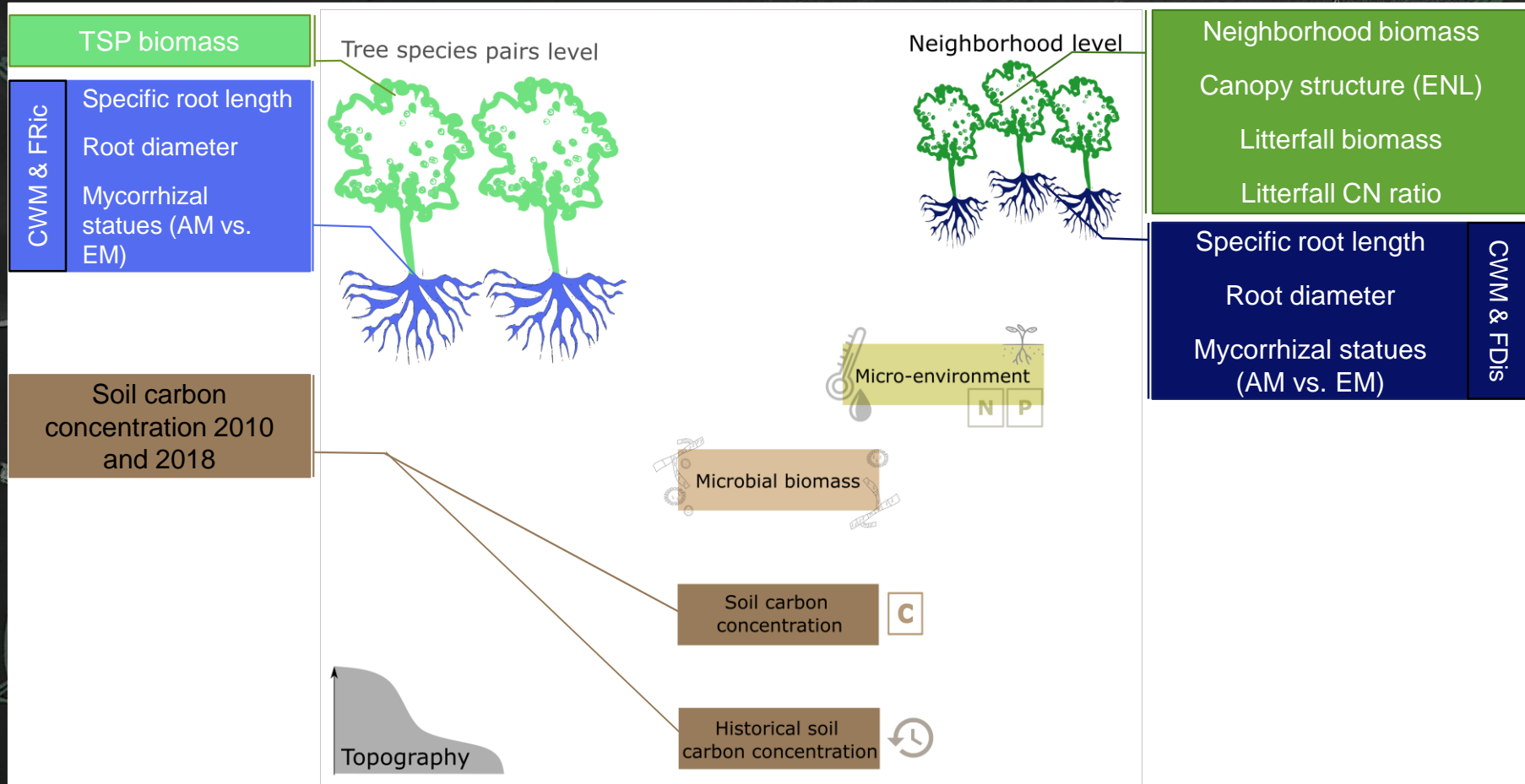


Topography

# Sampling design

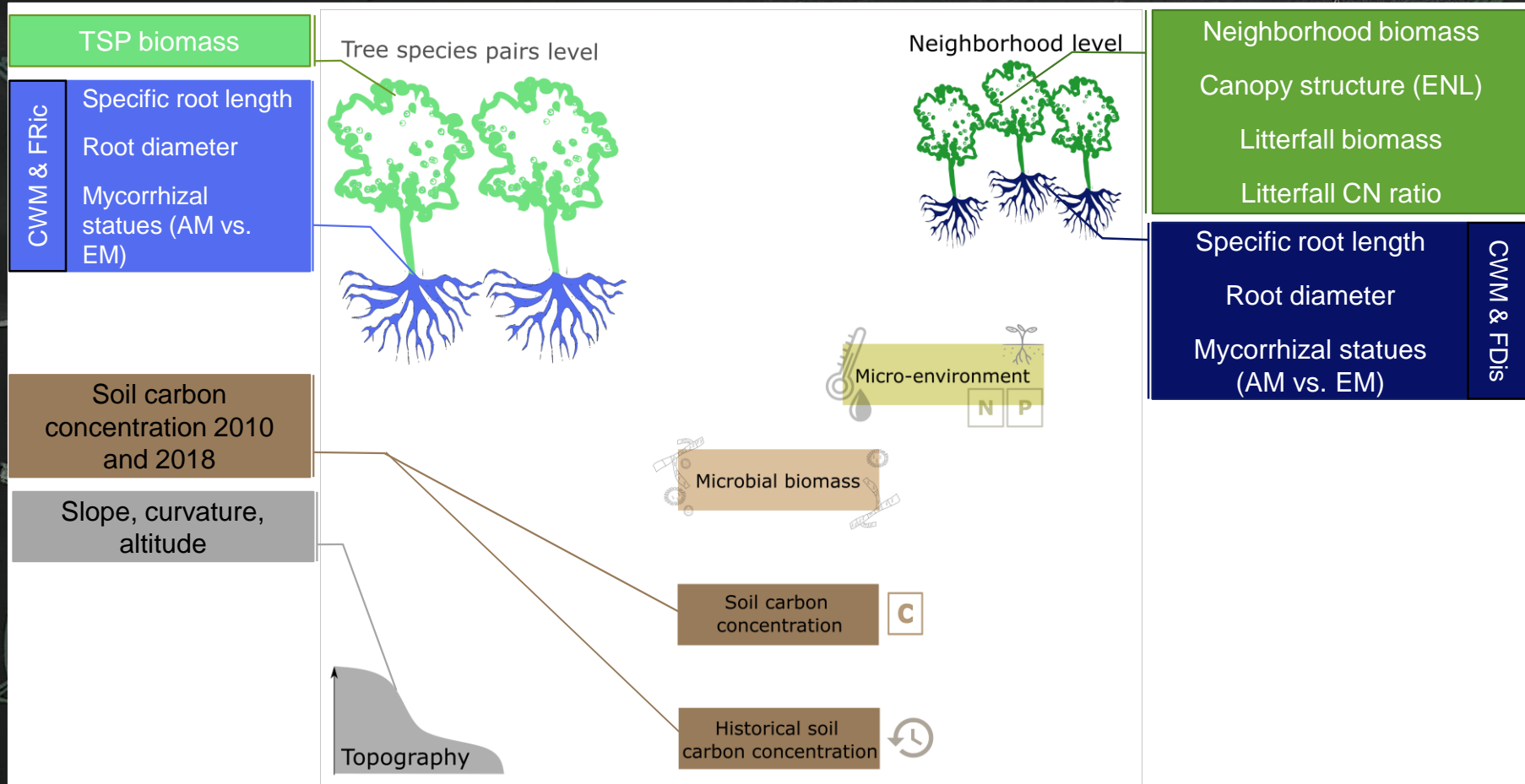


# Sampling design

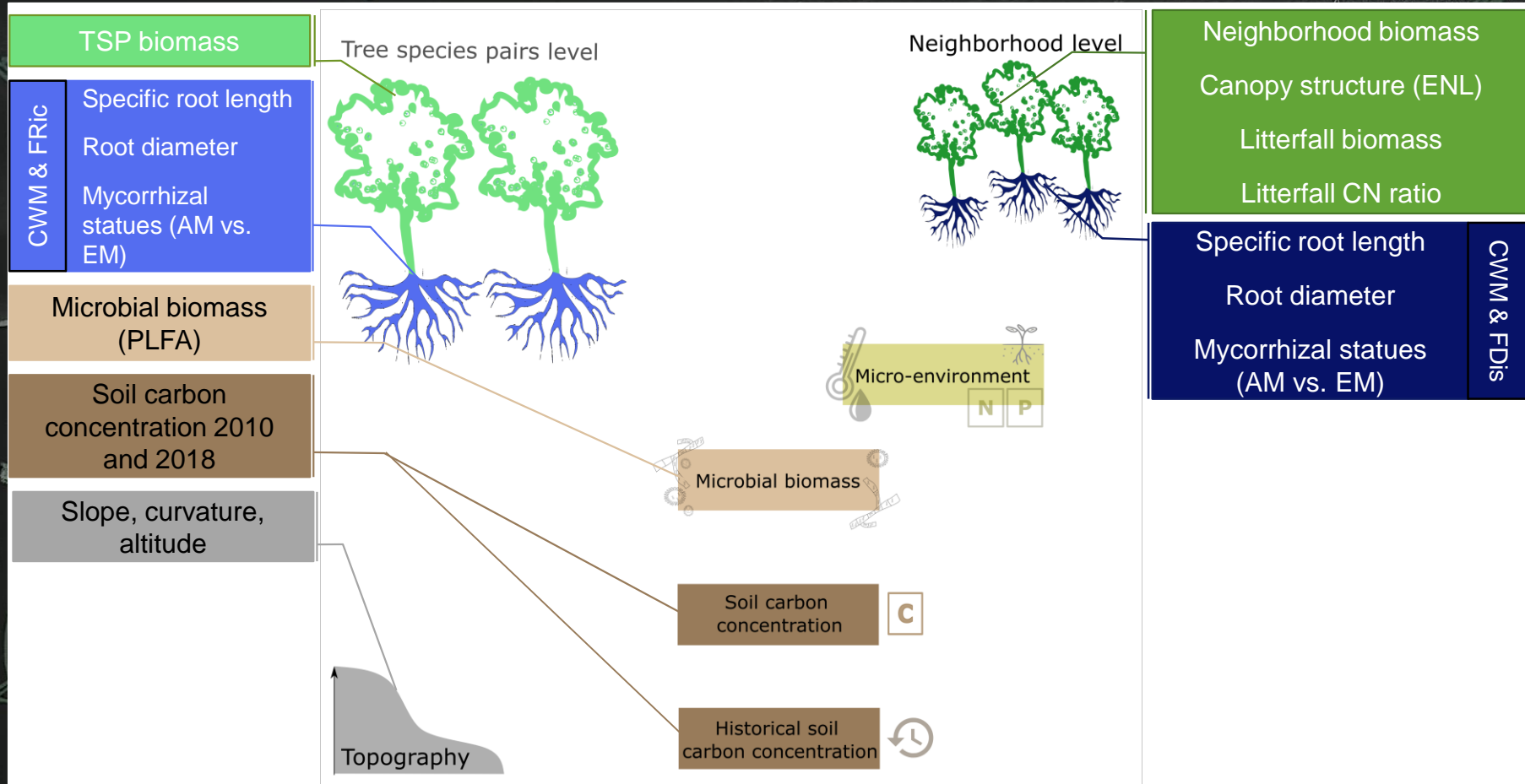




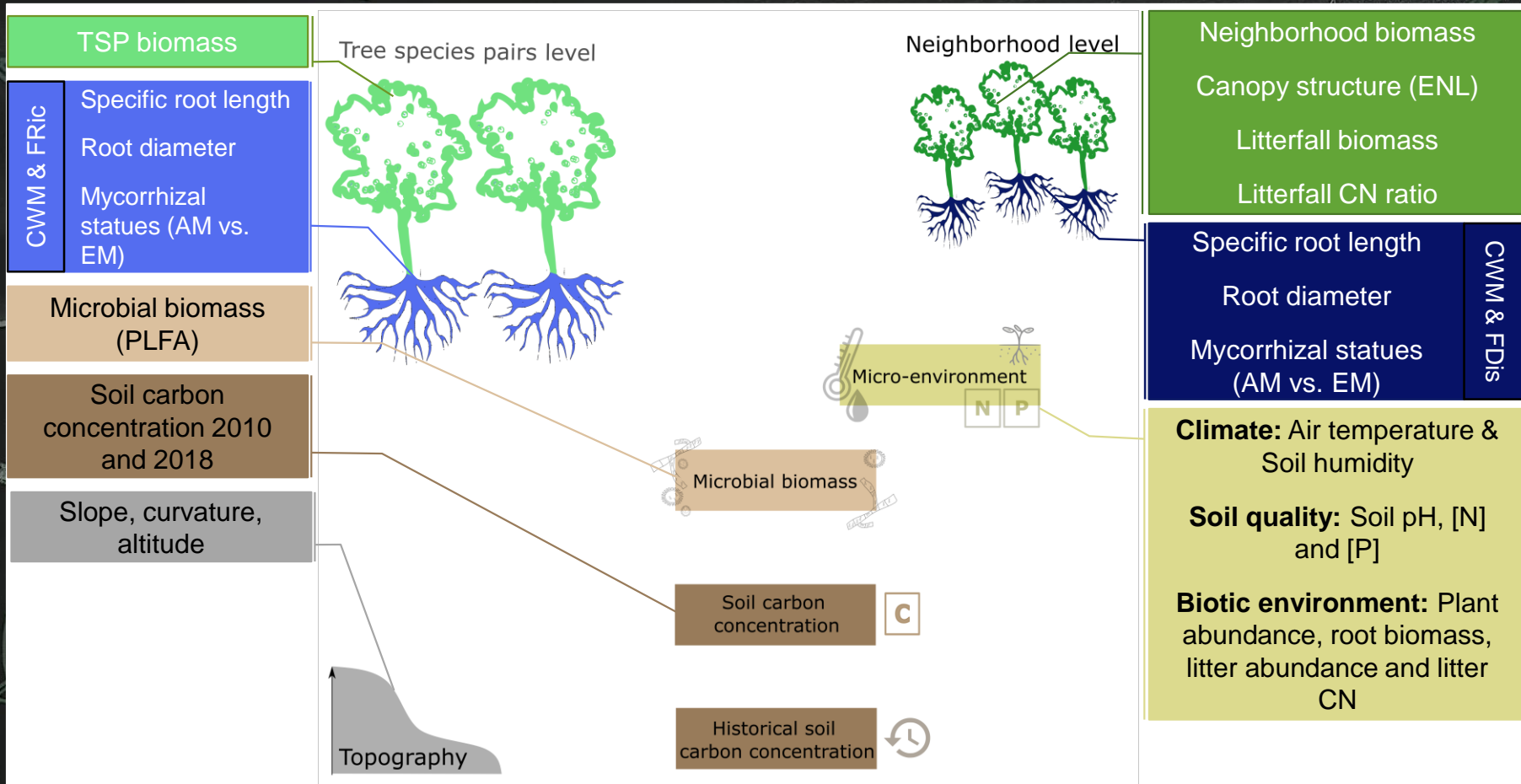
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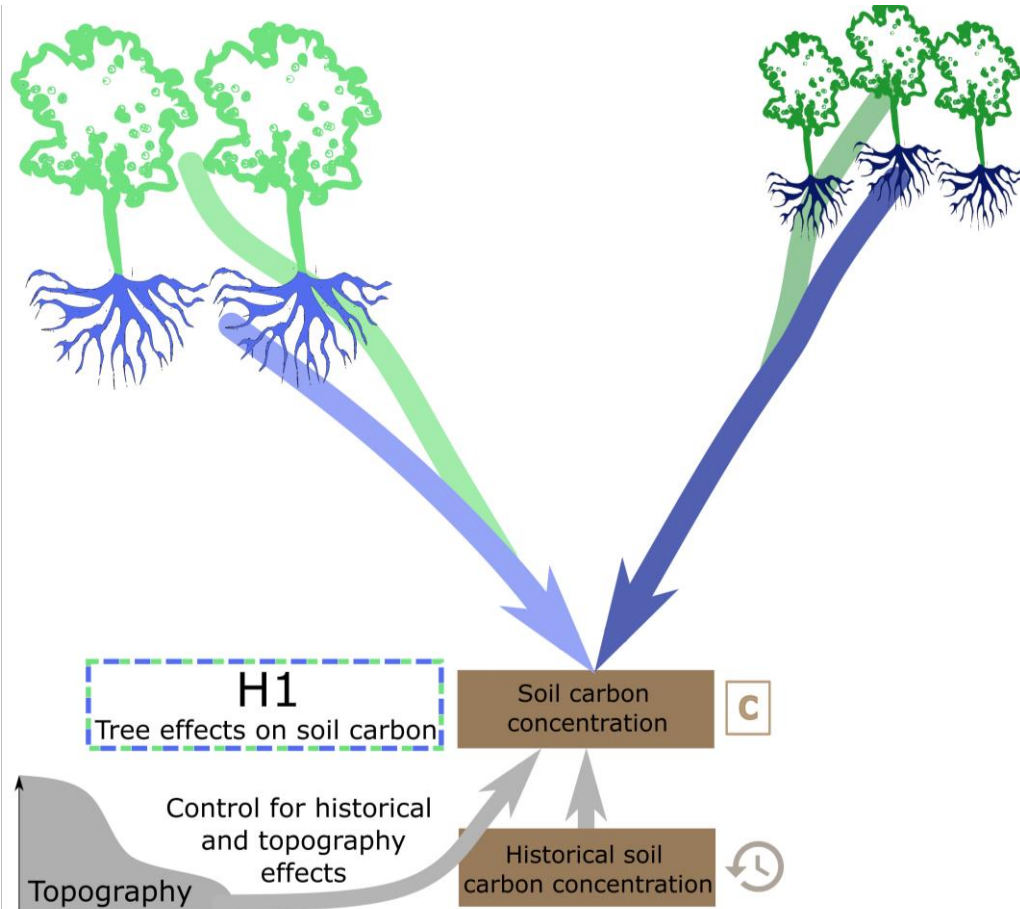


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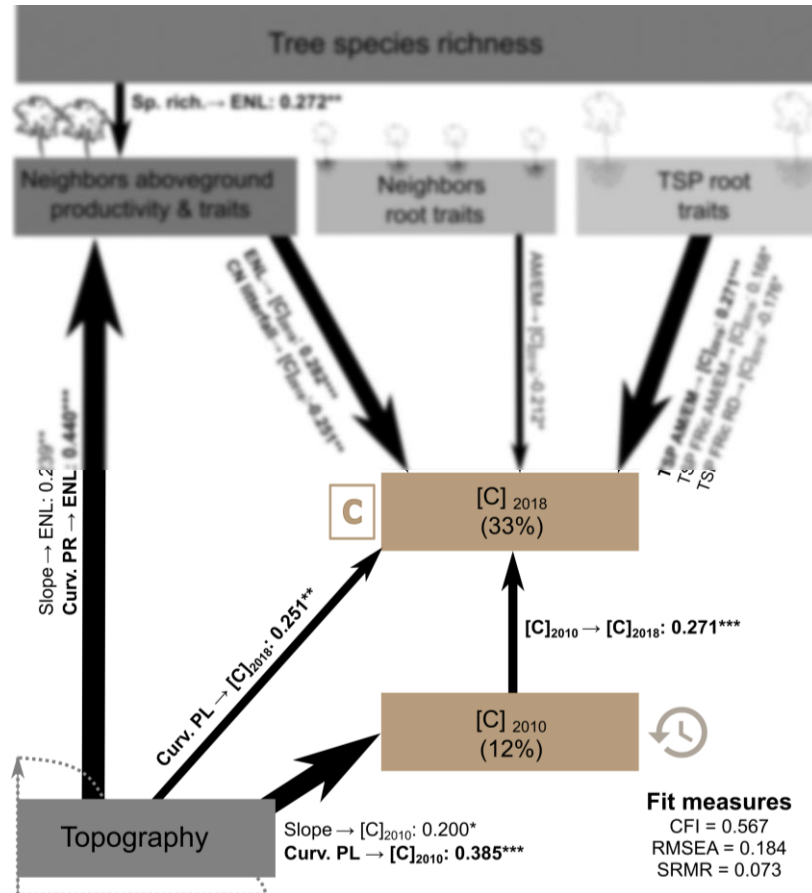


# Drivers of soil carbon concentration

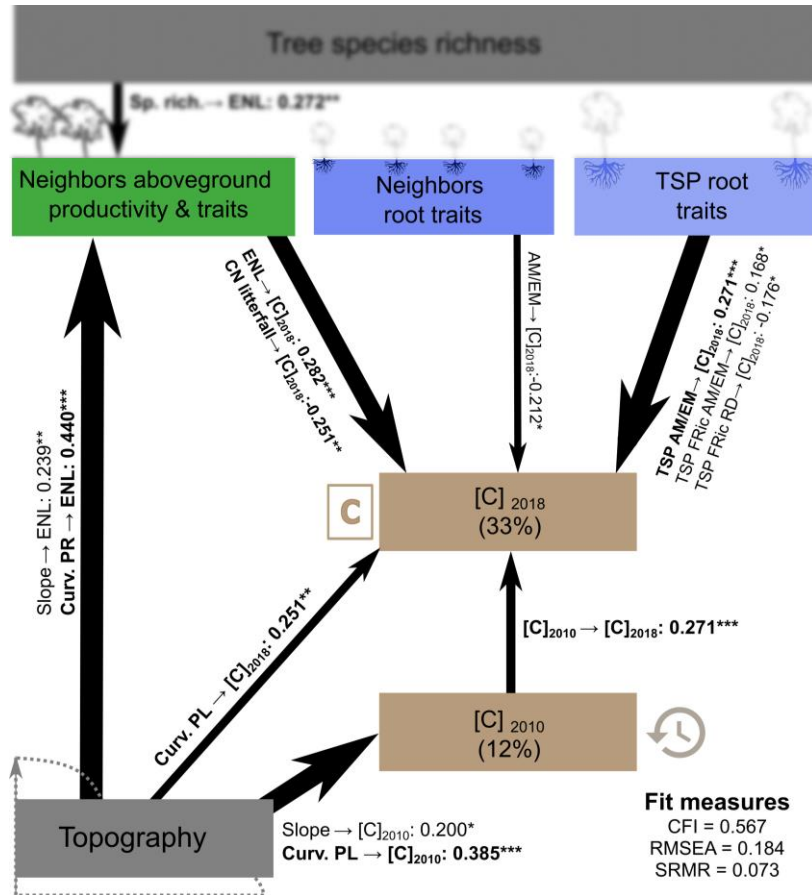


# Drivers of soil carbon concentration

Historical carbon concentration and plot curvature increased soil concentration



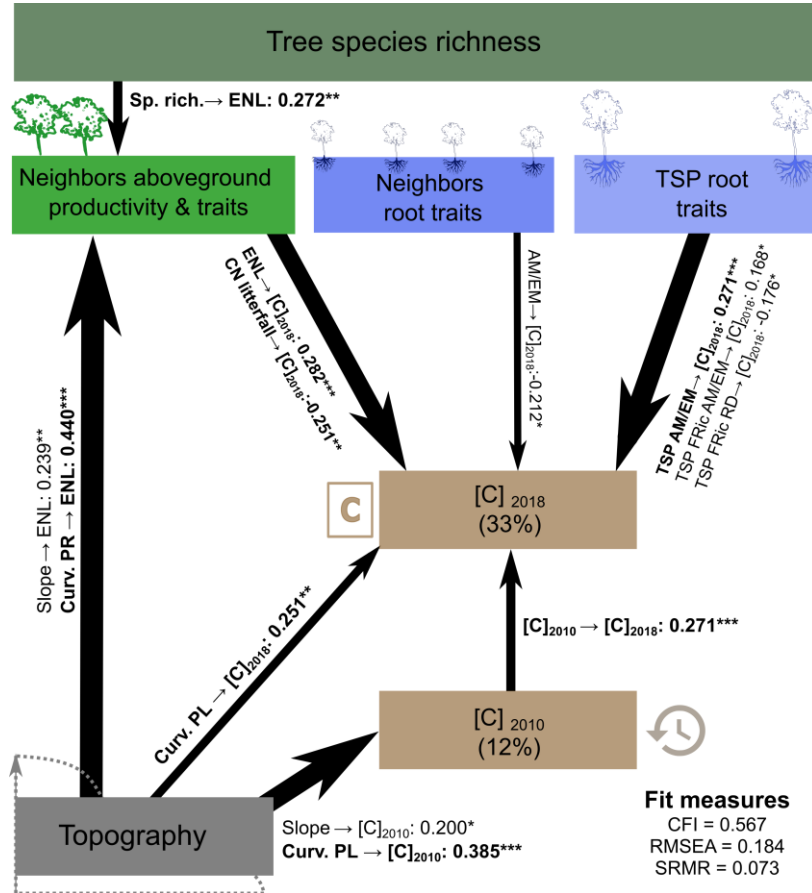
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Neighborhood productivity and TSP root traits strongly affected soil carbon concentration

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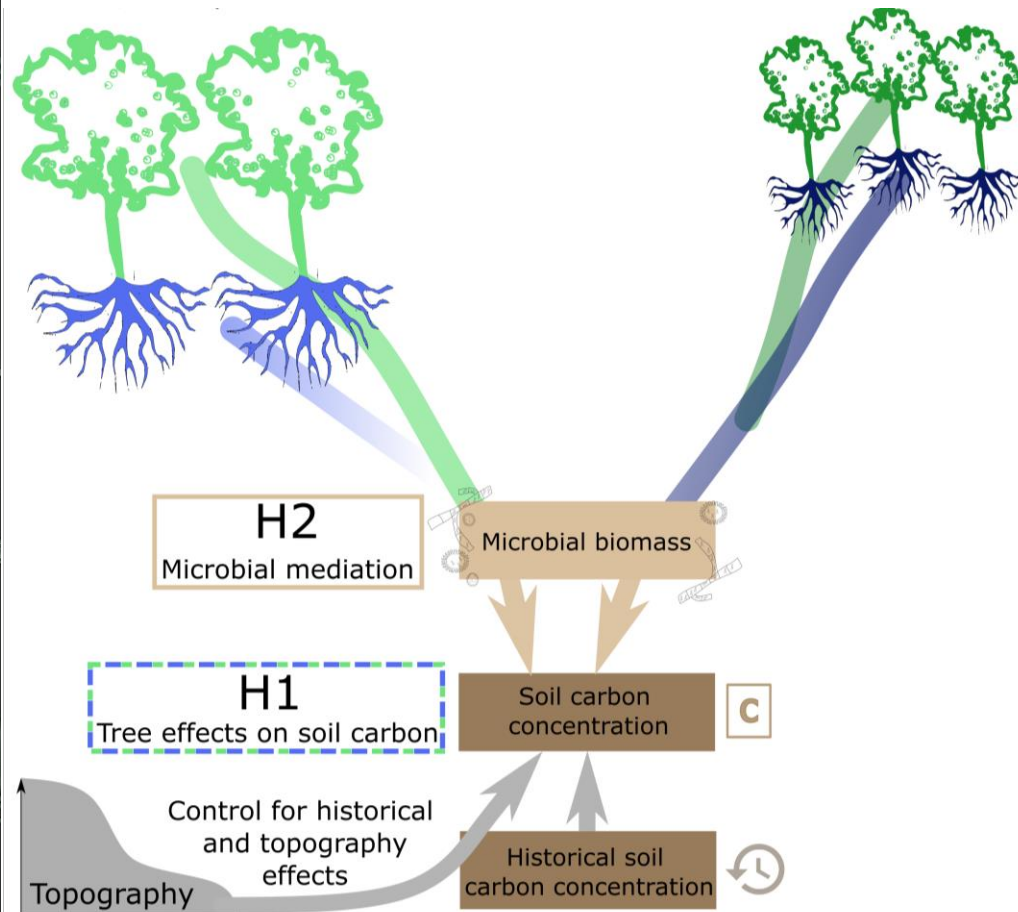


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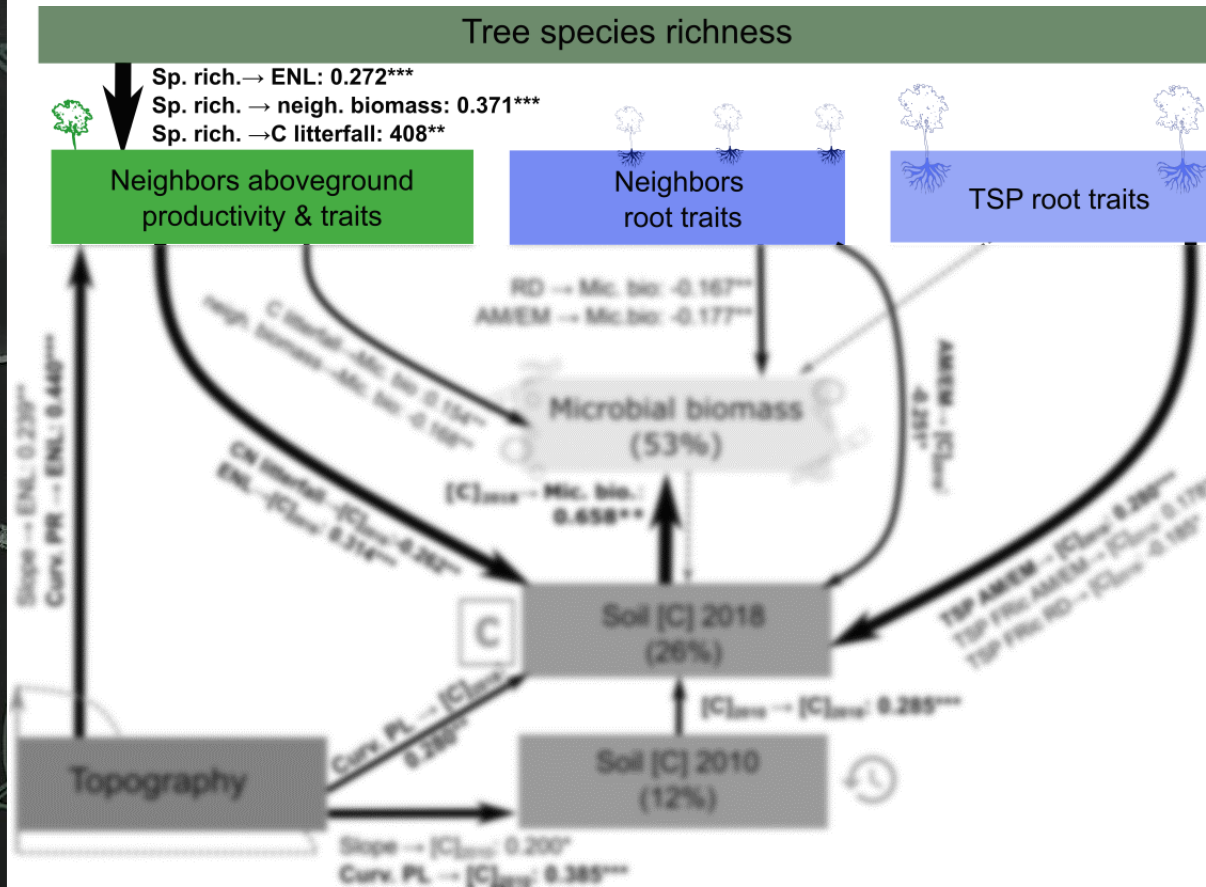
Neighborhood productivity and TSP root traits strongly affected soil carbon concentration

Neighborhood productivity increased with tree species richness

# Microbial biomass mediation of tree effects on soil carbon concentrations



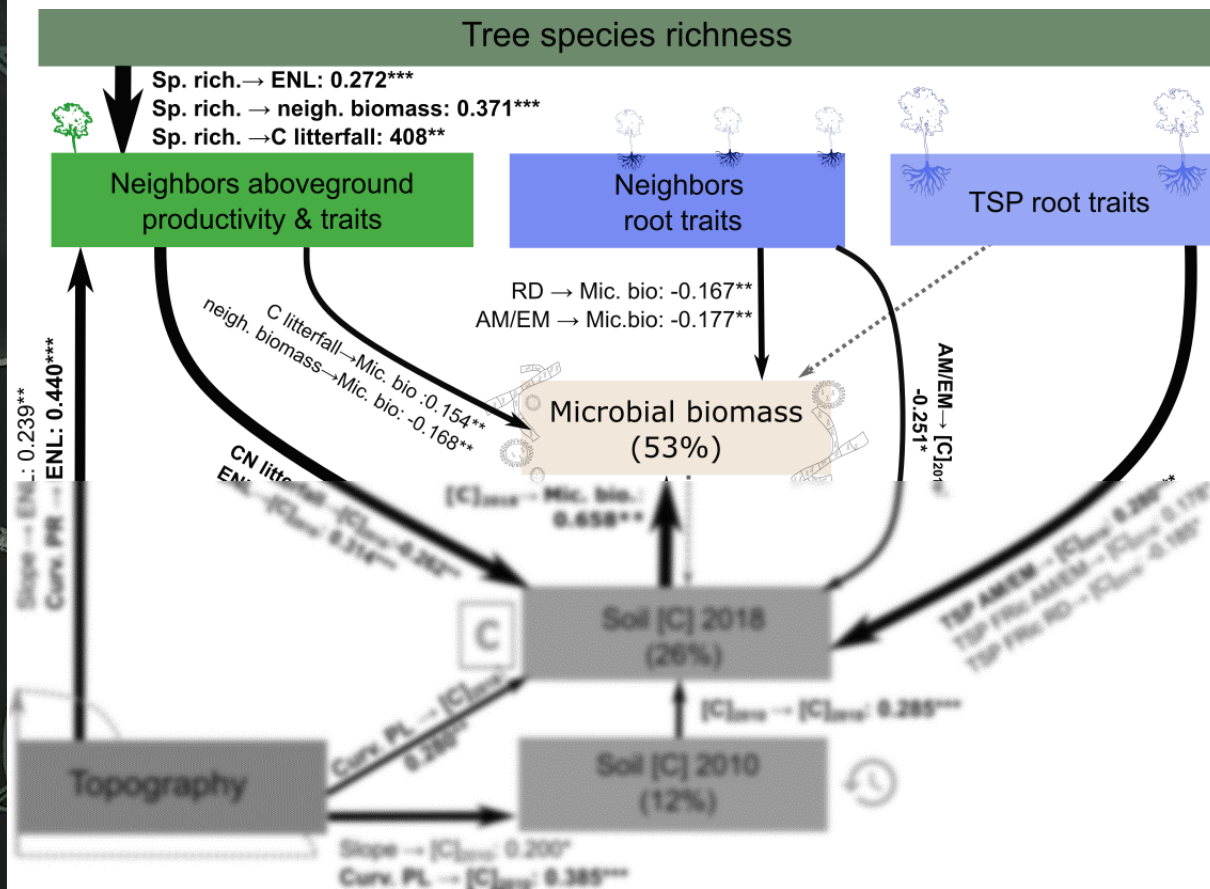
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Neighbors productivity increased with tree species richness



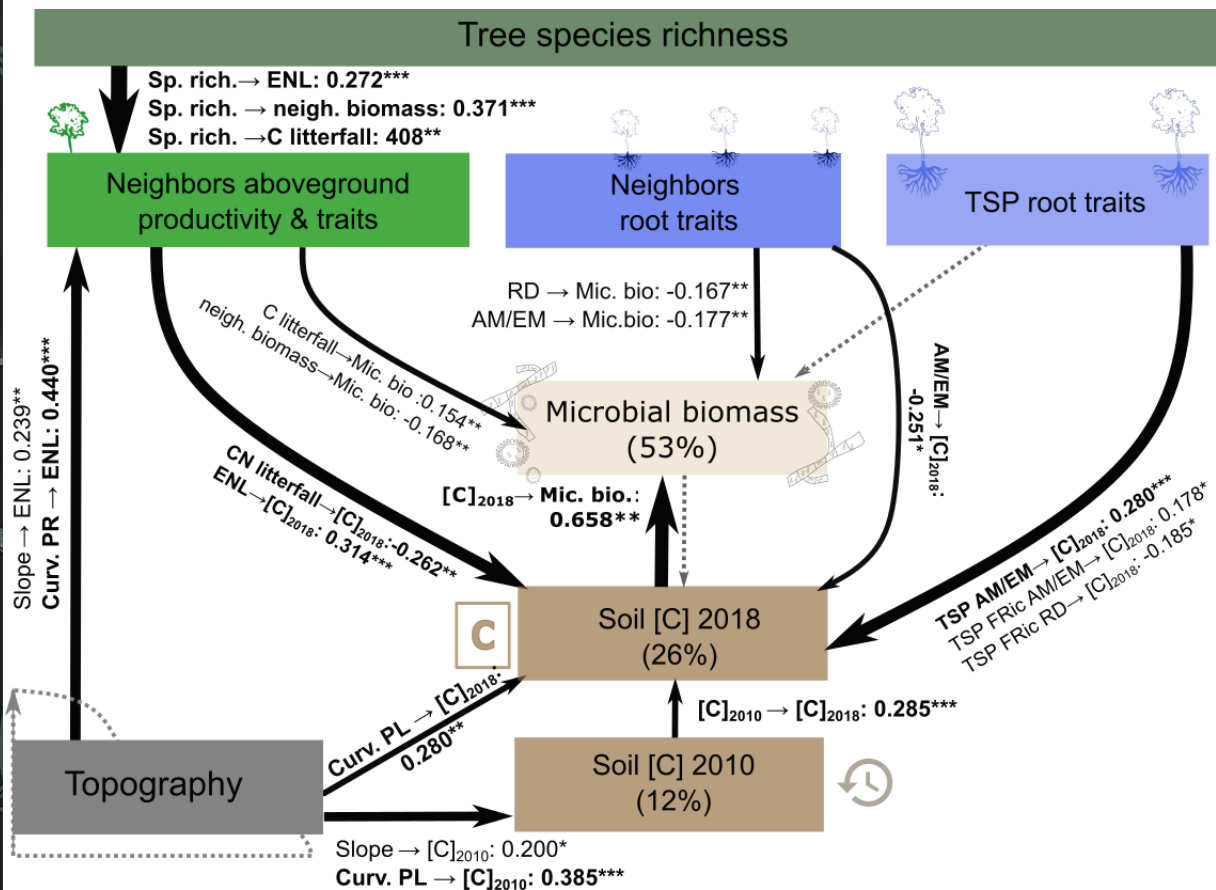
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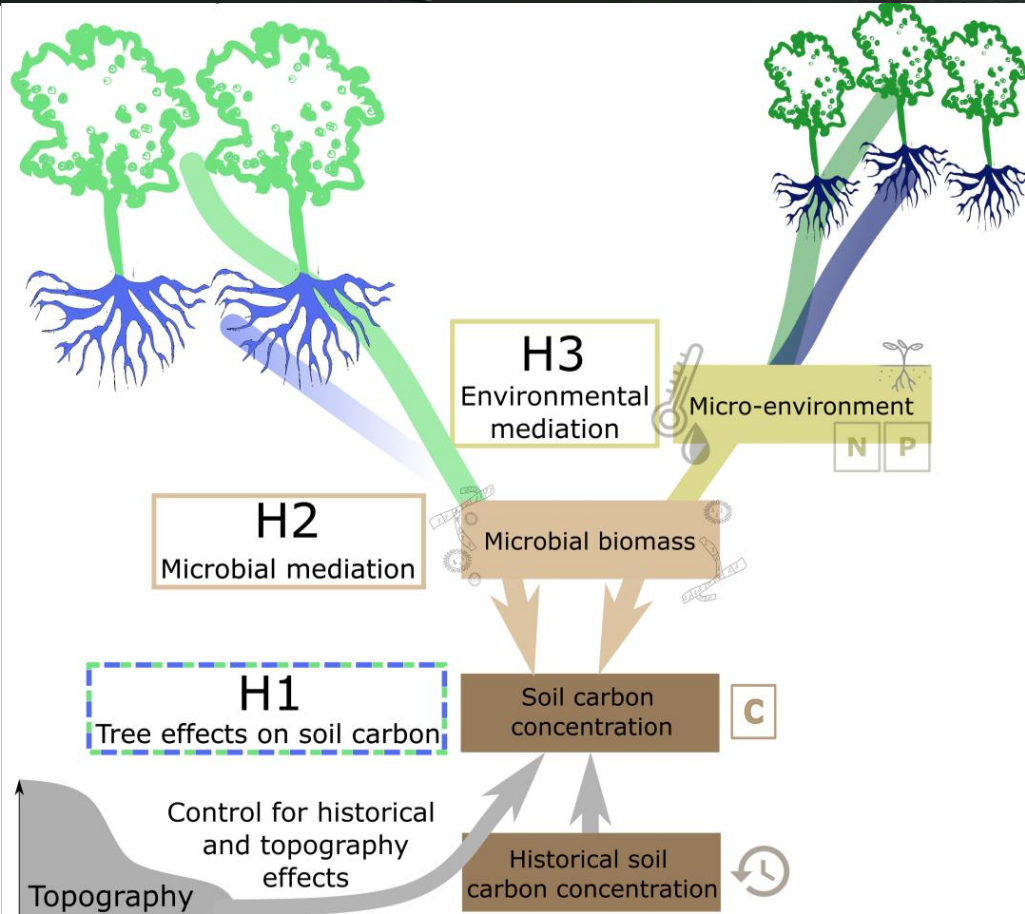
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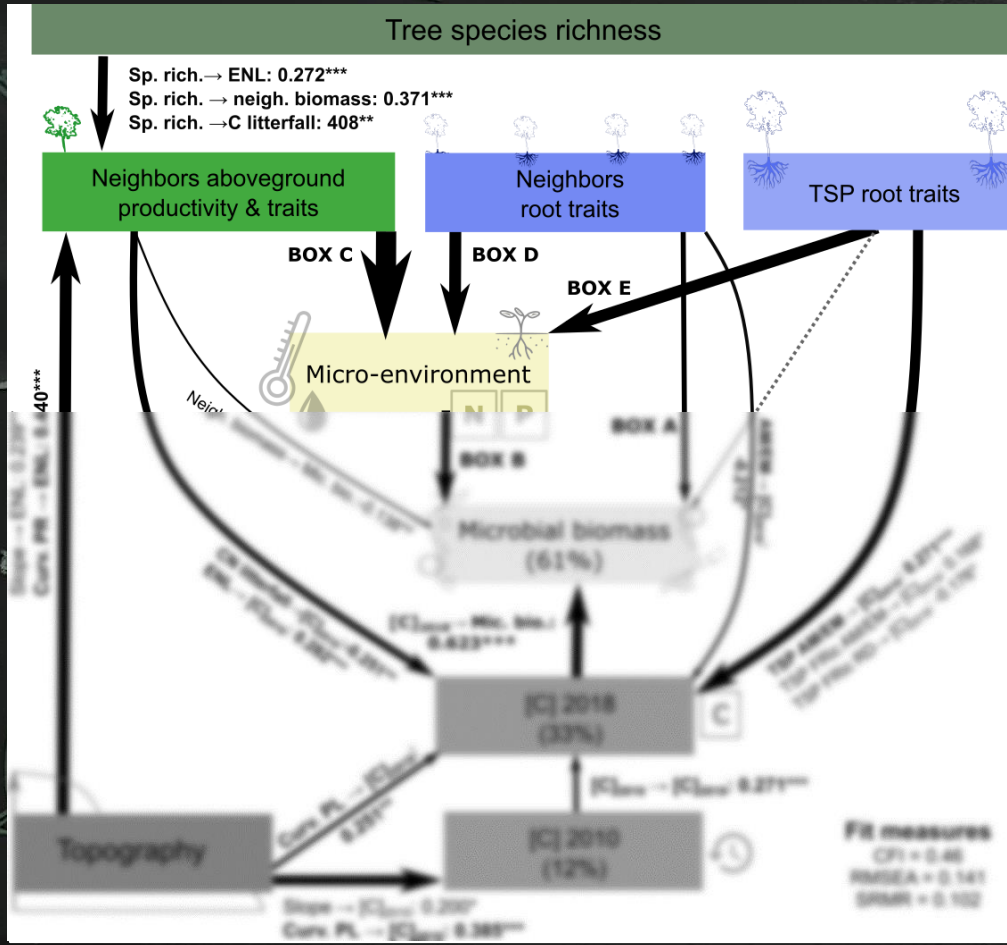
Soil carbon concentration strongly increased microbial biomass but the feedback effect wasn't detected



# Environmental mediation of tree effects on microbial biomass



# Environmental mediation of tree effects on microbial biomass



## BOX A

AM/EM → Mic. bio.: -0.211\*\*\*  
 RD → Mic. bio.: -0.124\*

## BOX B

Temperature → Mic. bio.: -0.270\*\*\*  
 Litter CN → Mic. bio.: 0.242\*\*\*

## BOX C:

ENL → Temperature: -0.446\*\*\*  
 ENL → Litter CN: -0.324\*\*\*  
 CN litterfall → Litter CN: 0.239\*\*  
 CN litterfall → Soil N: -.197\*

## BOX D:

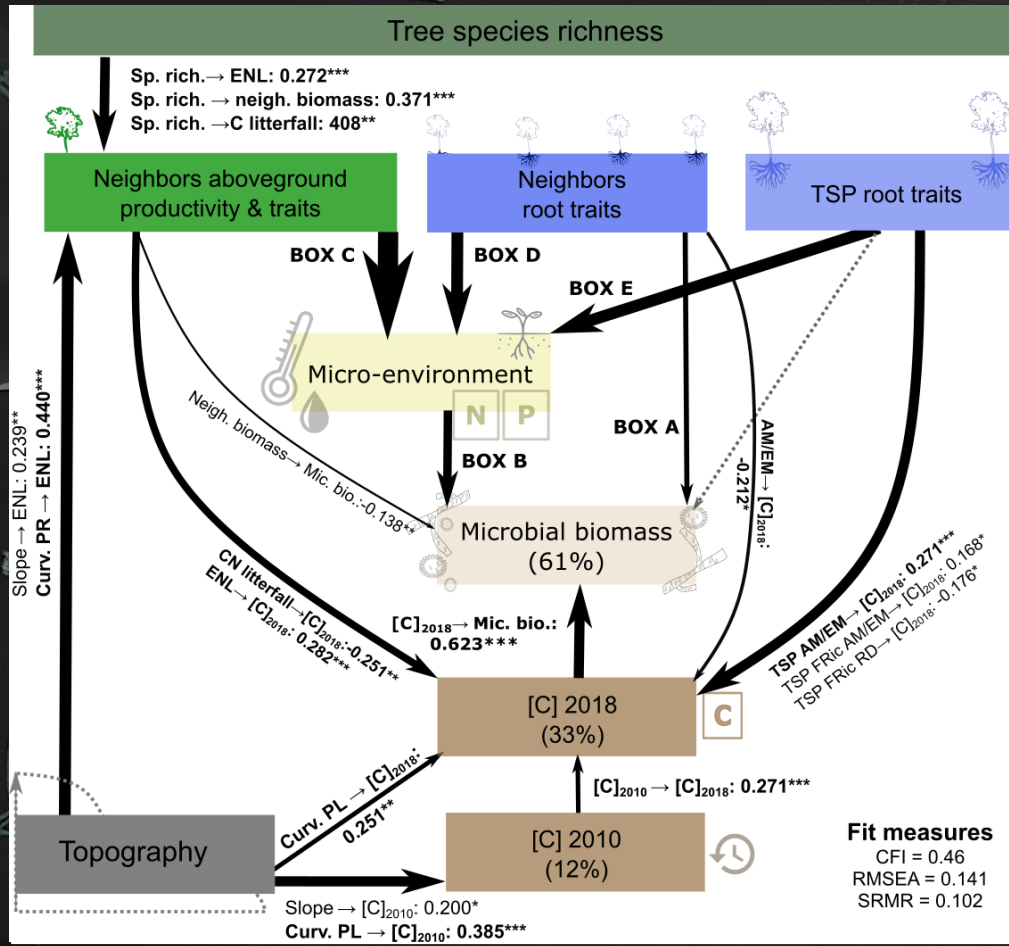
SRL → RH: -0.218\*\*  
 FDis AM/EM → Litter CN: 0.173\*  
 AM/EM → Litter CN: 0.315\*\*\*

## BOX E:

TSP RD → RH: -0.218\*\*  
 TSP FRic RD → RH: 0.198\*  
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Neighbors productivity,  
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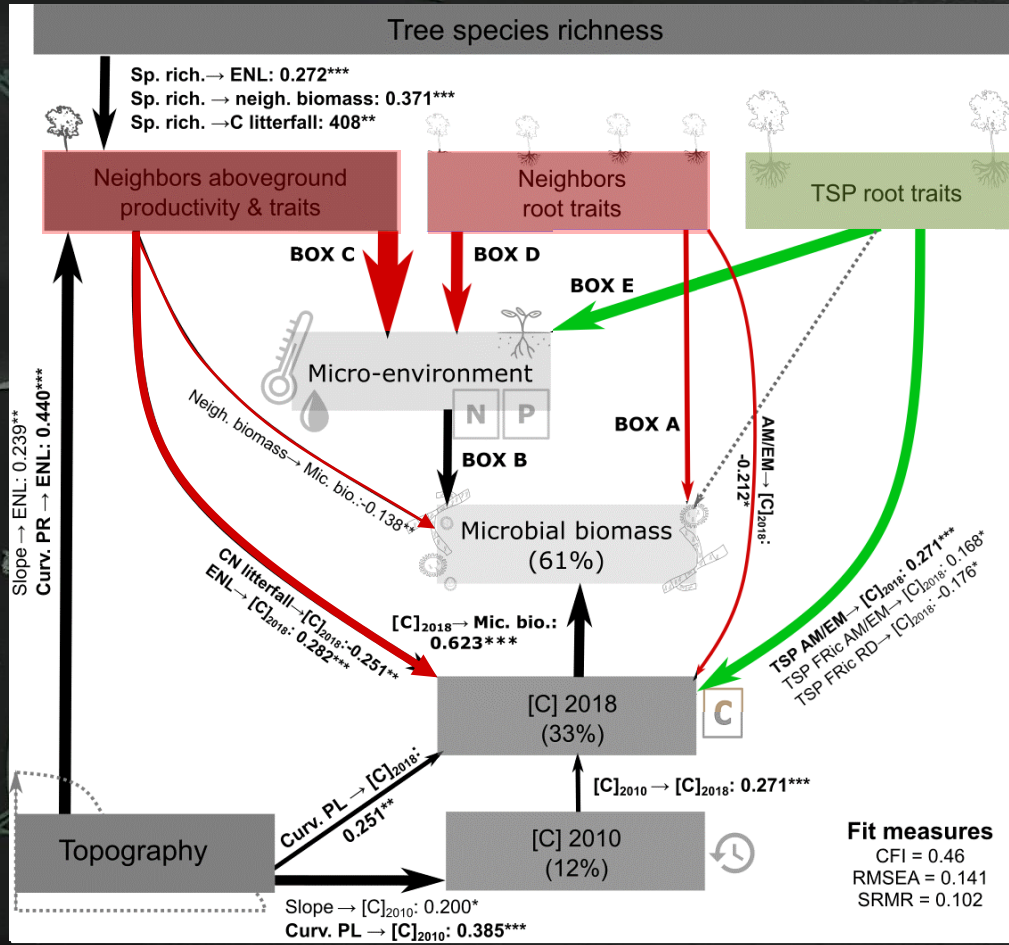
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Tree effects directly affected soil carbon concentration while their effects on microbial biomass were mediated by the environmental conditions

## Conclusion

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- **The effects of tree functional traits and productivity** on microbial biomass were mostly **mediated by the micro-environment**
- Our analyses suggested a strong positive effect of soil carbon concentration on microbial biomass but failed to detect feedback effects.

- Confirmation of **the close relationship between microbial biomass and soil carbon concentration**:
  - more temporal studies and measurement of soil carbon structure to understand the mechanisms

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- **High scale dependency** suggests scale dependent processes. This could explain the contradictory results previously found
- Our study highlights the **need to consider the spatial dimension in ecology**



Simone Cesarz & Nico Eisenhauer

### Field and lab helpers



### Collaborators:

Yang Bo, Wensheng Bu,

Helge Bruelheide, Andréa Davrinche,

Jianqing Du, Sylvia Haider ,

Goddert von Oheimb, Maria D. Perles-Garcia,

Mariem Saadini, Thomas Scholten,

Steffen Seitz, Bala Singavarapu,

Stefan Trogisch, Yanfen Wang,

Tesfaye Wubet, Kai Xue



experimental  
interaction  
ecology



Thank you for your attention

**DFG** Deutsche  
Forschungsgemeinschaft

