# INCyTE Spring Seminar 2023:

# ***Ecosystem Stoichiometry and Flexibility Across Scales***

Wednesday, March 1, 2023

9:00-10:30 MST

Please register for the INCyTE Network if you have not: https://www.umt.edu/incyte/participate/default.php

Info on seminars, seminar resources, and links to recording will be available on the INCyTE website: https://www.umt.edu/incyte/about-incyte/

Three high priority themes were identified in the first INCyTE meeting (2019) and were the focus of the 2021 seminar:

- *Ecological Stoichiometry
- *P Cycling
- *N Fixation

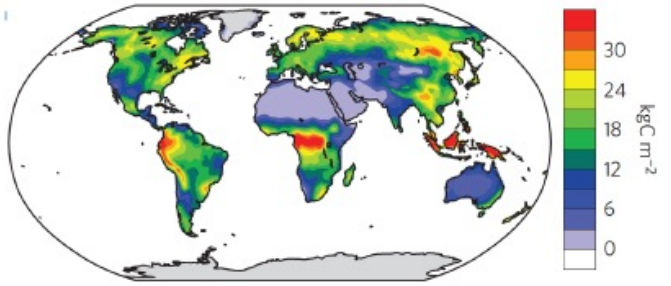
*(and Representation in Models)

**INCyTE seminar series: Nutrient cycles in Earth system models – challenges, opportunities, and frontiers**

**Format:** 1.5 hour weekly Zoom meetings (presentations by invited speakers and collaborative discussions)

**When:** Wednesdays, 9-10:30 am US MST/11-12:30pm US EST/4-5:30pm UTC January 13th – April 7th 2021

**Invited participants:** ecologists, biogeoscientists, and Earth system modelers of all career stages (early career participants are encouraged!)




**In this awesome online seminar series, we will:**

- Explore how nutrients (nitrogen and phosphorus) are currently represented in ESMs
- Identify key knowledge gaps
- Collaboratively consider and develop a "distributed experiment" plan to address identified knowledge gaps
- Lay out a road map for future research priorities in support of more robust representation of nutrient cycles in ESMs

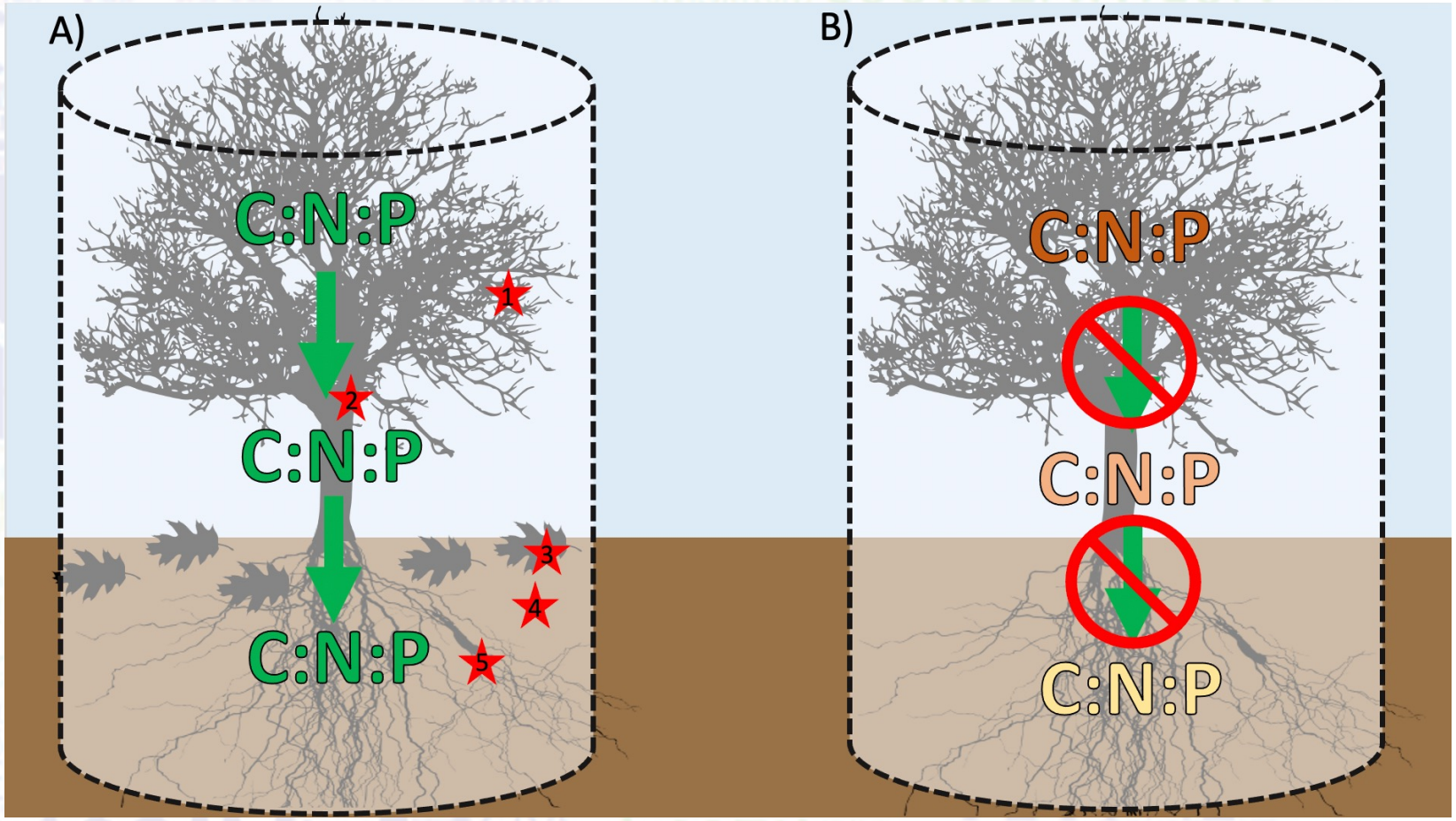
**More details on the INCyTE Research Coordination Network website!**

# Emergent questions about stoichiometric flexibility

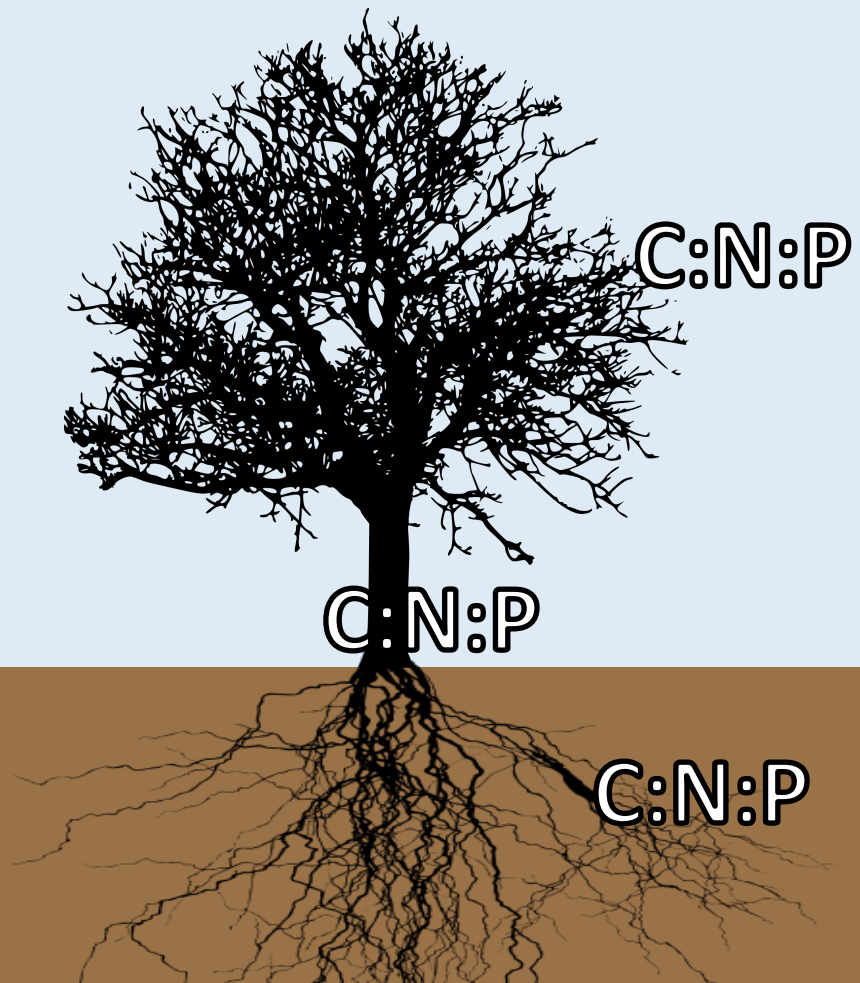
1. Plant tissue stoichiometric flexibility (leaves, wood, roots)? Patterns? Controls? Linkages within ecosystems?
2. Soil and microbial stoichiometric flexibility?
3. Mechanisms of stoichiometric flexibility?
4. Linkages between plant stoichiometry, soil stoichiometry, and ecosystem processes?

# *Ecosystem Stoichiometry and Flexibility Across Scales*

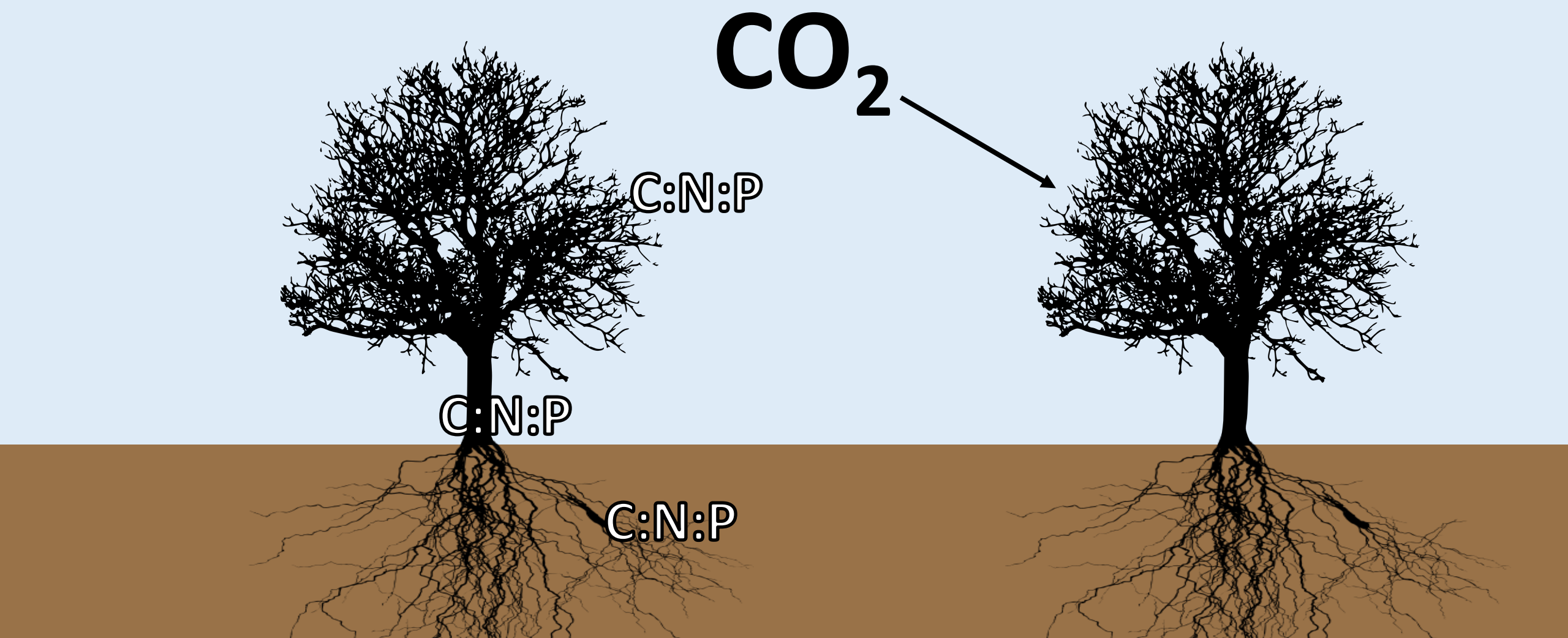
**Seminar Goal:** To collaboratively design a distributed experiment (*stoichiometric observatories)* to address some of these important questions



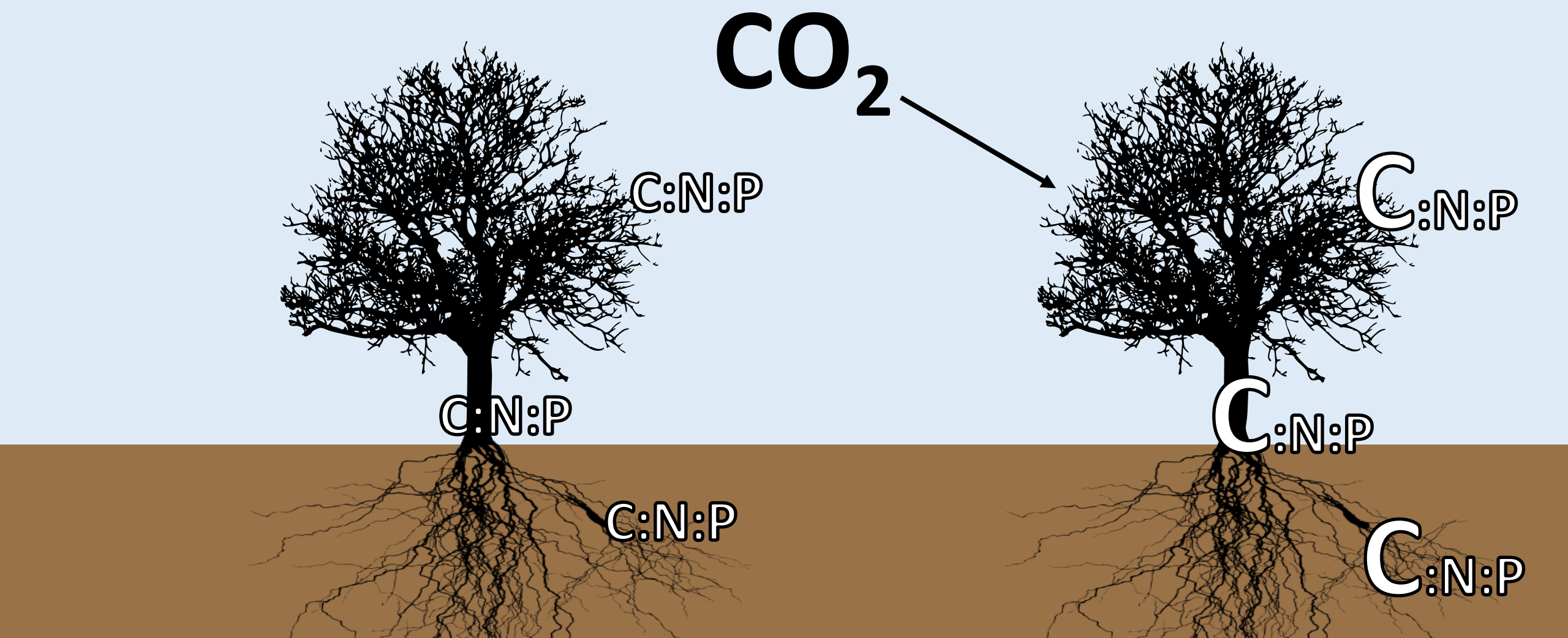
# Stoichiometric Flexibility



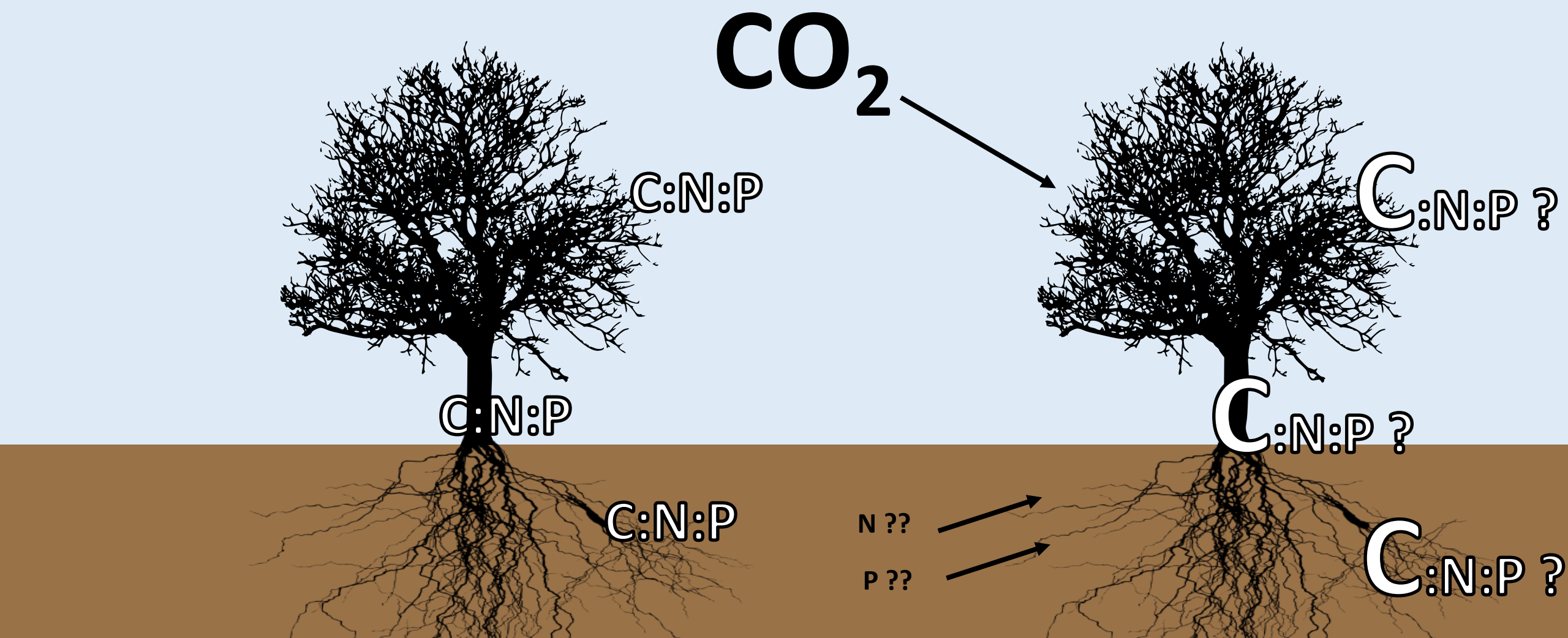
# Stoichiometric Flexibility



# Stoichiometric Flexibility



# Stoichiometric Flexibility

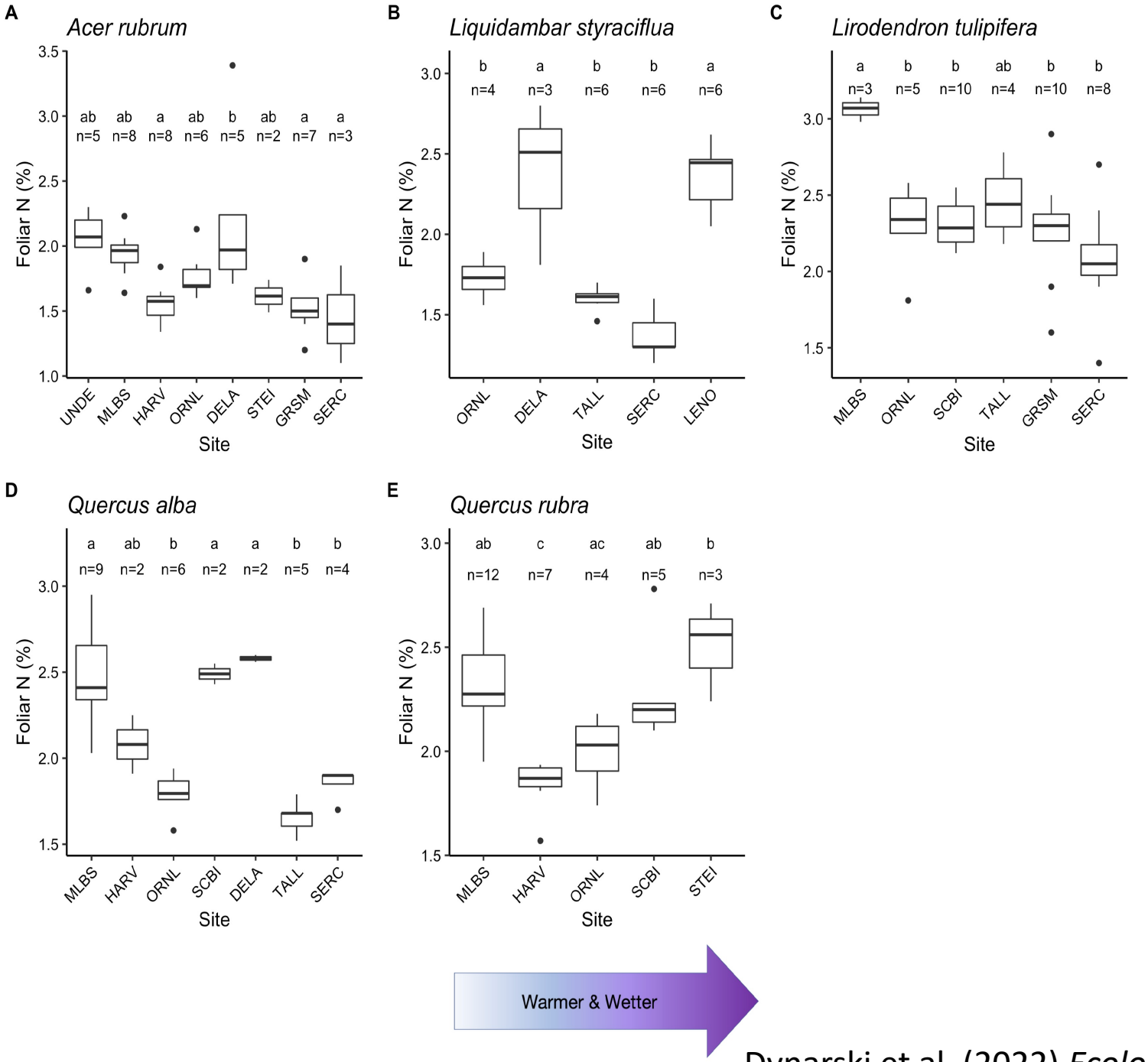


# Patterns and controls of foliar nutrient stoichiometry and flexibility across United States forests

KATHERINE A. DYNARSKI,[1] FIONA M. SOPER, [2] SASHA C. REED, [3] WILLIAM R. WIEDER, [4, 5] CORY C. CLEVELAND[1]

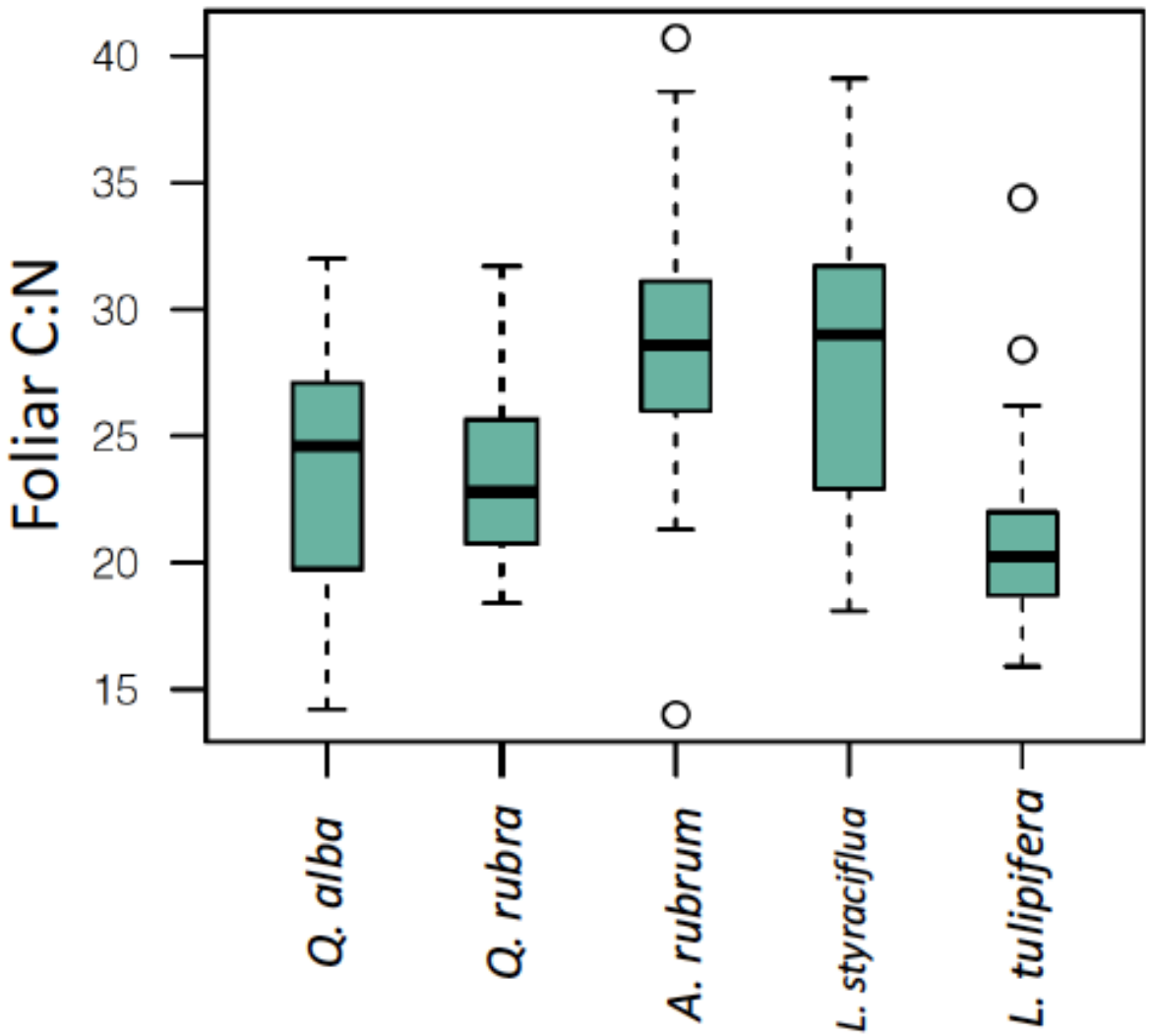
[1] *Department of Ecosystem and Conservation Sciences, University of Montana, Missoula, MT, USA*
[2] *Department of Biology and Bieler School of Environment, McGill University, Montréal, QC, Canada*
[3] *U.S. Geological Survey, Southwest Biological Science Center, Moab, UT, USA*
[4] *Climate and Global Dynamics Laboratory, National Center for Atmospheric Research, Boulder, CO, USA*
[5] *Institute of Arctic and Alpine Research, University of Colorado Boulder, Boulder CO, USA*

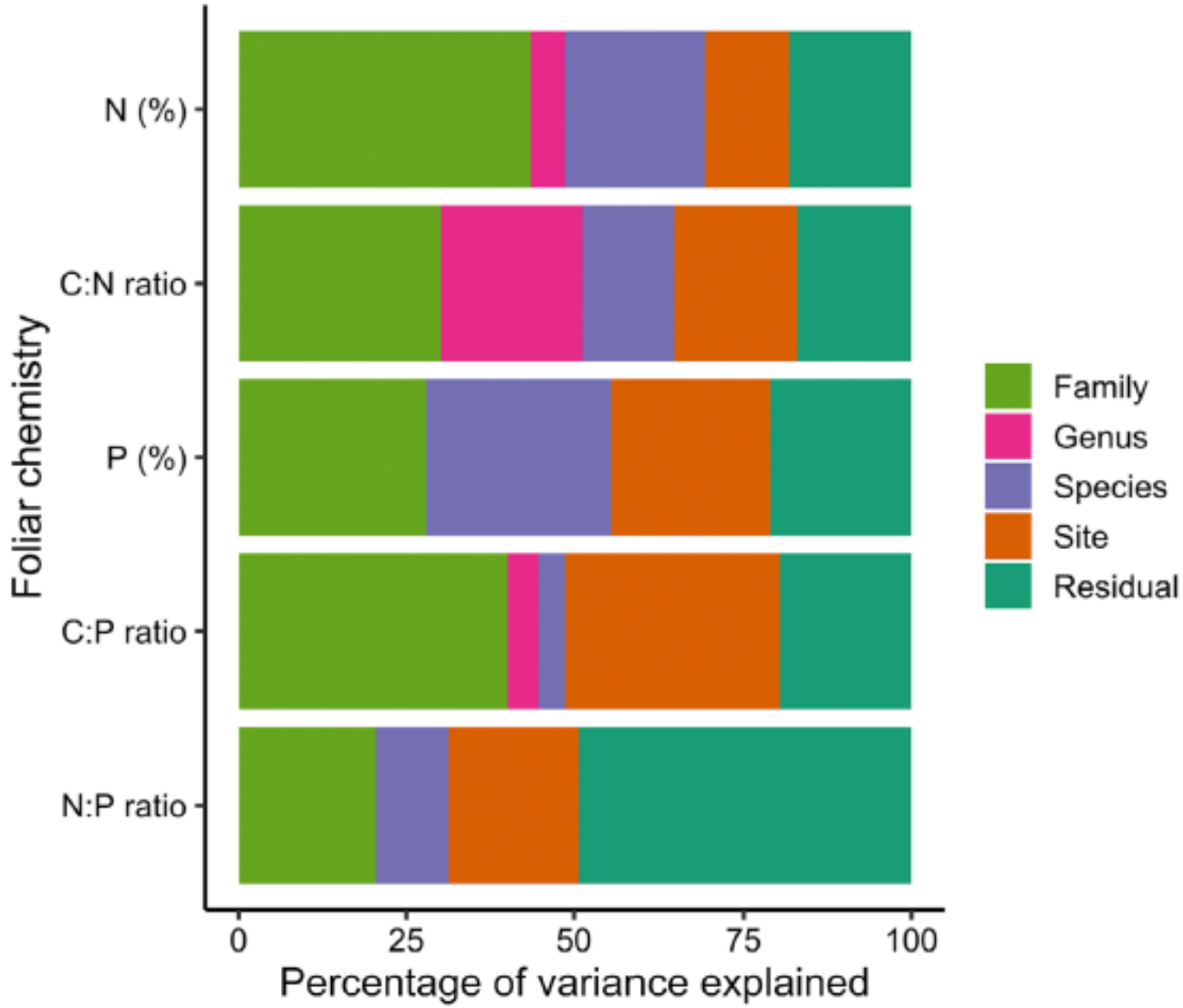
*Individual species exhibited up to a 2-fold range in foliar N within a single site, and all species displayed significantly different foliar N and C:N values among sites.*



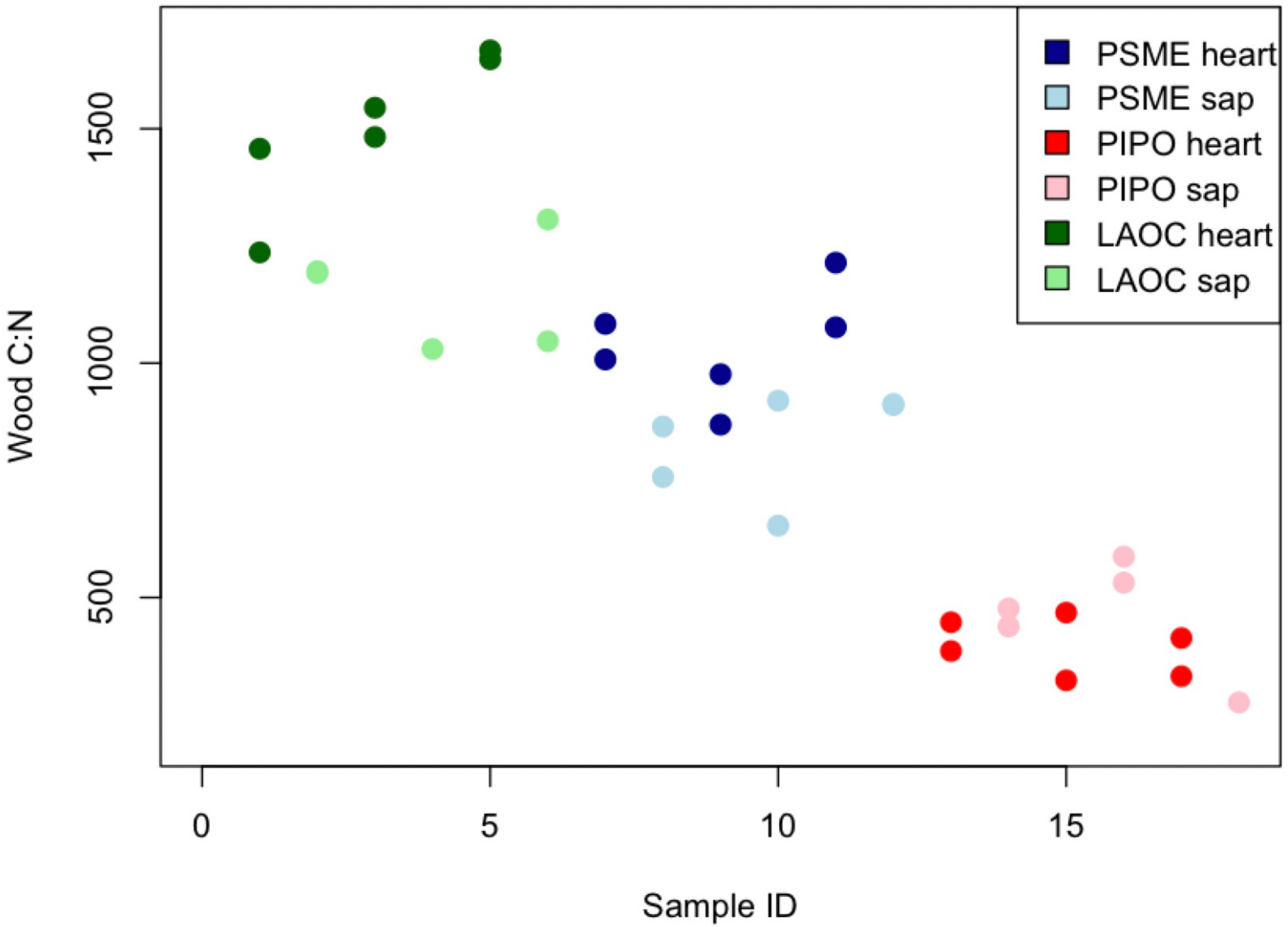

Dynarski et al. (2022) *Ecology*

# Variation in Foliar C:N in Common Species Across the NEON domain

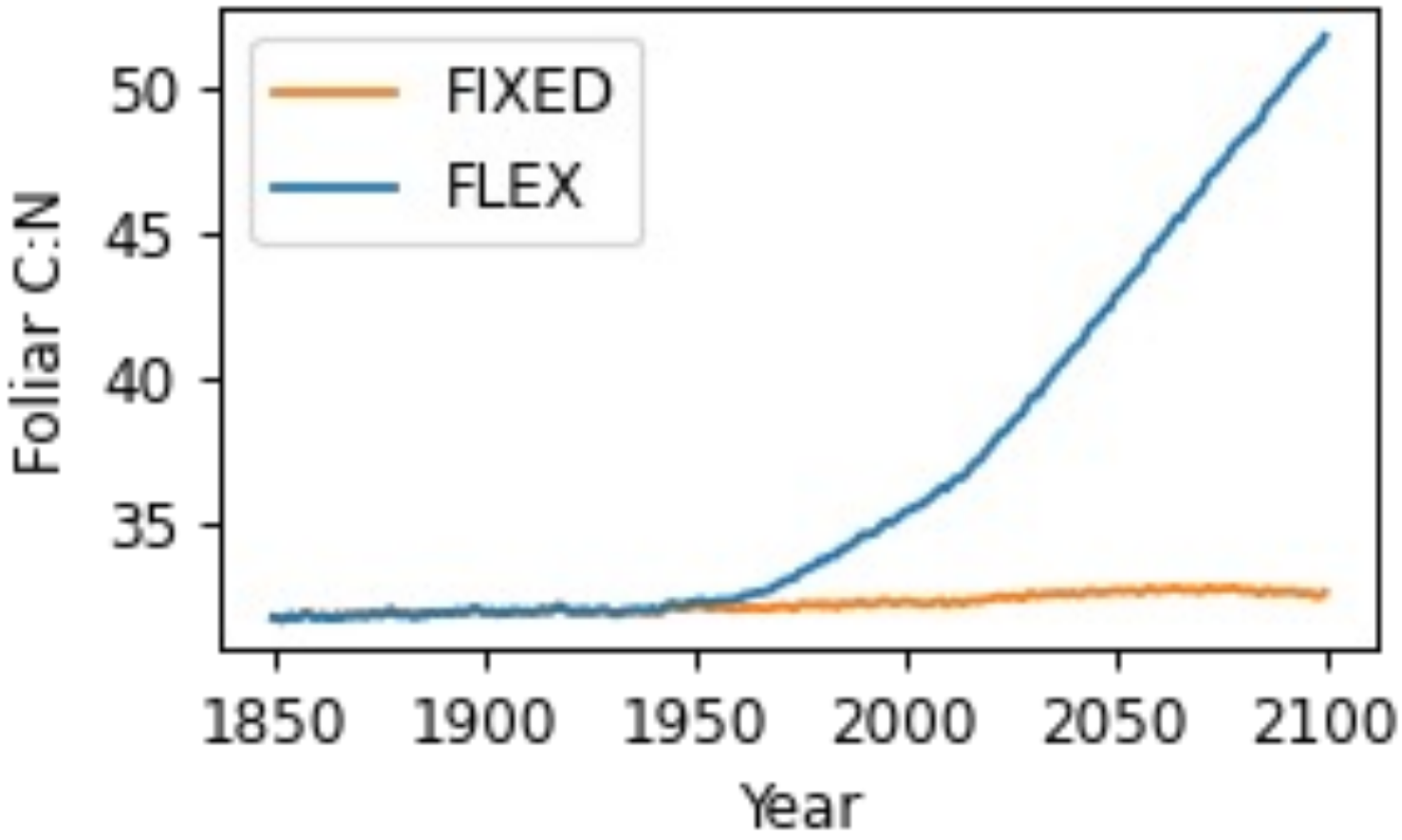


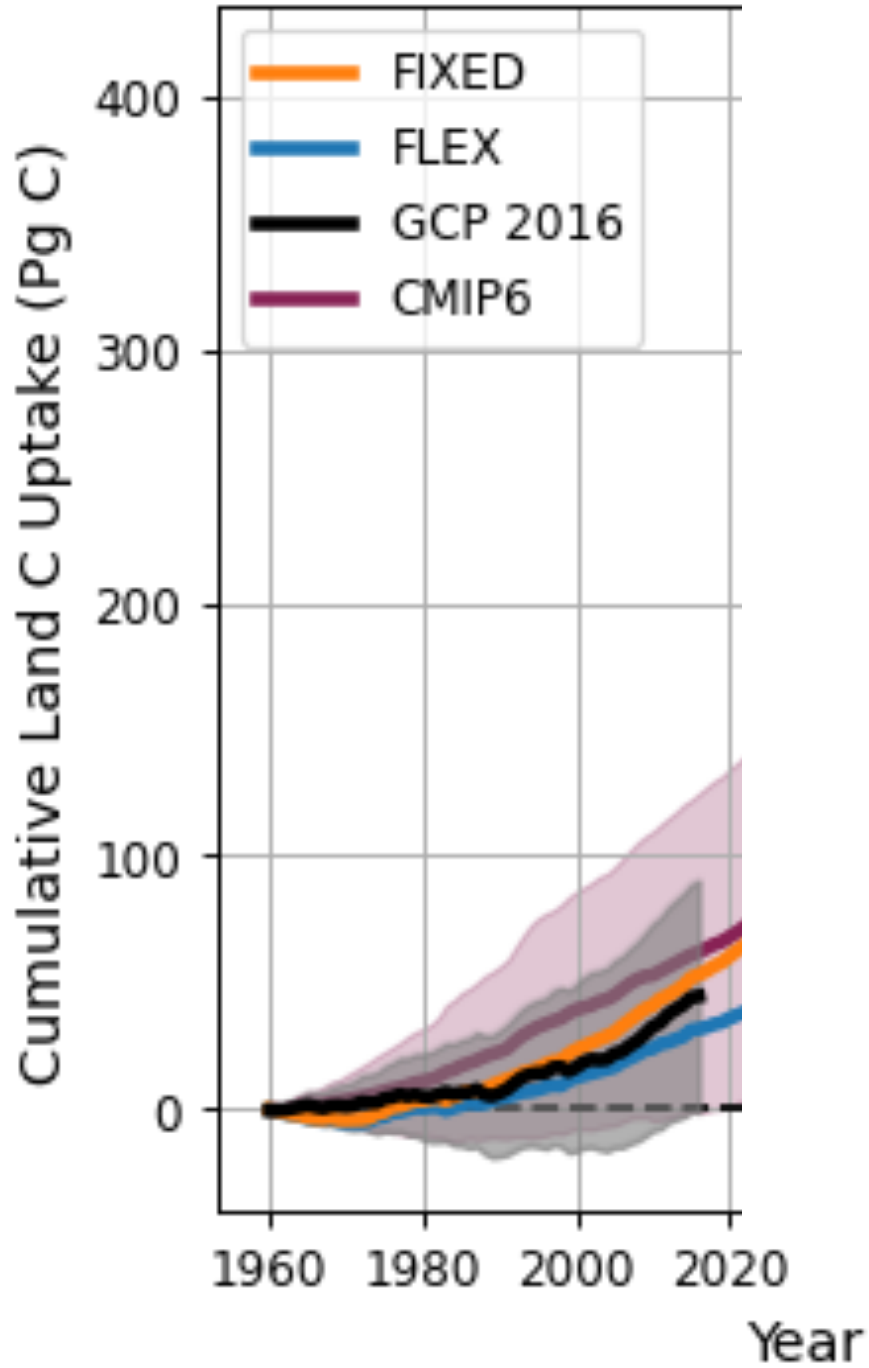



# Preliminary wood stoichiometry analyses

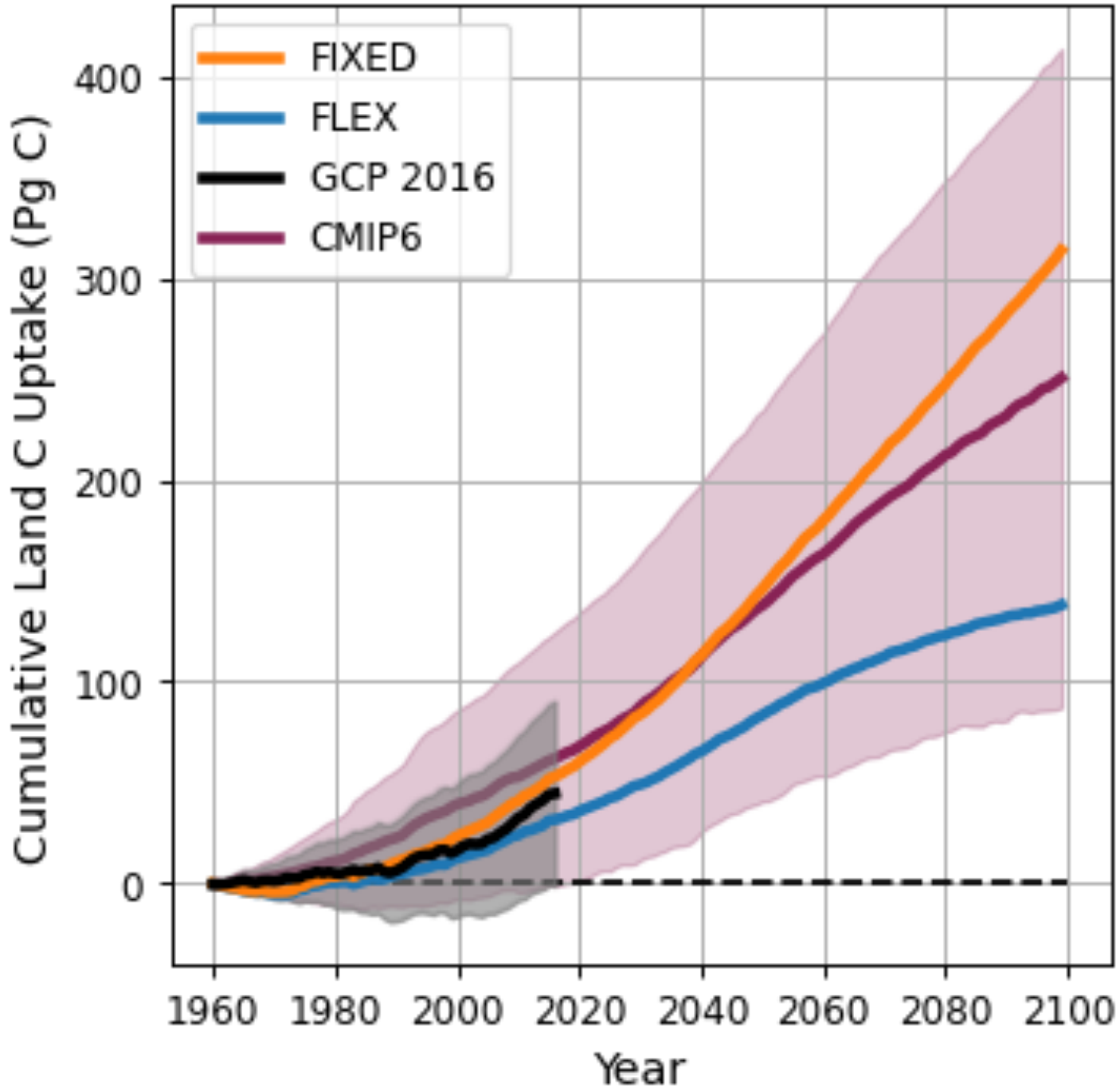


# Foliar C:N flexibility in CLM



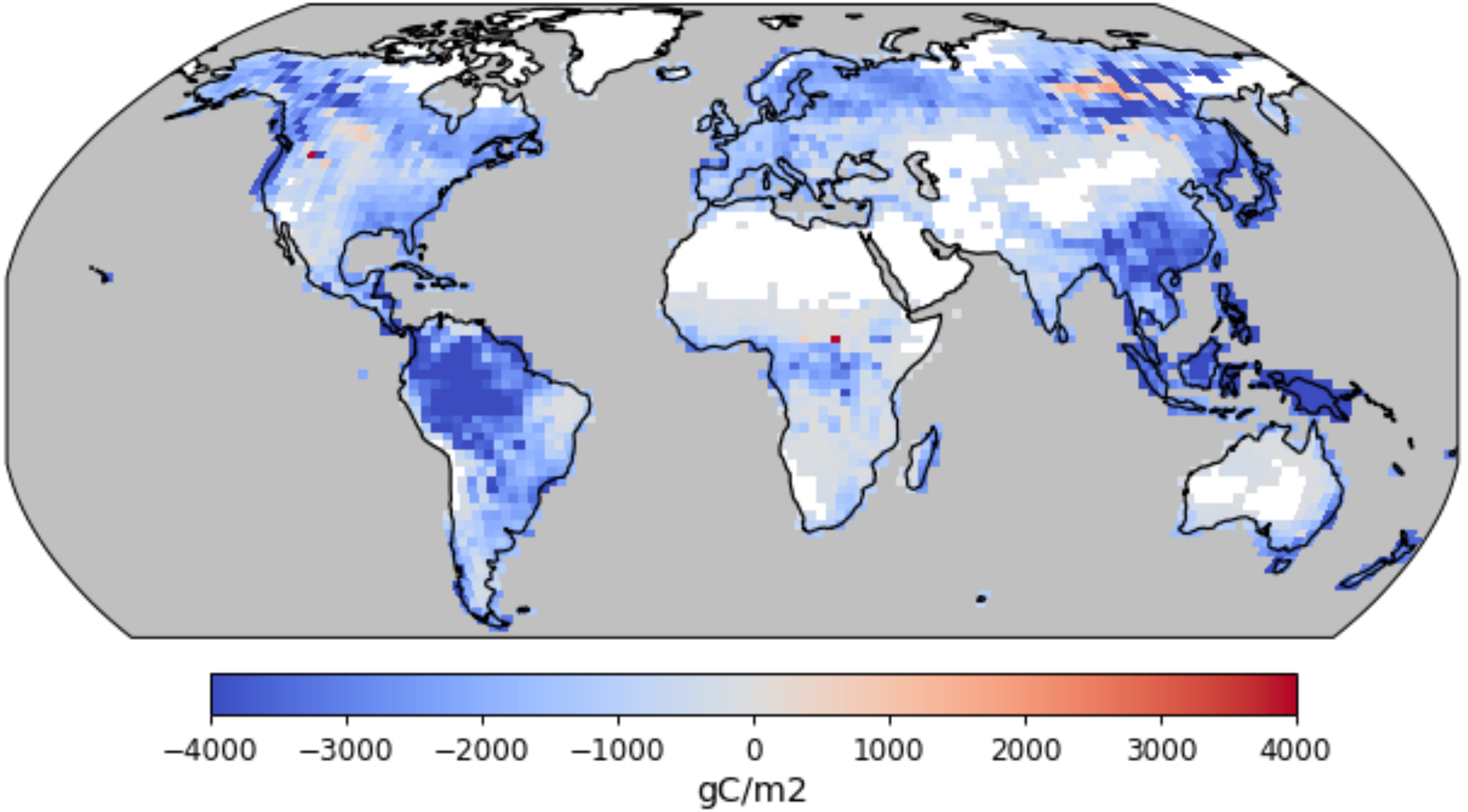

FIXED
FLEX
GCP 2016
CMIP6
Cumulative Land C Uptake (Pg C)
400
300
200
100
0
1960
1980
2000
2020
Year

Flexible C:N reduces land C sink by ~200 Pg C

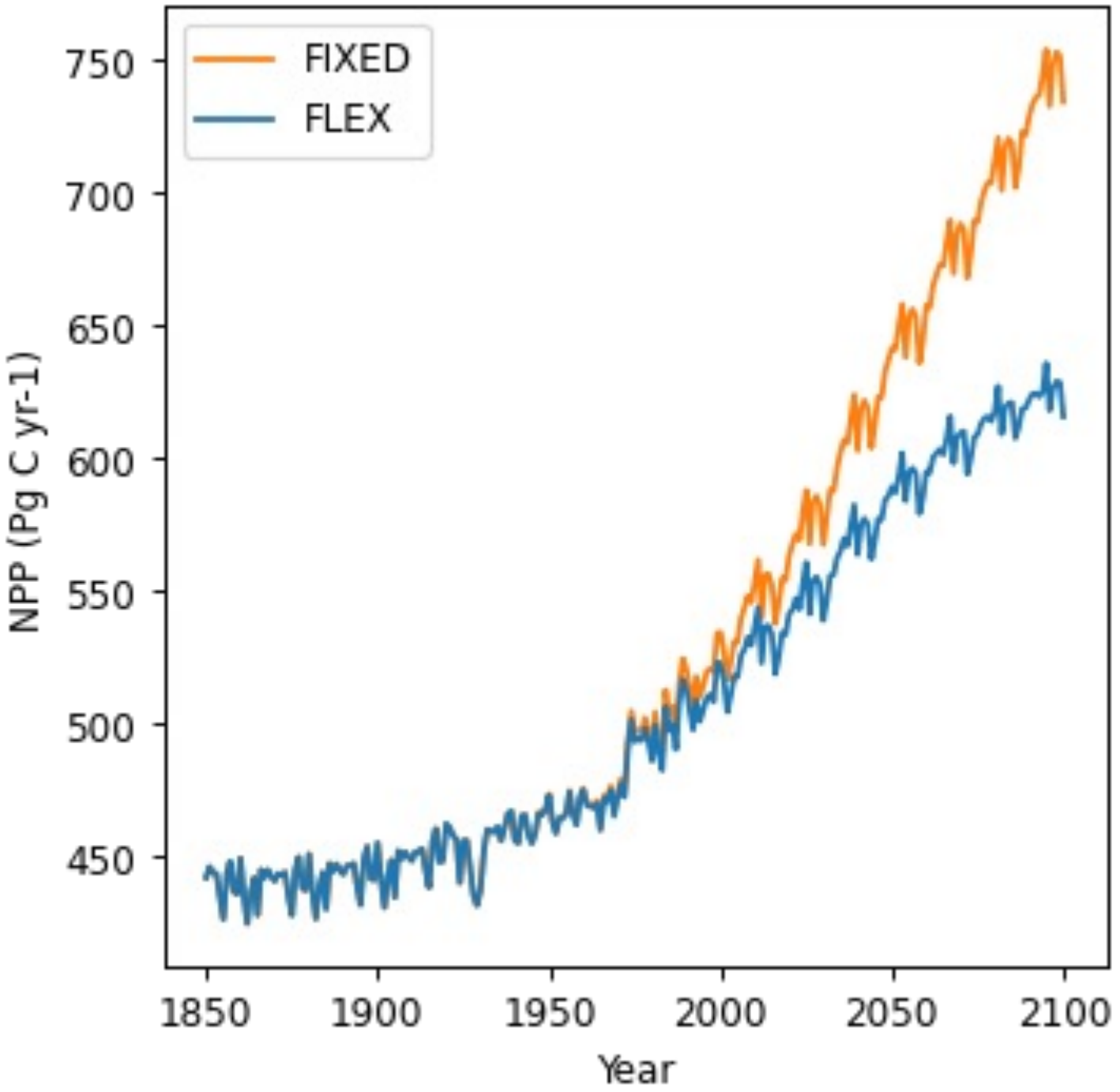


# Flexible C:N reduces land C sink by ~200 Pg C

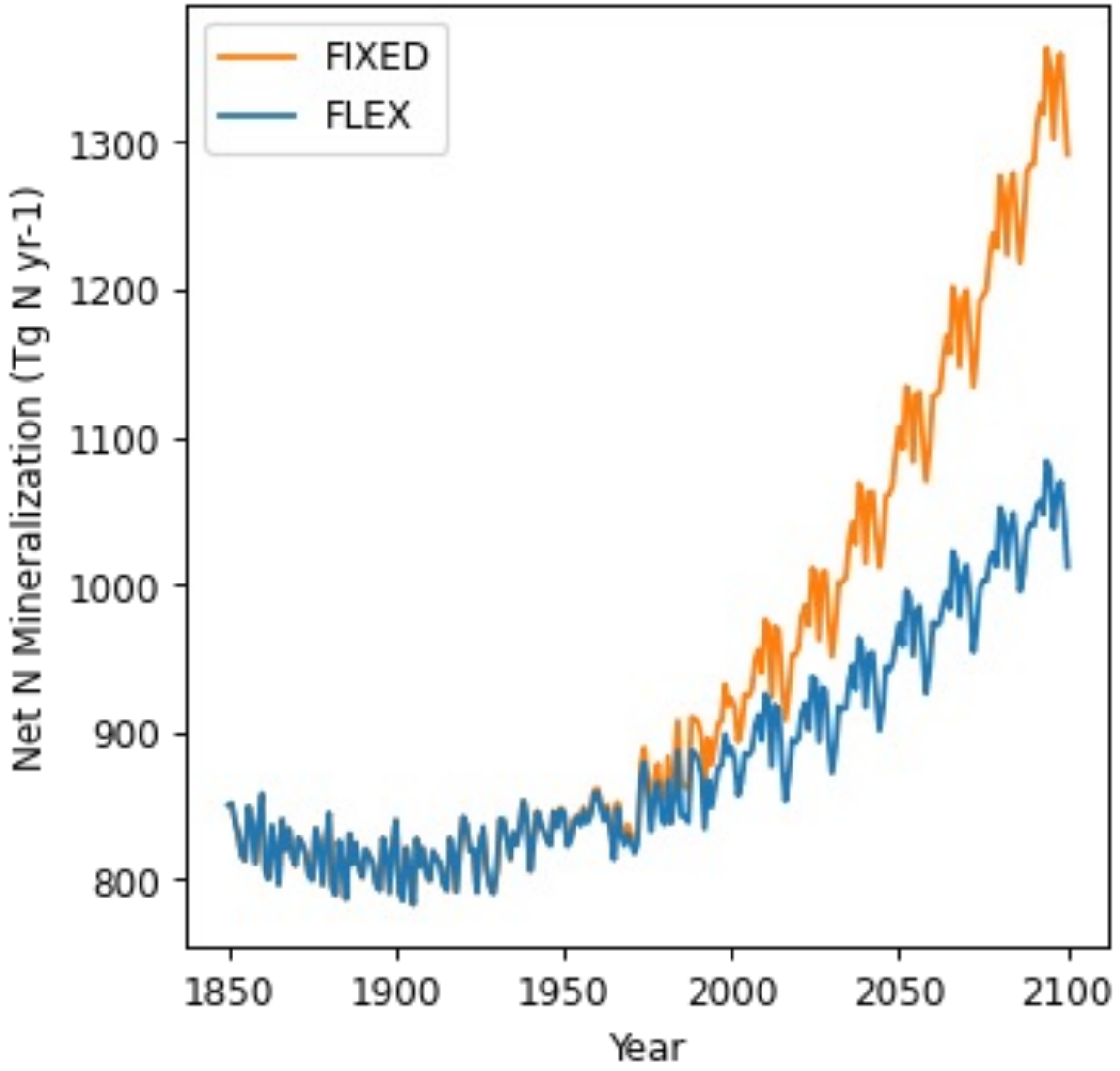
Difference between FIXED and FLEX in 2100

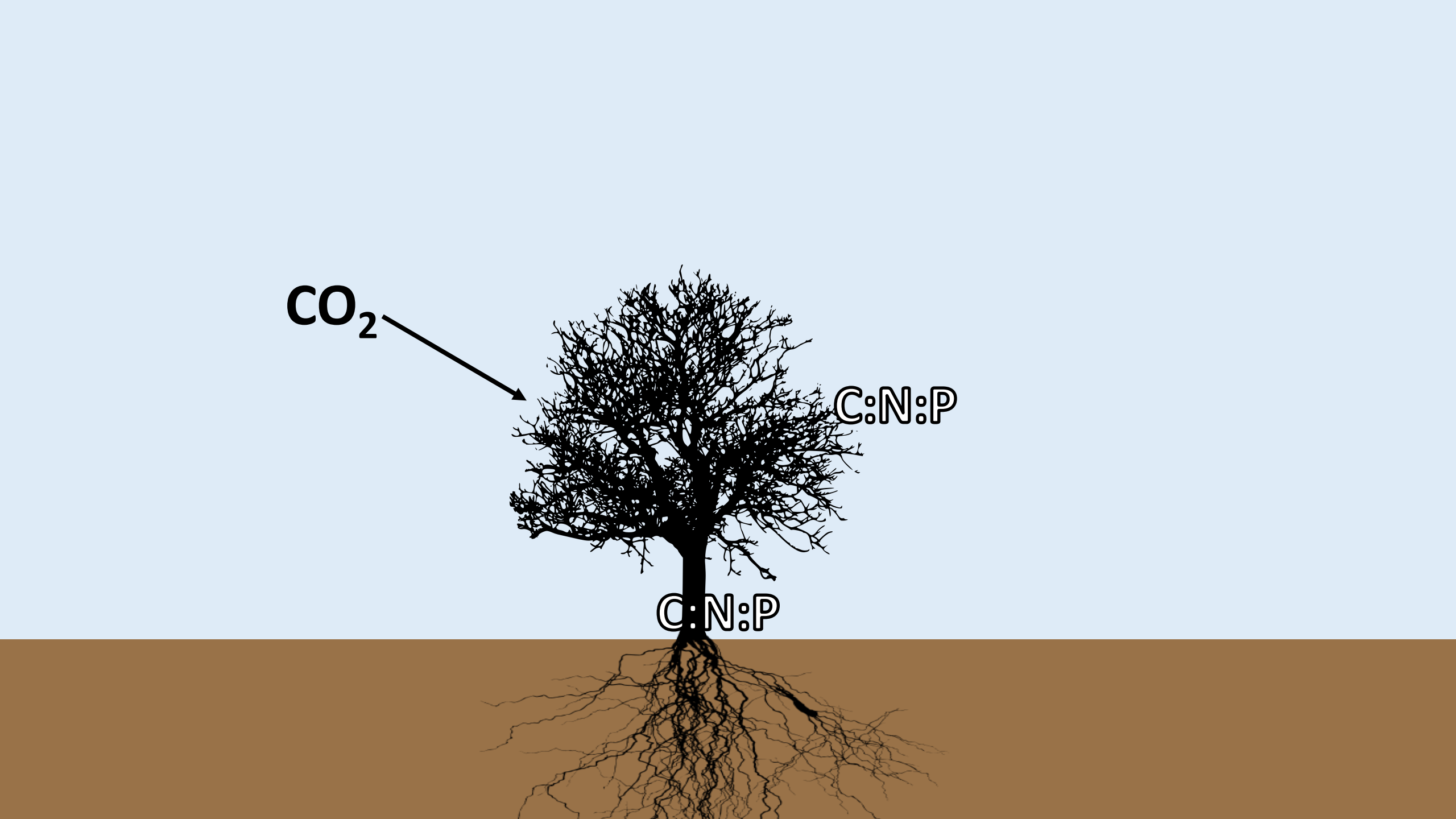


C sink reduction is due to reduced photosynthetic capacity

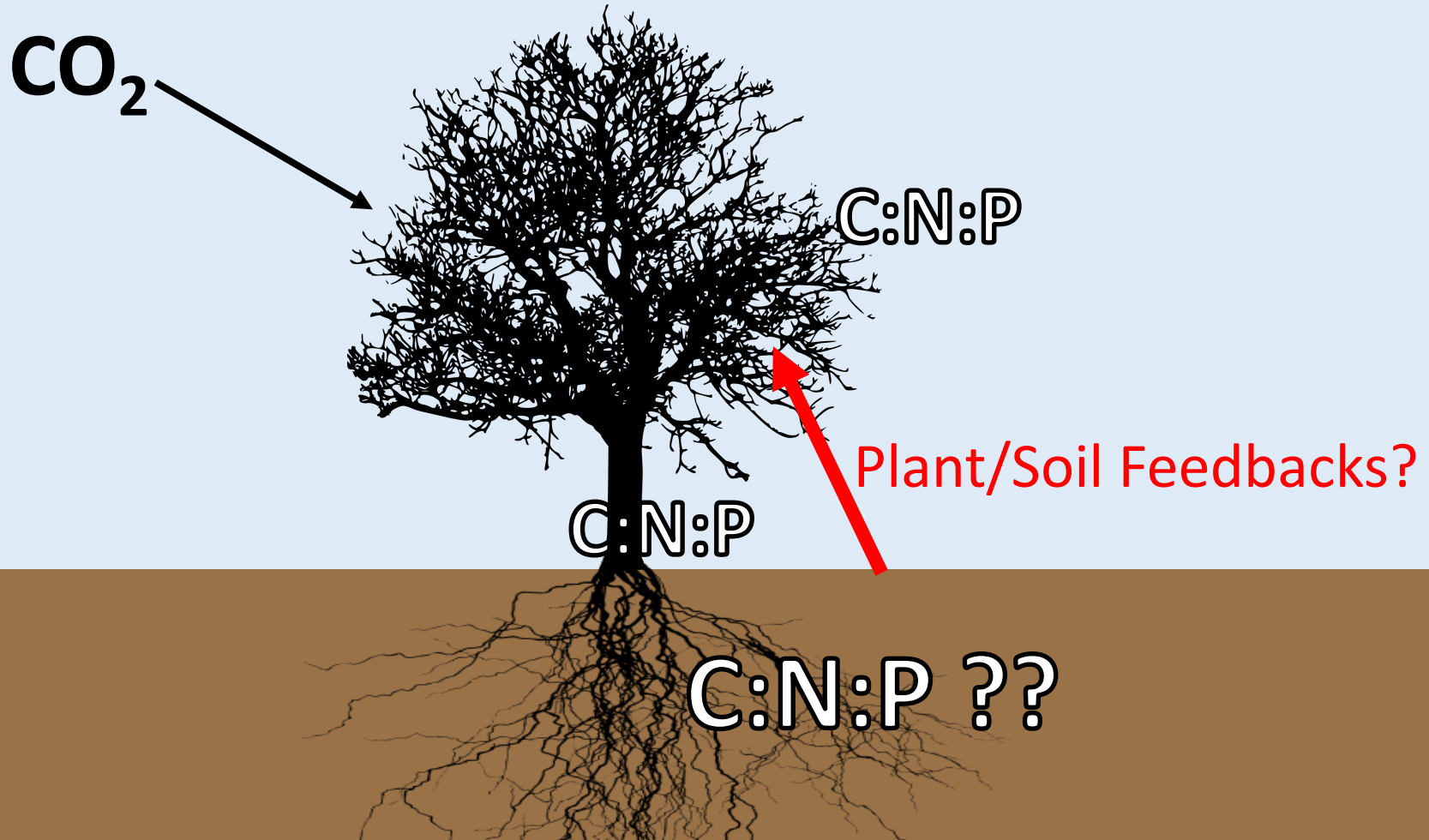


# Flexible foliar C:N produces effects on N cycling (reflecting changes in productivity).



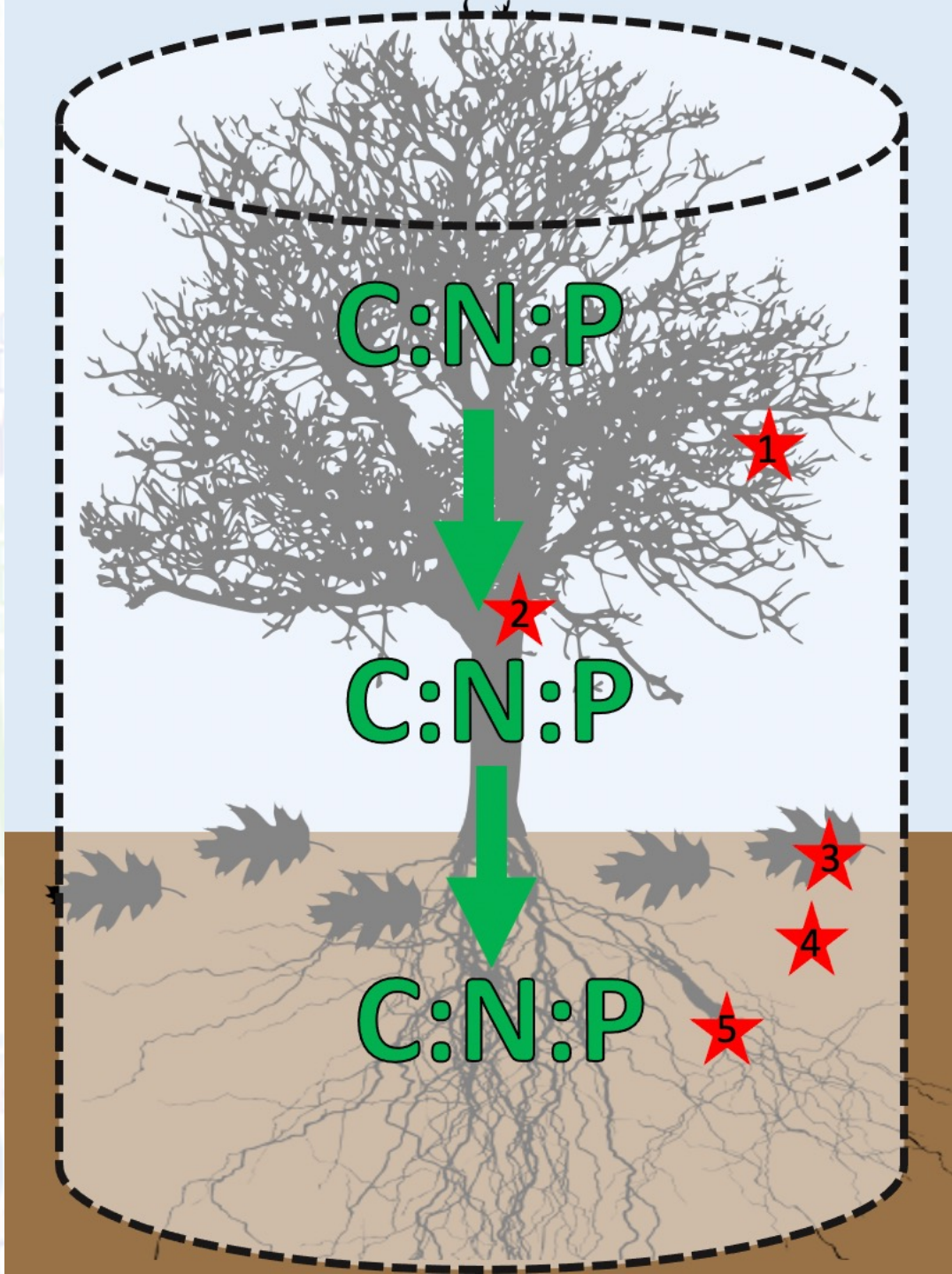

$CO_2$
C:N:P
C:N:P

# Need for integrated analysis of indirect effects.



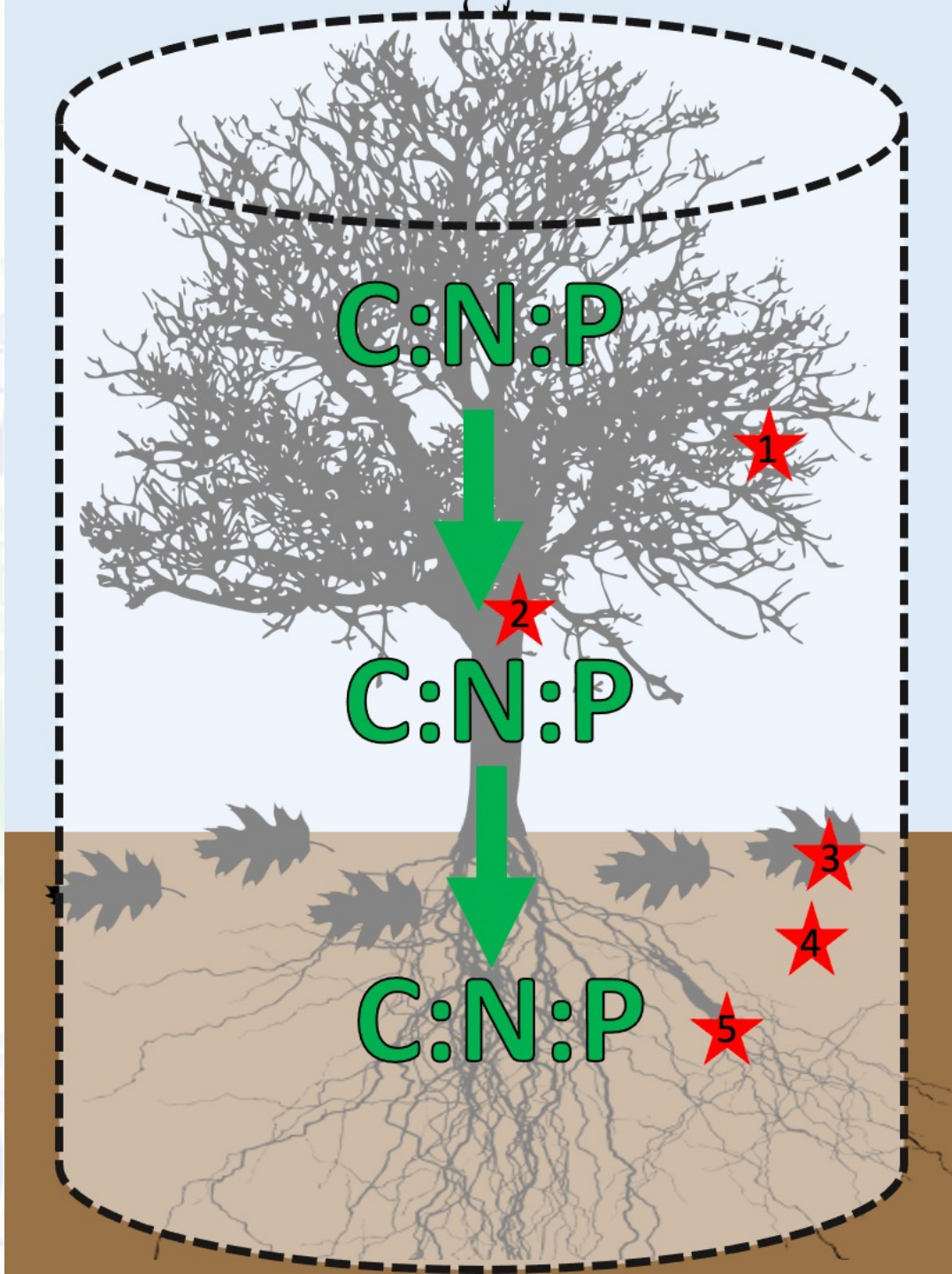
# INCyTE Distributed Experiment

# Stoichiometric Observatories



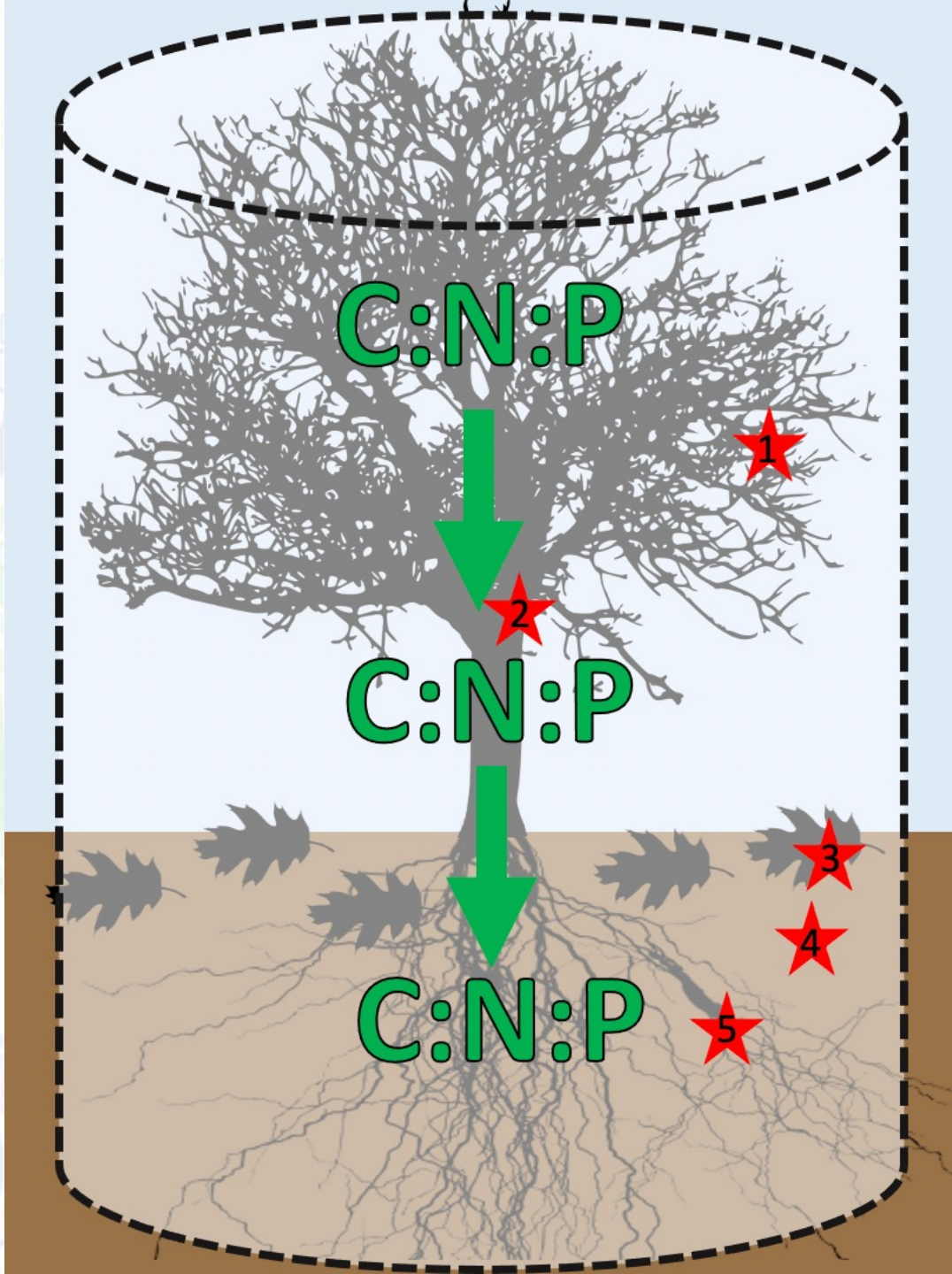
# Stoichiometric Observatories

- Measure:
  - Leaves, wood, roots, litter, soils, soil microbial biomass



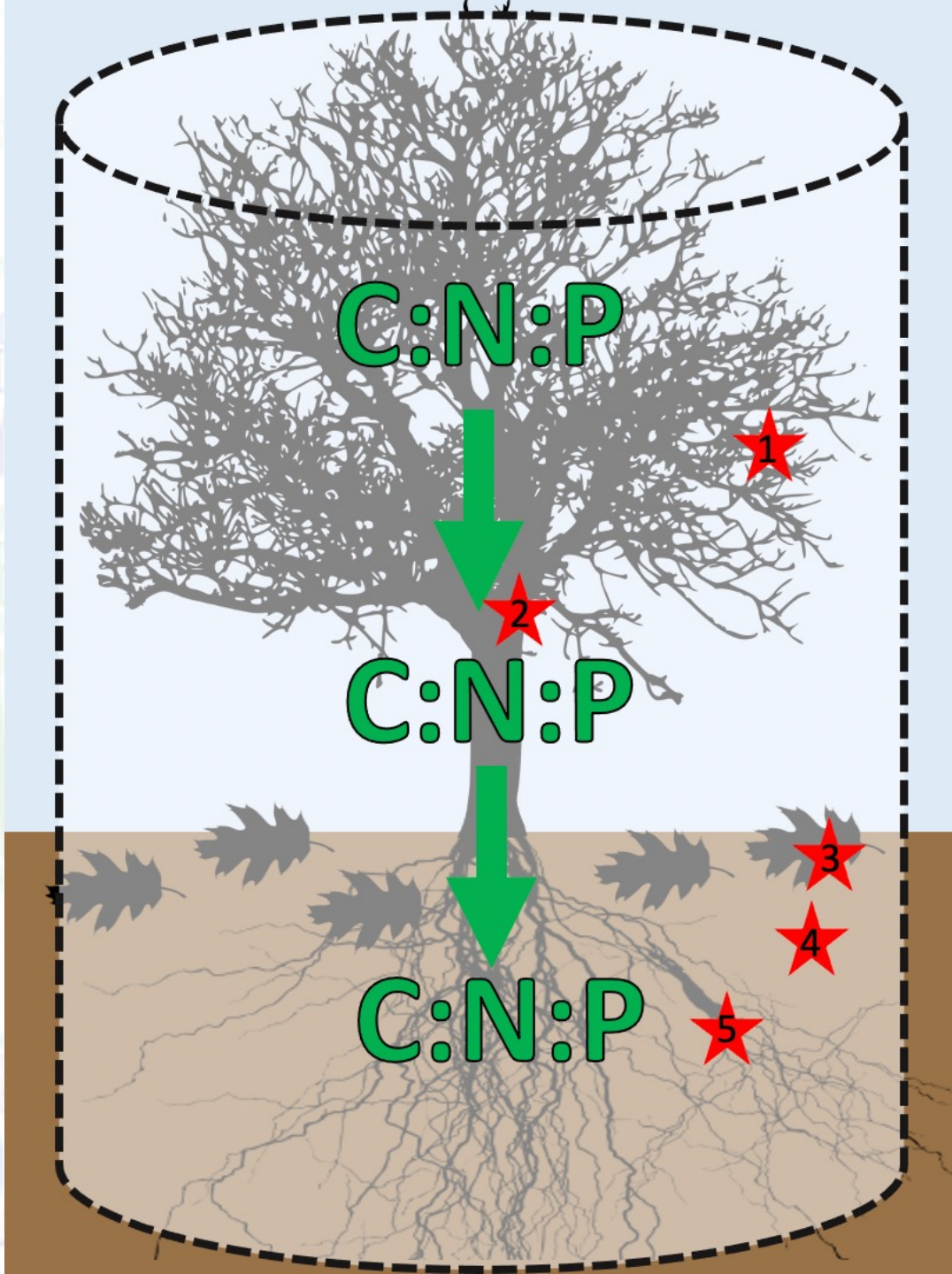
# Stoichiometric Observatories

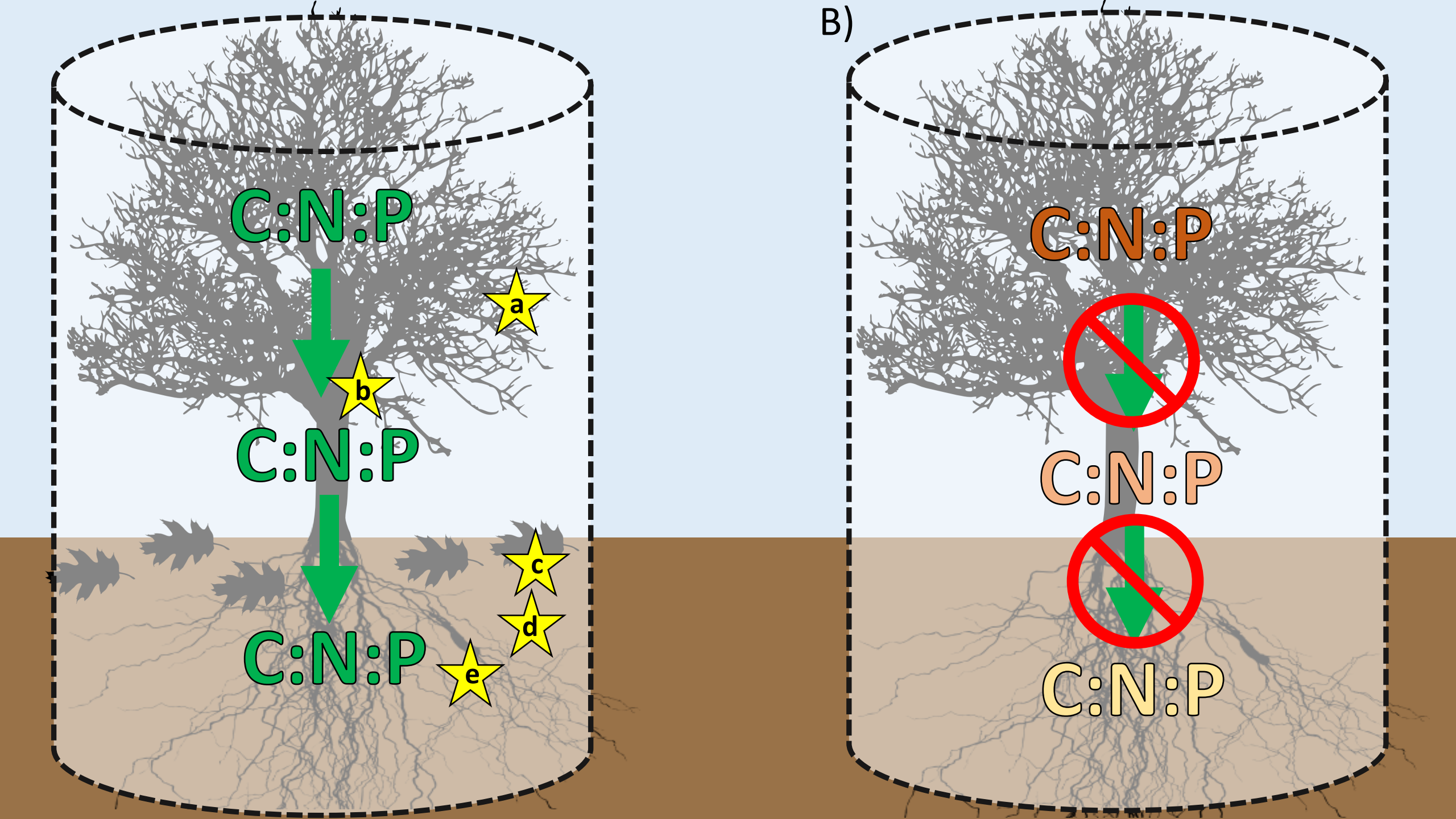
- Goals:
  - Explore C:N:P relationships between ecosystem compartments
  - Explore potential environmental drivers of stoichiometric flexibility
  - Develop a community supported experiment
  - Stoichiometry database



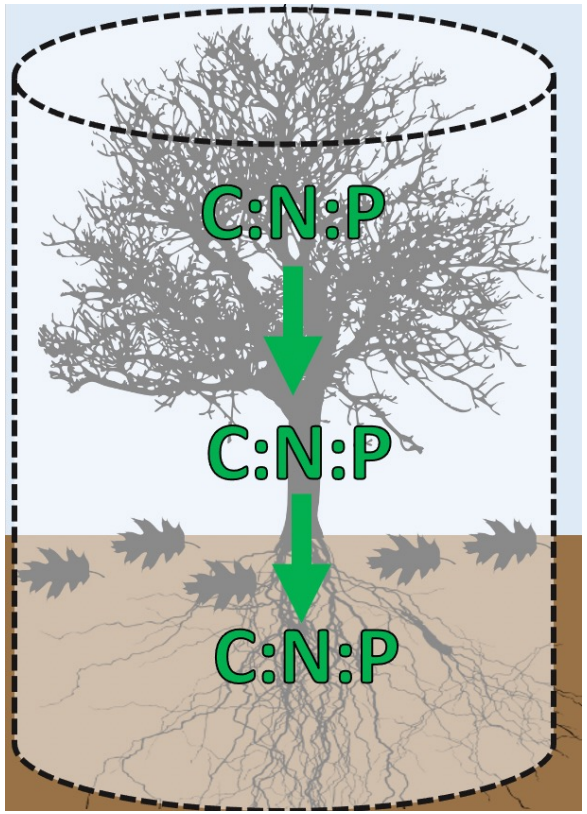
# Stoichiometric Observatories

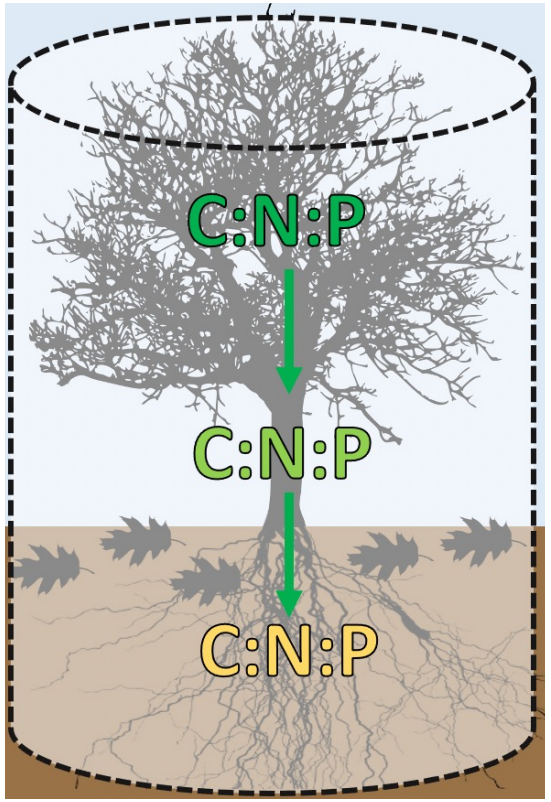
- Questions:
  - How much interest? Would you participate?
  - Study design and sampling protocols?
  - Hypotheses of interest?

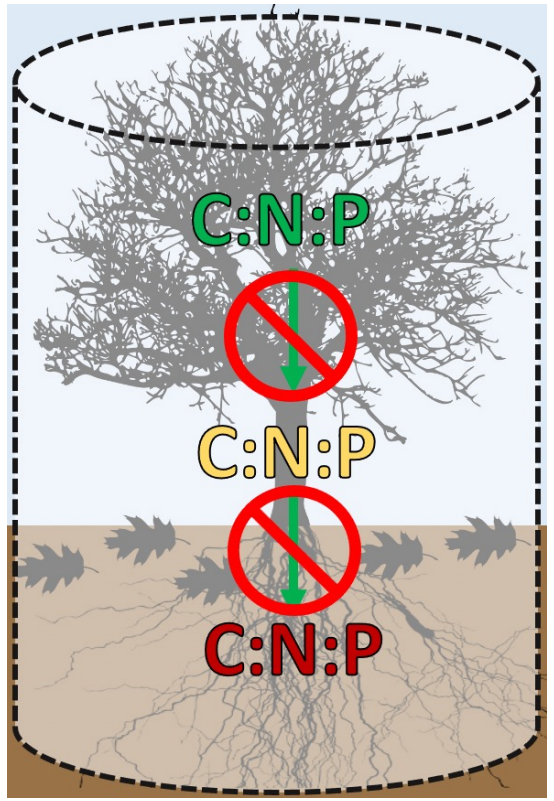



C:N:P
a
b
C:N:P
c
d
C:N:P
e
B)
C:N:P
C:N:P
C:N:P

C)




Low N,
Taxonomic control

High N,
Soil control