Effect of soil warming and N availability on the fate of recent carbon in subarctic grassland

Kathiravan Meeran[1], Niel Verbrigghe[2], Lucia Fuchslueger[2,5], Johannes Ingrisch[1], Sara Vicca[2], Jennifer Soong[3], Lena Müller[1], Bjarni Sigurdsson[4], Ivan Janssens[2], and Michael Bahn[1]

[1]Institute of Ecology, University of Innsbruck, Innsbruck, Austria
[2]Department of Biology, University of Antwerp, Antwerp, Belgium
[3]Lawrence Berkeley National Laboratory, University of California, California, United States
[4]Faculty of Environmental Sciences, The Agricultural University of Iceland, Hveragerði, Iceland
[5]Department of Terrestrial Ecosystem Research, University of Vienna, Vienna, Austria

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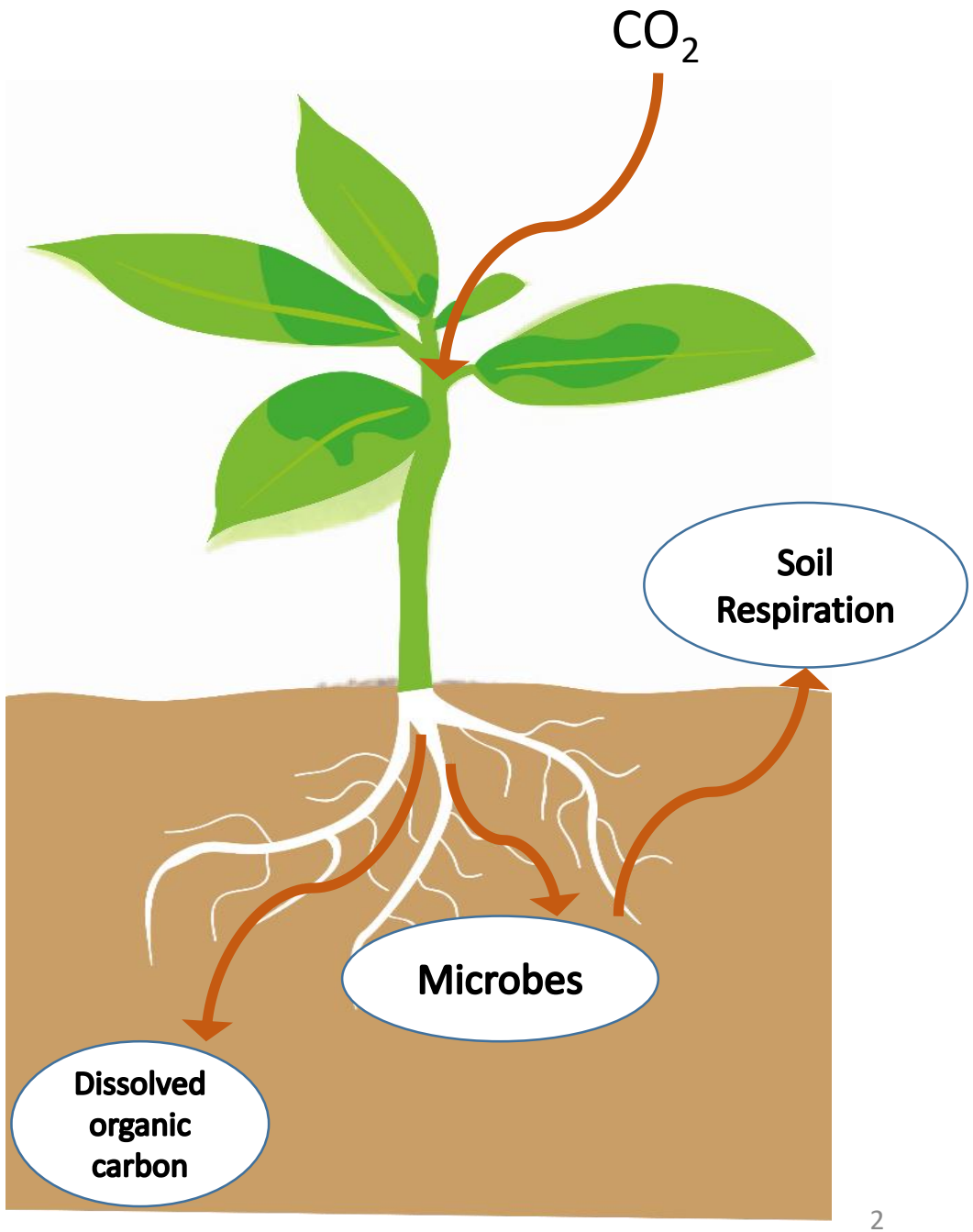
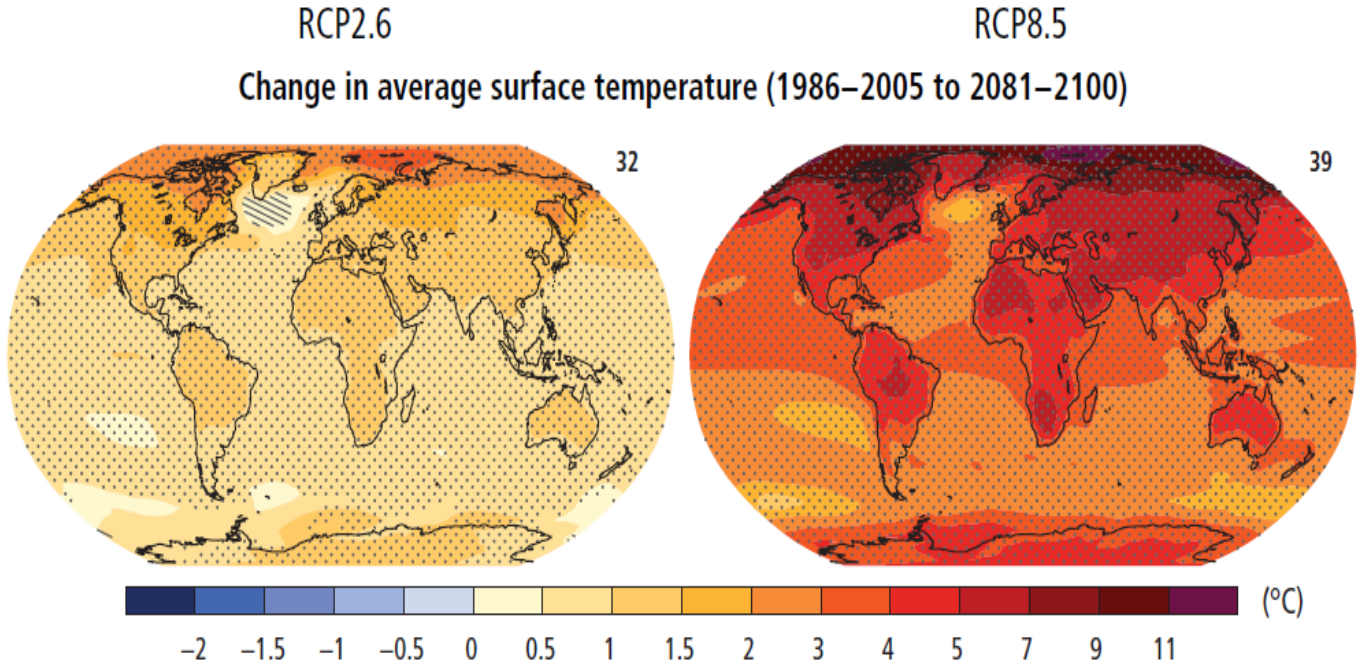
Background

- Plant carbon allocation is a key to ecosystem carbon sequestration.
- Plants allocate recently assimilated carbon to support structure, growth and sustain the rooting system and rhizosphere.
- In the process of belowground carbon allocation, root exudates of recent carbon can affect microbial process and thus soil respiration



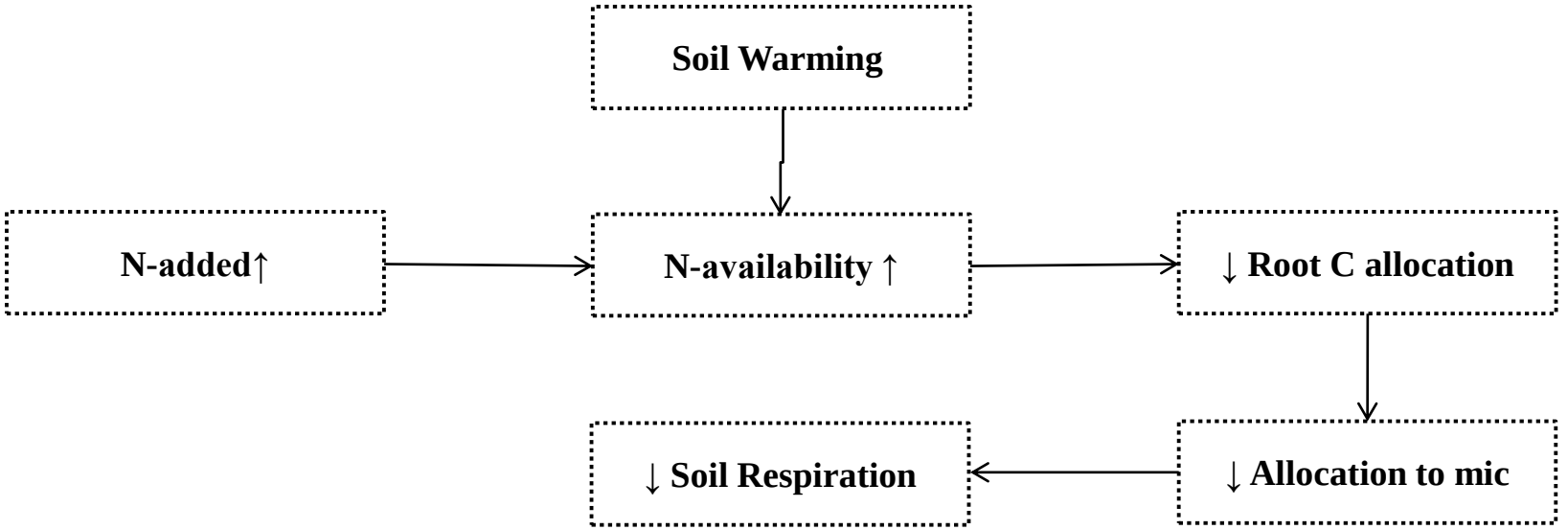
Projected Warming

- Climate models and projections predict that Earth's average surface temperature will increase in the future, especially in the arctic and subarctic.



IPCC (2013), modified

Research Question & Hypothesis

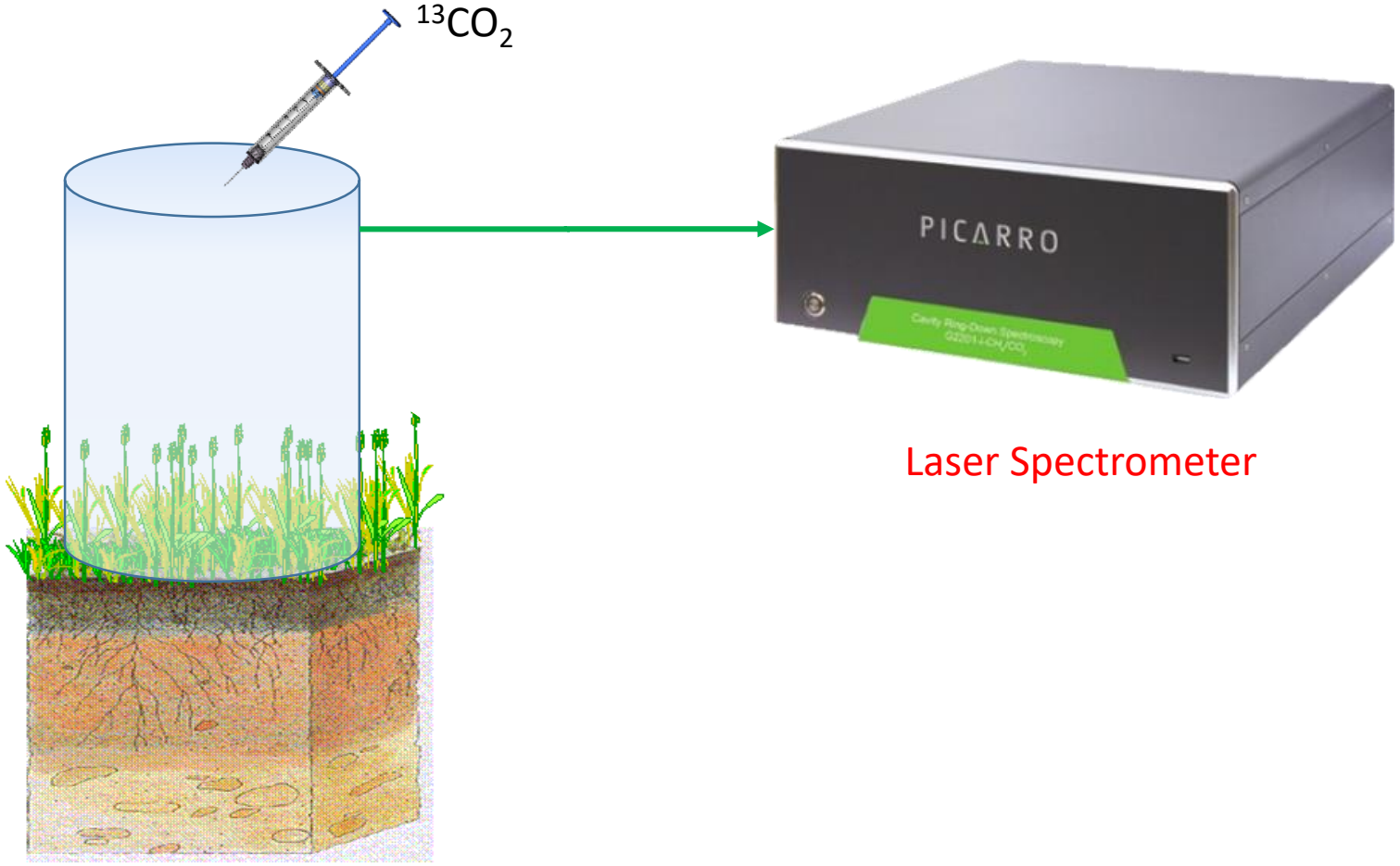


- How does soil warming affect carbon allocation and thus fate of recently assimilated carbon in subarctic grassland?
- How does **N-addition** affect carbon allocation?
- Will there be an interaction effect between soil warming and N-addition?

Field experiment site: Hveragerði, Iceland

- ForHot site in Iceland provides natural geothermal soil warming gradients.
- The geothermal gradient at this site was formed due to an earthquake occurred during May 29, 2008

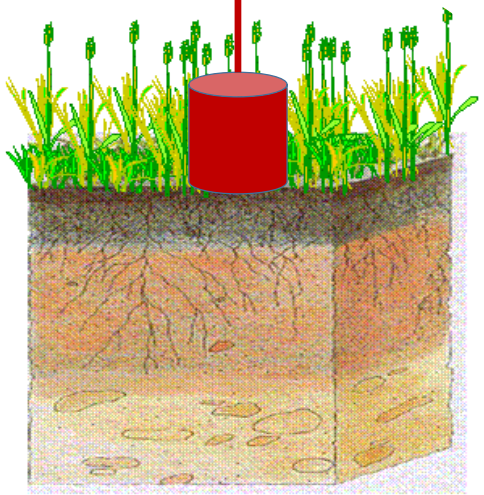
$^{13}CO_2$ Pulse labeling



Laser Spectrometer

Isotope Measurements

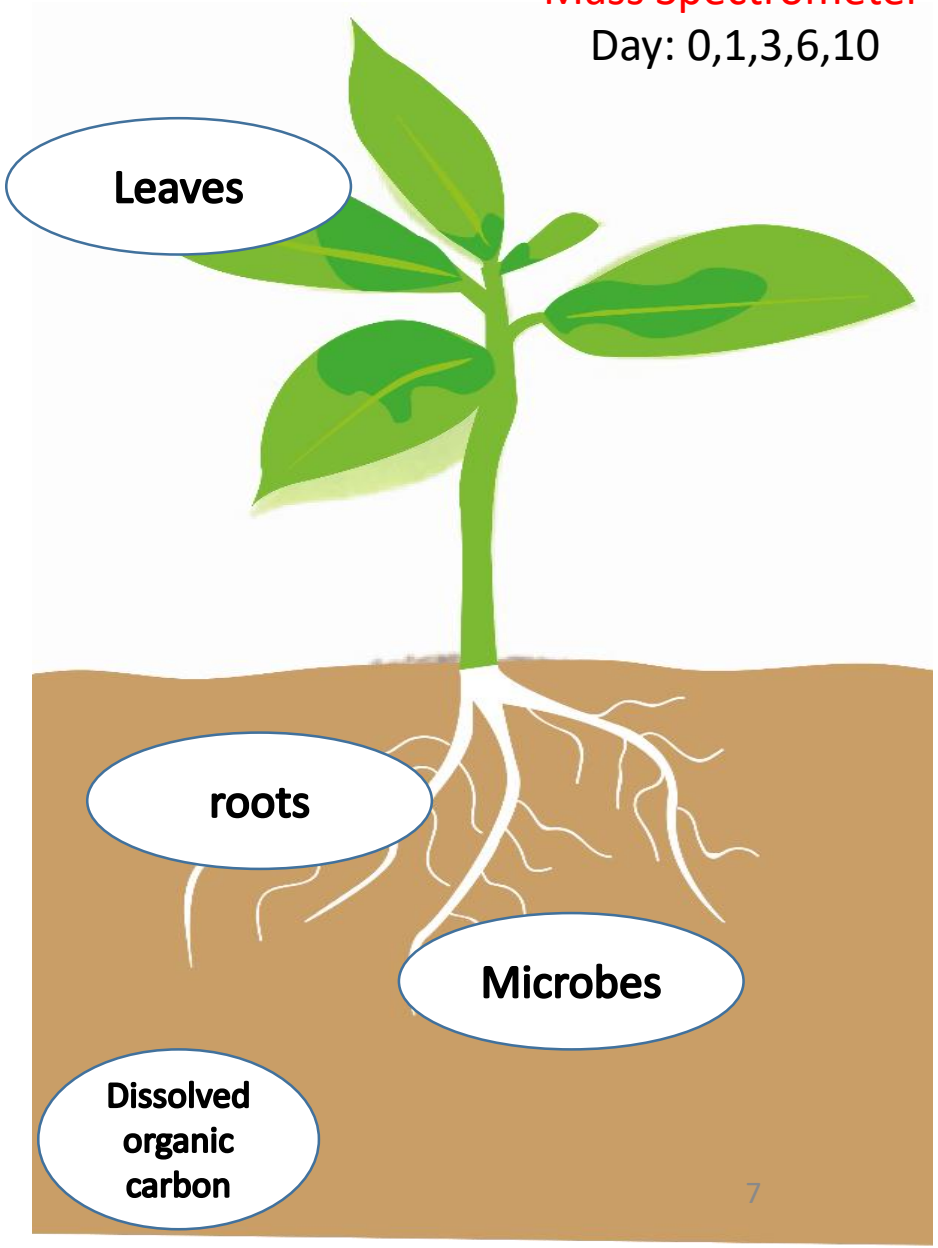
Laser Spectrometer



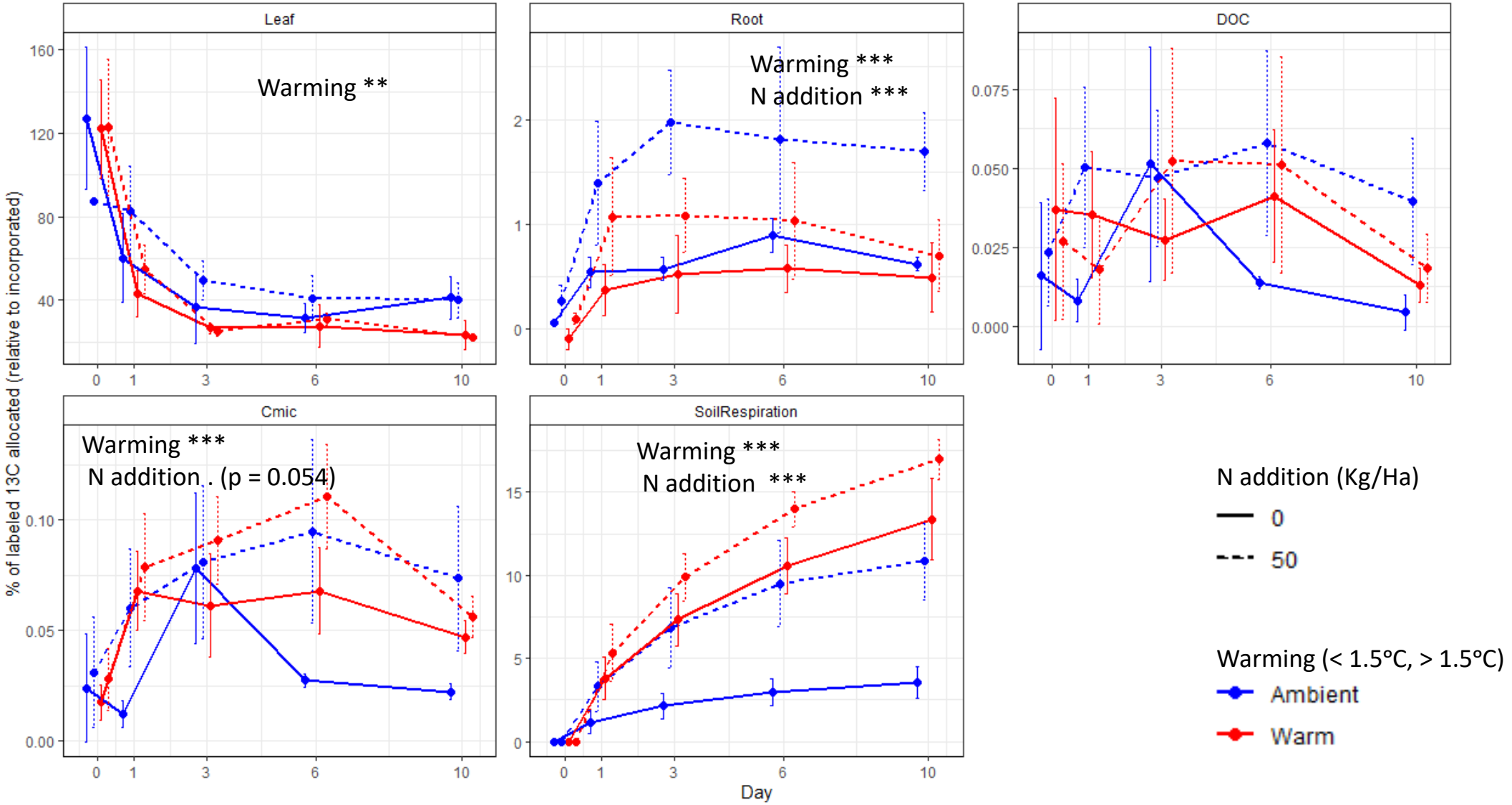
Soil Respiration

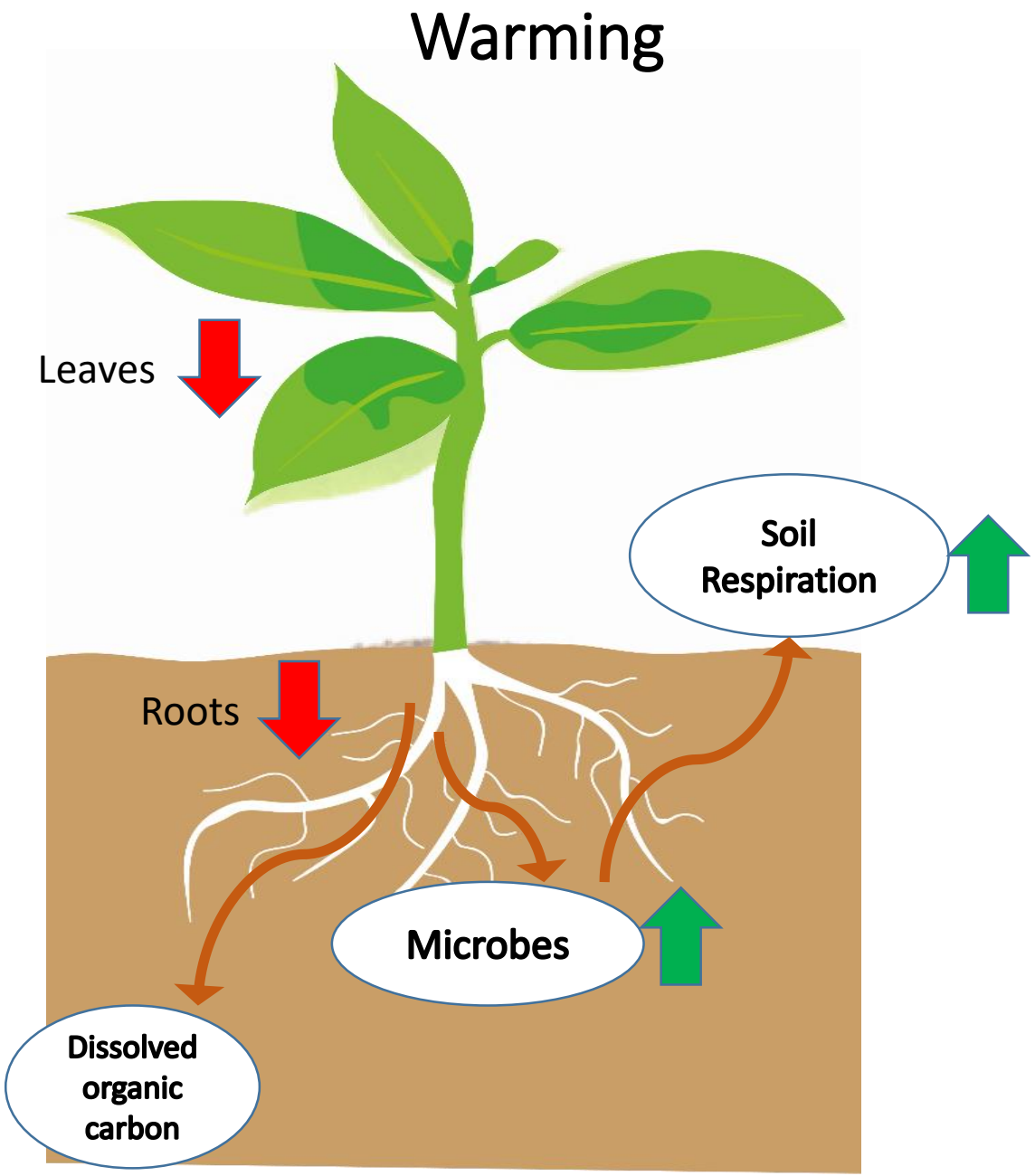
Mass Spectrometer

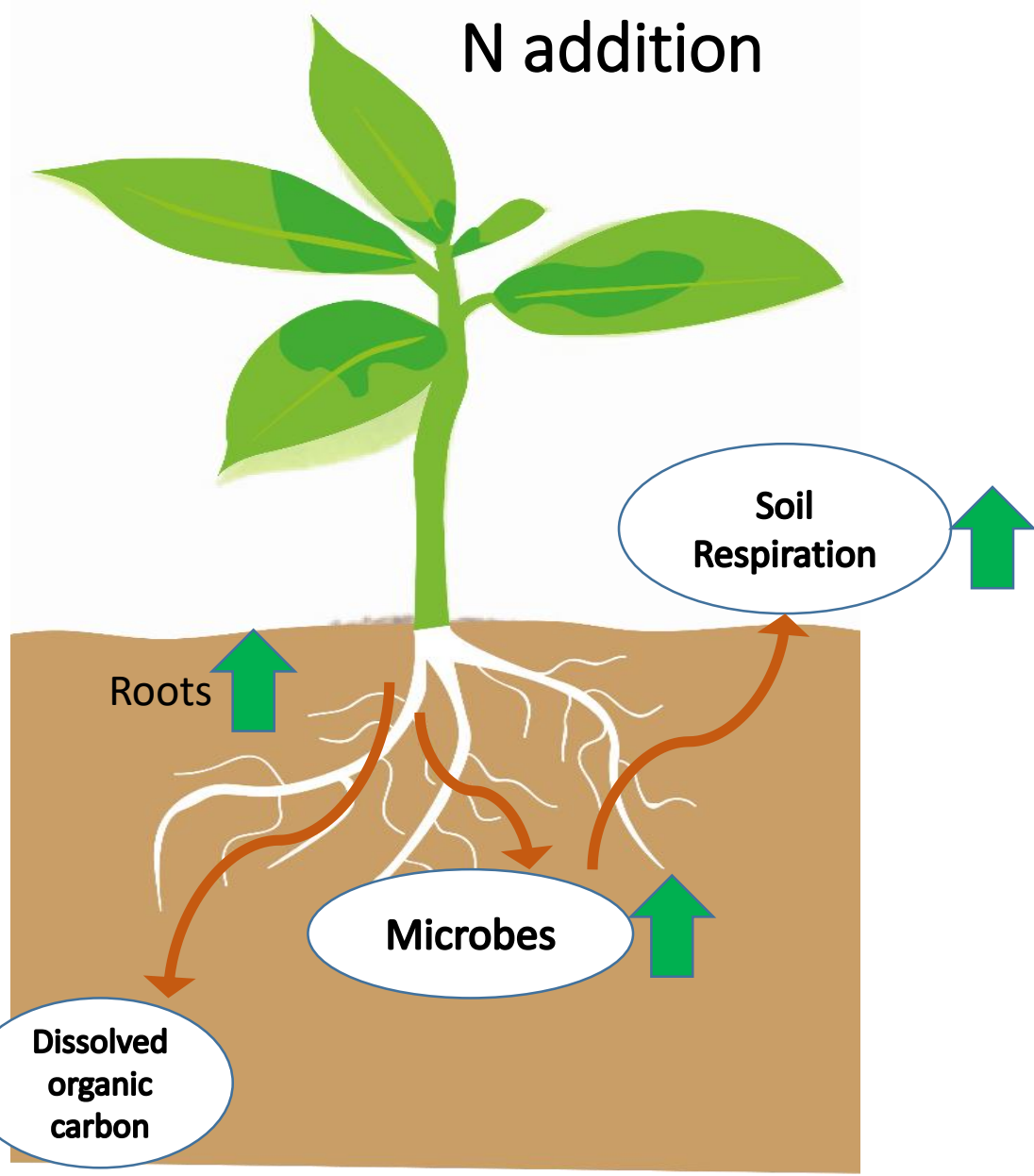
Day: 0,1,3,6,10



Results: Allocation of recently assimilated carbon




Warming
Leaves
Roots
Soil
Respiration
Microbes
Dissolved
organic
carbon


N addition
Roots
Soil
Respiration
Microbes
Dissolved
organic
carbon

Conclusion

- Under soil warming conditions, plants release more recent carbon into soil thus decreasing carbon allocated to leaves and roots and increasing carbon allocated to microbes and soil respiration
- Contradicting our hypothesis, N addition had different effects from soil warming conditions. N addition increased carbon allocation to roots, microbes and soil respiration.
- Our results indicate that the microbes in warmed soil may not be N limited, but could be C limited and depend more on the supply of recent C from plants.
- We conclude that in a future climate with warmer soils, more C may be allocated belowground, however, its residence time may decrease.