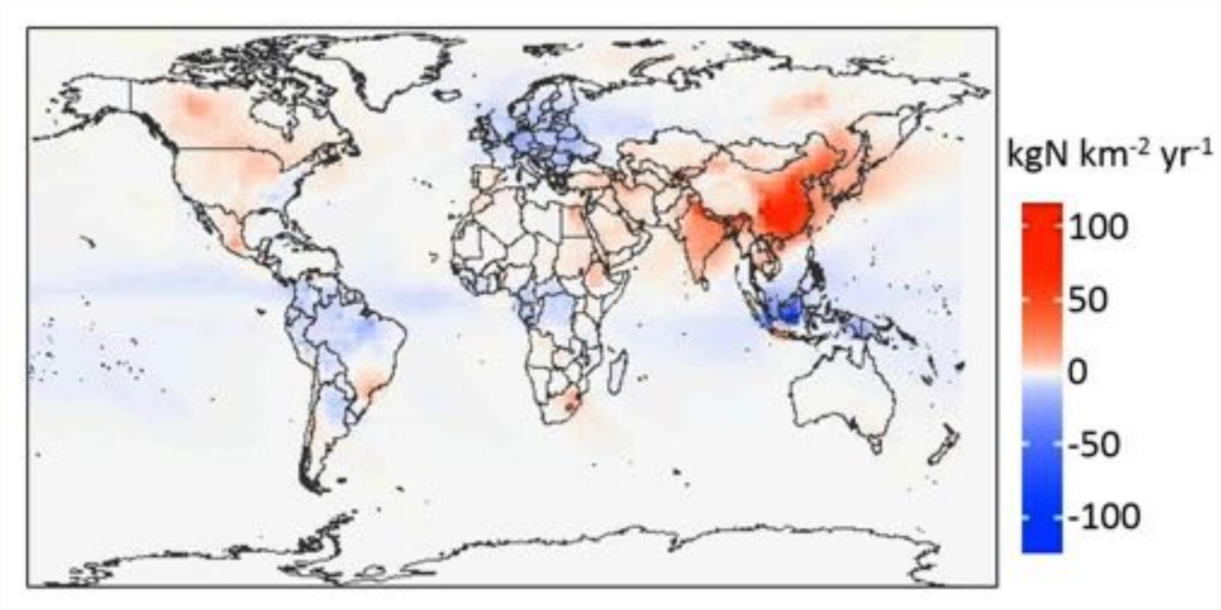
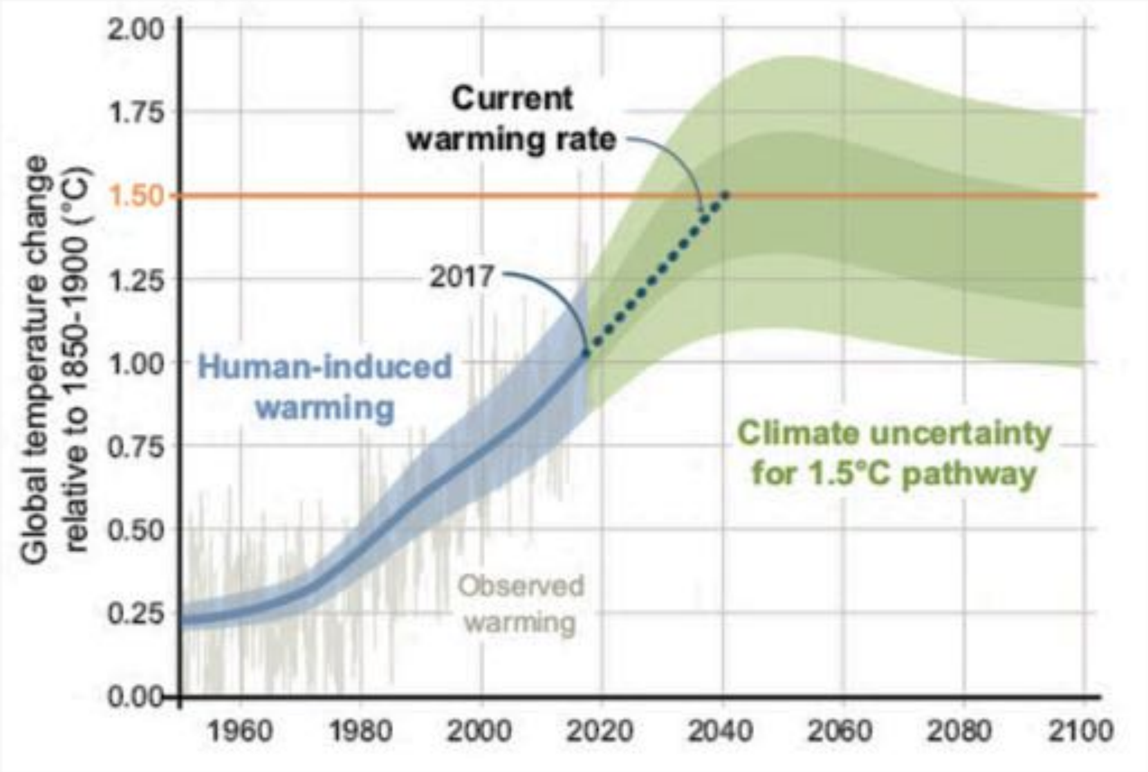
Warming up the forest: short-term fate of deposited nitrogen in temperate forest

Yihang Duan, Yunting Fang*
Institute of Applied Ecology, Chinese Academy of Sciences
University of Chinese Academy of Sciences

Global Nitrogen Deposition 1984-2016



Ackerman et al., 2018 Global Biogeochemical Cycle

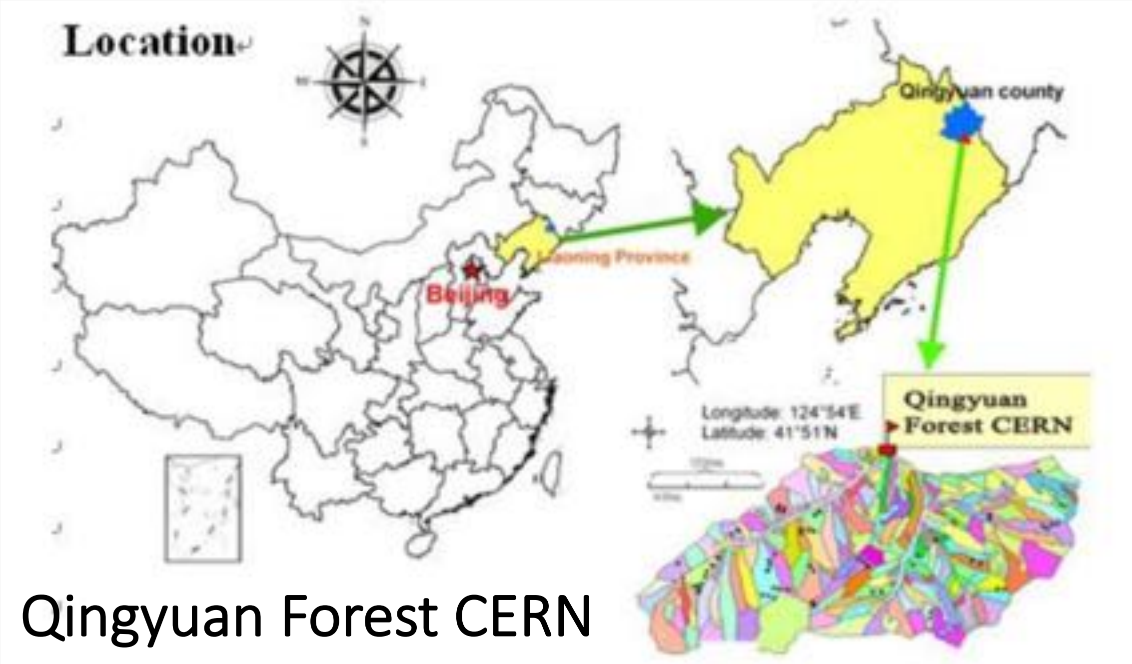


IPCC, Global warming of 1.5℃.

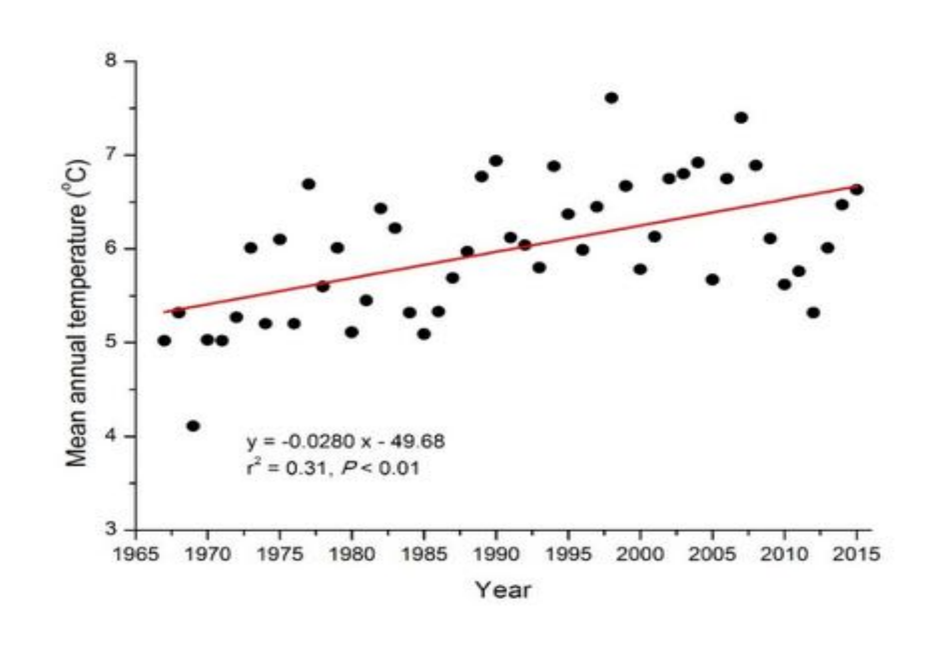
Nitrogen deposition and global warming continue to profoundly influence different ecosystems, including **forests**.

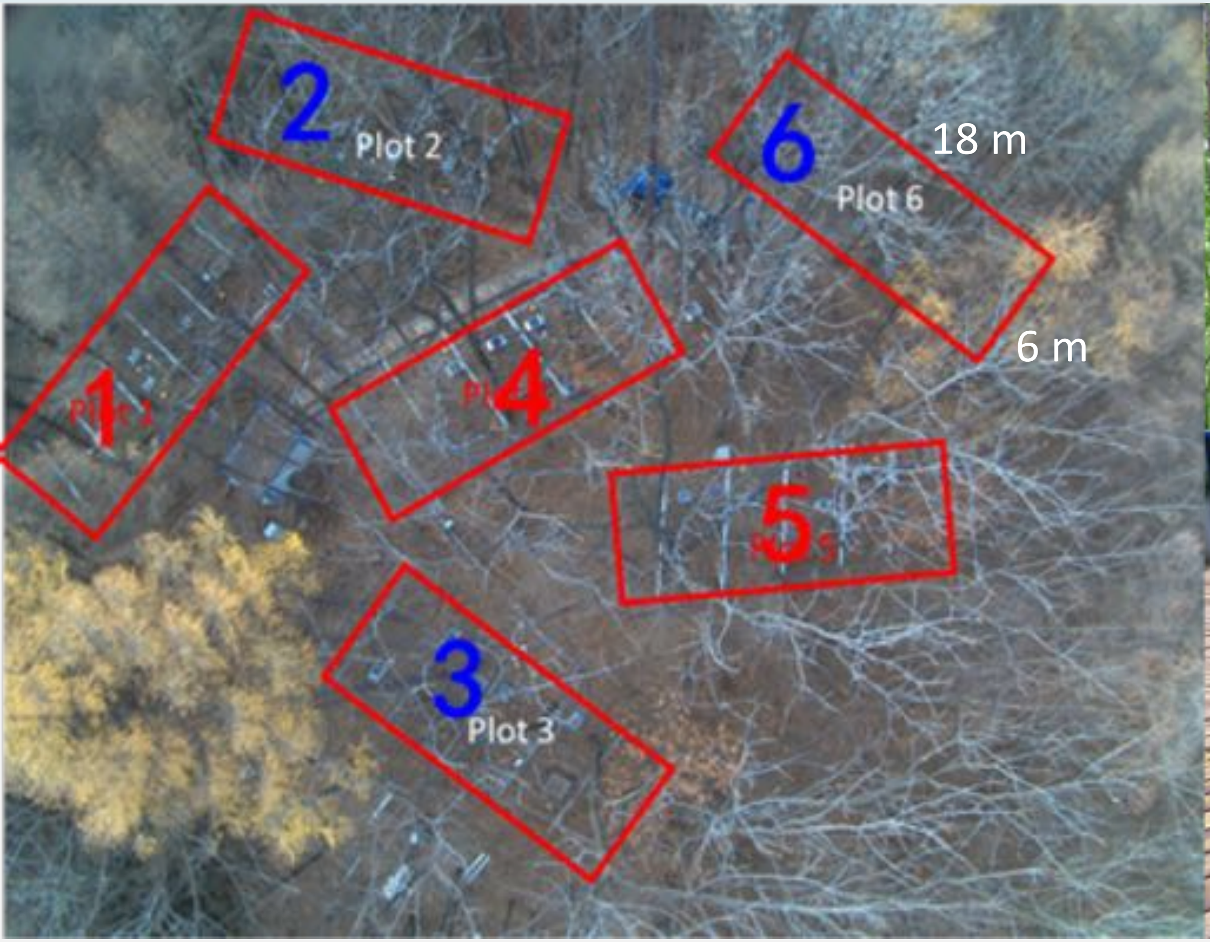
We designed an infrared heating system to warm up the forest to 2℃ in order to:

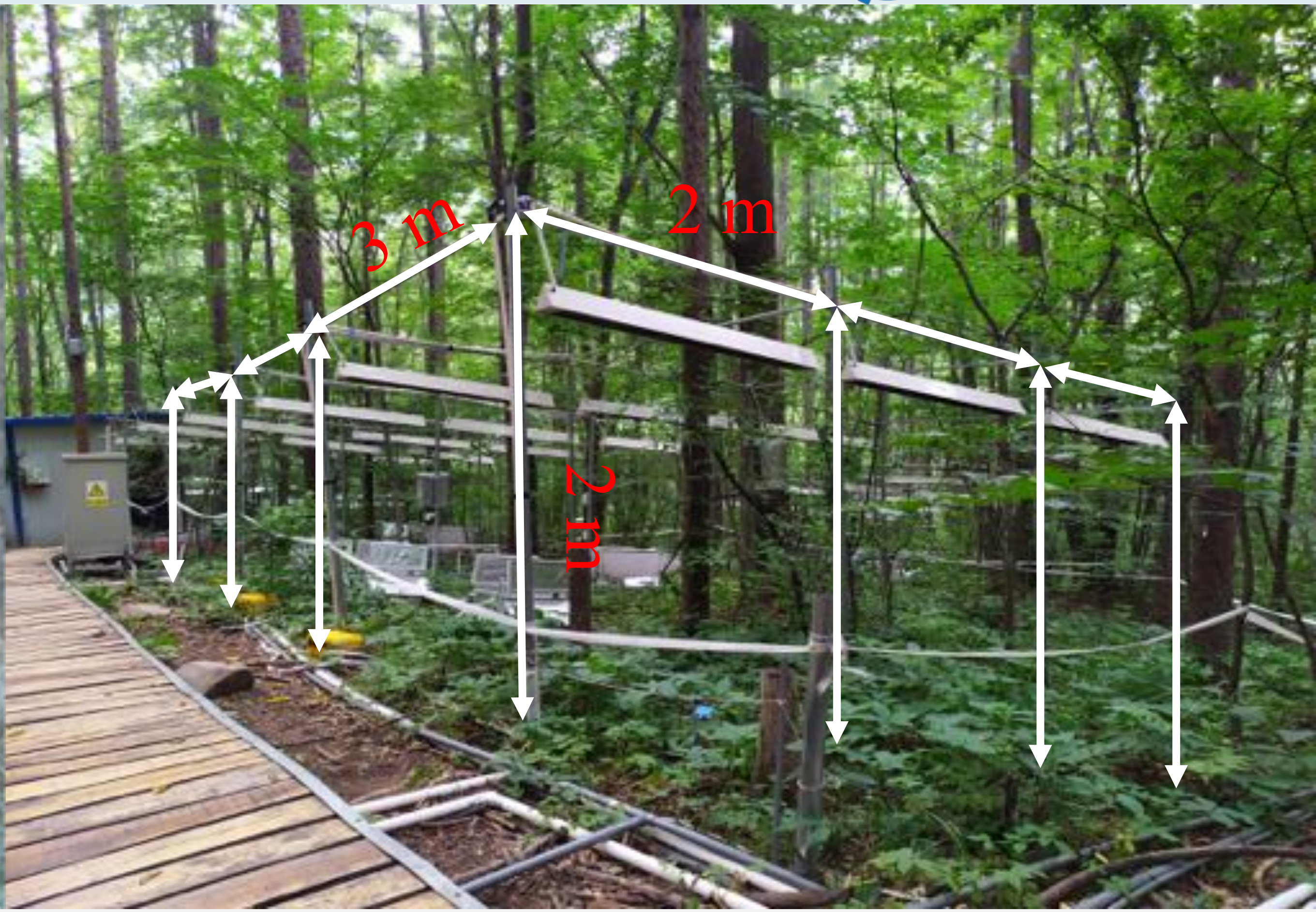
- To understand how forest may respond to warming
- To explore the fate of deposited N in a warmer forest



MAP: 700-850 (810.9) mm
MAT: 3.9-5.4 (4.7) ℃
Frost-free period: 130 days
Soil type: Clay loam
Dominant Forest stands: Larch/mixed forest



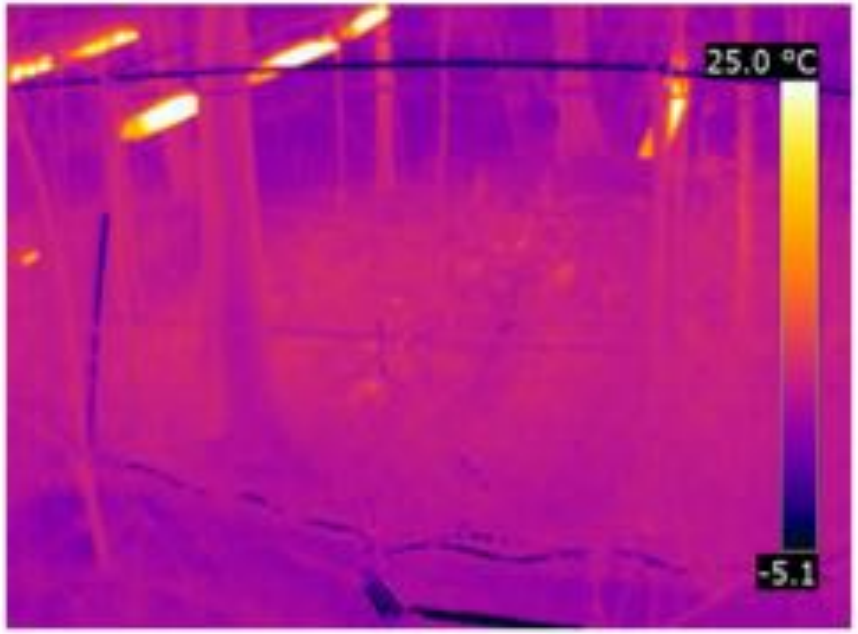


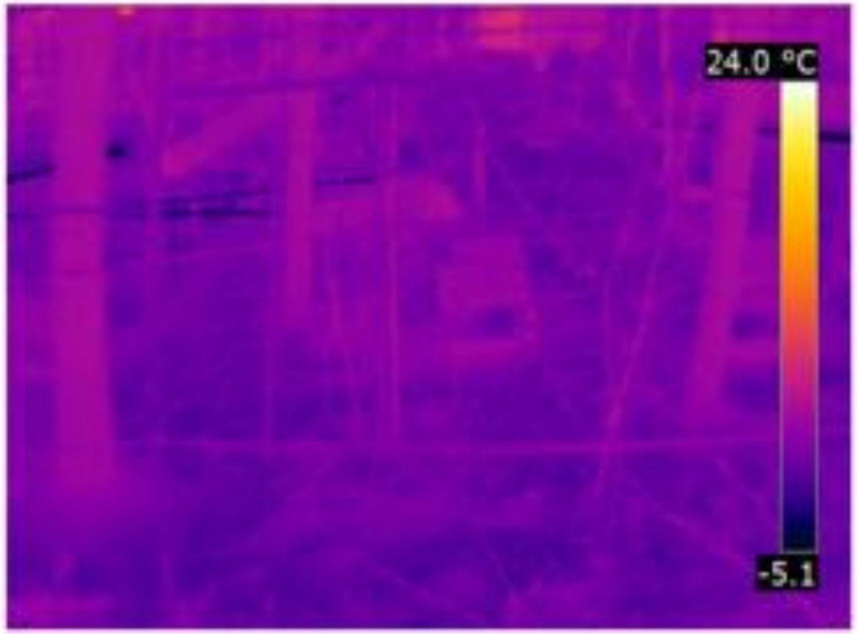


Qingyuan Forest Warming

- 3 warming and 3 control plots
- 24-7 warming by infrared heater from Apr. to Nov.
- 2℃ warming of top10 cm mineral soil layer
- Auto temperature control and measure system

Warming

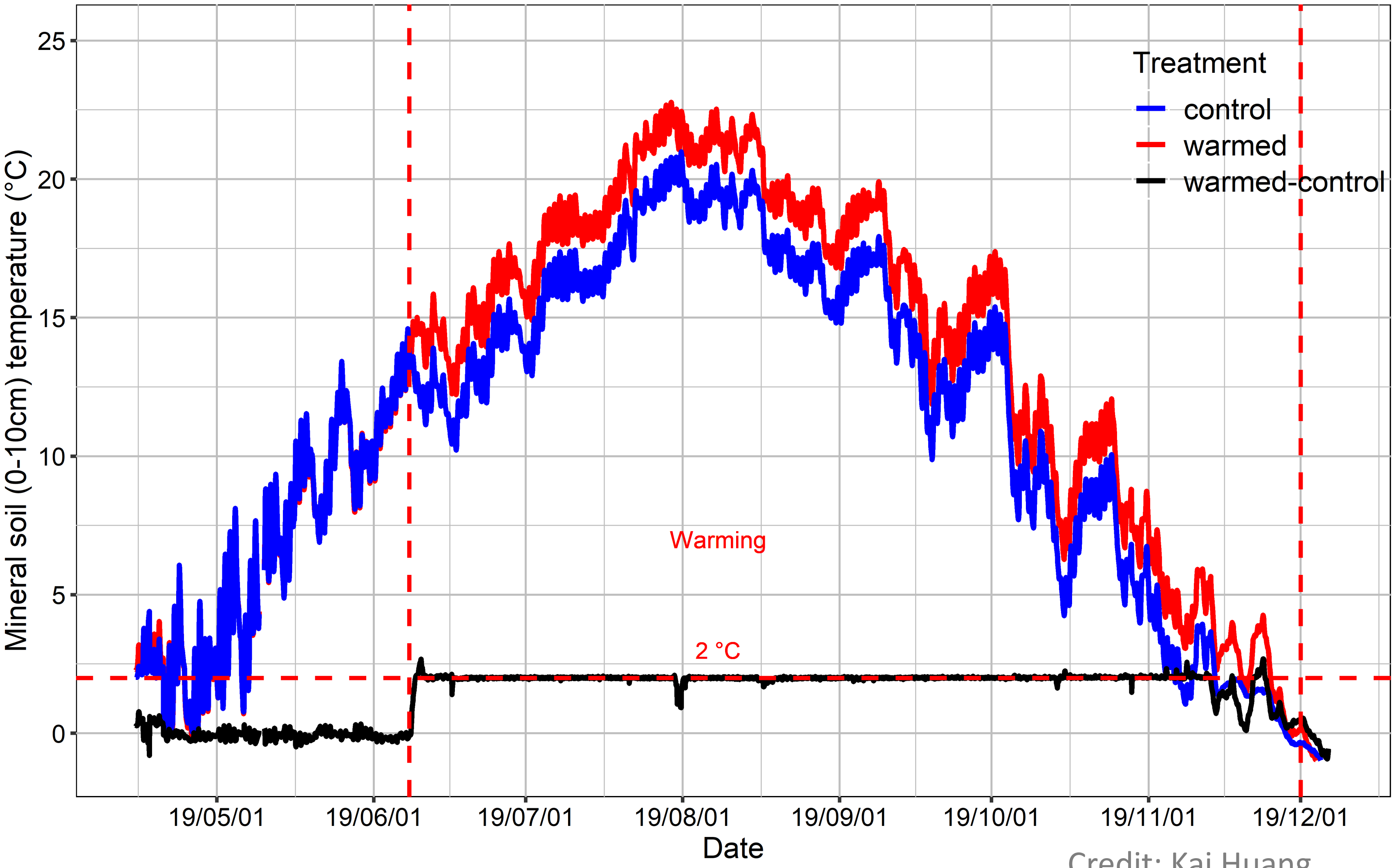




Control

Mineral soil warming

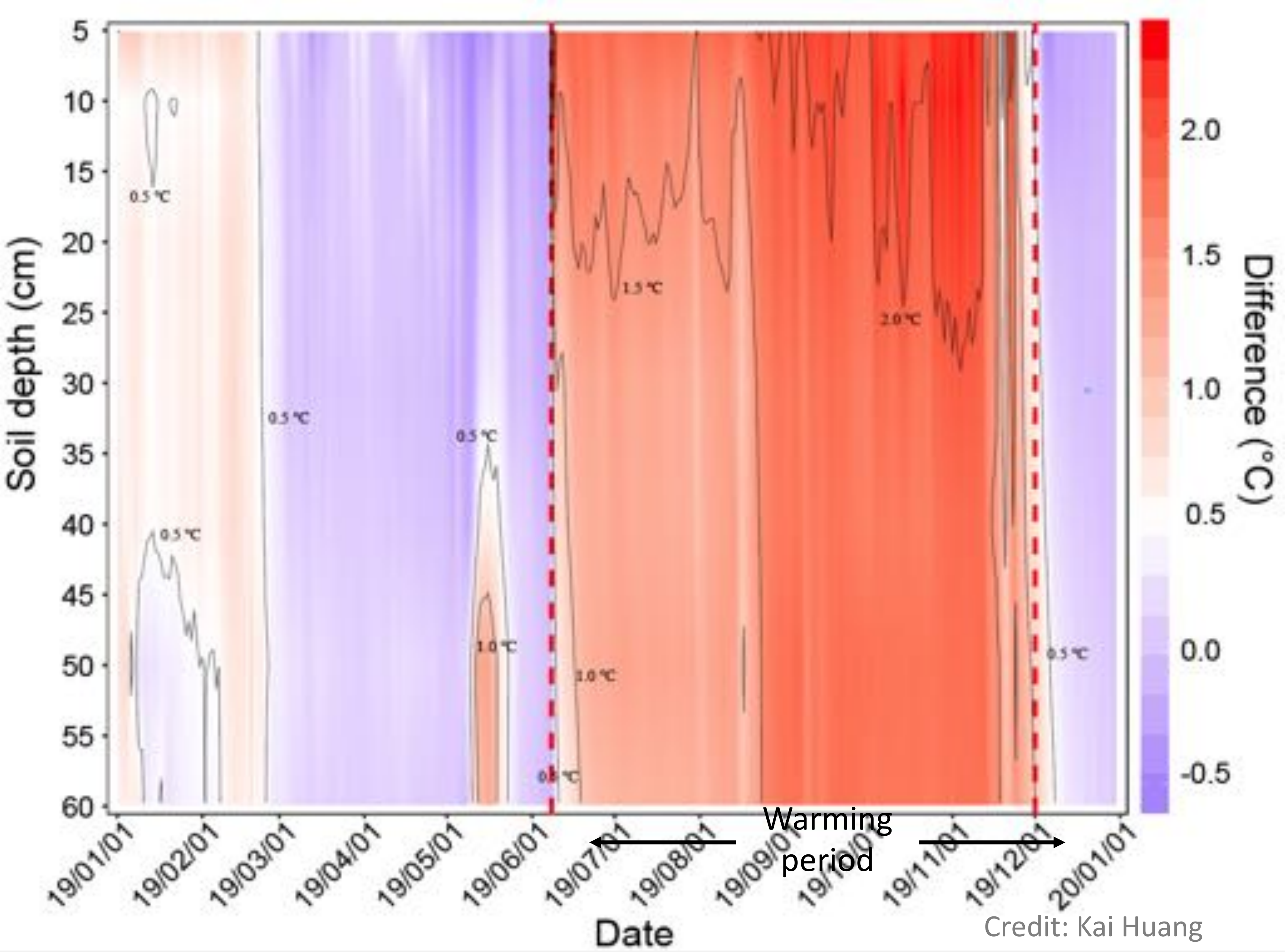
With this infrared heating system, warming plots maintain 2 ℃ temperature difference above the control plots in the top mineral soil layer.



Credit: Kai Huang

Whole-soil warming

Stable warming were also achieved in the whole-soil profile after continuously heating.

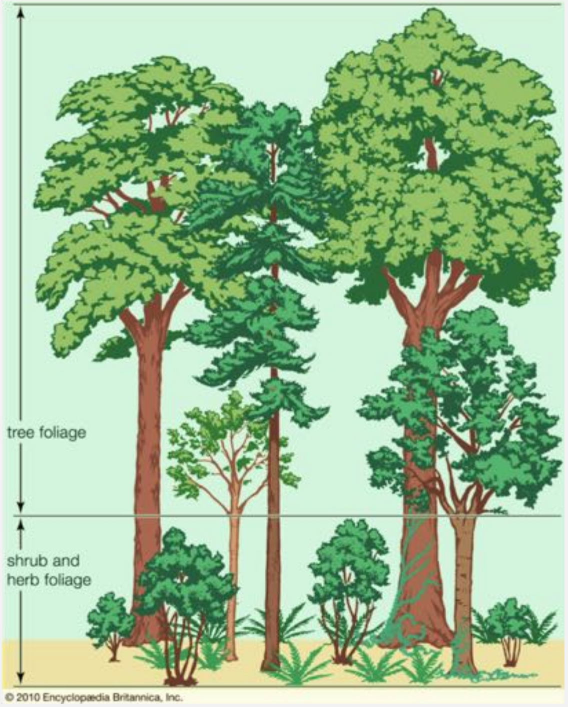


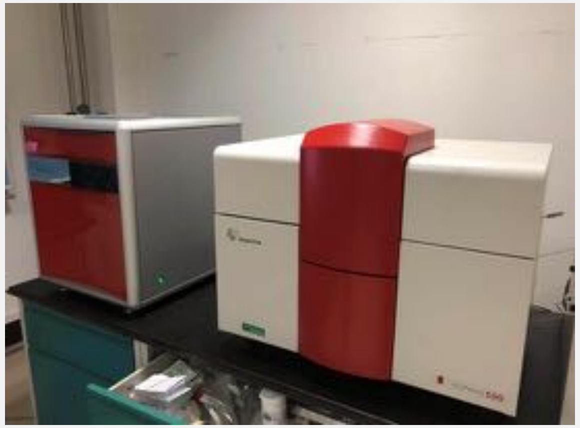
Credit: Kai Huang

^{15}N labelling-Pulse Addition

- Add $^{15}NH4^{15}NO3$ (50 atom %) to the forest floor, addition dose 50mg $^{15}N/m^2$
- Dissolve the tracer in water and uniformly spray above the ground vegetation with backpack sprayers

Plant sample



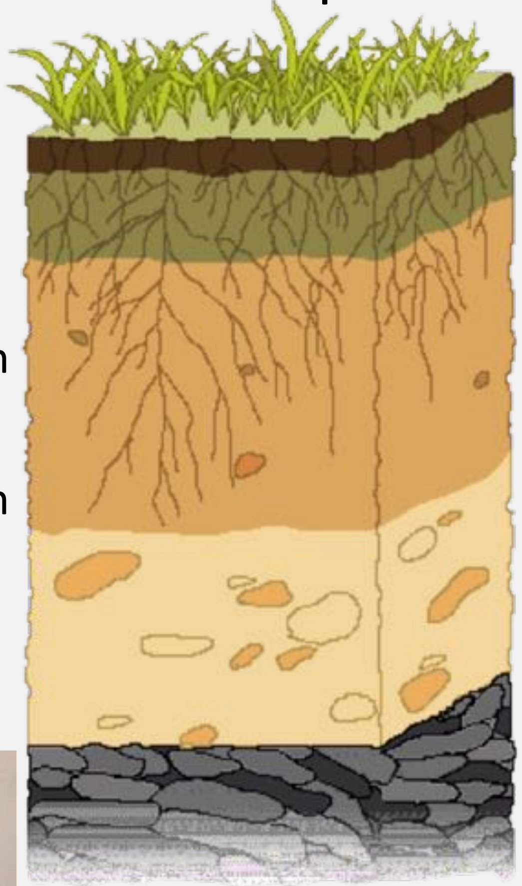


Soil Sample

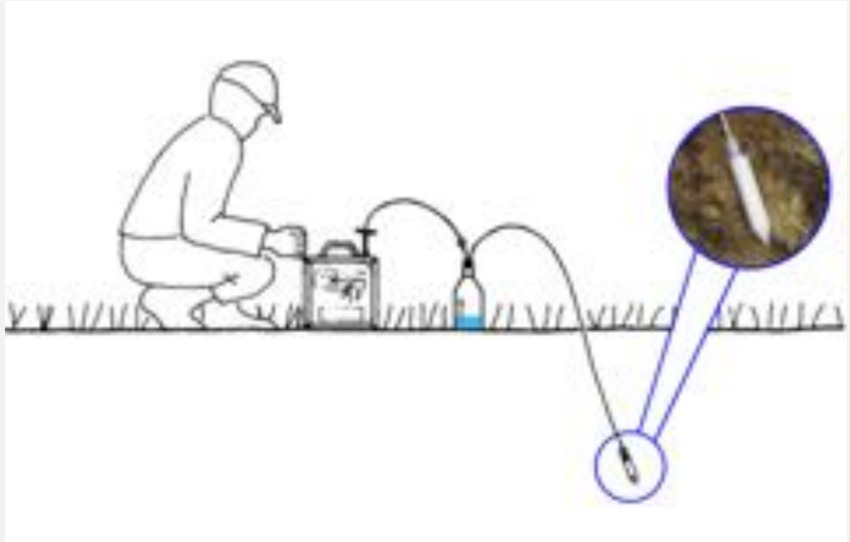
Grass
Litter
O layer
0-10 cm

10-20 cm

20-40 cm

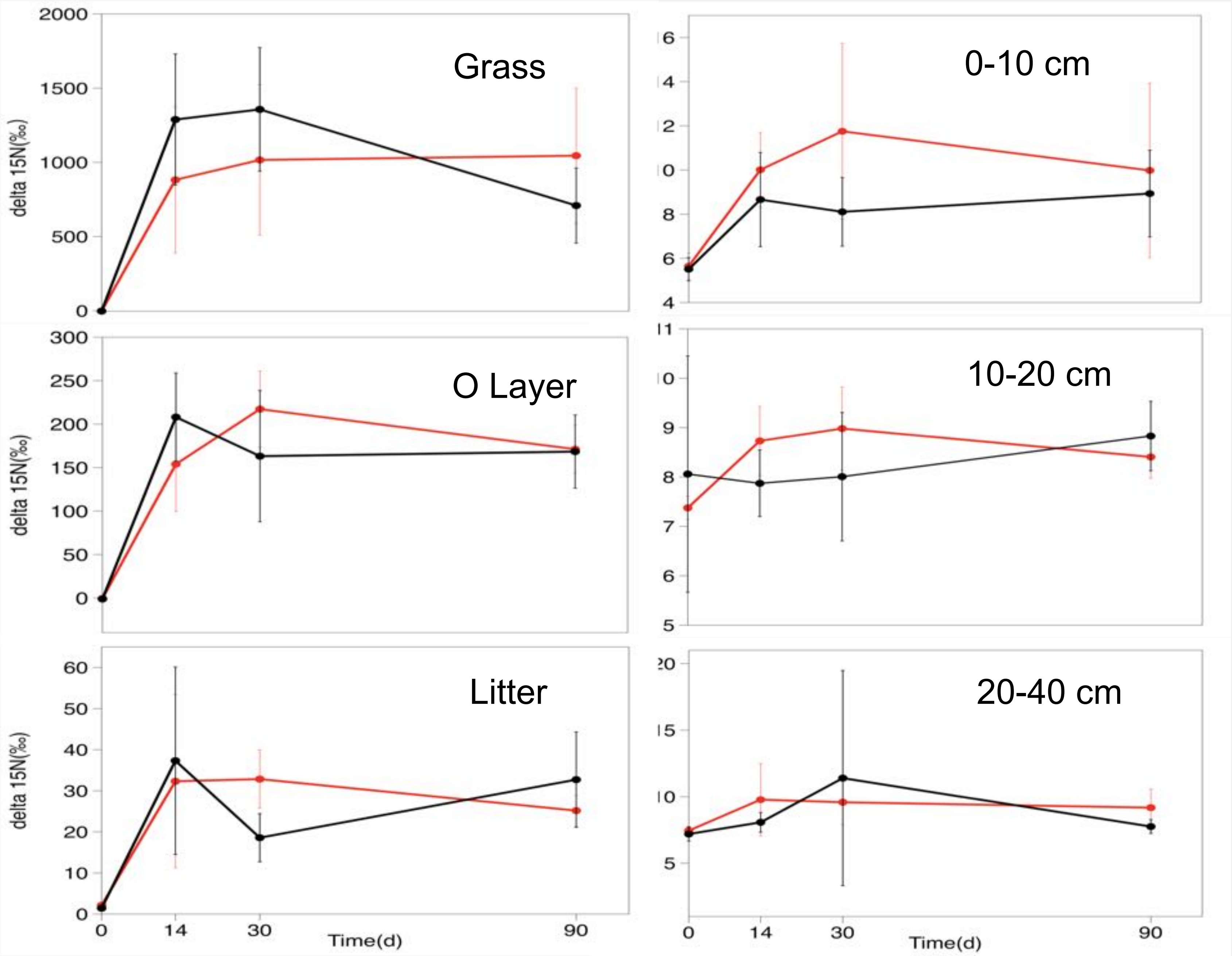


Soil water sample



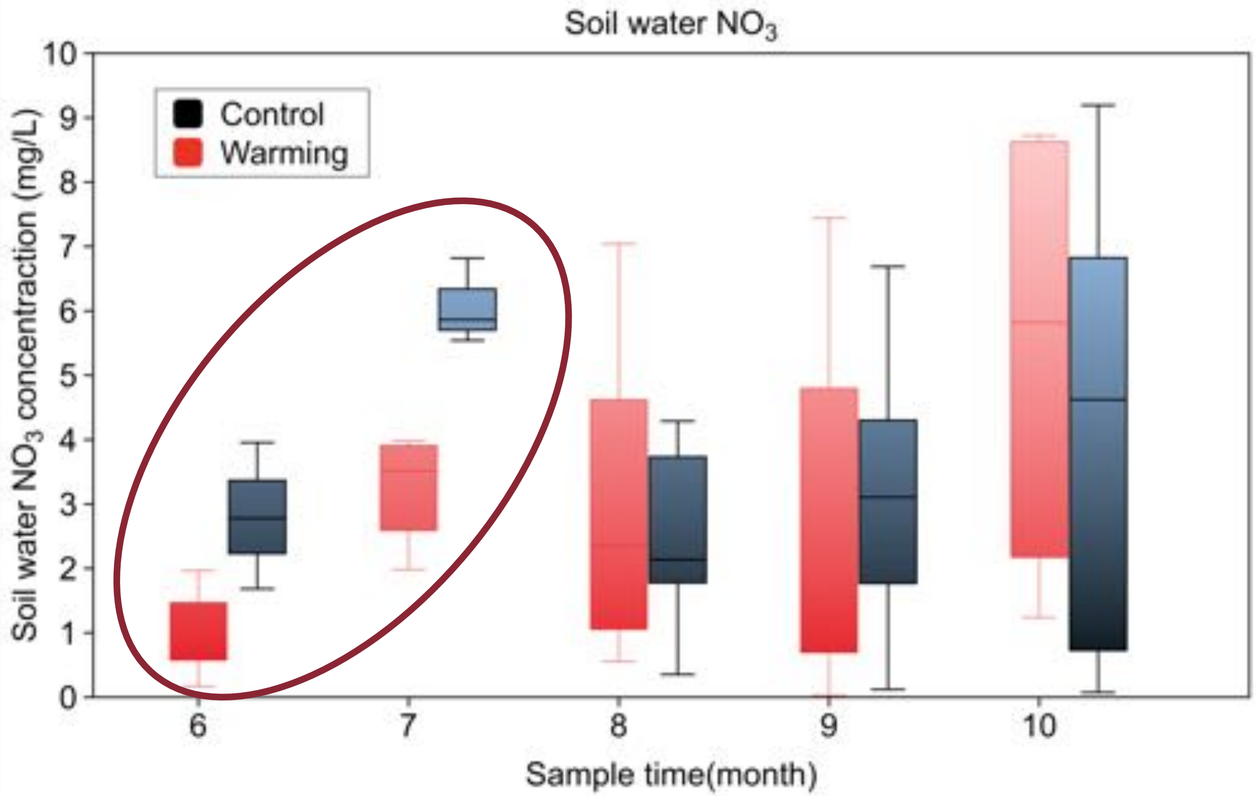
Short-term change of applied ^{15}N in different N stock

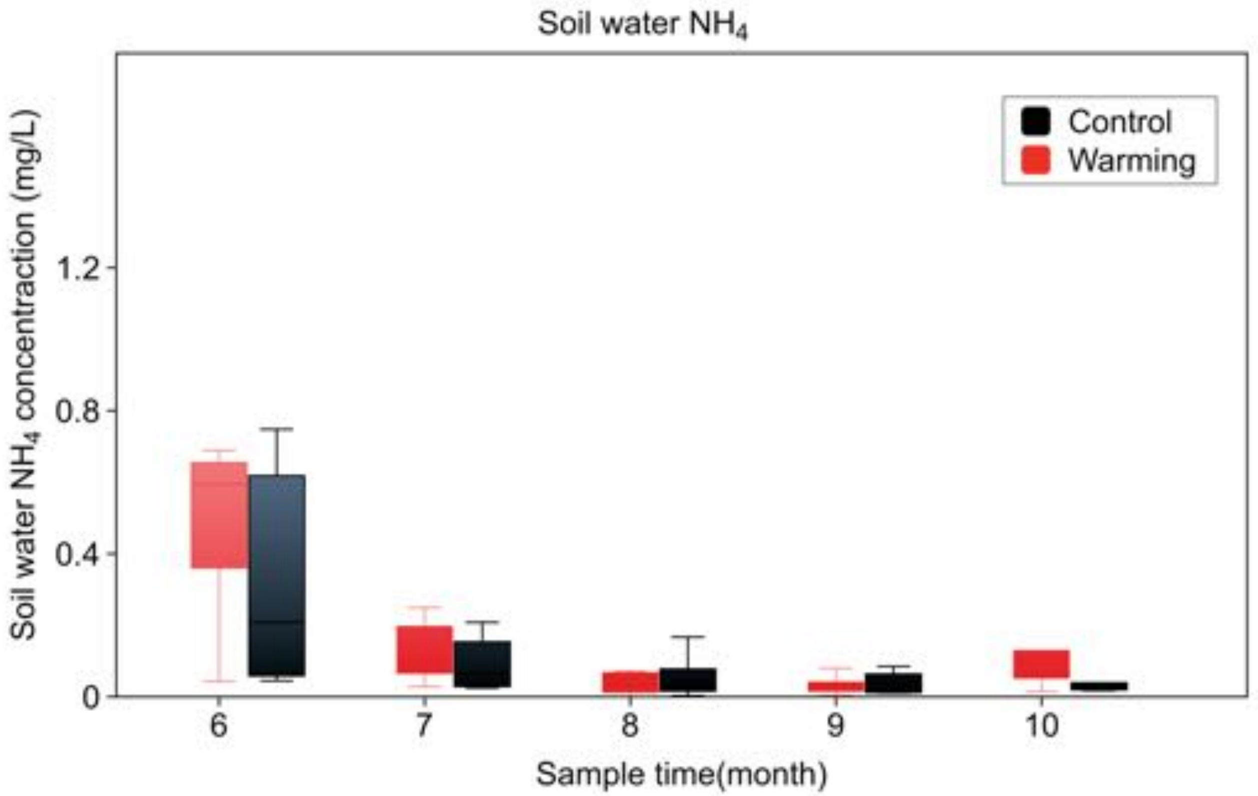
- In the short-term(90d), warming had little effect on the redistribution of ^{15}N in grass, litter and organic layer
- In the short term(90d), warming increased the retention of ^{15}N in the top mineral soil layer



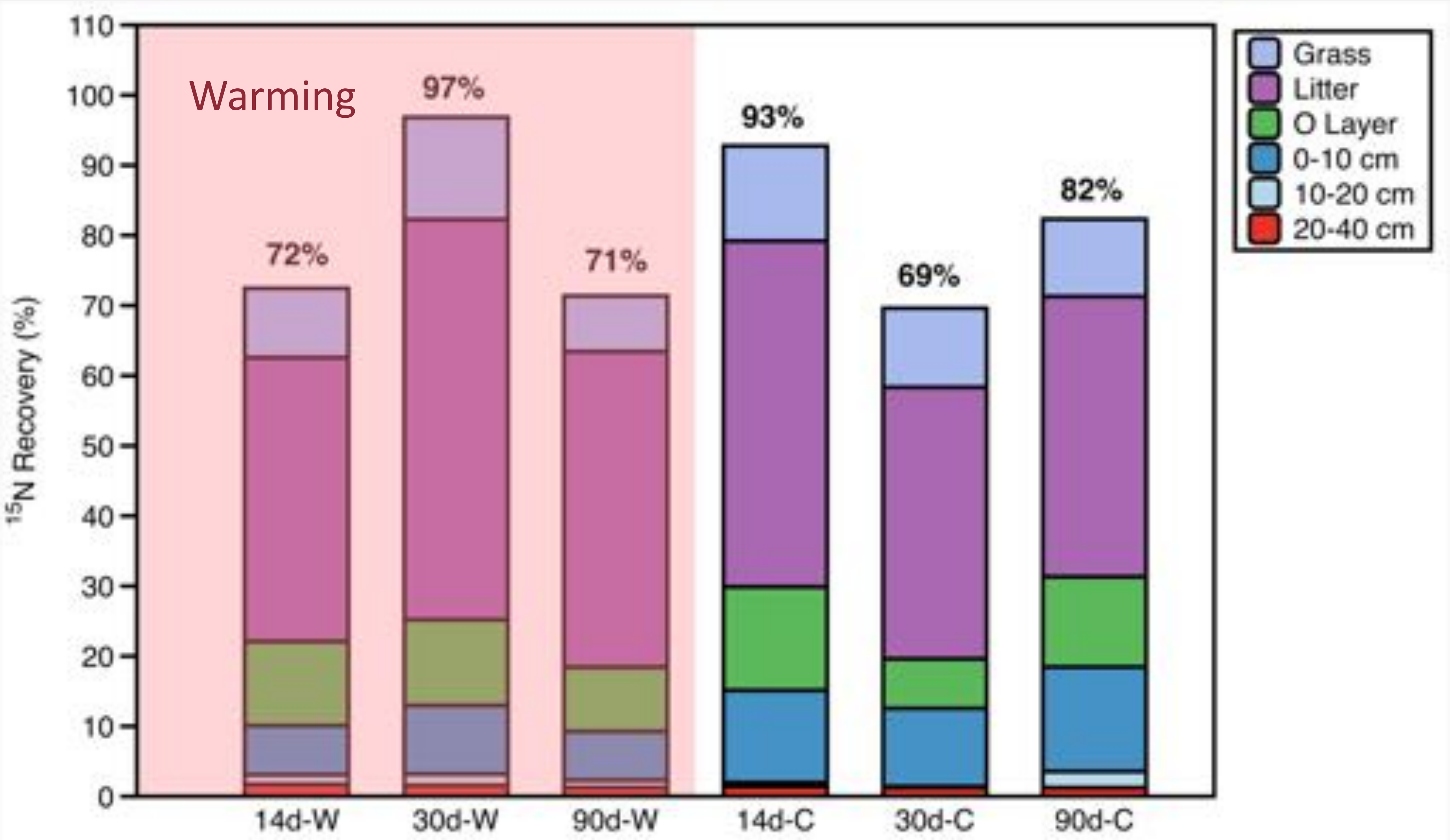
Soil leaching of NO_3/NH_4 from June to October during warming

- Warming decreased NO_3 leaching in the early warming months (June and July)
- Warming had no effect on the NH_4 leaching from soil





Recovery of ^{15}N in different N stock under the forest floor



Summary

- In the short-term of ^{15}N application and warming (90d), bulk of the ^{15}N was located on grass, litter, organic;
- Warming could increase the retention of deposited N in the top mineral soil layer (0-10cm);
- Warming decreased the leaching of NO_3 in June and July, this relocated nitrite by warming maybe uptake by trees or lost as gas;
- Warming may largely affect the redistribution of deposited N in the early growing season, namely June and July.

Special thanks

辽宁省稳定同位素技术重点实验室
Key Laboratory of Stable Isotope Techniques and Applications, Liaoning Province