

FroSen: Novel soil frost sensing systems for tracking freeze-thaw cycles and their implications for ecosystem carbon and nutrient dynamics

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The Frost Sensing (FroSen) Project

What is the spatial and temporal heterogeneity of soil frost?

How does changing soil frost affect ecosystem processes?



- Develop, test, deploy wireless sensors and GPR for detecting frost
- Characterize spatiotemporal changes in soil frost

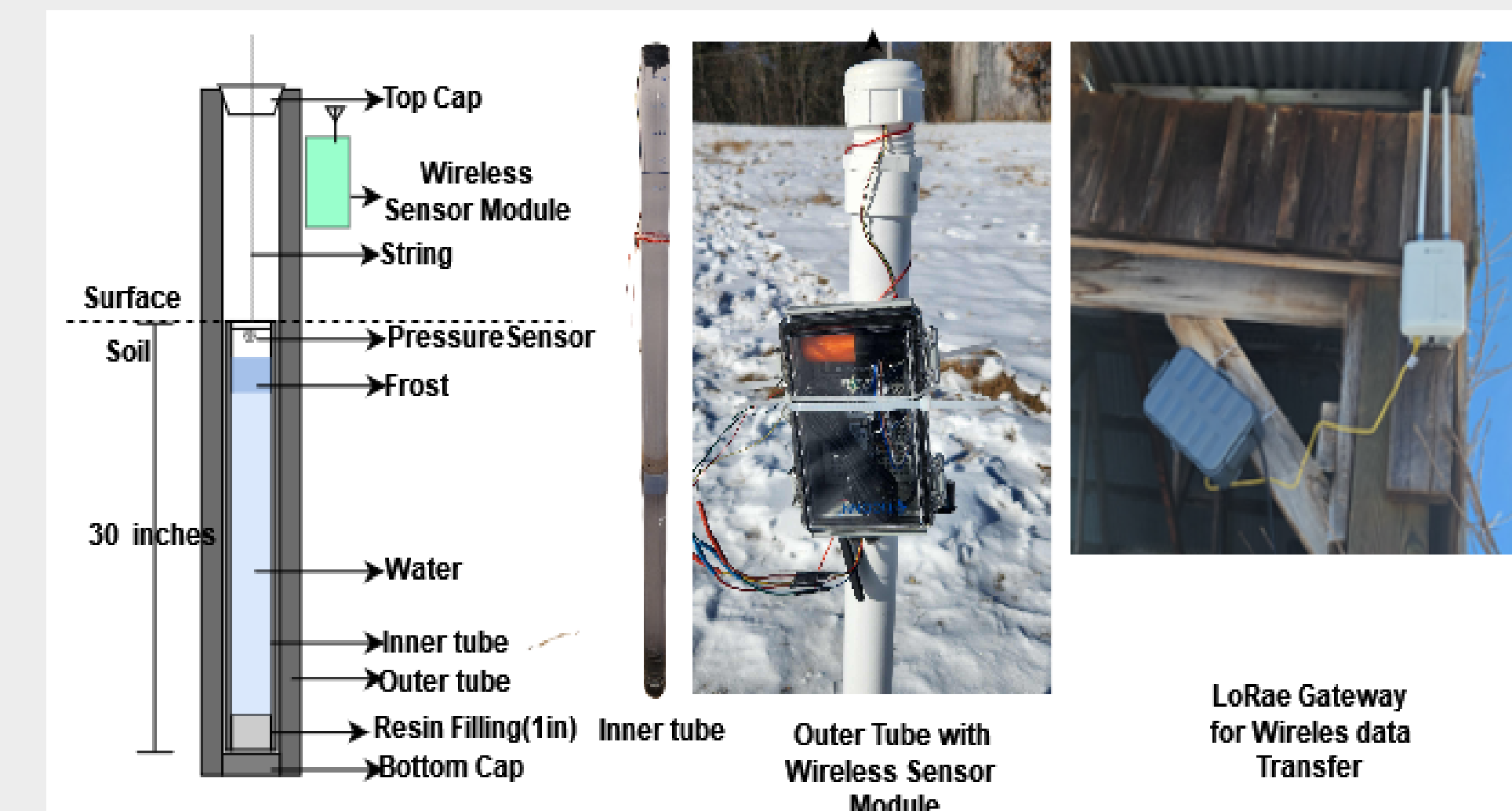
Assess ecosystem response to changing frost depth and duration

Train the next generation of scientists and stakeholders in to understand the impacts of changing winters

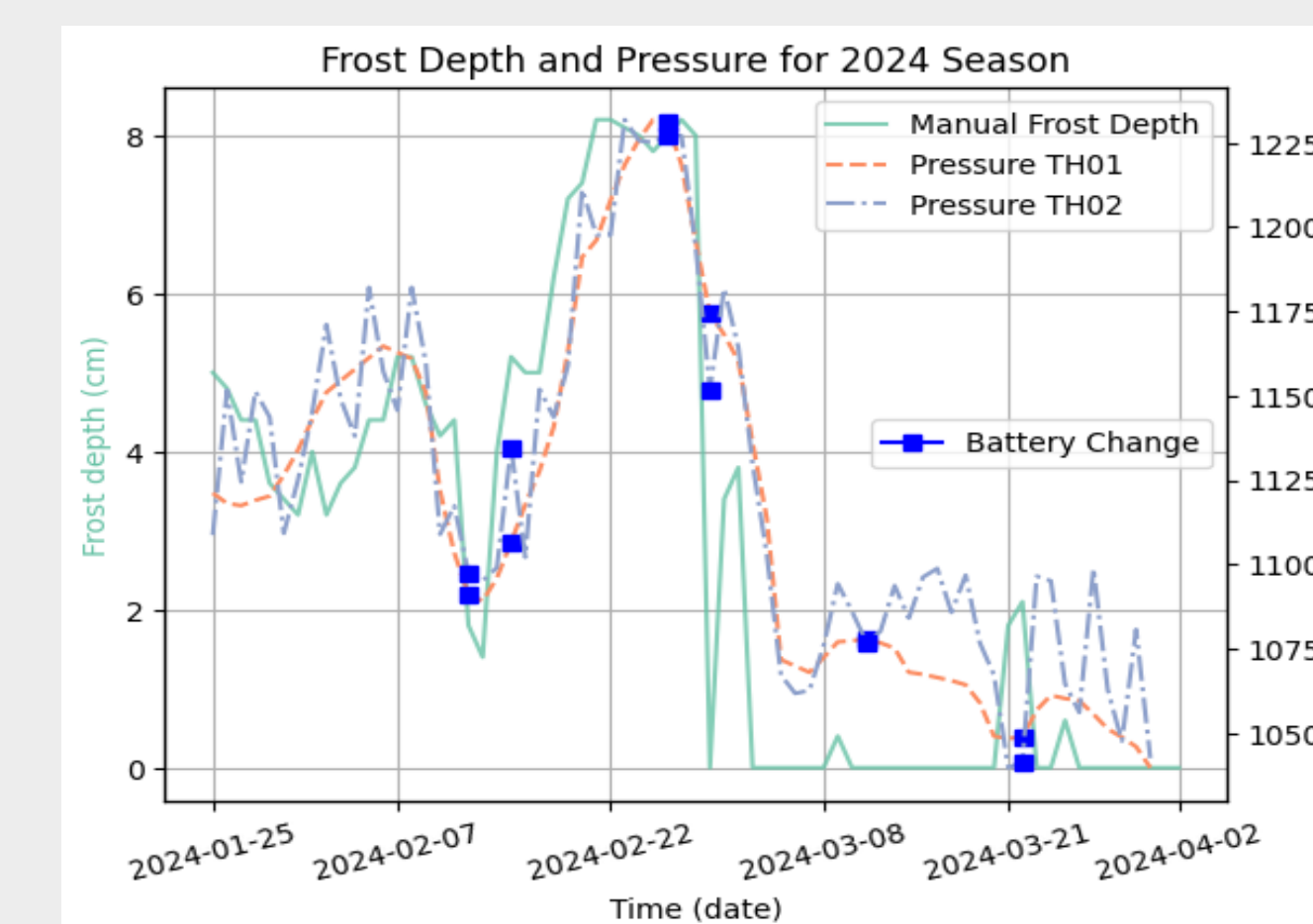
Develop, Test, and Deploy

Wireless Sensors

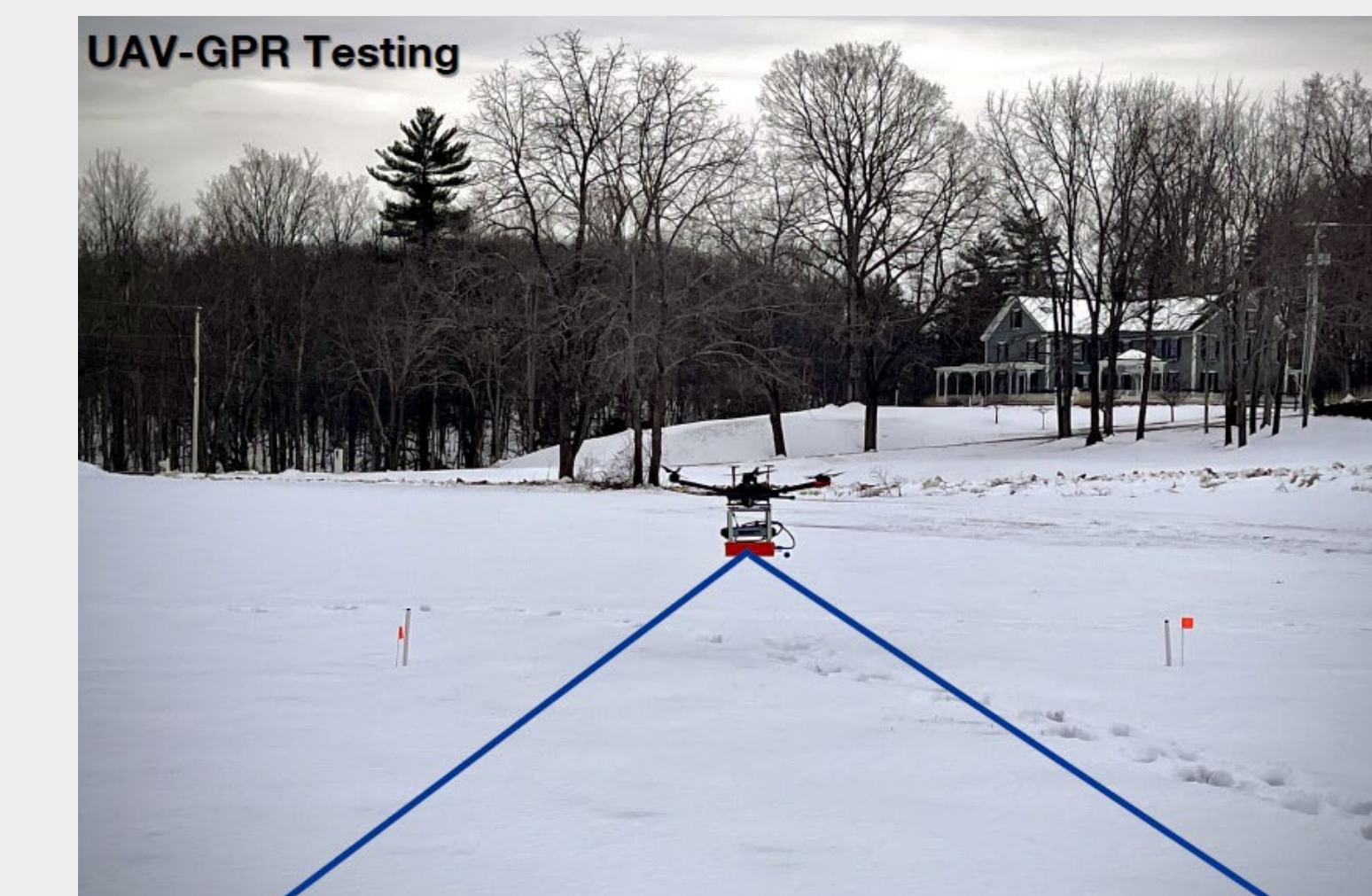
Field testing pressure-based wireless sensor.



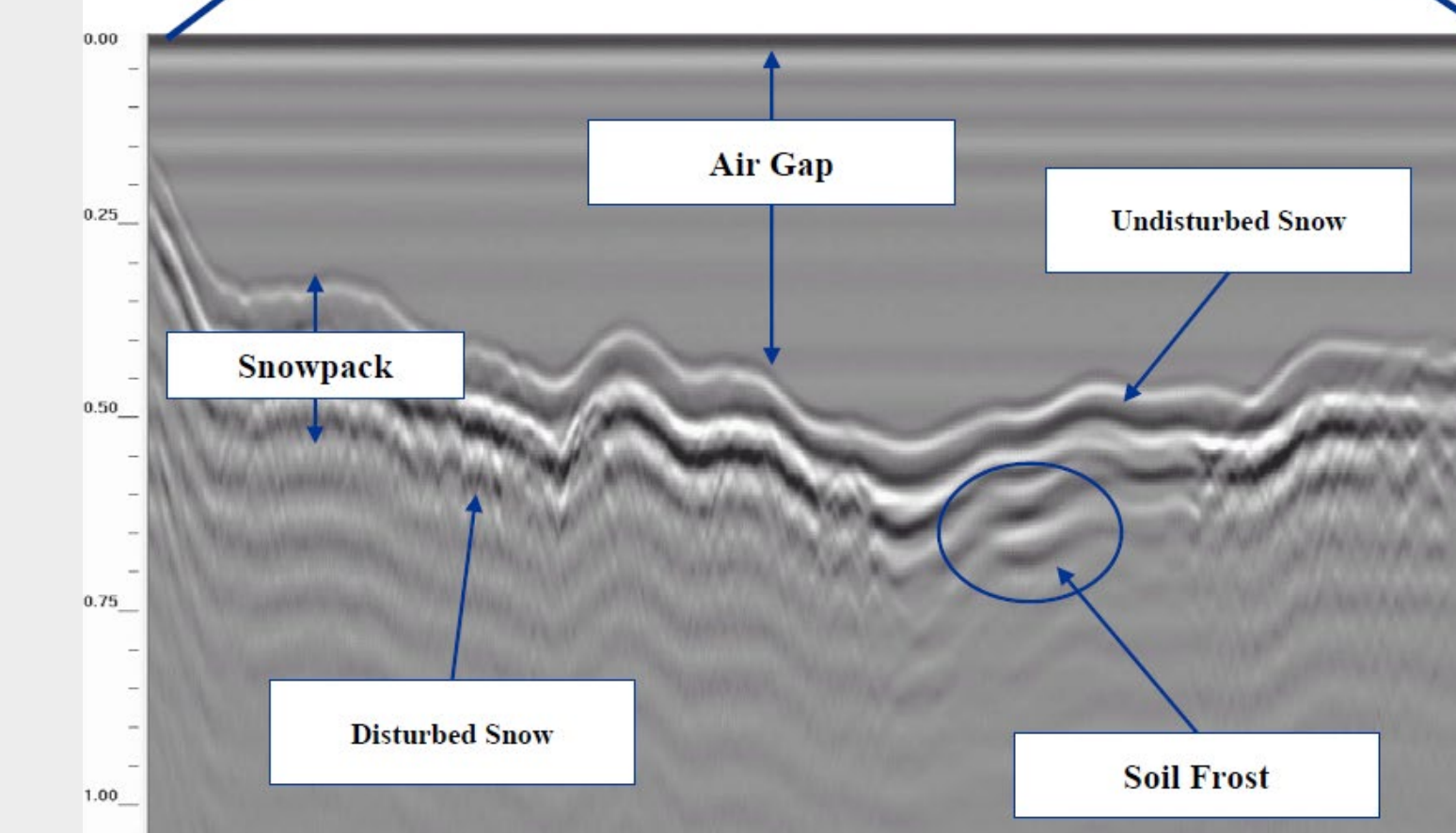
Comparison of pressure change due to freezing inside tube with manual frost data. More results on Yousuf et al. poster.



Ground Penetrating Radar

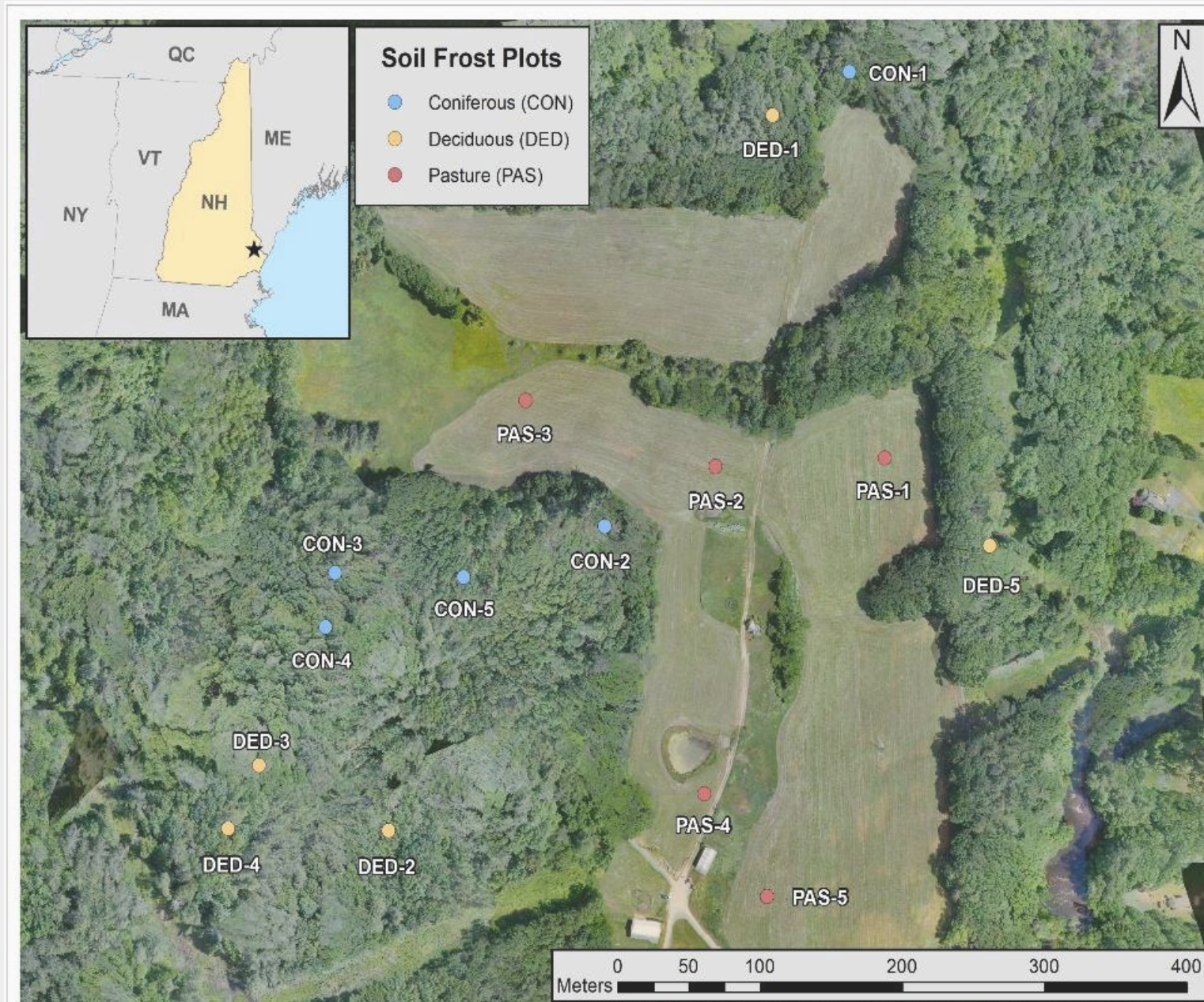


Field testing GPR unit mounted to drone flying 1m above surface.

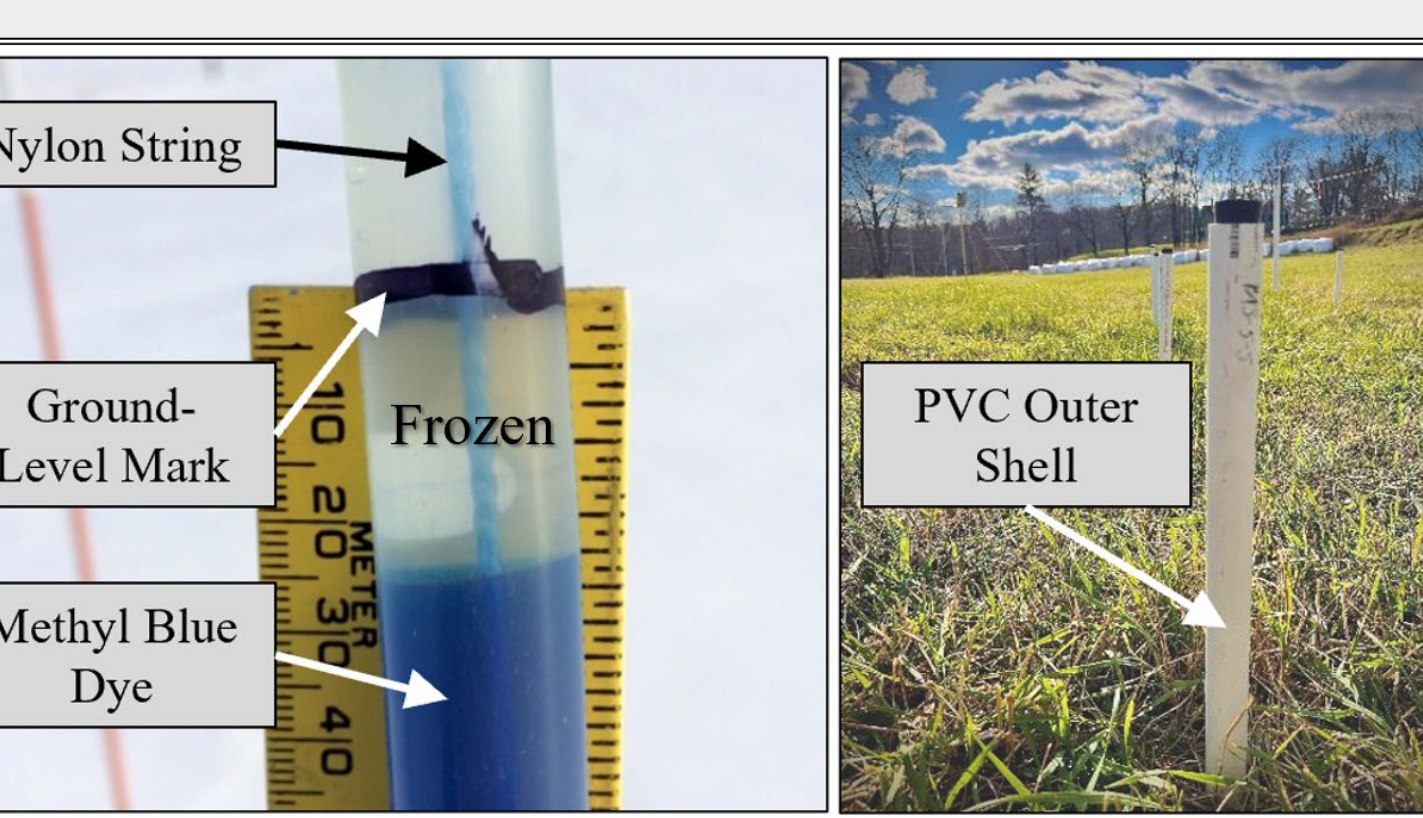
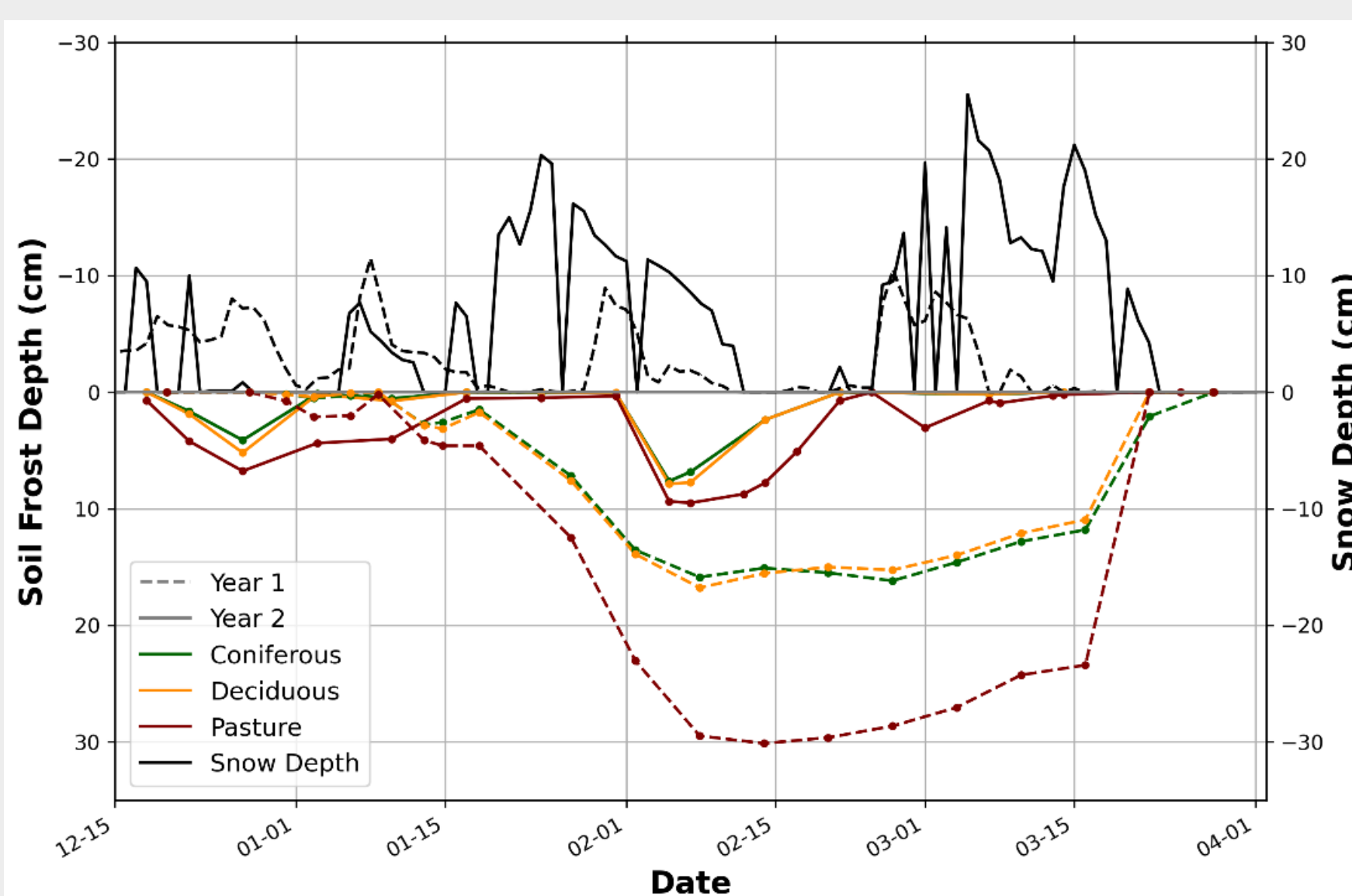


Manual soil frost and snowpack depth aligned with GPR-derived readings.

Characterize Spatiotemporal Changes



Weekly monitoring of soil frost across gradient of land cover and soil properties.



Gandahi-CRREL style soil frost tube used to manually measure soil frost and to validate measurements from wireless sensors and GPR.

Sub-zero temperatures and intermittent snow contributed to frost development that varied between winters and across land cover. Ongoing work to evaluate the role of soil properties.

Assess Ecosystem Response

Snow Removal

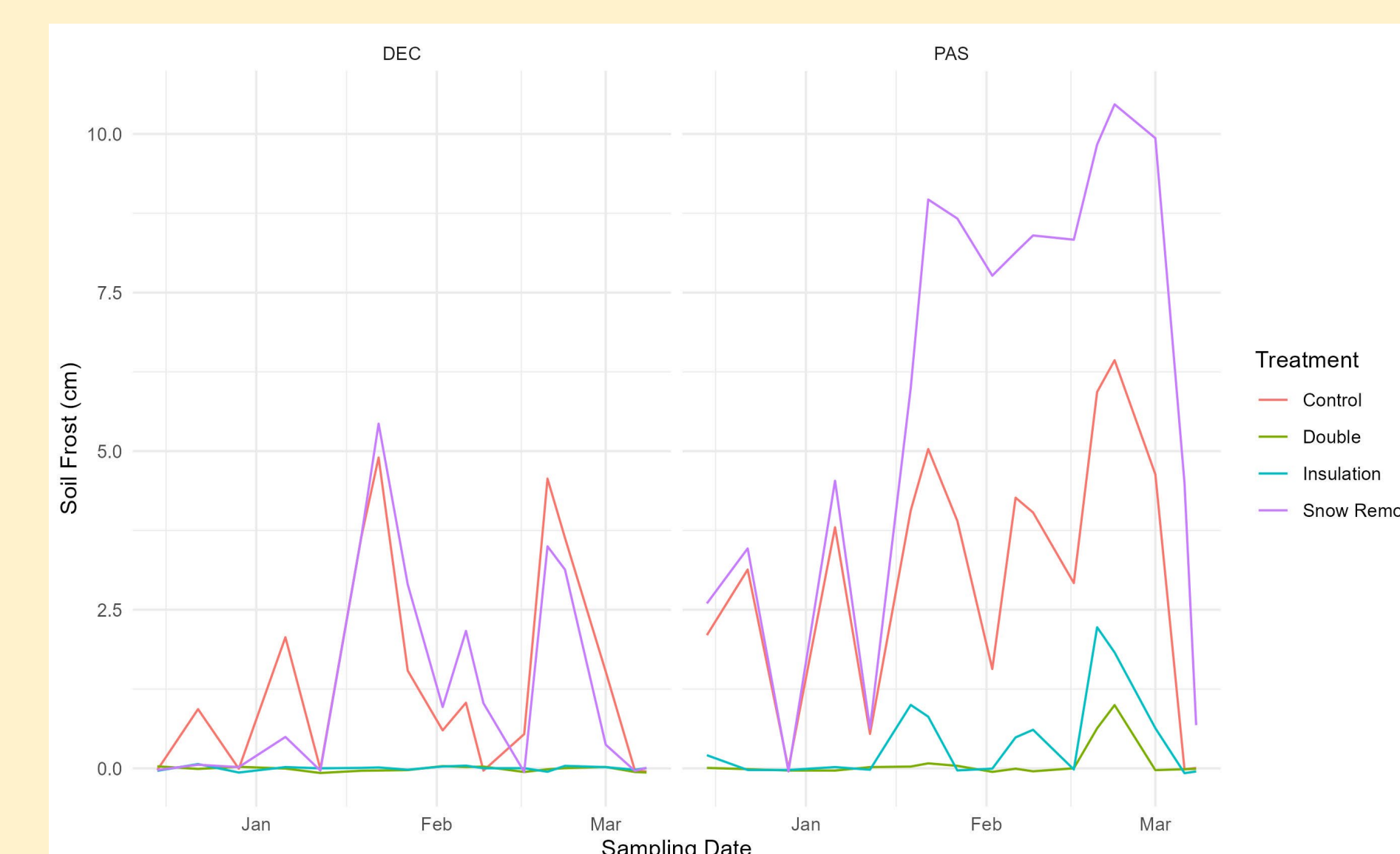
Insulation

Double insulation

Control



Field experiment to evaluate the greenhouse gas response to changing frost regimes.

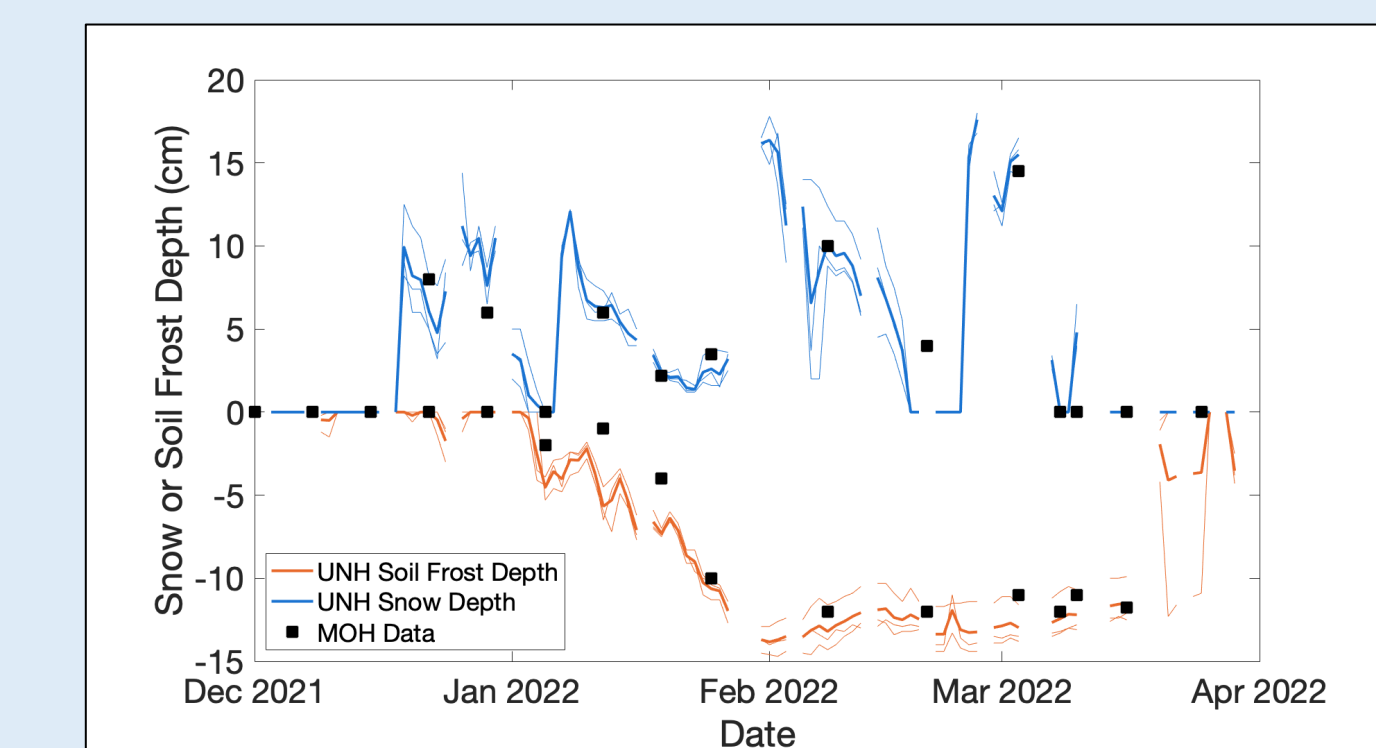


Frost depth varied with land cover and among treatments. More results on Teixeira et al. poster.

Train Future Scientists



First graders celebrate frost tube installation.



Student data (MOH) align with local site (UNH).



High schoolers install sensor suite.



Undergraduate students explore how soil properties drive soil frost depth and duration.