

Fingerprinting Soil Carbon Fluxes in Moist Tussock Tundra:

Integrating New Technology, ^{14}C , and Long-Term Experiments to Assess Permafrost C Stability



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Background: ^{14}C in Tundra Soil Respiration

- Active layer is thickening, are we losing fossil carbon (i.e. Yedoma deposit)?
- Because of timescale of permafrost C deposition, ^{14}C useful tool
- ^{14}C of traditional chamber fluxes deliver a net soil isoflux ***in the summer, but:***
 - This is only at the soil surface, doesn't tell us what's happening belowground
 - Chambers can't be left out in the winter (lose 75% of the year)
 - Summer respiration tends to be dominated by root respiration and surface microbes

Yedoma Deposit

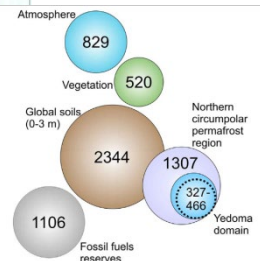
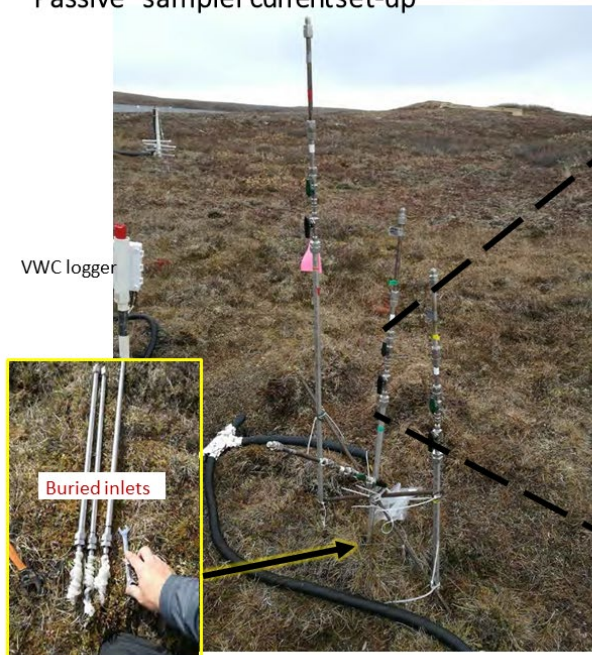


Fig. 6. Terrestrial carbon at the Yedoma domain. The stocks are given in Gt.

Strauss et al. 2017

Passive Continuous Soil CO₂ Sampling

“Passive” sampler current set-up



Exchangeable sieve

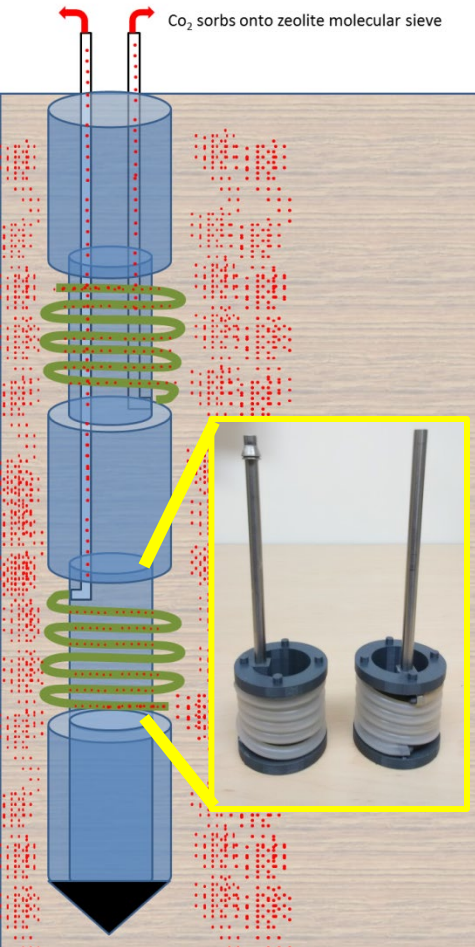
Inlet sample line

Towards an annual ¹⁴C Isoflux

“By sampling continuously at different depths throughout the year, we aim to address:

- Which soil C pools are being consumed by microorganisms during the winter
- What proportion of the carbon originates from microorganisms decomposing organic matter (as opposed to from the roots of plants that are fixing C from the atmosphere) during the summer” (Pedron et al. AGU 2019)

Version 2.0 Multi-Depth Passive Sampler



- Sampling modules at depths of interest
- Monthly trap swap
- Minimize disturbance, maximize sample comparability in highly heterogeneous tundra
- Molecular sieve desorbed and resulting CO₂ analyzed to determine fraction modern at the UCI AMS facility

Annual Soil CO₂ : Big Questions

- Are we losing permafrost C yet? How much, when, where? Yedoma C?
 - Substrate suitability, priming, etc.
- Winter snow scenarios. + snow, -snow, control