

EVIDENCE THAT A NORTHWARD RANGE SHIFT OF SUGAR MAPLE (*ACER SACCHARUM* MARSH.) IN EASTERN CANADA WILL REDUCE SOIL CARBON STORAGE

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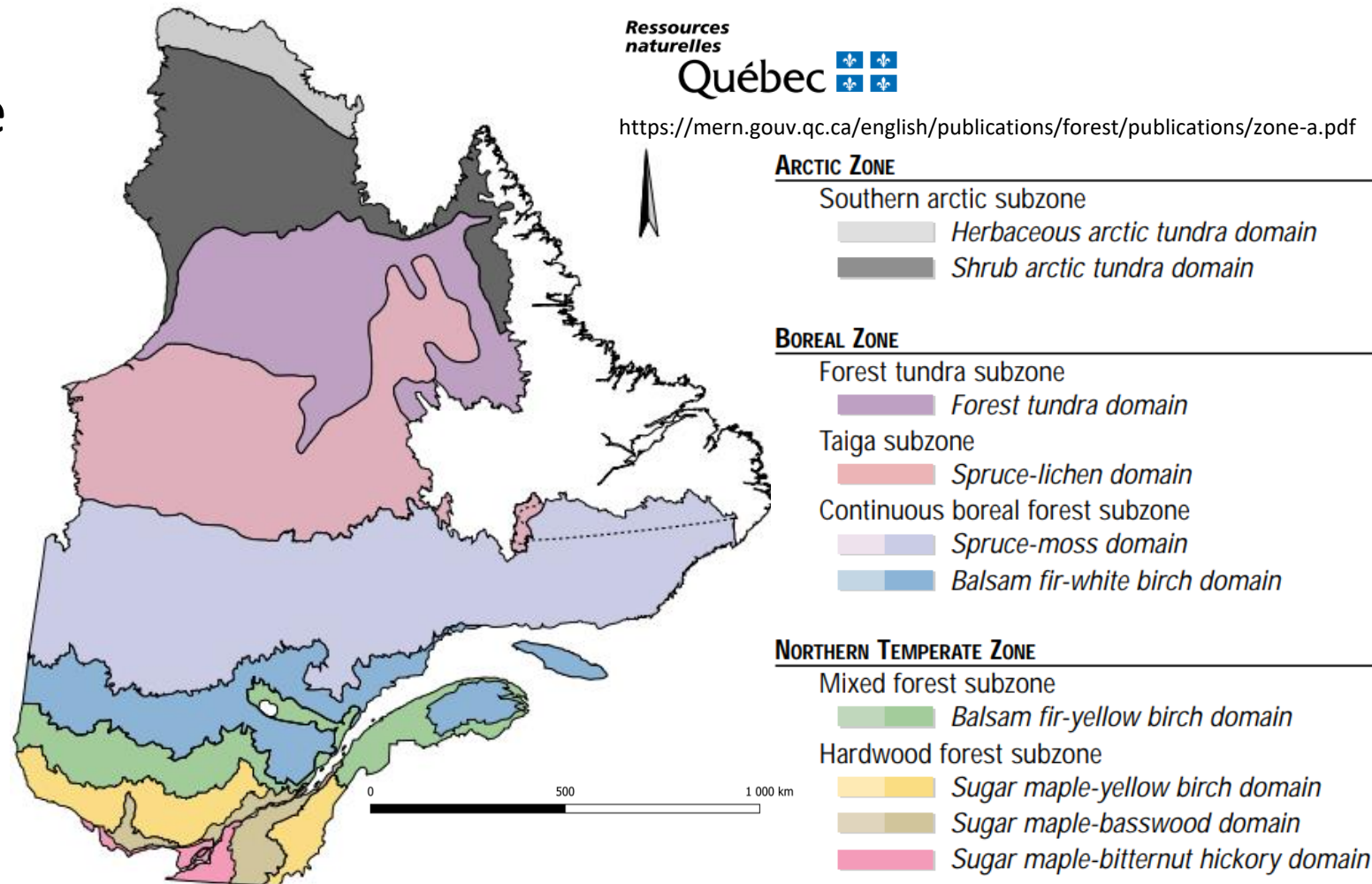
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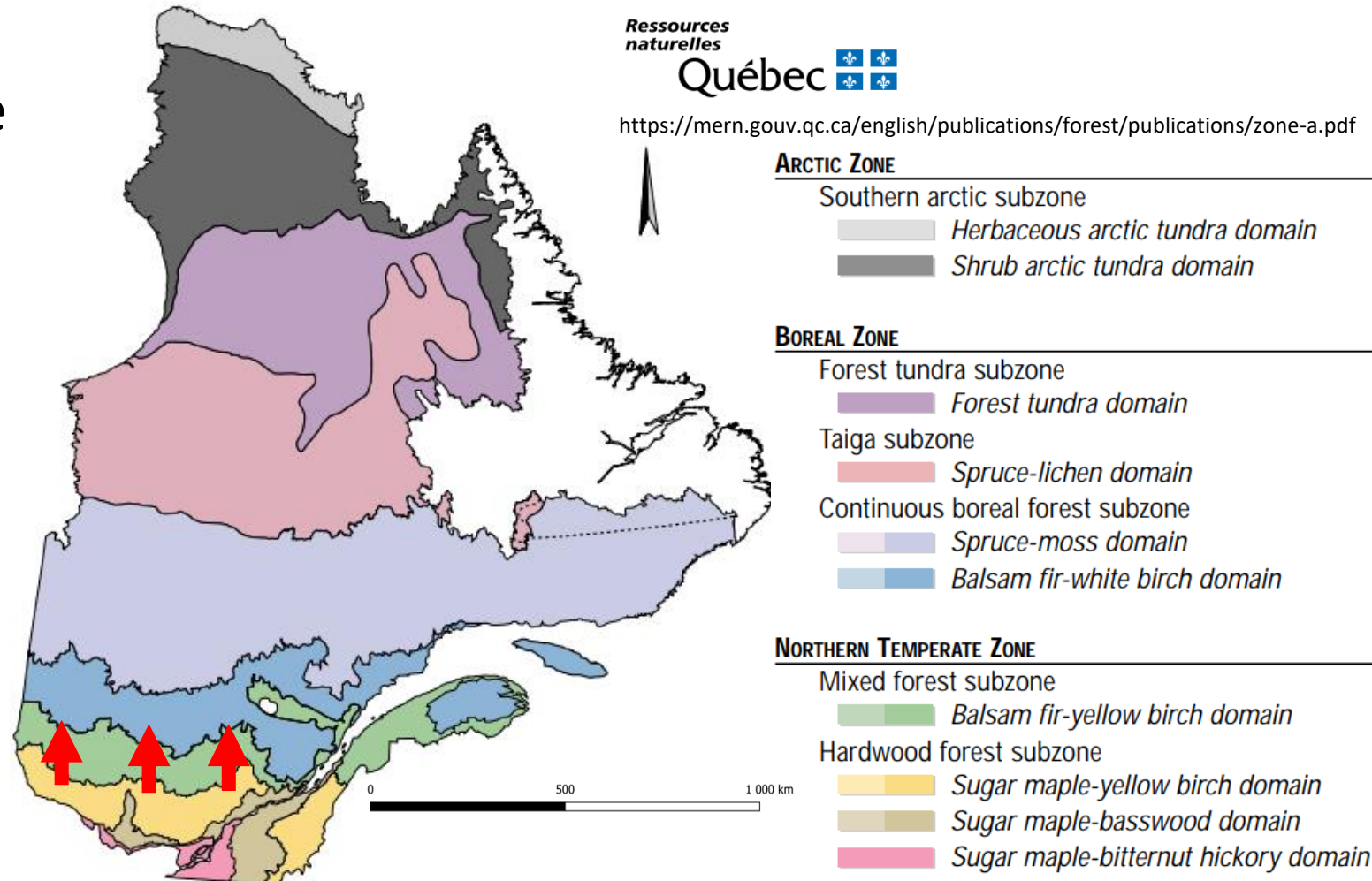
Vegetation shift in response to climate change

- Boreal – Temperate ecotone in eastern Canada
- North of the ecotone
 - Balsam fir stands (*Abies balsamea* (L.))
- South of the ecotone
 - Sugar maple stands (*Acer saccharum* Marshall)



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Northward shift of the northern range limit of Sugar maple

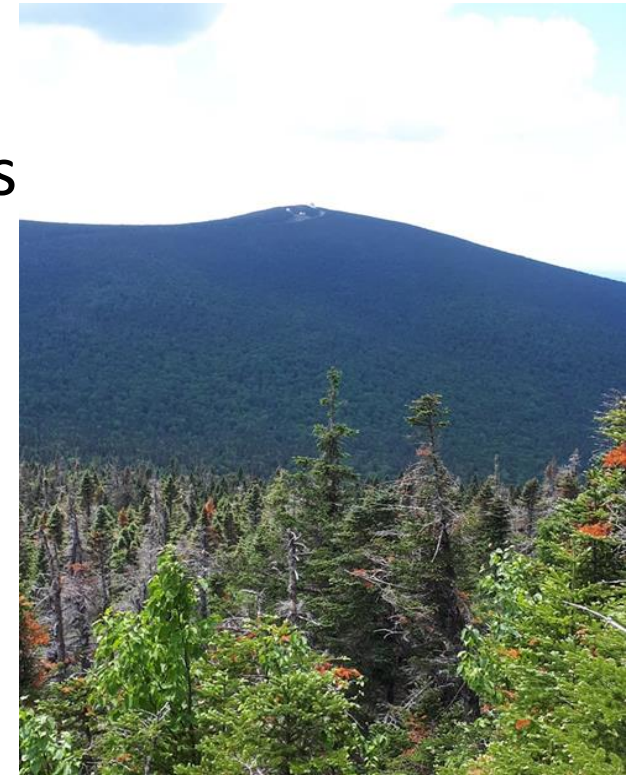
What is the impact of the vegetation on soil organic carbon (SOC) dynamic at the Boreal – Temperate ecotone?

Sugar maple – Yellow birch

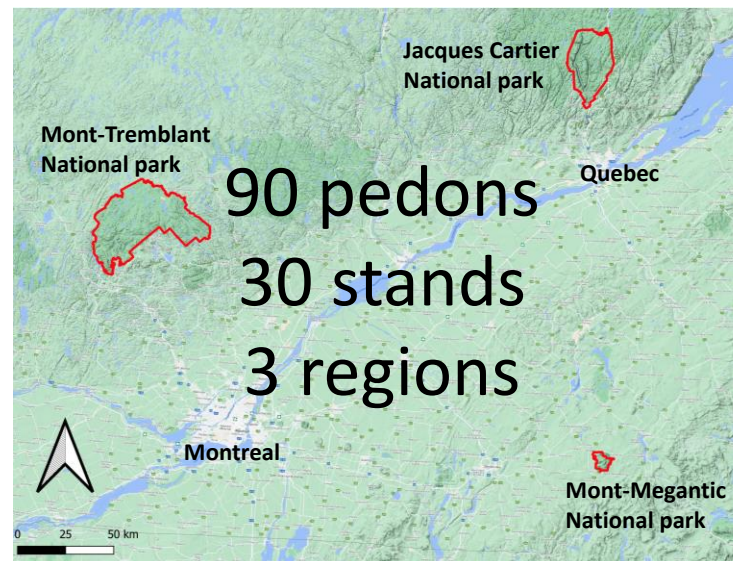


VS

Balsam fir – White birch

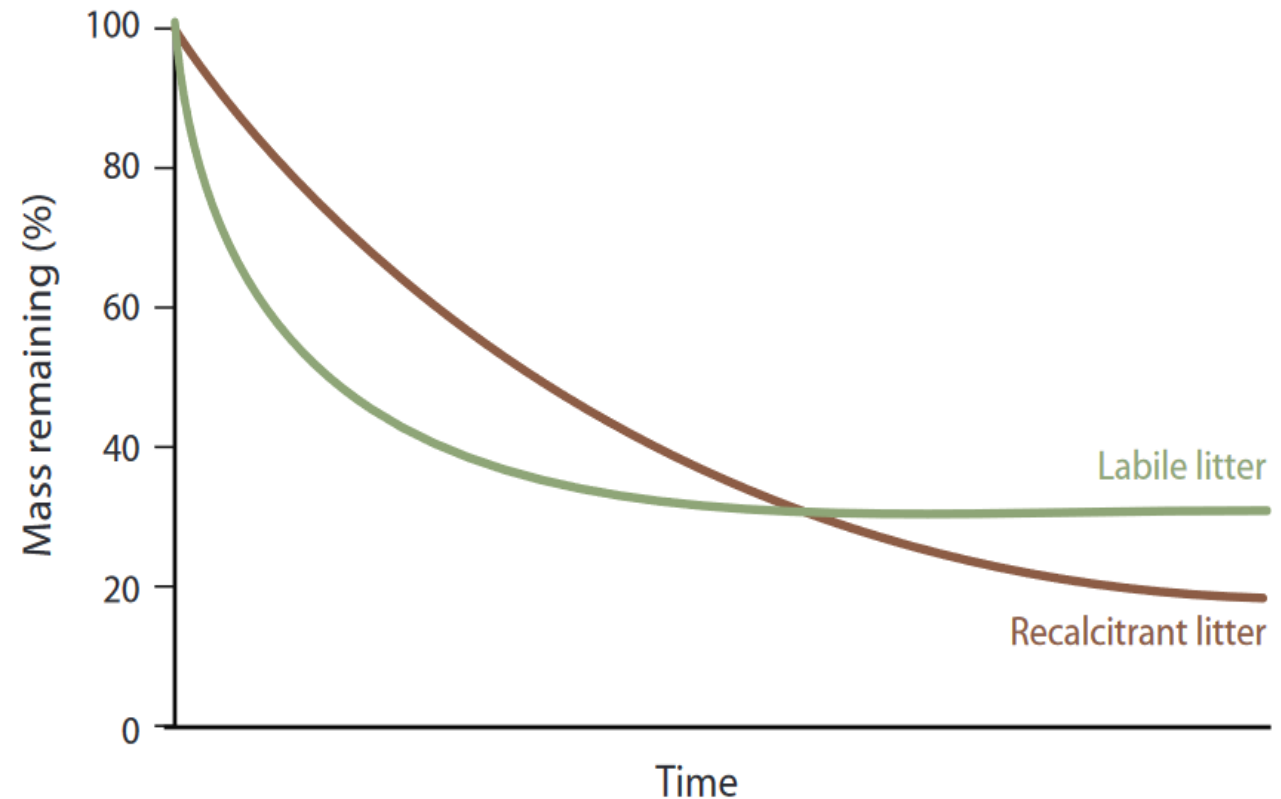


3 forest floor horizons
5 mineral soil depth increments



Hypothesis behind predictions

- Microbial efficiency matrix-stabilization framework (MEMS) (Cotrufo et al., 2013)
- Labile vs. recalcitrant litter
 - Decomposes faster in the beginning
 - Better carbon use efficiency
 - Higher proportion stabilized



From Cotrufo et al. 2013

Predictions

SOC stocks

- 1) ↑ SOC stocks in organic horizon of balsam fir stands
- 2) ↑ SOC stocks in mineral soil of sugar maple stands

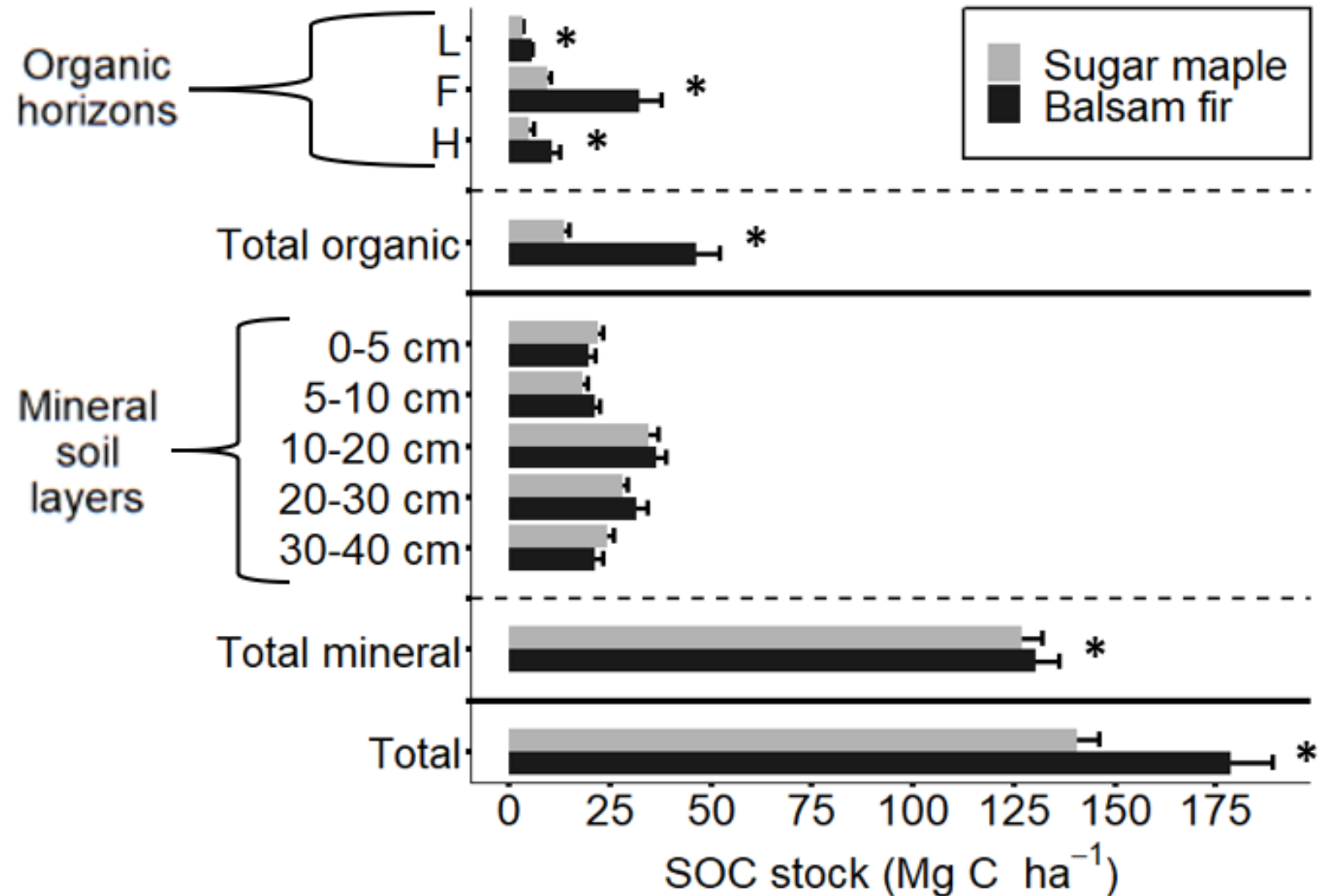
SOC stability

- 3) ↑ SOC bioreactivity in balsam fir stands
- 4) ↑ microbial turnover of SOC in sugar maple stands
- 5) ↑ proportion of SOC associated with minerals in sugar maple stands

in the mineral soil (0-40 cm)

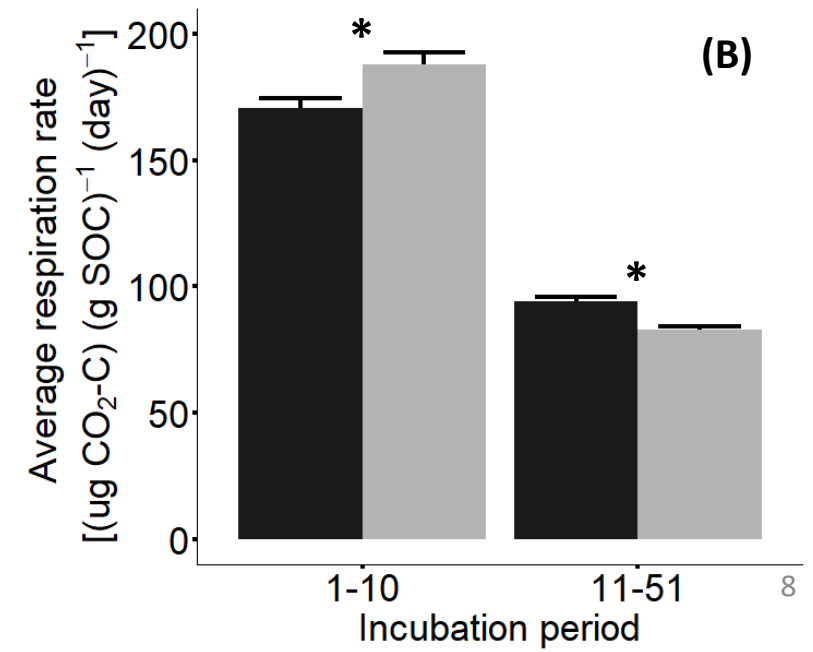
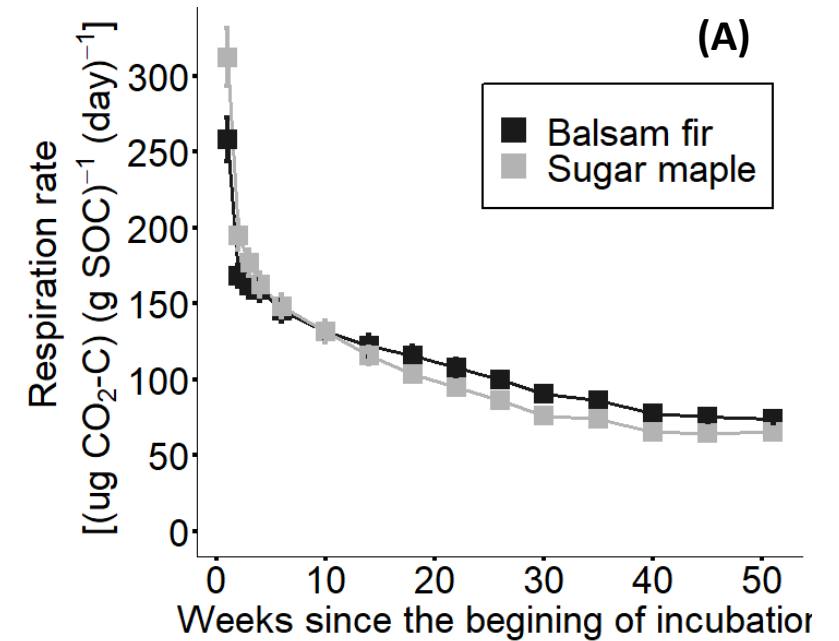
SOC Stocks

- Organic horizons
 - -71% in sugar maple
- Mineral soil layers
 - -3% in sugar maple
- Total down to 40 cm
 - -21% in sugar maple



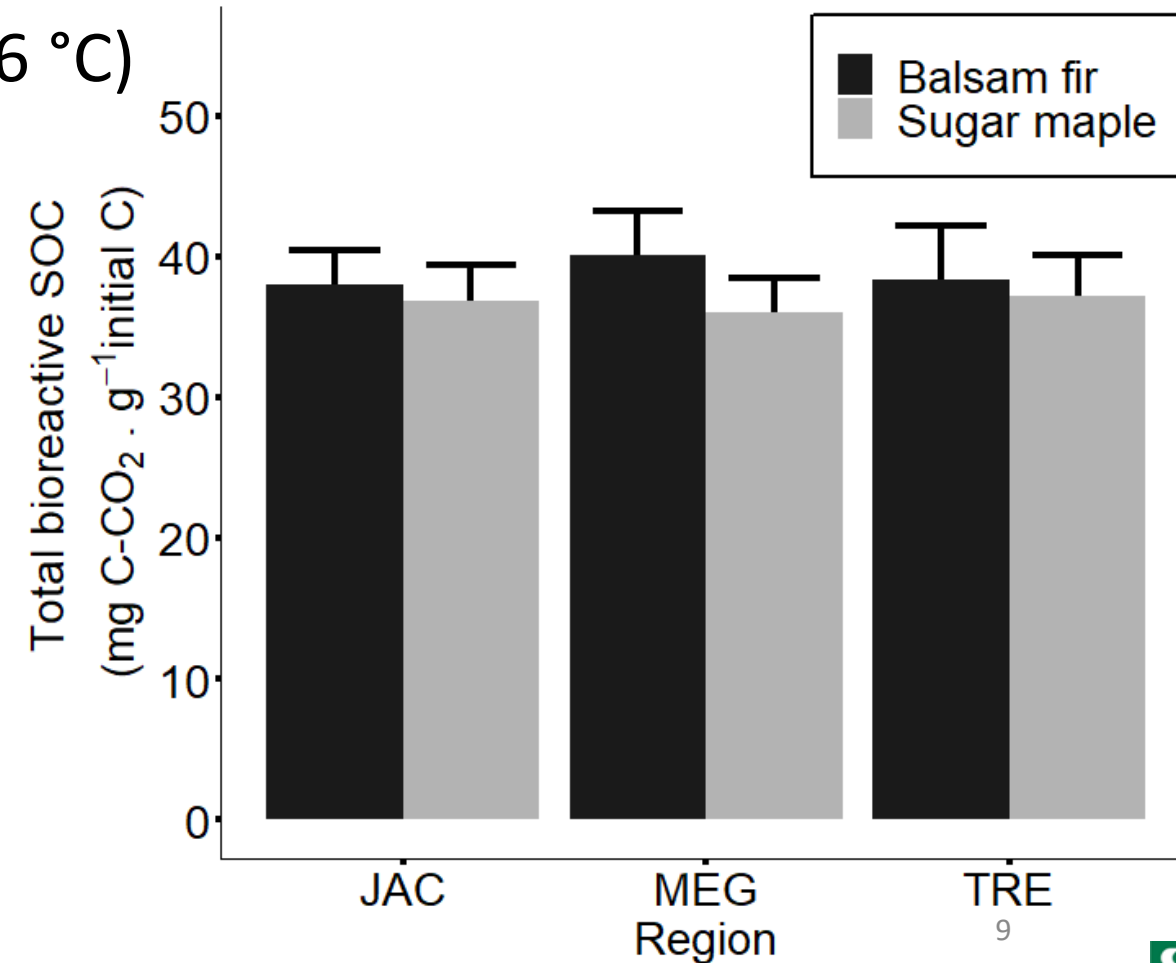
SOC bioreactivity

- Long term incubation (51 weeks at 26 °C)
- Respiration rates
 - Time x Stand type interaction
- Total bioreactive SOC
 - SOC mineralized during 51 weeks
 - Similar between stand types



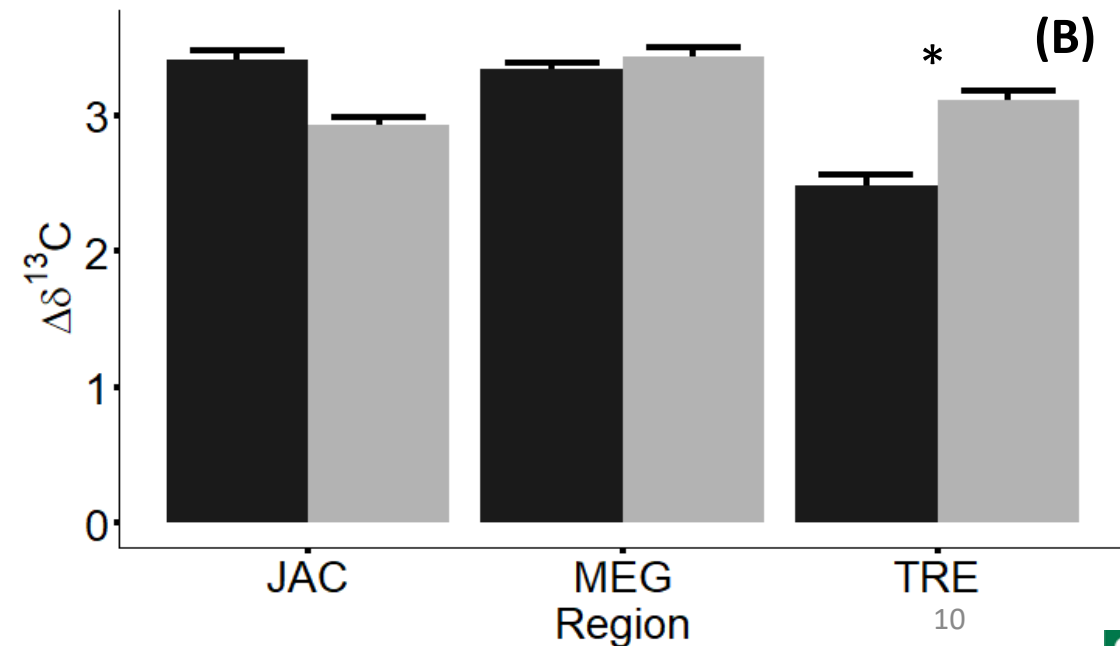
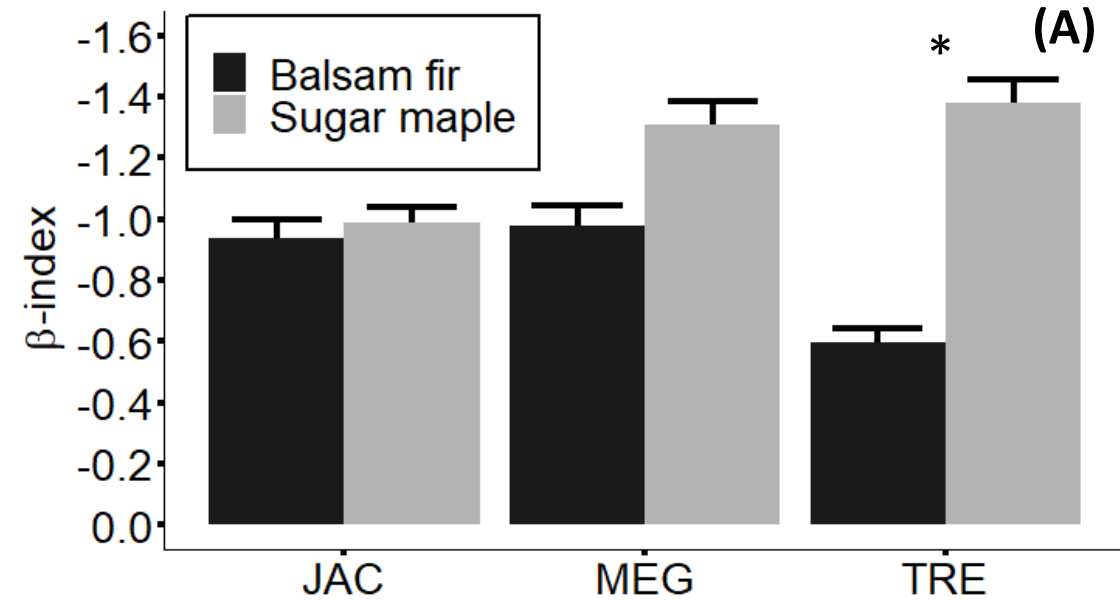
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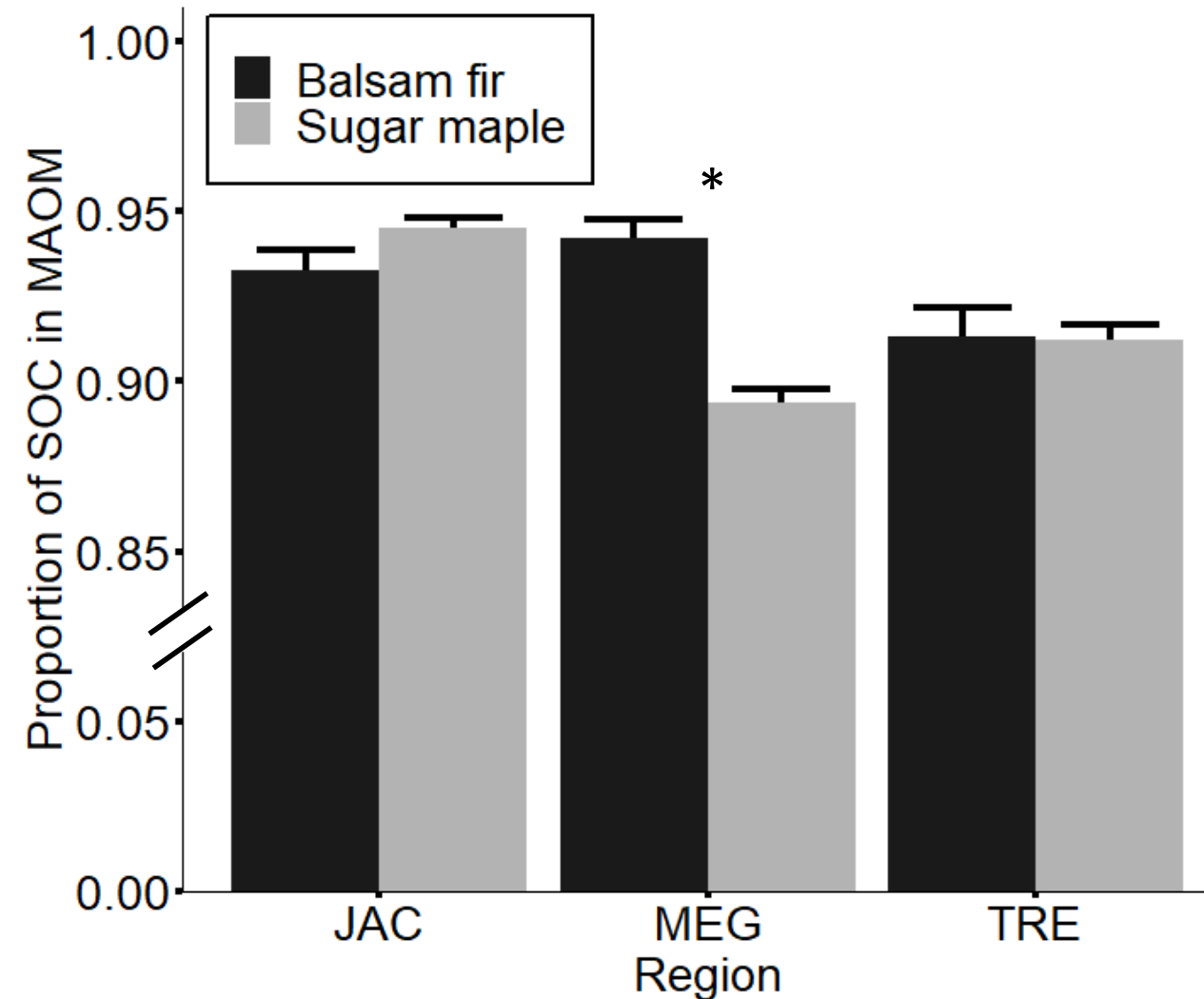
SOC turnover

- 2 SOC turnover indices
 - β -index (slope of $\delta^{13}\text{C}$ and $\log[\text{SOC}]$)
 - $\Delta\delta^{13}\text{C}$ ($\delta^{13}\text{C}$ sample - $\delta^{13}\text{C}$ litter)
- Region x Stand type interaction
 - Higher SOC turnover in sugar maple stands only in one region



Proportion of SOC in mineral-associated organic matter

- Wet sieving (53 μm)
- Region x Stand type interaction
 - Contrary to expectation in 1 region
 - Earthworms?



Take away messages

- ❑ ↑ SOC stocks under balsam fir
- ❑ No generalizable effect of stand type on SOC stability
- ❑ Sugar maple vs. balsam fir ≠ MEMS framework
- ❑ Northward range shift of sugar maple in eastern Canada has the potential to reduce SOC storage by 38 Mg ha⁻¹



Thank you for listening – Questions?

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Thanks to

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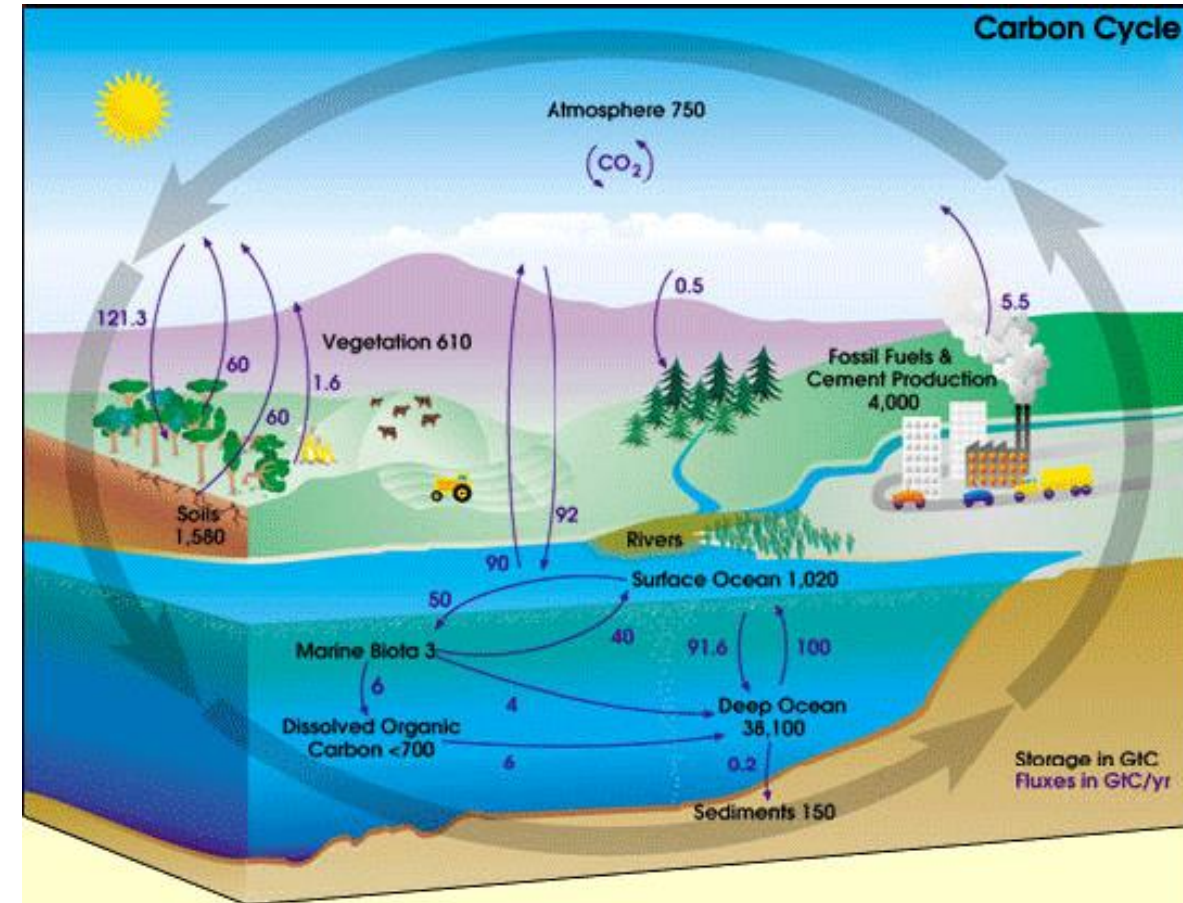
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technologies



Supplementary material

Soil organic carbon – Overview

- Carbon in soil organic matter
 - 1500 Gt of soil organic carbon (SOC)
- SOC dynamics affected by
 - Climate
 - Edaphic properties
 - Vegetation
- Potential to contribute or mitigate global warming
 - SOC mineralization
 - CO₂ sequestration



<http://www.rlq.uqam.ca/cartable/inforlq/InfoRLQvol5no12decembre2008.php>

Depth trends

- Pattern between indices
- Supports the stabilization mechanism proposed by the MEMS
 - \uparrow turnover, \downarrow bioreactivity and \uparrow proportion of SOC in MAOM

