OAK RIDGE National Laboratory

MAY 13, 2025 | SPRUCE ALL-HANDS MEETING

SPRUCE Carbon Budget Update

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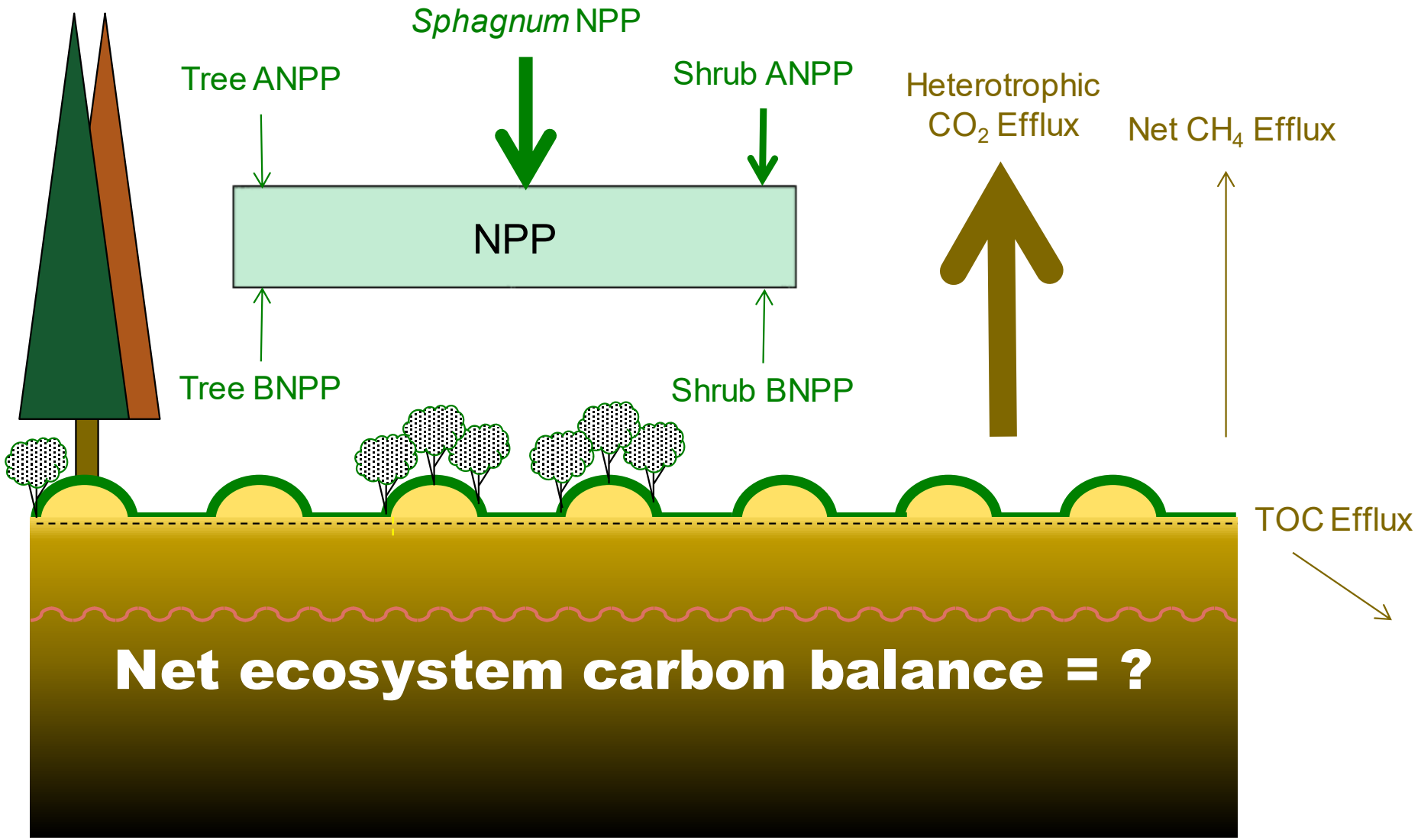
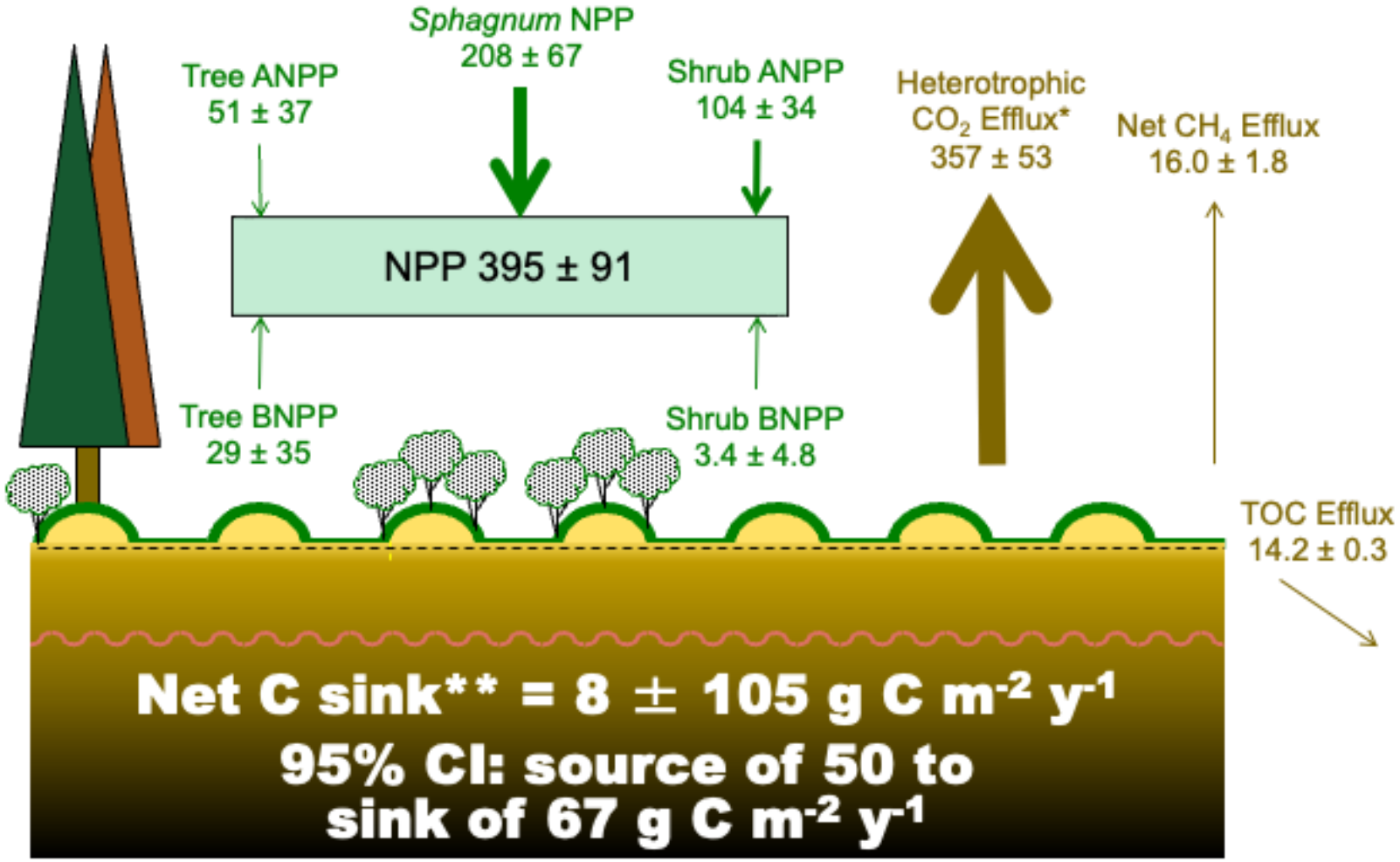
A key objective of SPRUCE is to synthesize the ecosystem carbon budget responses to warming and eCO_2



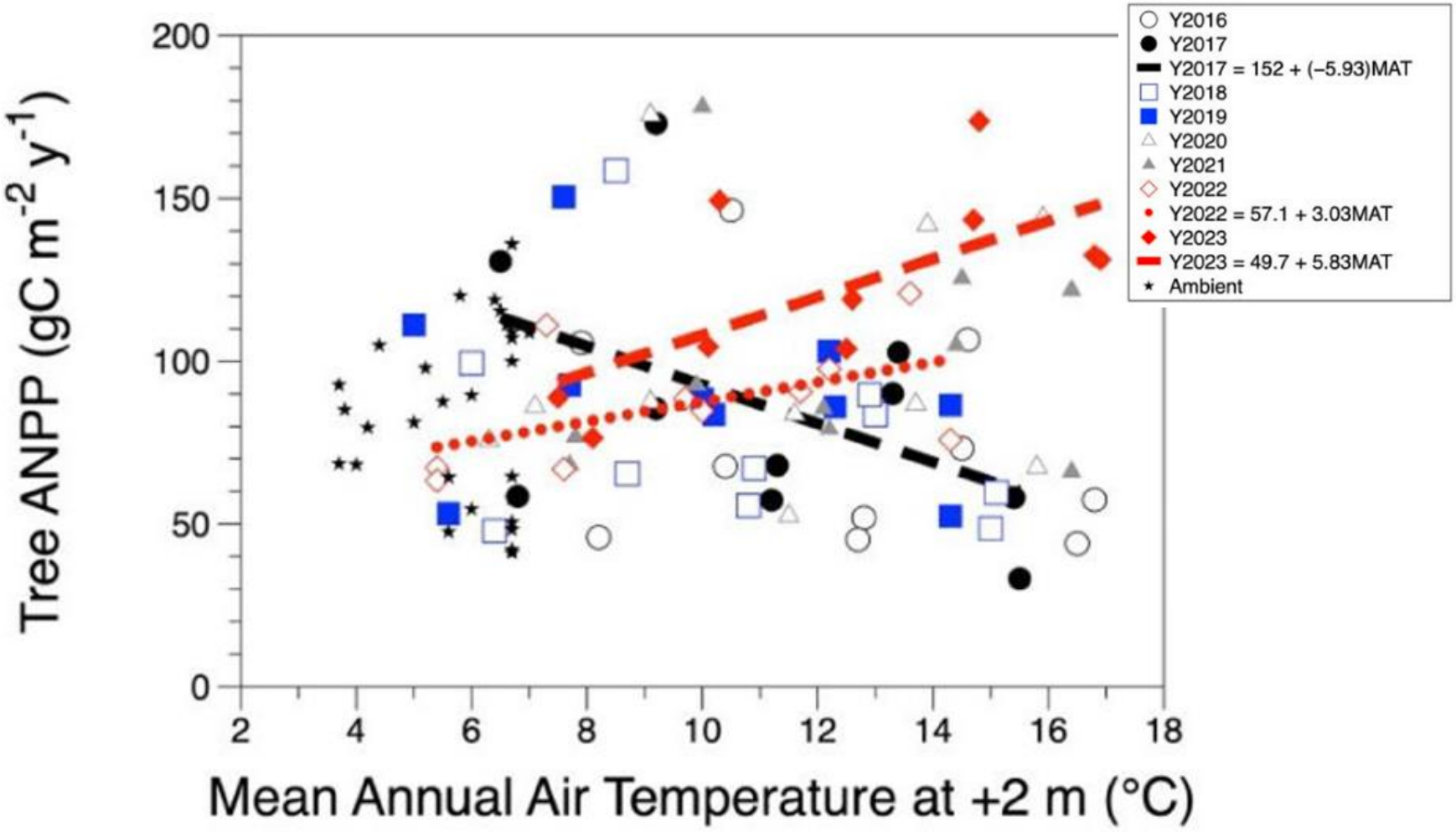
The pre-treatment C budget showed that the peatland was a slight sink for C, with considerable uncertainty



*Heterotrophic C losses are assumed to be 50% of total net "dark" CO_2 emissions.
**Net C Flux = NPP – Heterotrophic CO_2 Efflux – CH_4 Efflux – TOC Efflux

Griffiths et al. 2017

All components of the C budget have been influenced by warming, and some by eCO_2, to a lesser degree



- Significant response of normalized tree ANPP to the interaction of temperature and eCO_2.
- The positive growth response of *Larix* and *Picea* to warming was similar.

Hanson et al. 2025

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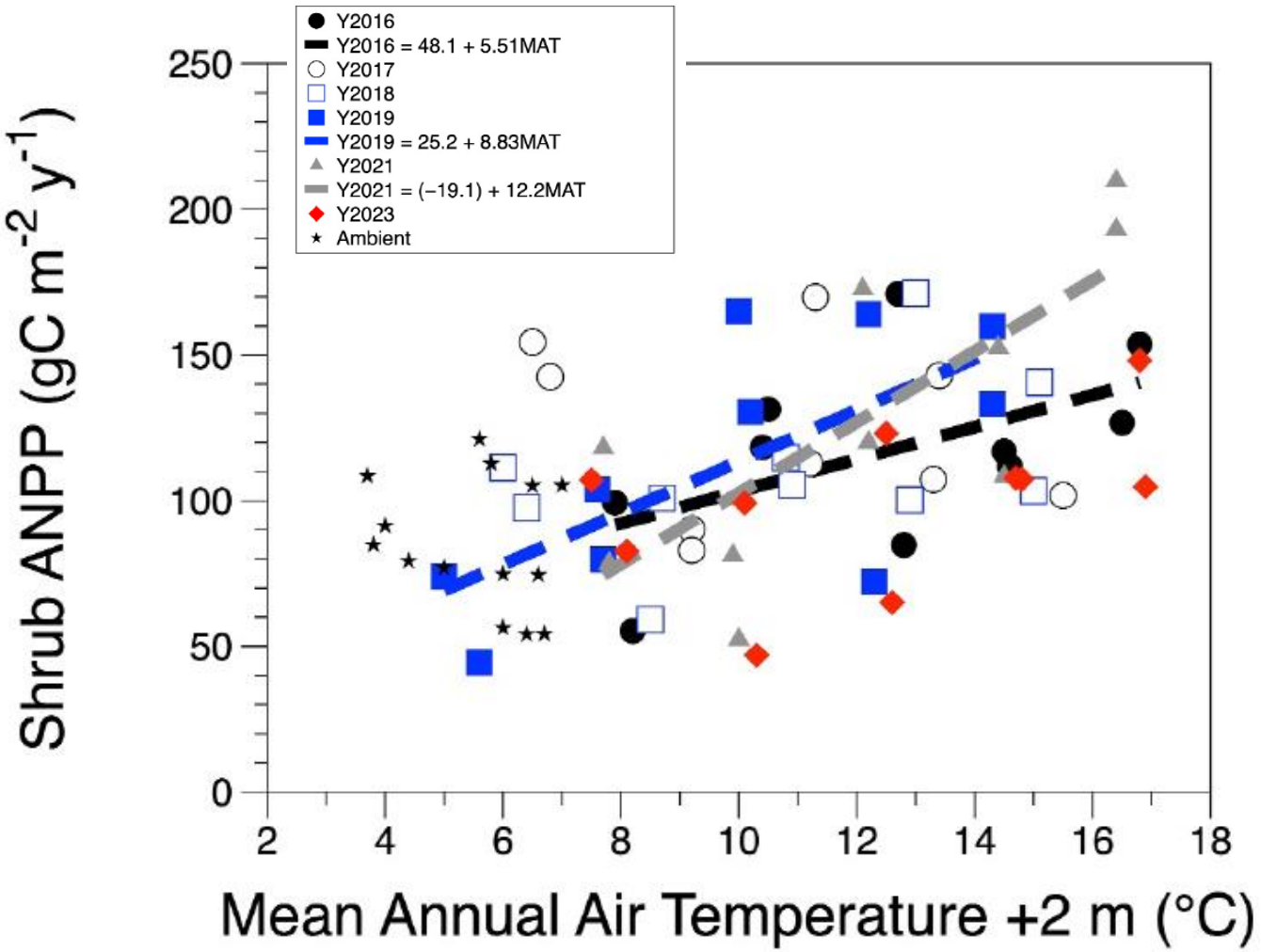

- Significant response of shrub ANPP to temperature and to eCO_2, but no significant interaction.

- Ericaceous shrub ANPP (especially blueberry) increased with warming.

Hanson et al. 2025

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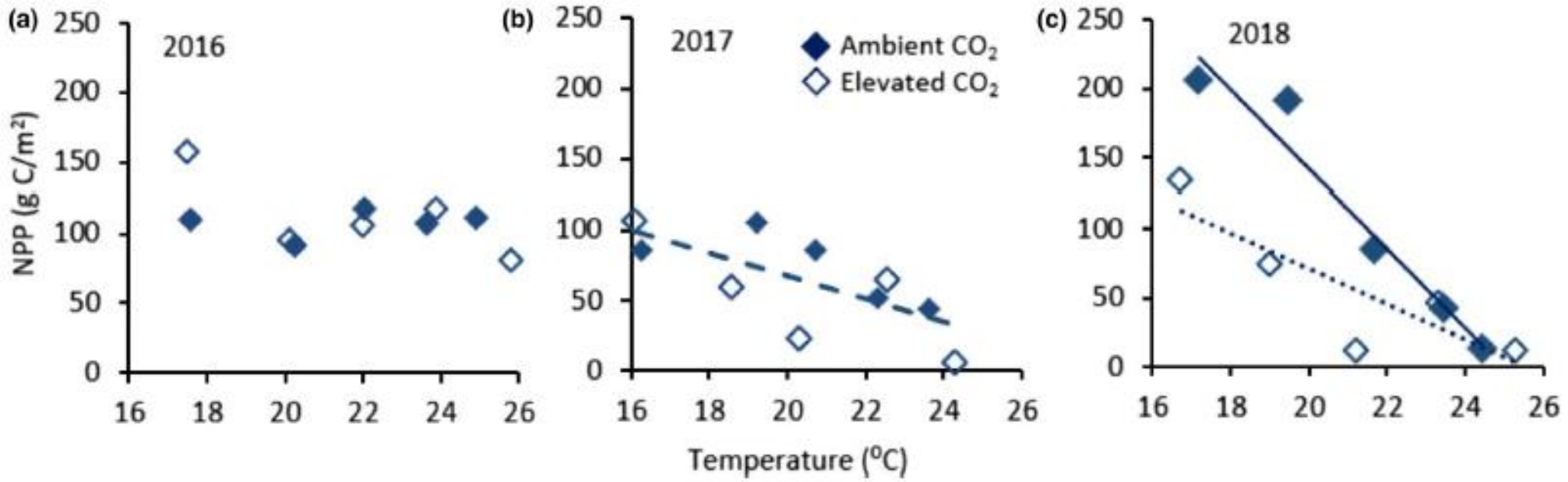

- Significant decline of *Sphagnum* NPP to warming, and an interaction with eCO_2 in 2018.

Norby et al. 2019

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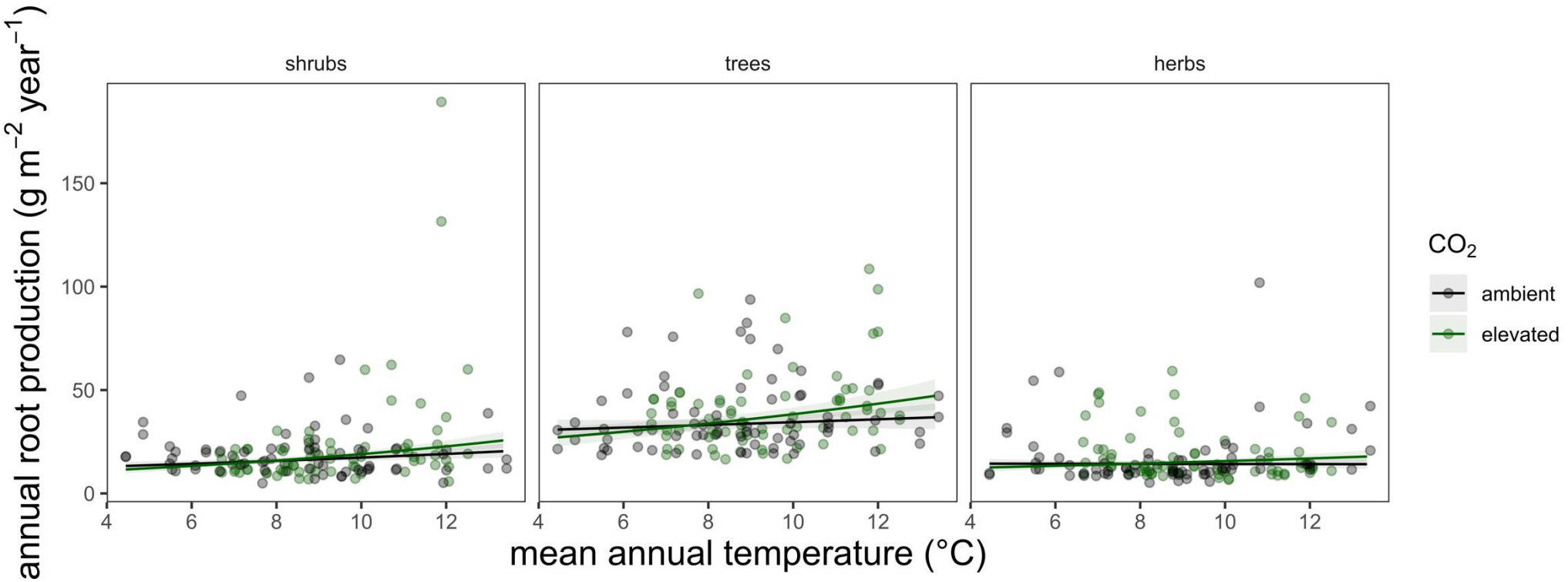

- Interactive response of belowground root production to warming and eCO_2, which is also dependent on plant functional type.

Weber et al. in prep

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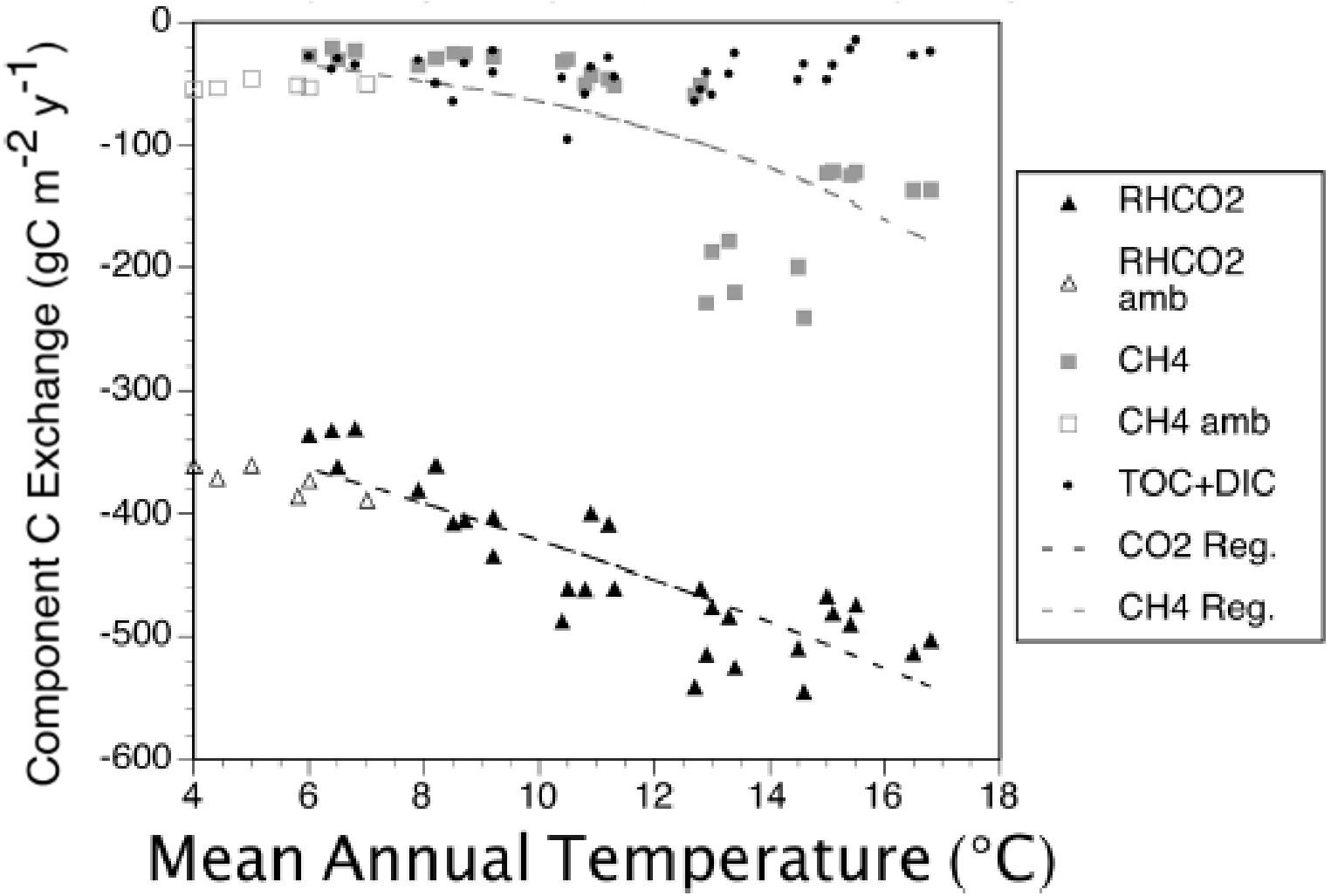

- Linear (CO_2) and non-linear (CH_4) C-efflux responses to warming.
- Interaction with water table for CH_4.
- Large component of the C budget, and also many assumptions and uncertainties in upscaling to the plot and annual scales.

Hanson et al. 2020

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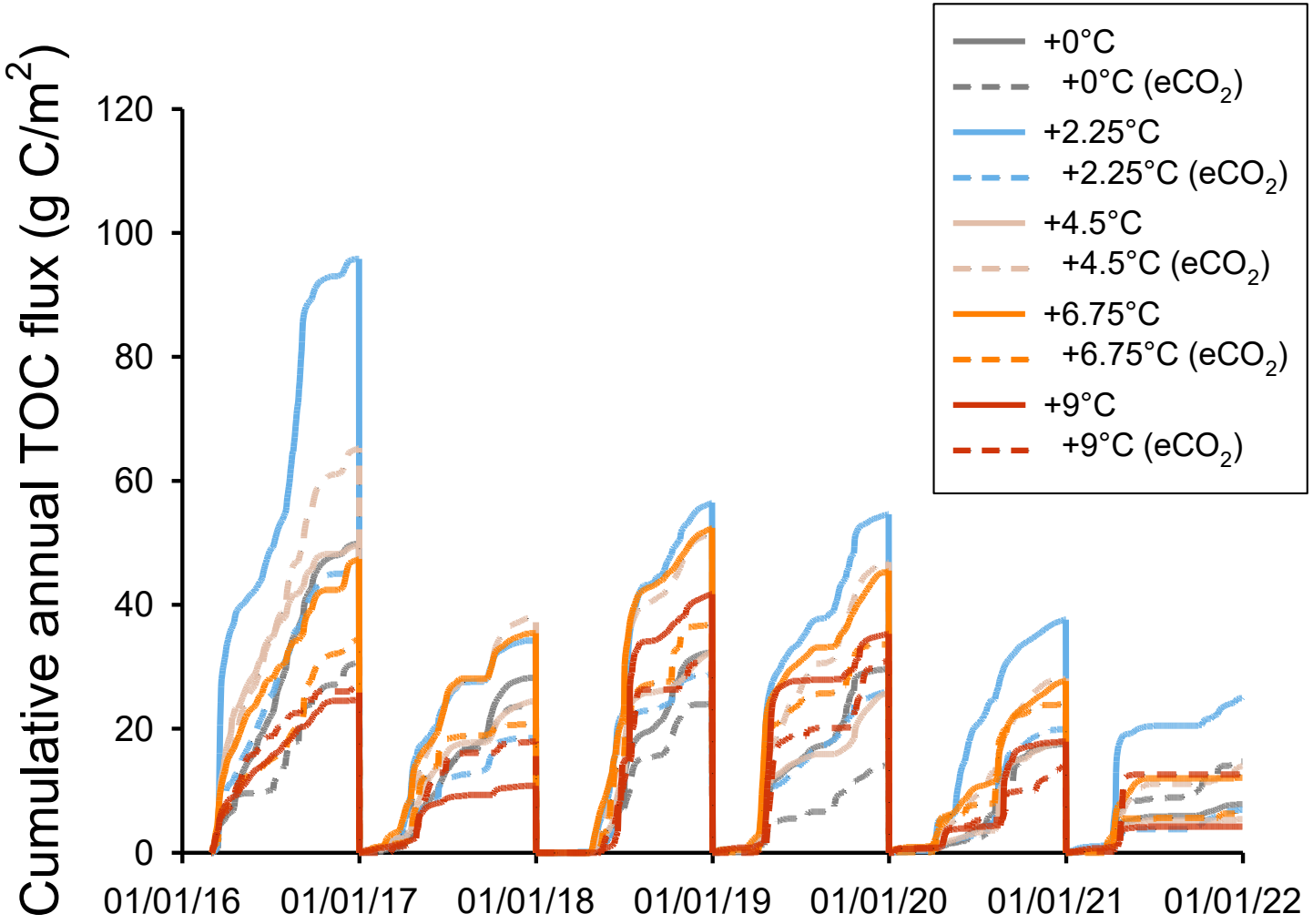
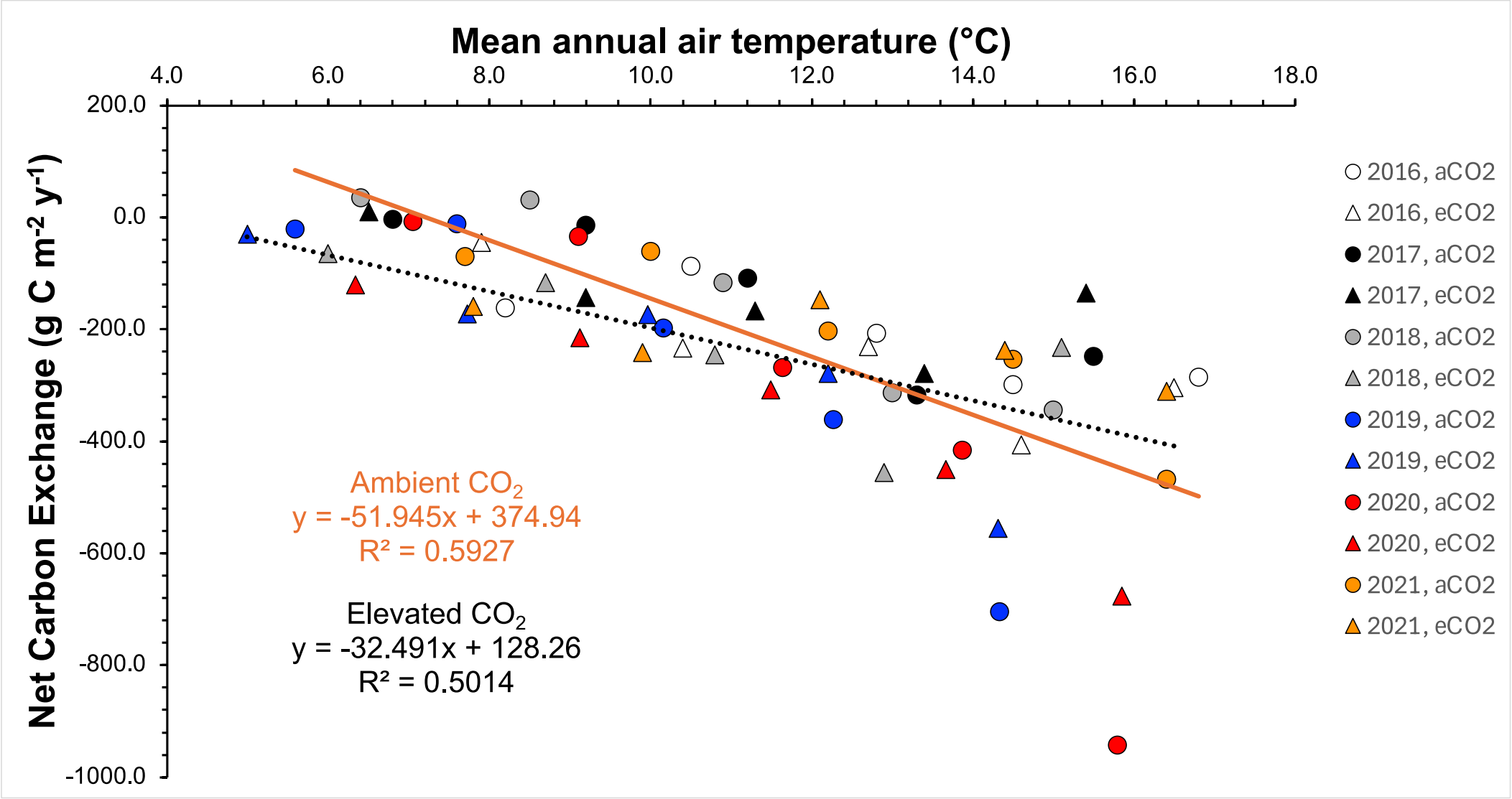


- Despite an increase in total organic C (TOC) concentration warming, the flux of TOC via streamflow has decreased due to reduced outflow.

Griffiths, Sebestyen, Oleheiser, et al.

We are still observing a net loss in C with warming, of ~32 to 52 g C m^{-2} y^{-1} per degree C of warming



On Thursday, a workshop will convene to discuss C and nutrient budget components (empirical + modeling)

- Share findings on key components of the C, N, and P cycle at SPRUCE;
- Assemble preliminary C, N, P budgets for SPRUCE;
- Discuss status of measurements/modeling/analyses;
- Identify model and what measurements/data synthesis needs;
- Identify and attempt to address challenges/assumptions/ uncertainty that go into various C and nutrient budget component calculations and model evaluations;
- Compare modelled vs. empirical results to examine cohesion between C and nutrient budget estimates;
- Outline C and nutrient budget synthesis papers.