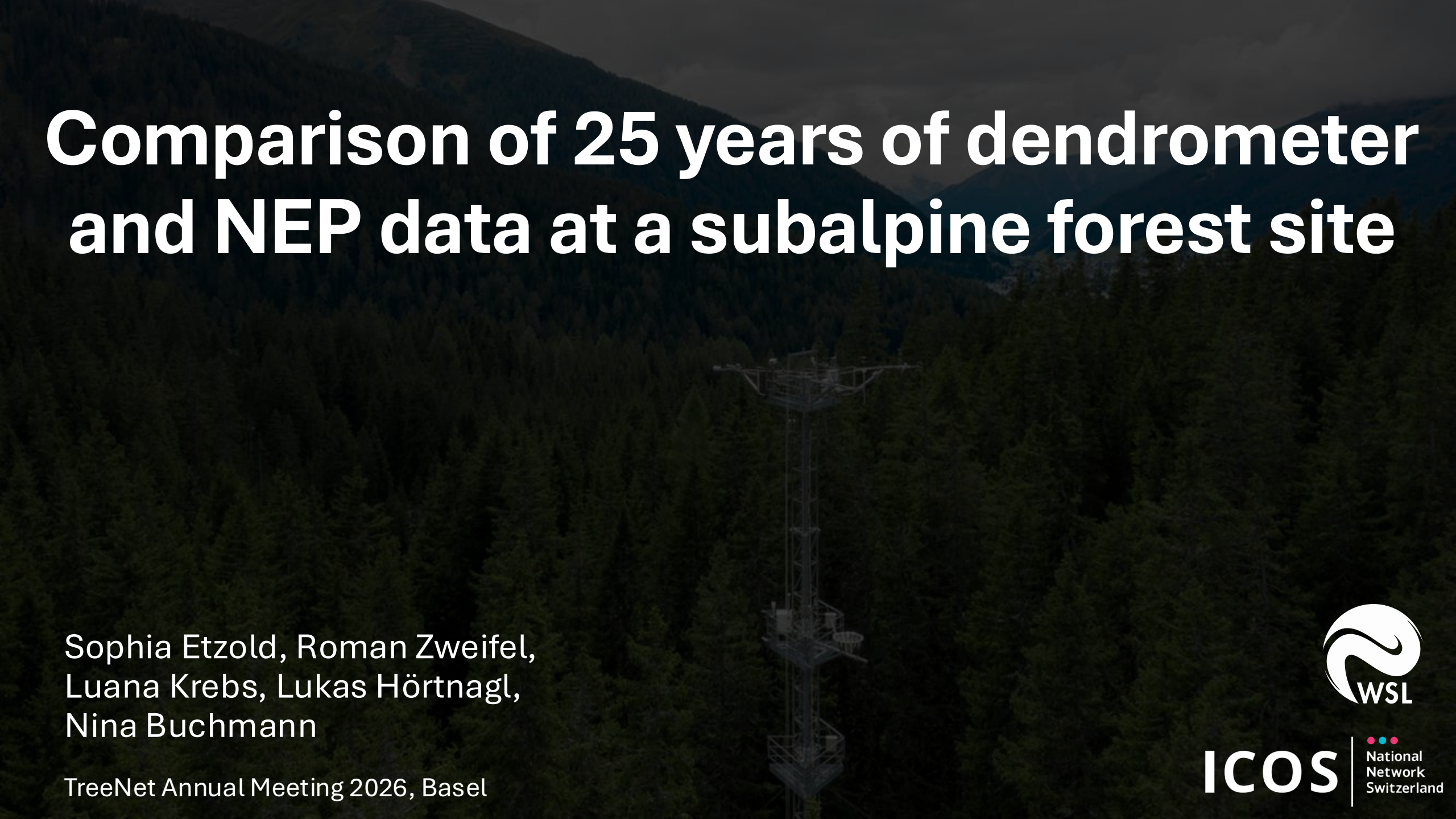
Comparison of 25 years of dendrometer and NEP data at a subalpine forest site



Sophia Etzold, Roman Zweifel,
Luana Krebs, Lukas Hörtnagl,
Nina Buchmann

TreeNet Annual Meeting 2026, Basel

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Eddy-Covariance Measurements:

- Net Ecosystem Exchange: CO2 uptake and release from the ecosystem **NEE**
- Gross Primary Productivity **GPP**
- Ecosystem respiration **TER**
- Measured 35m above the canopy
- Representative for the footprint area of

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- Representative for the footprint area

Point dendrometer measurements:

- Stem radius changes **SRC**
- Stem radial increment **GRO**
- Tree water deficit **TWD**
- Measured 1m above ground at the tree stem
- At 2 to 10 dominant trees

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New Phytologist

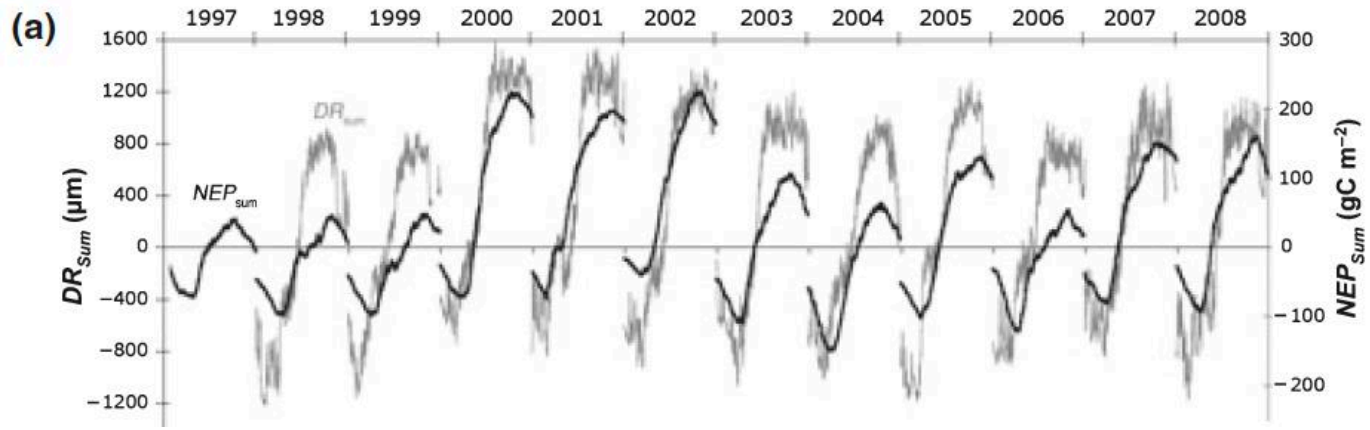
Research

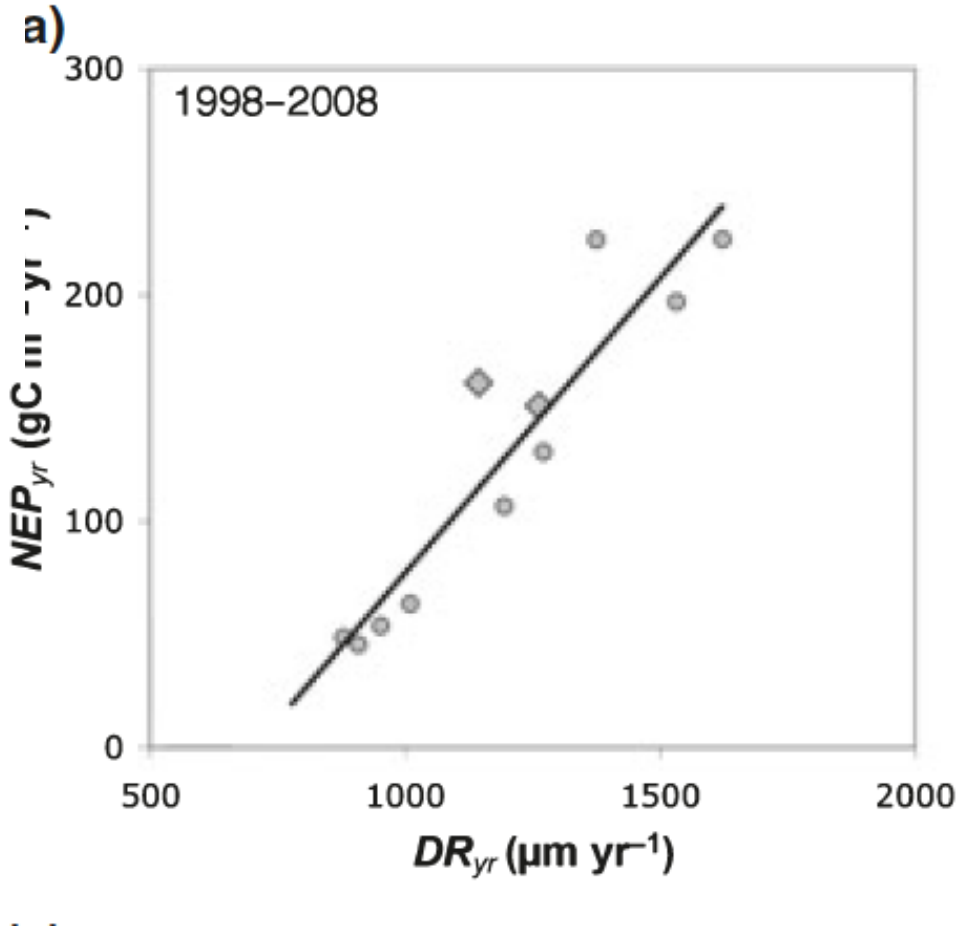
ICOS National Network Switzerland

Link between continuous stem radius changes and net ecosystem productivity of a subalpine Norway spruce forest in the Swiss Alps

R. Zweifel[1,2], W. Eugster[2], S. Etzold[2], M. Dobbertin[1], N. Buchmann[2] and R. Häsler[1]

[1]Swiss Federal Research Institute WSL, Forest Ecosystem Processes, Zuercherstrasse 111, CH-8903 Birmensdorf, Switzerland; [2]ETH Zurich, Institute for Plant, Animal and Agroecosystem Sciences, Universitaetsstr. 2, 8092 Zurich, Switzerland





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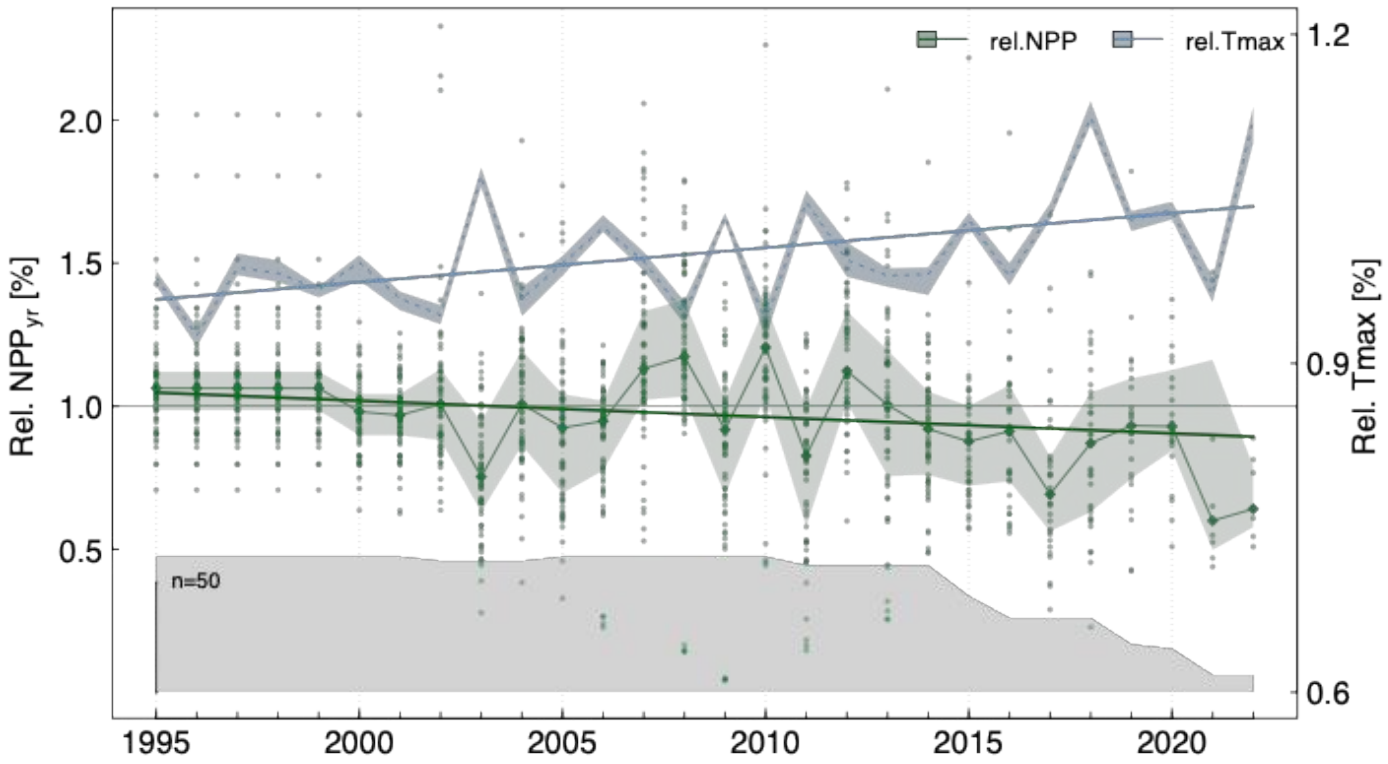
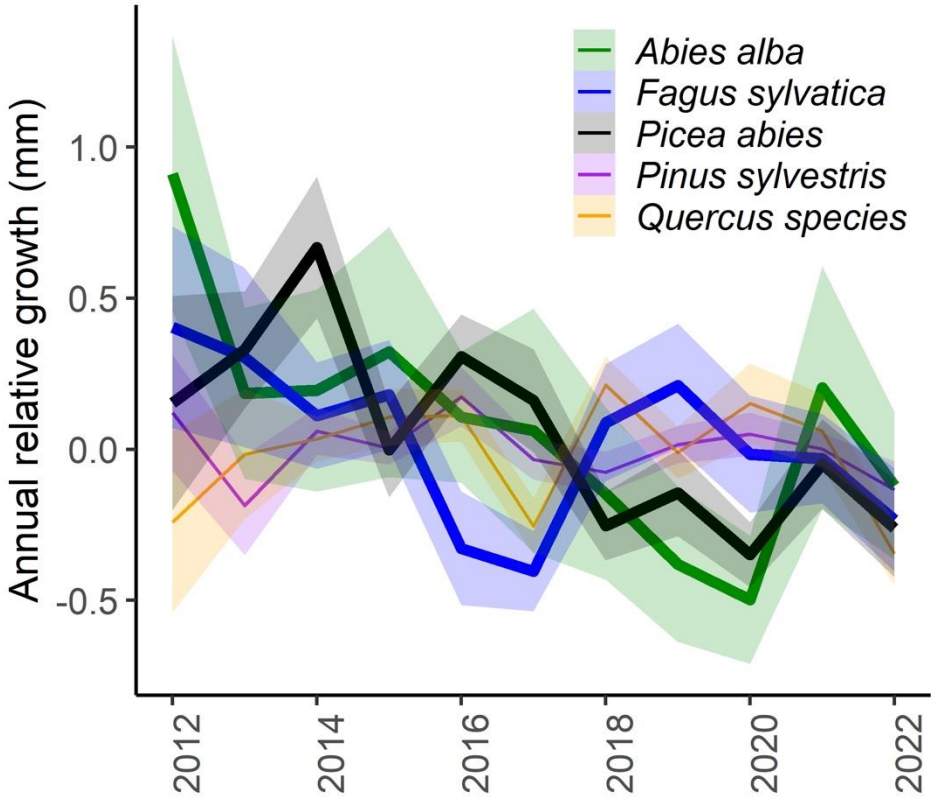
LWF and TreeNet monitoring data show decreasing growth trends



Etzold et al. in review



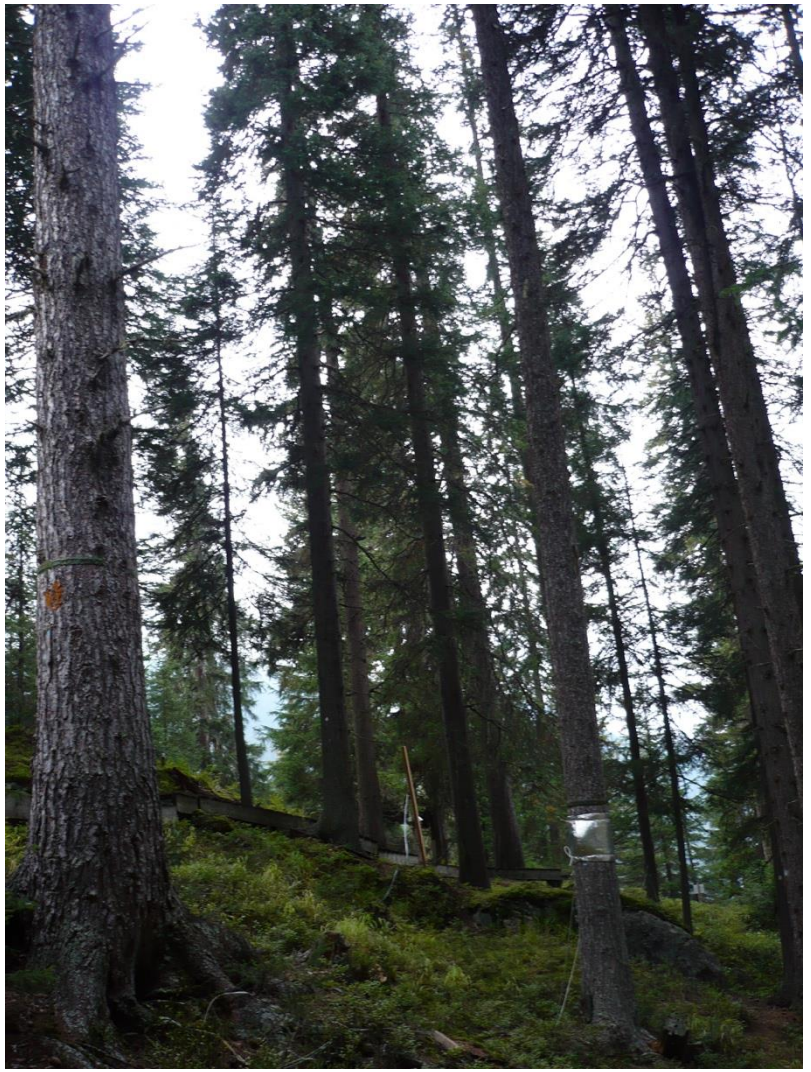
Bose et al. 2024, Global Change Biology

Research questions

- How is tree growth developing in Davos, a subalpine forest? Is the productivity benefiting from climate warming?
- How are tree growth measured by dendrometers and ecosystem fluxes related to each other?
- Do they show the same relations as in 2008? Do they show similar temporal dynamics in absolute terms and in phenology?

Davos site

- 1640 m
- Subalpine spruce forest
- Mean annual air temperature: 4.3°C
- Mean annual precipitation sum: 876 mm
- Understory: dwarf shrubs of Vaccinium myrtillus, mosses
- Average tree age: 119 years
- Average height: 17.5 m
- 25 years of dendrometer and EC measurements



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RESEARCH ARTICLE OPEN ACCESS

Net Ecosystem CO_2 Exchange of a Subalpine Spruce Forest in Switzerland Over 26 Years: Effects of Phenology and Contributions of Abiotic Drivers at Daily Time Scales

Luana Krebs[1] | Lukas Hörtnagl[1] | Liliana Scapucci[1] | Mana Gharun[2] | Iris Feigenwinter[1] | Nina Buchmann[1]

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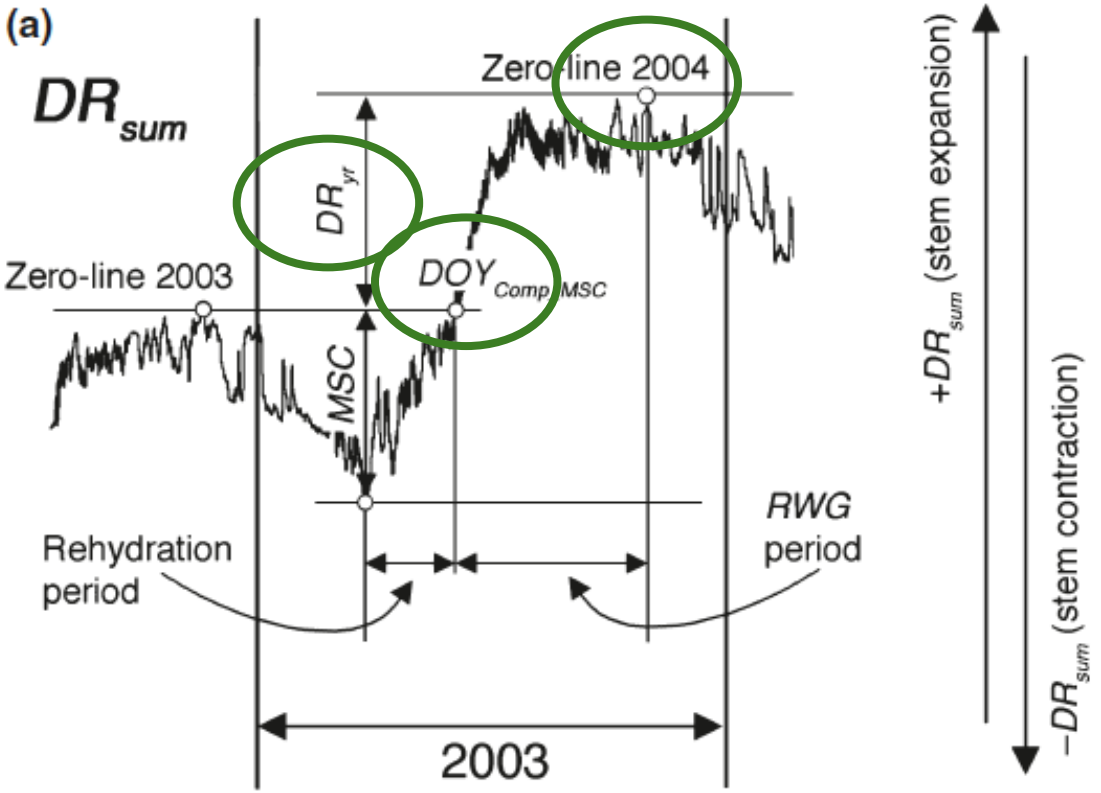
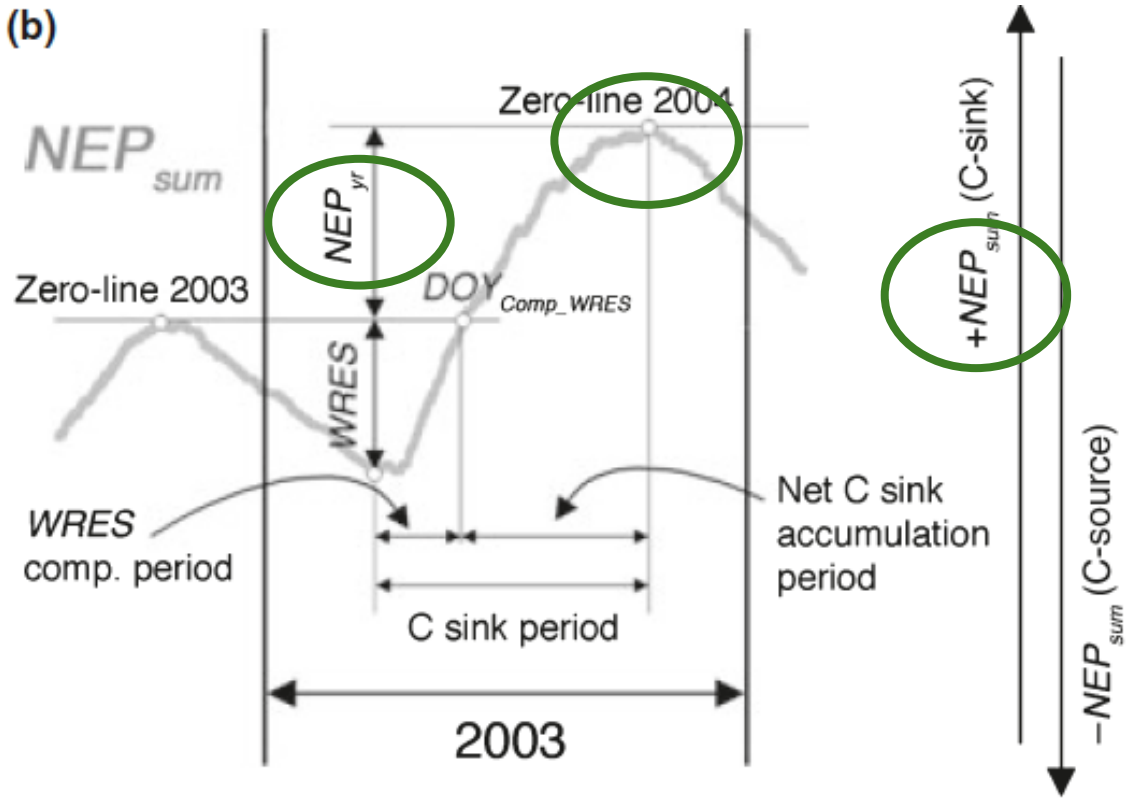
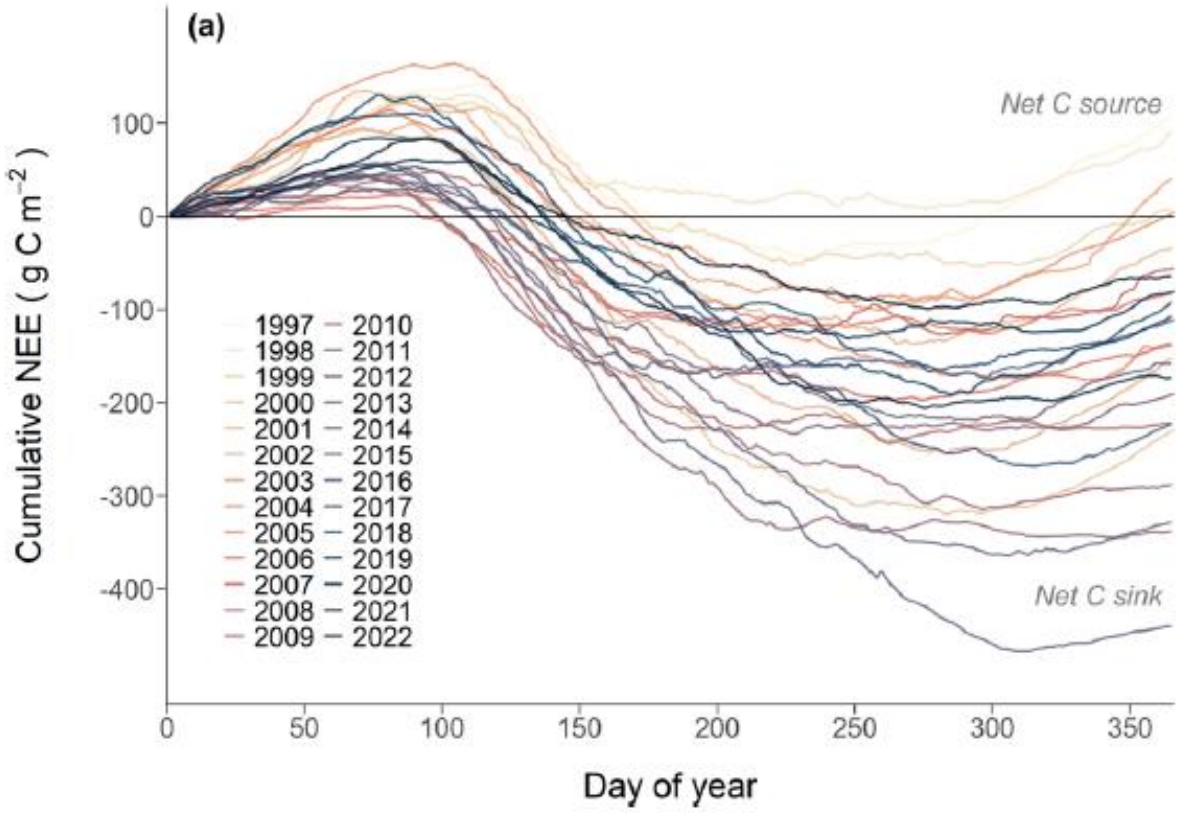
Dendrometer definitions



NEP definitions



Davos - a net CO_2 sink



Krebs et al. 2025, Global Change Biology

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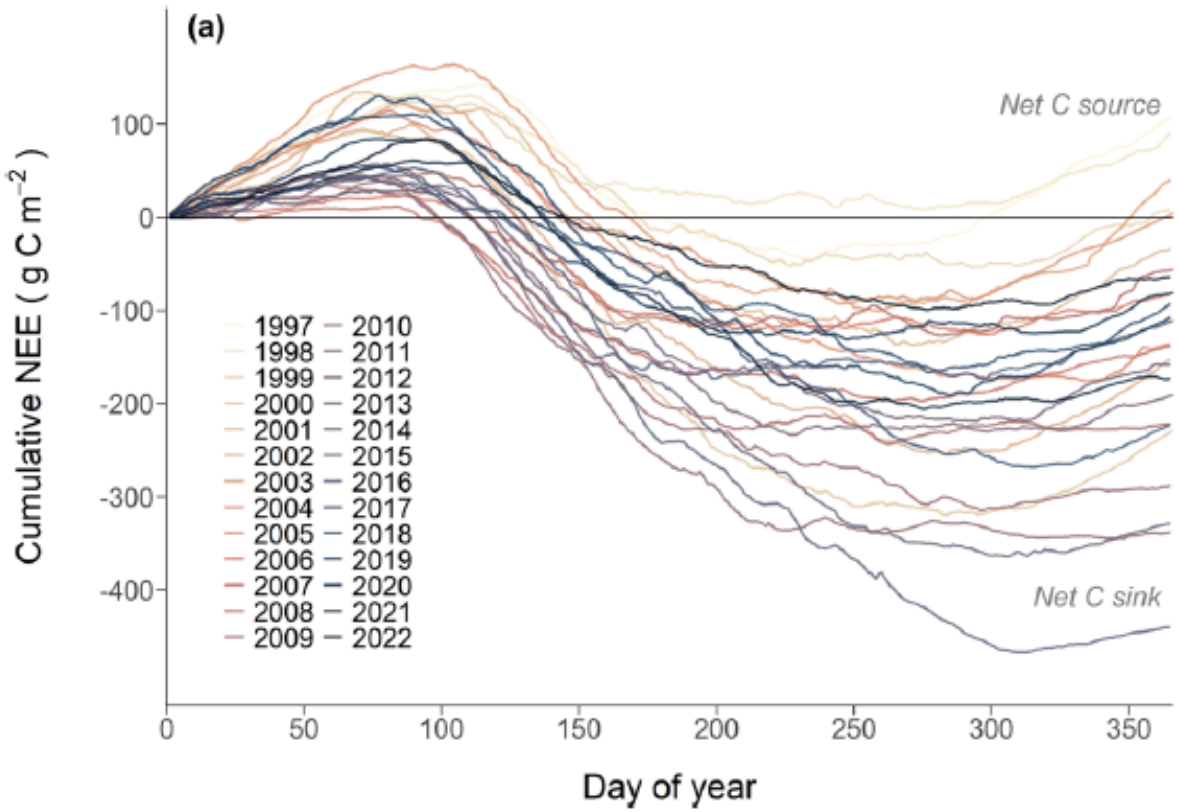
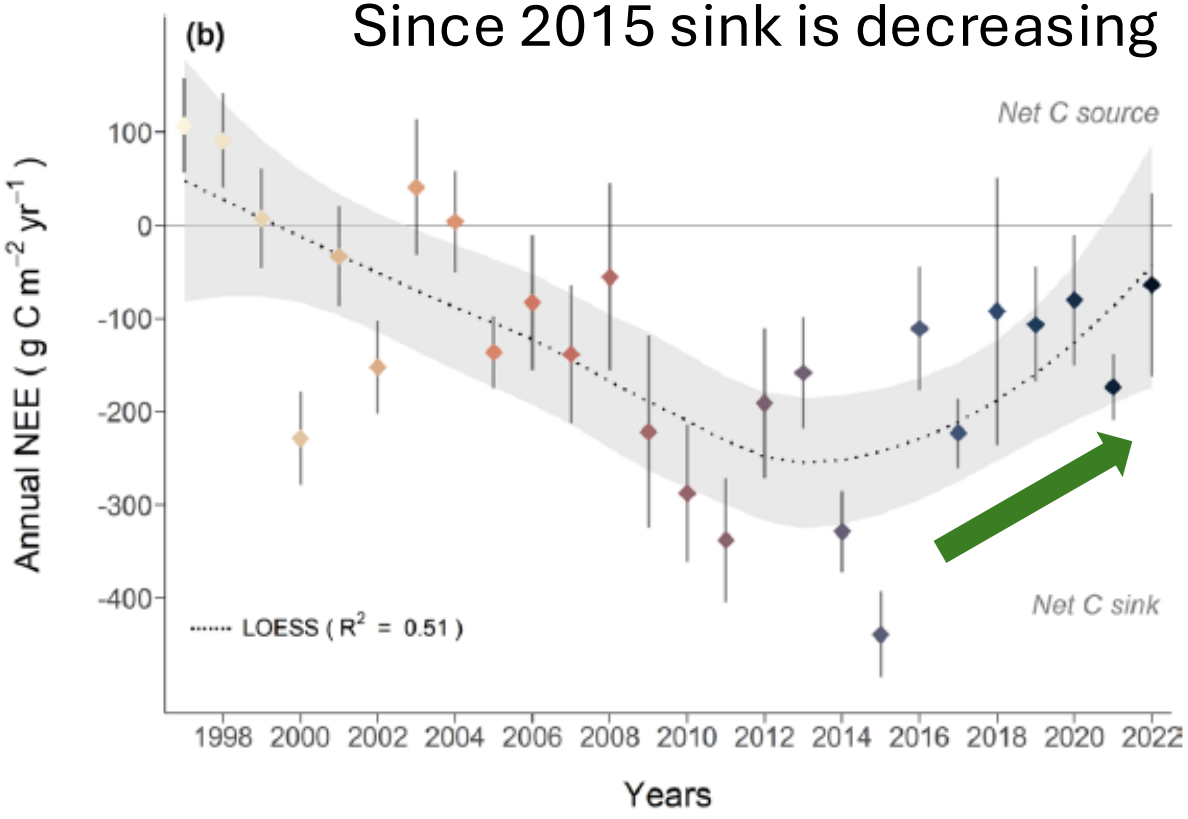
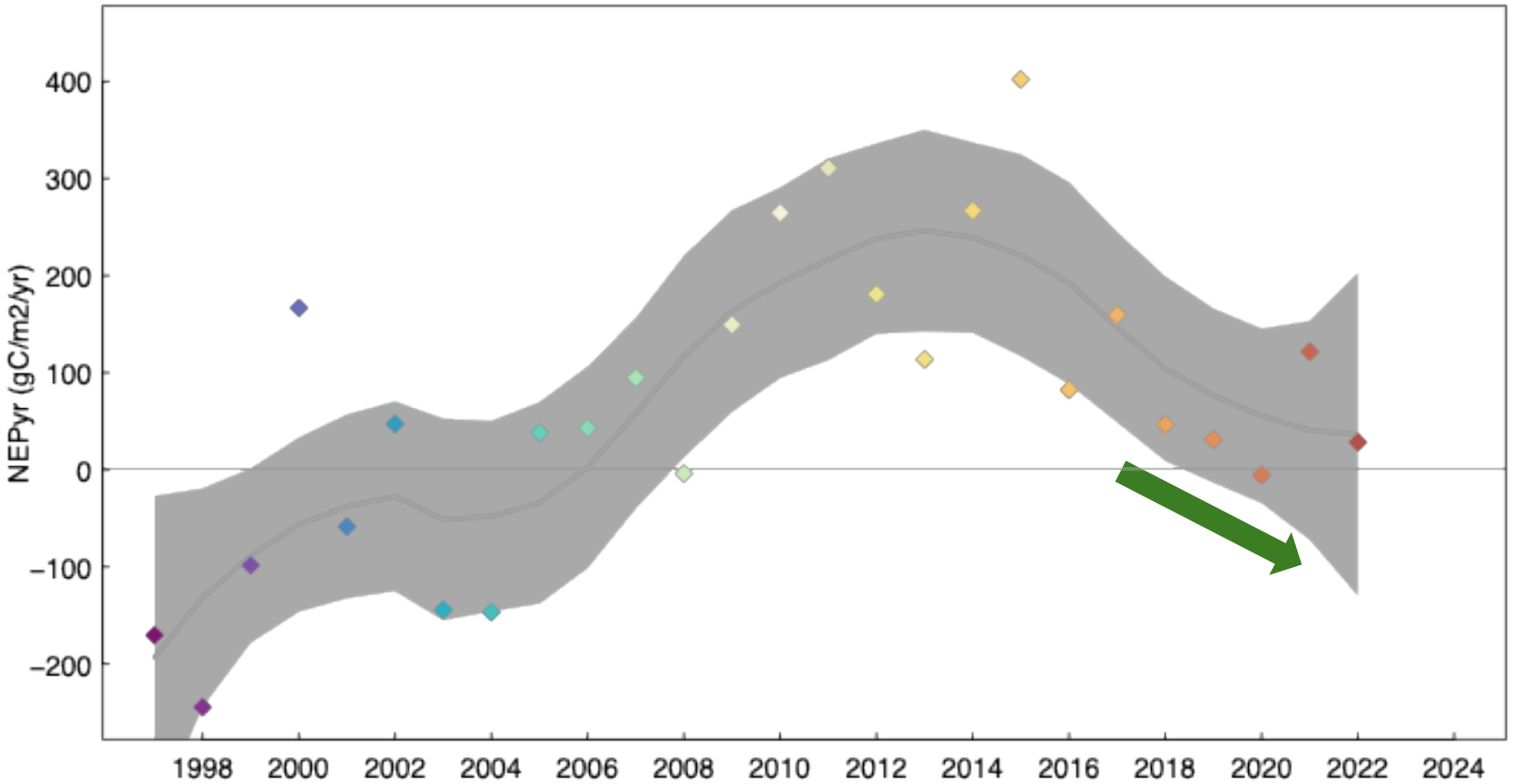


Since 2015 sink is decreasing



Krebs et al. 2025, Global Change Biology

NEPyr vs. rel. GROyr over 25 years



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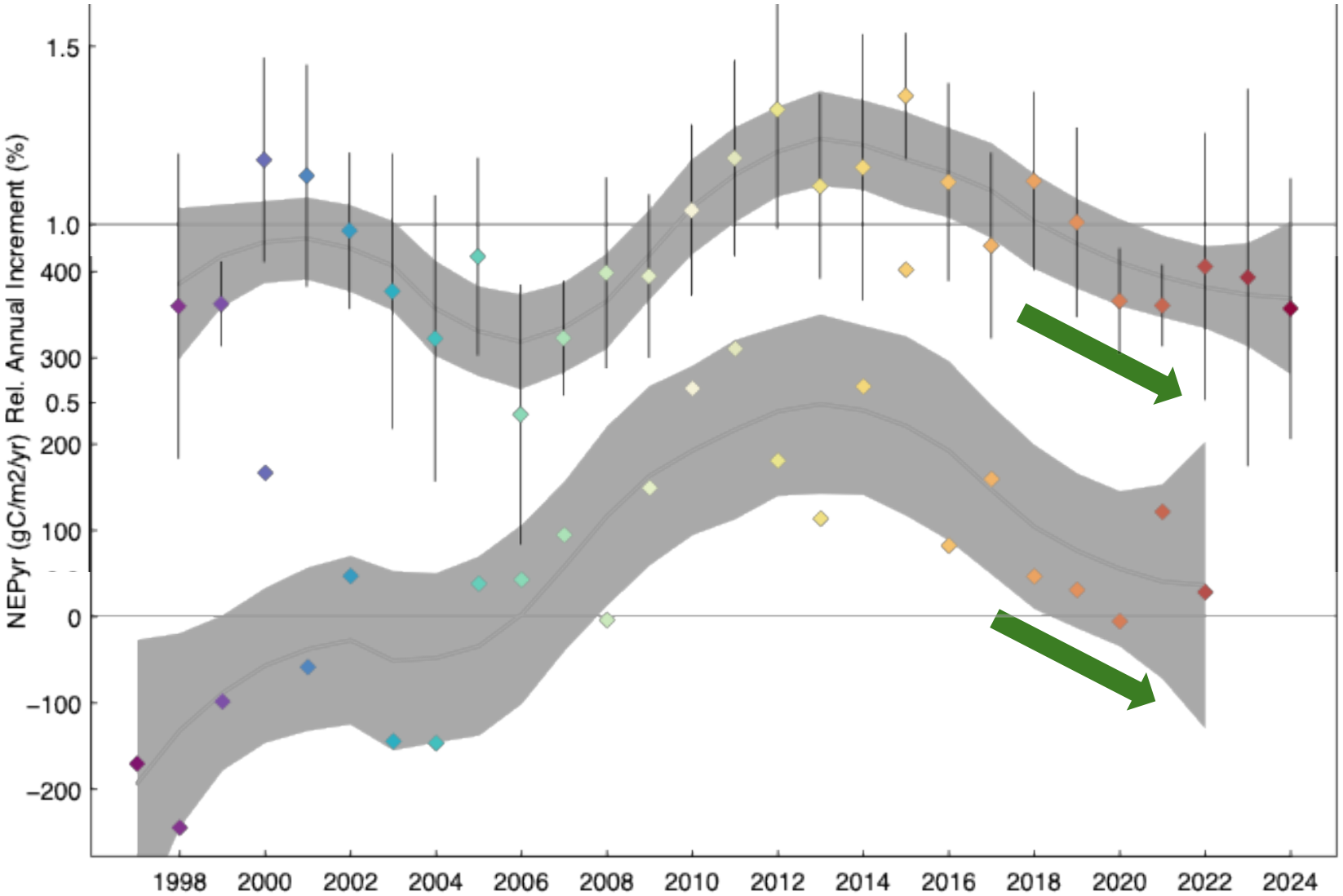
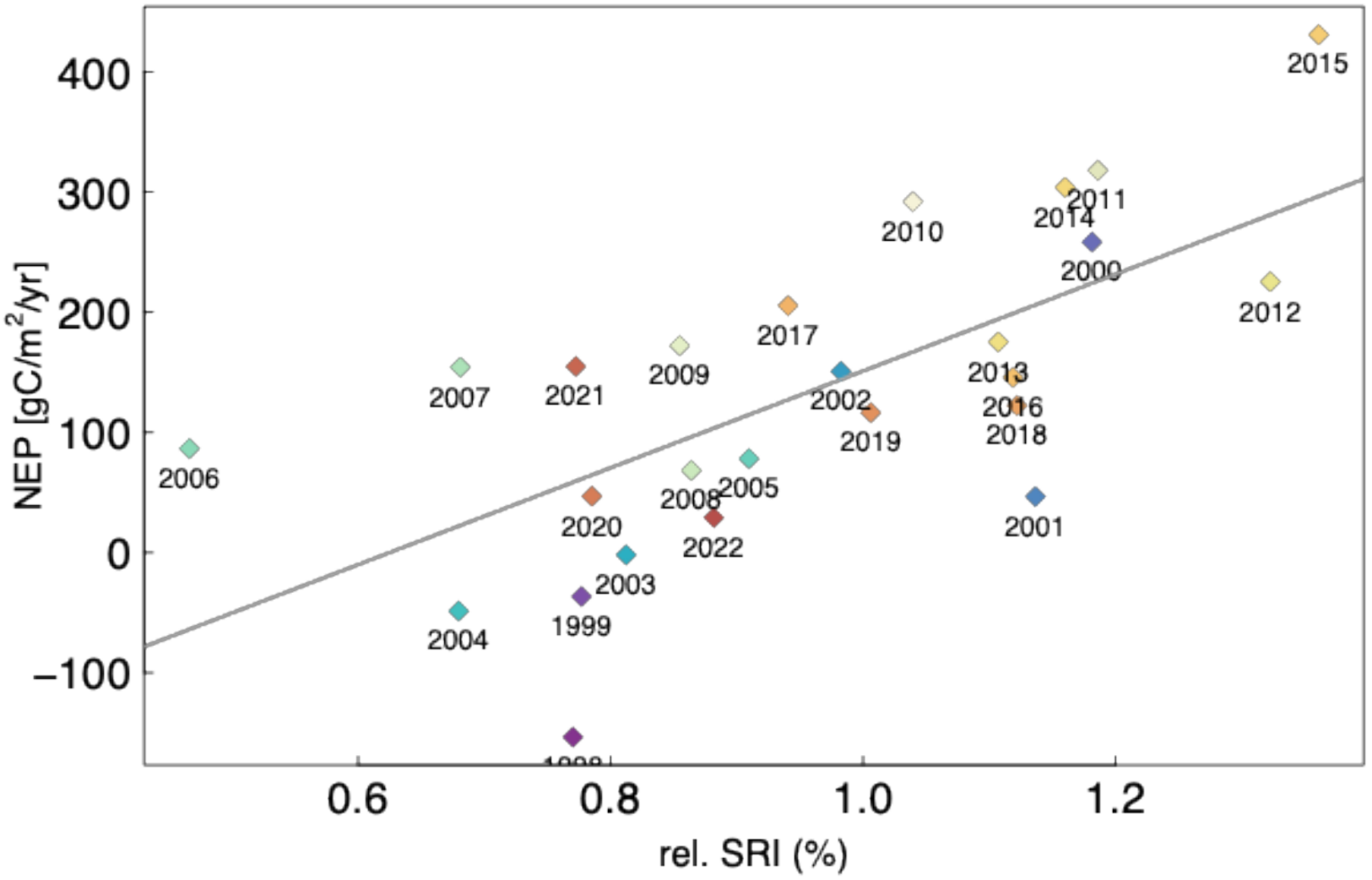


Autocorrelation of:

- rel. GROyr: 0.58
- GROyr: 0.67
- NEPyr: 0.54
- NEEyr: 0.42

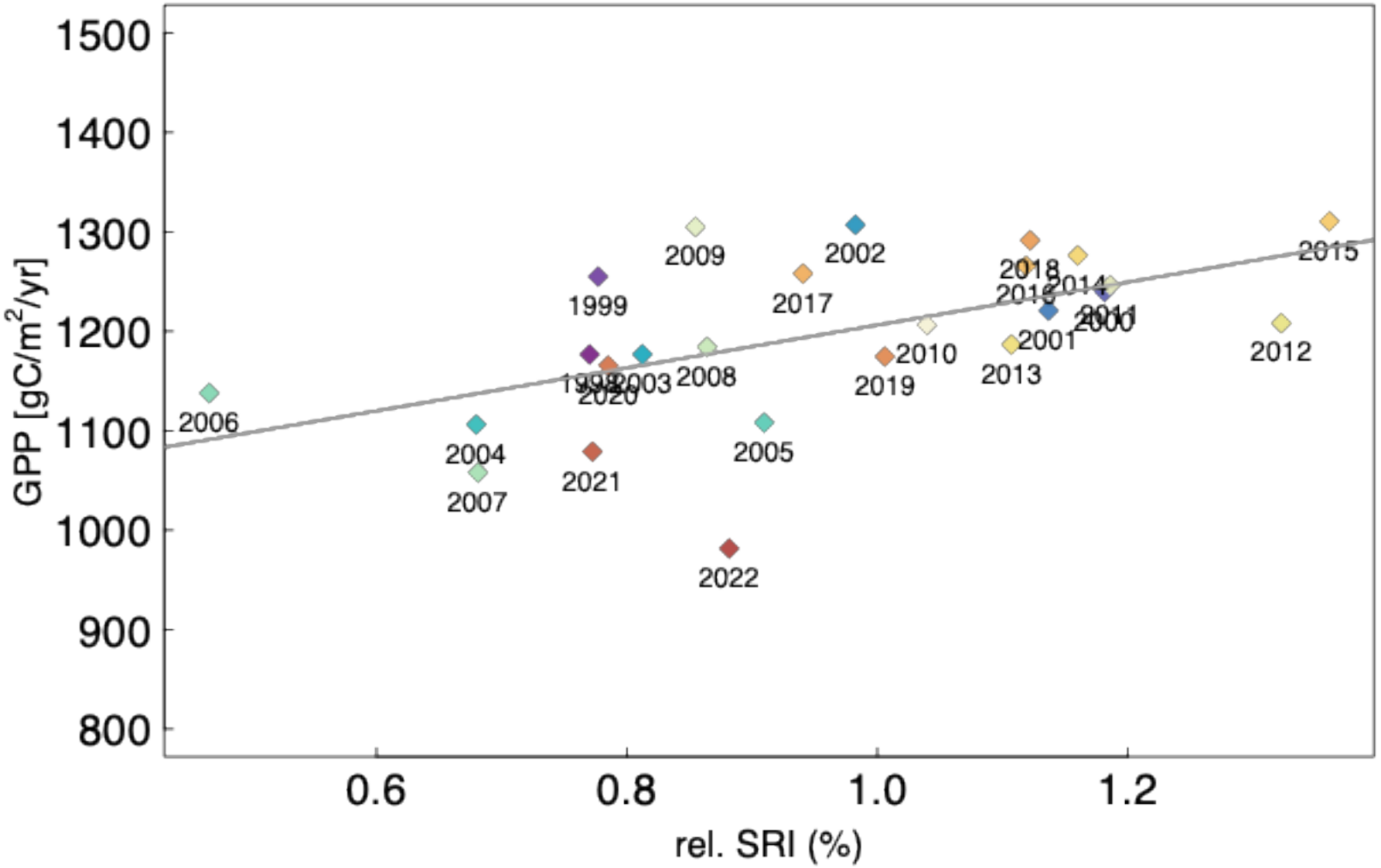
NEPyr vs. rel. GROyr over 25 years



Adj.R2=0.43***

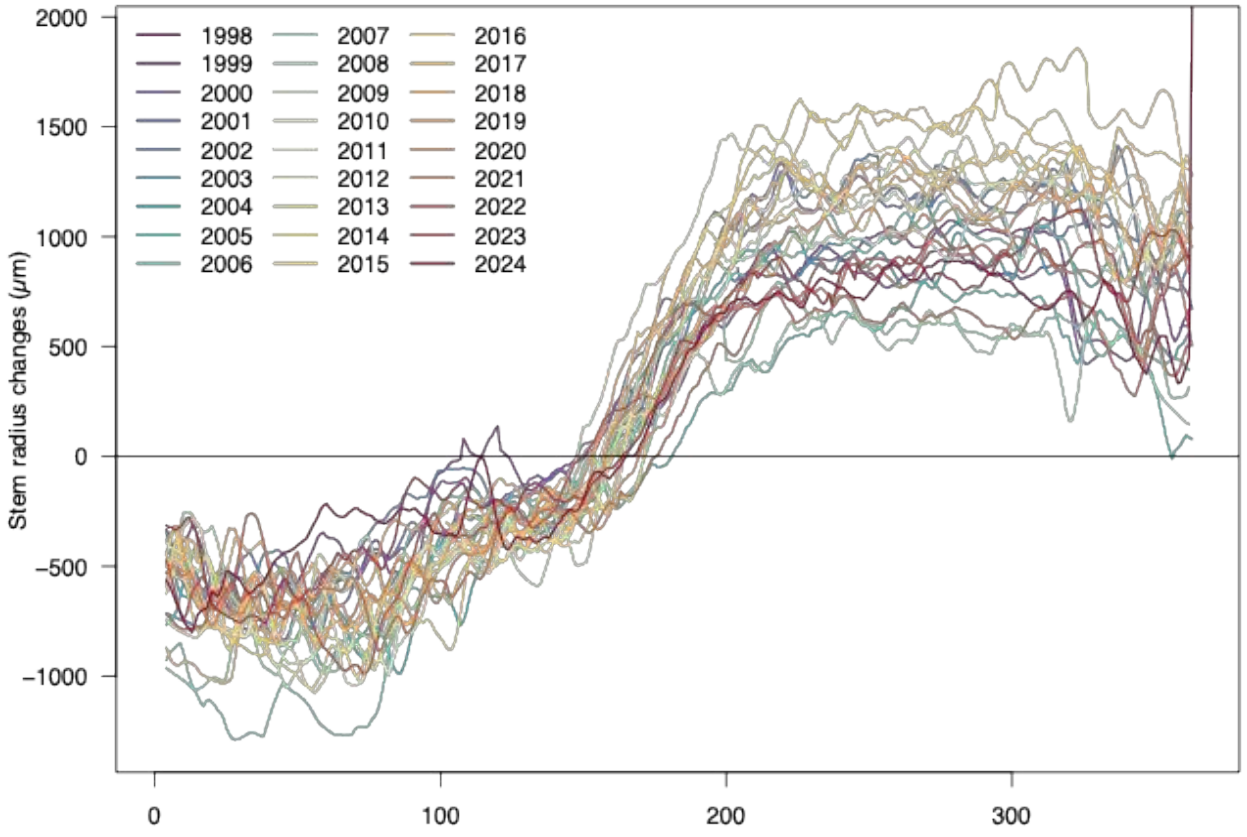
1mm SRI=293gC/m2

GPPyr vs. rel. GROyr over 25 years

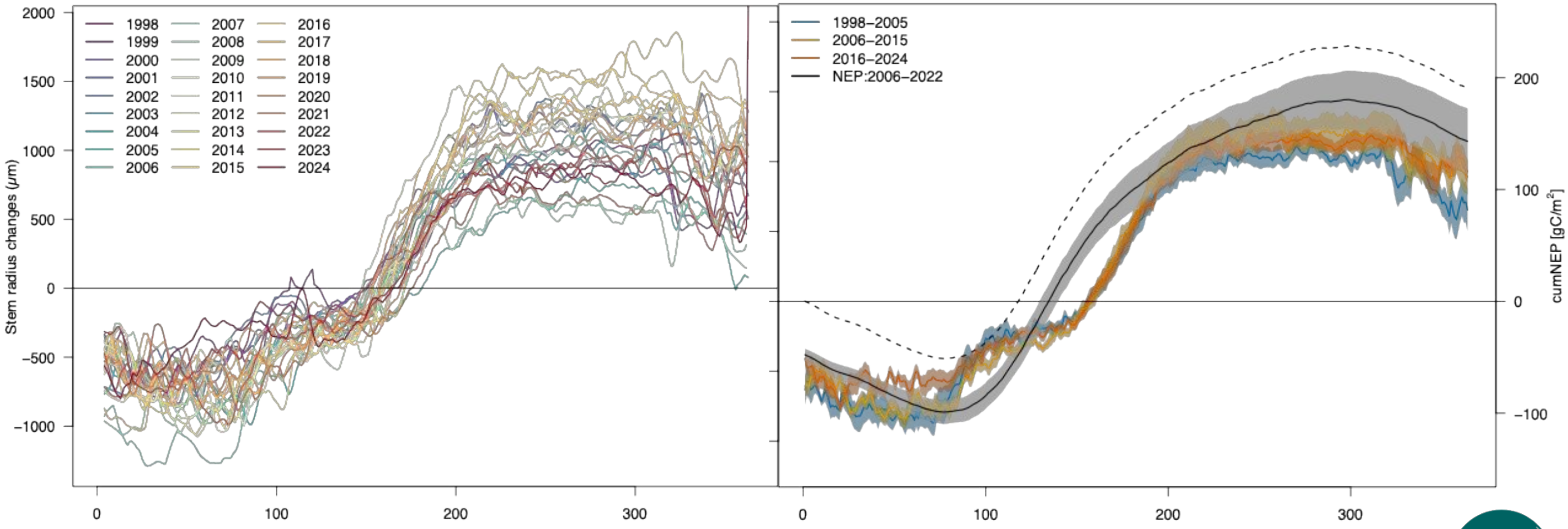


Adj.R2=0.28**

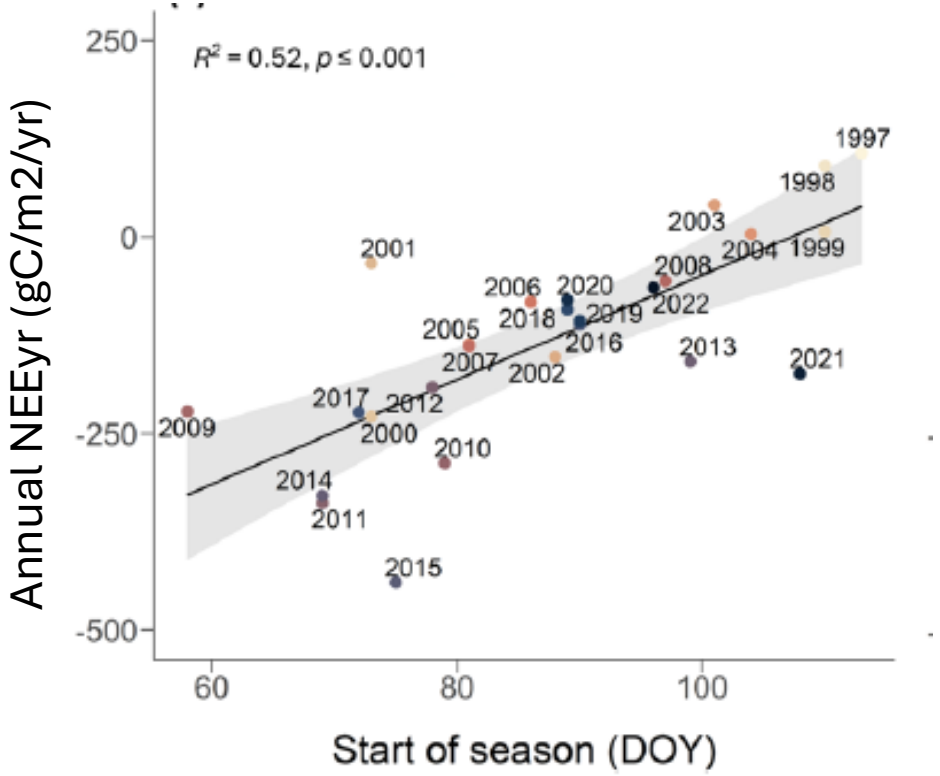
Seasonal Course of SRC



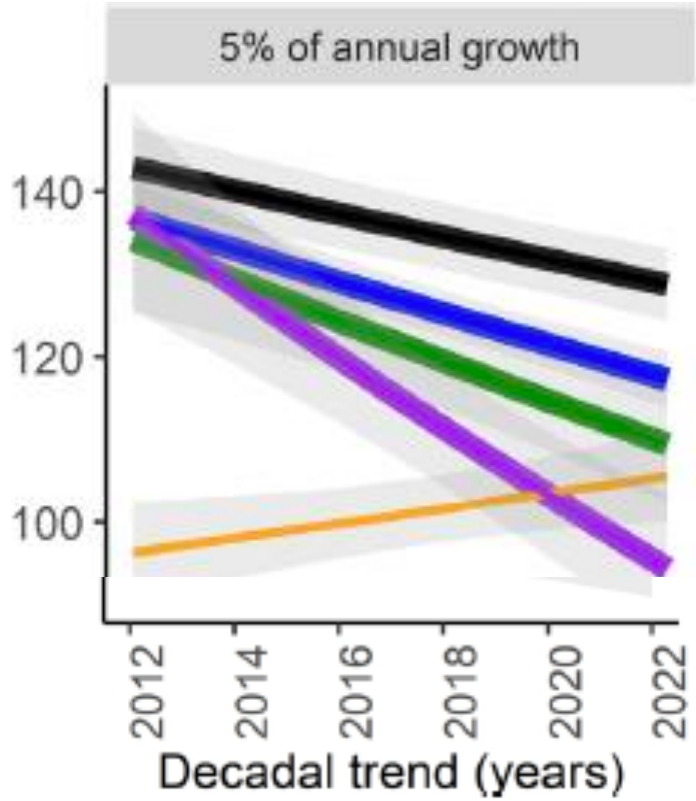
Phenology of GRO - Seasonal Course of SRC



Phenology of GRO – GRO Start



Krebs et al. 2025, Global Change Biology



Bose et al. 2025,
Global Change Biology

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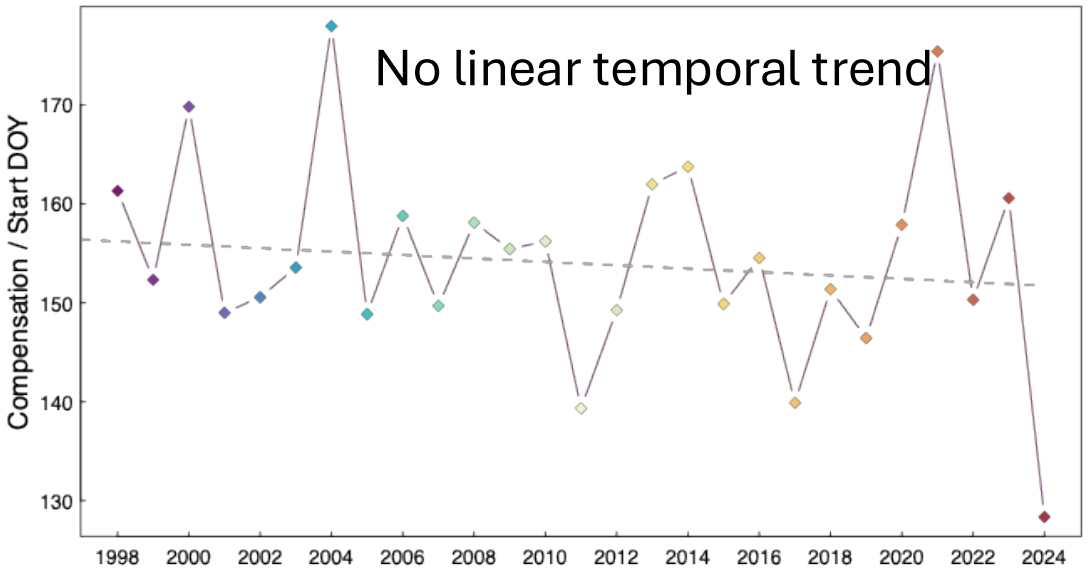
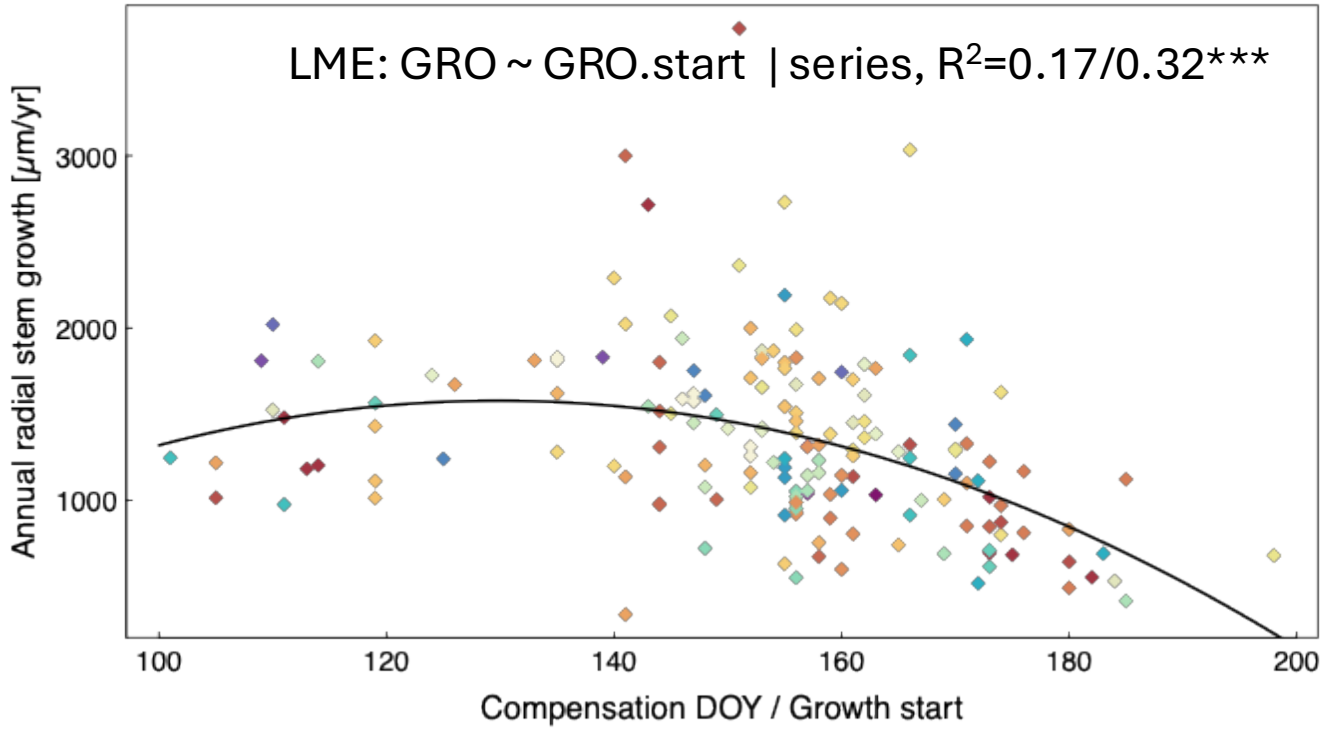
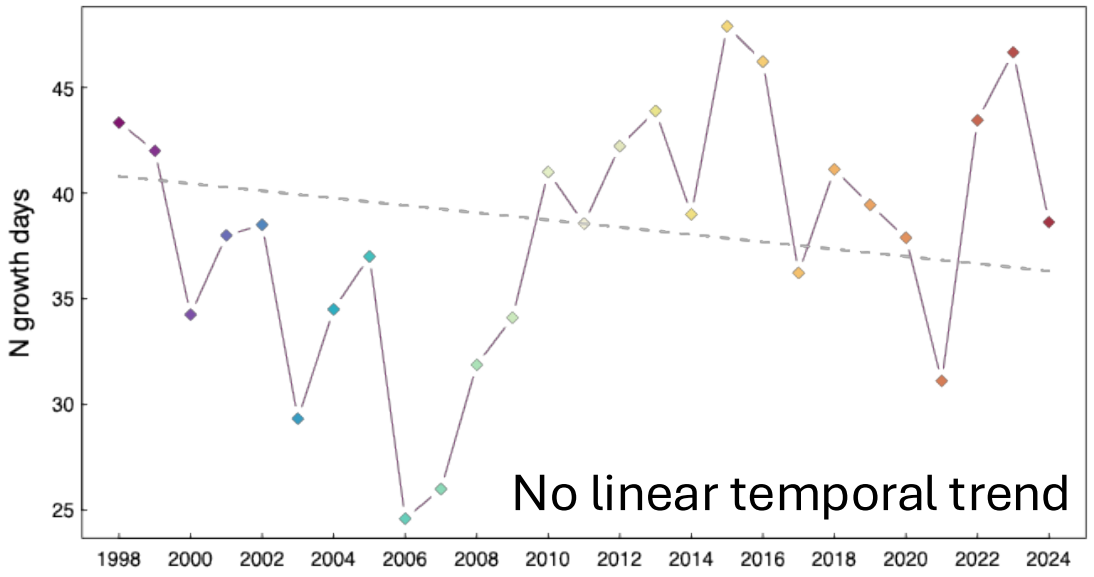
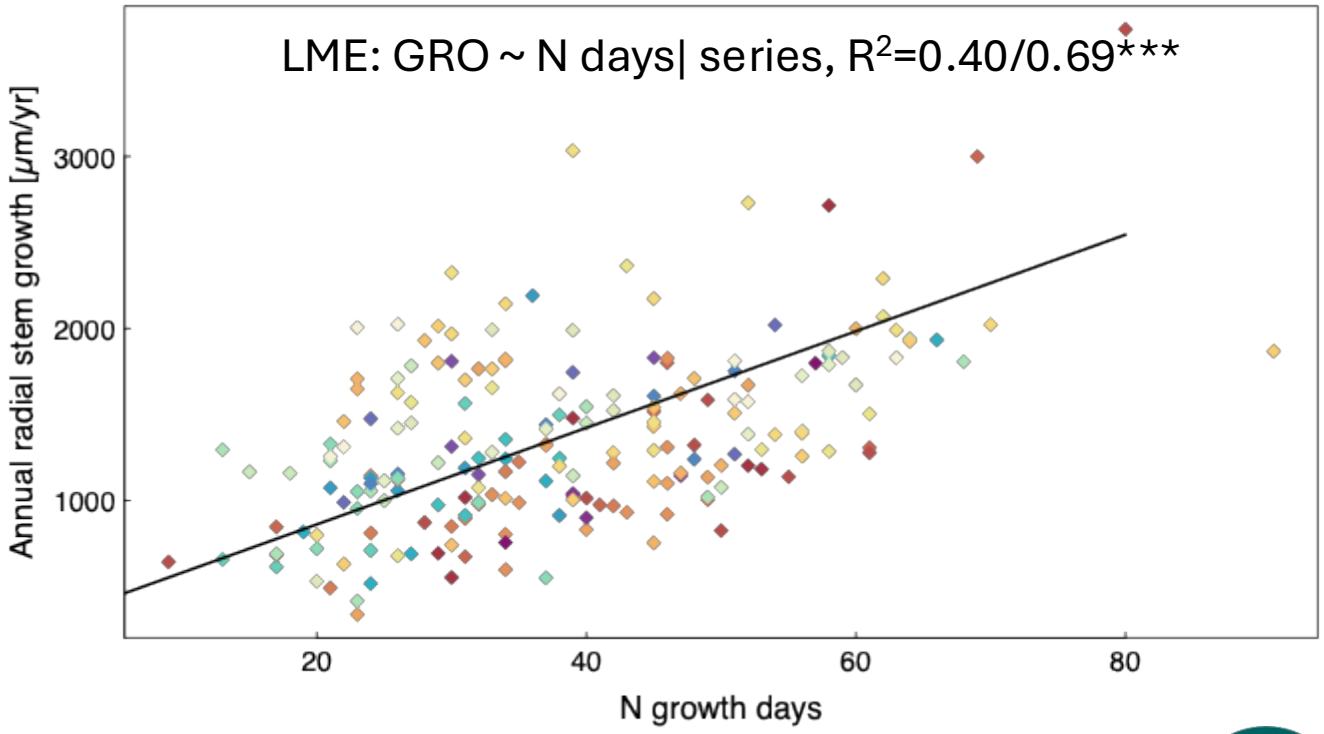


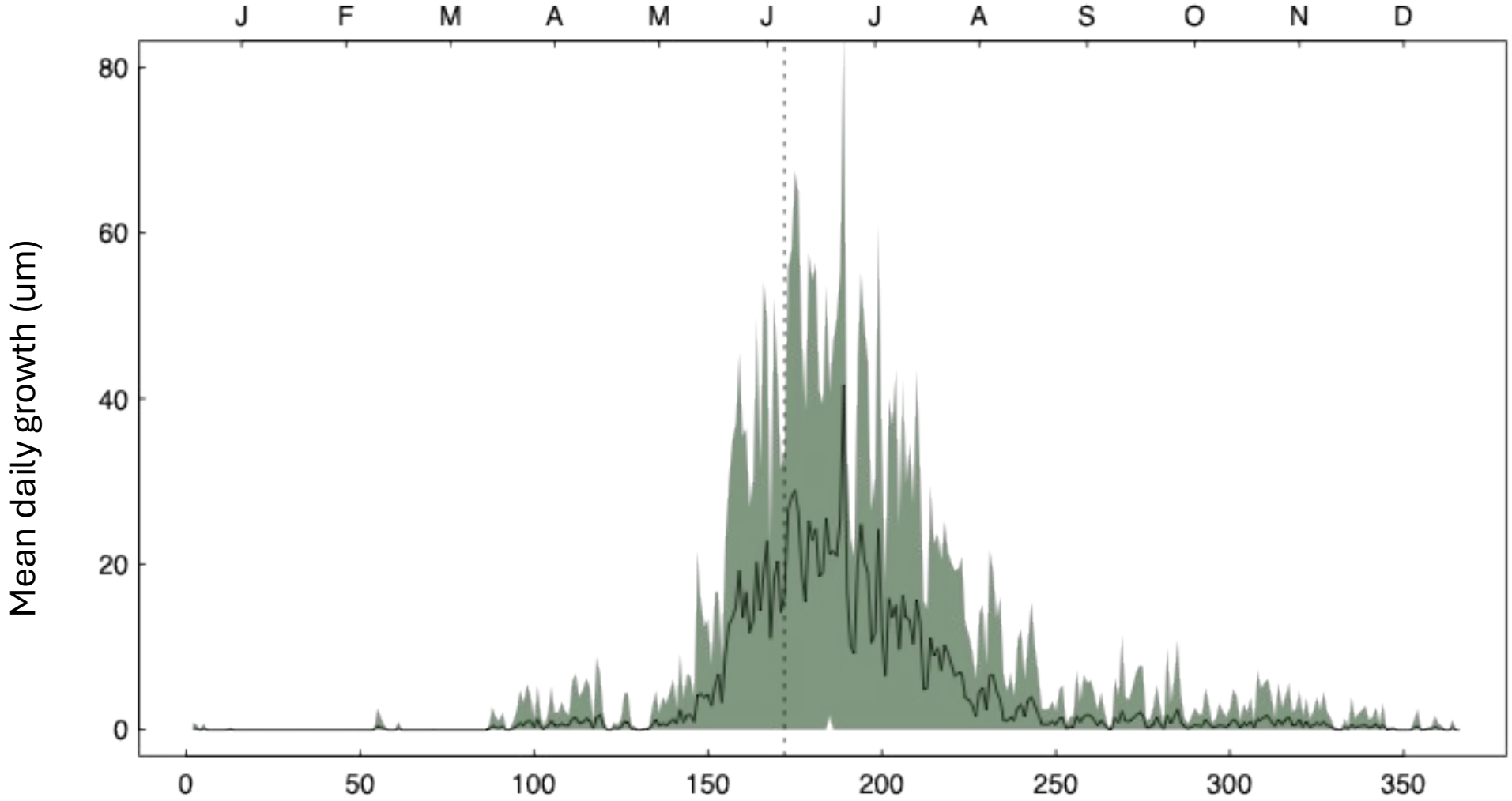


Phenology of GRO – N GRO days

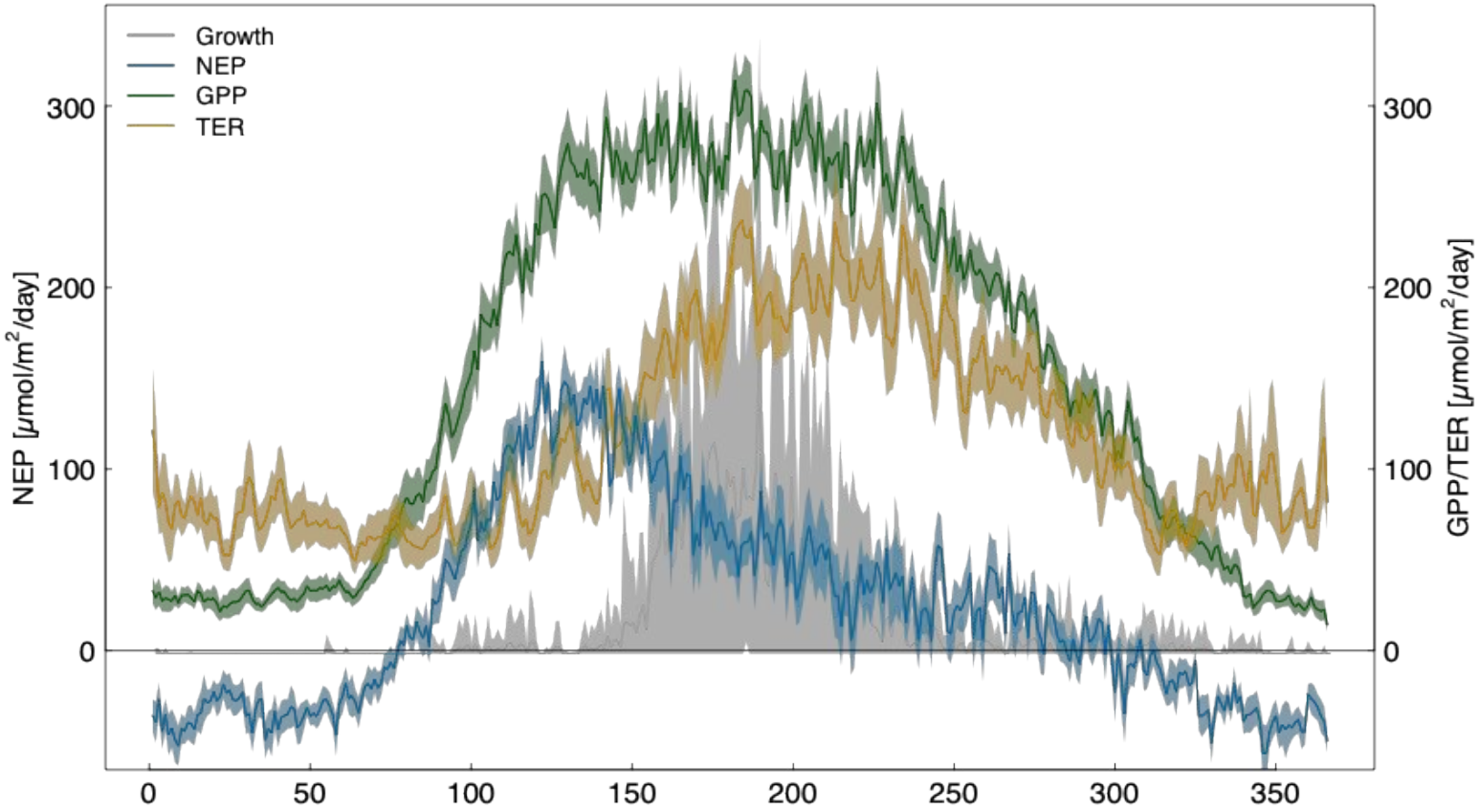




Phenology of GRO



Phenology of GRO, NEE, GPP and TER



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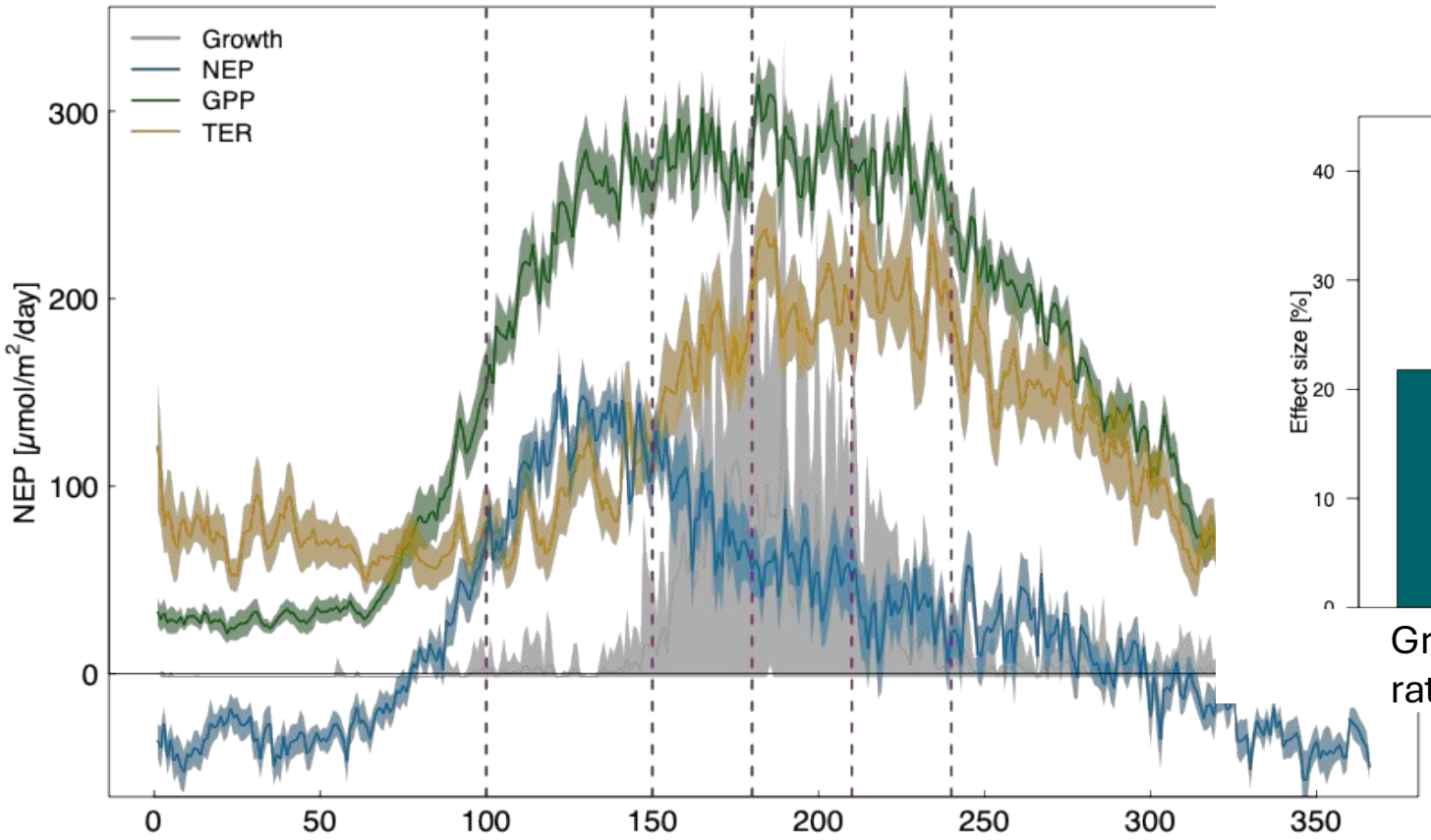
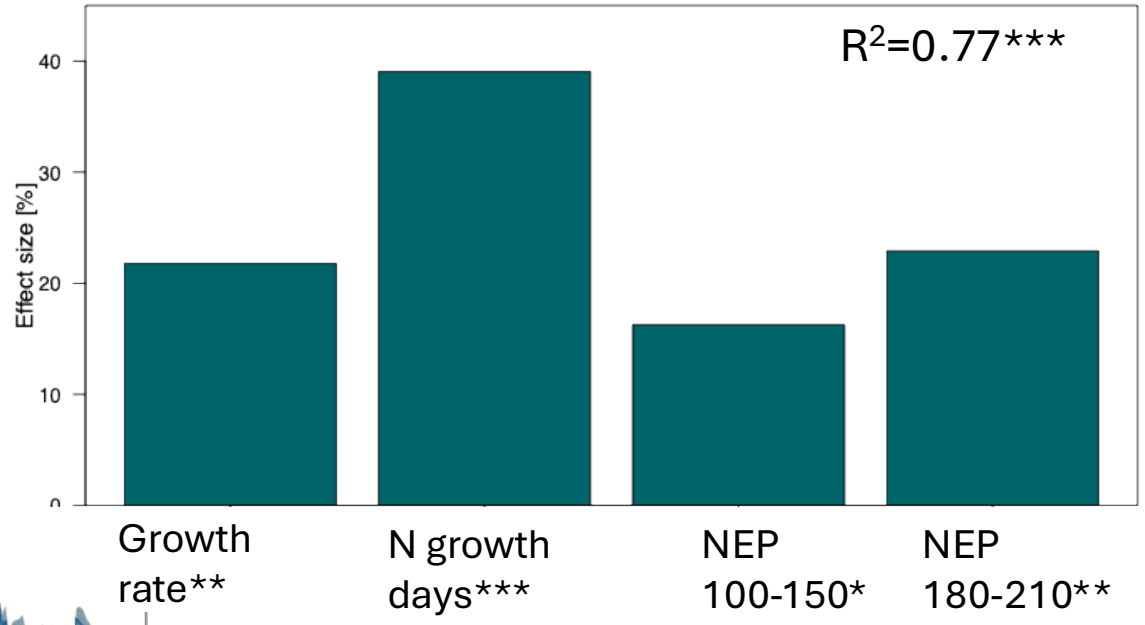


Linear model to explain annual growth:



Summary

- Close correlation between GRO and NEP
- Both show decreasing trends since 2015
- GRO is less correlated to GPP
- Growth start in Davos is not advancing
- Growth is done in three months
- NEP peak before growth starts
- Annual growth is closely related to growth rate and N growth days, but also to NEP before growth period and in July

Next steps: Contribution of abiotic drivers to growth at daily time scales