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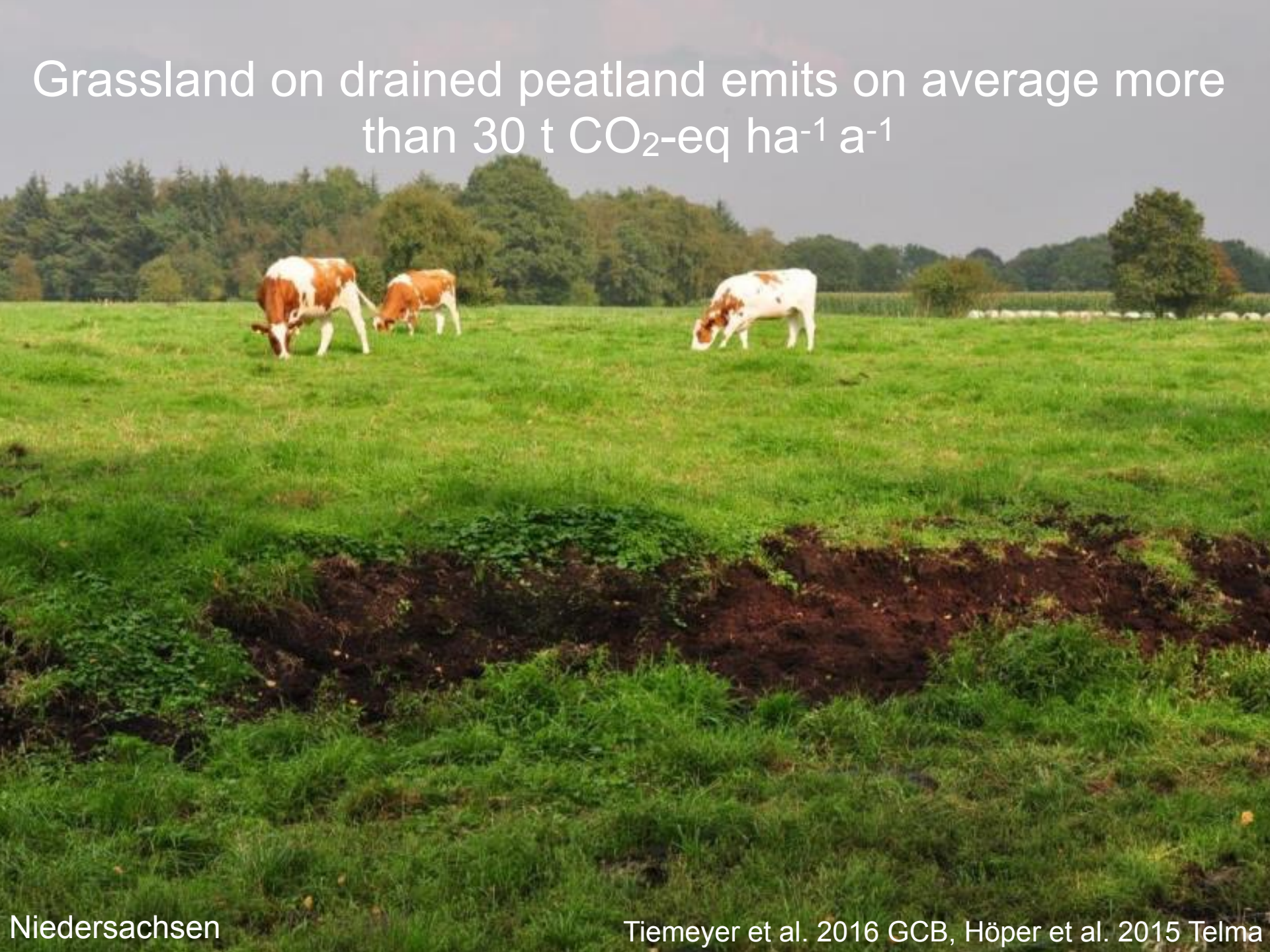
OPTIMOOR

WETSCAPES

OptiMOOR – optimizing management strategies for peat bog restoration after intensive agricultural use

Jurasinski G, Günther A, Bartel A, Gutekunst C, Heinze S, Hofer B, Jacobs O, Koebsch F, Rosinski E, Tonn C, Ullrich K, Huth V

Grassland on drained peatland emits on average more than 30 t CO_2-eq ha^{-1} a^{-1}



Niedersachsen

Tiemeyer et al. 2016 GCB, Höper et al. 2015 Telma

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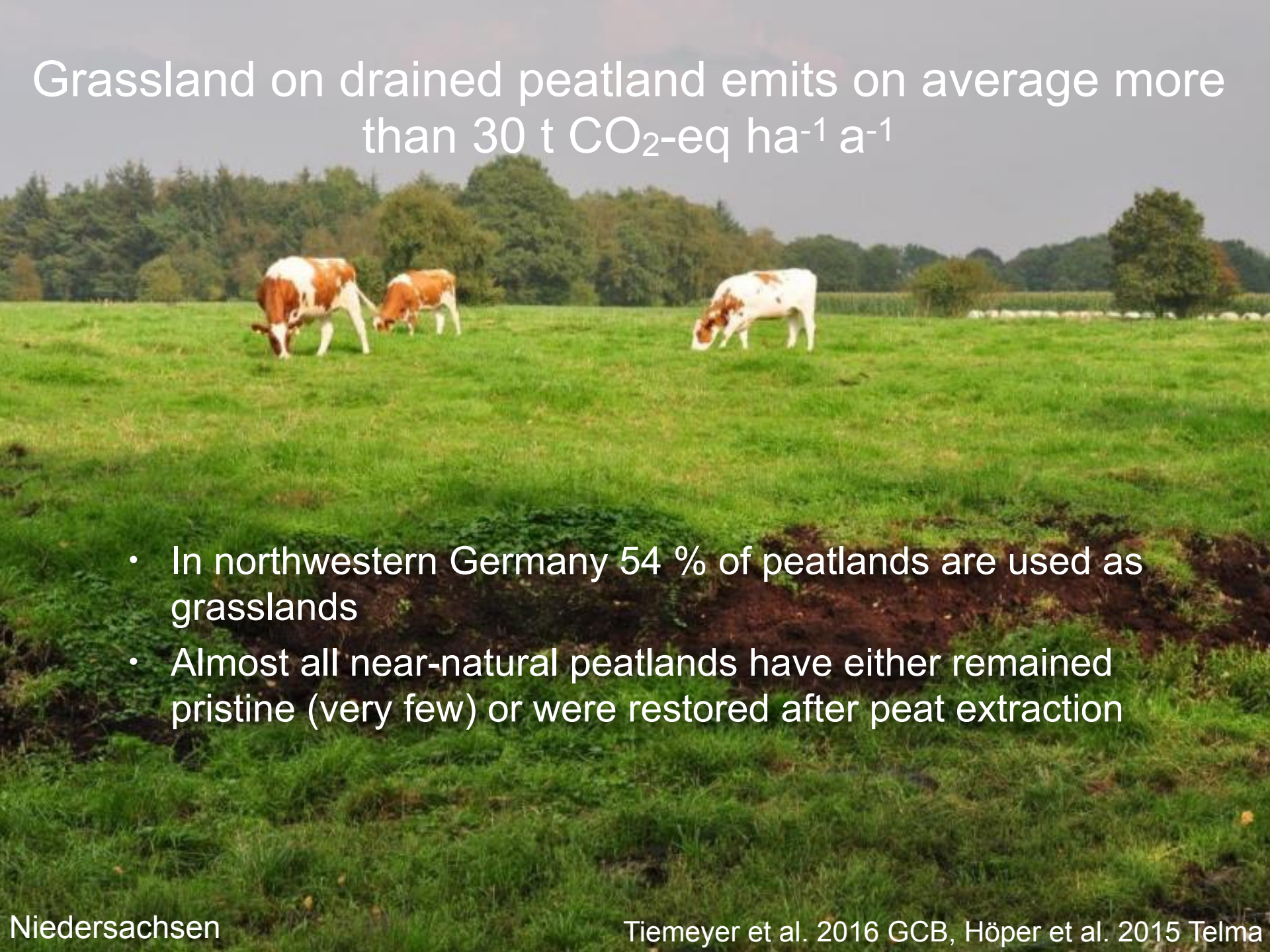


- In northwestern Germany 54 % of peatlands are used as grasslands
- Almost all near-natural peatlands have either remained pristine (very few) or were restored after peat extraction

Niedersachsen

Tiemeyer et al. 2016 GCB, Höper et al. 2015 Telma

Several options to re-establish carbon sink function of bogs formerly used as grasslands

1) Minimizing greenhouse gas emissions from the soil

   → Rewetting?

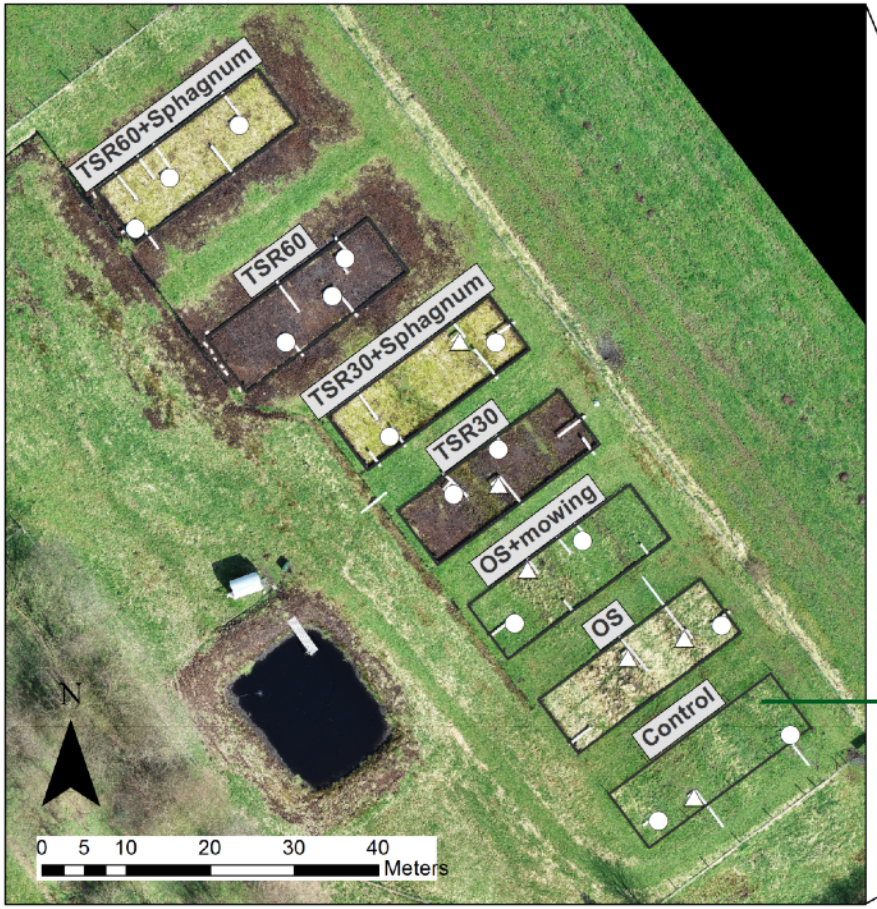
   → Topsoil-removal

2) Establishing peat-forming vegetation

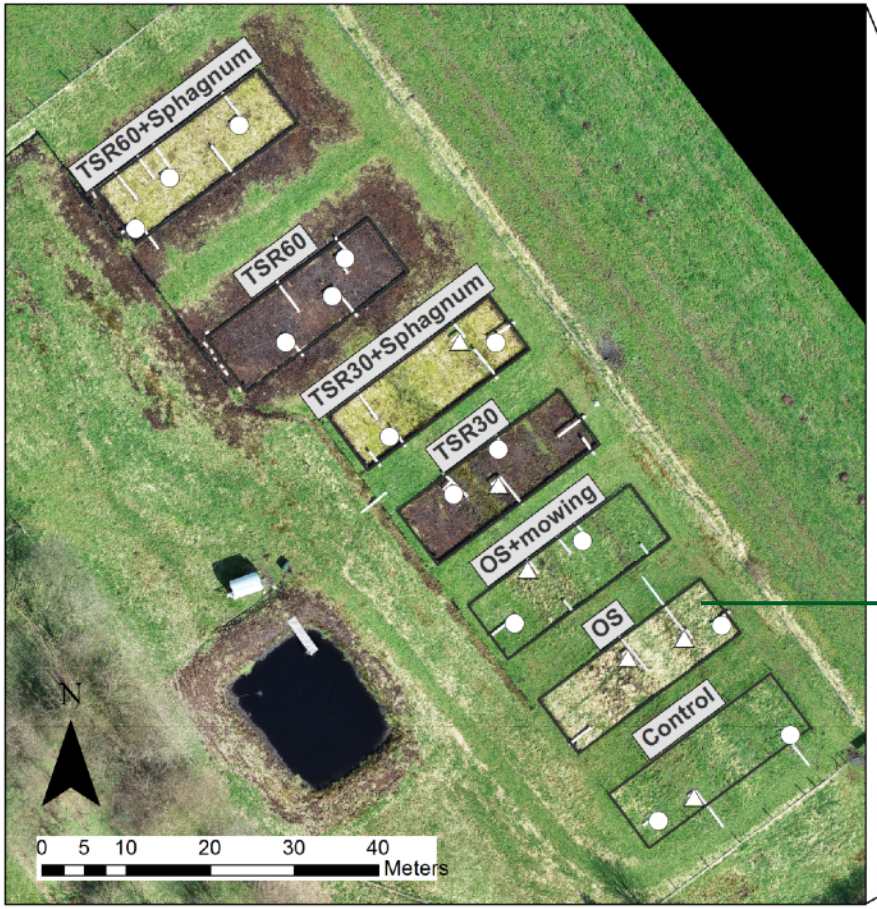
   → Inoculation with *Sphagnum* fragments?

The OptiMOOR field trial

The OptiMOOR field trial



The OptiMOOR field trial



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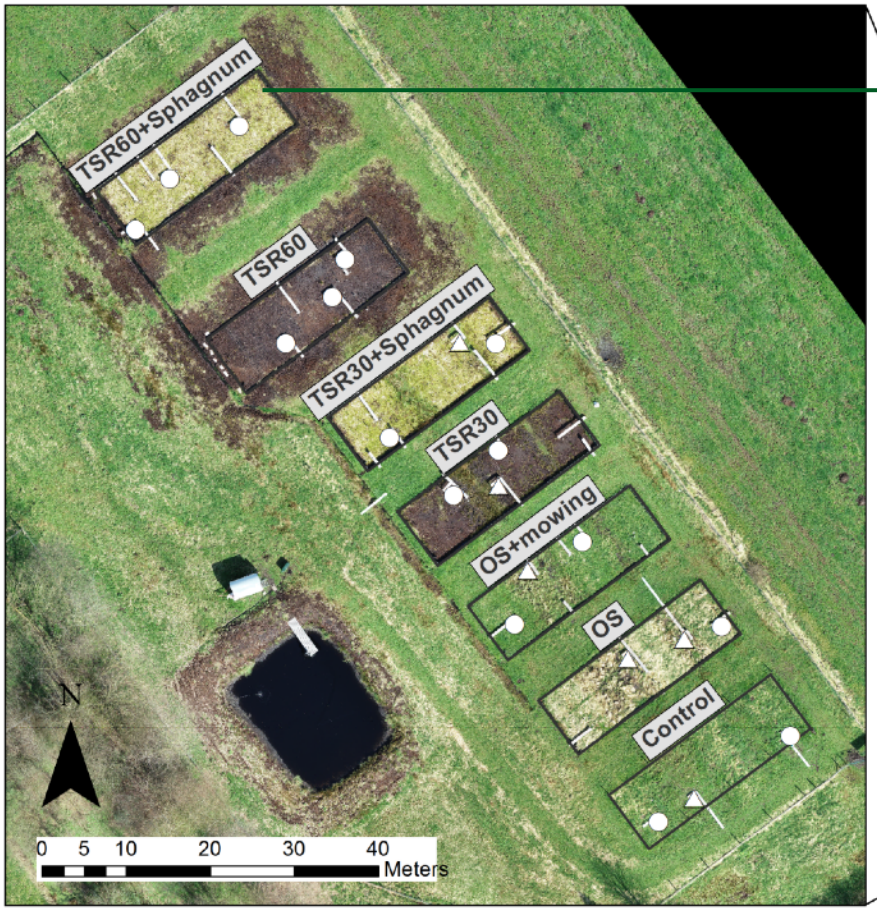
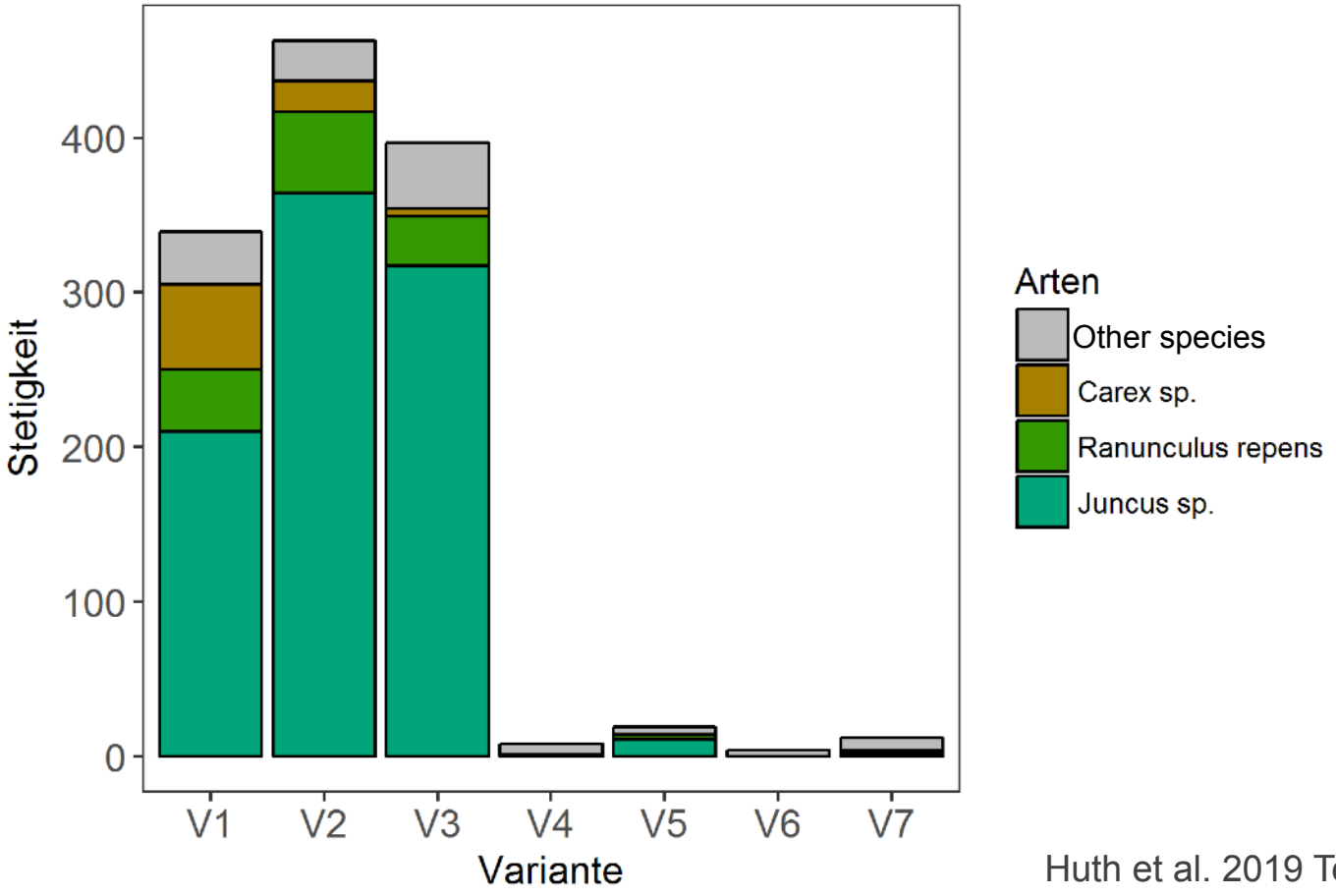
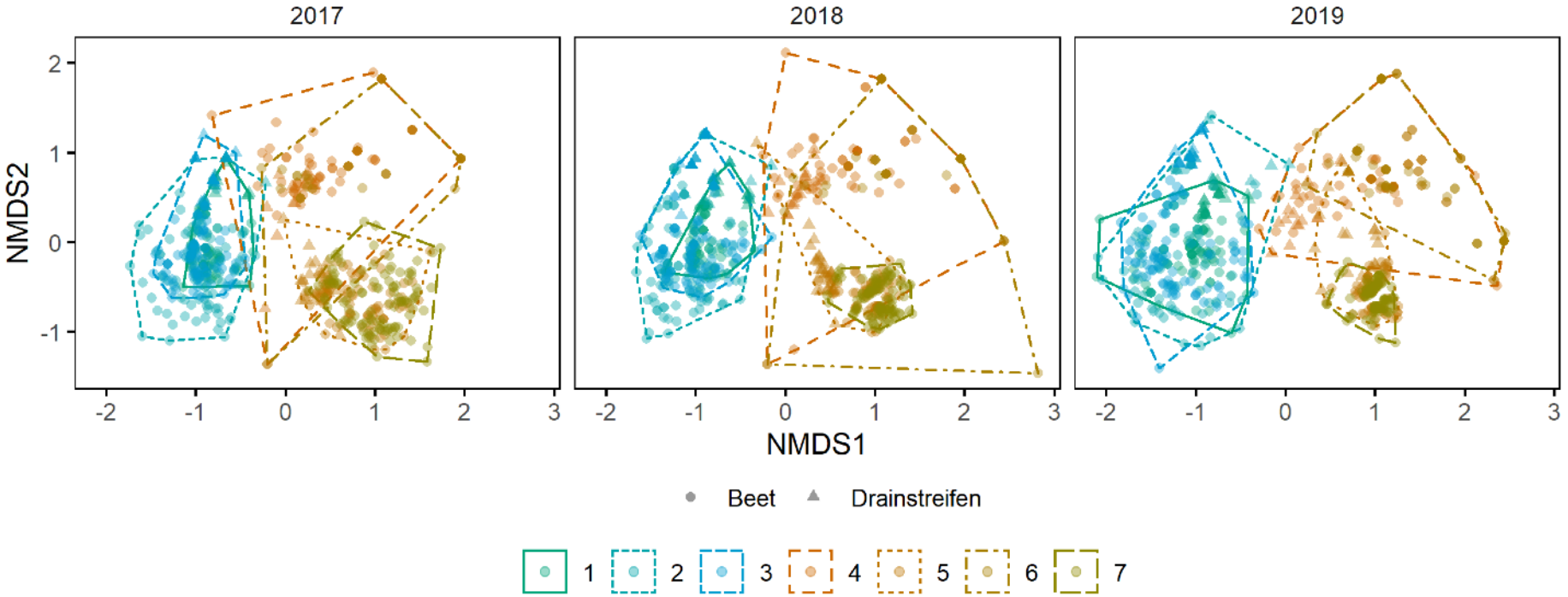


Without topsoil removal a large number of grassland diaspores remains available



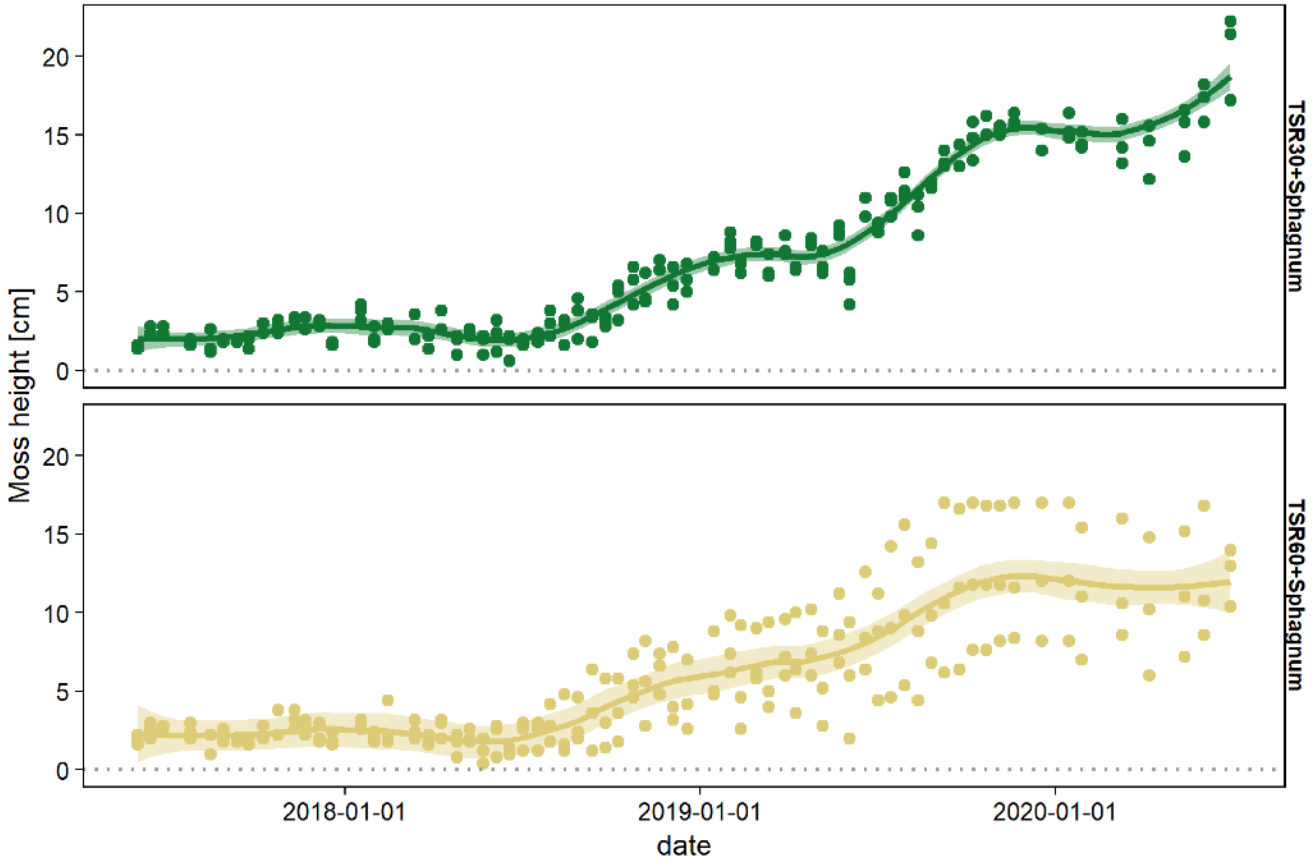
Huth et al. 2019 Telma

Vegetation strongly different with growing overlap between TSR and Sphagnum spreading

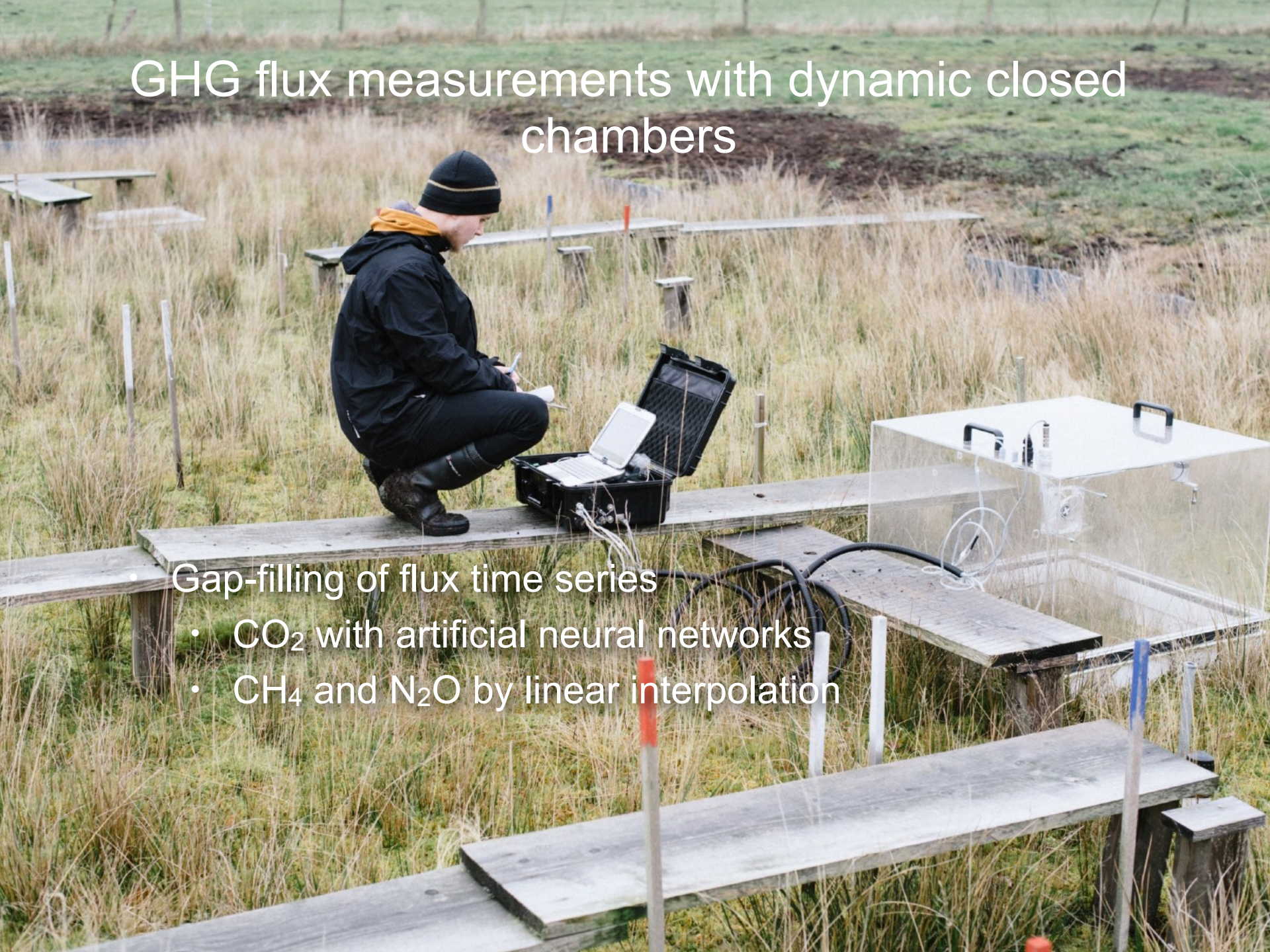


Rosinski et al. 2021 in press

Strong development of the moss layer with less growth and more spatial variability in the TSR60 plot

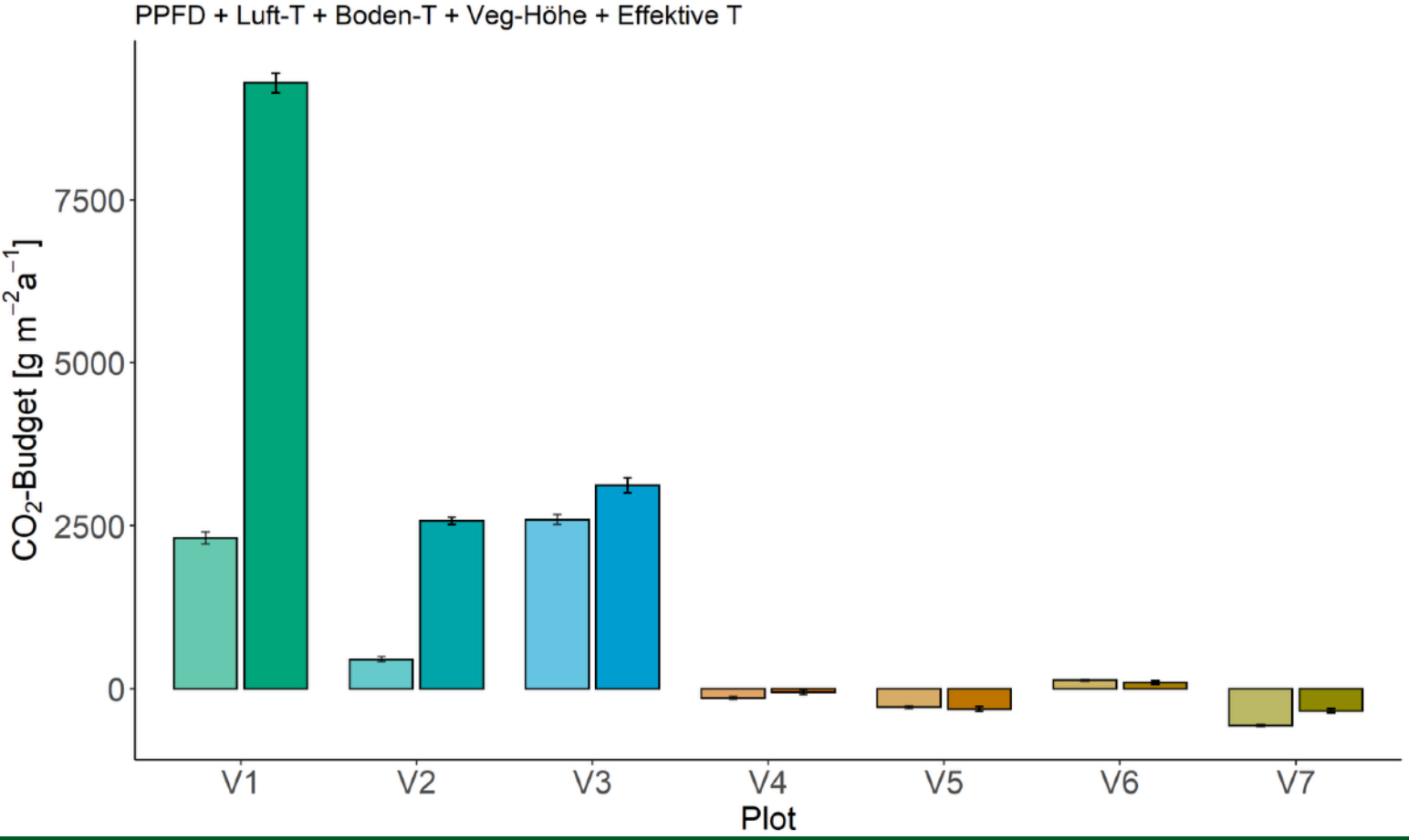


GHG flux measurements with dynamic closed chambers



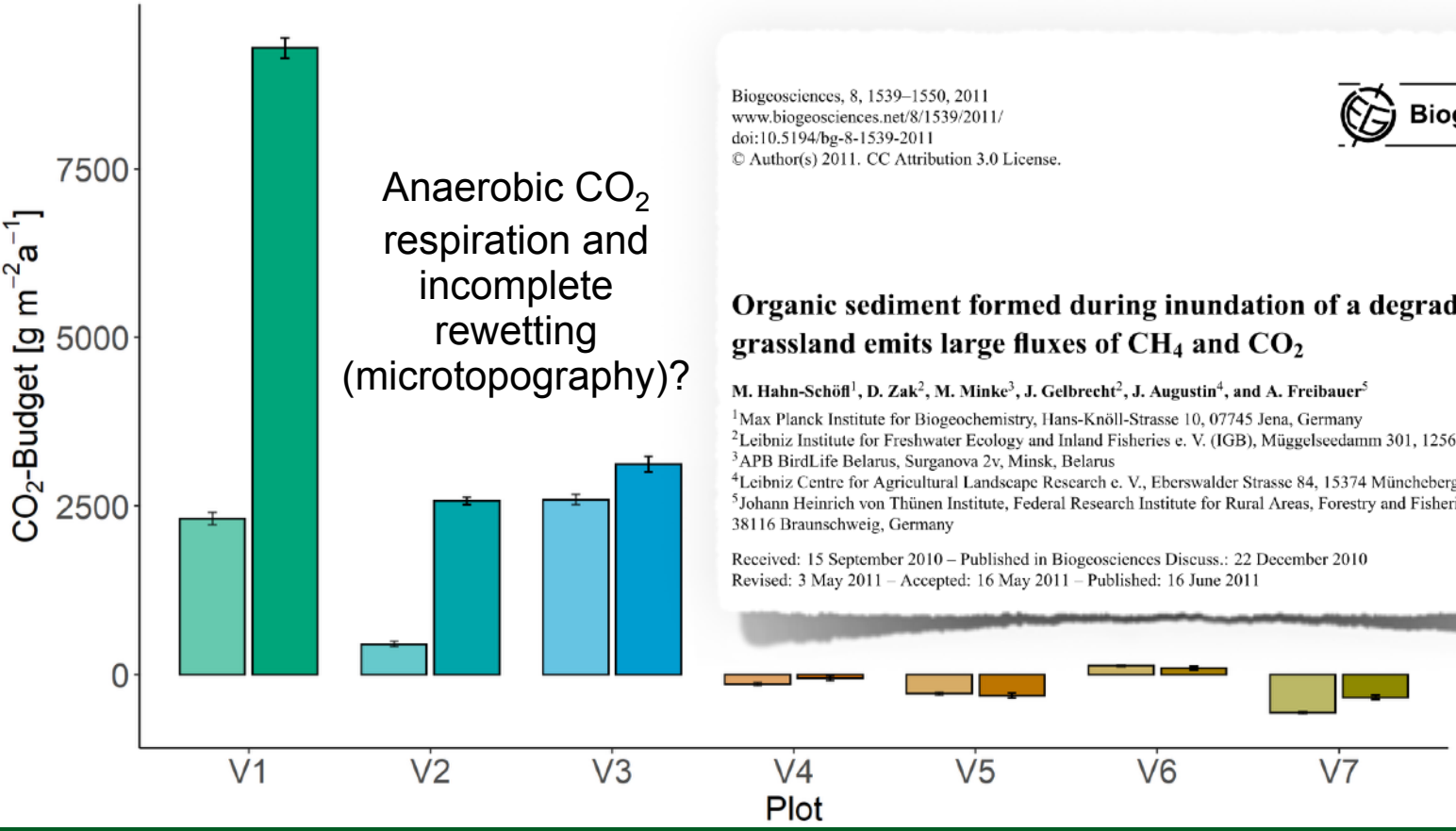
- Gap-filling of flux time series
  - CO_2 with artificial neural networks
  - CH_4 and N_2O by linear interpolation

Annual CO_2 budgets from 2017-09 to 2019-09 show hypothesised pattern (and some surprises)



Annual CO_2 budgets from 2017-09 to 2019-09 show hypothesised pattern (and some surprises)

PPFD + Luft-T + Boden-T + Veg-Höhe + Effektive T



Anaerobic CO_2 respiration and incomplete rewetting (microtopography)?

Biogeosciences, 8, 1539–1550, 2011
www.biogeosciences.net/8/1539/2011/
doi:10.5194/bg-8-1539-2011

Biogeosciences

Organic sediment formed during inundation of a degraded fen grassland emits large fluxes of CH_4 and CO_2

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Revised: 3 May 2011 – Accepted: 16 May 2011 – Published: 16 June 2011

Annual CO_2 budgets from 2017-09 to 2019-09 show hypothesised pattern (and some surprises)

PPFD + Luft-T + Boden-T + Veg-Höhe + Effektive T

Greenhouse gas balance of an establishing *Sphagnum* culture on a former bog grassland in Germany

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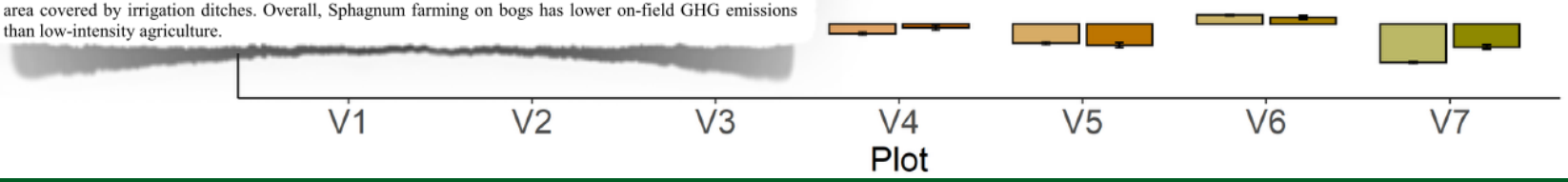
[1]Department of Landscape Ecology, University of Rostock, Germany
[2]Institute of Botany and Landscape Ecology, Ernst Moritz Arndt University of Greifswald, partner in Greifswald Mire Centre, Germany
[3]Department of Geography and Regional Research, University of Vienna, Austria

SUMMARY

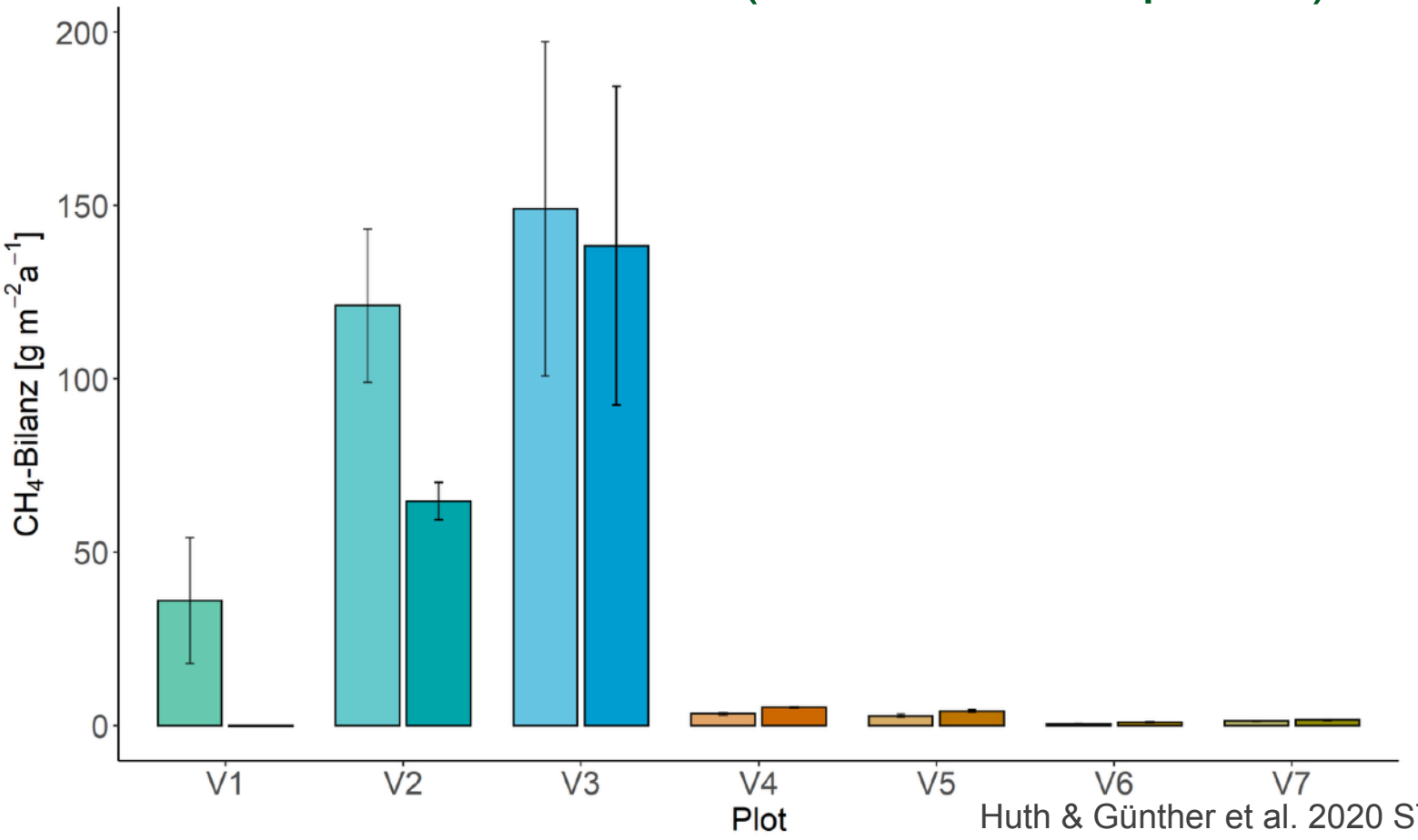
The cultivation of *Sphagnum* mosses on re-wetted peat bogs for use in horticulture is a new land use strategy. We provide the first greenhouse gas balances for a field-scale Sphagnum farming experiment on former bog grassland, i … nts of GHG exchange o … n irrigation ditches. Me … eriod. This trend was stronger for *S. papillosum*. In contrast, the estimated CO_2 fluxes did not show a significant temporal trend over the study period. The production strips of both *Sphagnum* species were net GHG sinks of 5–9 t ha^{-1} a^{-1} (in CO_2-equivalents) during the establishment phase of the moss carpets. In comparison, the ditches were a CO_2 source instead of a CO_2 sink and emitted larger amounts of CH_4, resulting in net GHG release of ~11 t ha^{-1} a^{-1} CO_2-equivalents. We conclude that Sphagnum farming fields should be designed to minimise the area covered by irrigation ditches. Overall, Sphagnum farming on bogs has lower on-field GHG emissions than low-intensity agriculture.

Net CO_2 sinks of 5-9 t ha^{-1} a^{-1}

A combination of an establishing Sphagnum carpet and resprouting of grassland vegetation?

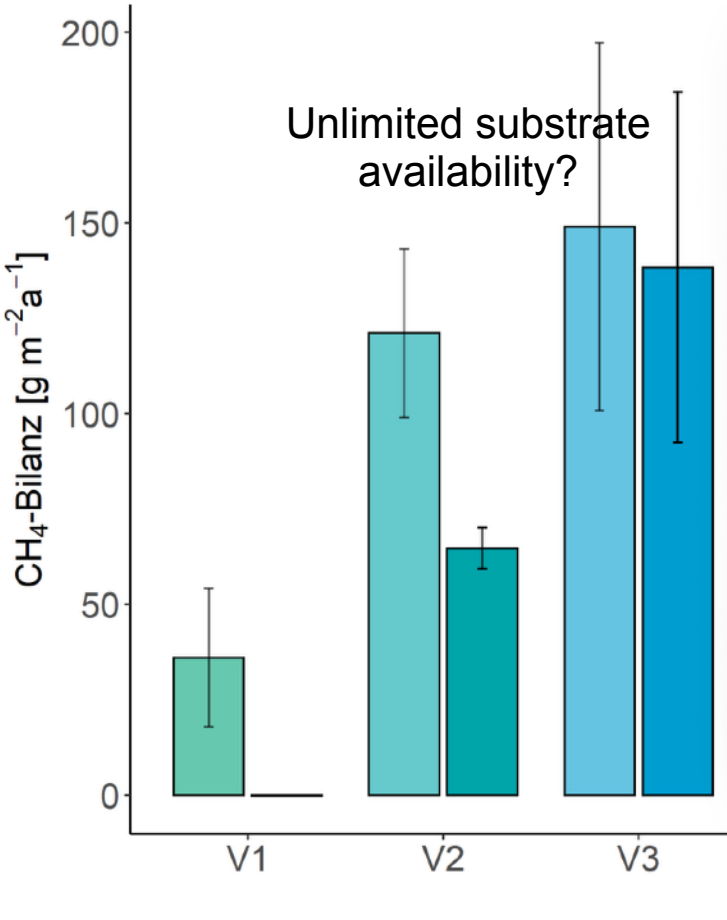


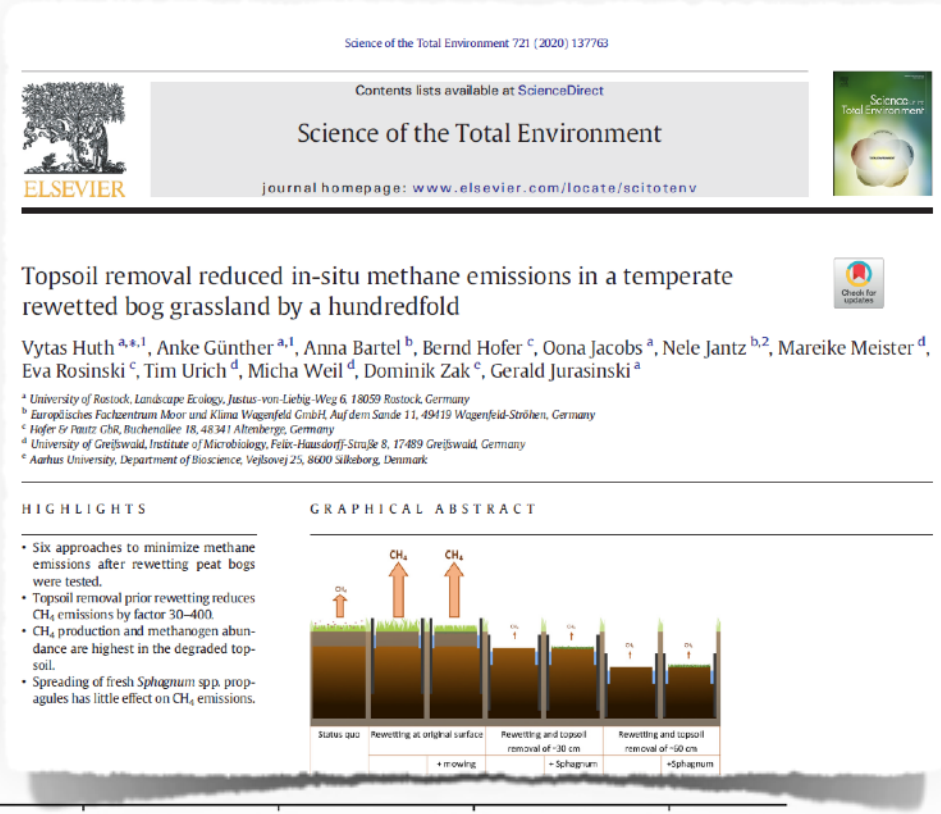
Annual CH_4 budgets from 2017-09 to 2019-09 show effectiveness of TSR (and some surprises)



Huth & Günther et al. 2020 STOTEN

Annual CH_4 budgets from 2017-09 to 2019-09 show effectiveness of TSR (and some surprises)





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journal homepage: www.elsevier.com/locate/scitotenv

ELSEVIER

Topsoil removal reduced in-situ methane emissions in a temperate rewetted bog grassland by a hundredfold

Vytas Huth [a,*,1], Anke Günther [a,1], Anna Bartel [b], Bernd Hofer [c], Oona Jacobs [a], Nele Jantz [b,2], Mareike Meister [d], Eva Rosinski [c], Tim Urich [d], Micha Weil [d], Dominik Zak [c], Gerald Jurasinski [a]

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[b] Europäisches Fachzentrum Moor und Klima Wagenfeld GmbH, Auf dem Sande 11, 49419 Wagenfeld-Ströhen, Germany
[c] Hofer & Pautz GbR, Buchenallee 18, 48341 Altenberge, Germany
[d] University of Greifswald, Institute of Microbiology, Felix-Hausdorff-Straße 8, 17489 Greifswald, Germany
[e] Aarhus University, Department of Bioscience, Vejlsovej 25, 8600 Silkeborg, Denmark

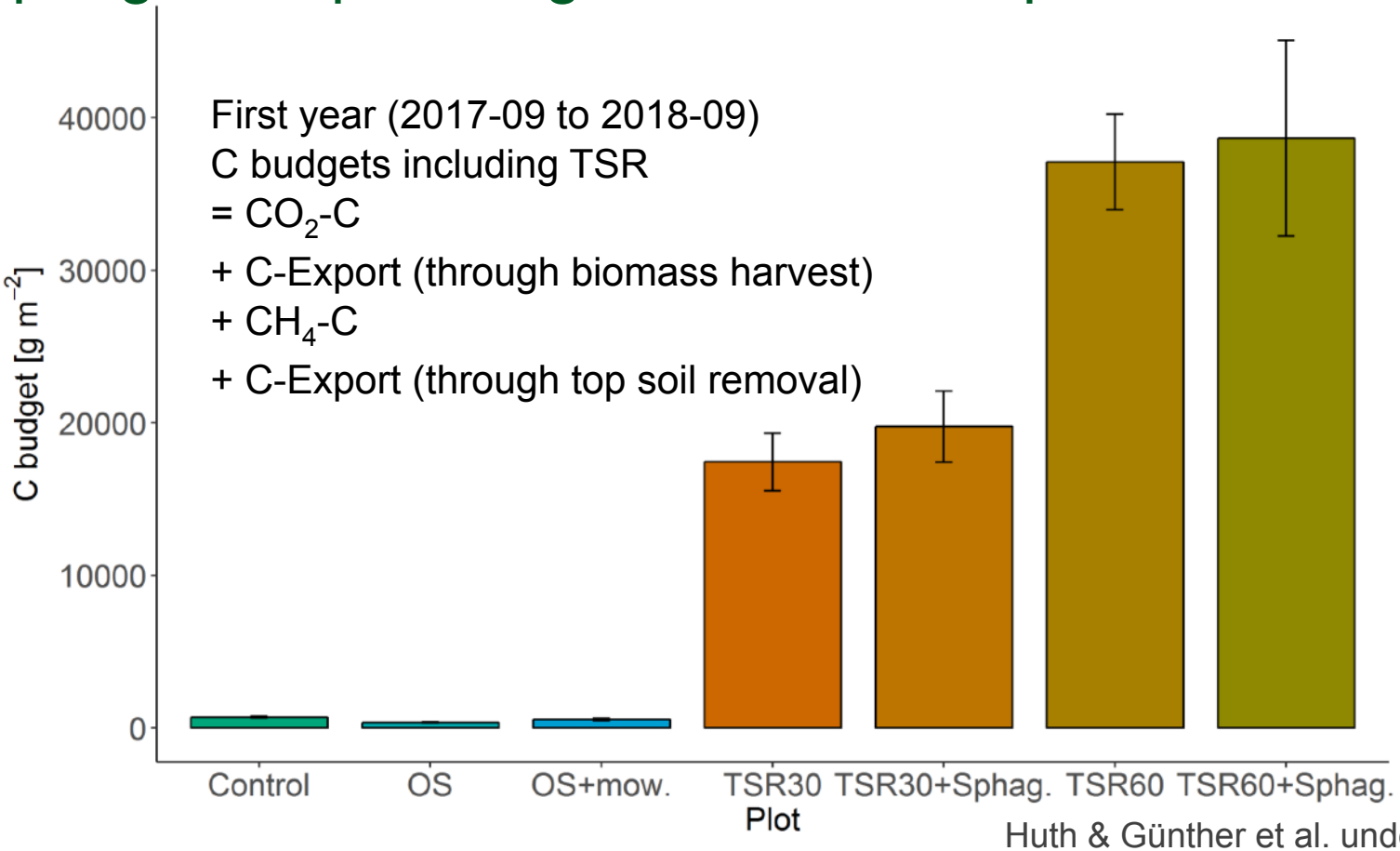
HIGHLIGHTS

- Six approaches to minimize methane emissions after rewetting peat bogs were tested.
- Topsoil removal prior rewetting reduces CH_4 emissions by factor 30–400.
- CH_4 production and methanogen abundance are highest in the degraded topsoil.
- Spreading of fresh *Sphagnum* spp. propagules has little effect on CH_4 emissions.

GRAPHICAL ABSTRACT

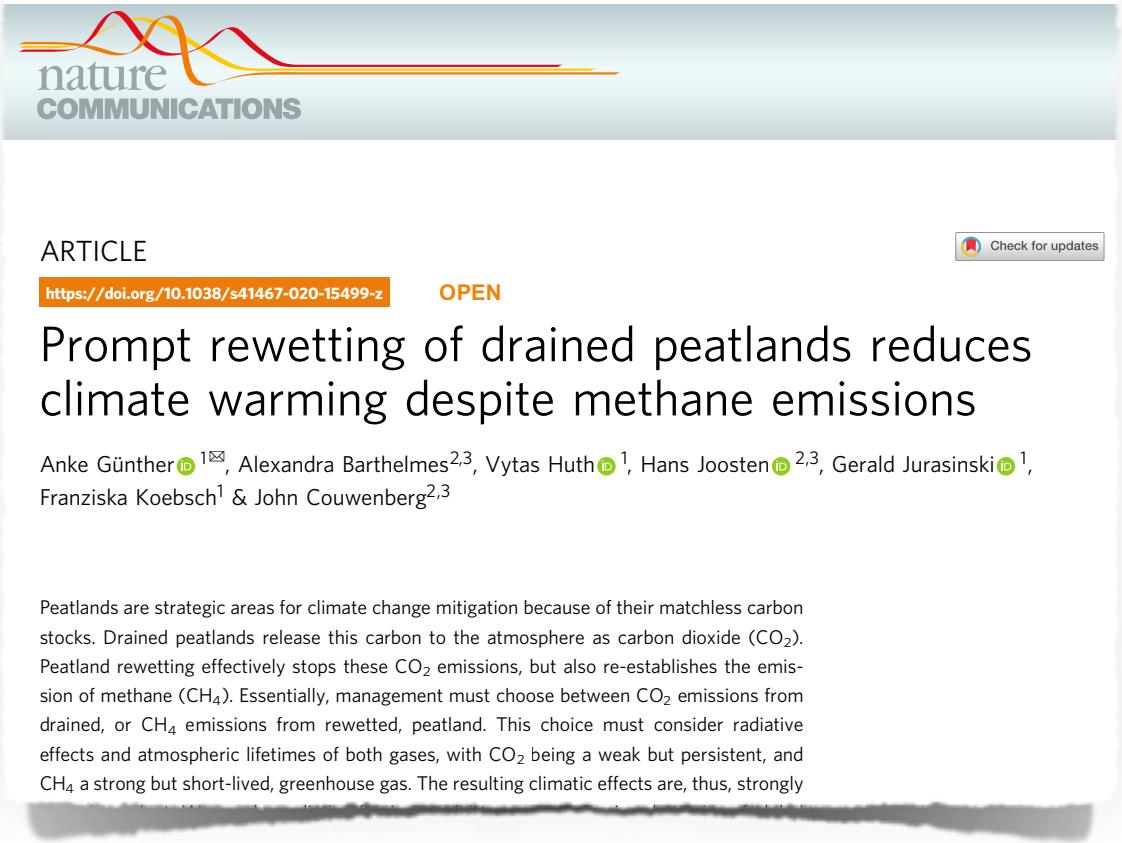
Huth & Günther et al. 2020 STOTEN

While GHG exchange is as desired after TSR and Sphagnum spreading, there is an elephant in the room



Huth & Günther et al. under revision

What is the climate effect of the tested restoration approaches?



nature COMMUNICATIONS

ARTICLE

Check for updates

https://doi.org/10.1038/s41467-020-15499-z OPEN

Prompt rewetting of drained peatlands reduces climate warming despite methane emissions

Anke Günther[1✉], Alexandra Barthelmes[2,3], Vytas Huth[1], Hans Joosten[2,3], Gerald Jurasinski[1], Franziska Koebsch[1] & John Couwenberg[2,3]

Peatlands are strategic areas for climate change mitigation because of their matchless carbon stocks. Drained peatlands release this carbon to the atmosphere as carbon dioxide (CO_2). Peatland rewetting effectively stops these CO_2 emissions, but also re-establishes the emission of methane (CH_4). Essentially, management must choose between CO_2 emissions from drained, or CH_4 emissions from rewetted, peatland. This choice must consider radiative effects and atmospheric lifetimes of both gases, with CO_2 being a weak but persistent, and CH_4 a strong but short-lived, greenhouse gas. The resulting climatic effects are, thus, strongly

Following Günther et al. 2020

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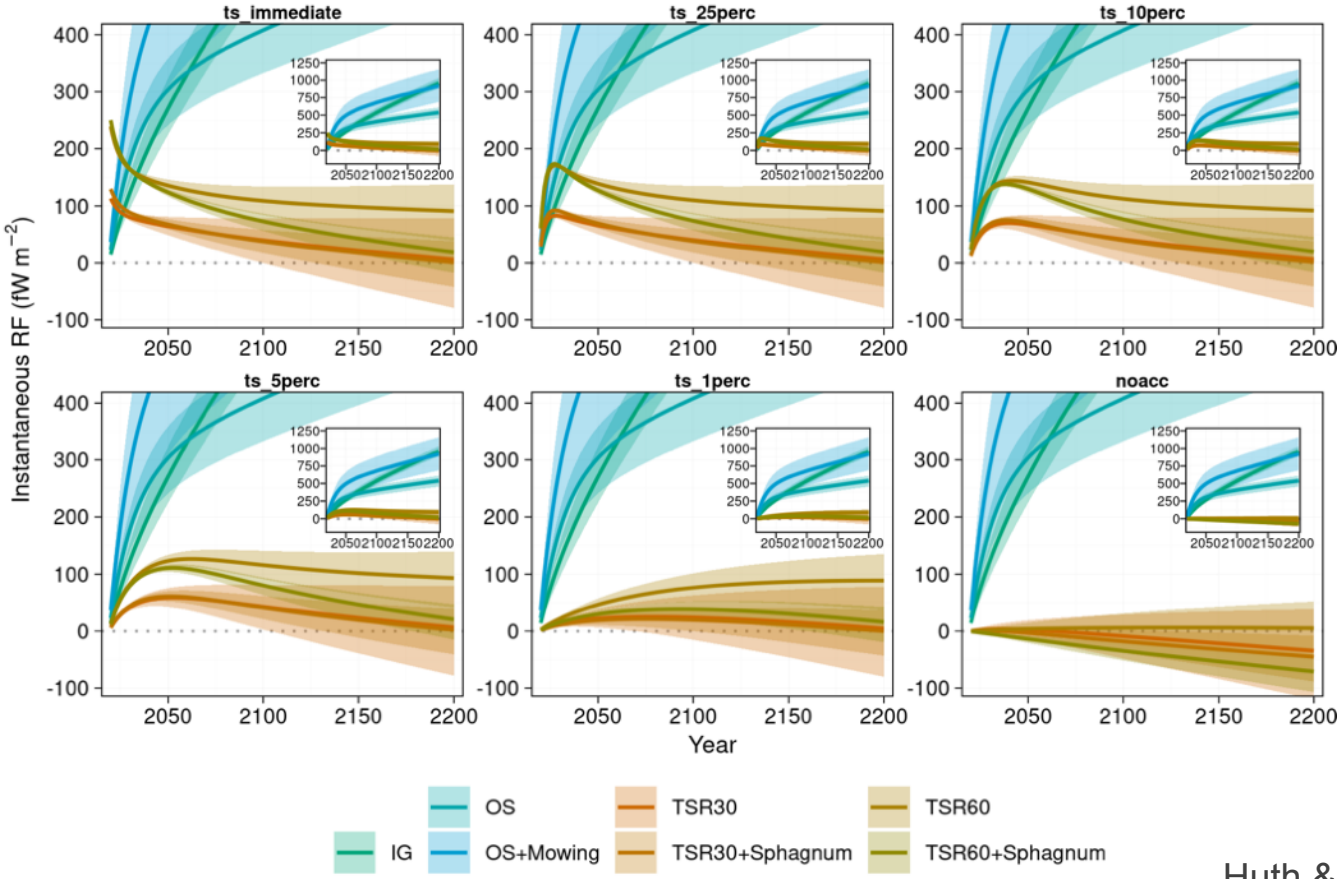
What is the climate effect of the tested restoration approaches (assuming measured exchange rates)?



ts_immediate: C export by TSR is accounted as CO2 emission in the year of extraction (IPCC, 2006)

ts_25-1perc: 25-1% annual decomposition of C in TSR expressed as CO2 emission

noacc: C export by TSR is not accounted as CO2 emission

Huth & Günther et al. under revision

Results suggest a TSR sufficient to achieve nutrient-poor and acidic conditions for *Sphagnum* spp. establishment

- Rewetting alone reduced net CO_2 emissions by approx. 75% but substantially increased CH_4 emissions
- After top soil removal (TSR) CO_2 and CH_4 emissions were close to zero
- *Sphagnum* spp. introduction lead to development of a substantial moss carpet with immediate C sequestration
- Climate warming effect of rewetting with shallow TSR is lower than rewetting nutrient-rich peatlands after a few decades the latest (timeframe depends on fate of the removed topsoil C)

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Thank you for your attention!

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