Klimawandel – Waldböden und Waldbodenveränderung in den Kalkalpen:

Bodenerwärmungsexperiment Achenkirch

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Wald.Boden.Klima.Wandel

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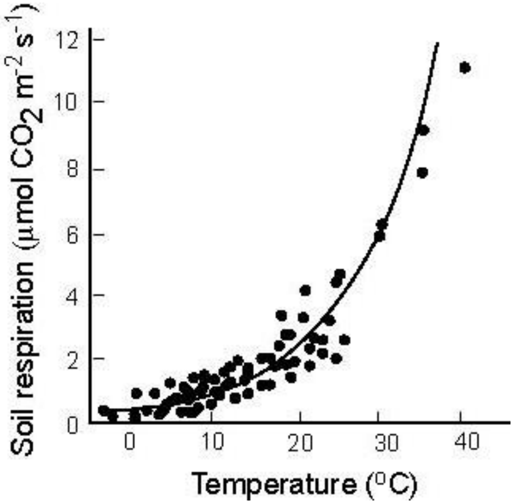
Hintergrund

- Klimawandel findet statt
- Boden speichert große Mengen organischen Kohlenstoff
- Es wäre schön, noch mehr davon zu speichern
- Oder verliert der Waldboden gar Kohlenstoff an die Atmosphäre?

Was wir wissen

- Je kälter die Umgebung, desto mehr Kohlenstoff im Waldboden
- Bodenmikroorganismen werden umso aktiver, je wärmer es ist



Was wir gerne wissen würden

- **Was geschieht mit dem organischen Boden C mittelfristig?**

Möglichkeit -> 1. Bodeninventur (was bisher geschah)

nature geoscience

ARTICLES

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Organic matter losses in German Alps forest soils since the 1970s most likely caused by warming

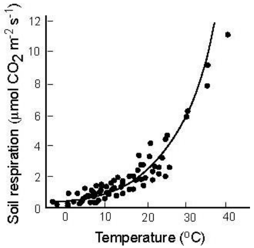
Jörg Prietzel[1]*, Lothar Zimmermann[2], Alfred Schubert[2] and Dominik Christophel[1]

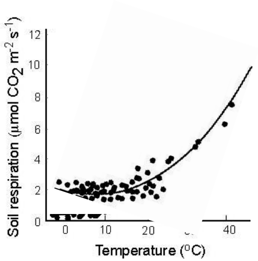
Climate warming is expected to induce soil organic carbon losses in mountain soils that result, in turn, in reduced soil fertility, reduced water storage capacity and positive feedback on climate change. Here we combine two independent sets of measurements of soil organic carbon from forest soils in the German Alps—repeated measurements from 1976 to 2010 and from 1987 to 2011—to show that warming has caused a 14% decline in topsoil organic carbon stocks. The decreases in soil carbon occurred over a period of significant increases in six-month summer temperatures, with the most substantial decreases occurring at sites with large changes in mean annual temperature. Organic carbon stock decreases were largest—on average 32%—in forest soils with initial topsoil organic carbon stocks greater than 8 kg C m^{-2}, which can be found predominantly on calcareous bedrock. However, organic carbon stocks of forest soils with lower initial carbon stocks, as well as soils under pasture or at elevations above 1,150 m, have not changed significantly. We conclude that warming is the most likely reason for the observed losses of soil organic carbon, but that site, land use and elevation may ameliorate the effects of climate change.

Möglichkeit -> 2. Klimamanipulations-Experimente (ein oder mehrere Parameter werden künstlich verändert, Zeitmaschine...)

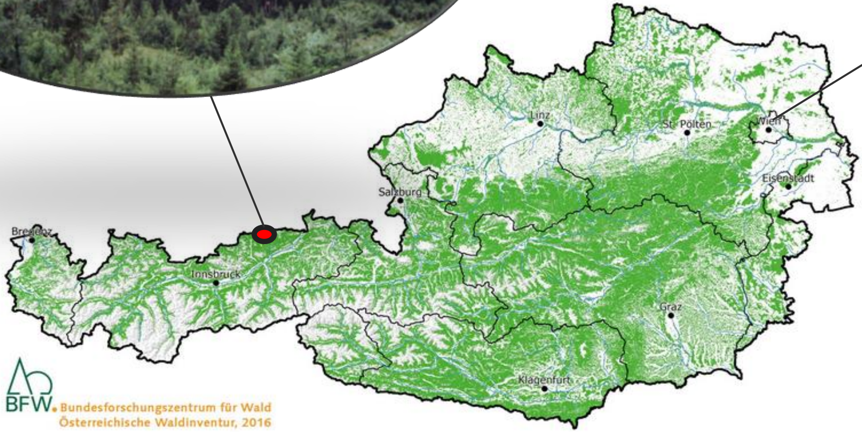
Input

Möglichkeit -> 3. Modellierung (Prozessverständnis als Voraussetzung)





Bodenerwärmungsexperiment Achenkirch



Robert Jandl

Site

- Bergwald
- 80% Fichte, 20% Buche
- > 120 Jahre
- 910m a.s.l.
- Ø 6.8°C
- Ø 1563 mm

Boden

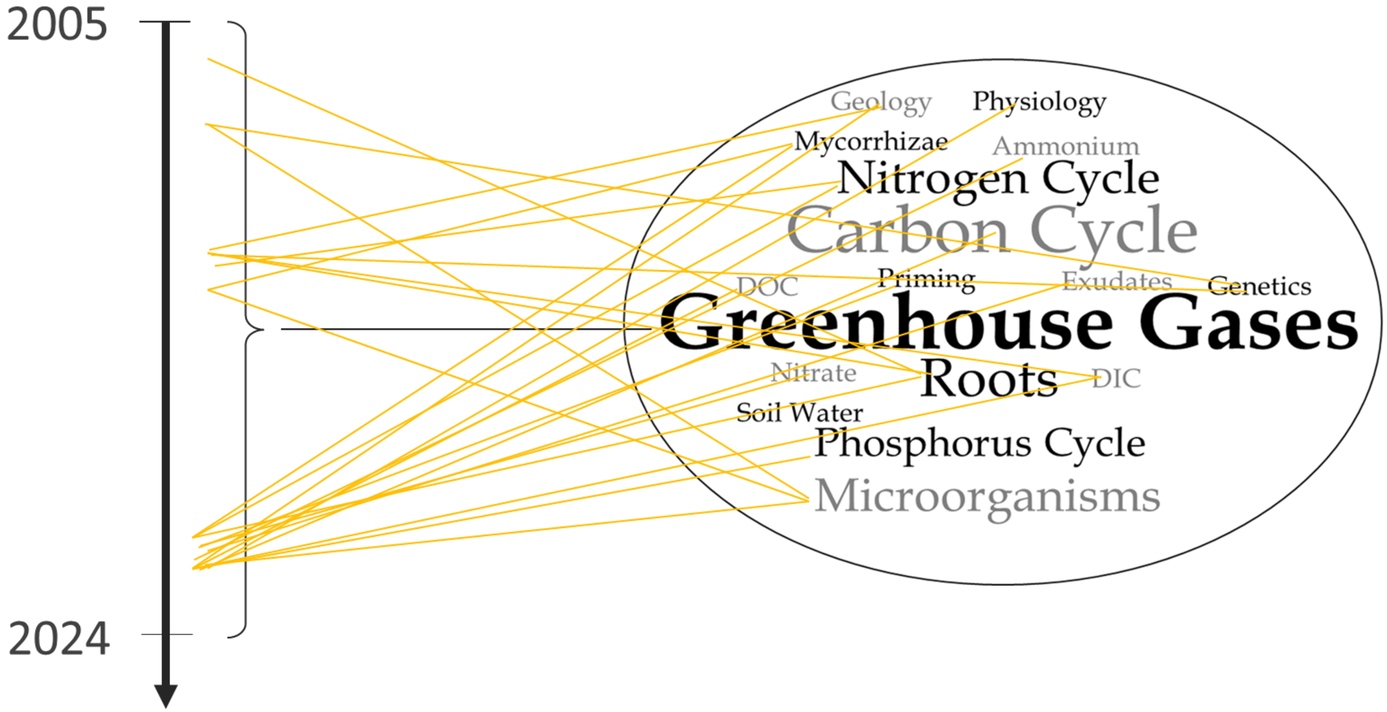
- seichtgründig
- heterogen
- auf Dolomit
- neutraler pH
- hoher SOC Gehalt

Boden-Erwärmung

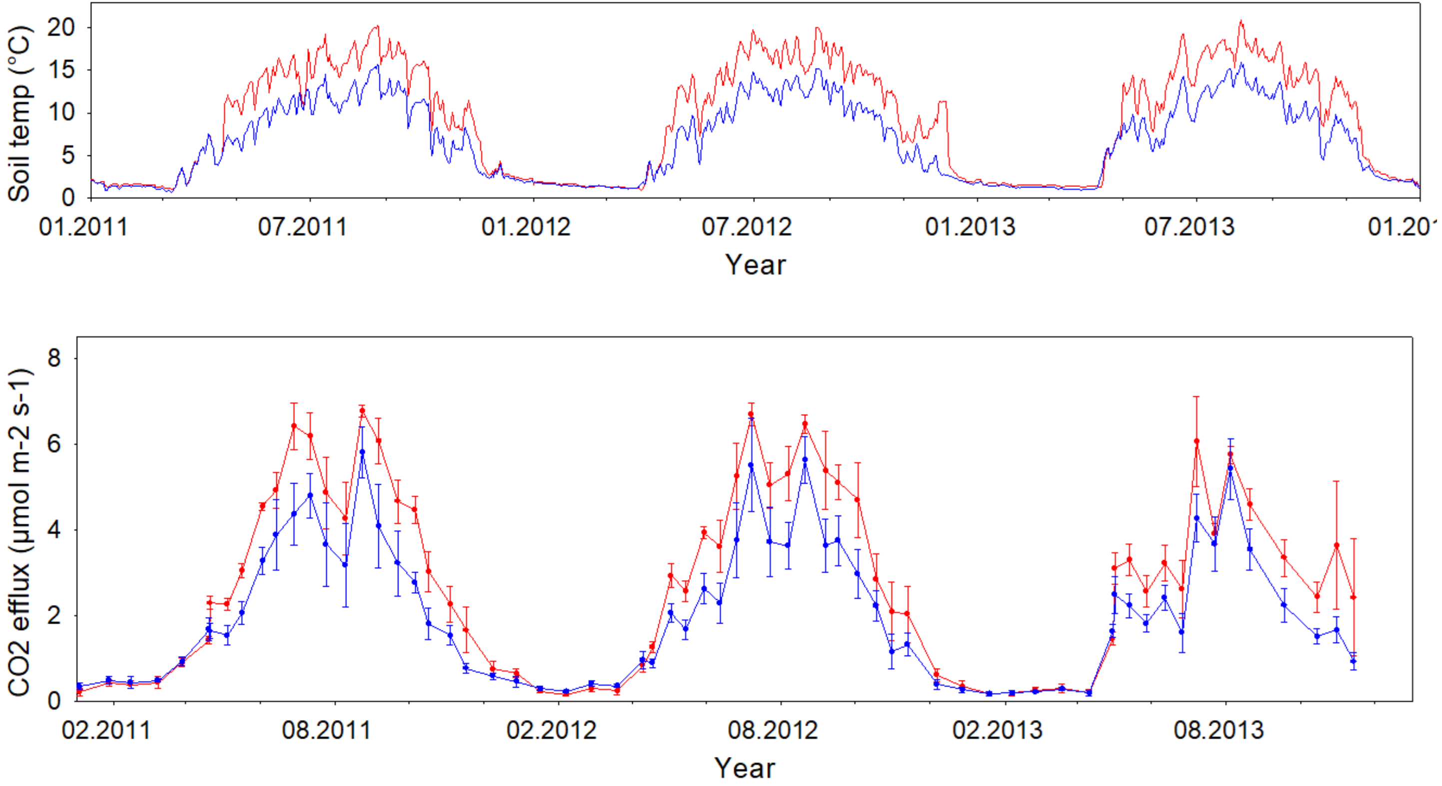
- 6 Plot-Paare
- + 4°C
- Heizkabel
- Winter Heizung aus

Zeit

Parameter gemessen



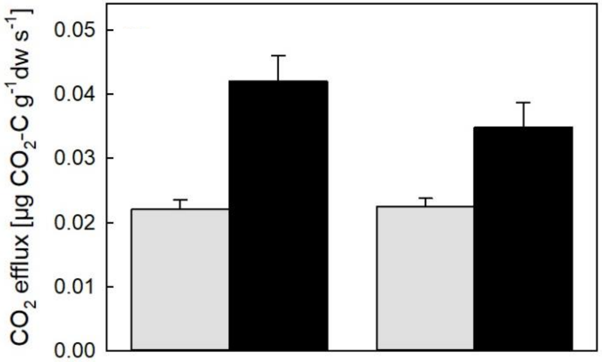
Ergebnisse: CO2 Emissionen aus dem Boden steigen



ca. 40% Wurzel-Atmung (trenching 2005, 2006)

Feinwurzel-Atmung ist im erwärmten Boden höher

(freigelegte Wurzeln 2021)



C-Bilanz im Boden

C-Inputs:

Streu (Laub, Wurzeln)

Wurzel-Exsudate

DOC

CH_4-C

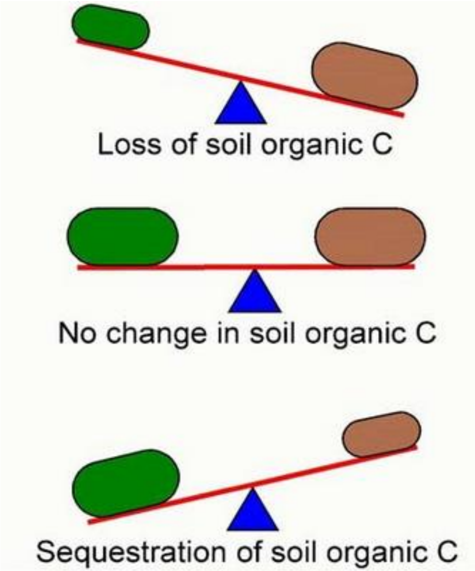
C-Outputs:

CO_2-C

DOC/DIC

CH_4-C

Erosion



Feinwurzel Biomasse wird mehr

Wurzeln wachsen schneller und werden schneller umgesetzt

Feinwurzel Biomasse wird mehr

Wurzeln wachsen schneller und werden schneller umgesetzt

RESEARCH ARTICLE

Global Change Biology WILEY

Long-term soil warming alters fine root dynamics and morphology, and their ectomycorrhizal fungal community in a temperate forest soil

Steve Kwatcho Kengdo[1] | Derek Peršoh[2] | Andreas Schindlbacher[3] | Jakob Heinzle[3] | Ye Tian[4] | Wolfgang Wanek[4] | Werner Borken[1]

Contents lists available at ScienceDirect

Science of the Total Environment

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

Increase in carbon input by enhanced fine root turnover in a long-term warmed forest soil

Steve Kwatcho Kengdo [a,*], Bernhard Ahrens [b], Ye Tian [c], Jakob Heinzle [d], Wolfgang Wanek [c], Andreas Schindlbacher [d], Werner Borken [a]

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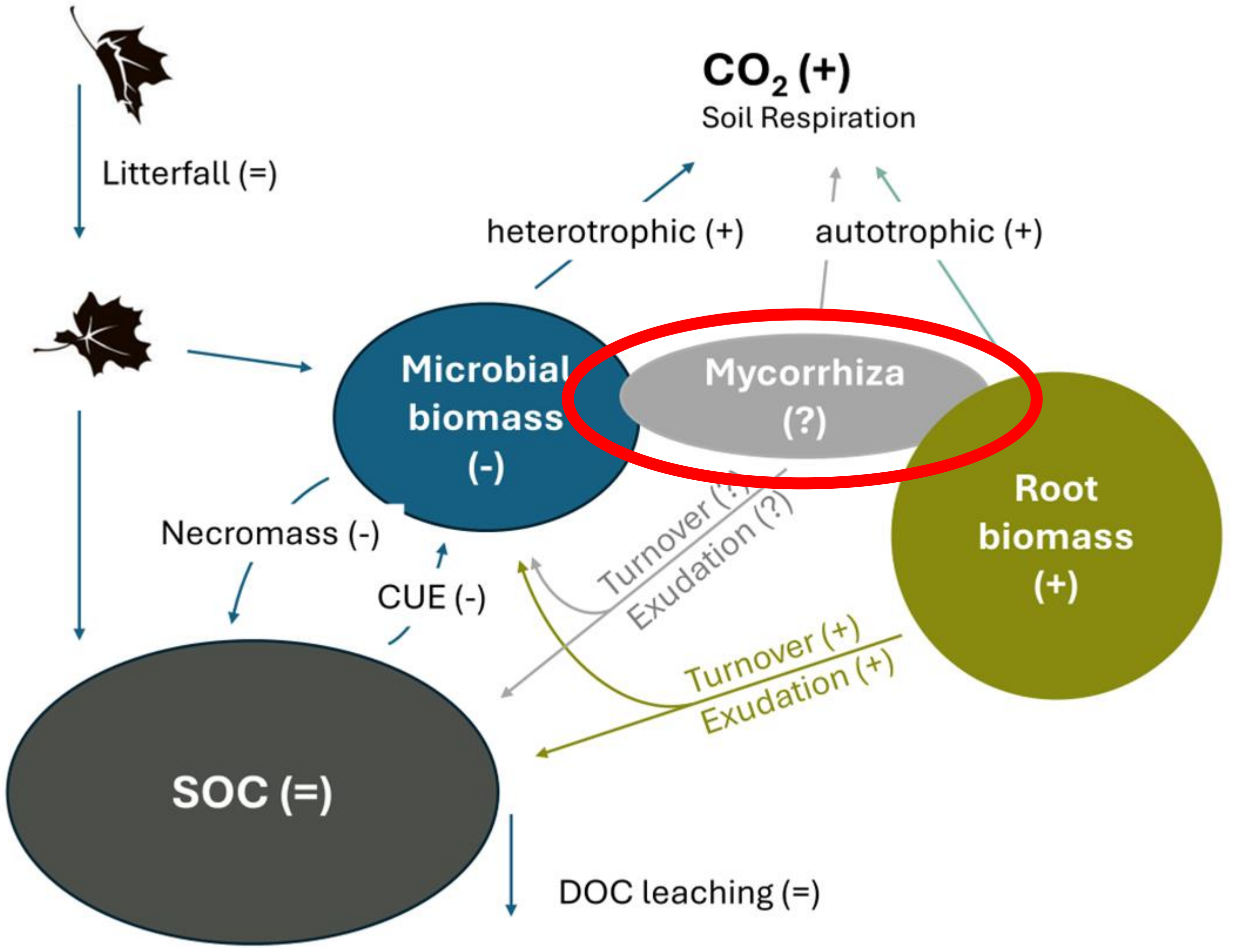
Feinwurzel-Exsudation steigt nicht

aber mehr Wurzeln -> mehr Exsudation

Heinzle et al. Frontiers ForGlobChange 2023

Bodenwasser DOC unwesentlich, DIC ?



Balance

(warmed – control)

ΔC-inputs	(g C m^{-2} yr^{-1})
Leaf litter	-
Root turnover	56
Root exudation	10
Mycorrhiza	?
ΔC-outputs	
Soil CO_2 efflux	281
autotrophic	125
heterotrophic	156
DOC leaching	1-2
DIC leachnig	?

Bilanz geht nicht ganz auf

Erkenntnis

- Die Erwärmung kurbelt den C-Kreislauf generell an
- Corg Verluste werden durch höhere Inputs ganz, oder zumindest zum Teil, wieder aufgefüllt

BFW
Bundesforschungszentrum für Wald

nature communications

Article

https://doi.org/10.1038/s41467-023-36527-8

Long-term soil warming decreases microbial phosphorus utilization by increasing abiotic phosphorus sorption and phosphorus losses

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Check for updates

Ye Tian[1,2], Chupei Shi[1,3], Carolina Urbina Malo[1,4], Steve Kwatcho Kengdo[5], Jakob Heinzle[6], Erich Inselsbacher[7], Franz Ottner[8], Werner Borken[5], Kerstin Michel[6], Andreas Schindlbacher[6] & Wolfgang Wanek[1]

Phosphorus (P) is an essential and often limiting element that could play a crucial role in terrestrial ecosystem responses to climate warming. However, it has yet remained unclear how different P cycling processes are affected by warming. Here we investigate the response of soil P pools and P cycling processes in a mountain forest after 14 years of soil warming (+4 °C). Long-term warming decreased soil total P pools, likely due to higher outputs of P from

Foto | Filmstill aus „See Aural Woods“ (Luma.Launisch & Takamovsky)

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