Is priming influenced more by in situ or incubation temperatures? Evidence from a 1500 m elevation gradient in the Amazon

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Introduction

Soil microbes are crucial in controlling soil carbon (C) storage by mineralizing plant residues and soil organic matter (SOM). Warming and higher levels of carbon dioxide might increase litter and root exudate C inputs, which can speed up or slow down the microbial breakdown of older SOM via priming effect. *We investigated how temperature, and the availability of C and nutrients affect the magnitude and direction of priming.*

(H1) We expect higher priming in soils at high elevation with nitrogen limitation, where the microbes have a greater need to mine SOM.

(H2) Increasing temperature can boost the decomposition rate of recalcitrant SOM together with the release of nutrients. Hence, the microbial need for additional mining of nutrients from SOM can be alleviated. This could lower the magnitude of priming at higher incubation temperature.

(H3) Climate warming can increase microbial activity and turnover. Thus, entombing could exceed priming in soils incubated at a higher temperature (20 °C).

Results: Soil respiration, priming and remaining ^{13}C in soils

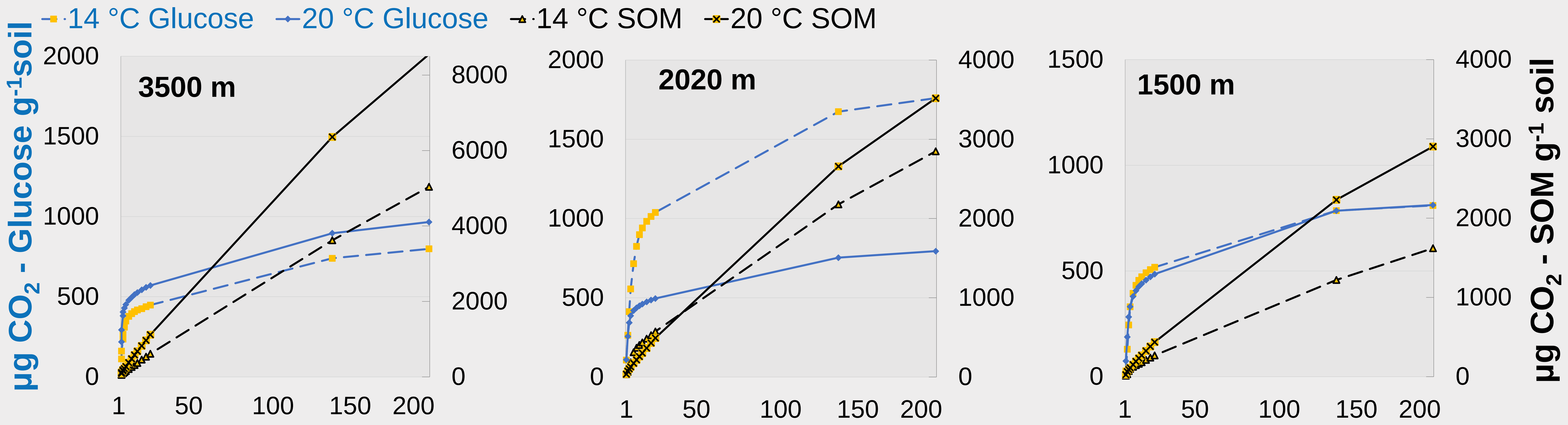

Fig 3. Cumulative soil respiration (μg of CO_2 g^{-1} soil) from the added ^{13}C glucose (Y-right axis) and from soil organic matter – SOM (Y-left axis) during incubation period

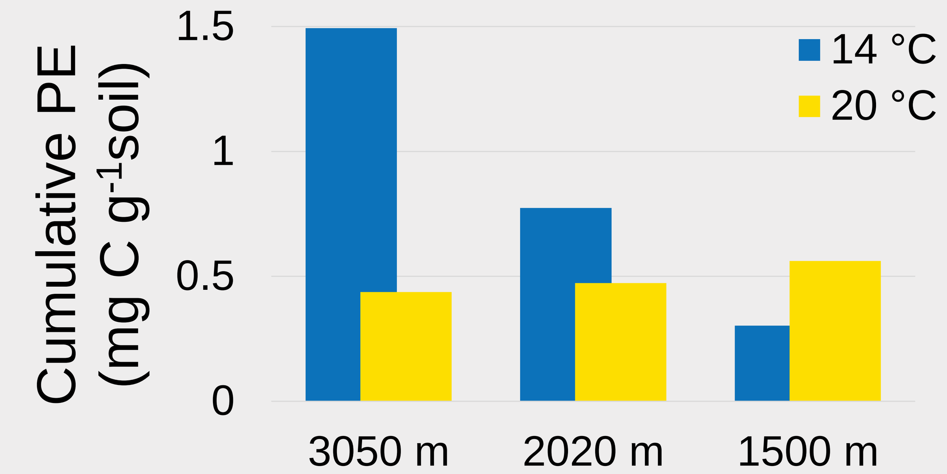

Fig 4. Cumulative priming effect (PE) at day 214

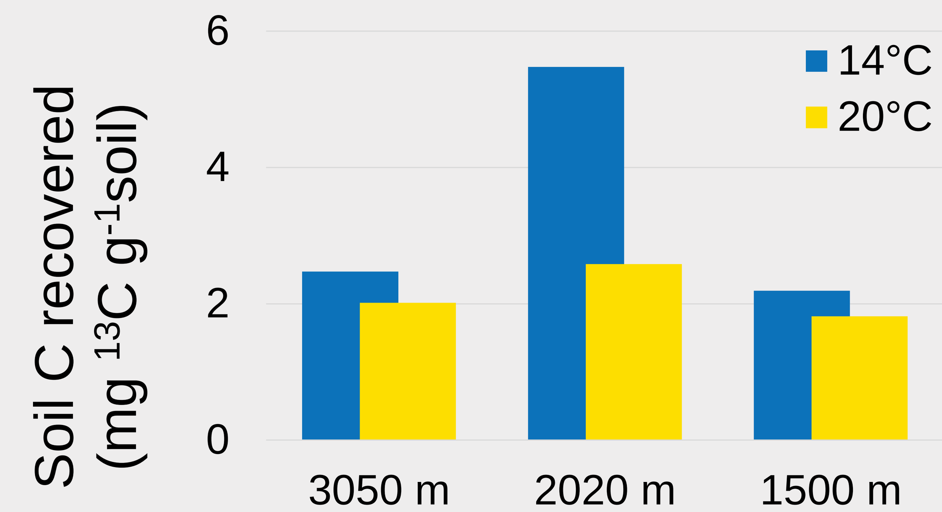

Fig 5. Soil ^{13}C remaining after 214 incubation days

- PE increased with elevation when measured at 14 °C (supporting H1), while the PE results at 20 °C were similar across the gradient (Fig 4).
- Warming decreased PE at the high-elevation soils (supporting H2), but slightly increased it at the lowest elevation site (Fig 4).
- Glucose-derived ^{13}C more than compensated C loss due to priming at both temperatures (Fig 5).

Materials & Methods: Study sites, laboratory incubation and analyses

We collected intact soil cores from the *Kosñipata* gradient in Dec 2020 from the Peruvian Amazon from three elevations.

Table 1. Study sites information

Site	Elevation (m asl)	MAT (°C)	MAP (mm)	Soil type
Wayqecha	3050	11	1700	Umbrisols
Trocha Union	2020	15	1800	Cambisols
San Pedro	1500	17	2600	Cambisols

We set 4 plots per elevation and extracted 4 soil cores per plot.

Fig 1. South America

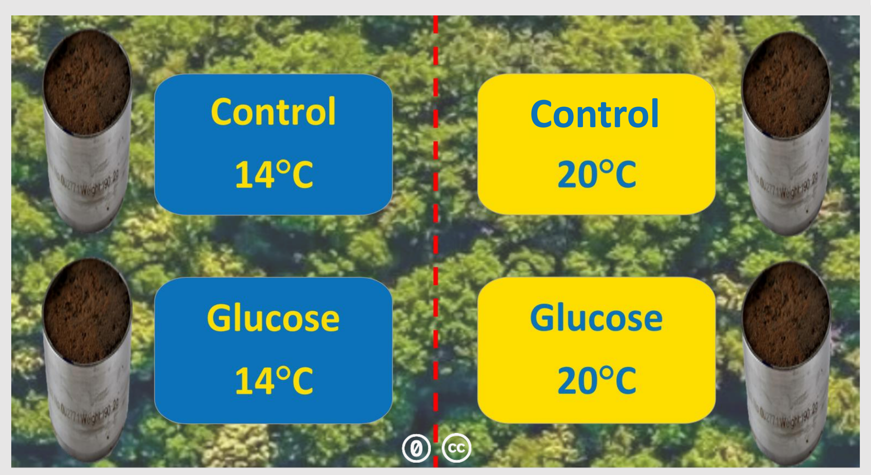

Fig 2. Extracted cores per plot

Core size: 196.3 cm^3 (10 by 5 cm diameter)

Glucose solution 15.06 ^{13}C at%
130 mg of glucose per core
50% of microbial biomass C

We incubated the soils at 14 and 20 °C for 214 days to assess temperature effects on priming caused by added ^{13}C-glucose, while control soils received only water.

The CO_2 was analyzed on days 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 18, 21, 24, 31, 37, 50, 80, 113, 147, 171, and 214.

- Total soil C and N were measured at the end
- Microbial biomass C and N by CFE (end of the incubation, day 214).
- ^{13}C-CO_2 was sampled frequently for 1 month and less often to day 214, and remaining soil ^{13}C at day 214, both ^{13}C data were measured at KOSI lab at Göttingen Uni.

We calculated SOM respiration and Priming effect (PE) as follows:

$$SOM_{Respiration} = Total_{Respiration} - Glucose_{Respiration}$$

$$PE = SOM_{Respiration} - Control_{Respiration}$$

Conclusions

- In accordance with our second hypothesis, our results suggest that, regardless of the origin, warming the soils might hasten SOM decomposition together with nutrients release, which might reduce microbial mining demands and thus priming effect.
- In soils from high elevation, PE decreased relatively more with warming which, in turn, might balance out priming induced C losses.
- We are analyzing the soil ^{13}C in microbial necromass (amino sugars) at the end of the experiment, to determine the relationship between the residual soil C and the buildup of microbial residues.

Acknowledgements:

Institute of Life Science
Doctoral Programme
Academy of Finland

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ABSTRACT
EGU23-357