High-Andean wetlands release more CO_2 under short-term warming, study suggests

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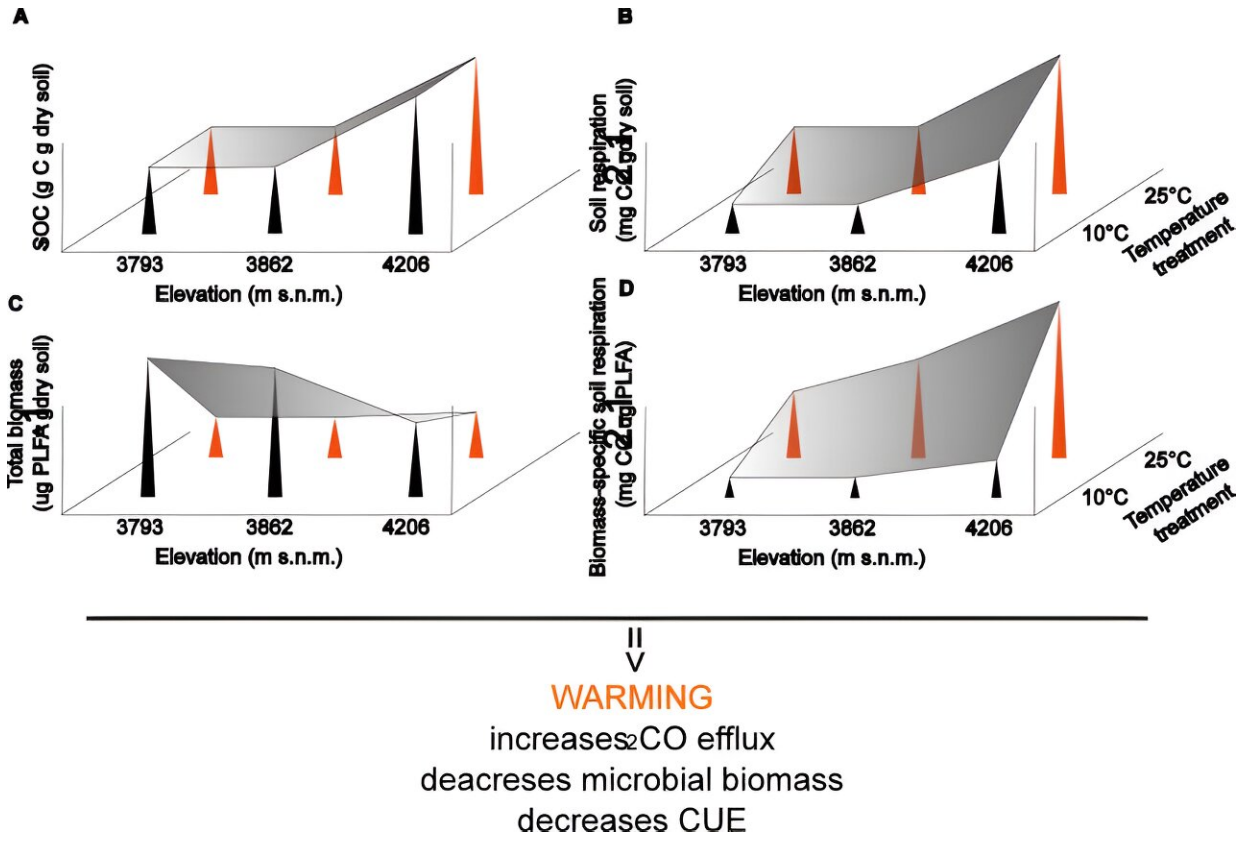

The vegas' soil from the highest altitude showed the highest soil organic carbon (SOC) content (A). Warming increased soil respiration rates and this effect was higher in soil from the highest altitude (B). Also, warming affected microbial biomass resulting in a decrease respect to lower temperature treatment (C); however, the biomass-specific soil respiration rates were higher in warming treatment (D). These results evidence that, in the short-term, warming stimulates resource allocation to respiration rather than microbial growth, which could be related to a reduction in the carbon use efficiency by microorganisms, with the

consequence of soil C losses. Credit: M. Fernanda Chiappero, María V. Vaieretti, Norma Gallardo, Andrea E. Izquierdo

The high-Andean wetlands of the Argentinean Puna region, called "vegas" by local inhabitants, although covering less than 1% of this arid mountain region, are important ecosystems as they support biodiversity and provide local people with fresh water and food for their livestock.

Vegas are also critical for soil carbon sequestration. Because of the waterlogging conditions and low temperatures, they can store large amounts of soil carbon. These carbon reservoirs could be very sensitive to rising temperatures, which can increase microbial decomposition, increasing the release of CO_2 from the soil. However, the magnitude of CO_2 emissions could depend on the altitude at which the vegas are located.

In a study published in *Soil Ecology Letters*, researchers incubated soils from vegas located at different altitudes (from 3,793 to 4,206 m a.s.l.) at 10 °C and 25 °C for 68 days and measured the soil respiration rates and its temperature sensitivity (Q_{10}). The researchers also measured biomass and composition and enzymatic activity of soil microbial communities.

The researchers found that soils of vegas released threefold more CO_2 when they were incubated at 25 °C compared to incubation at 10 °C. In addition, soil from the highest altitude (4,206 m a.s.l.), containing twice more stored carbon than soil from vegas located at lower altitudes, also presented the highest respiration rate during warming treatment.

Despite having these different responses, the Q_{10} did not differ between vegas. The authors say, "These results suggest that raising temperatures over the Puna region, in the short-term, could increase CO_2 emissions

from wetlands located at similar altitudes [to] that studied here, which also could present a similar sensitivity to warming."

Soil microbial communities were also affected by warming. Soils incubated at 25 °C showed lower microbial biomass. However, they were more active as they showed more respiration rate and enzymatic activity expressed per unit biomass. These results suggest that in the short-term, warming could alter the metabolism of microorganisms, particularly carbon use efficiency, with microbial communities deriving more carbon resources from catabolic activities than biomass accrual.

This study represented a first step in disentangling the effects of raised temperatures in soil carbon processes linked to microorganisms of vegas. The findings indicated that warming could affect the carbon balance of these important high-Andean ecosystems, reducing the capacity of storing carbon in their soils.

More information: M. Fernanda Chiappero et al, Experimental warming increases respiration and affects microbial communities of soil wetlands at different elevations of the Argentinean Puna, *Soil Ecology Letters* (2024). DOI: 10.1007/s42832-024-0242-6

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