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Large spatial variability of GHG emissions from an alpine peatland detected by chamber based measurements.

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The study focuses on GHG fluxes analysis (CH_4 and CO_2) under climate change pressure at "Le Viote" alpine peatland (46.01 N, 11.04 E, 1560 m asl), located in the middle of a plateau in the Mt. Bondone area (eastern Alps, Italy).
Soil GHG fluxes were monitored from 12th May to 18th November 2025 using a LiCor Smart Chamber and a LiCor 7810 $CH_4/CO_2/H_2O$ Trace Gas Analyzer. Being the Smart Chamber opaque, measured CO_2 fluxes regarded only the total respiration fluxes of heterotrophic and autotrophic origin. GHG flux measurements were performed over 24 plots, with a sampling design consisting of transects along microtopographic and soil moisture gradients intersecting different areas featuring homogeneous vegetation classes. A total of six dominant vegetation classes were considered following a botanical survey to update the vegetation map of the peatland area, and eight transects of three plots each were set. Ancillary environmental variables such as soil moisture and soil temperature were measured at 6 cm and 15 cm depth respectively on each plot using portable probes.
For both GHG fluxes, vegetation classes were characterised by high spatial variability, even within the same vegetation type. For example, CH_4 fluxes ranged from -3.91 to -0.04 nmolm^{-2}s^{-1} in grassland, while in the wettest area dominated by sedge communities it ranged from 13.19 to 1271.88 nmolm^{-2}s^{-1}. This highlights the close relationship between CH_4 emissions and the soil moisture content. CO_2 fluxes instead ranged from 0.21 to 8.22 µmolm^{-2}s^{-1} in sedges area, and from 0.22 to 34.67 µmolm^{-2}s^{-1} in grassland.
Fluxes were cumulated over the whole monitoring period averaging plots data for each vegetation class and performing a linear interpolation between consecutive measurement dates. CH_4 fluxes ranged from -2.96 g C-CO_2eq m^{-2} over grassland to a maximum value of 194.91 g C-CO_2eq m^{-2} in the wettest area, characterized mainly by sedges and sphagnum mosses. CO_2 fluxes, on the contrary, showed maximum emissions in grassland, with 1613.90 g C m^{-2}, and minimum emissions in the wettest area, with 542.34 g C m^{-2}.
CH_4 and CO_2 fluxes were then aggregated and cumulated over the entire measurement period, for the different vegetation classes: grassland reached the highest GHG emissions, with a maximum value of 1610.94 g C-CO_2eq m^{-2}. Sedge areas characterised by higher soil water content, on the other hand, showed lower fluxes, with values ranging from 1221.60 g C-CO_2eq m^{-2} for the

intermediate sedge zone to 736.76 g C-CO_2eq m^{-2} for the wettest area. The transition zone reached the third highest emissions, with 1113.32 g C-CO_2eq m^{-2}.
Mean GHG effluxes assessed for the whole peatland area of 0.99 km^2 resulted in 942.27 g C-CO_2eq m^{-2} .
The sensitivity of both CO_2 and CH_4 and fluxes to soil temperature was analyzed: the first showed a significative exponential response for all vegetation types, while CH_4 fluxes did not show a consistent, nor significant response pattern being on the contrary clearly modulated by soil moisture.