

Non-proportionality between anoxic CO₂ fluxes and soil organic carbon mass

CRISTIAN ESTOP-ARAGONÉS^{1,2*}, LIAM HEFFERNAN²,
DAVID OLEFELDT²

¹Institute of Landscape Ecology, University of Münster,
48149 Münster, Germany (*correspondence:
cristian.estop@uni-muenster.de)

²Dept. of Renewable Resources, University of Alberta,
Edmonton, Alberta T6G 2H1, Canada

We designed a simple and robust experiment to determine if CO₂ (and CH₄) fluxes derived from soil heterotrophic respiration were proportional to soil organic carbon mass under oxic and anoxic conditions. Surface peat collected from a peatland underlain with permafrost was thoroughly homogenized and used to fill columns (25cm inner diameter) 30, 50 and 100cm high with peat mass being proportional to column height.

CO₂ fluxes under oxic conditions measured during the first week were proportional to soil organic carbon mass ($R^2=0.98$), as expected. Soil columns were then slowly filled with peat porewater and maintained water saturated with distilled water to provide for >200 days anoxic conditions. CO₂ fluxes measured under anoxic conditions (water saturated) for the entire experimental period were clearly not proportional to peat mass ($R^2=0.01$).

This non-proportionality has strong implications for gas emissions modelling in waterlogged ecosystems since models typically assume the CO₂ flux to increase with soil depth due to incremental heterotrophic respiration upon addition of soil layers, an assumption we provide evidence against.

