Effects of natural rewetting on soil respiration and temperature sensitivity (Q_{10}) under contrasting water table regimes: A case study in a Belgian floodplain

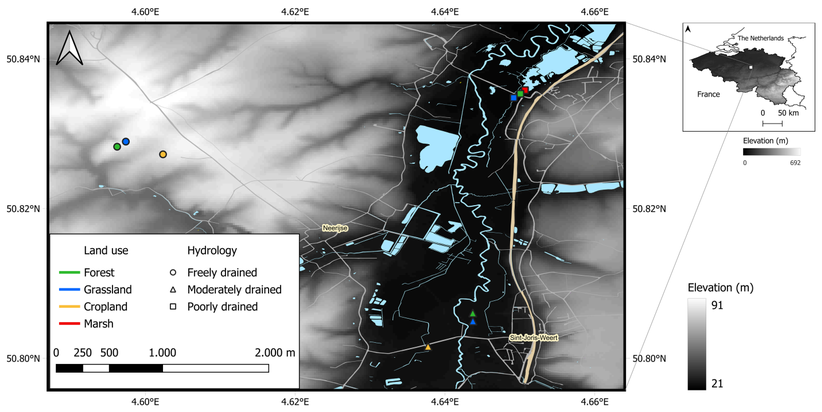
Nicolas Kovacs*[1], Gilles Colinet[1], Bernard Longdoz[1], Jens Leifeld[2], Suzanna Lettens[3], Maud Raman[3], Karen Vancampenhout[4], Gert Verstraeten[4], Jeroen Meersmans[1]

Sharing not permitted

Introduction

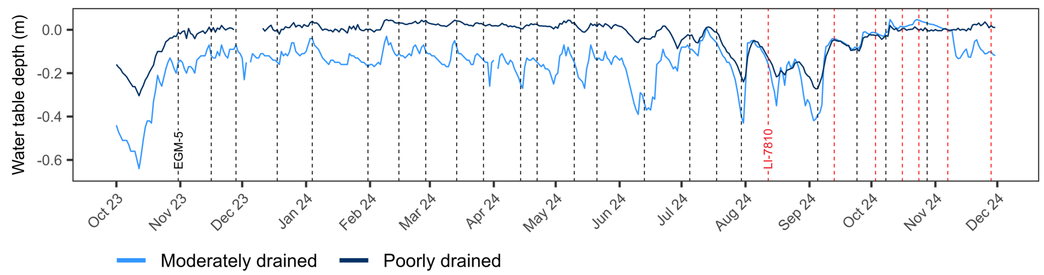
Hydrological conditions strongly influence soil carbon release into the atmosphere. In Belgium, floodplains have been extensively modified by drainage and land-use change, yet the combined effects of hydrology and land use on soil greenhouse gas (GHG) fluxes remain unclear.

Material and Methods



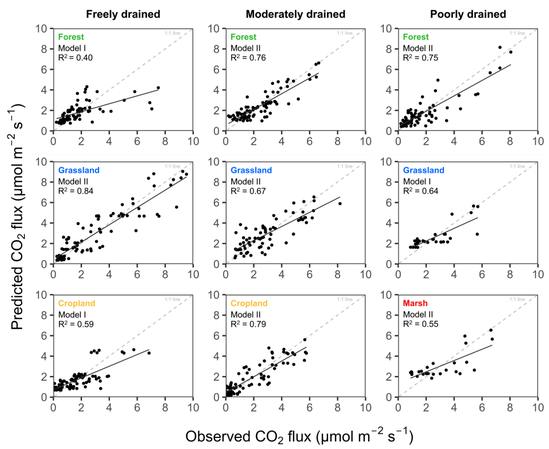
In the Dijle valley (Belgium), we compared a freely drained plateau with two floodplain zones (moderately and poorly drained) across forest, grassland, cropland, and marsh. We measured in situ CO_2 and CH_4 fluxes during the wettest year on record and modelled basal respiration at 10°C (R_{10}) and temperature sensitivity (Q_{10}) using two models (I and II), compared using AICc.

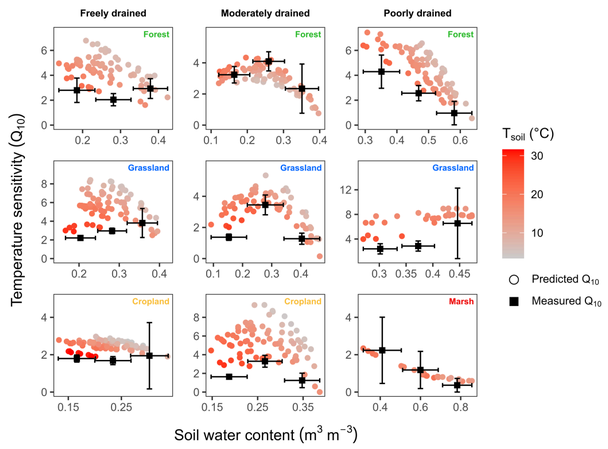
$$(I): R_S = R_{10}\, Q_{10}^{(T_S-10)/10} \qquad (II): R_s = R_{10}\,(a_1 - a_2\,T_s + a_3\,SWC + a_4\,SWC^2)^{(T_s-10)/10}$$

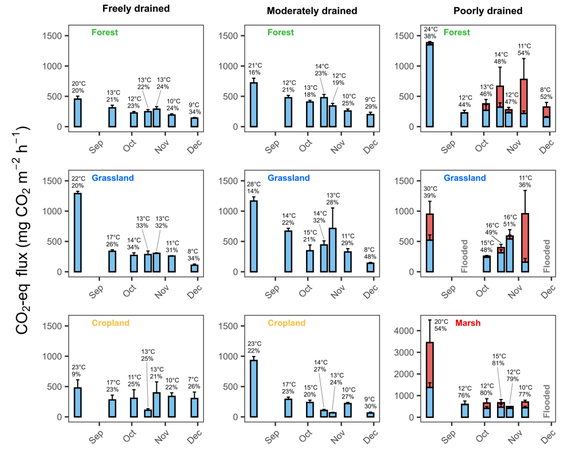


Results

R_{10} followed the order: Poorly drained < Freely drained < Moderately drained for forest and grassland (forests: 0.65, 1.16, and 1.51 µmol CO_2 m^{-2} s^{-1}; grasslands: 1.13, 1.61, and 1.88 µmol CO_2 m^{-2} s^{-1}, respectively). Overall, Q_{10} was not affected by soil moisture on the plateau. In moderately drained sites, Q_{10} peaked at intermediate moisture and strongly decreased at higher moisture, while in the poorly drained sites, Q_{10} increased with decreasing soil moisture. CH_4 contributed substantially to combined GHG fluxes only in the poorly drained sites.







Y-axis: best model (I or II) selected using the lowest AICc

Conclusion

A dynamic temperature sensitivity model improved soil respiration predictions in floodplains. Rewetting drained floodplains may reduce both CO_2 emissions and their temperature sensitivity, especially by maintaining a water table just below the soil surface.

Affiliations

[1] Gembloux Agro-Bio Tech, University of Liège, Belgium
[2] Agroscope, Switzerland
[3] Research Institute for Nature and Forest (INBO), Belgium
[4] KU Leuven, Belgium

Nicolas Kovacs
TERRA Teaching and Research Center,
Gembloux Agro-Bio Tech,
University of Liège, 5030,
Gembloux, Belgium.
nicolas.kovacs@uliege.be