

Iron cycle interactions with hydrological dynamics reduce methane production in a simulated Arctic soil

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Contents of this file

Figures S1 to S4

Introduction

This supporting information includes four supplemental figures. Figure S1 shows the pH response function used for methanogenesis along with the data points used to parameterize it. Figures S2 and S3 show the results of simulations using a range of fermentation rate constant and acetate half saturation constants. Figure S4 shows time series of various quantities from a simulation of repeated oxic-anoxic cycling in an organic horizon.

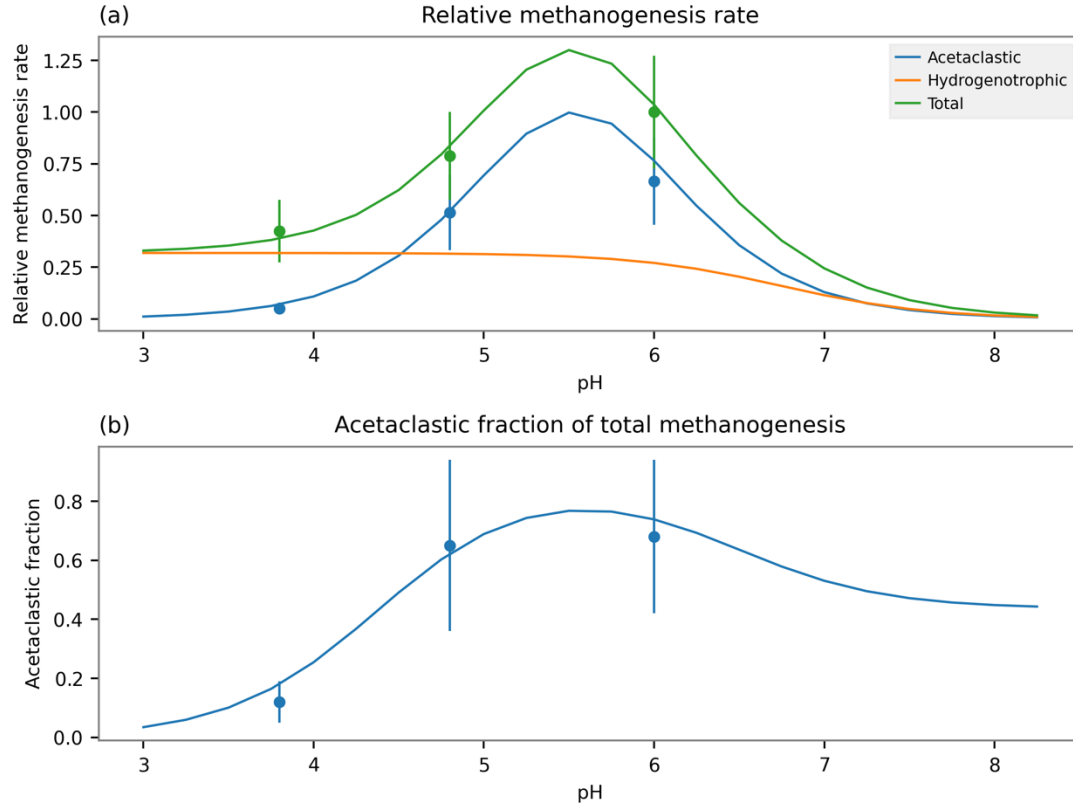


Figure S1: pH dependence of acetoclastic and hydrogenotrophic methanogenesis. Measurements show reported mean and uncertainty values from Kotsyurbenko et al. (2007). Lines show a least squares optimization of Eq. (1). (a): Optimization (lines) and measurements (circles) of acetoclastic and hydrogenotrophic methanogenesis rates as a function of pH, normalized to the maximum acetoclastic rate. (b) Acetoclastic methanogenesis rate as a fraction of total methanogenesis rate.

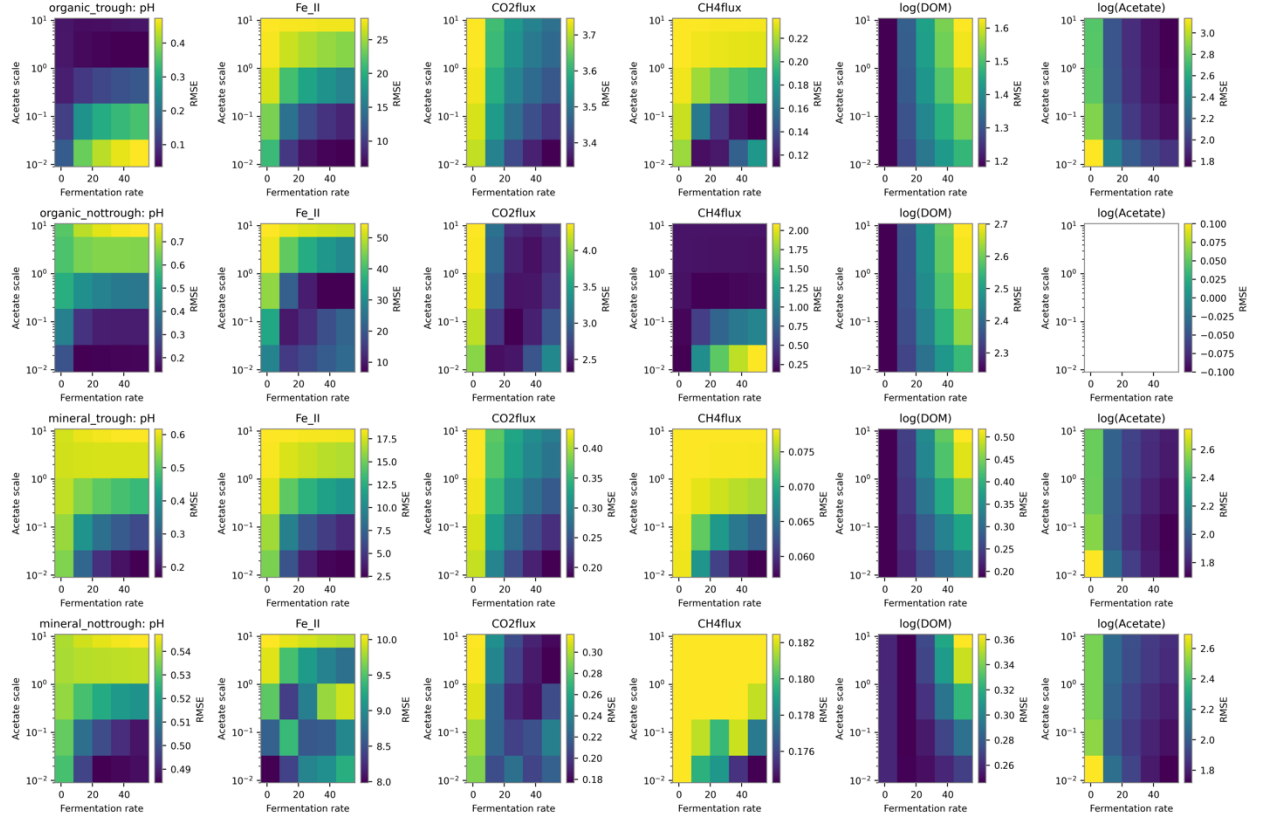


Fig. S2: RMSE between measured and modeled quantities for different values of fermentation reaction rate constant (“Fermentation rate”) and K_S parameter associated with acetate (“Acetate scale”). Each column shows a different quantity (from left to right: pH, Fe(II), CO₂ flux, CH₄ flux, log DOM concentration, and log acetate concentration). Each row shows a different incubated soil core (from top to bottom: Trough organic horizon, rim organic horizon, trough mineral horizon, rim mineral horizon). Lower RMSE (bluer colors) indicate better fit between model and measurements.

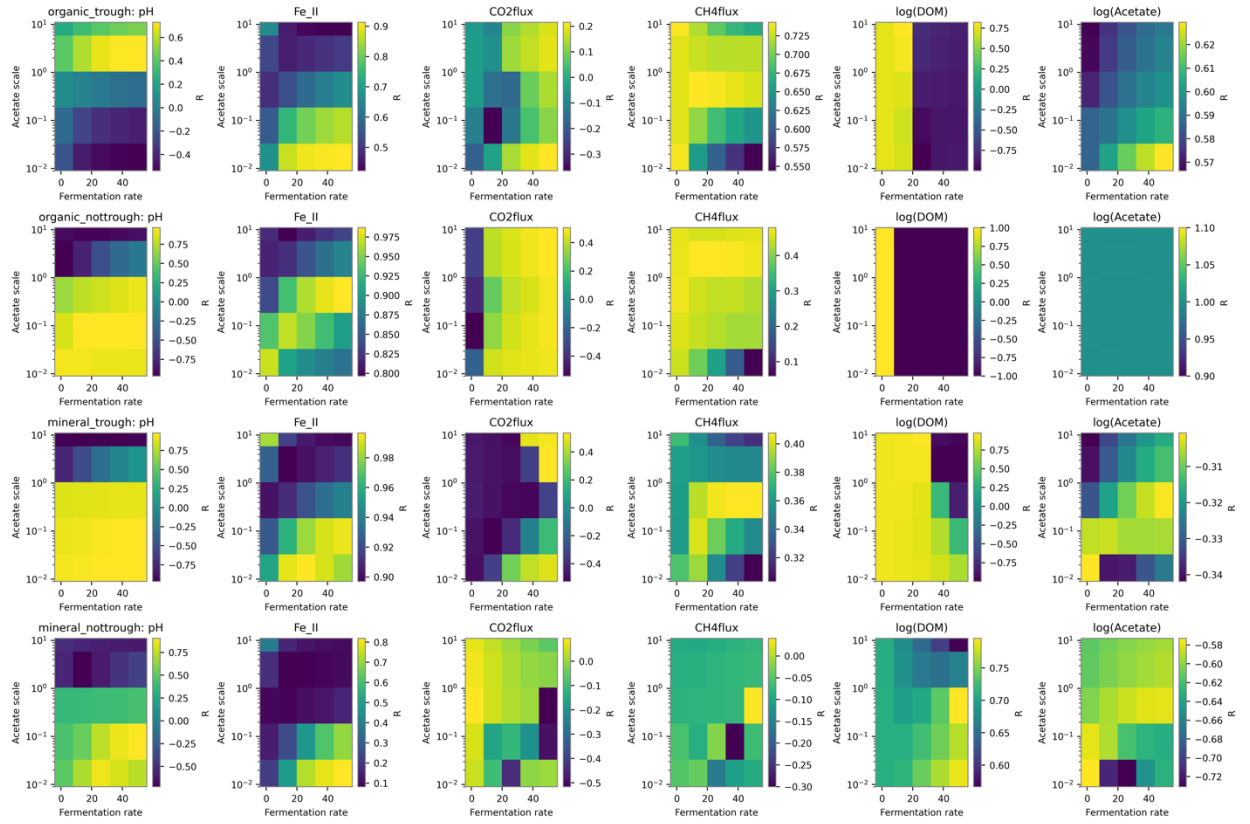


Fig. S3: Correlation coefficient (R) between measured and modeled quantities for different values of fermentation reaction rate constant (“Fermentation rate”) and K_s parameter associated with acetate (“Acetate scale”). Each column shows a different quantity (from left to right: pH, Fe(II), CO₂ flux, CH₄ flux, log DOM concentration, and log acetate concentration). Each row shows a different incubated soil core (from top to bottom: Trough organic horizon, rim organic horizon, trough mineral horizon, rim mineral horizon). R closer to 1 (yellow colors) indicate better fit between model and measurements.

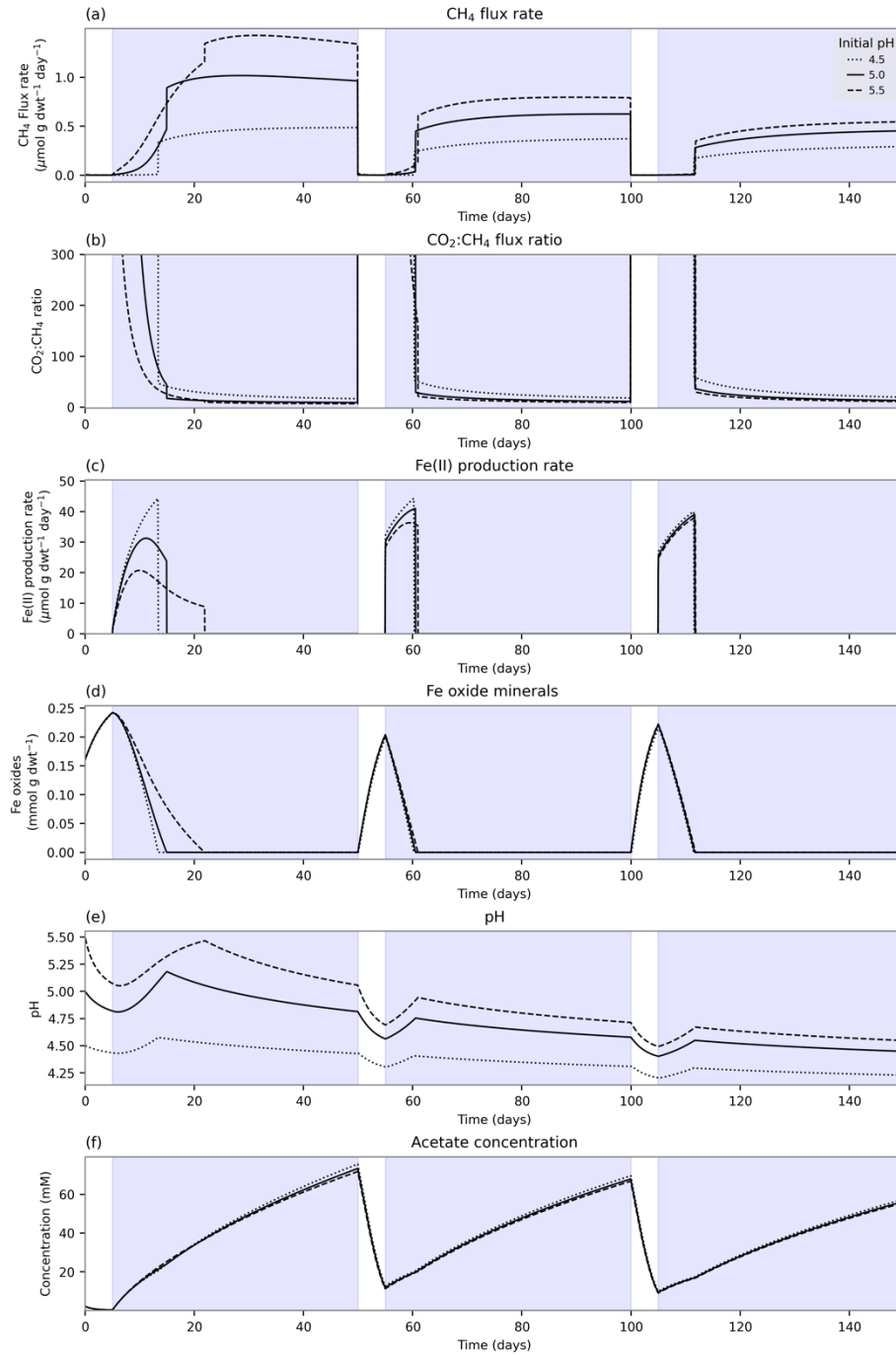


Figure S4: Simulated oxic-anoxic cycles for organic horizon. Blue backgrounds indicate saturated conditions and white backgrounds indicate aerated conditions. (a): CH₄ flux rate. (b): Ratio of CO₂ flux rate to CH₄ flux rate. (c): Fe(II) production rate via Fe(III) reduction. (d): Fe oxide mineral concentration. (e): pH. (f): Acetate concentration.