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A dynamical system approach to soil iron and carbon cycles

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Soil iron is fundamental to plant growth, carbon cycle, and soil properties. While experimental studies to disentangle its intricate dynamics abound, theoretical models aimed at exploring the hydrologic control on soil iron cycle and its repercussion on irrigation and fertilization strategies have been missing. Here we present a spatially implicit model that couples carbon, soil air composition, and iron dynamics in the soil root zone at the daily time scale. The dynamical system of coupled nonlinear differential equations allows us to analyze the soil moisture control on the soil redox potential, the partitioning between Fe2+ and Fe3+, iron fluxes at equilibrium and during relaxation towards it as well as on the alternation of oxidizing and reducing conditions imposed by a seasonal climatic forcing. Data collected at the Critical Zone Observatories are being used to test the prediction of the proposed dynamical system.