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How important is a detailed hydrological representation when modelling soil carbon dynamics in Chinese red soils.

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Soil carbon and nitrogen processing are strongly influenced by the hydrology of soils. When simulating these processes models represent soil hydrology in some way. The hydrological components of soil carbon and nitrogen models vary greatly in their complexity, as does the burden of simulation time and data requirements. Hydrology specific models, such as Hydrus, have more detailed representations of soil hydrology than those used in some soil carbon and nitrogen models, such as ECOSSE, and can provide a more accurate and precise description of the movement and content of water in soil. Moisture content is one of the key variables controlling the processing of carbon and nitrogen in soil models. A higher soil moisture content results in increased methane production through the anaerobic decomposition of soil carbon pools. It also alters the rate at which aerobic decomposition occurs, with low and high soil moisture contents limiting the decomposition of SOC. An inaccurate estimate of soil moisture will introduce errors in the estimated rates of model SOC transformations, which would result in errors in the simulated SOC.

In order to shed light on this uncertainty we use the same input data to simulate soil moisture contents in a Red Soil region of China, using both the ECOSSE model and Hydrus 2D. We compare the simulations of both models with measurements of soil moisture at the site and each other. We highlight where the models differ and identify the conditions under which errors are likely to occur. We then simulate SOC dynamics using the ECOSSE model and its original hydrology with the ECOSSE model simulations using the Hydrus 2D simulations. This shows the importance of including a detailed representation of soil moisture when simulating soil organic matter dynamics.