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Upscaling the effect of priming on carbon turnover in the earth system

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Priming, increase in decomposition rate of native soil organic carbon (SOC) in response to a supply of fresh organic matter, is a process that has been observed at the lab scale. It is difficult, however, to experimentally assess its importance on the field or global scale. Here we used an earth system model, the Community Land Model (CLM), to assess the possible impact of priming on SOC on a global scale. First we compared the SOC output from the unmodified CLM to estimates from a global data set (ISRIC-WISE). Then we modified the model by including a simple description of a priming effect based on an increase in SOC decomposition rate when fresh litter is decomposed. The unmodified CLM predicted somewhat too much SOC in areas with high productivity and too little SOC in high latitude areas. Whilst the underprediction in high latitude areas can be explained because the model does not take into account peat accumulation and water-logging, the overprediction in high productivity areas is harder to explain, but could be reduced by including priming. Including a priming effect did decrease SOC most in areas with high plant input, which were also the areas where the unmodified model predicted too much SOC. Including a priming effect therefore improved the prediction of SOC distribution, although the model may need re-calibration to improve predictions of global totals. The model was then run with climate change prediction. Future simulations showed that differences between the standard and modified versions were maintained and somewhat increased in a future with climate change.