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Increased risk of soil organic carbon loss and warming feedback under lowered water table

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Terrestrial ecosystems across the globe have experienced widespread water table drawdown caused by intensive anthropogenic exploitation and climate drying. Soil is the largest reservoir of the terrestrial carbon and a major source of greenhouse gases, but it is unclear how sensitive is soil carbon storage to water table drawdown globally and its consequence on carbon-climate feedback. Taking advantages of large scale observations of water table depth (WTD) and soil organic carbon (SOC), we detected an exponential correlation between WTD and SOC distribution across the globe, that is, a higher SOC as well as a higher sensitivity when WTD is low (i.e., close to the soil surface). Therefore, future lowering of WTD is likely to reduce soil carbon storage, with the most vulnerable regions characterized by shallow WTD (e.g., peatland). With additional synthesis through water table manipulation experiments, lowering WTD caused an overall global warming feedback with the dominant contribution from enhanced release of carbon dioxide, counterbalanced by reduced methane emissions. In short, further withdrawn of groundwater and/or exacerbating of climate drying are likely to decrease SOC storage and increase the risk of future climate warming.