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A large carbon source from soil carbonates: evidence from China's grasslands

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Soil carbon (C) stocks consist of organic and inorganic components, $\sim$ 1.7 times larger than the total of the C stored in vegetation and the atmosphere together. Significant soil C losses could thus offset any C sink in vegetation, creating a positive feedback. However, compared with the susceptible sensitivity of organic matter decay to climate warming, soil inorganic carbon (SIC) stocks are often assumed to be relatively stable. Here we evaluate SIC changes across China's grasslands during the last two decades, using data from a recent regional soil survey during 2001-2005 and historical national soil inventory during the 1980s. We show that SIC stocks in the top 10 cm have decreased significantly between the sampling periods, with a mean loss rate of 26.8 (95%CI: 15.8-41.7) g C m-2 yr-1. The larger SIC loss occurred in those regions with stronger acidification and richer soil carbonate. Globally, grassland soils with similar carbonate content could release 53.9 Tg C yr-1 if subjected to similar drivers, potentially offsetting 2-11% of postulated residual C sink in the terrestrial biosphere. The large C loss from soil carbonates may diminish the strength of C sequestration in land ecosystems, amplifying the positive C-climate feedback.