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Mollisol erosion accelerates soil gas emission from cold regions under agricultural intensification

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Mollisols are organic-rich soils that represent a significant terrestrial carbon reservoir and host some of the most important and productive agroecosystems on the globe [1]. The majority of the world's Mollisols are seasonally frozen and distributed in northern cold regions that are disproportionately vulnerable to climate change. Climate warming is accompanied by the expansion and intensification of agricultural production in Mollisol regions, such as in the Mollisol regions of northeastern China [2]. The resulting greater soil erosion threatens the sustainability of Mollisol resources, and perturbs the regional-to-global carbon cycle. Here, we present novel mechanistic insights into how Mollisol erosion affects the emission of greenhouse gases and methylated selenium from agricultural watersheds, by combining field investigation, customized mesocosm experiments, and theoretical calculations. Overall, our results confirm the increased emissions of CO_2, CH_4, and selenium to the atmosphere from Mollisol agricultural landscapes and receiving rivers, primarily driven by the mobilization and decomposition of biodegradable terrestrial organic matter [3]. The role of Mollisol organic matter turnover is further examined in relation to microbial carbon use efficiency and metabolic energy requirements. The findings should help inform appropriate Mollisol conservation practices that enable sustainable agricultural development in cold region Mollisols.

[1] Liu *et al.* (2012) *Can. J. Soil Sci.* **92**, 383-402. [2] Pi *et al.* (2023) *Environ. Sci. Technol.* **57**, 6228-6237. [3] Li *et al.* (2022) *Environ. Sci. Technol.* **56**, 16494-16505.