Historical carbon and GHG budget of global grassland (1901 – 2010) - A modelling approach

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Résumé

The greenhouse gas (GHG) balance of global grasslands, including CO2, CH4 and N2O, is estimated using the new process-based biogeochemical model ORCHIDEE-GM v3.1 (Chang et al., 2013; 2015; 2016) at a resolution of 0.5∘ by 0.5∘ over the period 1901–2010. The simulation takes into account: (1) a mechanistic representation of grassland management including grazing and mowing; (2) the history of grassland management reconstructed by combining livestock production information and modeled grassland productivity (Chang et al., 2016); (3) the history of nitrogen fertilization and deposition; (4) land-use change; (5) variable CO2 and climate. Grassland acted as the GHG source from 1901 to 2010. The decadal GHG balances of global grassland varied between 0.87 to 2.12 Gt CO2-equivalent per year, while the inter-decadal variation resulted from CO2 fluxes (i.e., net biome productivity, NBP). Globally, rapid increases in grassland CH4 and N2O emissions were simulated, mirroring the increase in domestic livestock numbers. However, global grassland was not simulated to be a larger GHG source in the past five decades, due to an increasing CO2 sink since 1960s was simulated. The modeled grassland carbon and GHG balances showed regional differences in spatial pattern and time evolution, which could be attributed to climate change, management history, and land-use change.

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