Microbial roles in the terrestrial carbon dynamics during 1901-2016 as simulated by the CLM-Microbe model

Abstract

We applied a microbial-explicit model – the CLM-Microbe – to investigate the dynamics of C in vegetation, litter, soil, and microbes during 1901-2016. The CLM-Microbe model was able to reproduce global averages and latitudinal trends of gross (GPP) and net (NPP) primary productivity, heterotrophic (HR) and soil (SR) respiration, biomass C in fungi (FBC) and bacteria (BBC) in the top 30 cm and 1 m, dissolved (DOC) and soil organic C (SOC) in the top 30 cm and 1 m. In addition, the CLM-Microbe model captured the grid-level variation in GPP (R^2=0.78), NPP (R^2=0.63), SR (R^2=0.26), HR (R^2=0.23), DOC in 0-30 cm (R^2=0.2) and 0-1 m (R^2=0.22), SOC in 0-30 cm (R^2=0.36) and 0-1 m (R^2=0.26), FBC (R^2=0.22) and BBC (R^2=0.32) in 0-30 cm, and MBC in 0-1 m (R^2=0.21). From the 1900s to 2007-2016, simulated C variables increased by approximately 30 PgC yr^{-1} for GPP, 15 PgC yr^{-1} for NPP, 12 PgC yr^{-1} for HR, 25 PgC yr^{-1} for SR, 1.0 PgC for FBC and 0.4 PgC for BBC in 0-30 cm, 1.5 PgC for FBC, 0.8 PgC for BBC, 2.5 PgC for DOC, 40 PgC for SOC, and 5 PgC for litter C in 0-1 m, and 40 PgC for vegetation C. The relative increases in C fluxes and pools varied across the globe. Increases in vegetation C were closely related to warming and increased precipitation, while C accumulation in microbes and soils was jointly governed by vegetation C input and soil temperature and moisture.

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