Geophysical Research Abstracts
Vol. 21, EGU2019-245-1, 2019
EGU General Assembly 2019

Evaluating future changes in soil carbon stocks using data-model integration

Oleksandra Hararuk
University of Central Florida, Department of Biology, Orlando, United States (ohararuk@gmail.com)

Soil is the largest terrestrial carbon (C) pool, containing 1500-2400 Pg C globally, which constitutes 70-84% of global terrestrial C storage. Accurate representation of carbon dynamics in soils is important for predicting future carbon-climate feedbacks, however it has posed a persistent challenge for biogeochemical modelling community. The rise in the availability of observations of the terrestrial biogeochemical variables promoted model evaluation, however few studies have focused on using the observations to inform model structure and parameters. In this study I (1) combine several datasets from the Harmonized World Soil Database (HWSD), a Compilation of Global Soil Microbial Biomass Carbon, and Global Database of Soil Respiration Data; (2) apply a data assimilation technique to parameterize two commonly used C cycle model formulations: a model with first-order C dynamics and a model with explicit microbial dynamics; and (3) use the best performing model to evaluate future changes in soil C stocks.

Root mean squared error of soil C produced by the calibrated model with first-order C dynamics was 5,323 mmol kg^{-1} soil, however modeled soil C did not correlate significantly with the soil C from HWSD. Root mean squared error of soil C produced by the calibrated model with explicit microbial dynamics was 4,131 mmol kg^{-1} soil, and there was a moderate correlation between modeled soil C and that from HWSD ($r = 0.52$, $p < 0.001$). Future changes in soil C were highly sensitive to microbial turnover rates: microbial death rate of 4.5 yr^{-1} soil led to an average decrease in soil C by a total of 2,094 (±4,100) mmol kg^{-1} soil, whereas a microbial density-dependent death rate of 12 yr^{-1}led to an average decrease of 215 (±2,312) mmol kg^{-1} soil. The largest potential soil C gain was expected in tropical forests averaging at 976 (±862) mmol kg^{-1} soil, and the largest potential soil C release was expected in the boreal forests averaging at 2,677 (±3,896) mmol kg^{-1} soil. Soil C was also sensitive to changes in C input and temperature: a 50% increase in soil C input could increase C storage potential by an average of 247 (±1,902) mmol kg^{-1} soil, whereas a 2°C increase in temperature would decrease SOC stocks by 1,297 (±3,174) mmol kg^{-1} soil.