Geophysical Research Abstracts
Vol. 17, EGU2015-1732-1, 2015
EGU General Assembly 2015

Linking the climatic and geochemical controls on global soil carbon cycling

Sebastian Doetterl (1,2), Antoine Stevens (3), Johan Six (4), Roel Merckx (5), Kristof Van Oost (3), Manuel Casanova Pinto (6), Angélica Casanova-Katny (7), Cristina Muñoz (8), Mathieu Boudin (9), Erick Zagal Venegas (8), and Pascal Boeckx (1)

(1) Isotope Bioscience Laboratory, Ghent University, Ghent, Belgium (sebastian.doetterl@ugent.be), (2) Department of Geography, University of Augsburg, Augsburg, Germany, (3) George Lemaître Centre for Earth and Climate Research, Université catholique de Louvain, Louvain-la-Neuve, Belgium, (4) Department of Environmental Systems Science, ETH Zurich, Zurich, Switzerland, (5) Department of Earth and Environmental Sciences, Katholieke Universiteit Leuven, Heverlee, Belgium, (6) Departamento de Ingeniería y Suelos, Universidad de Chile, Santiago, Chile, (7) Departamento de Microbiología, Universidad de Concepción, Concepción, Chile, (8) Departamento de Ciencias del Suelo y Recursos Naturales, Universidad de Concepción, Chillán, Chile, (9) Royal Institute for Cultural Heritage, Bruxelles, Belgium

Climatic and geochemical parameters are regarded as the primary controls for soil organic carbon (SOC) storage and turnover. However, due to the difference in scale between climate and geochemical-related soil research, the interaction of these key factors for SOC dynamics have rarely been assessed. Across a large geochemical and climatic transect in similar biomes in Chile and the Antarctic Peninsula we show how abiotic geochemical soil features describing soil mineralogy and weathering pose a direct control on SOC stocks, concentration and turnover and are central to explaining soil C dynamics at larger scales. Precipitation and temperature had an only indirect control by regulating geochemistry. Soils with high SOC content have low specific potential CO_2 respiration rates, but a large fraction of SOC that is stabilized via organo-mineral interactions. The opposite was observed for soils with low SOC content. The observed differences for topsoil SOC stocks along this transect of similar biomes but differing geo-climatic site conditions are of the same magnitude as differences observed for topsoil SOC stocks across all major global biomes.

Using precipitation and a set of abiotic geochemical parameters describing soil mineralogy and weathering status led to predictions of high accuracy (R2 0.53-0.94) for different C response variables. Partial correlation analyses revealed that the strength of the correlation between climatic predictors and SOC response variables decreased by 51 - 83% when controlling for geochemical predictors. In contrast, controlling for climatic variables did not result in a strong decrease in the strength of the correlations of between most geochemical variables and SOC response variables.

In summary, geochemical parameters describing soil mineralogy and weathering were found to be essential for accurate predictions of SOC stocks and potential CO_2 respiration, while climatic factors were of minor importance as a direct control, but are important through governing soil weathering and geochemistry. In conclusion, we pledge for a stronger implementation of geochemical soil properties to predict SOC stocks on a global scale. Understanding the effects of climate (temperature and precipitation) change on SOC dynamics also requires good understanding of the relationship between climate and soil geochemistry.