Geophysical Research Abstracts
Vol. 20, EGU2018-10743, 2018
EGU General Assembly 2018

Soil erosion constraints on global agricultural productivity potential

Won Seok Jang (1), Jason Neff (1), Jeffrey Herrick (2), and Luca Doro (3)

(1) Sustainability Innovation Lab at Colorado (SILC), University of Colorado at Boulder, Boulder, Colorado 80309, United States (won.jang@colorado.edu), (2) U.S. Department of Agriculture - Agricultural Research Service, Research Unit @The Jornada, Las Cruces, New Mexico 88003, United States (Jeff.Herrick@ars.usda.gov), (3) Blackland Research and Extension Center, Texas A & M AgriLife Research, Temple, Texas 76502, United States (ldoro@brc.tamus.edu)

Land degradation poses a threat to food security particularly in developing economies where the pace of agricultural development is rapid and where soil erosion mitigation efforts are often lacking. Soil erosion from agricultural lands leads to the loss of soil fertility and simultaneous changes to soil hydrology which collectively reduce the potential for crop yields. Soil erosion is controlled by a variety of factors including agricultural management, climate, soil properties, and site characteristics but the relative importance of these factors at a global scale remain poorly quantified. Moreover, there are a number of uncertainties regarding the cumulative impacts of erosion on agricultural productivity and limited understanding of the relative importance of soil hydrologic and biogeochemical changes on potential crop yields.

Here, we carry out a series of multi-decadal model simulations of erosion and crop yields under a variety of climate, soil, crop, slope steepness, and management scenarios. The simulations are based on a modified version of the EPIC simulation model that has be updated to better simulate long-term erosion-induced changes in soil fertility and hydrology on both gentle and steep slopes. We carried out simulations for soils present in twenty-one global climate zones using the Köppen climate classification combined with soils from the Harmonized World Soil Database (HWSD) from the Food and Agriculture Organization (FAO) of the United Nations. Crop cover was determined from the Global Food Security-support Analysis Data (GFSAD) from USGS (United States Geological Survey) and NASA (National Aeronautics and Space Administration).

Our results provide a global estimate of the magnitude of erosion induced changes in hydrology and soil fertility in a diverse array of soils and climate zones. Although there are general and expected trends of reduced soil fertility, we also find that the impacts of erosion on soil available water content can lead to large (more than 25%) reductions in crop yield potential. These hydrologic impacts are particularly important on shallow soils and soils with subsurface clay horizons. From these results, we provide a preliminary global estimate of areas likely to have been impacted by erosion over the past two decades as well as the potential loss of yields that will have accompanied these changes.