Geophysical Research Abstracts
Vol. 18, EGU2016-1525, 2016
EGU General Assembly 2016

Assessing the impacts of agricultural change on soil erosion over the last century: a multi-model ensemble approach

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Soil erosion models (SEMs) are valuable tools for understanding the links between past agricultural practices and soil erosion. Use of SEMs allows assessment of impacts from agricultural change over timescales that exceed instrumental records but correspond to periods for which considerable land use and climate information are available. Here, we develop a modelling framework to investigate the potential impacts of changes in agricultural practices and climate on soil erosion and sediment transport over the last 100 years in six lake catchments in Britain spanning upland and lowland environments. The modelling platform comprises a multi-model ensemble of derivatives of the Morgan-Morgan-Finney (MMF) and RUSLE models. Simulation of change in land use/land cover (LULC), drainage features, crop rotation and livestock grazing are accounted for by reconstructing LULC maps from 1888 to 2007. Reconstructions of climatic conditions combine multiple records using regression and artificial neural network techniques to derive long-term daily precipitation and temperature series from 1880 to present. The modelling platform uses a grid-based modelling approach to handle the spatial distribution and heterogeneity in LULC, soil and topographic information. For each soil type, a database of physical parameters was created by combining information from the literature, LandIS soil database and pedotransfer functions. At each grid cell, a rainfall-Runoff (RR) model based on saturation excess runoff generation mechanisms provides daily soil moisture content. Furthermore, the modelling platform encompasses a crop cover model (CC) based on the Heat Unit approach developed to simulate daily Leaf Area Index for each crop type. Both the RR and CC models are used to update the canopy and ground cover parameters. In the absence of long-term river monitoring data, lake sediment records are used to compare the multi-model simulations thus creating a baseline from which to project impacts from future agricultural scenarios under a changing climate.