Geophysical Research Abstracts
Vol. 16, EGU2014-14060-1, 2014
EGU General Assembly 2014

Tracing soil erosion impacts on soil organisms using ^{137}Cs and soil nematodes

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The application of environmental radionuclides in soil tracing and erosion studies is now well established in geomorphology. Sediment and erosion-tracing studies are undertaken for a range of purposes in the earth sciences but until now few studies have used the technique to answer biological questions. An experiment was undertaken to measure patterns of soil loss and gain over 50 years, effectively calculating a field-scale sediment budget, to investigate soil erosion relationships between physical and biological soil components. Soil nematodes were identified as a model organism, a ubiquitous and abundant group sensitive to disturbance and thus useful indicator taxa of biological and physico-chemical changes. A field site was selected at the James Hutton Institute's experimental Balruddery Farm in NE Scotland. 10 metre-resolution topographical data was collected with differential GPS. Based on these data, a regular 30 m-resolution sampling grid was constructed in ArcGIS, and a field-sampling campaign undertaken. 104 soil cores ($\sim$50 cm-deep) were collected with a percussion corer. Radio-caesium (^{137}Cs) activity concentrations were measured using high-purity germainum gamma-ray spectroscopy, and ^{137}Cs areal activities derived from these values. Organic matter content by loss on ignition and grain-size distribution by laser granulometry were also measured. Additional samples were collected to characterise the soil nematode community, both for abundance and functional (trophic) composition using a combination of low-powered microscopy and molecular identification techniques (dTRFLP). Results were analysed with ArcGIS software using the Spatial Analyst package. Results show that spatial relationships between physical, chemical and biological parameters were complex and interrelated. Previous field management was found to influence these relationships. The results of this experiment highlight the role that soil erosion processes play in medium-term restructuring of the physico-chemical soil environment and the soil community.