Geophysical Research Abstracts
Vol. 21, EGU2019-15048, 2019
EGU General Assembly 2019

Spatial analysis and modeling of cesium-137 redistribution in the soil cover of the Bryansk region

Vitaly Linnik (1), Alexander Sokolov (1,2), Anatoly Saveliev (3), and Iya Mironenko (4)

(1) Vernadsky Insitute, Geochemistry, Moscow, Russian Federation, Kosygin Street 19, 117975 (linnik@geokhi.ru), (2) Institute for Information Transmission Problems (Kharkevich Institute) of Russian Academy of Science, Moscow, Russian Federation, 127051, Bol'shoi Karetnyi per., 19, (3) Institute of Ecology and Geography, Kazan Federal University 18 Kremlevskaja Street, Kazan, 420008, Russia, (4) Moscow State University, Geographical Department, GSP-1, 119991, Moscow, Russia

Radioactive fallout, that entered the landscape, is strongly absorbed by soil particles and their further fate is the fate of the redistribution of many soil particles in the landscape. Therefore, Cs-137 is a unique tracer for studying soil erosion and sedimentation. Numerous studies of the behavior of Cs-137 by fallout from nuclear test have shown its uniqueness for investigation of soil erosion and sedimentation. Global Cs-137 fallout was successfully used to measure soil erosion rates and delineate patterns of soil erosion and deposition within landscape units.
The accident at the Chernobyl Nuclear Power Plant, which occurred on April 26, 1986, provided a unique opportunity to use radioactive tracers in different landscapes of the Bryansk region, which were most affected by radioactive contamination. In 1993, the airborne gamma survey of the Bryansk region covered an area of 180x200 km in 100 m steps and embraced all contaminated areas with different soil types, including sod-podzolic, alluvial, gray forest, and peat bogs.
The main radioactive contamination was formed by Cs-137, a well-tested tracer in soil studies. Air-gamma survey revealed significant spatial heterogeneity of Cs-137 contamination. The initial "spotting" of Cs-137 contamination, which in the spring of 1986 represented multi-scale complex patterns of contamination, was substantially transformed by 1993 due to erosion processes of various intensity.
The objective of this study is to test various mathematical models actively used in pedometrics to evaluate the contribution of various landscape factors to the erosion and sedimentation processes that led to the formation of Cs-137 patterns at the time of the survey in 1993. Actually, this is a solution of the inverse problem when, according to the 1993 air-gamma measurement, it is necessary to restore the Cs-137 patterns that existed at the time of their formation in April-May 1986.
Modeling the transformation of Cs-137 cesium-137 patterns is demonstrated using four plots as an example. Two remote sites (Kostitsa and Dubrovka) are located 280 km and 250 km away from the Chernobyl NPP, respectively, and characterise the transformation of cesium-137 patterns at levels slightly exceeding the global background: with regard to the Kostitsa site, the pollution is 8-21 kBq/m2, while for the Dubrovka site it is 3-16 kBq/m2. The two sites closest to the Chernobyl NPP (Vyshkov and Brakhlov), located at a distance of 175 km and 195 km from the Chernobyl NPP, respectively, have a contamination with cesium of 460-1570 kBq/m2 and 60-207 kBq/m2, respectively.
To assess the relationship of Cs-137 with various landscape factors derived from DEM we used different statistical models, such as GLM, GAM. To analyze Cs-137 distribution depending on a number of parameters (Curvature, LS index, Slope) initial DEM and layer of Cs-137 was resampled to a grid 25 $\times$ 25 m using two methods: 1) spline approximation with optimal weights and 2) Bayesian interpolation methods.