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Lateral migration of Caesium-137 as a heterogeneity factor of soil radioactive contamination within small catchments

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Caesium-137 is long-lived artificial radionuclide with half-life of about 30.17 years. Due to Chernobyl accident in 1986 were received 270-280 PBq of 137Cs. The radioactive material is spread in different directions and then fell to the vast territory on the earth's surface as part of rainfall and under the influence of gravity. The deposition of 137Cs was very heterogeneous due to significant impact of changing weather conditions during the accident. Fixing 137Cs in the soil is because of the high content in the upper layer of fine fractions (especially clay) and organic substances that increase the sorption properties of soil. As a result of small vertical migration down the soil profile, the main migration processes of 137Cs is lateral migration which may occur in soil particles under the deflation but mainly water erosion.The aim of this study was to analyze the main factors of changing the current radioecological situation of small catchments in Chernozem zone of European Russia. The 1st small catchment with total area 1.98 km2 is located in the Kursk Region, where 137Cs soil inventories currently does not exceed 37 kBq/m2. The 2nd small catchment with total area 0.99 km2 is located in the Tula Region called "Plavsk Cs deposition hotspot" was highly contaminated with radioactive fallout with levels up to 600 kBq/m2.For reconstruction of 137Cs initial fallout was defined 4 references sites in Kursk Region and 5 sites in Tula Region. All reference sites were located at the flat interfluve areas in or nearby the study catchment. The analysis of 137Cs inventory within 1st study site references did not show significant differences between them which indicates the absence of the initial fallout heterogeneity. The mean values of 137Cs inventory is 8,7±0,5 kBq/m2 and Cv varies in a range of 13-22%, which are typical for the faraway from Chernobyl territory. Based on 4 references was created the map of initial Chernobyl fallout using the formula of radioactive decay. The next step was creation map of 137Cs contamination of soils using data from slopes and bottoms and its comparison with the map of initial Chernobyl fallout. Subsequently, the 137Cs inventory of soil on slopes and watersheds decreased due to the processes of radioactive decay and removal 137Cs with soil erosion but increased on foot of the slopes and bottoms as a result of accumulation processes. In the bottom of catchment formed zones with 2 times excess of the 137Cs initial fallout which is associated with concentrating runoff of soil material from large areas to the bottom, which occupies about 1 % of the total catchment area.The 137Cs inventory within 2nd study site references varies in a range of 82-211 kBq/m2. There is notable spatial trend on the map of initial fallout have been determined in submeridional direction but no trend in sublatitudinal direction. In 2013 the 137Cs inventories within small catchment bottom also in 1.5-2 times higher than the inventories within watershed. Soil erosion significantly changes composition of 137Cs contaminaition in catchment within no polluted area and no changes within heavily polluted area because of heterogeneous deposition.