Geophysical Research Abstracts
Vol. 16, EGU2014-9585, 2014
EGU General Assembly 2014

Bioavailability of caesium-137 from chernozem soils with high and low levels of radioactive contamination

Tatiana Paramonova (1), Eugenia Shamshurina (2), Ekaterina Machaeva (1), and Vladimir Belyaev (2)

(1) Soil Science Faculty of Moscow State Lomonosov University, Moscow 119991, Russian Federation (tapara@mail.ru), (2) Geography Faculty of Moscow State Lomonosov University, Moscow 119991, Russian Federation

Bioavailability of Cs-137 in "soil-plant" system of radioactively contaminated terrestrial ecosystems is the most important factor in the understanding of ecological situation. There are many factors affecting the features of Cs-137 biogeochemical cycle: period since an accident, type and intensity of radioactive fallout, general properties of landscape and the specifics of soil and plant covers, etc. In order to evaluate the importance of soil contamination level for the process of Cs-137 translocation from soil to plant the research in forest-steppe areas of Russia with similar natural properties, but contrasting high (Tula region) and low (Kursk region) levels of radioactive Chernobyl fallout (about 25 years after accident) was conducted. Soil cover of both sites is presented by chernozems with bulk density 1.1-1.2 g/cm3, 6-7% humus and neutral pH 6.5-7.2; plant cover under investigation consist of dry and wet meadows with bioproductivity 1.6-2.5 kg/m2 and 85-90% of biomass concentrated underground, that is typical for Russian forest-steppe landscapes. At the same time levels of soil regional contamination with Cs-137 differ by an order – 620-710 Bq/kg (210-250 kBq/m2) in Tula region and 30-55 Bq/kg (10-20 kBq/m2) in Kursk region. At a higher level of soil radioactive contamination specific activity of Cs-137 in vegetation of meadows is noticeably increased (103-160 Bq/kg in Tula region versus 12-14 Bq/kg in Kursk region) with correlation coefficient r 0.87. Increasing of Cs-137 in the underground parts of plants plays a decisive role in this process, while the specific radionuclide's activity in the aboveground parts of different sites is almost invariant (and ubiquitously roots contain 2-5 times more Cs-137 than shoots). The values of transfer factors for Cs-137 (the ratio of the specific Cs-137 activities in the plant tissue and in the soil) at various levels of soil radioactive contamination vary within a relatively narrow range 0.1-0.4, that confirms the discrimination in the radionuclide root uptake. And the higher the level of soil contamination, the more pronounced decreasing of Cs-137 transfer factors with correlation coefficient r – 0.89. Further, transfer factors of Cs-137 for aboveground parts of meadow vegetation consist of 0.03-0.012 and always are 2-4 times lower than transfer factors for underground parts. This suggests an existence of biological barrier between the roots and shoots and suppression in the translocation of Cs-137s into aboveground parts of plants. Moreover bioavailability of Cs-137 in the sites of wet meadows is, in accordance with the transfer factors values, even a few more then in the sites of dry meadows regardless of the level of soil radioactive contamination. Thus, general parameters of radionuclide's accumulation in vegetation is closely dependent on its supplies in soil. However, the proportion of Cs-137 root uptake isn't determined by the level of soil radioactive contamination, but mostly by the biological features of vegetation. Study was conducted with the support from the Russian Foundation for Basic Research (project no. 14-05-00903).