ESTIMATION OF RAIN INTENSITY BY RADIATION MARKERS

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Soil radioactive gases and atmospheric radionuclides are among the main components of the atmospheric radiation background. They are excellent tracers of various atmospheric and geophysical processes.

Monitoring of the radiation background of the surface layer of the atmosphere has shown that its magnitude is not constant and depends on various factors, such as the state of the atmosphere, time of day, season of the year and geographical position of the region. An abnormal increase in the radiation background is observed with rainfall. This phenomenon is explained by the processes of leaching of short-lived radon and toron decay products from the atmosphere, and the greater the intensity of rainfall, the greater the dose rate increases. Previously, scientists of TPU and IMCES jointly developed the GammaRain method, which relates the intensity of rainfall and the dose rate of γ-gamma radiation. To implement this method and determine the quantitative relationship between precipitation parameters and an increase in the background radiation, detailed data with good temporal resolution on precipitation intensity dynamics are needed, which became possible after installing a shuttle precipitation gauge at the TPU–IMCES experimental site.

The purpose of this work was to estimate the intensity of precipitation using radiation markers, which used the magnitude of the anomalous surge of the γ-radiation dose rate and the β-radiation flux density during precipitation. The study analyzed the dependences of the γ-radiation dose rate and β-radiation flux density on meteorological parameters, such as the height of rain clouds, the density and turbulence of the atmosphere. The simulation took into account the spatial (in the vertical direction) and temporal dynamics of the γ-radiation dose rate generated by short-lived daughter products of the decay of radon and toron in the surface atmosphere, washed out to the surface of the earth during rainfall. When calculating the spatial distribution (in the vertical direction) of the volume activity of short-lived daughter decay products of radon and toron, the state of the atmosphere was taken into account. As a result of assessing the contributions of individual atmospheric radionuclides to the total dose rate at various coefficients of turbulent diffusion and the height of the lower edge of rain clouds, the radionuclides were identified that make the main contribution to the total γ-background. Using the GammaRain method patented in the Russian Federation, the determination of precipitation intensity from the measured γ-radiation dose rate and β-radiation flux density was used to verify the calculated values and dynamics of rainfall intensity with experimental data obtained using a shuttle precipitator (Fig. 1).

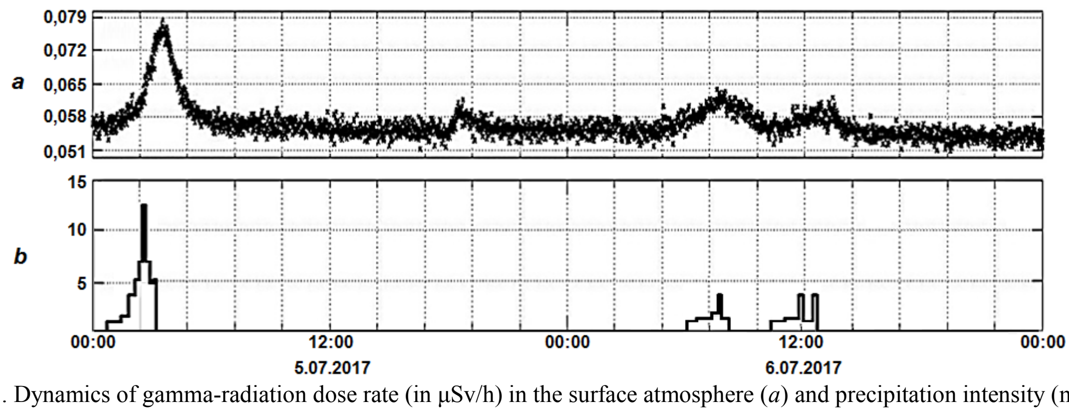

Fig.1. Dynamics of gamma-radiation dose rate (in μSv/h) in the surface atmosphere (*a*) and precipitation intensity (mm/h) according to the shuttle precipitation gauge (*b*) in the period from July 5 to July 7, 2017

A good convergence of the calculated and experimental results was obtained, which indicates the possibility of using the parameters of the dose rate of γ-radiation and the β-radiation flux density to estimate the intensity of precipitation.