DETERMINATION OF SNOW WATER EQUIVALENT BY THE ATMOSPHERIC BETA-BACKGROUND

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In connection with the natural and climatic changes that are currently taking place in all regions of Russia, the most urgent problem in agriculture is water saving. The development of new technical solutions in the field of crop water consumption is required. Maintaining optimal soil moisture parameters allows you to: get the maximum yield of agricultural crops; rational use of irrigation water, fuel and energy resources. Seasonal snow cover is one of the most important components of the water balance of crop areas. Assessment of snow cover is often difficult.

It is known that in the winter period the radiation background of the surface atmosphere is significantly reduced due to the absorption of photons and electrons, formed during the decay of natural radionuclides, coming out of the soil, by the snow cover. The atmospheric beta-background in the winter period is caused by the secondary beta-radiation generated by the interaction of photons with the atoms of the environment. The aim of the work was to identify the relationship between the snow water equivalent (SWE) and the density of the flux of secondary beta radiation in the surface atmosphere.

The beta-radiation flux density characterizing the beta-background was measured at the Tomsk Observatory of Radioactivity and Ionizing Radiation (TORIR) using the BDPB-01 beta-radiation detection units installed at heights of 1 and 10 m from the earth's surface. Analysis of the monitoring data in TORIR revealed the relationship between the beta-radiation flux density in the atmosphere and SWE (Fig. 1). The SWE was calculated using free-access data on snowfall from the website of «Reliable Prognosis» (https://rp5.ru/Weather_in_Tomsk). The beta radiation flux density in the surface atmosphere during the winter period (Fig. 1a) decreases almost exponentially with an increase in moisture content (snow water equivalent) (Fig. 1b) until the beginning of snow melting. After a complete melting of snow cover, the beta-radiation flux density increases to the values observed during the warm season.

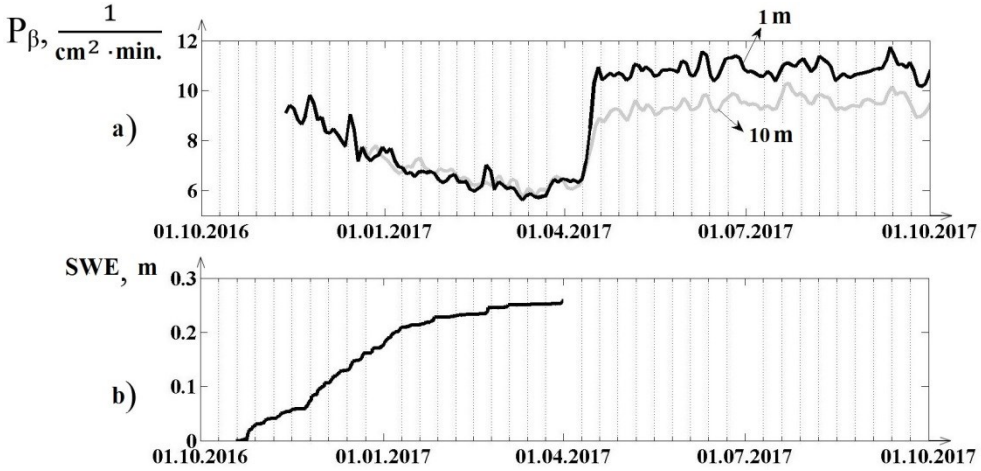

Fig.1. Dynamics of beta-radiation flux density in the surface atmosphere at different heights (a) and snow water equivalent (b) in the winter period 2016-2017

Bursts observed in the atmospheric beta background in different seasons of the year are due to rain (at a positive atmospheric temperature) or snow (at a negative atmospheric temperature). An analysis of the research results revealed a significant relationship between the SWE and the beta-radiation flux density that makes it possible to quantify the moisture accumulated during the winter. The resulting relationship is valid for any height measurement of the beta background (up to at least 10 m). To estimate the SWE you need to know the mass attenuation coefficient of radiation in the snow cover, which depends on the radionuclide composition of the soil of the study area, the activity of the radionuclides, and can be calculated by the Monte Carlo method.