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Methods for measuring daughter products of radon decay in the surface atmospheric layer of the Earth

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Despite numerous studies of radon emanation [1-3], the problem of studying the distribution of radon concentrations in the surface atmospheric layer of the Earth is relevant. The contribution of radon and its daughter decay products to the general background radiation is large and amounts to more than 50%. Time of variations of radon emanation, studied by the authors of [4], showed its strong concentration dynamics not only from daily and seasonal variations, but also from other external factors. In addition to time of distributions, we and other authors have shown that radon and its daughter decay products are distributed in the surface atmospheric layer of the Earth both in a complex manner depending on the height inside the buildings and on the geological landscape [5]. We performed measurements with a spectrometric setup of beta spectra for the period from October 2018 to February 2020, from which it is clear that the integral values of the spectra of beta particles during the day strongly fluctuate relative to the average daily value. The mechanism of such fluctuations may be the soft electron-photon component of the secondary cosmic radiation.

To measure the low-background beta radiation of various samples for the content of natural beta-radionuclides in the present work, the authors proposed a technique that will allow for taking into account events arising from other sources. Based on this technique, a spectrometric "telescope" was developed [6], in which, as protection against cosmic radiation, active protection was applied in the form of a second detector that detects external radiation, which is included in the anticoincidence scheme with the main detector. The opposite arrangement of the detectors on the vertical axis and in the lead glass of the main detector allows one to register events that occur in the local area of the space to which the telescope is oriented.

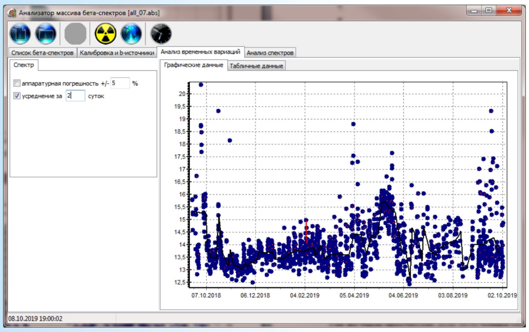


Fig. 1. Beta Spectra Array Analyzer software interface. Temporal variations

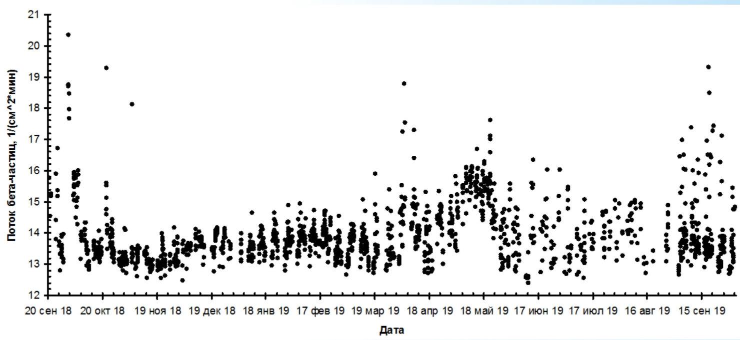
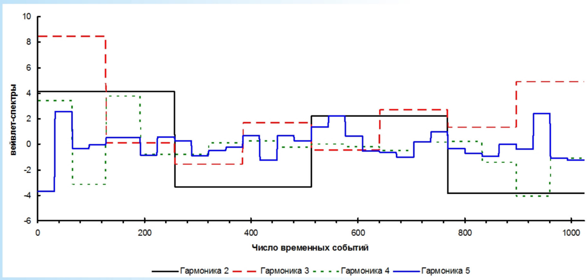
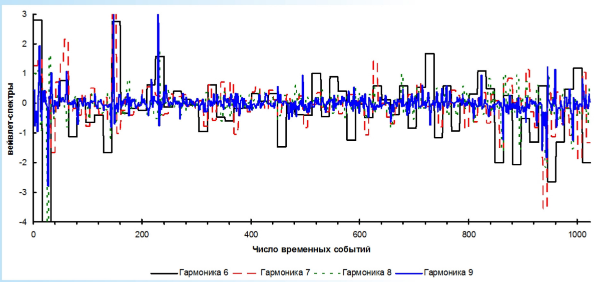
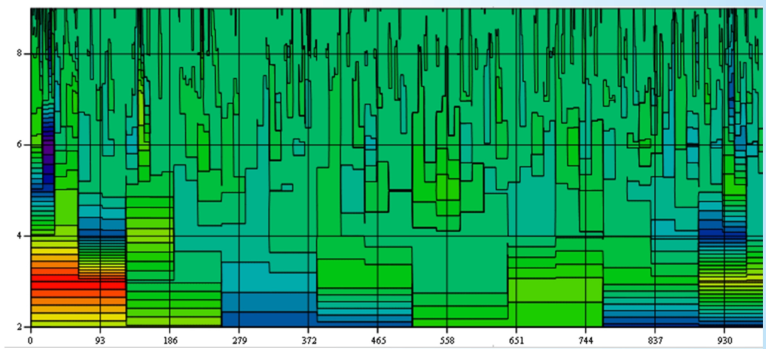


Fig. 2. Time variation of the radiation beta background for the period from October 2018 to October 2019







Figures show the complete wavelet spectrum for the measured temporal beta background. Using the calculated wavelet spectra, it is possible to reconstruct the temporal variation of the beta background according to using the required set of wavelet spectra to identify the temporal event of interest.

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