Radioactive isotopes occurring in the natural environment accompany man from the beginning of his existence. The vast majority of radioactivity observed in nature is of natural origin, and only a small part was released into the environment as a result of human activity. Nevertheless, the civilization sources of radioactive contamination, due to the possibility of creating potential radiation hazards to the environment (particularly to living creatures), are carefully monitored and analyzed.

Research on the dynamics of radioisotope transport processes in the atmosphere plays an important role in modelling the directions and speed of radioactive contamination spread, both for nuclear accidents, nuclear weapons testing and during the operation of nuclear facilities. The ability to model and predict spatial and temporal pathways of radioactive contamination enables a faster and more precise assessment of the exposure of living organisms to ionizing radiation, which, together with the understanding of the mechanisms of radioisotope retention in the atmosphere, is an essential element of radiological protection of the natural environment. Due to the multitude of physical and chemical phenomena that govern the processes of radioisotope transport in the atmosphere and their transfer through the ecosystem, knowledge in this field is still not complete and requires verification and supplementation, which justifies undertaking further investigations on this subject.

The proposed research project concerns the study of the dynamics of changes in the activity of selected radionuclides in the atmosphere based on a long-term dataset of aerosol samples from the ground layer of air collected at the Polish Polar Station. Stanisław Siedlecki in Hornsund in the years 2007-2021. The isotopes under study represent important (due to their origin) groups of radioactive isotopes occurring in the environment, i.e. Earth's crust (K-40 and Pb-210, U-238), cosmogenic (Be-7) and anthropogenic (Cs-137, U-236, Pu-238, 239, 240, Am-241) radionuclides, and can therefore be used as indicators of various aerosol transport processes in the atmosphere. A comprehensive and long-term analysis of the temporal variability of their concentration, as well as the isotopic ratios in the lower atmosphere, could make a valuable contribution to the database on radioactivity in the Arctic atmosphere. The problem of atmospheric pollution is even more important now when the polar regions are undergoing a strong transformation due to rapidly changing climatic conditions. Over the past 50 years, the average warming in the Arctic has increased by more than twice that of the global mean. Global warming may be a significant factor triggering or intensifying the spatial and temporal differences in the distribution of pollutants accumulated so far in the northern regions. In particular, the re-suspension of contamination in the lower atmosphere appears to be a significant potential secondary source of contamination for the Arctic.

Within the research project, the following scientific goals will be realized: • determination of Pu-238, 239, 240 and Am-241 activity concentrations as well as activity ratios of Pu-238/Pu-239+240 and Am-241/Pu-239+240 and mass ratios of Pu-240/Pu-239 and U-236/U-238, • study on the seasonality and long-term trends in the time series of activity concentrations of considered radioisotopes and region, • recognition of mutual correlations, in particular, seasonal correlations between selected anthropogenic, terrestrial and cosmogenic isotopes, • examining the relationship between the activity concentration of considered radionuclides and the concentration of dust suspended in the ground-level air layer, • examining the dependence of activity concentration of studied radioisotopes on selected meteorological indicators, • identification of dominant sources of radioactivity based on isotopic compositions, • estimation of doses from external and internal exposure to ionizing radiation emitted by the considered isotopes.

Due to the long measurement period (14 years) and a large number of samples (weekly air filter samples) the analyzed dataset will be composed of about 3000 measurement results. Analysis of such a large set of real data requires a comprehensive, systematic approach, therefore all analyzes will be made using data mining methods based on the CRISP-DM model.