Blue rings: summer cooling events after volcanic eruptions recorded in sub-arctic shrub rings (bRING)

We still know so little about the intra-annual resolution of the impact of large volcanic eruptions on the climate. Moreover, this recognition is very limited at high latitudes, such as in the Sub-Arctic.

Long-lived junipers, i.e., dwarf shrubs, live in the sub-arctic areas, which, like the trees in our latitude, develop growth rings each summer. The rings of trees and shrubs are a unique archive of climate change. They allow for the reconstruction of past environmental conditions, including global disturbances, with an annual resolution. The latest research shows that much more can be read from the wood anatomy of individual growth rings.

The aim of the project is to investigate how the northernmost long-lived plants, sub-arctic shrubs, record summer cooling events following large volcanic eruptions. The chronology and anatomy of dwarf juniper wood from northern Fennoscandia will be used for this purpose.

We will focus our research on 'blue rings', i.e. growth rings that contain incompletely lignified cell walls, formed during severe cooling, which may be related to volcanic eruptions. We will check if the blue ring chronology of the dwarf juniper can confirm, complement or strengthen the signal of past summer cooling events after large volcanic eruptions reconstructed from existing tree records. Investigation on blue rings in the wood of shrubs has not been conducted yet. Project outcomes could therefore provide the first anatomical indicators of volcanic eruptions from sub-arctic shrubs.

Modern research techniques, including quantitative wood anatomy analysis, will allow the characterization of the stages of cell wall lignification in relation to strong volcanic eruptions. We estimate that the chronology of blue rings from sub-arctic junipers will cover the last 250 years. Such a time scale will allow for the analysis of the impact of large volcanic eruptions, such as Tambora (1815) or Krakatoa (1883) on the summer climate and the growth of shrubs in the northernmost part of Europe.

Project results will help determine the impact of large volcanic eruptions on climate cooling and the growth of sub-arctic shrubs in the northern Fennoscandia region. Additionally, juniper chronologies may allow for the reconstruction of the climate for the pre-instrumental period, i.e. before the period of meteorological temperature measurements.

Large volcanic eruptions can be of enormous importance not only for natural ecosystems but also for society. Therefore, the recognition of the effects of large volcanic eruptions on climate and vegetation in the past is crucial to assess the impacts of future eruptions both on climate and human life.

The innovativeness of the project manifests itself in the cooperation of specialists from various disciplines of science, such as dendrochronology, plant physiology and paleoclimatology. The project will strengthen cooperation between a Polish research unit and a top university in the world, i.e. the University of Cambridge, in the field of paleoenvironmental and sub-arctic research.