Research project objectives

The last three decades of instrumental measurements clearly document the progressing process of global warming, while climatological models predict no end to this trend in the near future. In the Sudetes, as well as other mountainous regions of central Europe, the following phenomena can be observed: unprecedented scale of warming, a downward trend in precipitation totals in spring, decreasing snowiness of winters as well as constantly growing threat of drought.

The main objective of the project is to describe the role of contemporary climate changes and highly variable topoclimatic conditions in the shaping of spatial dynamics of growth response and stability of spruce ecosystems in the Western Sudetes. On this basis, an attempt will be made to select and prioritize the factors that have the greatest impact on the development of the incremental response in various habitats.

Research project concept and methodology

Characteristics of the thermal and rainfall conditions of the Western Sudetes in the long-term course:

- an attempt to assess to what extent the currently observed increase in air temperature is a result of climate changes on a regional and supra-regional scale and changes in atmospheric circulation;
- obtaining digital maps presenting different topoclimatic conditions – they will be used to explain the spatially differentiated rate of the trees' incremental reaction;
- calculation of thermal and humidity indicators to assess the risk of drought: HTC – Selianinov; SPI (Standardized Precipitation Index), RPI (Relative Precipitation Index) and SPEI (Standardized Precipitation Evapotranspiration Index).

Dendrochronological studies will provide information on the spatial differentiation of the incremental reaction of trees, with particular emphasis on the last, warmest decade 2011-2020. The aim is to describe the variable growth rate of trees in the context of progressive warming and the impact of various climatic and anthropogenic factors. On this basis, an attempt will be made to select and prioritize the factors that have the greatest impact on the development of the incremental response in various habitats. The following will be analyzed separately: natural stands; spruce monocultures of foreign origin; stands with a varied influence of climatic factors; stands of various degrees of destruction caused by the increased deposition of atmospheric pollutants in the last decades of the 20th century.

One of the adopted hypotheses assumes, that the observed spatial differences in the shaping of the incremental response depend on variable topoclimatic conditions. Measurements will be carried out at 12 sites during two growing seasons (i.e. 2022 and 2023) using the "micro-core" method. The measurement points will be arranged in two profiles: "vertical" (to compare the incremental response as a function of altitude above sea level) and "horizontal" (high variability of climatic conditions along the lower montane belt should translate into large differences in the course of the incremental reaction between sites).

The significance of the project for the development of the given scientific discipline

This project is an attempt at complex identification of the impact of diverse atmospheric factors on the development and condition of spruce forest ecosystems of different provenance. The current knowledge is insufficient to make an unambiguous assessment of the performance of various forest ecosystems in the age of global climate change. A high degree of uncertainty applies particularly to ecosystems that, due to their history, are characterized by lower stability and tolerance. In this context, it is extremely interesting how the forest ecosystems of the Western Sudetes, which have undergone enormous transformations under the influence of anthropogenic factors over the past several hundred years, react to contemporary climate change.