

During the past decades, the Arctic has experienced a more rapid and pronounced temperature increase than most other parts of the world. Arctic air temperature continues to increase at double the rate of the global mean air temperature increase, which is a phenomenon known as Arctic Amplification. It is believed that strong Arctic warming may modify extreme weather events in Poland and Central Europe. There is a lack of complementary and detailed studies about past changes on a scale of hundreds years, in which climatic conditions can be reconstructed with high-resolution and verified by precise meteorological measurements. Thus, development of new sources of information about Arctic climate changes in the past is necessary for the correct recognition of climate variability during the time frame of last hundreds years.

The main goal of the project is reconstruction of climatic conditions in the Arctic and assessment of the extent of their natural changes based on the analysis of biological, terrestrial proxy data - annual growth rings of tundra plants. The Arctic tundra, a woodless plant formation occurring in the northern hemisphere in high latitudes, consists mainly of low creeping dwarf shrubs, as well as mosses and lichens. Dwarf shrubs, small plants with wooden branches growing in extreme climatic conditions, produce very narrow growth rings which can be used as indicators of past climate change. The oldest shrubs that have been found date back to just over 100 years. Therefore, the innovative idea of the project is to combine field work with work in museums that have collections of shrubs collected during scientific expeditions in the 19th and early 20th centuries. The field work will be conducted in three areas: Kaffiøyra (NW Spitsbergen), Tarfala (northern Scandinavia) and Sermilik (south-eastern Greenland). The field studies will focus on collecting plants such as polar willow and dwarf birch. In museum collections, such as Herbarium at Royal Botanic Gardens in Kew (United Kingdom) and National Museum of Natural History in Washington (United States), there are samples of the same plants collected over 100 years ago in the vicinity of designated research areas. To overcome the main limitation, related to the potential age of the specimens, an innovative approach linking growth-ring chronologies obtained from contemporary growing tundra species with growth-ring chronologies from specimens collected in museums, historical botanical collections, old microscope slide collections and Herbaria will be used. This new approach will contribute to the development of the scientific field. Thus, the combination of this unique research material and the use of “cross-dating method” will enable the development of dwarf-shrub growth-ring chronologies reaching back in the past over the last hundreds years. Precise analysis of the width of annual growth rings of modern and “historical” dwarf shrubs in combination with meteorological measurements will allow us to determine past climate conditions.

Propose an innovative approach, that has never been used in any dendrochronological research so far, will allow for accurate and reliable reconstruction of climate change going back several centuries. A thorough understanding of the past Arctic climate variability is important for its future predictions.