The dramatic change of the Arctic climate continues and has a strong impact on environment and society. It is widely acknowledged that the climate has been warming and the High Arctic is particularly vulnerable to changes in air temperature and precipitation. During the past few decades the Arctic has warmed approximately twice as rapidly as the entire northern hemisphere. The behavior of river catchments, in conjunction with glaciers, permafrost and biotic elements, is undoubtedly one of the most important indicators of climate and environmental change in the Arctic. The increase in air temperature, the change of annual precipitation run, the more frequent occurrence of liquid precipitation, a decrease in snow cover and the shortening of the snow cover observed recently in the Arctic are reflected in the annual flow of catchments in the catchment area.

The main objective of the project is to identify the rainfall-runoff processes in the four Arctic catchments located in South Spitsbergen, the largest island of the Svalbard archipelago. This project aims at presenting an updated water-balance study based on meteorological, hydrological, and glacier mass-balance monitoring from previous years and projections for the future. For that purpose it is planned to use archival data and to collect new hydrometeorological data that will enable the development of rainfall-runoff models for the Southern Spitsbergen Arctic catchments. Due to the existing logistics facilities the study area includes: Fuglebekken and Ariedalen - located in the vicinity of the Polish Polar Station Hornsund, Bratteggelva and Werenskioldbreen near the Wrocław Polar Station "Baranówka". It is planned **to develop several rainfall-runoff models**, which will allow **the reconstruction of the past hydrological conditions**, as well as **projection of the future hydro-climatic conditions** on the basis of simulations using climate models with different spatial resolution.

Due to complexity of cold region hydrological systems, a catchment response can vary depending not only on climate forcing but also on catchment properties including: the state and distribution of permafrost, water storage capacity, glacial coverage, soil properties, elevation, and geomorphology. One of the most important factors influencing the water runoff regime, and so far poorly recognized is the degree of glacial coverage. In this project it is planned **to analyze the effect of the level of catchment glaciation (analysis of four basins with different glacial coverage) on the current and future hydrological regimes**, based on observation data and climate simulations.

Another objective is to **evaluate the effect of changes of the active layer thickness on the rainfall-runoff transformation**. The research **hypothesis is that changes in the active layer have a significant influence on parameterization of hydrological models and on catchment response to precipitation**. Hydrological modelling of polar catchments with varying depths of active layer, requires analysis of non-stationarity of environmental conditions and their influence on simulated runoff. For this purpose, the results of measurements of the ground thermal regime at selected polar stations will be applied.

Svalbard is located in the Atlantic sector of the Arctic, the area with the greatest climate change observed. Hydrological studies carried out by the Polish polar expeditions were started in the '70s of the twentieth century. Despite the series of hydrochemical and hydrological measurements carried out in Southern Spitsbergen, there are not many publications that would address these achievements to the international scientific community.

International scientific research has been taking place for several decades, aiming at better understanding of the ongoing processes. The observed expansion of the ice-free areas in High Arctic region is essential to the functioning of river ecosystems and the supply of fresh water to the surrounding fjords and seas.

Novel exploration and projection of future hydrological conditions in global, regional, and local scale are currently one of the key challenges in the Earth sciences. An important aspect is the analysis of seasonality of hydrological conditions due to changes in climatic and environmental conditions. The results of the proposed project will have extensive interdisciplinary applications, primarily in hydrology and climatology, but also in hydrogeology, geomorphology and ecology of plants and animals. Research efforts carried out in previous years and continued as part of this project will give valuable results that are of high importance as water balance of river catchments is one of the most important indicators of the state of the climate.