Abstract

Lakes are an integral part of many high-mountain ecosystems. The variability of their thermal conditions and icing reflects the regional climatic conditions and characteristics of the lake basin and catchment topography. Modern climate warming leads to changes in the water temperature in lakes, their even later freezing, reducing the maximum thickness of the ice cover and its earlier melting. A detailed understanding of the diversity and interrelationships between the components of the high-mountain environment, along with feedback, is crucial to determine the impact of the snow on climate variability and lake thermal conditions. The study is aimed to recognize the regularities in the spatio-temporal variability of thermal conditions and icing of lakes in the Tatra Mountains. Moreover, the study seeks to determine their thermal sensitivity to changes in meteorological conditions.

There were distinguished 5 groups of lakes similar to each other and 2 groups of lakes characterized by high individualism. It was done based on the duration of the ice cover, height, volume and potential insolation of Tatra lakes with an area > 1 ha and using the Wrocław taxonomy method. It was established that over the last 100 years the time of their icing has significantly shortened. The scale of changes related to climate warming differs in individual groups of lakes. It has been established that over the last 100 years, their icing time has significantly shortened. The scale of changes related to climate warming differs in individual groups of lakes. Detailed studies of the thermal sensitivity of lakes were therefore conducted on three reservoirs selected so that their similarities and differences in location, shape and size would enable us to conclude about the importance of morphometry and topography in heat exchange processes between the lake and the atmosphere.

The results of the monitoring of thermal conditions and ice of the selected lakes during 5 years indicate that the year-to-year variability of the average temperature of their water is related primarily to the variability of air temperature and ice. The durability of the ice and snow cover depends mainly on the thermal and precipitation conditions in the autumn and spring seasons. The annual heat losses of lakes in the periglacial zone of the Tatra Mountains are inversely proportional to the thickness of the seasonal ice and snow cover. High and sunny lakes can be warmer in winter and summer from shaded lakes situated much lower - even if their shape and size are similar. Climate warming and the accompanying decrease in the thickness and durability of lake ice does not have to result in increasing the average annual water temperature. Sometimes, paradoxically, it can terminate in cooling the lake. The sensitivity of Tatra lakes to a rise in air temperature increases with a decrease in their surface/depth and shading, as well as with an increase in the altitude and share of wind-blow snow in the formation of the snow/ice cover. Small reservoirs at high altitudes distinguished by insolation and supplied with wind-blown snow, are most sensitive to climate warming. It transpires that the modern climate changes in the Polish Tatras can best reflect not the most sensitive lakes but the largest ones located in the subalpine zone due to the complex interactions between lake thermal conditions and its icing and the rate of heat exchange.