INTRODUCTION

Mountain regions are proved to be most susceptible to potential climate change due to immense sensitivity of mountain ecosystems to changes in temperature and precipitation. Moreover, forest area increase has been observed over the last century in many parts of Europe, such as in the Alps and the Carpathians.

The main aim of the study is to evaluate temperature and precipitation variability in the Swiss Alps and the Polish Carpathians since the 19th century in the context of ongoing climate change by examining spatial and temporal patterns of the tendencies including temperature variability in vertical zones.

The research areas cover the territories of Graubünden in Swiss Alps and the Polish Carpathians. The regions differ in geographical location, extent and compactness, and most of all the relief. Such a choice enables to determine factors responsible for any spatial and temporal differentiation of the tendencies including atmospheric circulation and local variables.

DATA & METHODS

Air temperature and precipitation data from the period 1891-2010 were used considering both in-situ and gridded global and regional databases.

- Data covering the years 1931-2010 for Switzerland and 1961-2010 for Poland were processed from station data using DAYMET interpolation software for Switzerland and CARPACTCLIM database for Poland.
- The long-term data were obtained from a multiproxy approach gridded databases: temperature by Luterbacher et al. (2004) and precipitation by Pauling et al. (2006).

With the historical data, all monthly values were calculated as anomalies relative to the normal state of the baseline 1961-1990 period (difference anomalies for temperature, relative anomalies for precipitation). The resulting anomalies were combined with the fine scaled normal state to obtain fine scaled maps of the resolution 100 m for all the years 1891-2010.

The analyses were conducted for the whole period with a few sub-periods, i.e. 1891-1930, 1931-1970 and 1971-2010, defining annual and seasonal temperature and precipitation variability in different vertical climatic zones.

For the final analyses and the presentation, precipitation totals were not taken into account as representing insignificant tendencies for both regions.

RESULTS

Spatial differentiation of air temperature: annual and seasonal means 1891-2010

LONG-TERM VARIABILITY AND TENDENCIES

ANNUAL MEANS

1891-1930 ; 1931-1970 ; 1971-2010

SUMMER SEASON MEANS

1891-1930 ; 1931-1970 ; 1971-2010

WINTER SEASON MEANS

1891-1930 ; 1931-1970 ; 1971-2010

Long-term trends (°C / 10 years)

Deviations from the long-term (1891-2010) mean (°C)

CONCLUSIONS

- The analysis showed significant spatial differentiation of climate variability and trends comparing the examined mountain regions. Although Swiss Alps are characterized by much bigger, temperature influencing, vertical relief differences, their thermal conditions do not demonstrate any strong tendency. More significant variability can be seen in the Polish Carpathians.

- It is worth emphasizing that in the Swiss Alps the higher altitude, the stronger the trends, whereas in the Polish Carpathians the intensity of the trends varies seasonally.

- The most significant changes can be observed in the last period (1971-2010), especially in winter season. Summer in the Alpine region is characterized by temperature decrease while the annual tendency on the other hand in the Carpathians the increase in annual mean temperature gives the evidence also for spring and/or autumn tendency (what has not been examined, yet).

- The demonstrated spatial and temporal differentiation of the air temperature variability suggests the necessity of further studies, concerning its possible factors. According to preliminary research results it might be presumed that atmospheric circulation variability is of the most important. For the research areas (high-mountain regions) it is necessary to examine circulation conditions in low and mid troposphere.