The influence of variability in snow cover thickness and extent on the runoff regime in the Skawa, Soła and Upper Vistula catchments

Agata Drabek, Alicja Biesmer
University of Silesia in Katowice, Faculty of Natural Sciences

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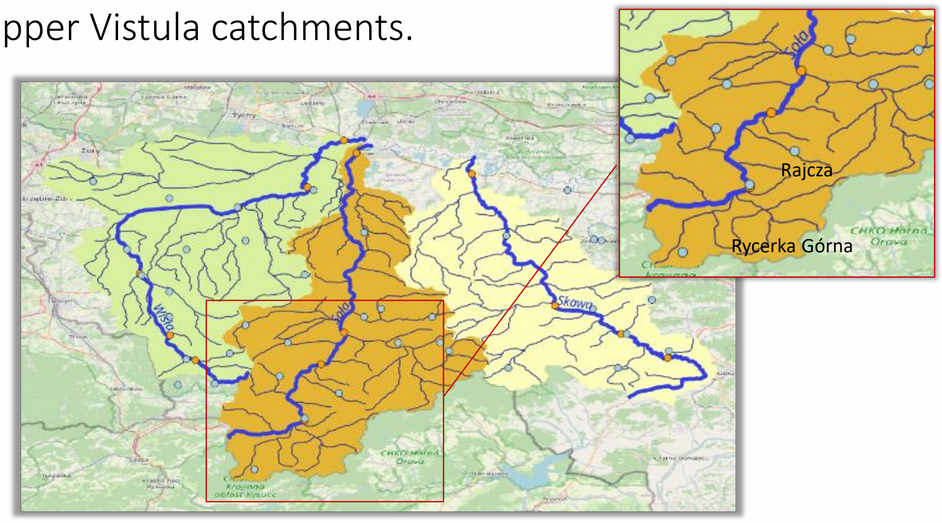
1. Introduction

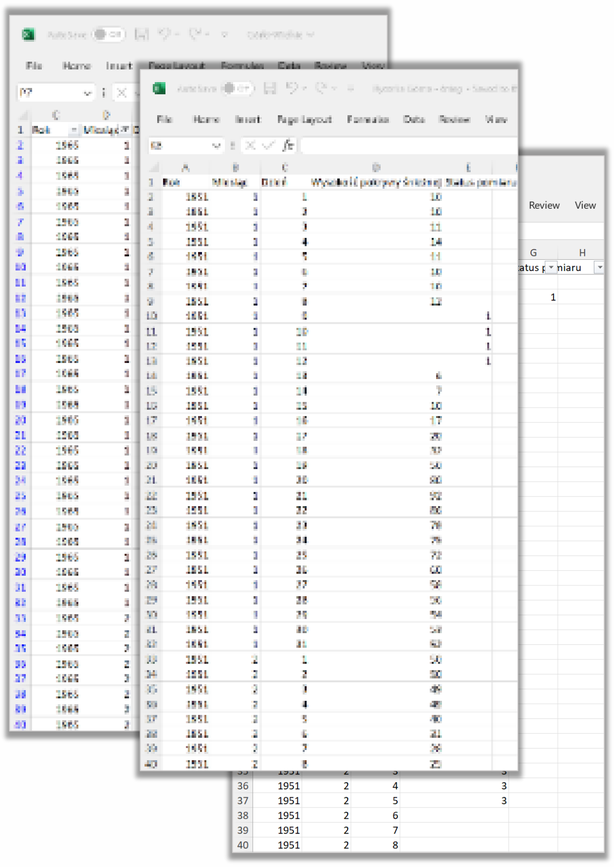
- The snowmelt water is responsible for 60-70% of water supplies in upland regions worldwide .
- Changing snow cover patterns are expected to impact the water supply to rivers, affecting the runoff and subsequently the river regime.
- Over the last 60 years, the snow cover patterns in the study area could have potentially changed significantly enough to affect the runoff regime in the Skawa, Soła and Upper Vistula catchments.



2.Materials and Methods

Data collection

The records of daily snow cover thickness and precipitation were collected, covering the longlist of 35 weather stations in the area and a period of over 60 years (1951-2011). Daily discharge data from 15 gauging stations was obtained. The data was organized into a baseline database containing daily records of snow cover thickness, precipitation and runoff. For the purpose of this analysis and to serve as a pilot for the entire study, a precipitation and snow cover data subset representing a 60-years long period for a selected weather station in Soła catchment (Rycerka Górna) was paired with a corresponding discharge subset (Rajcza).



Data analysis

Departing from the baseline database, selected snow cover characteristics were calculated. Those featured but were not limited to the following indicators: mean snow cover duration (annual, seasonal, monthly), snow depth indicators (mean, min. and max.) and sums (annual, seasonal, monthly), as well as the snowiness coefficient. Similarly, the analysis of the hydrologic data included mean, max. and min. discharge, monthly mean min. and max. discharge, coefficient of discharge variation and other discharge coefficients. Additional characteristics can be derived for the remainder of the data if deemed relevant.

3. Objectives

- Determine if snow cover thickness and extent patterns in the study area have changed over the last 60 years
- Establish links between changes in snow cover patterns in the analyzed time period and the runoff regime in selected catchments

Measuring snow depth

Obtaining accurate snow depth measurements requires using an unobstructed flat yard or a wooden deck for snow collection. The measuring takes place at 6 AM UTC and involves pushing the snow measuring stick into the snow, perpendicular to the ground. The procedure takes place three times, the measurements are recorded, and the mean value calculated constitutes the daily snow depth value.

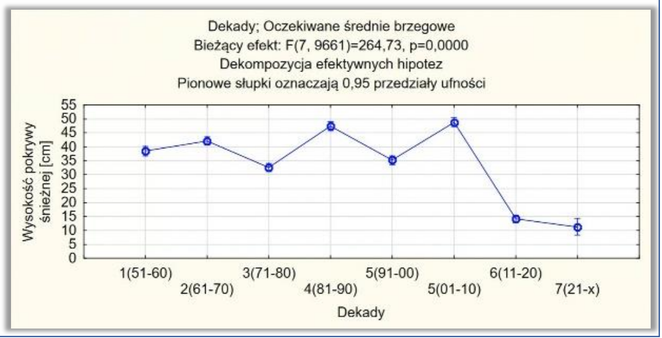
Other values usually measured include:

- Snowfall (maximum amount of new snow)
- Water equivalent (water content)
- Snow depth water equivalent

4. Results

In course of the preliminary analysis of the model data, several early-stage conclusions were reached:

- The variance analysis of the daily snow cover data suggests higher deviance from mean values in the last two decades (2001-2010 and 2011-2020).
- The analysis of selected characteristics and literature review indicates high seasonal variation of mean snow cover duration and of the snowiness coefficient values.
- Further reading suggests the existence of intensity patterns among the values of seasonal snow cover duration, as well as snow covers sums, lasting between 16 and 19 years.
- Furthermore, the literature review indicated that snow cover duration might be gradually decreasing at a rate of 4.5 days in each decade.
- A more detailed investigation of existing trends is required.



5. Discussion

The analysis of correlation between snow cover, precipitation and discharge characteristics offers an opportunity to gain insight into potential links between changing snow cover patterns and the regime of nearby rivers.

Scaling up the research can potentially help better understand the hydrological consequences of climate change-related shifts in snow cover patterns.

References

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