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Extreme nival conditions in Poland in relation to the atmospheric circulation

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There are three main aims of the study: 1. the knowledge of the scale of extreme nival conditions in Poland; 2. a fragmentary, regional verification of the IPCC thesis of the increasing frequency of extreme atmospheric phenomena during the last decades by the estimation of extreme nival conditions tendencies in the second half of the 20th century; 3. an attempt of indicating the circulation causes of extreme nival conditions.

There were analyzed: 1. seasonal data on the snow cover duration and the maximum snow cover depth in 60 meteorological stations in Poland for the period 1954-2001; 2. daily data of snow cover depth in 12 meteorological stations for the period mentioned above.

Two calendars of the atmospheric circulation types i.e. the Grosswetterlagen classification (for the central Europe) and the Osuchowska-Klein's classification (for Poland) were used in the investigation.

Winter season with the extreme nival conditions is the season, when the snow cover duration value or the maximum seasonal snow cover depth value was of the empirical probability at most 10 per cent or at least 90 per cent.

The most important results of the investigations are as follows:

- snow cover occurs in non-mountainous area of Poland during at most 10-50 days with the probability 10 per cent and during at most 70-110 days with the probability 90 per cent. Maximum snow cover depth in the winter season reaches (outside the mountains) at most 5-15 cm with the probability 10 per cent and at most 20-50 cm with the probability 90 per cent;

- extremely short (long) snow cover duration is observed in winter seasons with high, at least 2 for Dec-Feb, (low, at most -2 for Dec-Feb) values of the North Atlantic Oscillation index. However, there were in the investigated period winter seasons, when high (low) activity of the NAO was not accompanied by the extremely short (long) snow cover duration in Poland;
- winter seasons with the extremely long (short) snow cover duration and the extremely thick (thin) snow cover depth cluster mainly in the first (second) half of the investigated period;
- there is observed a negative, not statistically significant tendency in the seasonal number of days with the snow cover of a considerable (at least 20 cm) depth in the second half of the 20th century in the whole area of Poland;
- the seasonal maximum snow cover depth indicates a negative (statistically significant in some measure points) trend in the southern Poland, near-neutral tendency in the central and the coastal parts of the country and a positive one (statistically significant at one station) in the northeast. Such a trend distribution is probably connected to the increasing activity of the western advection over Poland. Air masses from the west (relatively warm and wet) usually bring liquid or mixed precipitation in most area of Poland, while solid precipitation in the coldest (north-eastern) region, where the air temperature, though higher than usually, still complies with the requirements to the forming and persistence of snow cover;
- the maximal 24-hour increase of the snow cover depth exceeded 20-30 cm outside the mountains and 50 cm in the highest part of the mountains; it does not indicate any statistically significant trend in the second half of the 20th century;
- a considerable 24-hour decrease of the snow cover depth is observed mainly under the influence of low pressure pattern with the advection from the western sector and occurred the most often in March and April;
- in the highest mountains (Tatra) the extreme nival phenomena are snow avalanches. During the period 1984-2003 44 persons died and 36 persons were hardly injured due to them.

The main conclusion of the study is: there are slight, not statistically significant, decreasing tendencies of most of the extreme snow cover conditions in Poland caused probably by the intensification of the west advection in the last decades of the 20th century.