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LONG-TERM ATMOSPHERIC RAINFALL FLUCTUATION IN NORTHERN MORAVIA (CZECH REPUBLIC) 1881-1980

Abstract: The study deals with the long-term atmospheric rainfall fluctuation in Northern Moravia (Czech Republic) in the period 1881-1980. Long-term fluctuation is described from the both temporal and spatial aspects on the base of series of spatial precipitation sums. Northern Moravia represents a territory with considerable vertical variations of the relief. A large part of this territory is used for intensive agricultural production. Mostly wooded highlands and mountains are important water reservoirs. Therefore the knowledge of characteristics of rainfall fluctuation is very important. The paper is a contribution to the solution of problem on which has been focused the attention of many Czech, Slovak and foreign authors during the past several decades.

Key words: Northern Moravia, rainfall, long-term fluctuation, spatial precipitation sums.

1. Introduction

The facts presented here are part of results achieved during research of project "Long-term Fluctuation of Atmospheric Precipitation in the Czech Republic and their Relation to the Atmospheric Circulation in Central Europe". Investigation was proceeded during 1981–1990. The paper can be conceived as an attempt of comprehensive and independent description of rainfall conditions and their fluctuation in Northern Moravia in 100-year period 1881–1980.

2. Methods

For the analysis and description of atmospheric precipitation and their temporal and spatial fluctuation in Northern Moravia monthly, seasonal and annual time series of 69 stations were used of the period 1881-1980. These series were used as basis for calculation of sequences of spatial precipitation sums on the territory of Northern

Moravia by application of method of double use weighted arithmetic mean (e.g. Šamaj, Valovič 1982). The analysis of the long-term rainfall fluctuation was made by evaluation of the course of sequences of spatial amounts, integral curves of deviations from the mean, and especially the curves of 11-year running means. The trends in 100-year long series were described from courses of curves of the third degree. In the same way the analysis of 9 selected stations was done (Bystřice pod Hostýnem, Hošťálková, Jeseník, Krnov, Nový Jičín, Olomouc, Opava, Přerov, Vítkov), in the paper results are mentioned only if important or unlike from predominate tendency. The analysis was supplemented by the detailed statistic characteristics of the rainfall regime on above 9 selected stations. The dependence between rainfall totals and altitude was calculated too using the method of linear regression for different geomorphological regions of Northern Moravia as supplement to the main mentioned goals.

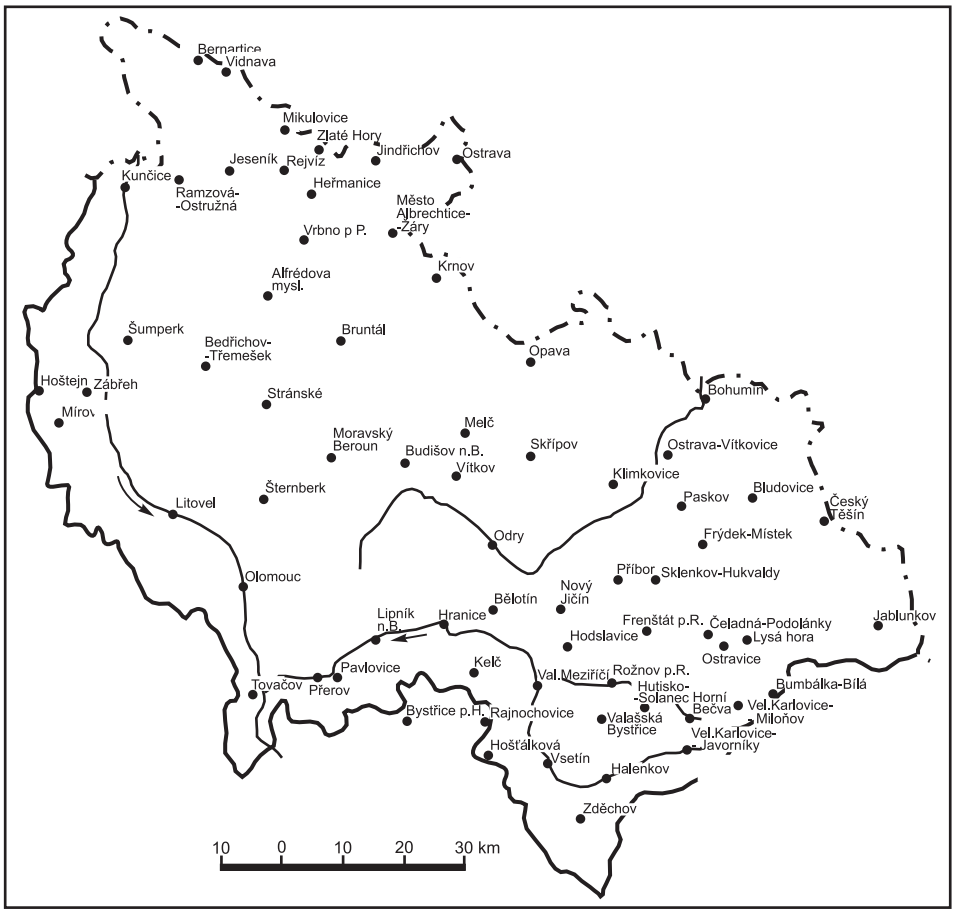

Fig. 1. Spatial distribution of analysed meteorological stations in the Northern Moravia.

3. Long-Term Rainfall Fluctuation

3.1 Monthly analysis

January

It is evident from the course of the curves that over the years 1881-1910 a rainfall increase was registered, followed by the decrease in the period 1917–1950. Second period of decrease is tied with years 1966–1980. These trends are typical for all analysed stations in the region, different are only their durations.

February

Period 1881–1942 can be characterised of long-term gradually increase of rainfall totals which is later replaced with an epoch more or less without trend. On many stations in Northern Moravia the situation is more complicated.

March

The trends are not to be well distinguished and only period 1881–1901 with slight increase and period 1927–1980 with slight decrease of rainfall totals can be mentioned

April

Long-term trends in April are expressed clearly. Among two intervals of increase: 1881–1907 and 1962–1980, there is a period of global decrease of rainfall totals 1915–1950. These trends are typical for all analysed stations in the region, only their duration and level of decrease is different.

May

Trends during May are quite simple. Relatively long period of increase (1987–1959) is exchanged with shorter period characterised with decrease of rainfall totals (1967–1980). Situation at individual stations is more complicated.

June

The course of trends curve for June is fundamentally different in comparison with other months. For the years 1881–1921 there is well marked considerable decrease of rainfall totals, since 1938 till 1980 the tendency is gradually increasing. Most of stations show similar scheme in Northern Moravia.

July

The rainfall trends in July are as follows: years 1881–1894 and 1960–1980 show an increase, years 1909–1945 - a decrease. On the other hand, some from 9 analysed stations appear to show altered trends.

August

Increasing trend for period 1881–1910 is followed by the slight decrease during 1926–1958. For the stations Hošťálková, Jeseník, Krnov, Přerov and Vítkov sequence of 3 periods were analysed.

September

Rainfall trend in September appears to be very similar to the tendency for the months of January, April and July.

October

The trend curve for October looks similar to the curve for March, and especially for August. It means that considerable increase (1881–1896) is altered to more and more decreasing trend to the end of the studied period.

November

Feature of long-term tendency is due to others months unusual and only in this month a decreasing period did not appear. Longer increasing period belongs to the years 1881–1923 and then up to 1957 there is no visible trend. Following stage can be marked as slowly increasing.

December

Excluding period 1881–1905 (increase tendency) the course of rainfall is smooth in the both cases, increasing (1963–1980) or decreasing (1936-1949).

3.2 Annual analysis

From the course of the curves it is evident that over 1881-1980 three great rainfall increases were registered: most significant around the years 1915 and 1940 and less significant in the years 1960-1970. Dry periods are noted around 1930 and 1950 and the course of the annual rainfall sum shows first the increase (1881-1906), then a decrease (1917-1951), and again an increase (1964-1980). Between these periods the trend is not well developed. The analysis was supplemented by the detailed characteristic of the rainfall regime in 9 selected stations.

4. Spatial Analysis

The average spatial rainfall totals over the past 100 years for study area is 850 mm. In several regions the annual rainfall totals fluctuate from 1,110 mm (in 1903) to 641 mm (in 1921). The distribution of rainfalls during the year is continental, with maximum in July (116 mm) and with minimum in February (44 mm). In some stations in the region of the Hostýnsko-Vsetínské vrchy hills, the Javorníky Mountains and the Zábřežská vrchovina highlands, the October's increase was found out and can be considered as maximum of the 2nd order. The share of the summer and winter amounts, i.e. the degree of rainfall continentality, is 2.22, but e.g. for the Opava station it is

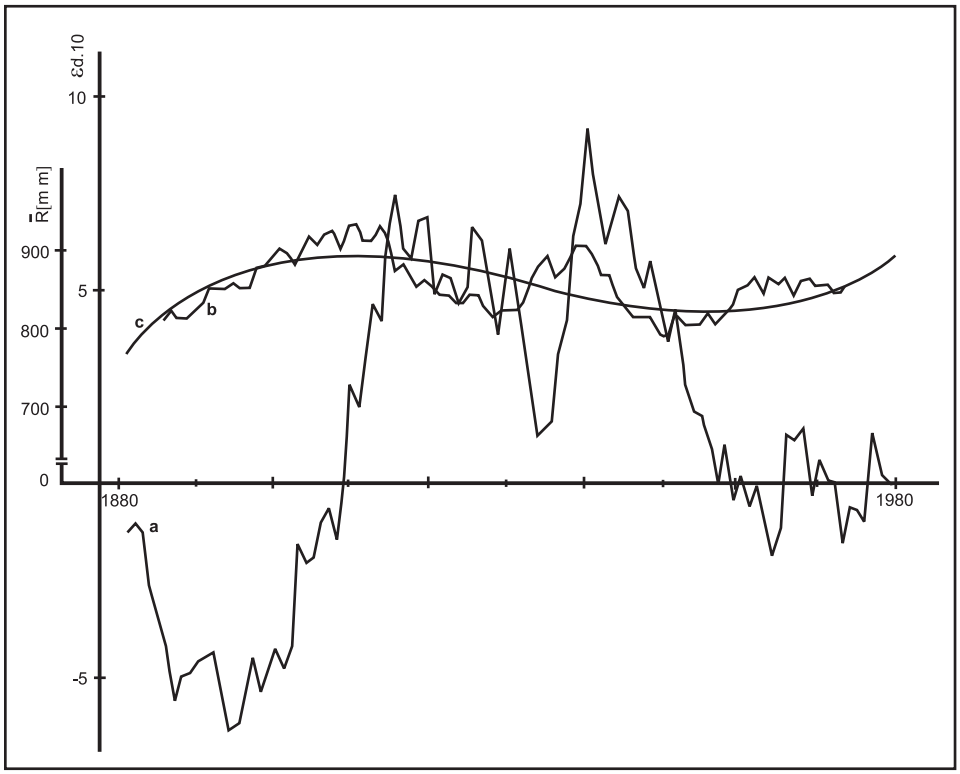

Fig. 2. Annual course of spatial rainfall totals: a) integral curves of deviations from the mean b) 11-year running means, c) curves of the 3rd degree.

3.47. The share of the rainfall amount is 62.8%. The variation coefficient of the annual sequence is 12.9% but, like the other characteristics, it varies a great deal at each station. Beside the varied shapes of the relief, they are the influences of the Atlantic Ocean and the Mediterranean Sea that make great differences in the rainfall values. The annual rainfall amounts fluctuate from 1,513 mm at the station Lysá hora (the Moravsko-Slezské Beskydy Mountains) to 566 mm at the station Litovel in the central part of the Hornomoravský úval valley. The whole region, and of Vnitrokarpatské snízeniny, the extension of the Slezská nízina lowlands in the north can be called as extremely subnormal dry area (delimited by the isohyet 625 mm). The peaks in the region of the Moravsko-Slezské Beskydy Mountains, on the other hand, have extremely extremely high rainfall totals (1,075 mm isohyet). The dependence of rainfall on altitude appears in all cases to have the character of direct dependence. Vertical rainfall gradients were determined for the whole territory of Northern Moravia (73 mm 100 m^{-1}) as well as for the height intervals below 400 m a.s.l. (138 mm 100 m^{-1}), 401-800 m a.s.l. (44 mm 100 m^{-1}), and above 800 m a.s.l (96 mm 100 m^{-1}). Their values were

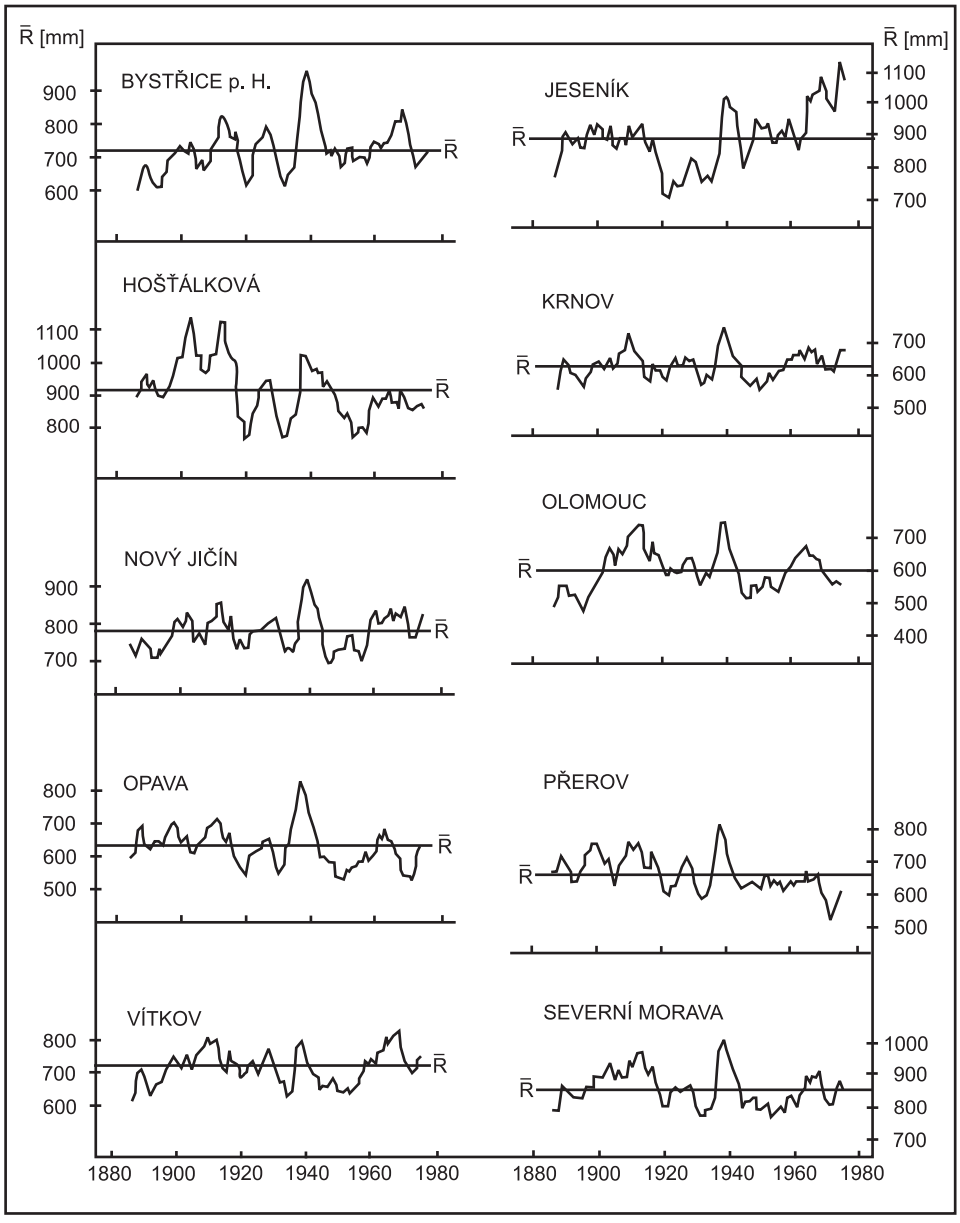

Fig. 3. Annual courses of rainfall totals on selected station in Northern Moravia 1881–1980 by use 11-year running means (R_{av} – 100-year average).

found also for the geomorphological region of Jesenická soustava subsystem and within this for the Hrubý and Nízký Jeseník Mountains as well as for the Západní Beskydy Mountains and the Javorníky and Jablunkovská vrchovina Highlands.

Tab. 1. Yearly course of precipitation sums on the territory of Northern Moravia (1881-1980).

Month	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	*Year*
R(mm)	48	44	50	60	86	103	116	98	70	66	57	52	850

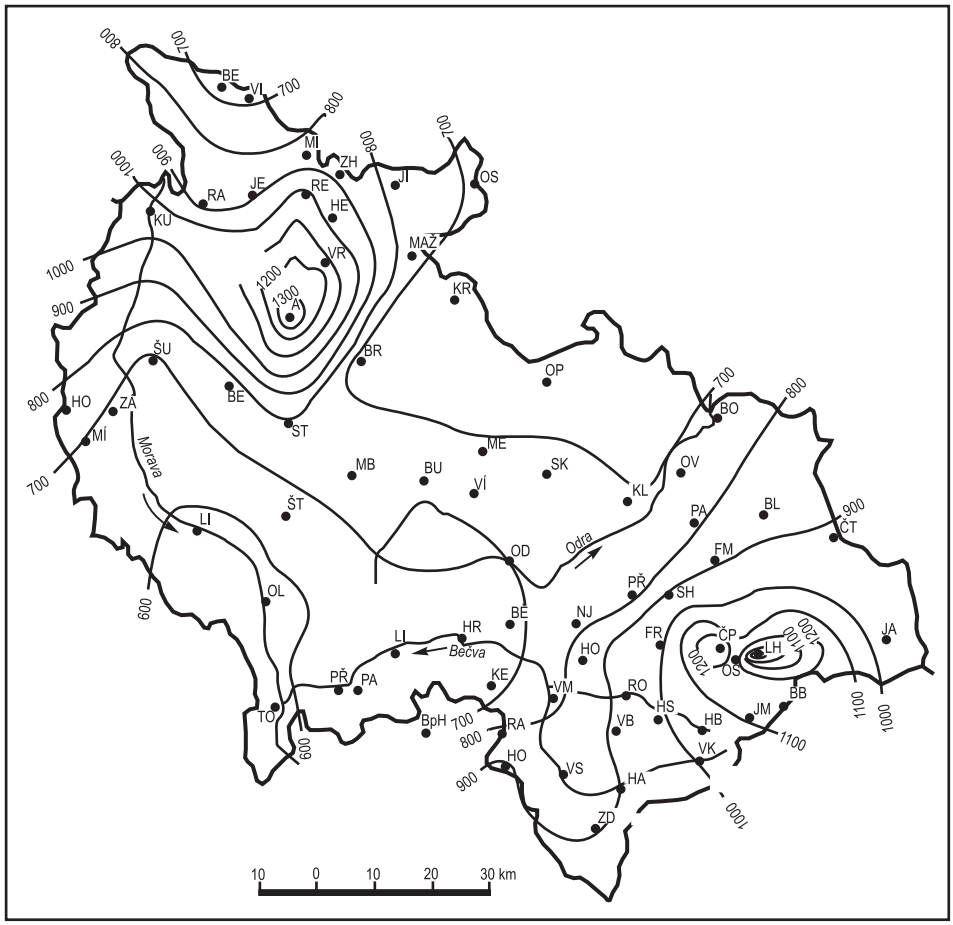

Fig. 4. Spatial distribution of rainfall totals on the territory of Northern Moravia (1881-1980).

5. Conclusion

The results presented here concerning temporal and spatial distribution of atmospheric precipitation could be considered as contribution to better understanding of fluctuation of one of the most important meteorological and climatological element. Study area belongs to the place with complicated atmospheric circulation which altogether with complicated character of the relief influence on the rainfall occurrence.

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