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VARIABILITY OF THE EXTREMES IN ANNUAL COURSE OF THE MONTHLY PRECIPITATION SUMS IN EUROPE

Abstract: In this article I discussed the variability of the concentration and the season of occurrence of maximum and minimum monthly precipitation sums between 1931-1960 and 1961-1990 based on 383 meteorological stations in Europe and Asia Minor. Furthermore, I have characterised changes in the annual course of precipitation between 1901-1930, 1931-1960 and 1961-1990, on the basis of the data from 11 selected stations representing different types of precipitation regime in Europe. I concluded, that the spatial distribution of the types of annual precipitation during the examined periods was not subjected to any radical changes. Nevertheless, in certain areas some alteration in particular characteristics of the precipitation distribution were observed.

Key words: precipitation, annual course, Europe, monthly precipitation totals.

1. Introduction

Annual course of precipitation is often characterised by the existence of the maximum and minimum monthly sums. It bears great significance for the life and proper being of living organisms. In the moderate climatic zone, to which almost the whole territory of Europe belongs, the annual rhythm of precipitation and its changes decides about the conditions (favourable or not favourable) for the agriculture.

In the climatological literature this aspect of the precipitation characteristics is treated as a phenomenon unchangeable in time and is represented by indicating the season of appearance of the maximum sum of monthly precipitation (Kendrew 1927; Trewartha 1954; Martyn 1985; Thran, Broekhuizen 1965; Blűthgen 1966). The appearance of the minimum monthly precipitation is often omitted.

The purpose of this article is to discuss the variability of the both maximum and minimum monthly sums of precipitation, the irregularity of annual distribution and the period of occurrence of the maximum monthly sums of precipitation. I have applied

the seasonal index of precipitation, suggested by Markham in 1970 (Kożuchowski, Wibig 1988). This index enables to express both the degree of irregularity in the annual course of precipitation and the period of occurrence of the maximum precipitation sums. It can change from 0% to 100%. The value 100% means, that the whole annual sum of precipitation occurs in one month (the extreme concentration of precipitation). Occurrence of the minimum was expressed by indicating the month with the minimum precipitation sum. The analysis was conducted basing on the data from 383 stations situated in Europe and Asia Minor (Fig. 1). In addition, I examined

Fig. 1. Localization of meteorological station

● - stations where the long-term changeability of annual course of precipitation was examined

the variability of the annual course of precipitation between 1901-1930, 1931-1960 and 1961-1990 (Fig. 1) on the basis of the data from 11 selected stations.

2. Irregularity of the annual course of precipitation in Europe

In Europe in the period 1961-1990 the value of Markham index varies between 1% to 50%.The highest concentration of precipitation occurred in the central and eastern part of the Mediterranean Basin, particularly on islands far out in the south (Malta 56%, Crete 53%) (Fig. 2a). In the areas located in the western part of the Mediterranean and in Iberian Peninsula, I have observed considerable spatial changes in the annual course of precipitation, which was pointed out by the index values from about 10% to above 40%. To the areas with the precipitation evenly distributed during the year we can include the Western part of Great Britain, the lowland part of France, Benelux and the territory north to The Black Sea, where the indicator did not exceed 10%. In the remaining part of Europe we can distinguish the areas with the highest concentration of precipitation, in which the index was changing between 20% to 30% (Fig. 2a).

By comparing the spatial distribution of the Markham index in 1931-1960 and 1961-1990 I observed that in Iberian Peninsula and the middle and north–eastern part of Europe there is a tendency for an increase of precipitation concentration (Fig. 2b). In the eastern Britain, Benelux, the middle part of Italy and in the Balkans the precipitation concentration during the year was decreasing (Fig. 2b). I wish to point out that the distribution of the precipitation concentration did not change considerably between 1931-1960 and 1961-1990.

3. The Period of Occurrence of the Extreme Monthly Precipitation Sums

Peculiar geographical features of Europe are the reason why the extreme monthly sums of precipitation can be observed in any month of the year. In the vast areas of the central and eastern Europe the maximum precipitation was occurring in the summer months (July, August), whereas the minimum at the end of winter (February, March) (Fig. 3a). The characteristic feature of this part of continent is the existence of precipitation extremes in the same month, in the large area. This rule can be also observed in the Mediterranean Basin with a little difference - the highest sums of precipitation fall in the winter month and the lowest in the summer months. As we move from the middle part of continent toward the western coastline, the spatial occurrence of the extreme monthly precipitation becomes more complex. Spatial changes of the discussed elements take place much abruptly. Consequently almost in every distinguished area, much smaller than in the middle of continent, both maximum and minimum precipitation sums were noted within three months (Fig. 3a). In the case of maximum precipitation sums they were usually autumn or winter months, whereas in the case of the minimum it was spring and summer months.

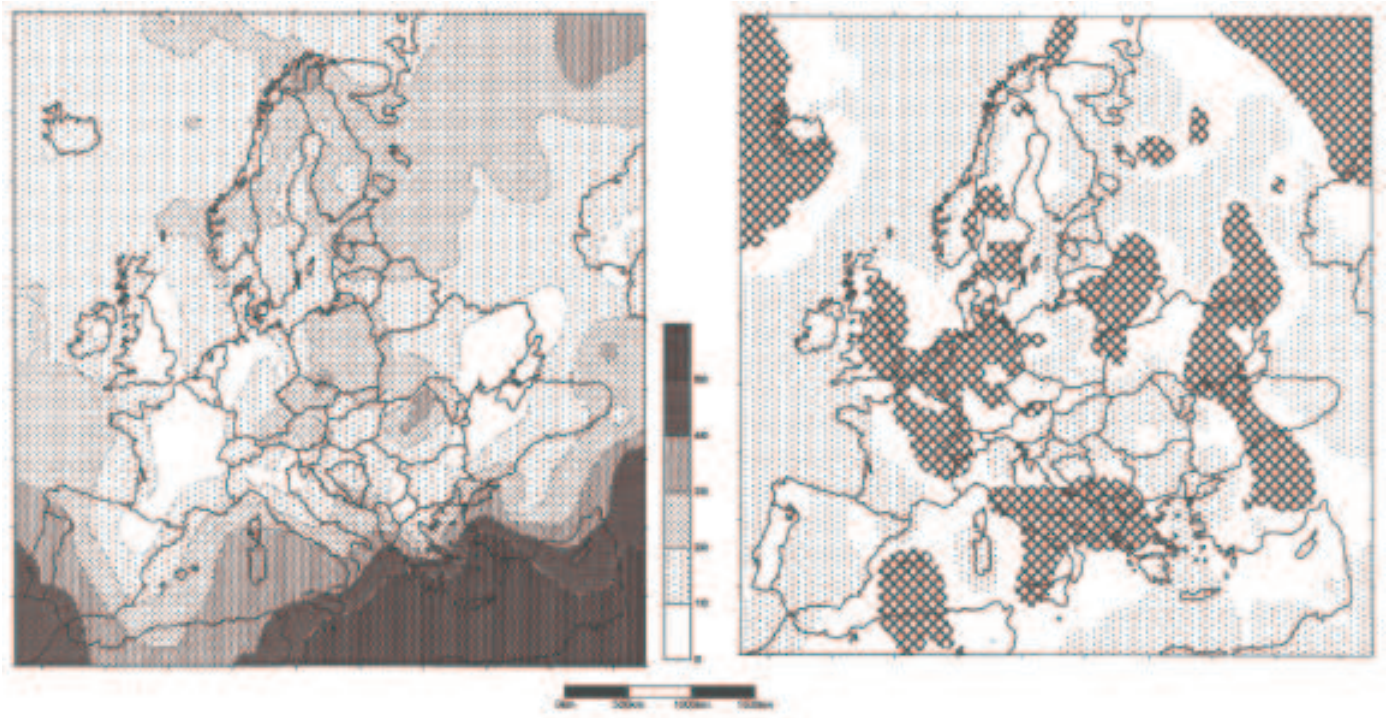

Fig. 2. Distribution of the index of seasonality in annual course of precipitation in Europe in 1961-1990 (a), and its changeability between 1931-1960 and 1961-1990 (b).

the increase of precipitation concentration

the decrease of precipitation concentration

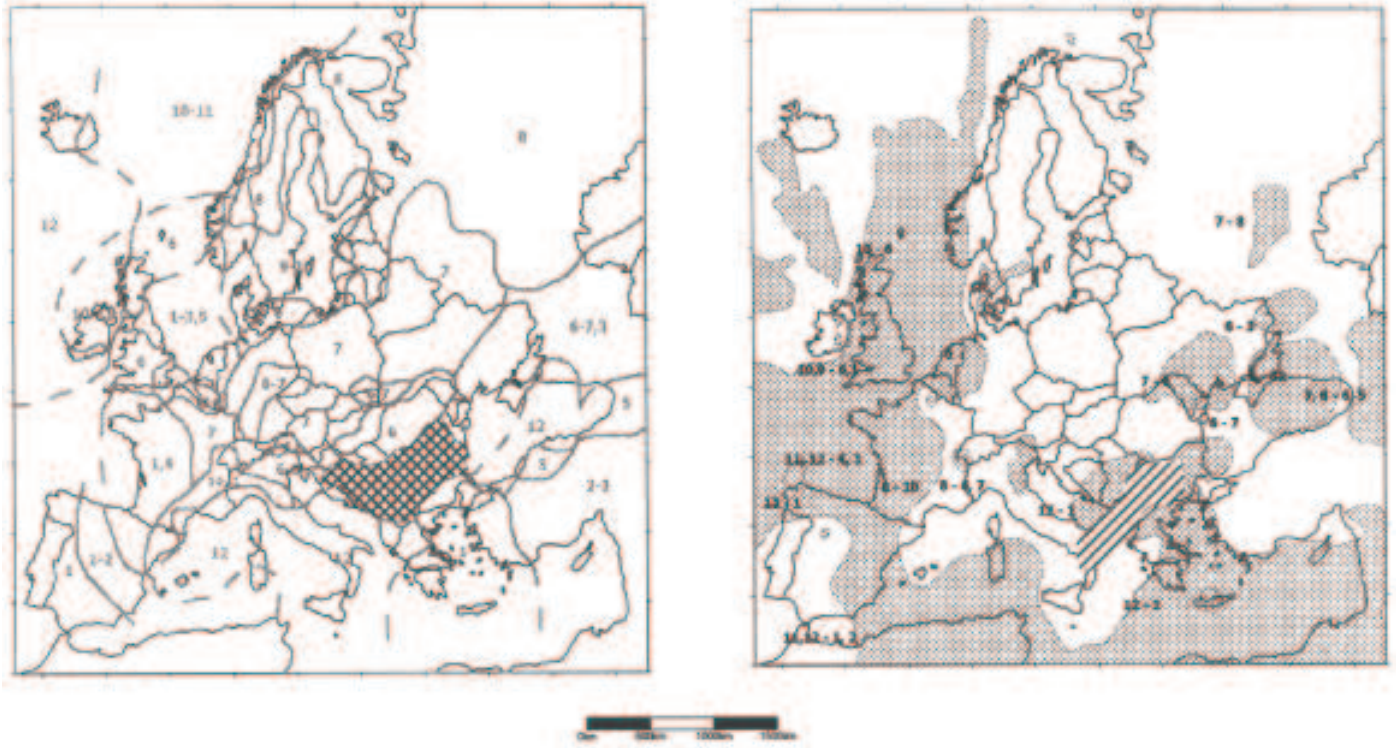

Fig. 3. Month of occurrence of maximum sums of precipitation in Europe in 1961-1990 (a) and the shift of the month of occurrence the maximum sums of precipitation in Europe between 1931-1960 and 1961-1990 (b)

the area with shift of occurrence the maximum monthly precipitation sums

Spatial picture of occurrence of the highest and lowest precipitation depends to a large degree on the examined decade. By comparing two normal periods 1931-1960 and 1961-1990 we can see, that in certain areas of Europe the season of occurrence of both maximum and minimum precipitation was changed. In most cases this changes consisted in slight shift by one month (Fig. 3b). In the case of the maximum monthly precipitation sums the most important changes are those which took place in Western part of Europe, especially in Great Britain, south–eastern Norway (from October to July) and western France (from November and December to April and January) (Fig. 3b). In the case of minimum precipitation important changes in the term of its occurrence have been observed in Ukraine (from March to October).

4. Annual Course of Precipitation for Selected Stations for Europe

To discuss the annual course of precipitation in the following normal periods: 1901-1930, 1931-1960, 1961-1990, the stations which represent characteristic types of precipitation regimes in Europe were chosen. In these periods spatial distribution of the precipitation types was subjected to the same rules. Stations localised on islands and on the coast of Western Europe (Tromsoe, Surundal, Valencia) have shown the highest precipitation, equally distributed during the year (Fig. 4a, b, c). Depending on the longitude, maximum precipitation has been noted there in winter and autumn months, but the month of their occurrence changed in subsequent decades. Similar changes were also noted in the case of minimum precipitation but they happened during the spring and summer months. (Fig. 4a, b, c). In discussed part of Europe, the annual courses of precipitation, during periods that are mentioned above, have shown the highest variability. Equally large changes of the annual course of precipitation during all those periods took place on the remaining two stations in Western Europe (Cambridge, Toulouse). In the eastern part of the continent decreasing of precipitation sums was observed. The lowest precipitation during the whole year was observed in Orenburg (Fig. 5c). High degree of concentration in summer months (Middle Europe) or winter months (Southern Europe) have characterised the precipitation sums in the middle and the southern part of Europe (Fig. 5a, b). The long–term variability of the annual course of precipitation at selected stations in Middle, Eastern and Southern Europe was less changeable in subsequent periods than it was observed in western part of continent.

5. Conclusions

Spatial distribution of types of precipitation regimes during examined periods in Europe has not changed considerably. On the basis of the analysis of the particular elements of the annual course of precipitation I have concluded that the precipitation concentration in Iberian Peninsula and in the central and north-eastern part of Europe has increased, whereas the precipitation concentration during a year in eastern Great Britain, Benelux, central part of Italy and Balkan States decreased. A change of the

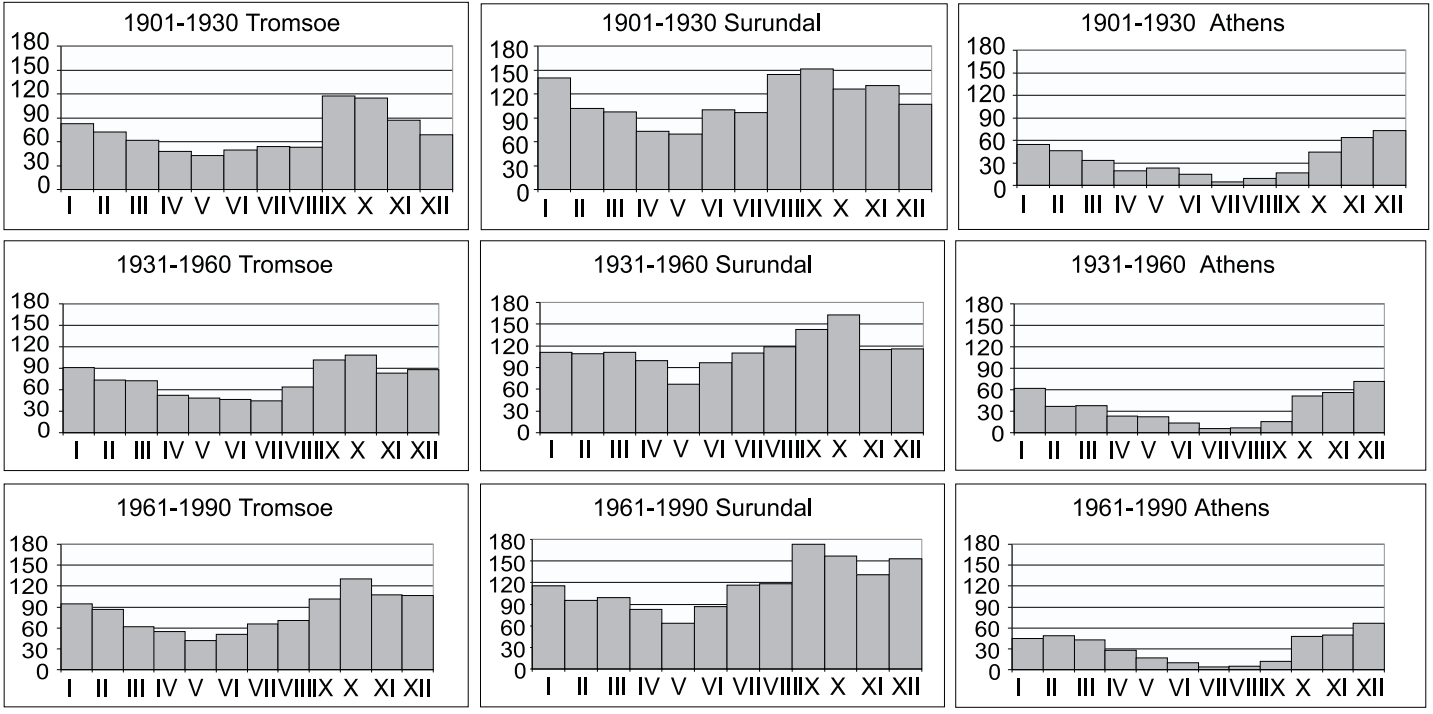

Fig. 4. The annual course of precipitation at selected stations in Europe, a. Tromsoe, b. Surundal, c. Athens.

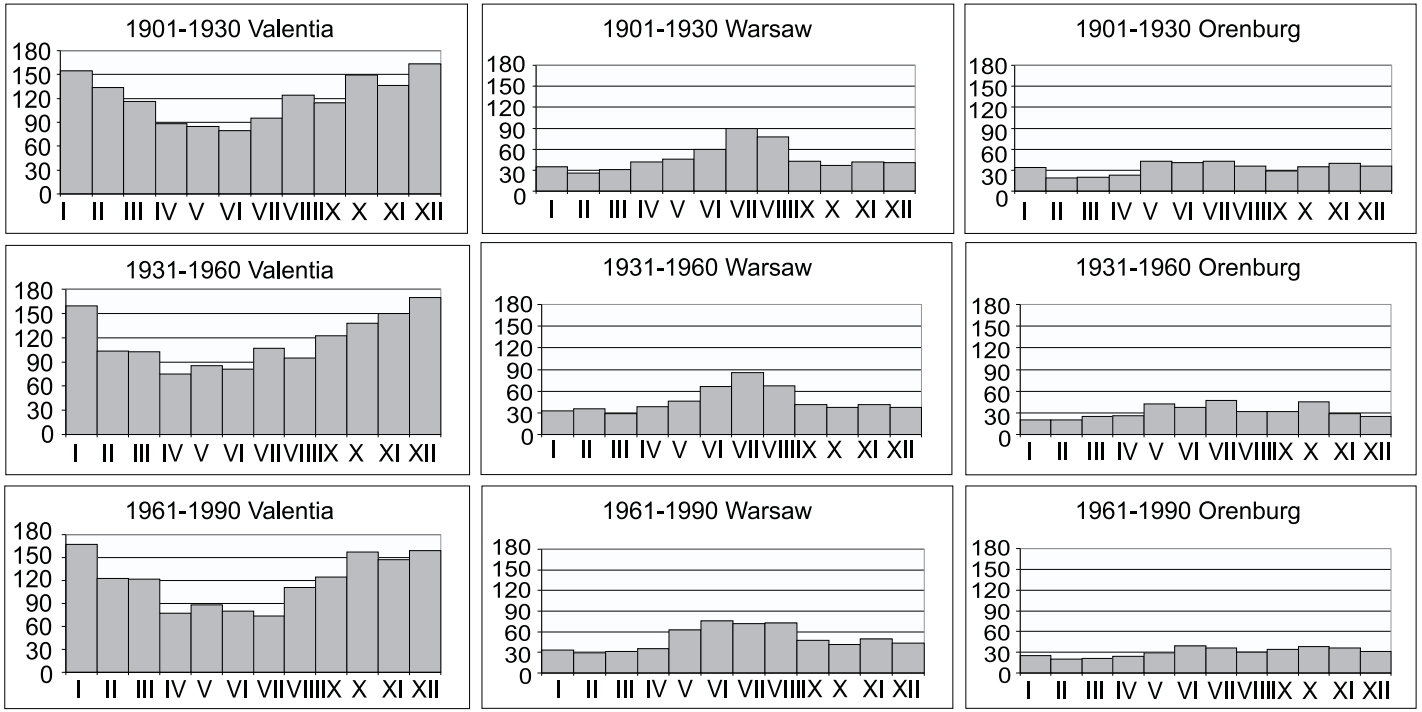

Fig. 5 The annual course of precipitation at selected stations in Europe, a. Valencia, b. Warsaw, c. Orenburg

month with maximum precipitation sums was observed in Great Britain, south-eastern Norway, and western France. In the case of minimum sums significant changes were observed only in Ukraine. On islands and western coasts of Europe annual course of precipitation has shown the highest variability between subsequent periods, than in other parts of the continent.

References

Blűthgen J., 1966, *Allgemeine Klimageographie*, Berlin, t. 2, 173-187.

Kendrew W. J., 1927, *Climates of Continents*, Oxford University Press, New York.

Kożuchowski K., Wibig J., 1988, *Kontynentalizm pluwialny w Polsce: zróżnicowanie geograficzne i zmiany wieloletnie*, Acta Geographica Lodziensia, 55.

Martyn D., 1985, *Klimaty kuli ziemskiej*, PWN, Warszawa.

Thran P., Broekhuizen S., 1965, *Agro–Climatic Atlas of Europe*, vol. 1, Amsterdam – London – New Jork.

Trewartha G. T., 1954, *An Introduction to Climate*, Mc Graw – Hill Book Company, New York – Toronto – London.

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