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THE RAINFALL REGIME IN THE MUREŞ AND BANAT PLAINS IN THE TIMESCALE 1950 – 2020 AND THEIR ASSOCIATED RELATIONSHIP TO AGRICULTURE

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Abstract *The present study aims to present the atmospheric precipitation regime for the western part of Romania, mainly the area located in the Mureş and Banat plains. Relying on the amounts of water gauged at the weather stations and substations located in the fork plain lying between the White Criş and the Danube valleys and which were intermittently operational during the period from 1950 to 2020, a study regarding the areal distribution and time variation of the main parameters of rainfall has been made. A display is made of the main characteristic features of the annual mass curve, the rainfall periodicity and randomness, the maximum rainfall in 24, 48 and 72 hours and the snow cover. The data reduction and validation were done by keeping a close eye on the specific weather phenomena and by analysing the synoptic situation for the most important weather events. The characteristic parameters of the pluviometric regime in the Mures and Banat Plains, which were analysed in this paper, can constitute basic materials for the design of hydro-ameliorative systems, for the construction of irrigation systems or to combat excess moisture, all of which are an important component of the development agriculture in the western part of Romania.*

Keywords: *rainfall, synoptic scale, agriculture, climatology, western Romania*.

INTRODUCTION

The Mures and Banat plains are obvious morphological units with specific characters of the Tisa Plain, a low, young plain formed on the site of a maritime-lacustrine basin. The Tisza plain is flat, not wavy at all and seems to have barely emerged from the receding waters and the action of the flowing waters that cross it (MĂHARĂ, 2001). On its surface, in addition to the current water courses, there are abandoned courses that indicate the morphological youth of this region. Towards the contact with the Western Hills, in a few sectors, it has the character of a high plain in terraces, such as the Gătaia and Vinga Plains (DONEAUD, 1958; STANCIU, 2005).

With all its uniformity, the Tisei Plain can be divided into a series of distinct morphological units such as: Somesului Plain, Ecedului Plain, Nirului Plain. Eri Plain, Crisurilor Plain, Mures Plain and Banat Plain. This paper analyses the atmospheric precipitation regime in the area of the Mures and Banat Plains and in the area of the high contact plains of Vinga, Lugoj and Gataia. The morphological characteristics of these geographical units are described as diverse.

The Mures plain corresponds to the so-called discharge cone of the Mures river, with the appearance of a low plain, with abandoned courses, old arms of the Mures river. It is an alluvial plain from the overflows of this river, forming increasingly wide winding meanders towards the confluence with the Tisza (MIRCOV ET AL., 2017).

The Banat Plain, in which the Timisoara Plain has a special place, is a low plain, covered in the past by lakes and marshes, which were mostly drained due to recent subsidence movements. The clayey silts and clays that cover them determined soils rich in humus (BERBECEL & STANCU, 1970).

The Vingai, Lugojuli and Gataiei plains are the contact plains, developed to the west and south of the Lipovai Hills and to the west of the Pogonişului Hills. In reality, these are fluvial terraces that do not exceed the relative altitude of the terrace level of 20 meters, being clearly differentiated from the Plains of Mures and Banat (STOENESCU, 1962, 1966).

MATERIALS AND METHODS

In order to characterize the precipitation regime, the data recorded at 9 stations and 20 meteorological stations that operated in this area in different years between 1950 and 2020 were used. The non-homogeneity of the series of observations determined that the multi-annual data should be obtained through special processing, as the methods of iso-percentages and graphic correlations.

RESULTS AND DISCUSSIONS

It is noted that the territorial distribution of atmospheric precipitation in this area is special. It should be emphasized that the homogeneity of the relief has less influence on the formation of precipitation, which in the respective area is the result of cyclonic activity and atmospheric fronts. The prevailing circulation from the north, north-west and south-west determines amounts of precipitation between 500 mm in the western part of the area, i.e., in the lowest part and 700 mm in the eastern, higher part, where in the contact area with the Western Hills there is an intensification of frontal processes (POVARĂ, 1990).

There is also a shift of the isohyets to the east, especially in the areas characterized by dense hydrographic networks, which in the warm period of the summer cause a much-intensified local circulation. Thus, following the downward movements of the air, the phenomenon of the breaking up of thermal convective clouds, developed above the heated plain, occurs, the effect of the mentioned process being the quantitative decrease of precipitation (ION-BORDEI, 1983).

The multi-annual average amounts on the basis of which the annual isohyets were drawn are not sufficient for the characterization of the precipitation regime, because even on an area with a low surface area and with a weak relief energy, the precipitation differs greatly in value, from one year to another as a result of continuous fluctuations of the general atmospheric circulation. The variability of precipitation can be highlighted by the wide limits between which the different annual amounts fluctuated. The largest annual amounts of precipitation fell in the years in which the cyclonic activity was very intense and persistent, and the smallest amounts were recorded in the years in which the anticyclonic regime prevailed for a long time and the adequacy of continental tropical or continental polar air, the differences between the extreme values oscillating between 450 and 1150 mm (SANDU ET AL., 2010).

Due to the inhomogeneity of the series of observations, the actual maximum annual amounts of precipitation cannot be established, nor can the years of their production be rigorously established. As a guideline, it is mentioned that at most of the stations, the largest amounts of precipitation were recorded once per decade.

During the year, the precipitation presents an uneven distribution, the value of the recorded monthly amounts being linked both to the great variability of the general atmospheric circulation and the intensity of thermal convection, as well as to some local peculiarities that intensify or weaken the processes of cloud formation and precipitation fall.

In general, a main maximum is observed in June, which is determined by the cyclonic activity within the polar front and by intensified thermal convection, and a secondary maximum in November and December determined by the development of cyclonic activity in the Mediterranean basin. Based on the hail climatology and taking into account hail distribution in the area, the area was subjected to greater quantity of hail during the years. As such, many of the structures might have had a well-developed structure, associated with supercell structures or multi-cell clusters (BROWNING & FOOTE, 1976).

The main annual rainfall minimum is observed between February and March, as a result of the weakening of cyclonic activity, and the secondary minimum is noted in September, when tropical air masses, initially of oceanic origin, but with a low content of water vapor, as a result of the continentalization process (MĂRĂZAN ET AL., 2020).

The highest and lowest monthly amounts of precipitation highlight the great variability of the annual regime of atmospheric precipitation. It should be noted that there were years in which the highest monthly amounts of precipitation exceeded 2-4 times the multi-year average monthly amount, and the lowest monthly amounts of precipitation totalled only 20 mm, there were even months with no precipitation.

The maximum daily amounts of water from precipitation are generally lower in winter, also determined by the lower content of water vapor in cold air masses, and increase in the warm part of the year, when the absolute humidity is higher and when the frontal processes have added those of thermal convection.

Atmospheric precipitation falling in 24 hours meant in some observation points amounts greater than the multi-year average monthly amount. In order to solve certain practical problems related to the fight against floods and excess moisture, the dimensioning of the canals is of interest not only to the amounts of precipitation collected in one day, but also to those accumulated in two or three consecutive days. For such situations, the maximum amounts of water that can be collected in 24, 48 and 72 hours were determined by calculation.

A special practical interest is also the rains in the form of showers, also known as torrential rains that give large amounts of water in short intervals of time. The characteristics of torrential rains, i.e., sudden beginning and end, changes in intensity and the establishment of special intensities can be determined with the help of recordings made with the help of pluviographs (MIRCOV ET AL., 2018).

In the analysed area, exceptional rains of a local nature were reported at all meteorological stations and posts, some of them being mentioned in the accompanying table.

Table 1

Rainfall regime in the western part of Romania during heavy rainfall

Meteorological station	Data	Quantity	Duration (min)	Intensity	Maximum intensity	Maximum intensity duration
Chisineu-Criș	17.06.1966	10.4	20	0.52	2.43	3
Arad	7.06.1970	22.4	32	0.69	7.30	1
Sannicolau Mare	14.06.1969	32.8	31	1.06	5.40	1
Timișoara	9.09.1970	15.8	45	0.38	3.30	3

An important characteristic of the atmospheric precipitation regime is the frequency of days with certain amounts of precipitation. The annual average number of days with precipitation amounts greater than 0.1 mm decreases from the northern part, from approximately 120-140 days to the southern part, where 90-100 days with precipitation were recorded. There were years in which only 100 - 120 days were reported and years in which 160 - 170 days were recorded with precipitation amounts greater than 0.1 mm.

Days with amounts of precipitation that exceeded 20 or 30 mm were reported sporadically and only in the warm period of the year, and the average monthly values of these parameters only reached 1 or 0.7 days at some stations, respectively. It should be mentioned that there were consecutive years in which such amounts were not collected in any month and years when, due to the intensification of frontal activity and thermal convection, three or even four days with such amounts were reported.

In the cold period of the year, when the air and soil temperatures are negative, the solid precipitation that falls forms the snow layer. In the territory under study, the average decadal thicknesses of the snow layer gradually increase from the end of autumn until the first decade of February, then decrease relatively quickly, until the 3rd decade of March. In the first decade of April, the average thickness of the formed snow layer did not exceed 1 cm, being completely isolated and lasting 1-2 days. The highest average decadal thicknesses were measured at the weather stations and posts located in the southern part of the Banat Plain, where, compared to the rest of the area, the amounts of precipitation fell were higher (CIULACHE & POVARĂ, 1997).

Of particular interest is the maximum decadal thickness in winters characterized by large amounts of precipitation and low air and soil temperatures. In such situations, the decadal values exceeded 25-35 cm. In this area, the snow layer forms and disappears several times during the fall, as a result of the air and soil temperature oscillating around 0°C, settling for a longer period of time when the thermal conditions allow maintaining this one. In the spring, after the snow melts, the snow layer can form again, for short periods of time and only in the case of cooling accompanied by the production of solid precipitation.

The date of the first and last snowfall, as well as that of the first and last day with a layer of snow, fluctuates in the analysed area within very wide limits, dictated by the synoptic conditions of the intervals in which they occurred. From the vapor analysis, it is found that the annual number of days without snow and without a layer of snow increases slightly from the northern and eastern part to the southern and western part. Thus, annually there are on average about 25-35 days with solid precipitation in the Plains of Arad, Vingai, Lugojului and about 15-20 days in the Plains of Timis and Gataiei, where the areas characterized by higher air and soil temperatures are located. This parameter therefore shows a decrease in value from the northeast to the southwest (TEODORESCU et al., 2021).

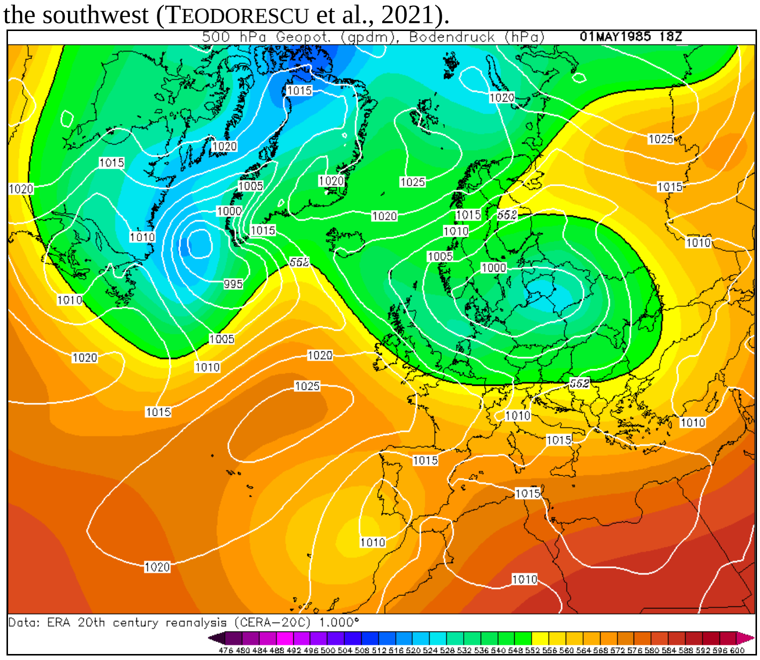

Figure 1. The geopotential field at the level of 500 hPa from May 1, 1985, 18.00

Figure 1 is representative for a cold air advection in the beginning of May 1985. This event caused massive flash-floods in the northern part of Romania and thus also exceeding the flooding level in the basins of the western part of Romania.

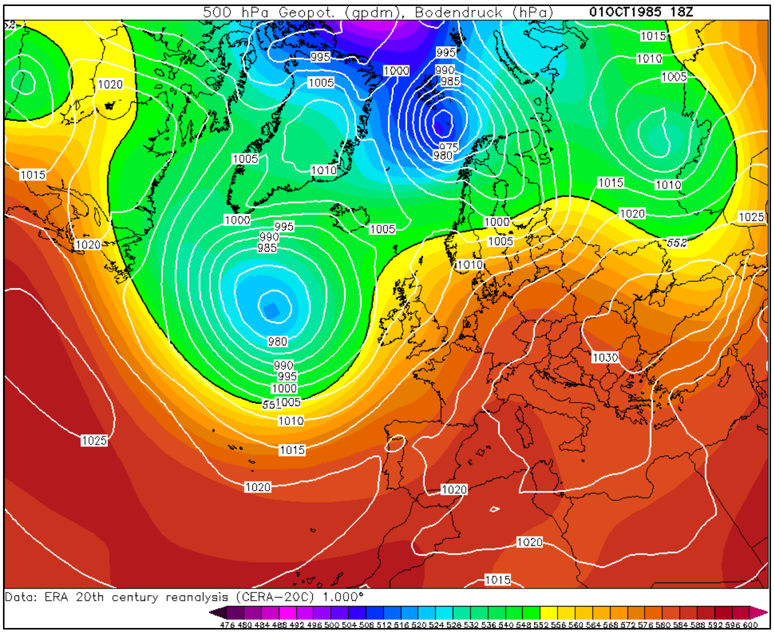

Figure 2. The geopotential field at the level of 500 hPa from October 1, 1985, 18.00

Figure 2 shows a hot air advection in the beginning of October 1985. This anticyclonic ridge influenced the pluviometric regime in the western part of Romania and affected, as such, also the soil moisture for the incoming spring season.

From one year to another, the number of days in which precipitation fell in the form of snow oscillated between very wide limits, i.e., 5-50 days, depending on the synoptic characteristics of the respective cold interval. Dictated by the number of days with snow, the amount of solid precipitation that fell and the existence and persistence of low air and soil temperatures, the duration of the snow layer totalled between 1-99 days. The longest duration of the snow layer was reported in the winter of 1963. In the northern half of the Mures Plain, 99 days were reported in Chisineu-Cris and 91 days in Arad, and in the southern half of the Banat Plain, in the same interval, there were a total of 59 days in Milcoveni. It is found, as is natural, the reduction of the snow layer in the north-south and east-west directions, related to the factors that determine its appearance and maintenance. The shortest durations of the snow layer were recorded in the winter of 1961 and especially in the winter of 1971, when in the Mures Plain the snow layer lasted up to 7 days, in the Lugoj High Plain 8 days, and in the south of Banat Plain 2 days. It should be noted that in the south-eastern extremity of the area, in the winter of 1971, there was only one day with snow, the snow layer not being able to form, because the temperature of the soil surface had positive values. Analysed by month, the most days with a layer of snow were summed up in January, followed by February and December. In the months of March and November, there were cases in which the snow layer lasted 12-13 days and 6-7 days, respectively. Most of the years studied were characterized by the lack of snow cover in the months of March and November or by its formation and maintenance for only 1-2 days.

CONCLUSIONS

The characteristic parameters of the pluviometric regime in the Plains of Mures and Banat, analysed in this paper, can constitute basic materials for the design of hydro-ameliorative systems, for the construction of irrigation systems or to combat excess moisture, as the real situation on the ground was claimed, for the sizing of reservoirs needed for drinking or industrial water supply, for the design of sewage systems, constructions of various types and for agriculture. With the help of archive data and synoptic charts for both low level, mid-level and high-level troposphere, a climatology of the area can be constructed and, as such, some weather patterns can be established at least at a theoretical level.

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