

## **THE RELATIVE MOISTURE OF AIR IN THE CRIȘURI PLAIN**

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### **Abstract**

*The goal of this paper is to present the multiannual regime of relative moisture in the Crișuri Plain area, as well as the monthly and annual regime of the relative moisture, the lowest monthly and annual values, the mean frequency of days with relative moisture  $\leq 30\%$ ;  $\leq 50\%$ ;  $\geq 80\%$ , based on data recorded at weather stations located in the area of the study (Salonta, Chișineu Criș, Săcueni and Oradea) from 1970 to 2017 (48 years).*

*Due to the influence of the wet climate from the west of the continent, the multiannual mean values of relative moisture are high in the area of Crișuri Plain. The relative moisture values vary between 75.3%, in Săcueni and 81.5% in Salonta.*

*The annual regime of relative moisture is characterized by higher values in winter, especially in December, due to the higher frequency of warm and wet air from the Mediterranean Sea, as compared with January, when the frequency of cold and dry air from the north and north-east increases.*

**Key words:** frequency, monthly and annual regime, relative moisture

### **INTRODUCTION**

Relative moisture is the ratio of the pressure of water vapours ( $e$ ) to the saturation pressure ( $E$ ). This value is of practical interest, as it shows the degree of saturation of an air volume with water vapours.

In the lower layer of the atmosphere, the relative moisture of air depends on the moisture degree of the subjacent surface, since the characteristics of the local evapotranspiration alter the character imposed by the general circulation of the atmosphere (Ciulache, 2002; Moza, 2009).

Relative moisture is in inverse correlation to air temperature and in direct correlation to atmospheric nebulosity, being influenced both by the particularities of the moving air masses and the local characteristics of the active surface (Gaceu, 2005; Pereș, 2012).

### **MATERIAL AND METHOD**

The characteristics of relative moisture in the Crișuri Plain area were studied using the data recorded at four weather stations: Salonta (95 m), Chișineu Criș (96 m), Săcueni (125 m) and Oradea (136 m). The data were recorded over a period of 48 years (1970-2017) at most of the weather

stations. The weather station in Salonta was closed, it was in operation from 1983 to 1998.

## RESULTS AND DISCUSSION

### The monthly and annual regime of relative moisture

The relative moisture of air in the area included in the study shows relatively high values, which is due to the influence of the wet climate from the west of the continent.

Within the area of Crişuri Plain the annual mean values give close multiannual mean values, with 75.3% in Săcueni and 81.5% in Salonta (Fig. 1).

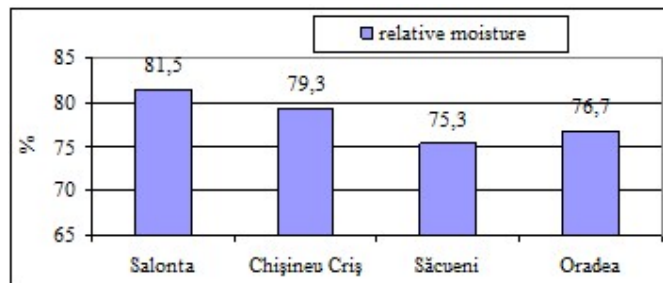


Fig. 1. Distribution of air relative moisture multiannual mean values (%) in the Crişuri Plain

In the period included in the study (1970-2017), in Oradea the annual mean values of relative moisture varied between 69% in 2007 and 2009, and 84% in 1985 and 2001 (Fig. 2). The highest monthly mean values were recorded in January and December, that is, 97% in January 1989 and 95%, in December 1998. In Oradea, the lowest monthly means occurred in April and August. Thus, in April 2007 46%, while in August 2003 47%.

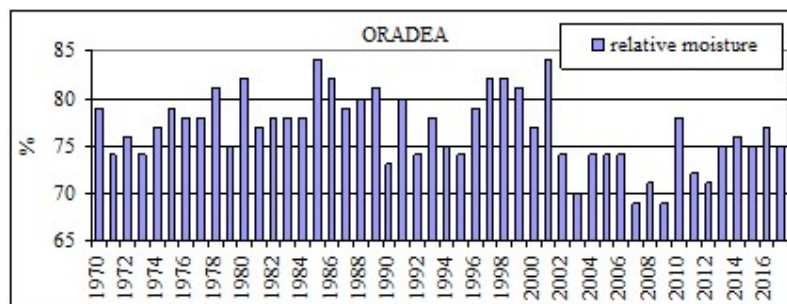


Fig. 2. Relative moisture annual values in Oradea, 1970-2017

In Săcueni, the annual mean values of relative moisture varied between 68% in 2008 and 82% in 1980, 1985, 1988 and 2001 (Fig. 3).

Over the 48 years included in the study, in Săcueni the highest monthly mean values were recorded in January and December, with 96% in January 1989 and 94% in December 1984. The lowest monthly mean values of relative moisture were recorded in April 2009, 46%, and in June 2000, 50%.

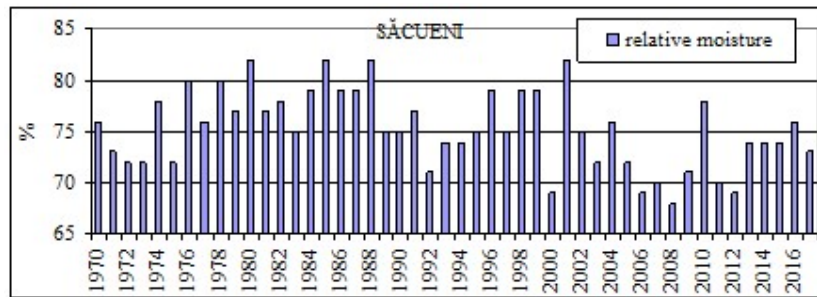


Fig. 3. Relative moisture annual values in Săcueni, 1970-2017

The annual mean values show deviations from the multiannual mean, which is due to the general circulation of the atmosphere, physical geographical factors etc.

The highest positive deviations recorded in the area of the study during the 48 years occurred in Oradea, 54.2%, while in Săcueni the percentage of positive deviations is 45.8%.

The highest negative deviations occur in Săcueni, 54.2%, while in Oradea the figure is 45.8% (Fig. 4, 5).

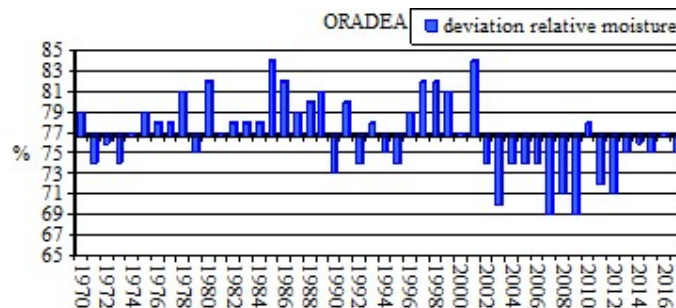


Fig. 4. Air moisture annual deviations from the multiannual mean in Oradea, 1970 – 2017

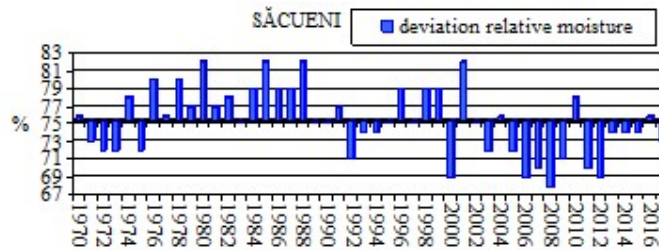


Fig. 5. Air moisture annual deviations from the multiannual mean in Săcuieni, 1970 – 2017

The relative moisture values of air are influenced by the evolution of the air temperature, thus, in winter, when air temperature has the lowest values, relative moisture shows the highest values, while in summer things happen the other way around.

Looking at the annual regime of relative moisture, it can be seen that it is characterized by higher values in winter, especially in December, for example, 92.9% in Salonta, 90% in Chişineu Criş, 87.9% in Oradea, and in Săcuieni 86.2%. Higher moisture in December can be explained by the higher frequency of warm and humid air from the Mediterranean Sea, as compared with January, when the frequency of cold and dry air from the north and north-east increases due to the East-European, Siberian or Scandinavian Anticyclone (Gaceu O., 2005; Pereş A. C., 2012).

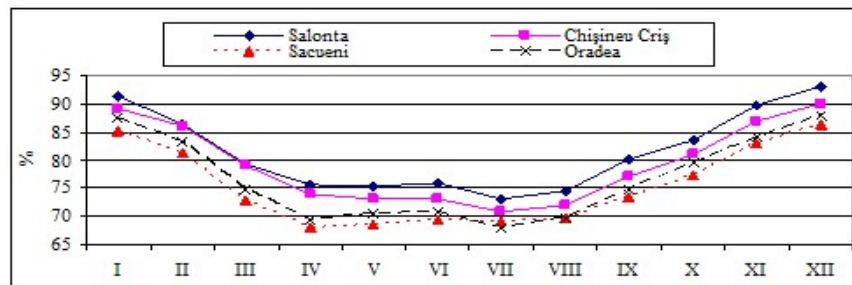


Fig. 6. Distribution of air relative moisture monthly mean values (%) in the Crişuri Plain

The lowest values of relative moisture occur in the warm season of the year, with minimums recorded in April and July, with the highest frequency in July. Thus, in the Crişuri Plain, the lowest values of multiannual mean of relative moisture vary between 68.2% in Săcuieni and Oradea in April and July, and 73.1% in Salonta in July (Fig. 6).

The monthly pattern of relative moisture is in inverse correlation to air temperature, thus, the highest values of relative moisture are recorded in

winter months (December, January), when the temperatures are the lowest within the year (Table 1).

Table 1

Monthly pattern of relative moisture and monthly mean temperature in the Crişuri Plain

Month/station		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	An
Salonta	Rh%	91.4	86.4	79.3	75.6	75.3	75.9	73.1	74.5	80.2	83.5	89.6	92.9	81.5
	Temp.	-0.8	0.3	4.9	10.9	16.3	19.1	21.5	20.9	15.9	10.5	4.4	0.1	10.3
Chişineu Criş	Rh%	89	86	79	74	73	73	71	72	77	81	87	90	79.3
	Temp.	-1.4	-0.1	5.2	10.3	16.1	19.1	20.9	20.4	15.9	10.3	4.3	0.8	10.2
Săcueni	Rh%	85.1	81.4	72.8	68.2	68.6	69.5	69.2	69.9	73.4	77.2	83.0	86.2	75.3
	Temp.	-0.9	0.9	5.8	11.3	16.6	19.7	21.4	20.8	16.1	10.6	5.2	0.6	10.7
Oradea	Rh%	87.5	83.2	74.8	69.5	70.5	70.9	68.2	69.7	74.8	79.5	84.2	87.9	76.7
	Temp.	-0.8	0.9	5.6	11.0	16.4	19.5	21.4	20.9	16.2	10.7	5.2	0.8	10.7

Source: data provided by National Meteorological Administration archive (A.N.M. Bucharest)

### The monthly and annual minimum of relative moisture

Looking at the evolution of the monthly minimum of relative moisture in the period 1970-2017 in the area of the study, it can be seen that the minimum values are recorded in the warm period of the year, thus, the absolute minimum value was recorded in Săcueni, 6%, on 20.04.2009, while in Oradea the absolute minimum was 14%, on 20.07.2007 (Table 2).

Table 2

Monthly minimum values of relative moisture in the Crişuri Plain, 1970 – 2017

Month/station	Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
Săcueni	Rh%	15	16	11	6	13	18	14	15	14	13	14	28	6
	Date	29.12	14.94	03.12	20.09	02.07 02.15	05.00 21.00	20.07 20.15	23.07 31.12 23.15	21.11	01.11	25.93	10.11	20.04.2009
Oradea	Rh%	27	28	18	15	16	15	14	15	15	23	25	27	14
	Date	01.73	14.94	26.03 15.12	07.05 22.07	03.07 18.09	14.09	20.07	31.12	01.12	16.07 03.11	14.70 05.97	28.72 05.11	20.07.2007

Source: data provided by the A.N.M. Archive

The absolute minimums of air moisture resulting from lack of precipitations over a period of 10-15 days can lead to the phenomena of dryness and atmospheric drought.

### The mean frequency of days with relative moisture $\leq 30\%$ ; $\leq 50\%$ ; $\geq 80\%$

The annual mean number of days with relative moisture  $\leq 30\%$  (dry days) and  $\geq 80\%$  (humid days) is of important practical interest, thus, the number of days with relative moisture  $\leq 30\%$  is considered an indicator of

dry weather, while the number of days with relative moisture  $\geq 80\%$  is considered an indicator of humid weather (Pereş A. C., 2012).

The frequency of days with various characteristics of relative moisture shows both a spatial and a temporal variation. The annual mean number of days with very low relative moisture of air, with values  $\leq 30\%$  at any time of data collection, varies in the area of the study between 9.4 days in Săcueni and 9.6 days in Oradea.

Over the year, the monthly mean frequency of days with moisture  $\leq 30\%$  varies from one region to another depending on geographical conditions. The frequency of these days shows higher values in summer and spring, thus in Oradea the number is 1.7 days in April and 1.6 days in July, and in Săcueni 1.6 days in July (Fig. 7). The higher values in April are the result of temperature increasing as against the previous months, of the frequent presence of the anticyclonic regime, which generates dry weather, but also of the higher frequency of days with warm and dry wind. The same weather characteristics also determine the higher number of days on which relative moisture of air reaches or goes below 30% in summer months, to which the high temperatures of the warm season of the year are also added (Măhăra Gh. et al., 2002; Dumiter A., 2007).

Relative moisture  $\leq 30\%$  is least frequent in winter, in December – January (0.0 – 0.1 days).

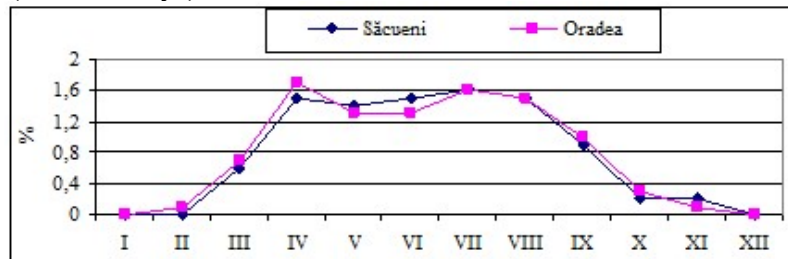


Fig. 7. Distribution of relative moisture monthly mean values  $\leq 30\%$  in the Crişuri Plain

The annual mean number of days with relative moisture  $\leq 50\%$  at least at one of the data collection times is 115.8 days in Oradea and Săcueni.

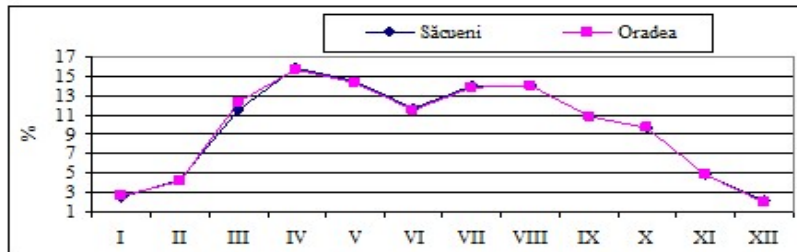


Fig. 8. Distribution of relative moisture monthly mean values  $\leq 50\%$ , in the Crişuri Plain

The monthly mean frequency of days with relative moisture  $\leq 50\%$  shows highest values April, thus, there are 15.8 such days in Săcueni and 15.6 in Oradea. The lowest monthly means in the area of the study occur in December, that is, 2.0 days in Oradea and 2.1 days in Săcueni (Fig. 8).

The annual frequency of days with relative moisture  $\geq 80\%$  at noon (the time of highest temperature) is 89.8 days in Săcueni and 91.1 days in Oradea, values which show the influence of the humid climate from the west and south-west of the continent, which is felt in the western part of the country.

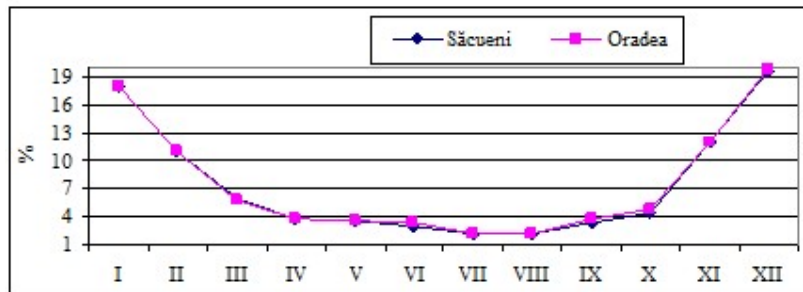


Fig. 9. Distribution of relative moisture monthly mean values  $\geq 80\%$ , in the Crișuri Plain

The monthly mean number of days with relative moisture  $\geq 80\%$  reaches a maximum in December, thus, there are 19.7 such days in Săcueni and 19.9 in Oradea. The relative moisture values are higher in winter, as the temperatures are lower and the advection of the humid Mediterranean air is more frequent. The minimum values are recorded in the summer months (July and August), thus, there are: 2.3 days in Oradea and 2.2 days in Săcueni (Fig. 9). The values are lower in the summer, as the air mean temperatures are higher.

The high number of days on which relative moisture reaches and goes beyond 80% is determined by the geographical location of Oradea in the western part of the country, where the influences of the humid climate from the western and south-western part of the European continent is stronger than in other parts of the country (Dumiter, 2007; Köteles, Moza A, 2010; Pereș, Köteles, 2014).

High value relative moisture, as well as the high number of days when it is recorded, is a risk factor for the population, especially in the cold season, when high moisture is accompanied by low temperatures, which leads to the persistence in the atmospheric air of the city of high amounts of pollutants coming from the industrial zone or from the traffic (Erhan, 1979, cited by Dumiter, 2007; Pereș, 2011).

## CONCLUSIONS

Due to the influence of wet climate, in the Crişuri Plain area the multiannual values of relative moisture are relatively high, with values between 75.3% in Săcueni and 81.5% in Salonta. The positive deviations from the multiannual mean in Oradea and Săcueni were 54.2% and 45.8%, respectively. The negative deviations varied between 54.2% in Săcueni and 45.8% in Oradea.

The annual regime of relative moisture is characterized by higher values in winter, especially in December (92.9% in Salonta, 90% in Chişineu Criş, 87.9% in Oradea, and in Săcueni 86.2%), due to the higher frequency of warm and humid air from the Mediterranean Sea, as compared with January, when the frequency of cold and wet air from the north and north-east increases. The lowest values of relative moisture occur in the warm period of the year, especially in July.

The absolute minimum relative moisture was recorded in Săcueni, the value of 6%, on 20.04.2009, followed by Oradea, with 14%, on 20.07.2007.

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