RELATIVE AIR MOISTURE IN CRISUL REPEDE DRAINAGE AREA

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Abstract: *The current research was carried out on the basis of the data provided by a generous meteorological database, and recorded by 5 meteorological stations within Crisul Repede drainage area (Sacueni, Oradea, Borod, Huedin, Stâna de Vale), on a long time span, between 1970 – 2008, respectively. The relative moisture represents the percentage ratio between the watery (aqueous) vapours (e) and saturation pressure (E). This parameter is of practical interest as it indicates the saturation point of a certain air volume with watery vapours. In order to carry-out this research study we employed both a series of traditional research models as well as a series of modern means and models. The main methods used in the current research are the following: analysis method, induction method, deduction method, comparative and statistics-mathematics methods and graphs. The use of traditional research methods and instruments specific to climatology targeted computing as accurately as possible of all the available data, by this studying the impact of the relief as climacteric factor in the evolution of the relative moisture parameters. In the current paper we put forward an analysis of the monthly and annual regime of relative moisture, its multi-annual monthly evolution, the median frequency of the days with relative moisture ≤ 30%; ≤ 50%; ≥ 80%. Die to the impact of humid climate, the annual median parameters of relative humidity are very high, with values between 76.3%, recorded at Sacueni meteorological station, and of 88.6%, recorded at Stana de Vale meteorological station. The watery (aqueous) vapours amount is dependent on air masses origin, physico-geographical conditions, soil surface' condition, continental depth, level of rains, annual rainfalls, etc. The largest amounts of watery vapours in the analysed area come from Atlantic Ocean and Mediterranean Sea. To air moisture level increase, it contributes in a smaller share the water evaporation out of soils, rivers surfaces, humid surfaces and plant transpiration. The air nebulosity, rainfalls, solar radiation, etc. all are dependent of this meteorological element. Moisture excess or deficit along with other meteorological factors may have negative impacts, of which we mention the following: degradation of people's health condition, draught, the later leading to sudden dehydration both of plants and animals, etc.*

Key words: *relative humidity, climate element, median values*

INTRODUCTION

Air relative humidity is conditioned by the atmosphere lower level, the level of moisture of the subjacent surface, the local vaporisation and transpiration characteristics altering the general conditions regulated by the general air dynamics. As for the other parameters, the relief altitude is a major factor of influence. The vertical gradient of relative humidity has values between 0.5 – 0.9 % / 100 m altitude, showing lower values in mountain areas (APOSTOL L., 2004).

MATERIAL AND METHODS

In order to highlight this climate constituent in Crisul Repede drainage area, we have used the data collected during the 1970 – 2008, time span by instrumental observation at the locations of the five meteorological stations within the analysed areal.

By the intermediate of statistics and mathematics methods, the data collected out of the archive of the National Meteorological Administration (A.N.M.). The outcomes we had obtained through mathematics and statistics methods were subsequently translated into graphs in order to highlight clearly the phenomenon' evolution and fluctuation on time scale.

We target for available data processing as much precise as possible, by means and method specific to climatology research, thus analysing the role the relief plays in the evolution of relative humidity rates.

RESULTS AND DISCUSSIONS

One of the most important indicators of air humidity, namely the air relative humidity, is hereunder analysed and presented, by using the data collected in the analysed areal for a period of 39 years.

Monthly and annual regime of relative humidity

The air relative humidity in the analysed area shows relative high values due to the influence of the humid climate in the Western part of our continent.

Within the Crisul Repede drainage area, the annual levels of relative humidity raise, in general, directly with the altitude, from 76.3% the level recorded at Sacuieni up to 86.6%, the level recorded at Stana de Vale (tab.1). Due to the influence and impact of local factors, the repartition on altitude of relative is inconsistent on some areas. This, at the level of Huedin city, this indicator's value (77.9) is lower than the one recorded at Borod (80%).

Table 1

Multiannual average of monthly values of air relative humidity (%) a within Crisul Repede drainage area 1970 – 2008

Month/station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	An
Oradea	88.2	83.3	76.3	71.3	71.6	72.1	70.1	71.6	76.5	79.9	84.5	88.1	77.8
Sacueni	86.3	82.1	74.1	70.1	69.2	70.1	70.6	71.6	74.8	78.3	84.1	86.8	76.3
Borod	85.7	81.7	77.4	74.1	75.4	76.6	76.1	77.3	81.7	81.9	84.2	86.2	80.0
Huedin	86.4	81.9	75.2	71.5	71.8	73.1	72.0	72.5	77.0	80.6	85.0	87.2	77.9
Stana de Vale	91.4	88.4	87.2	86.4	85.7	86.7	86.7	88.1	90.9	89.2	89.9	92.0	88.6

Source: data collected out of A.N.M.'s archive and processed

The levels of air relative humidity are biased by the evolution of air temperature, thus, in winter when air temperature levels are the lowest, the relative air humidity records the highest levels while, during the summer, the process is reversed.

By analyzing the annual regime of relative humidity, one notices that this indicator is characterized by higher values in winter, especially in December; thus these values are as following: 92% at Stana de Vale, 87.2% at Huedin, 86.2% at Borod and 86.8% at Sacuieni. The higher level of air humidity in December may be explained through the higher frequency of warm and humid air dynamics from the Mediterranean Sea, as against the month of January, when we observed an increased dynamics of cold and dry air from North and North-East due to East-European, Siberian and Scandinavian high-pressure areas (GACEU O., 2005).

The minimum values of air relative humidity occurs in the summer period of the year, thus in Aprils one recorded the following values: 74.1% at Borod and 71.5% at Huedin, while in May these levels were of 69.2% at Sacueni and 85.7% at Stana de Vale; as for Oradea city, the minimum level was recorded in the month July consisting in a value of 70.1% (tab.1, fig.1).

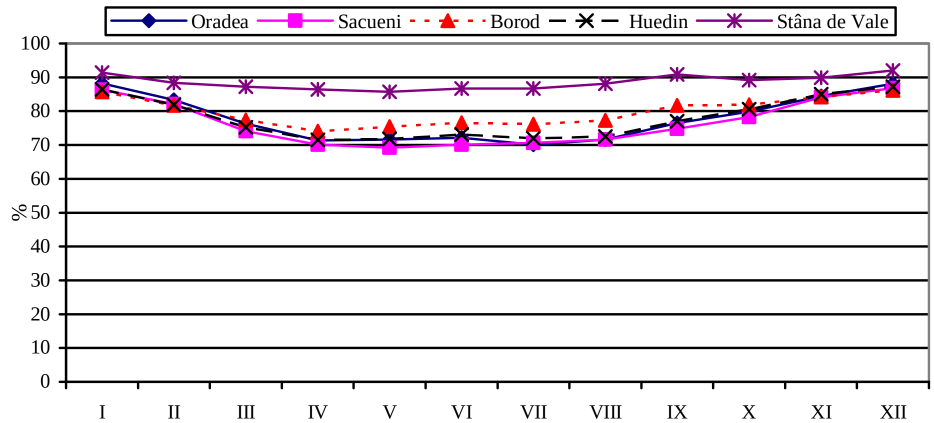

Figure 1: The distribution of multiannual average monthly values for air relative humidity in Crisul Repede drainage area

During the 39 years observed in our research, in the analysed area the highest monthly medians values were recorded in December and January, namely the level 98% was recorded at Stana de Vale during the month of January 1986, and during the month of December of 1987 and 1988. At Huedin city, the maximum value observed was of 97% recorded in November 1978. As for Sacuieni, Oradea city, and Borod, the mean maximum values were recorded in January 1989, these ones reaching the following levels: Oradea - 97%, Sacueni - 96%, and Borod - 95%.

The annual mean values are affected by annually deviations as against the multiannual average, due to the general air circulation, physical and geographical factors, etc.

The highest deviations recorded in the analysed area, throughout the 36 years observed, are at Huedin city with a 63.9% positive deviations and 36.1% negative ones, followed by Oradea city with 58.3% positive deviations and 41.7 % negative ones, while at Borod there were recorded a level of 52.8% positive deviation and 38.9% negative deviations, in the later case being recorded also a period of three years with no deviations (1992, 1999, and 2005), representing 8.3%. The annual deviations of relative humidity record the lowest values at mountain areas, being of 51.9% positive deviations and 48.1% negative deviations.

As one may observe in figure 2, the monthly evolution of relative humidity is inversely proportional to air temperature, thus the highest values of relative humidity being recorded during the winter season (the months of December and January) when the annual temperatures levels reach the lowest thresholds.

A practical application is represented by the monthly variations of relative humidity values corroborated with the air temperature values, mainly due the impact they do have on human body.

Annual and monthly minimum rate of relative humidity

By assessing the minimum multiannual evolution of relative humidity, in the analysed area, one observes that the minimum values are being in general recorded during spring season (March and April), thus the minimal multiannual value being recorded at Stana de Vale and being of 11% on 8th of March 2001, followed in a decreasing way by the level of 13% recorded at Sacuieni on 2nd of April 2003.

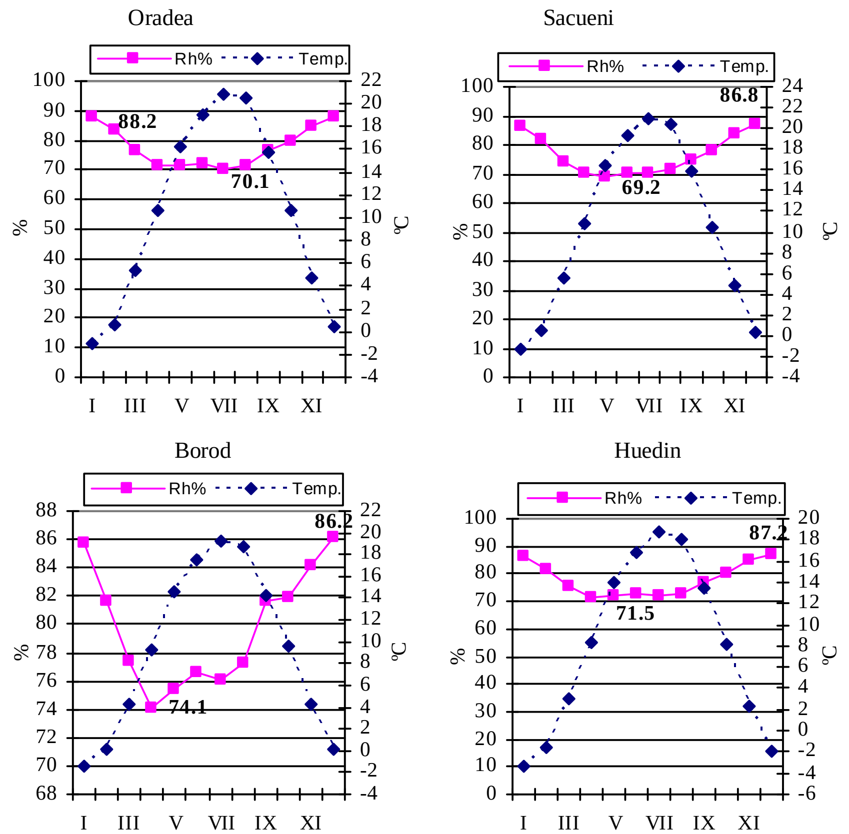

Figure 2: The monthly evolution of relative humidity and monthly median temperature within Crisul Repede drainage area (1970 – 2008)

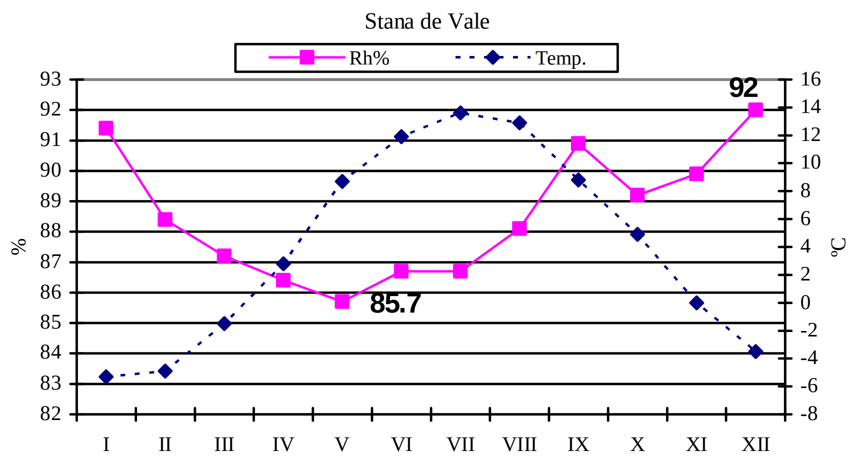

Figure 2: bis

Table 2

Minimum multiannual rates of relative humidity in Crisul Repede drainage area, during 1970 – 2008 time span

Month/Station	Luna	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
Oradea	UR%	27	28	18	15	21	23	16	22	22	25	25	27	15
	Data	01.73	14.94	26.03	07.05	05.03	29.03	28.94	13.03 27.03	03.92 22.03	28.88 17.90	14.70 05.97	28.72	07.04.05
Sacueni	UR%	23	16	19	13	18	18	16	18	15	15	14	32	13
	Data	04.93	14.94	17.72	02.03	13.00	05.00 21.00	31.92	11.95	03.92	03.92	25.93	28.72	02.04.03
Borod	UR%	25	21	15	20	20	24	25	25	24	21	23	31	15
	Data	04.93	25.81	23.05	07.05	03.92	18.71	11.00	21.00	06.82	28.88	10.82	01.81	23.03.05
Huedin	UR%	28	18	17	19	26	24	18	18	24	18	18	15	15
	Data	27.97	24.90 28.98	20.74	01.01	11.71 03.94	28.00	05.04	29.03	08.03 16.03	29.88 23.00	06.88	02.00	02.12.00
Stana de Vale	UR%	20	17	11	13	17	25	32	26	25	20	21	27	11
	Data	18.91; 23.97; 25.97	08.90; 15.02	08.01	02.03	27.03	29.03	20.01	30.03	18.79 12.04	15.00	06.97	02.92	08.03.01

Source: data collected out of A.N.M.'s archive and processed

As for the other three stations, there were recorded values of 15%, namely at Oradea city this values was recorded on 7th of April 2005, at Borod on 23rd of March 2005, while at Huedin city this minimum value was recorded on 2nd of December 2000 (Table 2).

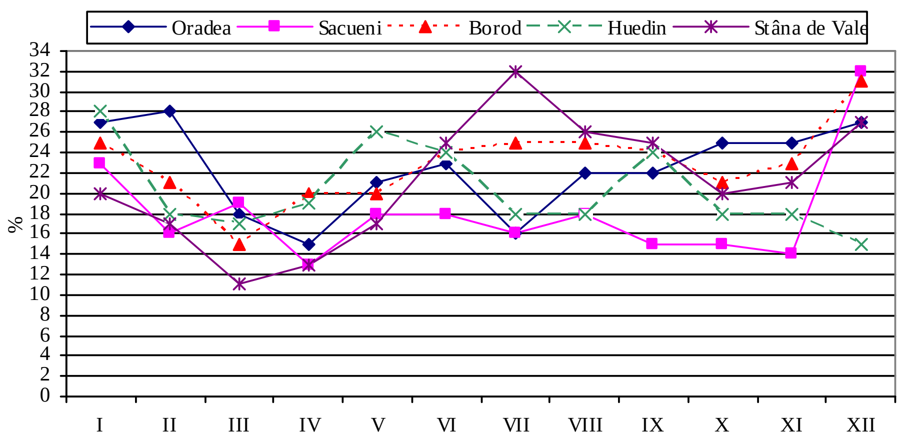

Figure 3: The multiannual monthly evolution of minimum relative humidity rates within Crisul Repede drainage area

Out of the multiannual monthly evolution of minimum relative humidity one may observe the fact that the highest variations of minimum relative humidity are being recorded in mountain areas, namely in here being recorded the highest and the lowest relative humidity rates (see figure 3).

The frequency of days with relative humidity ≤ 30%; ≤ 50%; ≥ 80%

The annual average number of days with relative humidity ≤ 30% (dry days) and ≥ 80% (humid days) show its relevant practical interest; thus, the number of days with relative humidity ≤ 30% is assessed as an indicator for dry weather while the number of days with relative humidity ≥ 80% is assessed as and indicator for humid weather.

The share of days with different characteristics of relative humidity shows a variation both in time and space.

The annual average number of days with very low rates of air relative humidity ≤ 30% lat any of the observation hours, varies within the analysed area between 9.6 – 9.4 days at Oradea city and Sacuieni. To 6.6 days at Huedin City, 4.2 days at Borod and 2.6 days at Stana de Vale (see Table 3).

Table 3

Annual and monthly average number of days with relative humidity ≤ 30% within Crisul Repede drainage area during 1970 – 2008 time span

Month/Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	An
Oradea	0.0	0.1	0.7	1.7	1.3	1.3	1.6	1.5	1.0	0.3	0.1	0.0	9.6
Sacueni	0.0	0.0	0.6	1.5	1.4	1.5	1.6	1.5	0.9	0.2	0.2	0.0	9.4
Borod	0.2	0.3	0.5	0.8	0.5	0.3	0.3	0.4	0.2	0.4	0.3	0.0	4.2
Huedin	0.1	0.2	0.7	1.5	0.9	0.7	0.5	0.5	0.5	0.6	0.3	0.1	6.6
Stana de Vale	0.5	0.3	0.1	0.2	0.2	0.0	0.0	0.2	0.1	0.4	0.5	0.1	2.6

Source: data collected out of A.N.M.'s archive and processed

Throughout the year, the monthly median frequency incidence of the days of ≤ 30% humidity varies from one region to another, function of geographical conditions. In general, the frequency of these days is higher values during cold season in mountain areas (0.5 days at Stana de Vale, in January); at lower altitudinal levels, in the depression areas, their incidence is higher in spring, namely in April (0.8 days at Borod, and 1.5 days at Huedin), while at the stations located in plain areas, the high rates are recorded on summer and spring seasons, namely at Oradea city these values are recorded in April – 1.7 days and July – 1.6 days while at Sacuieni a level of 1.6 days was recorded in July (see Table 3).

The relative humidity of ≤ 30% records the lowest values in mountain areas, during summer season, in the months of June and July, while at lower levels, in the depression areas and plains, these values are recorded during winter in the months of December and January (0.0 – 0.1 days).

The annual average number of days with relative humidity ≤ 50% at least one of the observation hours is higher in lower areas and in depressions, being contained between the following levels: 115.8 days at Oradea city and Sacueni, 115.1 days at Huedin city, 117.3 days at Borod and it is lower at mountain areas: 47.7 days at Stana de Vale (see Table 4).

The monthly average incidence of the days with relative humidity ≤ 50% has the maximum rates in April: thus they are 15.6 days at Oradea city, 15.8 days at Sacueni, 16.0 days at Borod, 15.1 days at Huedin and 7.0 days at Stana de Vale.

Table 4

Annual and monthly average number of days with relative humidity ≤ 50% within Crisul Repede drainage area during 1970 – 2008 time span

Luna/station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	An
Oradea	2.6	4.2	12.4	15.6	14.4	11.5	13.9	14.0	10.8	9.6	4.8	2.0	115.8
Sacueni	2.5	4.3	11.5	15.8	14.5	11.7	14.0	14.0	10.8	9.7	4.9	2.1	115.8
Borod	2.7	4.5	11.5	16.0	14.6	11.8	14.1	14.2	10.7	9.8	5.2	2.2	117.3
Huedin	2.7	5.2	10.8	15.1	14.4	12.2	13.7	14.4	10.9	9.5	4.0	2.2	115.1
Stana de Vale	2.2	3.8	4.9	7.0	5.3	3.0	3.9	4.2	2.7	5.4	3.8	1.5	47.7

Source: data collected out of A.N.M.'s archive and processed

The lowest monthly medians in the observed areas occurs in the month of December, namely 1.5 days at Stana de Vale, 2.0 days at Oradea city, 2.1 days at Sacueni and 2.2 days at Borod and Huedin (see Table 4).

The annual incidence of the days with relative humidity ≥ 80% at noon (on the hours of maxim temperature) is higher at mountain 134.0 days and decreases under 100 days in lower altitudes areas, namely 85.5 days at Huedin city, 79.8 days at Borod, 89.8 days at Sacueni and 91.1 days Oradea city (See Table 5).

The average number of days with relative humidity ≥ 80% records a maximum level in December: thus, there were recorded a number of 18.1 days at Stana de Vale, 16.5 days at Huedin city, 14.7 days at Borod, 19.7 at Sacueni, and 19.9 days at Oradea city.

Table 5

Annual and monthly average number of days with relative humidity ≥ 80% within Crisul Repede drainage area during 1970 – 2008 time span

Month/station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	An
Oradea	18.1	11.0	5.9	3.8	3.7	3.4	2.3	2.3	3.8	4.8	12.1	19.9	91.1
Sacueni	18.0	11.0	6.0	3.9	3.7	3.1	2.2	2.2	3.5	4.5	12.0	19.7	89.8
Borod	13.7	7.6	5.0	4.6	4.3	4.6	3.5	3.2	4.1	4.7	9.8	14.7	79.8
Huedin	14.6	8.1	5.5	5.7	4.2	4.6	3.3	3.0	4.0	5.0	11.0	16.5	85.5
Stana de Vale	13.4	12.4	12.0	8.4	5.4	10.2	10.0	3.4	10.6	12.8	17.3	18.1	134.0

Source: data collected out of A.N.M.'s archive and processed

The relative humidity rates are reaching higher levels during winter season as the temperatures are lower and the advection of humid Mediterranean air is more frequent. The minimum values are recorded in the summer season (July and August), as following: 2.3 days at Oradea city, 2.2 days at Sacueni, 3.2 days at Borod, 3.0 days at Huedin city, and 3.4 days at Stana de Vale (see Table 5). The rates are lower in the summer as air average temperatures are higher.

CONCLUSIONS

Due to the impact of humid climate, the annual median values of relative humidity are higher, with values contained between 76.3% - a level recorded at Sacuieni, and 88.6% - a level recorded at Stana de Vale.

The annual regime of relative humidity is being characterised by higher rates during winter season and lower rates during summer period of the year.

The average number of days with very low level of air relative humidity, namely with levels of ≤ 30% varies in the observed areas between 9.6 – 9.4 days at Oradea city and Sacuieni, 6.6 days at Huedin city, 4.2 days at Borod, and 2.6 days at Stana de Vale. Throughout the year, the incidence rate of these days show higher levels during winter season at mounting areas; in the depression areas the higher levels are recorded during summer and spring. The relative humidity ≤ 30% records the lowest number of days at mountain during summer season, while in the depression and plain areas during winter season.

The average number of days with relative humidity ≤ 50% is higher in the depression areas and plains, being contained between 115.8 days in plain areas and 47.7 days at mountain areas. The monthly average incidence rate of the days with relative humidity ≤ 50% shows maximum values in April and minimum values in December.

The annual incidence rate of the days with relative humidity ≥ 80% is higher in mountain areas, namely of 134.0 days and drops under and 100 days in plain areas. Throughout the year, the number of days with relative humidity ≥ 80% presents the maximum values in December and minimum values in summer season.

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