

THE VARIATION OF ANNUAL RAINFALL IN THE SUCEAVA PLATEAU

*Ioan GONTARIU¹, Ion TĂNASĂ²

¹Faculty of Food Engineering, Ștefan cel Mare University, Street. Universitatii no. 13, 720229, Suceava, Romania,
e-mail ioang@fia.usv.ro

*Corresponding author

²Ph.D. Candidate, Ștefan cel Mare University, Street. Universitatii no. 13, 720229, Suceava, Romania,
e-mail ion_tanasa.meteo@yahoo.com

Received 22 February 2011, accepted 6 May 2011

Abstract: *The atmospherical rainfall (resulted from the condensation and crystallization of water vapours which fall from the clouds in liquid, solid or mixed form) represents one of the most important climatic elements, with noticeable influence on the natural environment of a certain region. Rainfall has an important impact on the environment of terrestrial atmosphere (which is an important link in the water's nature circuit) and contributes to keeping the soil humid. After all, life wouldn't have been possible without water, a key element in the formation of terrestrial atmosphere, a real protection against ultraviolet radiations and against strong termic amplitudes. Besides influencing all the other climatic elements, water plays an important part in all earth's covers by continuously modifying the relief (so it is an external factor of modelation), the configuration of hydrographical network and being involved in the formation and development of vegetation, fauna and soils (the biosphere). Like all the other elements, atmospherical rainfall could be seen as either a resource (link in the water's circuit in nature) or a hazard (when its extremes are beyond normality and bring serious damage to society). Besides pluviometric differences, there is also an alternation of humid sectors which are positioned over the higher areas of the relief with drier sectors, sequence well distinguished on the direction North-West – South-East. Meanwhile, the slopes experiencing the change in masses of air from West and North-West, being more humid, perceive bigger quantities of precipitations while the Southern ones are drier, this also because of the foehn phenomenon.*

© 2011 University Publishing House of Suceava. All rights reserved

Key words: *climatical hazards, termic amplitudes, water vapours, terrestrial atmosphere*

1. Introduction

The Plateau of Suceava is positioned in the central and Northern part of Moldova, between the Eastern Carpathians and Moldova's Plain, being the highest part of The Moldova's Plateau and partially overlapping hystorical Bucovina [1].

The dynamic factors of the climate are the ones which record substantial changes from year to year, contributing mostly in the unperiodical variation of rainfall. The

various aspects of weather, continuously changing, are determined by the position of the baric centers in relation to the studied habitat, the existing dorsals of the two anticyclones, Azoric and Euroasian; cause in the North of our country the change in cold air in North and North-Est [2].

The mountainous chain of the Eastern Carpathians is a real obstacle against the movement of air masses to Suceava's Plateau but also against the Eastern and

North-Eastern ones, increasing their existence above this habitat [3].

The plateau is characterized by relatively abundant precipitations (between 500mm and 700 mm) and relatively moderated temperatures (between 7.5°C and 9.5°C). The most frequent pluviometrical or baric climatic hazards of termic nature are: early frosts in autumn or late frosts in spring (harmful to agricultural crop and plants), blizzards (from 9 to 14 days each year), white frost (from 10 to 12 days a year), glazed frost (9 to 12 days a year) and fog (30-50 days annually), each representing a specific phenomenon for the cold seasons of the year [4]. During the warm season, there are storms and showers, sometimes rich in precipitations, other times accompanied by hail (once or twice a year).

The extraordinary variability of this climatic aspect from the habitat of Suceava's Plateau points out remarkable pluviometrical differences during different temporal entities (annually, biannually, monthly and daily speaking), strongly related to the general or local circulation of the atmosphere (the physical, geographical factors, regional and local factors) and of the solar radiation [5].

2. Experimental

The database used in this material looks into the annual sums of precipitation from 1992-2010 (Suceava and Roman) and 1961-2010 (Radauti, Falticeni and Cotnari). Meaningful reasonings were based on documentation of specialty (see bibliography) and the main used processes were observation, statistical and mathematical analysis, comparison and also several graphical methods [6].

3. Results and Discussion

The annual average sum of atmospheric precipitations from Suceava's

Plateau is approximately 580 mm (the average of annual sums from 1961 to 2009, information provided by the 5 main meteorological centers).

As we have analyzed the pluviometric repartition from the area to be studied (figure 1), we can observe meaningful differences, of over 100mm between the Southern habitat and the Northern one; in Roman an annual average quantity of 523,9mm while in Radauti 634,8mm (figure 2a) is registered.

Taking into account the pluviometric stations, these differences increase even more, from 500mm in South (498.6 mm in Upper Muncel) to over 700mm in the North-Western part (737.5mm in Solca).

The atmospheric precipitations gradually decrease from North-West to South-East, once the relief loses altitude (figure 2b) and once the masses of humid air, of oceanic and atlantic origin, are less frequent (including a slight foehnization).

Also, the relief is largely open to East which facilitates the entrance of continental drier and warmer masses of air (of lower humidity).

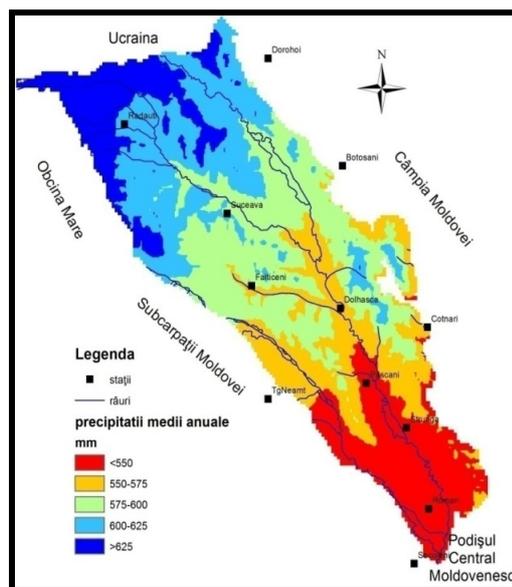
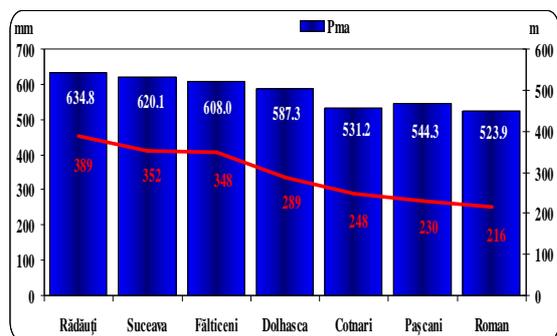
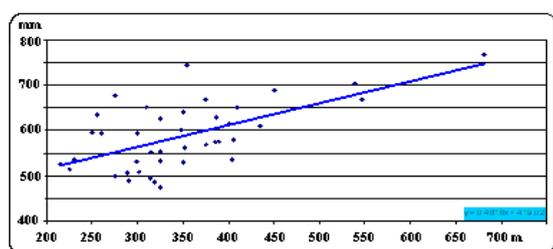


Figure 1. The territorial repartition of the annual quantities of precipitations in Suceava's Plateau



a.



b.

Figure 2. The variation of the annual average quantities of atmospheric precipitations, reported to the altitude from the meteorological centers (a) and pluviometric stations (b) from Suceava (1961-2010)

Besides pluviometric differences, there is also an alternation of humid sectors which are positioned over the higher areas of the relief with drier sectors, sequence well distinguished on the direction North-West – South-East. Meanwhile, the slopes experiencing the change in masses of air from West and North-West, being more humid, perceive bigger quantities of precipitations while the Southern ones are drier, this also because of the foehn phenomenon.

Analyzing the annual quantities of precipitations from 1961 to 2010, recorded at the meteorological centers from Suceava’s Plateau, we can observe a special variation in time of this climatic element, sometimes with opposite aspects.

The data covering a longer period of time (before 1961), indicate an even higher variation than in the period studied, due to

some years in which extremely different quantities were recorded (higher or lower, like in Suceava where the annual extremes were 330mm in 1946 and 1021.3mm in 1933, or 346.7mm in 1986 and 883.2mm in 2008).

The annual sums of precipitations from Suceava’s plateau have had bigger or smaller variations, situated between the extreme values reported by the 5 meteorological centers (table 1): Radauti – 352.8mm in 1986 (56% from normality); Suceava – 330.0mm in 1946 (57%) and 1021,3mm in 1933 (173%); Falticeni – 369.2mm in 1986 (61%) and 819,1mm in 1991 (137%); Cotnari – 313.5mm in 1986 (60 %) and 825,1mm in 1991 (158%); Roman – 299.0mm in 1973 (58%) and 945.6mm in 1991 (183%).

Table 1. The biggest and smallest annual sums of precipitations, exceptions and differences between them in the Suceava’s Plateau (1961-2010).

Precipitations	Radauti	Suceava	Falticeni	Cotnari	Roman
Medium	634.8	620.1	608.0	531.2	523.9
Minimum	352.8	346.7	365.3	313.5	299.0
Year	1986	1986	1986	1986	1973
Maximum	914.5	883.2	819.1	825.1	945.6
Year (ii)	2005, 2010	2008	1991	1991	1991
Deviation-	-282.0	-273.4	-242.7	-217.7	-224.9
%	56	56	60	59	57
Deviation +	279.7	263.1	211.1	293.9	421.7
%	144	142	135	155	180
Amplitude	561.7	-536.5	-453.8	-511.6	-646.6

The graphical representations of the evolution in time of the quantity of precipitations show us some very anfractuouse lines, oscillating from one side of the mean to the other.

Apparently, they do not obey any rule, registering general tendencies of soft increase in the analyzed time (figure 3).

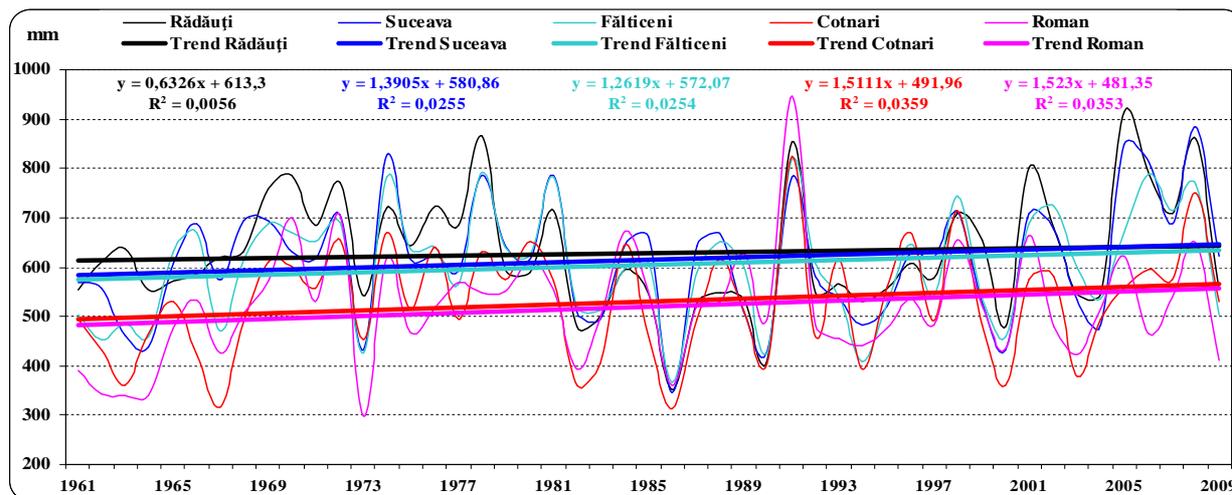


Figure 3. The evolution, variation and tendencies of annual atmospheric precipitations in Suceava.

In comparison with other climatic elements (temperature, pressure, humidity, nebulosity), the variation in the annual sums of precipitation is much more highlighted.

In the same time, the parallelism of the evolution of these sums is not that much noticeable, sometimes the sums intersect and other times they slowly move away one from another.

The general tendency of annual precipitations from 1961 to 2010 was to easily increase, the coefficients of the regression equation (y) being positive (between 0.8741 in Radauti and 1.9067 in Roman).

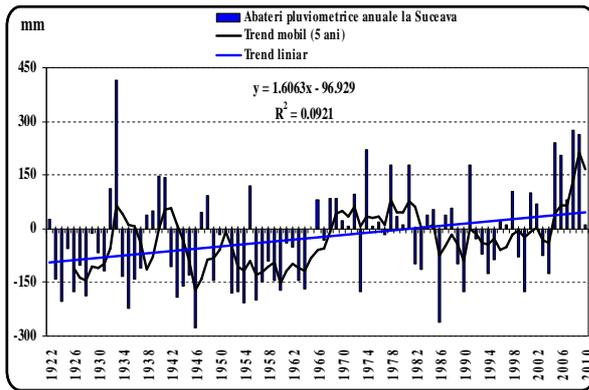
A more detailed analysis could determine smaller intervals of time with tendencies of a more accentuated increase between 1961-1972 and 1998-2008, but also of stagnation, between 1972-1979 and 1981-1998. On each station these periods are much more accurately registered.

The spreading of the annual values of precipitations is at minimum in Roman (0.053) and at maximum in Falticeni (0.0369), from 1961 to 2009, becoming even larger for a longer period of time we analyzed (between 0.067 in Roman and 0.0748 in Suceava).

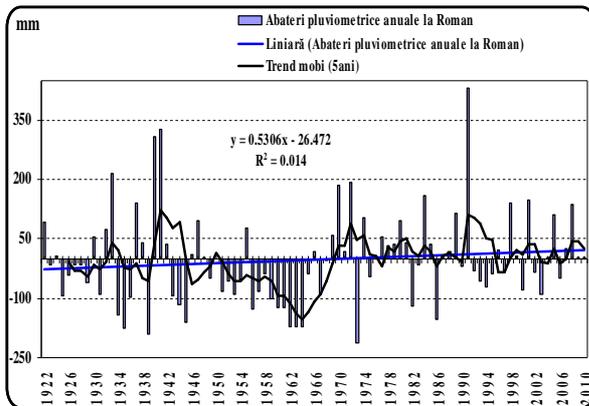
The calculus and the evolution of the precipitations' deviation from normality (the multiannual average) from all the meteorological centers in the period 1961-2010 or beyond it (figure 4) in Suceava and Roman, point out some interesting aspects.

In Radauti, some atmospheric precipitations have had the biggest variation from all Suceava's Plateau; the minimum was of -282.0mm(1986) and the maximum 279.7 mm (2005, 2010); for a larger period of observation (1955-2008), minimum negative exception becomes -286.9mm (1986) and the positive maximum exception changed to 577.9mm (in 1955 (when there was a maximum of 1217.6 mm per year).

In Suceava, the negative minimum was of -263.1mm (1986) and the positive maximum was of 263.1mm (in 2008, year known for the biggest floods ever experienced in this area); between 1922 and 2008, the variation increased, being comprised in the total precipitations of 330mm (1946 - the drought of the century), from a negative of -249.1mm to 1021mm in 1933 and a positive maximum change of 442.1mm.



a.



b.

Figure 4. The long run evolution of annual sums of precipitations from 1922 to 2009 in Suceava (a) and Roman (b)

In Roman, the variations of precipitations were registered between 299.0mm (1973) and 945.6mm (1991), with departures between -219.5 and 427mm (calculated for the period 1961-2009) or between 212.8 and 433.8mm (1986-2009).

Analyzing the frequency of the annual precipitations' sums (figure 5), we can see that the annual sums of precipitations between 500mm and 600mm are the most numerous as percentage in Suceava's Plateau, of 29%, with an assurance higher than 73%.

On stations, the situations do not always obey this rule. In Suceava and Falticeni, years with precipitations between 600mm and 700mm are the most frequent (38%), while annual sums between 500mm and 600mm are in

proportions of only 23-25%. So, the most frequent annual quantities of precipitations are between 500mm-700mm in Radauti (61%), Suceava (61%), in Falticeni (63%) and 400-600mm in Cotnari (56%) and Roman (62%).

Lower frequencies were registered by the sums of precipitations between 700-800mm (4-17%) and the minimum, the very large, ranging from 800-900mm and over 900mm (0-2%).

Between 1961 and 2009, there was just one case of precipitations which registered less than 300mm (Roman) and there were not more precipitations than 1000mm. In Radauti (where the maximum annual quantity of precipitations occurred), in 40% of the years were registered precipitations of 500mm-600mm and in the others below 400mm and above 900mm (2%).

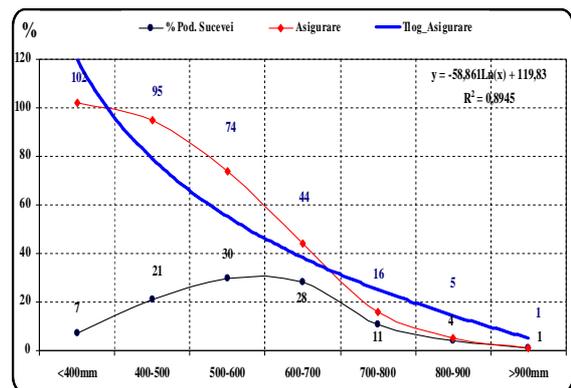


Figure 5. Probability and assurance rate on intervals of 100mm for annual sums of precipitations in Suceava's Plateau.

In most of the cases, years with precipitations in surplus, close to normal in deficit, are grouped in shorter or longer periods. Certain years have had annual quantities much more below average (1887, 1896, 1964 and 1973); the smallest sums of precipitations occurred due to atmospheric anticyclonic circulation, with changes resulting in warm masses of air [7].

In other situations, annual sums were beyond the multiannual average, thanks to

the predominant cyclonic activity (1933, 1943, 1974, 1981, 1985, 1988 and 1991).

These large quantities of precipitations were generated by rain and abundant showers during the warm season and transition periods (They characterize a relatively humid region, rich in precipitations, which combined with the thermal regime and evaporation (both low), assure a normal development of spontaneous vegetation and agricultural crops, because of the periods of drought and dryness [8]. Also, this phenomenon occurs in autumn months, when the vegetative cycle of plants is over or almost finalized and is more frequent in the South-Eastern part of the studied area.

From the pluviometric point of view, in the Plateau of Suceava rainy periods are more frequent than the droughty ones [9].

4. Conclusion

◇ The small quantities of precipitations in the habitat of Suceava city have had a great variation in time, the pluviometric excess and deficit following one another in many different intervals of time.

◇ Taking into account the frequency of the annual precipitations' sums we can see that the annual sums of precipitations between 500 mm and 600 mm are the most numerous as percentage in Suceava's Plateau, of 29%, with an assurance higher than 73%.

◇ This variation is increasing, as naturally, with the expanding of the periods we have analyzed and it fits numerically the extreme quantities of precipitations: annually (330mm-1946 and 1021mm-1933), seasonally (69mm-1935-1936, 311mm-1987-1988 in the cold season, 173mm-1976 and 694mm-1974 in the warm season), monthly (0mm in november 1926, february or december 1931 and 253mm july 2003), daily (between days without precipitations and

the maximum of 85.5mm registered July 8th, 1967).

5. References

1. POPP N., IOSEP I., PAULENCU D. 1973 - *Județul Suceava*, Editura Academiei R.S. România, București.
2. CĂLINESCU Gh., CĂLINESCU Niculina, SOARE Elena, 1994 - *Caracteristici și tendințe ale precipitațiilor maxime căzute în diferite intervale de timp în Moldova*, Lucr. Sem. Geogr. „Dimitrie Cantemir”, Iași.
3. APĂVALOAE M., APOSTOL L., PÎRVULESCU I., 1984 - *Topoclimatele orașului Suceava*, Buletin științific, I.I.S. Suceava.
4. APOSTOL L., 2000 - *Precipitațiile atmosferice din Subcarpații Moldovei*, Editura Universității “Ștefan cel Mare”, Suceava.
5. FILIPOV F., LUPAȘCU Angela, RĂDUCU Daniela, BELDIMAN Brândușa Elena, 2001 - *Influența măsurilor ameliorative asupra însușirilor morfologice fizice și chimice ale solurilor cu exces de umiditate din Podișul Sucevei*, Iași.
6. ȚÎȘTEA D., NEACȘA O., SABĂU A., SÎRBU V., CĂLINESCU N., 1974 - *Studiul parametrilor climatici locali pentru stabilirea condițiilor de restaurare și conservare a picturilor murale ale unor monumente istorice din Bucovina*, Studii de climatologie, vol. 1, I.M.H., București.
7. SLAVIC Gh., 1977 - *Podișul Sucevei - studiu climatologic*, Rezumatul tezei de doctorat, Iași.
8. ERHAN Elena, 1986 - *Fenomenul de grindină în Podișul Moldovei*, Analele Științifice ale Universității „Al. I. Cuza”, din Iași, secț. II b geol.-geogr., tom XXXII.
9. TOPOR N., 1963 - *Ani ploioși și secetoși în R.P.R.*, I.M., București.
*** (1962, 1966) „Clima R.P.R.”, Institutul Meteorologic, vol. I și II, București.
*** (1983) „Geografia României I. Geografia fizică”, vol. I, București.
*** (1989) „Geografia României IV. Geografia fizică”, vol. IV, București.
*** (1984) „Un secol de la înființarea Serviciului meteorologic al României”, I.N.M. București.
*** (1972 -2001) *Arhiva de date climatologice a Stației meteorologice Suceava, Centrul Meteorologic Regional Moldova*