

## THE VULNERABILITY OF THE CIBIN HYDROGRAPHIC BASIN FOR PRECIPITATIONS SURPLUS AND DEFICIT

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**Abstract:** *This paper aims first of all to analyse the periods with precipitations surplus and deficit in Cibin hydrographic basin, in a causal liaison with the synoptic situations that generate floodings or droughts, but also the effect they have on the geographic environment. The periods with precipitations surplus represent a risk that usually has a local prevalence, unlike the periods with precipitations deficit, where the areal spread is large, and the onset and evolution are slow. The perception in the case of periods with pluviometric surplus is that of a major hydrological risk, because of the violent and progressive way of manifestation, while droughts are perceived as being less dangerous phenomena. Precipitations are the main natural source of water supply in Cibin hydrographic basin. The complexity of the factors that determine the regime of precipitations imprints the studied area with special climatic characteristics that have an impact on the geographic landscape. The analysis of the annual regime of precipitations in Cibin hydrographic basin for the interval 1961-2009 and that of the frequency with which precipitations have been registered on different risk classes denote that in Sibiu only a low risk of surplus and deficit is manifested, in Agnita the extreme values with*

*medium and major risk are of deficitary nature, and in Păltiniș the extremes of medium and major risk are characteristic to the surplus quantities. The quantity of precipitations fallen in the area of Cibin hydrographic basin has been grouped according to deviation classes (one normal class and five classes for each of the quantities that are higher and lower than the normal) and to pluviometric domains (where there have been gathered the values of all the classes with positive and negative deviations, comparing them to the normal domain). Then there have been established groups of pluviometric risk through surplus and deficit, to these being added the group with no pluviometric risk. The ensemble and unitary analysis highlights the relations that are being realized between precipitations and the other components of the geographic environment and underlines the local hallmark of Cibin hydrographic basin. The major imbalances that are being generated on the environment by the excess of precipitations or, on the contrary, by the lack of precipitations, justify the interest of climatologists for these phenomena. This analysis has in view both the direct, determinant effect of precipitations on the components of the geographic environment, and the indirect effect, favouring or limitative, induced by precipitations.*

**Key words:** *vulnerability for precipitations, precipitation surplus and deficit pluviometric risk*

### INTRODUCTION

Cibin hydrographic basin is a dynamic system, its particularity deriving from the connection of characteristic elements such as:

- *The overlapping of the Cibin hydrographic system over three distinct relief units, respectively mountain, plateau and depression, aspect that reflects directly in the precipitations regime;*
- *The remarkable variety of the relief (depending on the lithology, structure, tectonics), which is reflected in the differentiate action of the precipitations, as exogenous modelling agent;*
- *Specific topoclimates that characterize the different units of Cibin basin which are traceable in the variation of the climatic parameters in general and the pluviometric ones in particular.*

The ensemble analysis of Cibin hydrographic basin has as purpose the prominence of the unity and at the same time the individuality of the precipitations regime, but not under the aspect of uniformity and unalterableness, but on the contrary, analyzed both in terms of the pronounced diversity of manifestations, with orographical, hydrological, biogeographical, ecological, socio-economic impact, and as a result of the relationships that are being formed between precipitations and the different components of the geographical environment.

That is why the analysis of precipitations implies the reference to all other geospheres, taking into consideration the interferences and interactions between them, within determinable limits.

#### **MATERIAL AND METHODS**

The analysis of the long data ranges offers an ensemble image regarding the succession of periods with pluviometric surplus and deficit for Cibin hydrographic basin. This approach allows the identification of a possible cyclicity of the episodes with floodings and droughts. The statistical data come from meteorological stations, pluviometric posts and hydrometric stations that have been selected on the basis of the representativeness and homogeneity of the data range. For Sibiu station, there have been used the monthly precipitations values from the interval 1851-2005 and the daily precipitations data from between 1970-2005. For Păltiniș, the daily data have regarded the same interval as for Sibiu, but the monthly values refer to the interval 1961-2005, which is a common period for all the selected points of interest. The chosen period benefits from a coherent observations programme, in which the meteorological instruments and apparatus, as well as the locations of the points of measurement have remained almost the same.

#### **RESULTS AND DISCUSSIONS**

Among the pluviometric parameters that visibly influence the precipitations regime and the components of the geographical landscape, whose evolution has to be taken into consideration in the environmental protection, there is the maximum precipitations quantity registered in 24 hours. This can cause the drench and the severe erosion of the soil, the displacement of boulders and of altered rock fragments from the slopes, and sometimes even the collapse on the highly inclined versants, as well as floods in the rivers' everglades and valleys, when roads, bridges and vegetation are destroyed.

The highest quantities fallen in 24 hours are registered in the interval May-August, when 60 mm a month are exceeded. On the crests of the alpine and subalpine level, this quantity exceeds in average 80 mm (Figure 1, 2).

The distribution of the duration of rains on the studied territory highlights both the movement direction of the air masses with the characteristic fronts, and the effects they suffer when they go over the Carpathians. The rains with the longest duration, of over 190 minutes, are produced in the areas of the Cindrel Mountains that are under the influence of the Western circulation.

The rains with the shortest duration, of under 150 minutes, are produced in the sectors where it predominates the descendance of air in the summer, respectively in the Sibiu Depression and Hârtibaciu Plateau.

The rains with the highest quantity of precipitations, of over 7-8 mm, are produced in the mountain region. In the depression and plateau there are produced rains with lower quantities, of under 6 mm.

The intensity of rains registers in average 0.04 mm/min. In the Hârtibaciu Plateau, where the descendent air currents predominate, as well as insular in the Cindrel Mountains, in the lower areas with reduced humidity, the average intensity of rains is of less than 0.03

mm/min. The absolute maximal intensities have no territorial ordering, being dependent of the nature of the atmospheric front, the intensity of the thermic convection and the particularities of the active surface.

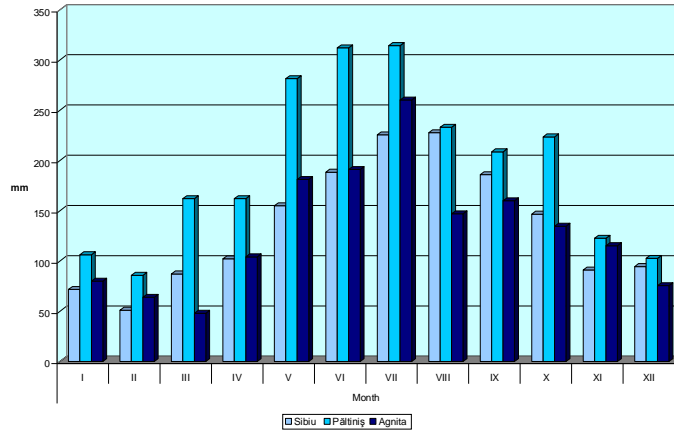


Figure 1. Highest monthly rainfall quantities fallen in Cibin hydrographic basin (1961-2005)

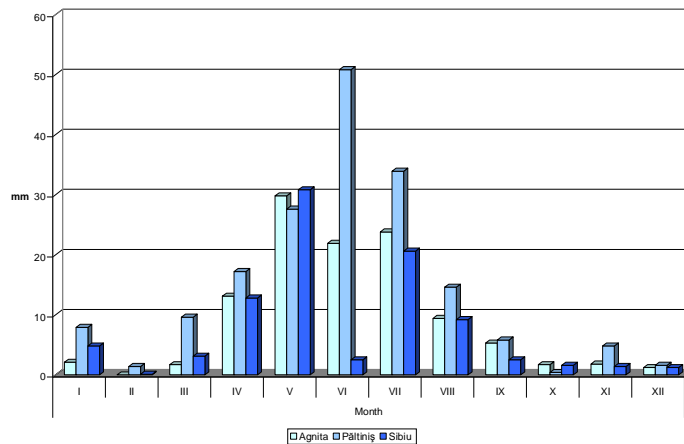


Figure 2. Deepest monthly rainfall quantities fallen in Cibin hydrographic basin (1961-2005)

The position and orientation of the Carpathian arch as compared to the North-Western circulation, as well as the intensification of the frontal activity and the forming of orographic clouds at the crossing of the mountains, determines the increase in the rains intensity.

The frequency variation of Cumulus and Cumulonimbus clouds highlights the accentuation of convective processes. During winter, on the background of thermic inversions, Cumulus and Cumulonimbus clouds are less frequent in lower areas and their frequency increases up to the altitude of 1500 m. During summer, when convection is strong, the frequency of these clouds is considerably increased.

From a spatial point of view, for Cibin hydrographic basin, a regioning of the precipitations that fall during 24 hours cannot be established (Table 1).

From a temporal point of view, the highest quantities of precipitations in 24 hours occur in the interval May-August. From the analysis of the precipitations in 24 hours for the interval 1961-2005, it has been noticed that the highest quantities were produced in the interval 1971-1980, then 1961-1970 and 1991-2005.

Table 1

The occurrence probability of the maximal quantities in 24 hours

Meteo station	Probability %				
	20	10	5	2	1
Sibiu	50,3	56,8	62,3	71,8	78,3
Păltiniș	68,4	84,5	96,2	110,1	123,4

In calculating the frequency of precipitations according to classes of values the days with precipitations have been considered, but also those without precipitations, because the vulnerability of the area is calculated both for precipitations surplus and deficit (Table 2).

By applying this method, it was possible to obtain a synthetic estimation of the real analysed parameters, in their evolution in time and space. Based on these estimates a prognosis regarding the evolution of phenomena with pluviometric risk was elaborated.

Cibin hydrographic basin is among the areas with an average vulnerability to the quantity of precipitations.

In this study, various calculation methods have been used for establishing the regime of precipitations at different temporal scales, as well as indexes based on which the characteristics of precipitations have been determined.

Table 2

Frequency according to classes of values of the annual maximal quantities of precipitations (mm) registered in 24 hours in Sibiu and Păltiniș in the interval 1961-2005

Class of values	Sibiu			Class of values	Păltiniș		
	F.a.	F.c.	F.r.		F.a.	F.c.	F.r.
16,5-25,3	3	36	8,3	20,3-31,8	7	36	19,4
25,4-34,2	10	33	27,7	31,9-43,4	5	29	13,9
34,3-43,0	9	23	25,0	43,5-55,0	13	24	36,1
43,1-51,9	11	14	30,6	55,1-66,6	5	11	13,9
60,0-68,8	2	3	5,6	66,7-78,2	3	8	8,3
68,9-77,7	1	1	2,8	78,3-89,8	1	7	2,8
77,8-86,6	0	0	0,0	89,9-101,4	2	5	5,6
86,7-95,5	0	0	0,0	101,5-113,0	0	0	0,0

The methods used in analysing the pluviometric regime of Cibin hydrographic basin are both the statistical-mathematical ones, and the ones based on the use of modern meteorological surveillance apparatus. The purpose of all the specified methods and indexes is to identify the periods with pluviometric surplus or deficit that represents phenomena with climatic risk. At the same time, the finding of a possible cyclicity of such situations, of the frequency with which they manifest and of their tendency in the studied area, has been taken into consideration.

### CONCLUSIONS

Cibin hydrographic basin is an area exposed to deluges and floodings due to the excess of precipitations. The greatest deluges occur in the spring, when on the background of the increase in the quantity of precipitations, temperature escalation also intervenes, triggering

the melting of the snow layer. Still, most of the deluges occur at the end of spring and beginning of summer.

Cibin hydrographic basin is sheltered from deluges and floodings neither during the winter, these being determined by the amplification of the circulation of cyclonic air masses of oceanic and mediterranean nature. Except for the autumn months, when the air circulation is predominantly anticyclonic, through the rest of the year deluges and floodings might occur, generated by the excess of precipitations.

The way in which the geographic environment responds to the action of precipitations, either through pluviometric surplus or deficit, has allowed the introduction of some categories of vulnerability to precipitations for the analysed area, necessary in elaborating a risk management.

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