THE MONTHLY FREQUENCY AND THE ASSURANCE DEGREE OF SQUALL IN MARAMUREŞ

Şerban Eugenia*

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048, Oradea, Romania, e-mail: eugeniaserban@yahoo.com

Abstract

The paper presents the monthly frequency (number of cases) and the assurance degree of squall produced in Maramureş county. For this study the meteorological data on the monthly and annual number of days with squall were used, during the period 1961-2007, from 4 meteorological stations. Work methodology used consisted of analyzing the mean and maximum monthly number of days with squall, setting the annual risk interval to phenomenon, calculating the assurance degree of the annual number of days with squall. The result was that the interval with maximum risk for squall occurrence is May-July, the interval with mean risk is August and March-April and the interval with minimum risk is September-February. The phenomenon occurrence in the interval November-February is quite exceptional, being due to some special synoptic situations. Generally, the values corresponding to the characteristic assurances are higher to the low elevation stations Sighetu Marmaţiei and Baia Mare and lower to Iezer.

Key words: number of days with squall, frequency, risk interval, assurance degree

INTRODUCTION

Maramureş county is characterized by a temperate-continental climate, with Baltic and oceanic influences. As a result, the climate is cool and wet. However, given that the land area is heating strongly in the hot summer days, amid air instability due to the intense thermal convection or crossing the territory by the very active weather fronts of European Cyclones, squall phenomena may occur (Geography of Romania, 1987).

Squalls are of two types: prefrontal and intramass. Both have the highest frequency in the warm season, but they can occur even in the cold semester of the year. Their intensity will depend on the temperature difference between the two air masses and the rotation angle of the wind before the cold front. Damage caused by squalls is large, being both economic and social. Therefore, they are considered climatic hazards and it requires knowledge of the favorable yearly interval of their appearance, of their return period, and of the areas in which they occur with high frequency (Ţuţuriga, 1987; Moldovan, 2003; Cristea, 2004; Şerban, 2010).

MATERIAL AND METHOD

The paper presents the monthly frequency (number of cases) and the assurance degree of squall produced in Maramureş county. For this study

the meteorological data on the monthly and annual number of days with squall were used, from 4 meteorological stations located in the county, during the period 1961-2007 (47 years). The four stations had a common observation period: Baia Mare, Sighetu Marmaţiei, Ocna Şugatag, Iezer. Stations are located under varying relief, both depressionary and mountain. Their altitudes oscillate between 216-1785 m (Baia Mare: 216 m; Sighetu Marmaţiei: 275 m; Ocna Şugatag: 503 m; Iezer: 1785 m).

The meteorological data used come from the database of the National Meteorological Administration of Romania.

Work methodology used consisted of analyzing the mean and maximum monthly number of days with squall, setting the annual risk interval to phenomenon, calculating the assurance degree of the annual number of days with squall.

For determining the annual number of days with squall that corresponds to some characteristic assurances (1, 2, 5, 10, 20, 25, 50, 80 and 100%), the assurance (total probability) was calculated using the formula:

$$p = \frac{m - 0,3}{n + 0,4} \cdot 100(\%)$$

where m is the serial number of the data row, ordered by descending, and n the number of observation years (Marin, 1986; Bogdan, 2000). This method offers the possibility of calculating several percentage degrees of assurance, so it has better accuracy.

RESULTS AND DISCUSSION

The mean monthly number of days with squall

During the year, in Maramureş county the squall generally occurs within the interval *March-October*. The number of days with phenomenon increases from March to *May-July*, when it reaches a maximum and then decreases until October (Fig. 1). The maximum in the period May-July is because the months of late spring and early summer are the most unstable, when the pluviometric and thermal maximum is recorded. Now the general circulation of the atmosphere and the warming by insolation of the land area generate a maximum dynamic and thermal convection, at the latitude of our country. Consequently, the air masses that cross Romania are very unstable, generating dangerous meteorological phenomena.

Baia Mare station records the maximum in May, Sighetu Marmaţiei in June-July, Ocna Şugatag in the hottest month of the year, July, and Iezer in April-May, when the air starts to become unstable.

At some weather stations, the squall may also occur in the period November-February. Thus, in Sighetu Marmaţiei it happened in November (one day with squall in 1964 and 1973), in Ocna Şugatag in the interval

December-January (January 1993 and December 1995) and at Iezer in February and December (February 1966 and December 1993). It is noted that at these 3 stations, the squall occurred in the cold interval November-February in the first decade and a half or in the fourth decade of the analyzed period.

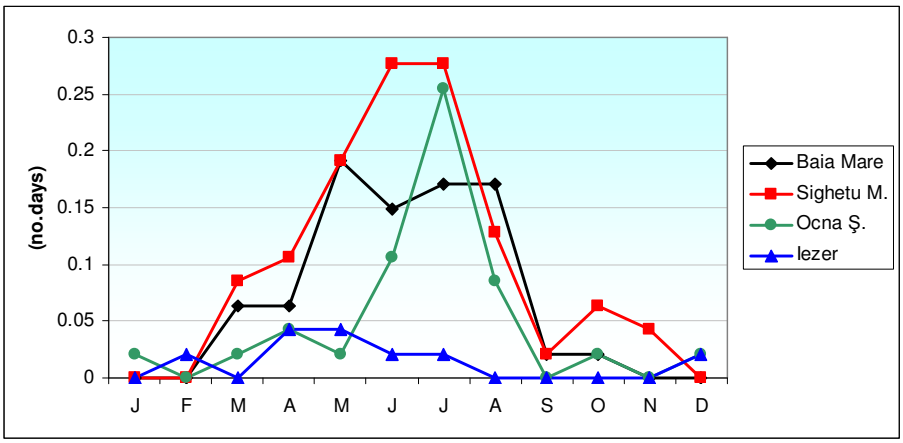

Fig. 1. The mean monthly number of days with squall in Maramureş (1961-2007)

In Maramureş, *the interval with maximum risk* for producing squall is generally, *May-July*. At Baia Mare, this interval also includes August. The interval with maximum risk is June-July at Ocna Şugatag and April-May at Iezer. The month that records the highest mean monthly number of days with squall is July. The high temperature of air and soil in the hot days of this month contributes to the great instability of the air, the thermal convection being pronounced. In July between 0.02 and 0.3 days with phenomenon occur, on average. The stations located in Maramureş Depression (Sighetu Marmaţiei and Ocna Şugatag) have the highest values, the squall forming here every 3 years. In June between 0.02 and 0.3 days with squall are also recorded, many in Sighetu Marmaţiei (1 day every 3 years) and Baia Mare (1 case every 6 years). In May between 0.02 and 0.2 days with phenomenon are signaled.

Sighetu Marmaţiei station has the highest mean monthly number of days with squall, because it is the northernmost station and is located in Maramureş Depression, which is shaped like an elongated golf, open to NW. The depression is thus oriented on the predominant direction of penetration of oceanic air masses.

The interval with mean risk for squall occurrence is *August* and *March-April*. As the thermal values decrease, the frequency of the phenomenon decreases. In August, the predominance of baric anticyclone regime makes the phenomenon to be less frequent than in the other months of summer. Now, between 0-0.17 days with squall are recorded, on average,

many in Baia Mare (1 case every 6 years) and Sighetu Marmaţiei (1 case every 8 years). In March (0-0.08 days) and April (0.04-0.1 days), the air dynamics specific to the spring months, when the land area begins to warm, is the main cause of the phenomenon emergence.

The interval with minimum risk for producing squall is *September-February*. Generally, in these months between 0-0.02 days with phenomenon are recorded, on average, many in October (0-0.06 days) and November (0-0.04 days). However, the phenomenon occurrence in the interval November-February is quite exceptional, being due to some special synoptic situations.

At the analyzed stations there were months in which the squall was not produced at all. Thus, we talk about an *interval without risk*. This interval is November-February at Baia Mare station, December-February at Sighetu Marmaţiei and August-November, January and March at Iezer. The squall lacked in February, September and November at Ocna Şugatag. Generally, this interval coincides with the cold winter months, when the air is more stable. At Iezer station, the high stability of the air in August-October, typical for high mountain ridges, makes the squall to not record here in this period.

We conclude that, in terms of the mean monthly number of days with squall, the highest risk of occurrence of the phenomenon presents the lowest stations Sighetu Marmaţiei and Baia Mare, followed by Ocna Şugatag and the lowest risk presents the highest station Iezer, where the phenomenon dissipates.

The maximum monthly number of days with squall

The maximum monthly number of days with squall was recorded in *May* at Baia Mare, in *May-June* at Sighetu Marmaţiei and in *April* and *June-July* at Ocna Şugatag (Fig. 2).

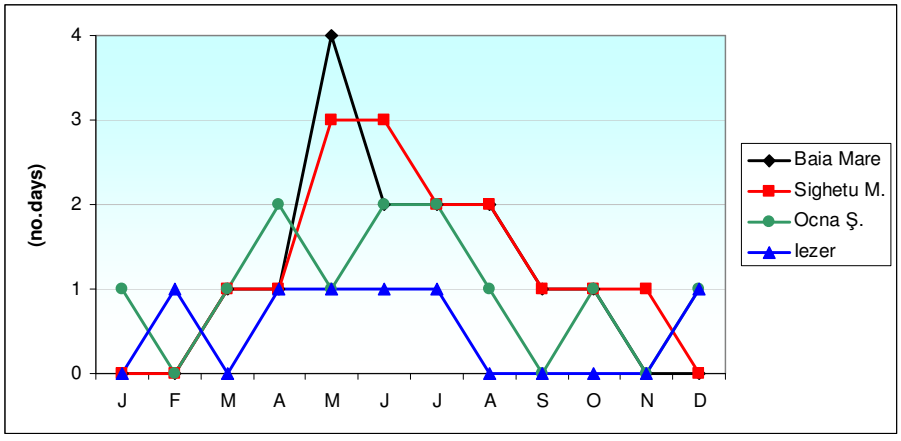

Fig. 2. The maximum monthly number of days with squall in Maramureş (1961-2007)

The maximum monthly number rose to *1-4 days* with squall. It was higher in Baia Mare (4 days in May 1984), Sighetu Marmaţiei (3 days in May 1972 and June 1973) and Ocna Şugatag (2 days in April 1995, June and July 1999). The maximum monthly number was only 1 day at Iezer and was reported in the interval April-July and in December and February.

At the lowest stations – Baia Mare and Sighetu Marmaţiei – higher values of the maximum monthly number were recorded in May-August period (2-4 days), and at the higher stations – Ocna Şugatag and Iezer – in April-July period (1-2 days). In the other months of the year (September-March period), the maximum monthly number was of 0-1 days with squall.

The assurance degree of the annual number of days with squall

The calculation of the assurance degree pointed out that, in Maramureş county, squall does not occur every year. Thus, at the analyzed weather stations, the assurance of 100% had values of 0 days (Table 1). Once every 2 years (50% assurance) the squall is produced only in the southwestern part of the county, at Baia Mare, where 1 day with phenomenon is noticed. In the rest of the territory, the squall does not occur so often. Once every 4 years (25% assurance) between 1-2 days with squall appear, and once in 5 years between 1-3 days, more in the north, in Sighetu Marmaţiei. Iezer station records the phenomenon only once in 10 years (1 day with squall). For this return period (10 years) up to 5 days with squall are signaled, in Sighetu Marmaţiei.

As the assurance degree falls, the values of the annual number of days with phenomenon grow. Thus, once in 20 years can occur between 2-5 days with squall. For a return period of 50 years (2% assurance), between 2-8 days with phenomenon may occur, and for a return period of 100 years, between 3-10 days. The table shows that, generally, most cases are reported at the stations with the highest risk to the squall, Sighetu Marmaţiei and Baia Mare. The fewest cases are signaled to the highest station, Iezer.

Table 1

The annual number of days with squall with various assurances, in Maramureş (1961-2007)

STATION	ASSURANCE DEGREE								
	100%	80%	50%	25%	20%	10%	5%	2%	1%
Baia Mare	0	0	1	1	2	2	3	5	6
Sighetu M.	0	0	0	2	3	5	5	8	10
Ocna Ş.	0	0	0	1	1	2	3	4	5
Iezer	0	0	0	0	0	1	2	2	3

CONCLUSIONS

On the analyzed territory, the highest risk of occurrence of the squall presents the lowest stations Sighetu Marmaţiei and Baia Mare, followed by Ocna Şugatag and the lowest risk presents the highest station Iezer, where

the phenomenon dissipates. The interval with maximum risk for producing squall is May-July, the interval with mean risk is August and March-April and the interval with minimum risk is September-February. The interval without risk to squall differs from one station to another. The phenomenon occurrence in the interval November-February is quite exceptional, being due to some special synoptic situations. At the lowest stations – Baia Mare and Sighetu Marmaţiei – higher values of the maximum monthly number were recorded in May-August period (2-4 days), and at the higher stations – Ocna Şugatag and Iezer – in April-July period (1-2 days).

In Maramureş county, squall does not occur every year. Generally, the values corresponding to the characteristic assurances are higher to the low elevation stations Sighetu Marmaţiei and Baia Mare and lower to Iezer.

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