THE SNOW LAYER, AS A CLIMATIC RISK PHENOMENON IN CRIŞANO-SOMEŞANĂ PLAIN

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Abstract

The analysis of snow layer has been performed for a number of 9 weather stations, on a period of 42 years (1961-2002). Data have been used concerning the number of days with soil covered with snow. The highest annual number of days with snow layer has risen at 55-97 days. During the last three decades, the duration of the snow layer reduced a lot compared to that of the first decade. The cause is the air temperature growth during the last years. The poorest decade in snow was the second one (1971-1980). The linear tendency also shows that during 1961-2002, the duration of the snow layer was decreasing in the West of the country. The most pronounced drop occurred to the North of the plain.

Key words: snow layer, soil covered with snow, climatic risk

INTRODUCTION

The snow layer forms during the cold season, when the air and soil temperature is negative and solid precipitation falls, which is stored on the land generating the snow layer. Three conditions are essential for the snow layer to form: negative temperatures in air and on soil, sufficient solid precipitation amounts and atmospheric calmness.

The snow layer can become a climatic risk both by its simple presence or its absence. In these circumstances it can have negative effects and produce damages to national economy. By its presence, the snow layer can be considered a climatic risk in the following cases [3]: when it occurs off-season, generating in spring, together with the frost that accompanies it frequently, chilblains to cultivated plants, vines or freezes the fruit trees buds, and in autumn forcing plants to shorten their annual cycle of active life; when it is very thick, after heavy snowfalls, affecting transportation systems; when it melts abruptly or when the soil water reserve is sufficient or in surplus, bringing flash floods.

By its absence the snow layer is an indirect climatic risk, because it gives chilblains to the autumn crops and deep ground frost in winter or early spring. So, by its absence it drives to an increased frost risk [3].

DATA AND METHODS

In the present work, data have been used concerning the number of days with soil covered with snow, data coming from the National Meteorology Administration Archive. The analysis has been performed for a number of 9 weather stations throughout the Crişano-Someşană Plain. They are as follows: Arad, Şiria, Ineu, Chişineu-Criş, Holod, Salonta, Oradea, Săcueni and Satu Mare. The annual frequency of producing of the snow layer on the soil has been calculated, as well as its tendency between 1961-2002.

RESULTS AND DISCUSSIONS

The annual average number of days with soil covered with snow. On the average, in the Crişano-Someşană Plain there are annually **30-50 days** with soil covered with snow. The average number rises from the South (32.4 days at Arad) to the North (50.6 days at Satu Mare), once with the latitude, but also from the West (29.8 days at Chişineu-Criş) to the East (45.4 days at Şiria, 38.9 days at Holod etc.), once with the altitude (table 1).

Table 1

The annual average number of days with soil covered with snow, in Crişano-Someşană

| T fuill. | | | | | | | | | | |
|-----------|------|-------|------|-------|------|-------|------|------|------|--|
| Station/ | Arad | Şiria | Ineu | Chiş- | Hol. | Salon | Ora | Săcu | Satu | |
| Period | | | | Cr | | ta | dea | eni | Mare | |
| 1961-2002 | 32,4 | - | - | - | - | - | 37,3 | - | 50,6 | |
| 1970-2002 | 29,3 | 45,4 | 33,9 | 29,8 | 38,9 | 34,4 | 33,3 | 38,1 | 44,8 | |

The growth of the number of days from the South to the North is due to the soil and air temperature drop once with the growth of latitude, which favours the maintenance of the snow layer on the ground. Also the amounts of precipitation grow to the North because of the oceanic climatic influences specific to the north-western part of the country, which bring to an increased number of days with snowfall, respectively of days with soil covered with snow. The same causes influence the growth of the number of days with soil covered with snow from the West to the East, because the growth of the altitude influences precipitation amounts and soil and air temperature. As a result, the highest values are recorded at the northern station Satu Mare (50.6 days) and eastern station Şiria (45.4 days) – the last not located in the plain (477 m altitude) – and also Holod (38.9 days), located to the East of the plain, at its contact with the hills.

Compared to the number of days with snowfall which has an annual average of 21-32 days in the West of the country, we can notice that the number of days with soil covered with snow is much higher. The fact is due

to the negative temperatures of both soil and air that help the snow fallen in a certain interval, generate a more or less thick snow layer, which lasts until air and soil temperature becomes positive and melts it [7].



Fig. 1. The annual number of days with soil covered with snow and its linear tendency, in Crişano-Someşană Plain (1961-2002).



Fig. 2. The annual number of days with soil covered with snow and its linear tendency, in Crişano-Someşană Plain (1968-2002).



Fig. 3. The annual number of days with soil covered with snow at the stations Şiria (1984-2002), Ineu (1979-1997) and Salonta (1983-1998).

We can notice that Salonta station has a slightly higher number of days with a snow layer compared to the northern station Oradea (34.4 days compared to 32.3, over the same period of time: 1983-1998). The cause lies in the lower air temperature values recorded at Salonta during the temperature inversions, frequent in the cold semester, given the lower landforms. They let the snow layer last longer on the soil (Salonta station has the lowest altitude of all the stations in the plain: 95 m. Consequently, the frequency of temperature inversions in winter is higher).

The annual number of days with soil covered with snow has varied a lot throughout the years (fig.1-3).

The highest annual number of days with soil covered with snow has risen at the stations located at the West of the country, at **55-97** days, surpassing highly the maximum number of days with snowfall (39-50). At the stations with the longest observation period (1961-2002) (fig.1), the highest values were recorded at the beginning of the period, in **1964**. They were of 70 days to the South at Arad, 84 days in the centre of the plain at Oradea and 97 days to the North, at Satu Mare. The value recorded at Satu Mare represents the highest in the Crişano-Someşană Plain (over three winter months, with a snow layer). The situation occurred again in 1965 (97 days), at the same station. After that year, the next year with high values was 1963, when the values rose from the South to the North, from 64 days in the South to 71 days in the centre and 91 days in the North. We can notice that for the three stations there is the consecutive period 1963-1964 of years with the highest number of days with a snow layer, which becomes longer to the North of the plain, at Satu Mare (1963-1965).

At the stations with a shorter observation period (fig.2-3) we can notice the highest values for 1996, when 52-71 days with soil covered with snow were recorded, the highest values being to the East at Şiria and to the North at Satu Mare (71 days).

Figures 1-3 show the similar course of the curves which represent the annual number of days with soil covered with snow. We can notice that at all the stations the same years occurred, with a high number of days with a snow layer and the same years with a reduced number of such days. Besides the years we have already mentioned, other years when the snow layer lasted long, were: 1962, 1967, 1976, 1981, 1985 -1987, 1993, when over 50 days occurred annually (even 70 days to the North at Satu Mare, in some of the years).

The lowest annual number of days with soil covered with snow was between **0-2** days in the West of the country and it was lower than the number of days with snowfall (4-7). Like in the case of the days with snowfall, the values correspond this time too, to the year **1972** (0 days at Holod and Chişineu-Criş, 1 day at Arad and Săcueni, 2 days at Oradea and Satu Mare). The cause of this reduced number of days lies in the reduced number of days with snowfall, which in its turn, occurred due to the superposing of the longest drought period in the West of the country over the cold semester, in that year (25 November 1972 - 7 January 1973). Other years with records of a reduced number of days with snow layer are as follows:

• 1994, with 6-18 days (and 22 at Şiria), the values being more reduced at Chişineu-Criş (6 days) and Salonta (9 days) and higher to the North at Satu Mare (18 days) and to the South at Arad (15 days);

• 1990, a droughty year in which, because of the lack of precipitation, the number of days with soil covered with snow has varied at the weather stations, between 5-20 days (and 36 at Şiria). The lowest number was recorded at Oradea (5 days) and Arad (7 days);

• *1974*, with much reduced values to the South at Arad (2 days) and Chişineu-Criş (3 days) and much higher in the centre of the plain (24 days at Holod and 14 at Oradea) and to the North (19 days at Săcueni and 29 at Satu Mare).

Between the curves of the graphs which show the annual number of days with snowfall and that of soil covered with snow at the same stations, a similar course can be observed. In both cases, of days with snowfall and with snow layer, the same periods of growth and drop of the annual values can be observed, the number of days with soil covered, depending directly to the ones with snowfall. The only difference lies in the recorded values, which are higher in the case of days with a snow layer.

The polynomial tendency of the annual number of days with a snow layer, shows that the period 1961-2002 starts with 1961, a year poor in solid precipitation on the soil (fig.4), which is continued the following few years when the snow layer lasted the most of the entire period, 1962-1969, followed by a period with the lowest amounts of snow, 1970-1975 and culminated with the absence of snow layer on the soil in 1972 at some of the stations. The curve of the polynomial tendency goes on with a period of growth of the number of days with a snow layer, 1976-1987, followed by a decrease 1988-1990, and after that the number of days with a snow layer increases slowly in the interval 1991-1999 (except 1994) then drops starting with the droughty year 2000.

Figure 4 shows a great difference between the values of the snow layer in the first decade of the interval 1961-2002 and the ones of the following decades. In fact, *during the last three decades, the duration of the snow layer reduced a lot compared to that of the first decade.* The fact is shown in figure 5. Accordingly, the poorest decade in days with a snow layer was the second one (1971-1980), when the annual duration of the snow layer was lower than the one of the first decade (1961-1970) with

about 17 days to the South of the plain, 20 in the centre and 31 days to the North of the plain. *In the last two decades* (1981-1990 and 1991-2002), *the duration of the snow layer reduced compared to the first decade with about 10-13 days to the South of the plain, 17 days in the centre and 20 days to the North of the plain.* We can say that in the second decade, the duration of the snow layer decreased with about 40-45% and in the fourth decade with 30-33% compared to the first decade. The cause of this drop lies in the air temperature growth recorded in the last years, in the West of the country.



Fig. 4. The polynomial tendency of the annual number of days with soil covered with snow, in Crişano-Someşană Plain (1961-2002).



Fig. 5. The annual average number of days with soil covered with snow, on the four decades of the period 1961-2002, in Crişano-Someşană Plain.

The linear tendency of the annual number of days with soil covered with snow (fig.1) shows again that *during 1961-2002, the duration of the snow layer was decreasing in the West of the country.* The tendency synchronises with that of the number of days with snowfall in the same period, as the two parameters vary directly. The most pronounced drop is recorded to the North of the plain, at the station Satu Mare. At the stations with a reduced number of observation years, for example Chişineu-Criş and Săcueni (fig.2), because of the lack of data in the first decade, a linear tendency of growth of the duration of snow layer during 1970-2002 has resulted, even though the annual number of days with snowfall had a decreasing tendency over the same period of time (at Chişineu-Criş) or a constant one (at Săcueni). In exchange, at the station Holod, the tendency is the same like on the entire plain that is of a decrease of the duration of snow layer. It synchronises with that of the number of days with snowfall.

At the stations Şiria, Ineu and Salonta no graphs of tendency have been made, as their observation period was too short and the resulted tendency was irrelevant and suffered no comparison with the other stations.

The disparity between the tendencies recorded at the stations Chişineu-Criş and Săcueni between the two parameters – number of days with snowfall and number of days with soil covered with snow – which hypothetically should vary directly, can be caused by a series of elements like landforms morphology, air and soil temperature, temperature inversions, sleet, liquid precipitation, wind etc, which can intervene locally, making this connection more complex [7].

CONCLUSIONS

In the plain regions at the West of the country, the snow layer forms discontinuously in winter. The shelter given to these regions by the mountain frame of the Carpathians makes blizzards to occur rarely and snow to lie evenly.

The average annual number of days with soil covered with snow is between 30-50 days, higher that the ones with snowfall and increases from the South to the North and from the West to the East. The highest annual number was 55-97 days in 1964 and the lowest, 0-2 days in 1972.

In the last three decades, the duration of the snow layer has reduced a lot compared to that of the first decade. The poorest decade was the second one (1971-1980), when the annual duration was more reduced compared to that of the first decade (1961-1970), with about 17 days to the South of the plain, 20 days in the centre and 31 days to the North of the plain. In the last two decades (1981-1990 and 1991-2002), the snow layer has reduced compared to the first decade by about 10-13 days to the South of the plain, 17 days in the centre and 20 days to the North of the plain. The cause is the air temperature growth during the last years. The linear tendency shows that the most pronounced drop occurred to the North of the plain, at the station Satu Mare.

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