

ANALELE ȘTIINȚIFICE ALE UNIVERSITĂȚII „AL. I. CUZA” IAȘI
Tom L IV s. II – c, Geografie 2008

CHARACTERISTICS OF THE FOG PHENOMENON IN THE SIRET CORRIDOR AND ASPECTS OF THE INDUCED CLIMATE RISK

Liviu Apostol, Lucian Sfică
„Al.I.Cuza” University Iași
Faculty of Geography and Geology

Rezumat : Caracteristicile fenomenului de ceață în Culoarul Siretului și riscurile climatice ale acestuia. Acest studiu prezintă ceața pornind de la condițiile genetice, durata și frecvența cu referiri la riscurile climatice induse. Importanța calmului atmosferic în apariția ceței, în special în condiții anticiclonale este un alt element analizat.

Ceața este un fenomen legat în primul rand de anotimpul rece, concentrându-se în intervalul Noiembrie-Martie, cu o predilecție pentru anumite intervale orare (între 7 și 10 a.m.). Durata anuală cumulată excedează 350 ore în decembrie și 200 în Ianuarie.

Keywords: fog, climatic risk, Siret Corridor, atmospheric calm.

1. General considerations

The Fog is a hydrometeor whose appearance in the Siret Corridor contributes to the climate individualization of this physical and geographical subunit compared to the neighboring subunits. This phenomenon is defined as the *water drops or ice crystals (or both) in suspension in the air layer very close to the Earth's surface and that has as its main effect the reduction of the visibility to less than one kilometer* (Ciulache, Ionac, 2003).

The analysis of the fog phenomenon was based on the identification of the periods when fog appears, at a diurnal, monthly and annual level. In order to do this we used the data from the weather stations in the Siret Corridor – Adjud, Bacău and Roman – at a monthly level for the 1960 – 2002 period and at a diurnal level for the 1991 – 2002 period.

Fog, as climate phenomenon in the Siret Corridor was analyzed in specialist works, especially for the Bacău town area, because of the fundamental importance of this phenomenon for the traffic conditions of the local airport (Grama, 1960).

Of what it is known until now, at Bacău meteorological station, fog has been noticed when air temperature ranges between -28°C and $+20^{\circ}\text{C}$, and 66% of the fog cases are registered between temperatures of -6°C and $+6^{\circ}\text{C}$, therefore when the air temperature oscillates around the 0°C value. Likewise, 42.9% of the fog cases were produced when the wind blew from the South, fact that underlines the importance of the Siret Corridor's

orientation and conformation on the North – South direction; moreover, other 42% of the fog cases occur in conditions of atmospheric calm (Grama, 1960).

Without further analyzing the appearance conditions, we have to underline that the same study mentions that Bacău meteorological station, 86,2% of the fog cases appear inside the same air mass. The radiation fogs, obviously linked to the presence of Bistrita and Siret rivers, prevailed. (Stănișor, 1975).

Regarding the climate risk aspects of the fog, the difficulty of the traffic, when this phenomenon appears, is underlined also by the fact that 7% of the fog cases are associated to the precipitations fall and the fog has the highest duration and intensity between 4 and 10 a.m., with its centre around 7 a.m. As we already mentioned, most cases of fog occur in the autumn (72.9%) and in the fall (20.9%) when this phenomenon can be also associated to other meteorological elements unfavorable to the traffic.

This phenomenon can appear all around the year, but the maximum occurrence is in the cold season, when it can be associated to other hazards, such as the glazed frost. In this case, the cumulated effect is intensified. About 15% of the aviation accidents are caused by meteorological conditions (Climate Change, 2001). It is interesting that this study indicates a constant for the entire second half of the past century, despite the obvious technical progress made by the aircrafts.

2. Genetic conditions for the fog's appearance of fog

According to the genetic aspect, fog is classified depending to the synoptic scale at which it appears. This way, fog can appear inside the same mass of air or at the contact between air masses with different characteristics, that is in the frontal regions.



Fig. 1 – Fog persistence in the Siret Corridor, south of Rachiteni, on 14 of February 2005 (MODIS satellite image)

The anticyclonic baric regime situations (fig. 2), when fog can occur, are more persistent in winter and in autumn and can go on for more than 5 days in a row.(tab.1). In these conditions, radiation fog can persist, in a similar way, for considerable periods of time.

As far as the *genetic conditions for the fog appearance* (fig.1, tab.2) in the Siret Corridor, for the 1980-2005 period, we could notice that the radiative situations associated to anticyclone conditions have a very high frequency. These conditions, favorable to the appearance of fog, have in Romania a frequency of about 25% of the annual total in Romania. If we take into consideration this high frequency of the anticyclone conditions at the level of the entire country, the depression characteristic of the Siret Corridor and the existence of extended water surfaces, we can say that this region integrates some special premises for the development, the persistence and the high intensity of this phenomenon. (fig.1).

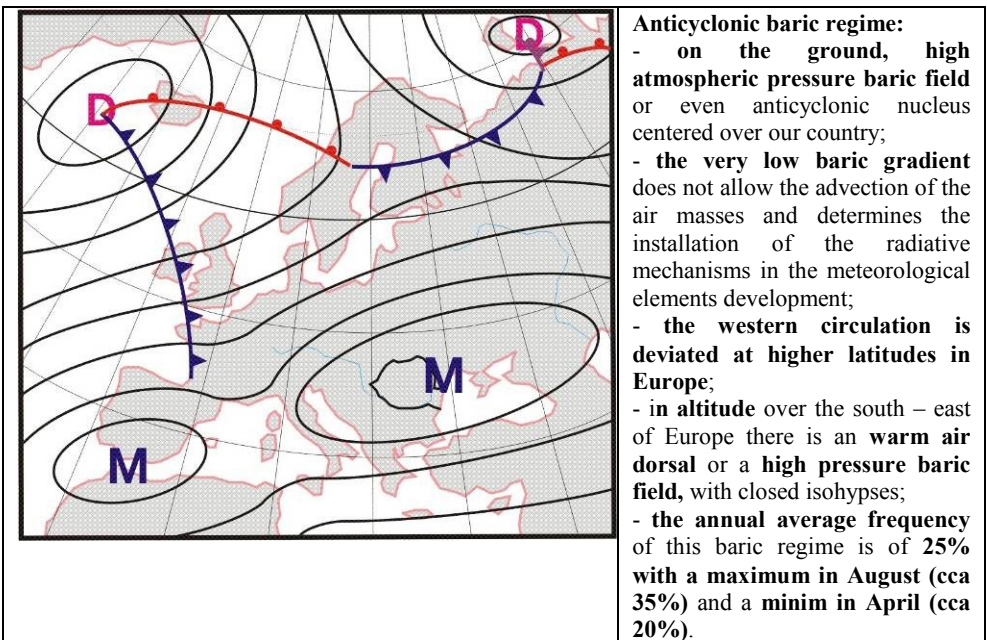


Fig. 2- Synoptic conditions favourable to the development of radiation fog in our country (left) and the delimitation criteria for the anticyclonic baric regime (right)

3. Peculiarities of the fog phenomenon in the Siret Corridor

We analyzed the appearance and the persistence of the fog in the Siret Corridor from various points of view:

Anticyclonic			January	April	July	October
Temperature	Minimum	Average	-7°C	4°C	14°C	4°C
		Absolute	-18°C	-2°C	8°C	-4°C
	Maximum	Average	-1°C	16°C	28°C	16°C
		Absolute	11°C	28°C	35°C	28°C
Thermal amplitude			6.5°C	12°C	13°C	12°C
Precipitations			Absent or very reduced	Absent or very reduced	Convective rains	Absent or very reduced
Specific meteorological phenomena			Fog, including the hoar frost deposits;	Frost and fog	-	Frost and fog
Persistence			8 days (1999)	4 days (1991, 1998)	8 days (1984)	12 days (1995)
Frequency			25.2 %	20.8 %	28.3 %	29.9%

Tab.1 -Meteorological characteristics of the anticyclonic baric situations in Bacau

a. Analysis of the annual regime of the number of foggy days.

From this point of view, in the Siret Corridor there are around 45 days with fog a year. (fig. 3). The average annual number of days with foggy air varies around 250 days a year. These meteorological phenomena characterize the cold season (October – March), when 90% of the average number of foggy days appear. We underline, as a characteristic of the spatial distribution, that in Bacau the number of days with fog is considerably higher; this situation can be explained by the presence of the barrage lakes, which represent an important source of water vapors and facilitate the radiation fog appearance, when the thermal contrast between these lakes' water and the atmosphere can be higher, in the conditions of the warm air advections, more frequent in April, or of the cold air advections, more frequent in October.

The monthly peak of the foggy days is reached in December – January, when the appearance of this phenomenon is facilitated by the high values of the relative humidity under the incidence of the low temperatures. In winter, fog is present in the Siret Corridor, as an average, in one of three days.

As far as the hazards produced by the fog are concerned, we underlined the fact that these winter months that have a high frequency of the fog phenomena and of the foggy air, are characterized by high road traffic, associated to the winter holidays.

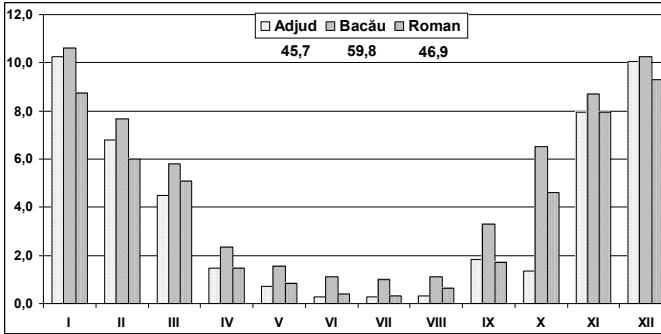


Fig. 3– Number of fog days in the Siret Corridor

b. Diurnal analysis of the fog phenomenon. As we have already mentioned, fog has the highest frequency between the hours 4 and 12 a.m., reaching its maximum values between 7 and 10 a.m. The daily minimum appears between 18-20 hours, moment that coincides, generally speaking, with the sunset interval. (fig.4).

From November till January, a period that we can consider as a peak of the annual regime of the phenomenon, the maximum incidence during the day appears between 6 and 11 hours, with a peak between 8 and 9 hours (fig. 5, 6 and 7). Between 6 and 11 hours, in average, every month has at least 5 days with fog, while during the second part of the day, the fog persists only in 2,5 - 3 days, a 50% decrease of the number of days, fact that underlines the predominant radiative character of this phenomenon.

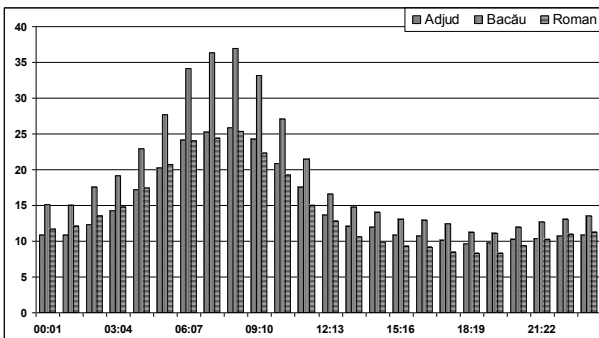


Fig. 4– The diurnal regime of the fog phenomenon in the Siret Corridor (cumulated annual frequency for the 1991-2002 period)

Likewise, the road traffic presents during the morning one of the two diurnal peaks in the morning. Of this superposition, we can see the importance of the fog as a hazard for transportation. Taking into consideration the physical and geographical characteristic of the Siret Corridor, due to the presence of the water streams, fog can also occur in summer, in the chillier mornings.

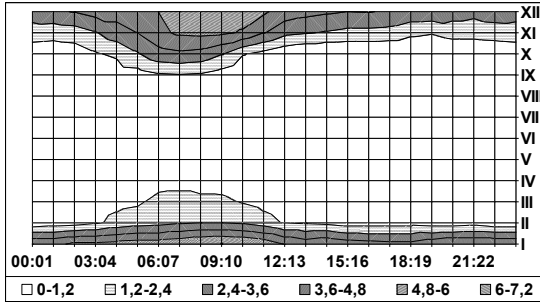


Fig. 5 – Hourly frequency of the fog phenomenon in Adjud⁹

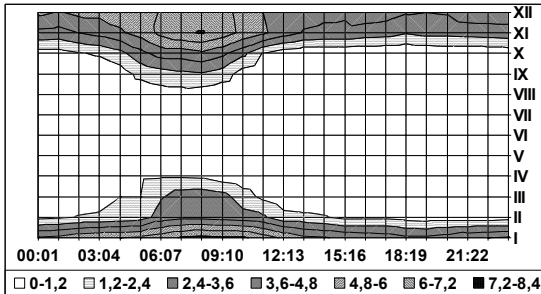


Fig. 6 – Hourly frequency of the fog phenomenon in Bacău

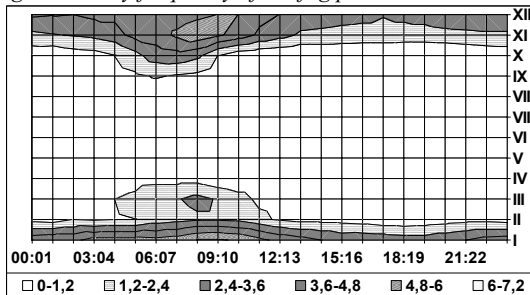


Fig. 7 – Hourly frequency of the fog phenomenon in Roman

⁹ Number of cases – hourly multiannual average (1991-2002)

c. Analysis of the duration of the fog phenomenon. In the November – February period, the average monthly duration of the fog phenomenon exceeds 50 hours. The fog duration decreases from Adjud (380 hours/year) towards Roman (340 hours/year), as the increase of altitude increases. (fig. 8).

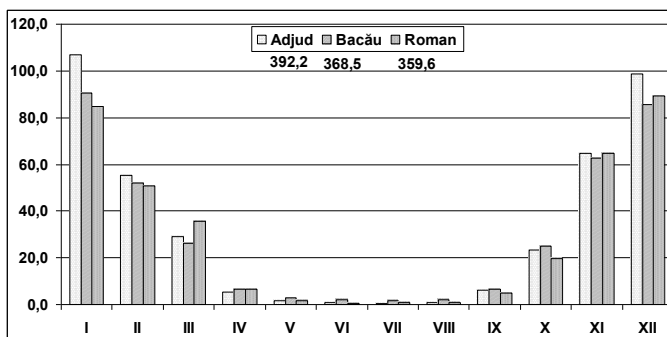


Fig. 8– Duration of the fog phenomenon in the Siret Corridor

In fact, the months with a high frequency of fog are also the months when duration of fog is longer, as a consequence of the high persistence of this phenomenon when the conditions for its formation are present. This situation underlines that the high number of foggy days in Bacău, is the result of the appearance of the radiation fog on the water surfaces during the morning, fog that dissipates at maximum two hours after the sun rise.

4. Areas with increased climate risk caused by the fog

As it is not possible to map the frequency of the fog phenomena in the region – because of the small number of meteorological stations and of the high frequency of the phenomenon in the low regions – those sectors in which *fog can constitute a hazard for the road circulation* were identified by means of field trips. This way, we can distinguish between various types of sectors of European/ national/ county roads that have a higher vulnerability to fog:

- road sectors *passing over water streams*, where due to the higher atmospheric humidity the phenomenon is more frequent;
- road sectors *neighboring the lakes* of the Bistrita and Siret valleys, where there are the same conditions of water vapors in excess occur;

- *road sectors crossing the Siret or the Bistrița meadow*, where the radiation fog, especially in the cold season, can cause a higher frequency of this phenomenon.

References

- Ciulache, S., Ionac, Nicoleta** (1995), *Fenomene atmosferice de risc*, Ed. Științifică, București.
- Bogdan, Octavia, Niculescu, Elena** (1999), *Riscurile climatice din Romania*, Acad. Română, Inst. Geogr, Bucuresti.
- Bogdan, Octavia** (1978), *Fenomene climatice de iarna și de vara*, Edit. Științifică și Enciclopedică, București.
- Day, J.** (2005), *Fog and mist* (379-380), Encyclopedia of World Climatology, Edited by John E. Oliver, Sprenger.
- Grama, Mariana** (1960), *Frecventa si cauzele ceturilor in regiunea Bacau*, Meteorologia, hidrologia si gospodaria apelor, nr.3, București.
- Sfîcă, L.** (2007), *Une nouvelle approche sur la circulation atmosferique dans nord-est de la Roumanie*, Actes du XX-eme colloque de l'Association le Internationale de Climatologie, 3-8 septembre 2007, Tunis.
- Goussot, M.** (1999), *Les transports dans le monde*, Armand Colin, Paris.
- Schönweise, Chr.D.** (2003), *Klimatologie*, 2.Auflage, Ulmer, 2003.