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THE HAIL PHENOMENON IN THE BÂRLAD DRAINAGE BASIN - SOME ASPECTS REGARDING GENESIS AND DIURNAL FREQUENCY

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Abstract. As a phenomenon whose maximum frequency is achieved in the warm season of the year, hail takes by surprise cereal crops, vegetables and herbs, vine and fruit trees in various stages of development, affecting or stopping the development of their vegetative cycle. A single case of hail, in a critical development phase of the plant can lead to total damage of the year crop. Hail is a phenomenon that must be taken into consideration in the normal course of activity in various fields, when one plans an outdoor work, especially in agriculture, where the cultivated species and their vegetation period are subjected to hail. Sometimes, the hail phenomenon can be less serious, if it occurs at the end of the growing phase of the plant, when the size of the hailstones is small, their density per square meter and the duration of the hail falls are each reduced. Hail's only positive effect is the precipitation input brought on the active surface, input that it is not known, as it is measured together with the rain, but which adds extra water, often necessary during periods of drought in the area of Bârlad drainage basin.

1. Data and methodology

The paper is based chiefly on factual material represented by measured data. These are summarized in tables of average and maximum values, the result of processing a large number of raw climatological data, average and maximums from the data network of National Meteorological Administration R.A.. The datasets used came from from 15 weather stations (Podu Iloaiei, Strunga, Iaşi, Roman, Negreşti, Huşi, Plopana, Vaslui, Bacău, Onceşti, Bârlad, Adjud, Balinteşti, Tecuci şi Măicăneşti, fig. 1).

In order to characterize the frequency and origin of air masses, which generate hail when passing Bârlad drainage basin there were analyzed synoptic maps of soil,

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the geopotential field at isobaric level of 500 hPa and temperature field at 850 hPa level, provided by the http://www.wetterzentrale.de site, took from the days with a record of hail at the weather stations from Bârlad drainage basin and surroundings, during the years 1961- 2009.

The evolution of hail genesis in 24 hours, and also other convective phenomena (rain showers and electric discharges) were examined by analyzing the frequency of their average values, recorded during the years 1961-2009 at the weather stations within the Bârlad drainage basin and the surroundings.

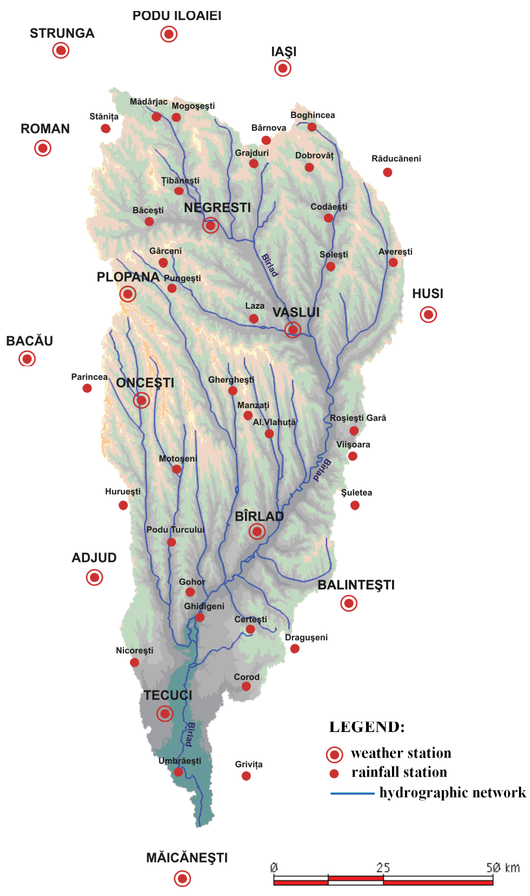

Fig. 1 - Location of weather stations and rainfall stations within the Bârlad drainage basin and the surroundings

2. Results

The following conclusions can be drawn for the period during the years 1961-2009, from the analysis of frequency and origin of air masses, which generated hail when crossing Bârlad drainage basin:

- every year, *air masses with a Maritime Polar origin (mP)* generate most frequently hail (about half of all cases of hail occurred due to penetration of these types of air masses in the Bârlad drainage basin) (tab. 1, fig. 2);

Tab. 1 - Monthly frequency (%) and origin of air mases which generated hail when crossing Bârlad drainage basin (1961-2009)

Air masses type	***I***	***II***	***III***	***IV***	***V***	***VI***	***VII***	***VIII***	***IX***	***X***	***XI***	***XII***	***Annual average***
mA	50.0		33.3	2.8							20.0	100.0	***17.2***
mP	50.0	66.7	33.4	55.6	35.6	52.7	55.1	56.7	31.6	37.5	80.0		***46.3***
cP		33.3	33.3	30.5	23.8	20.6	26.1	20.0	63.2	62.5			***26.2***
P→T				11.1	36.6	26.0	15.9	23.3	5.3				***9.9***
mT					1.0	0.8	2.9						***0.4***

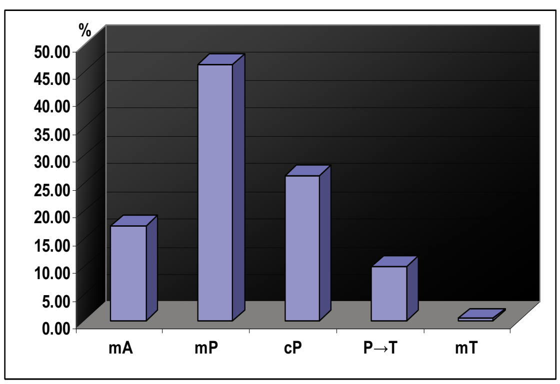

Fig. 2 - Annual frequency (%) and origin of air mases which generated hail when crossing Bârlad drainage basin (1961-2009)

- November and February are the months in which cold and moist *air masses with a Maritime Arctic origin*, coming from the North-West, generated most frequently hail. If we speak about seasonal trends this air mass holds supremacy in the Summer (Table 2, Fig. 3);

- *air masses with a Maritime Arctic origin (mA)* generally have a reduced frequency. In December occurred the only type of air mass which generated hail;
- *air masses with a Continental Polar origin (cP),* cold and dry coming from the North-East and East generate hail most often in the Autumn, in September and October;
- *air masses with a Polar origin which later developed into Tropical air masses (P-T)*, that come from West and South-West, have a reduced annually frequency, but in the warm season (April-September) represent the source of hail phenomenon between 5.3 % and 36.6 % from the total cases (May is placed first);
- *air masses of Tropical Maritime origin (mT) coming from the South-West and South*, warm and moist, rarely generate hail and only at the end of the Spring and the first two Summer months.

Tab. 2 - Seasonal frequency (%)and origin of air mases which generated hail when crossing Bârlad drainage basin (1961-2009)

Air masses type	***Winter***	***Spring***	***Summer***	***Autumn***
mA	50.0	12.1		6.7
mP	38.9	41.8	54.8	49.7
cP	11.1	29.5	22.2	41.9
P→T		16.3	21.7	1.7
mT		0.3	1.3	

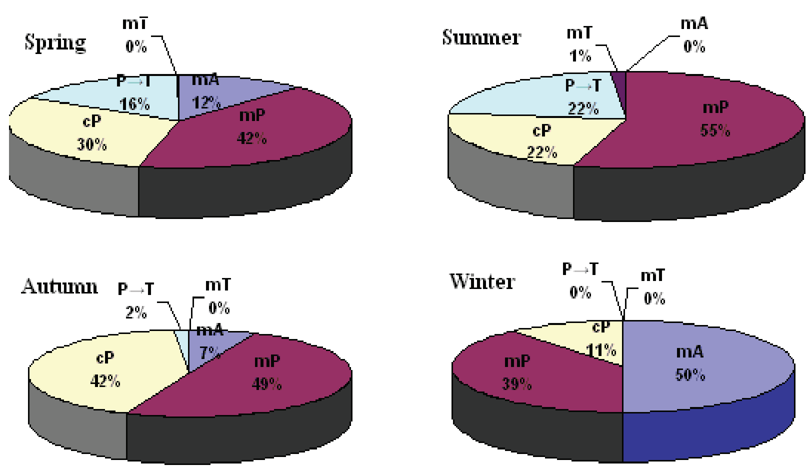

Fig. 3 - Seasonal frequency (%)and origin of air mases which generated hail when crossing Bârlad drainage basin (1961-2009)

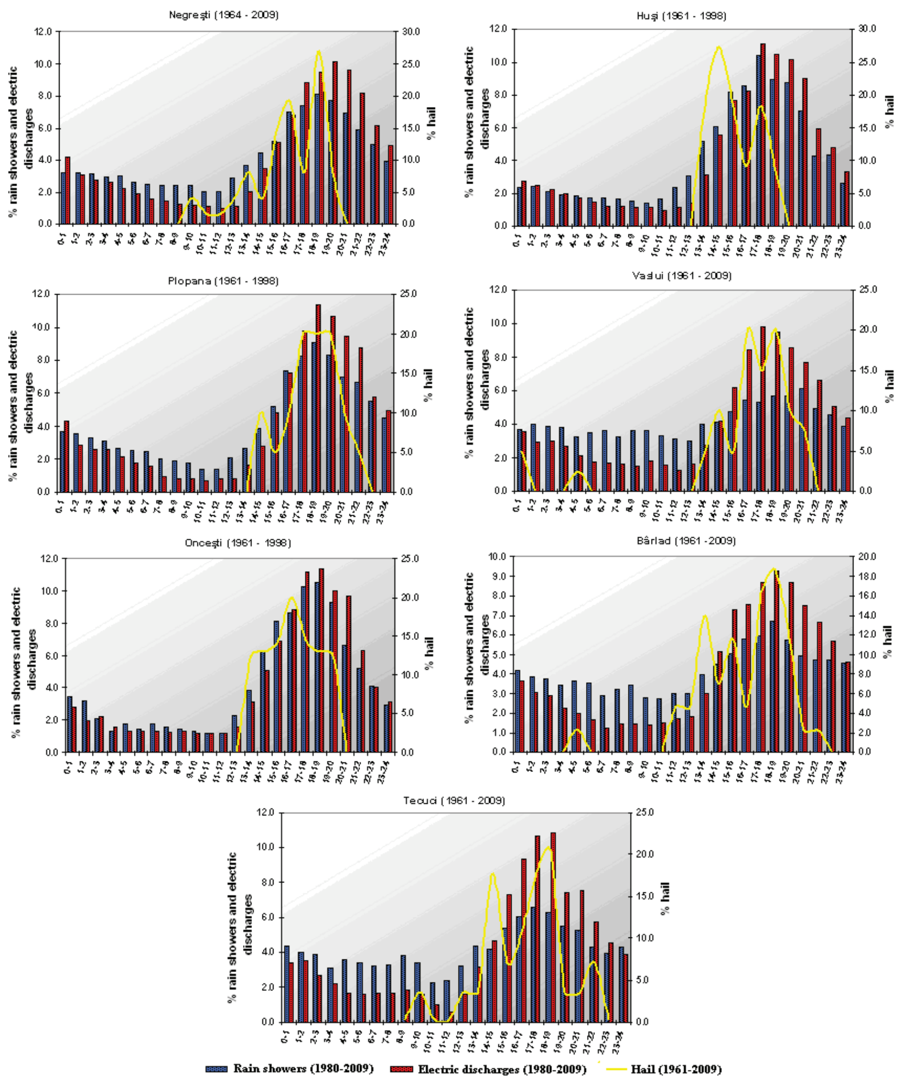

Fig. 4 - Average <u>annual</u> frequency of daytime hail, rain showers and electric discharges within the Bârlad drainage basin (1961-2009)

Regarding other types of air masses which transit the North-East area of Romania, like *the Artctic Continental air (kP)* and *the Tropical Continental air* *(cT),* we can say that at least in the Bârlad drainage basin they don't generate hail. This situation is explained by the fact that these are air masses with very little moisture, hence they generate a warm and dry weather in the worm season (Tropical Continental air) or dry and extremely cold weather in the cold season (Arctic Continental air).

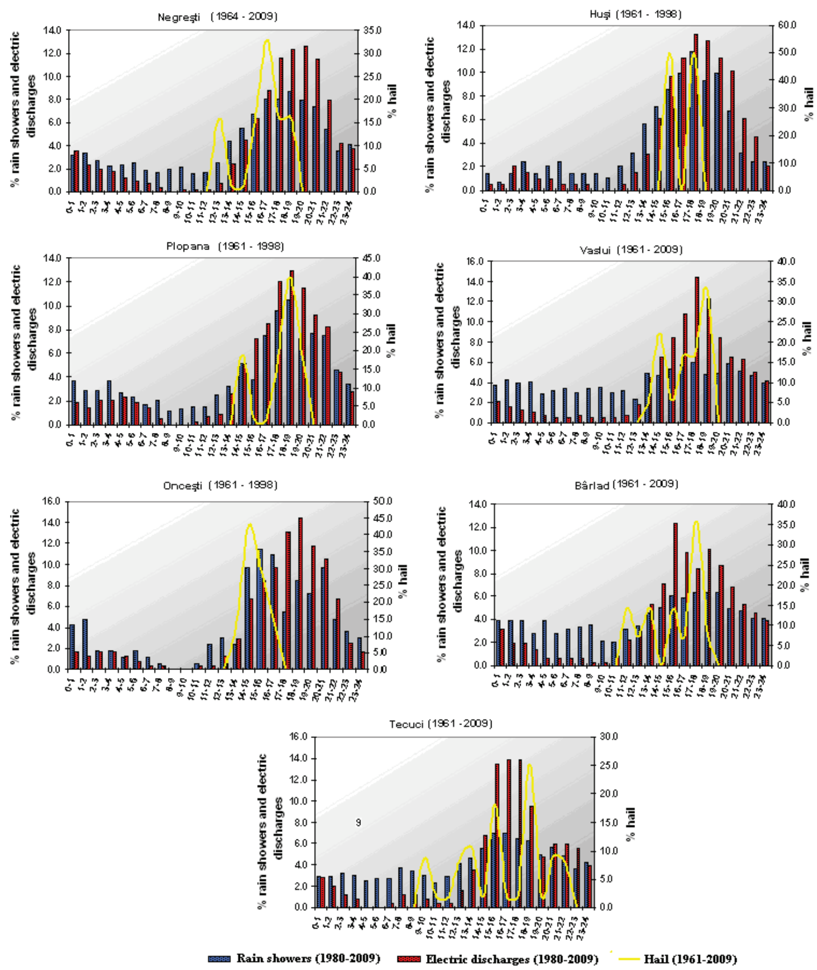

Fig. 5 - Average frequency of daytime in the Spring season of hail, rain showers and electric discharges within the Bârlad drainage basin (1961-2009)

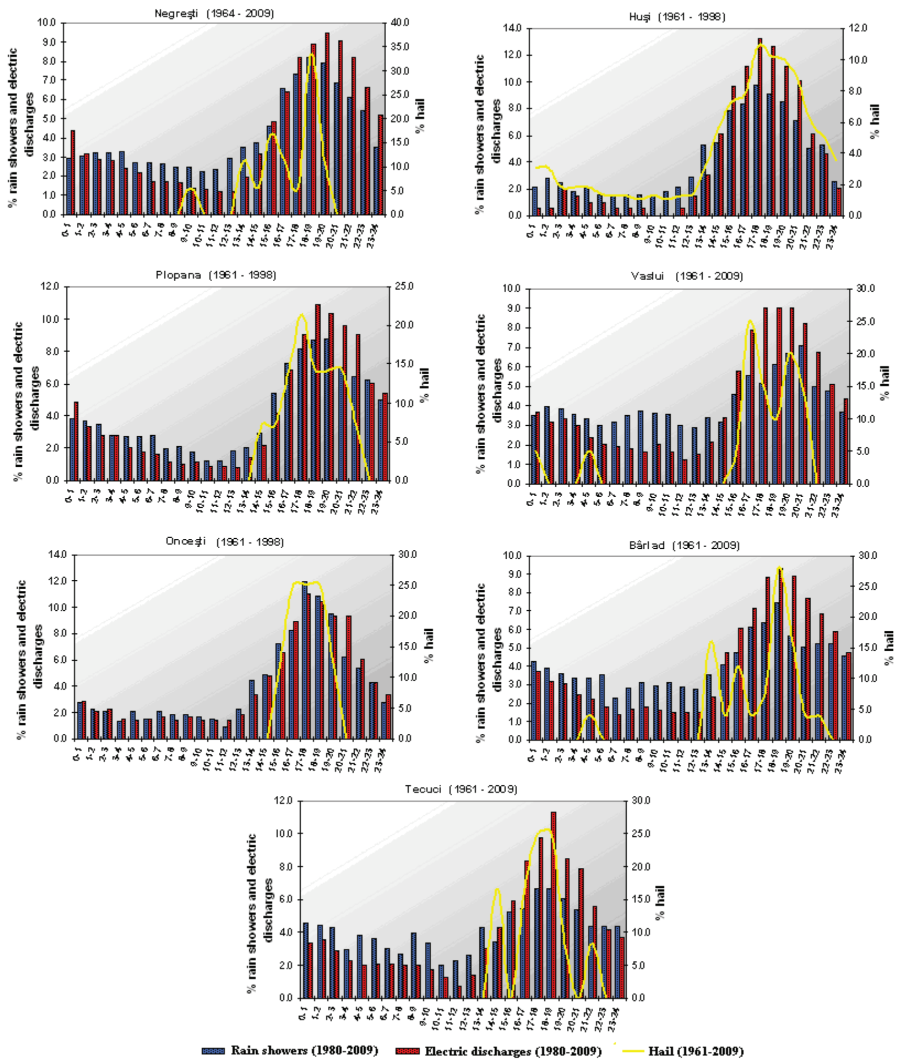

Fig. 6 - Average frequency of daytime <u>in the Summer season</u> of hail, rain showers and electric discharges within the Bârlad drainage basin (1961-2009)

If we observe the average diurnal course of the major convective meteorological phenomena, it can be noticed that their variation in the Bârlad drainage basin is characterised by periodicity and regularity, being directly linked

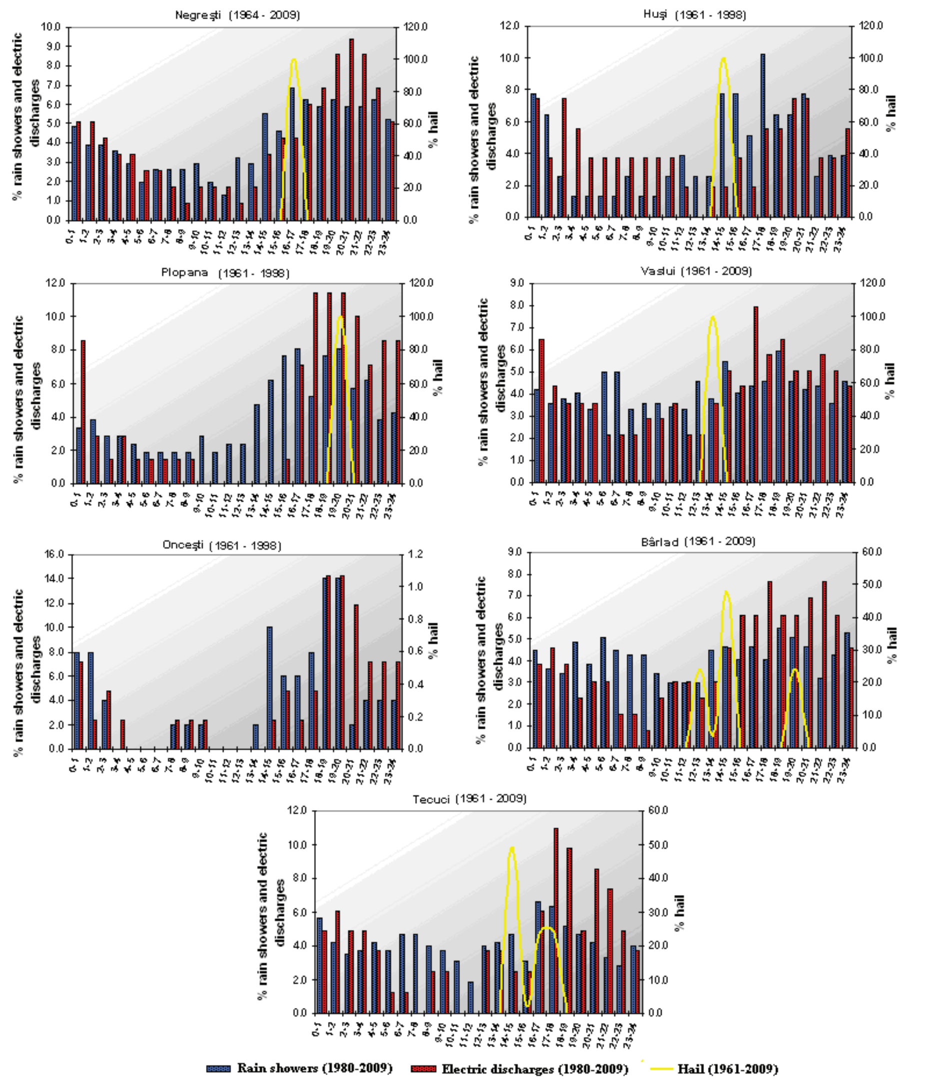

Fig. 7 - Average frequency of daytime in the Autumn season of hail, rain showers and electric discharges within the Bârlad drainage basin (1961-2009)

to fluctuations of radiation, dynamic and physical-geographical factors (Fig. 4). Under the influence of solar radiation, the characteristics of active surface above which the air is heating and the small influence of the atmospheric circulation, within 24 hours, the median values of the three analyzed convective phenomena are lower in the second part of the night and early morning and higher in late afternoon; the convective phenomenon in Bârlad drainage basin showing the maximum intensity during 5.00-7.00 PM.

In spring, when temperatures are rising, the maximum convective diurnal is generally maintained, between 5.00-8.00 PM. time while the minimum diurnal occurs after sunrise between 8.00- 11.00 AM. The diurnal convective regime of this season is almost identical to the annual diurnal (Fig. 5).

In Summer the minimum diurnal of the convective phenomena is recorded long after sunrise; some weather stations as Plopana, Vaslui and Oncesti had such records during 11.00-12.00 AM. The convective inertia that positively enhances every month, from Spring until the hot Summer, the maximum length of days, strong solarization, long duration of Sun shining, the high angle of the incident rays on the terrestial surface, are factors that ultimately lead to breaking the equilibrium of the air layers on big depths so that the convective motion commands maximum values during 5.00-7.00 PM, both in the monthly and annual profile (Fig. 6).

Autumn is the season when the intensity of solar radiation decreases, the general evolution of the daily temperature values has a dropping trend, hence the convective phenomena have less intensity. Under these circumstances, the diurnal evolution of the convective phenomena is less obvious in contrast with the other two seasons (Spring and Summer). However, it can be noticed that the diurnal minimum values occur early in the day, so that towards the end of the afternoon and the beginning of the evening the intensity of the convection is maximum (Fig. 7).

Conclusions

Regarding the frequency and origin of air masses transiting Bârlad drainage basin and generating hail, annually, air masses with a Maritime Polar origin generate most frequently hail (about half of the total cases of hail occurred due to the penetration of these types of air masses in Bârlad drainage basin). In smaller percentages, other types of air masses that generate hail are the Continental Polar air masses, Polar air masses transformed into Tropical and rarely Tropical sea masses (Summer) and Maritime Arctic (Winter).

Diurnal evolution of hail fall shows that the biggest decrease in the frequency of hail occurs during night and early morning, data recorded at the majority of weather stations and amplification of hail fall in the afternoon and towards evening hours.

The duration of hail occurrence is generally between 4-10 minutes. In Barlad Corridor there is a record of the longest duration of hail falls.

Being a phenomenon of a mere convective nature, the "thundercloud" produces only 4% of the annual amount of precipitation (Hârjoabă, Creţu, 1984) and under 2% of the number of days with hail. However, it is obvious the importance of the thermic convection in intensifying the dynamic convections of all the fronts types, if we observe the records of an exceptional medien pluviometric maximum per day during 4.00-6.00 PM and of the medien maximum duration of the hail fall in the area during 5.00-7.00 PM.

Acknowledgments

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