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# CLOUD-TO-GROUND LIGHTNING ACTIVITY IN ROMANIA FROM 2003 TO 2005

Bogdan Antonescu, Victor Daniel Carbunaru and Carolina Oprea

National Meteorological Administration

Bucharest, Romania

## 1. INTRODUCTION

Convective storms bring precipitation, which could be benefic, but also flash floods, hail, wind gusts, tornadoes and cloud-to-ground lightning. Climatological studies of convective phenomena have been developed for Romania, but the distribution of cloud-to-ground lightning strikes is not based upon a continuous, spatial and temporal data set throughout Romania. Once the National Lightning Detection Network was installed in 2002, it was possible to carry out a cloud-to-ground lightning database with no time gaps and extended throughout Romania. The aim of this paper is aimed to present climatology of the cloud-to-ground lightning activity over Romania using the 2003-2005 databases.

## 2. PRESENTATION OF RESEARCH

The physical and geographical characteristics of over 1.4 million cloud-ground lightning strikes recorded by the National Lightning Detection Network throughout Romania over 2003-2007 are presented. These characteristics include: total density of cloud-to-ground discharges, density of positive discharges, percentage of positive discharges, and diurnal variation of the total number of discharges. Analysis was carried out at 0.2° space resolution, corresponding to about 20-km resolution. The cloud-to-ground lightning density was not corrected according to detection efficiency, herein being presented only the measured values.

## 3. RESULTS

Maximum density tops 9 discharges $km^{-2}$ in Olteniei Plain and Jiu's Defile areas, situated in the southern part of Romania (Fig. 1).

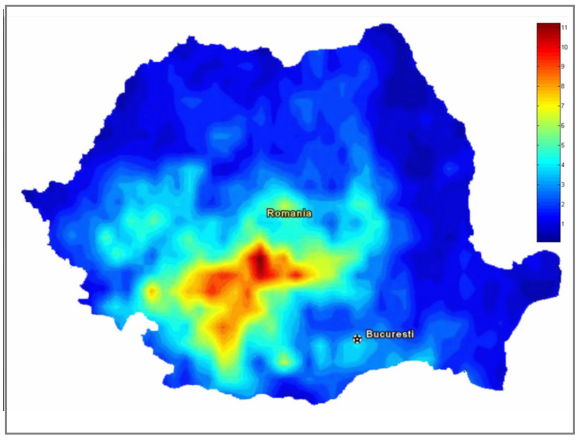


**Fig. 1** -The mean annual flash density for Romania.

This maximum can be explain by presence of the Romanian Plain Convergence Zone (RPCZ) that interacts, in appropriate synoptic conditions, with a southerly low-level jet or can intersect with other boundaries; in these conditions, severe convection is initiated near the RPCZ (Stan-Sion and Antonescu 2006). A flash density enhancement is associated with the Bucharest city. This effect had been reported previously by Westcott (1995) in United States, who observed that the lightning activity is increased by air pollution and urban size.

The mean monthly distribution for cloud-to-ground lightning is shown in Figure 2. The plot is approximately symmetric about July, with a minimum in the months of November-March. The monthly mean number of discharges

reached a maximum of about $12.5 \cdot 10^4$ discharges.

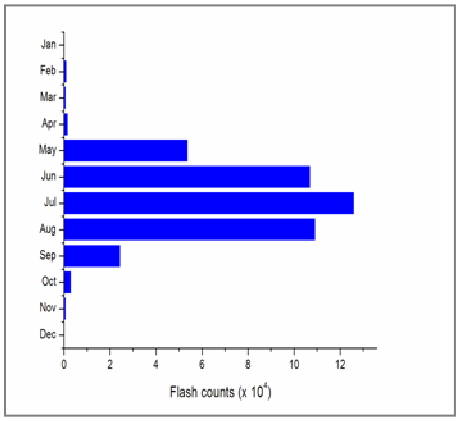


**Fig. 2** - The mean monthly flash counts.

Maximum density of positive cloud-to-ground, which is higher than 0.08 discharges $km^{-2}$, was recorded around the cities of Barlad and Suceava, north-eastern part of Romania.

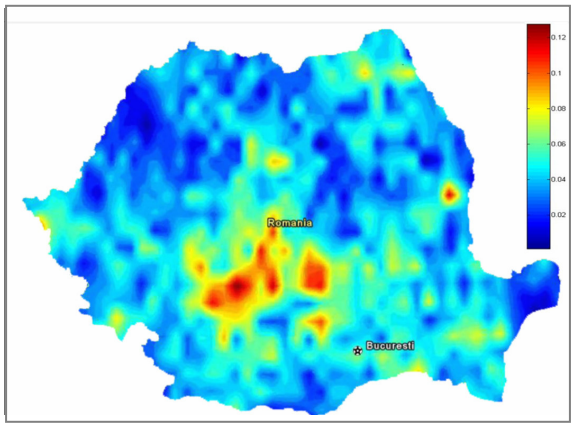


**Fig.3** - The mean annual positive flash density.

The mean monthly positive cloud-to-ground flash for 2003-2005, is shown in Figure 3. The positive flash count has a maximum in July (Figure 4). A secondary maximum occur in May, which may suggest that positive cloud-to-ground flashes peaks earlier than the total flash count (Orville and Huffines 2001).

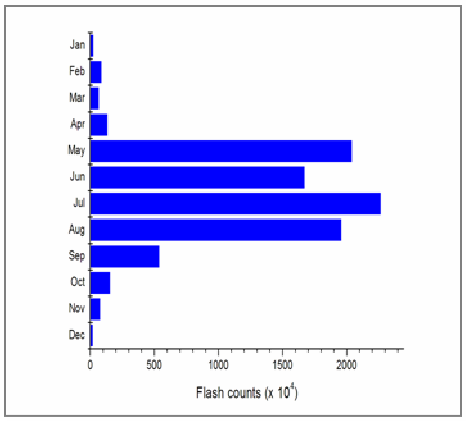


**Fig. 4** - The mean monthly positive flash counts.

High values (>10%) of the annual mean percentage of positive cloud-to-ground are specific to Eastern Romania regions (Figure 5).

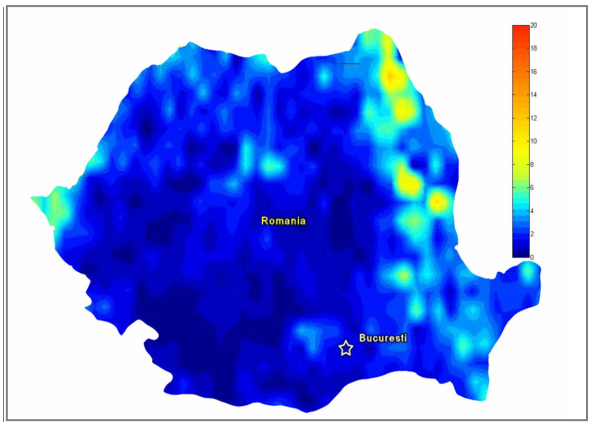


Fig. 5 - The percentage of flashes lowering positive charge to the ground.

The mean monthly percentage of positive flashes varies throughout the year, from high values (9-19%) in November -April, to low values (2-6%) from May to October (Figure 6).

The diurnal variation of the total flashes shows in the summer and winter seasons the same behavior, with a peak around 1600-1800 LT (Figure 7), associated with the maximum convective activity in the afternoon.

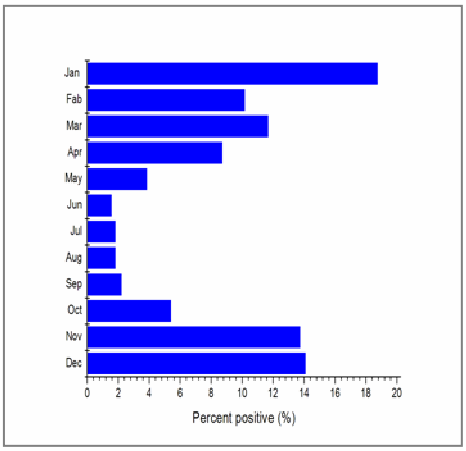


**Fig. 6** - The variation of mean monthly percentage of positive lightning.

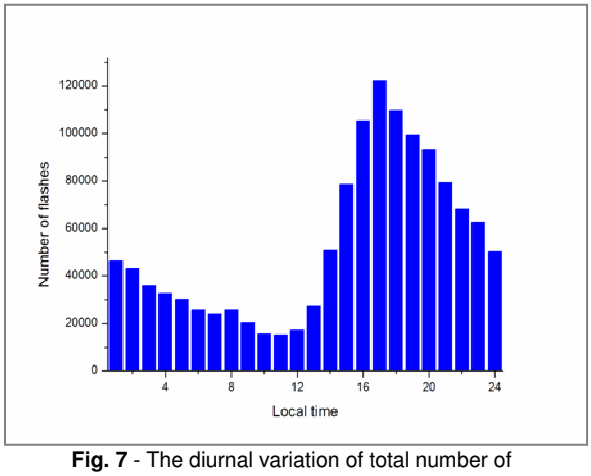


**Fig. 7** - The diurnal variation of total number of cloud-to-ground flashes.

The relationship between the total number of cloud-to-ground lightning and topography measurements obtained through ETOPO-2 (0.2x0.2 resolution) data base from NOAA (Figure 8), shown a lightning number decrease with height.

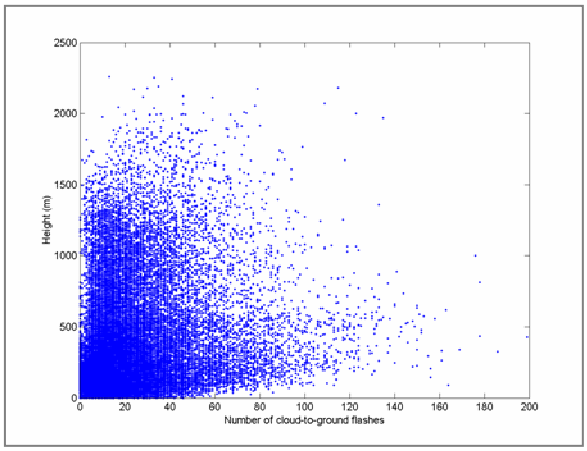


**Fig. 8** - The total number of cloud-to-ground flashes as a function of topography.

## 4. CONCLUSION

The 2003-2005 cloud-to-ground lightning activity recorded across Romania was analyzed in order to set off the geographic distribution of total lightning strokes, number and percentage of positive lightning strokes. Here are the main results:

- for the first time in Romania a cloud-to-ground lightning climatology was developed using lightning data from a national lightning detection network;
- the total measured flash counts for 2003-2005 is 1.47 million cloud-to-ground flashes;
- the area of maximum annual flash density (> 9 flashes $km^{-2}$) is extending from Southern to Western Carpathians and Oltenia Plain. The mean monthly total flash count peaks in July at approximately $3.2x10^5$ flashes;
- the mean monthly percentage for positive lightning flashes ranges from 2% in June to 19% in December;
- the lightning decreases with terrain elevation;
- the diurnal variation peaks in the interval between 1600 and 1800 LT.

## 5. REFERENCES


Orville, R.E., and G.R. Huffines, 2001: Cloud-to-Ground Lightning in the United States: NLDN Results in the First Decade, 1989–98. *Mon. Wea. Rev.*, 129, 1179–1193.

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Westcott, N.E., 1995: Summertime Cloud-to-Ground Lightning Activity around Major Midwestern Urban Areas. *J. Appl. Meteor.*, 34, 1633–1642.