LNS as a new tool for severe weather detection in relation to climatic studies

Oleksandr Kryvoshein, Oleksii Kryvobok

Ukrainian hydrometeorological institute, 37 Nauki street, Kyiv, Ukraine

Analysing the history and forecasts of lightning activity, along with other severe weather events and their effects, are required by almost all sectors of the economy and human activity. That is why the creation and development of such Lightning Network Systems is receiving increasing attention in different parts of the world [1]. Until recently, there were no such modern systems in Ukraine that would allow obtaining more accurate and complete information about lightning activity. That is why the Ukrainian Hydrometeorological Institute and the Ukrainian Hydrometeorological Center initiated the creation of such a system. The Lightning Network System (LNS) in Ukraine was installed in 2016 [2]. It consists of 12 sensors located in different parts of Ukraine, which allow identifying both types of lightning: "cloud-ground (CG)" and "inter-cloud (IC)“ for the entire territory of Ukraine and allows the determination of the CG with a probability of 95 %, and the spatial accuracy of lightning detection is about 200 meters (Fig.1)

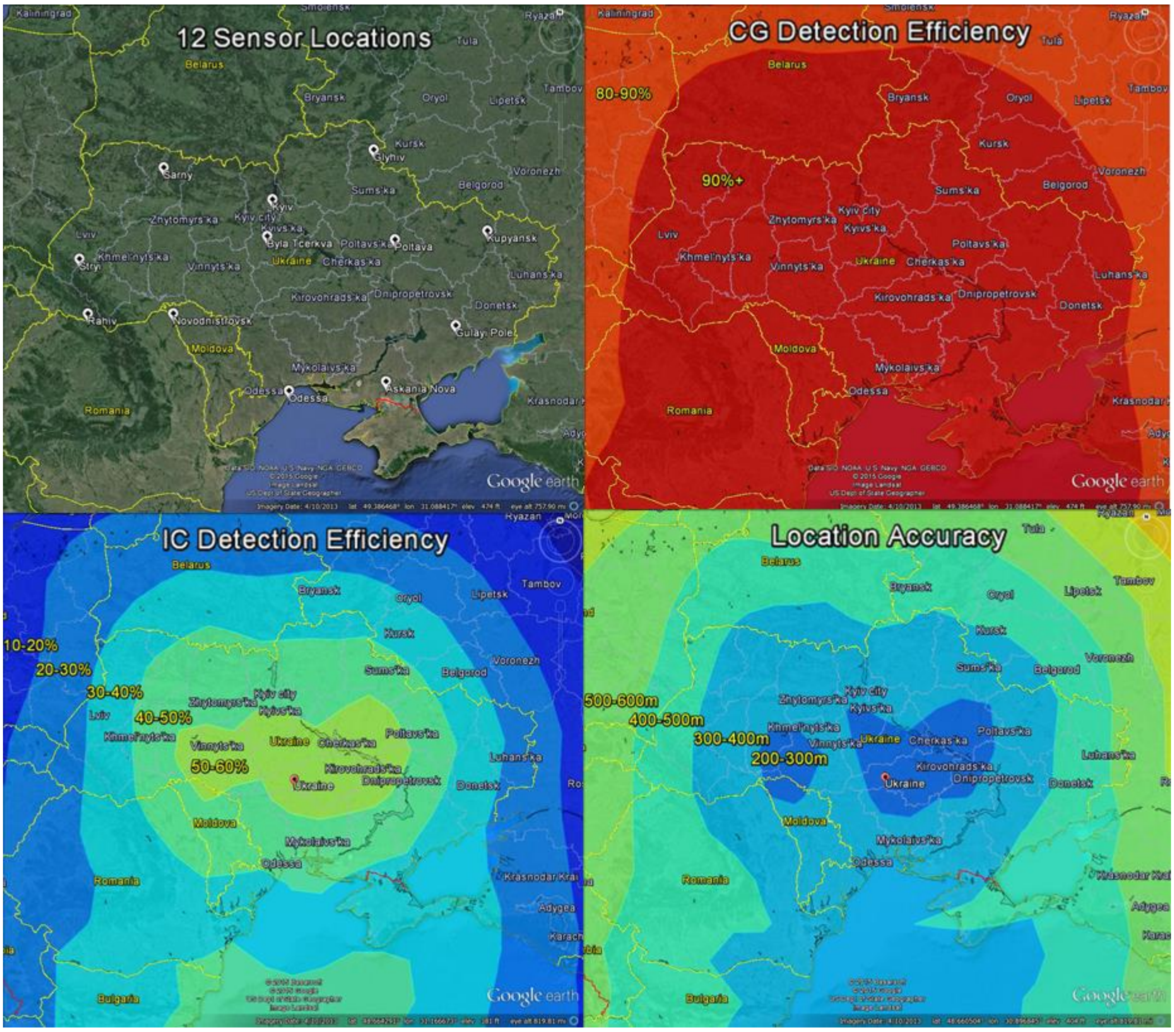

Figure 1: **LNS in Ukraine.**

To analyze the spatial and temporal distribution of lightning activity over the territory of Ukraine, data from LNS within June-September of 2016 period were used. The main idea of the analysis was to compare the average monthly data on lightning activity over the territory of Ukraine in the warm period of the year (June-September), obtained using the new technology (LNS) with the corresponding data at weather stations. The main climatological features of the spatial and temporal distribution of lightning activity over the territory of Ukraine were based on station observations (visual or auditory perception of observer).

It was noted [3] that the areas with the highest number of days with lightning activity are the Ukrainian Carpathians, Volyn, Podolsk, Dnieper and Donetsk highlands, and the smallest number was observed in the Crimea. Our analysis of LNS data showed (Fig.2) that in June, the maximum number of days with a lightnings was observed in the Kiev region (13 days), and the minimum - 1 day on the southern coast of the Crimea, in the rest of the Crimea these values were 5-7 days, which corresponded to the average long-term values. In July, the maximum number of days was noted in the Ukrainian Carpathians (15 days), which is also quite close to the average multiyear - 12 days. In August, there was an increase in the number of days in the south and east of Ukraine (in the Crimea up to 18 days), and the minimum number of days in the north-west was 3 days, which did not correspond to the average multiyear values. In September, almost all over the territory of Ukraine, 1-2 days were observed with lightning activity, which corresponded to the average long-term values.

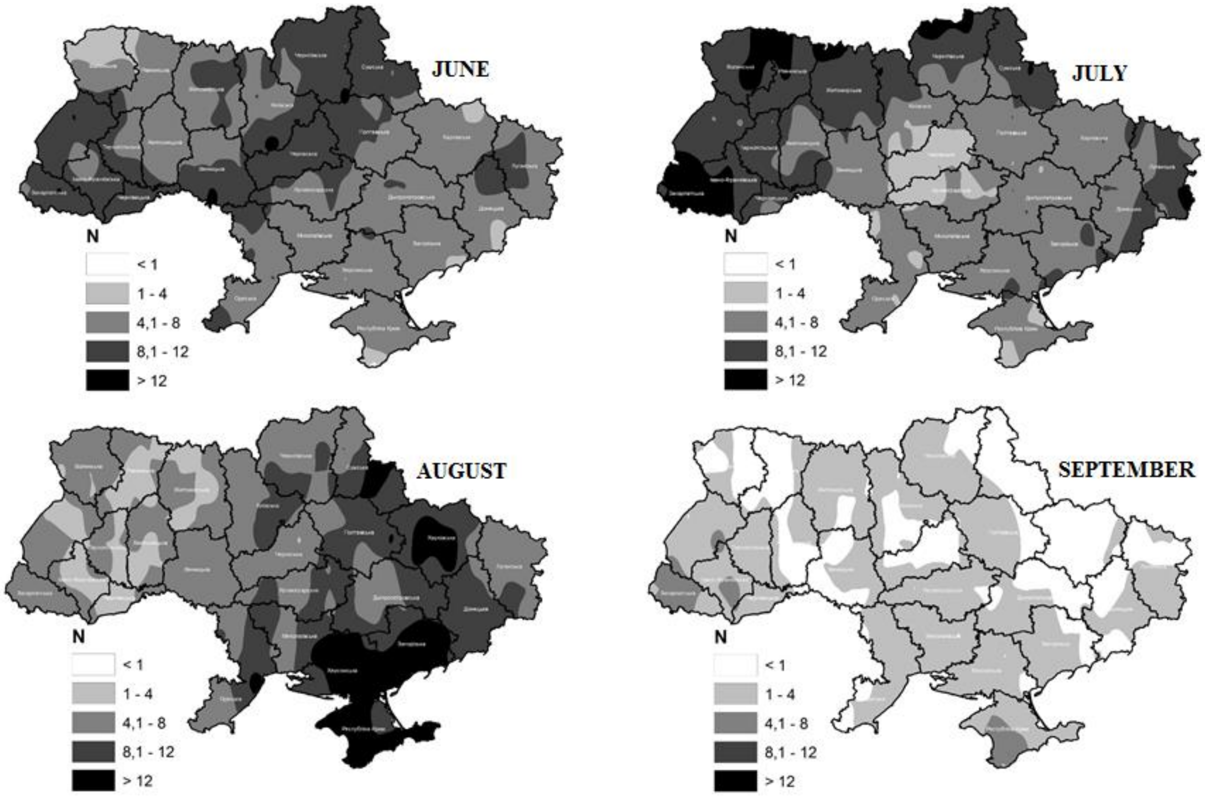

Figure 2: **Number of days with lightnings (LNS data for 2016).**

The greatest inconsistency between the average long-term data and data of LNS was when calculating the ratio of the lightnings number to the number of days with a lightning activity. These long-term averages are within 1.00 - 1.15 (station observations), our analysis showed that variations of this value range from 1 to 500 (Fig.3). Such a large difference is determined by the great technological capabilities of instrumental observations, unlike the observer's subjective assessment.

Of course, one year of LNS data is insufficient for climatic studies. At least 5-10 years of such system operation will help to make more confident conclusions, based on which can be possible to:

- clarify the average long-term indicators of lightning activity;
- determine the intensity of lightning activity in a certain period of time or over a certain territory;
- identify areas that require advanced lightning protection
- take into account areas with an abnormally high lightning density during sensitive objects building (power lines, solar and wind power plants etc.).

Therefore, the LNS should be supported by both local employees of the hydrometeorological service and the government of Ukraine.

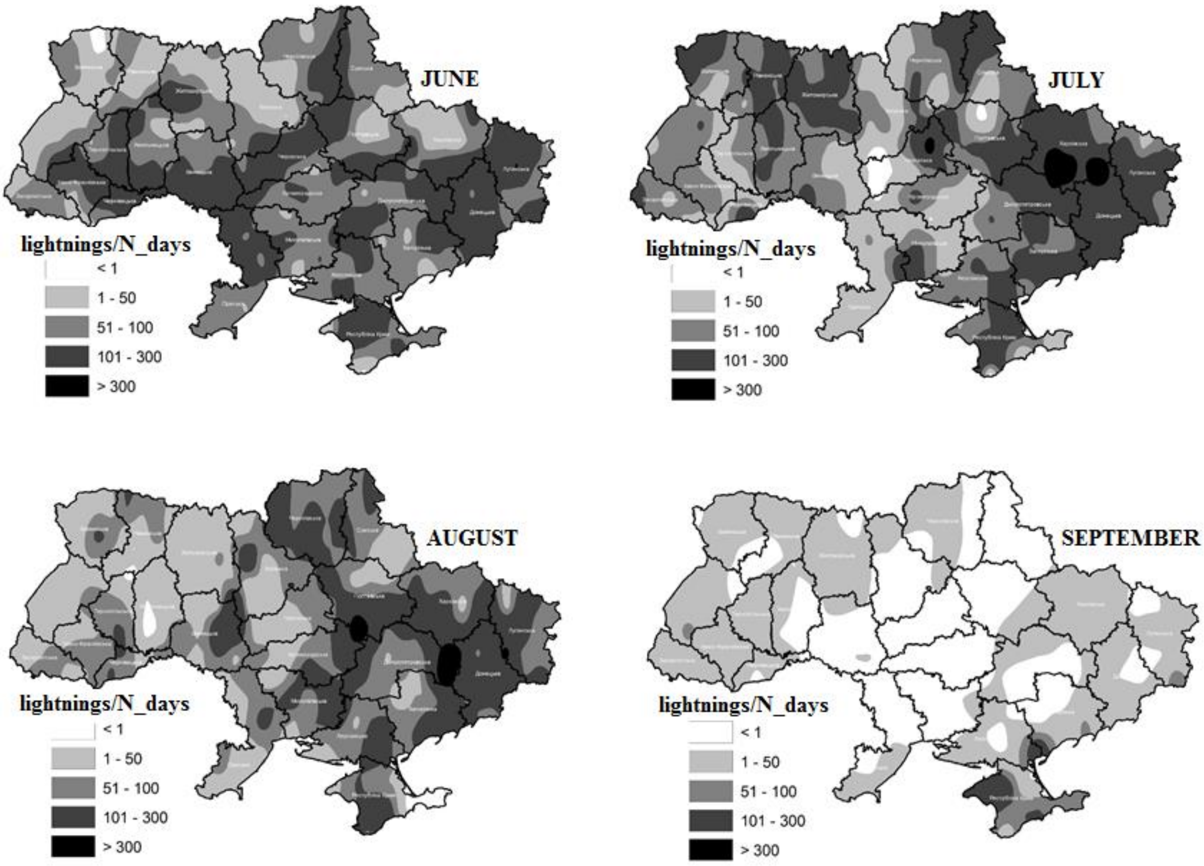

Figure 3: **Lightnings/Number of days with a lightnings (LNS data for 2016).**

References

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2. Kryvobok O.A., Kryvoshein O.O., Koman M.M., Krupa E.O. Ukrainian segment of the ENTLN (Lightning finding system) // Ukrainian hydrometeorological journal. – Odesa, 2018. №21. – P.5-20.
3. Lipinsky, V.M. (Ed). (2003). Klimat Ukrainy [The climate of Ukraine]. Kyiv : Raevsky Publishing House. (in Ukr.)