The lightening discharge registration complex "VEREYA"

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(Dated: September 12, 2007)

I.   INTRODUCTION

Studying of discharges related with the phenomena in clouds has been intensively carried out for a long time. This is the problem of scientific and applied significance. In goal of a satisfactory experimental and theoretical results modern technologies (Meteorological radar, storm detector, devices of selection and measurement of an echo signals, etc.) on active and passive methods of research of a storm electricity of clouds are applied. One of the modern technologies to be implemented in the given area is the lightening discharges (LD) registration system "VEREYA" (Russian Federation).

The system allows registration of LD in the radius of 1000 km (fig. 1). The given system has been installed at the airdromes Nakhchivan, Ganja and helidrome Zabrat (15 km from Baku) of Azerbaijan Republic.
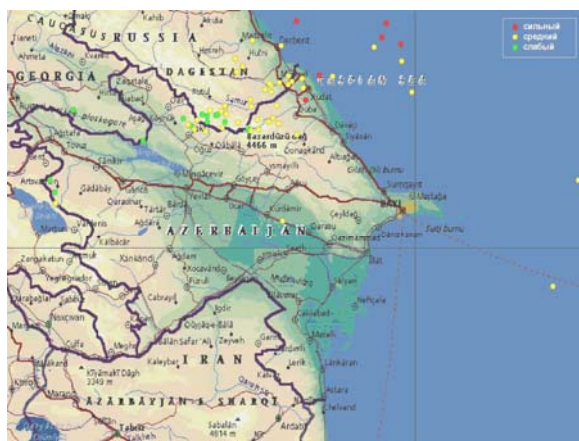

Fig. 1. Storm conditions (red-severe, yellow-moderate and green-weak storms).

II.   PRESENTATION OF RESEARCH

Functioning of the system is based on registration of the electromagnetic radiation generated by lightening discharges, in the several spatially points of registration (RP-registration point) – the lightening detection stations.

The direction (Fi), time of reception of a signal and its parameters is measured in each registration point (fig. 2). The Results of the measurements on each LD are transferred to the data processing center (DPC) where it is being calculated into coordinates and parameters.

Coordinates are calculated on crossing bearings relative to two and more RP and are corrected by hyperbolic method - on crossing the hyperboles formed by a difference of times of received signals (dt) in three and more RP.
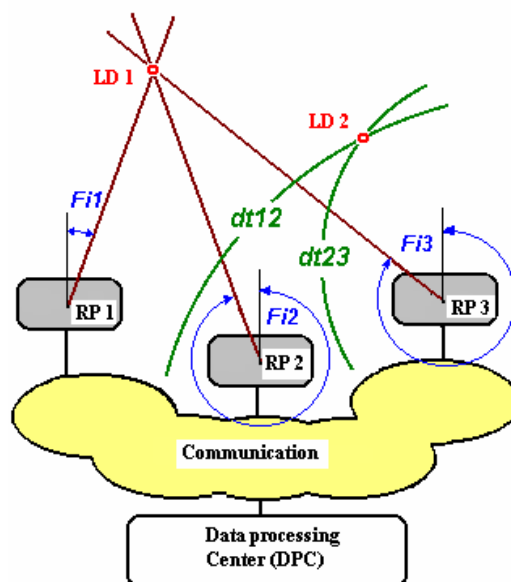

FIG 2. The lightening discharge detection.

On each LD the message containing the following data is formed: time of occurrence; geographical coordinates; deviation of the calculated coordinates; and intensity of the LD.

Data exchange between the RP and DPC is carried out trough the connection system on the basis of an Internet standard protocol TCP/IP.
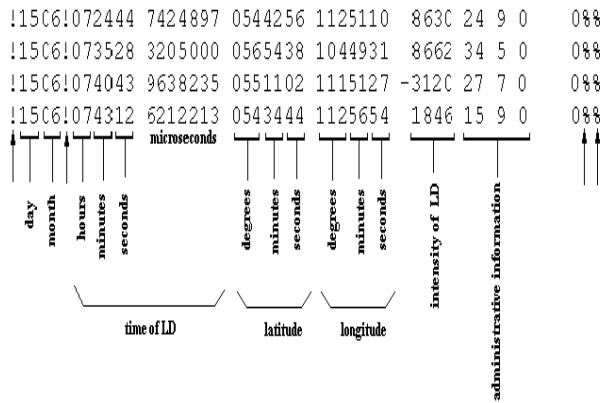
The DPC is functioning on the data gathering from stations, their processing, formation of the primary and derivative (secondary) information products, distribution, analysis and archiving.

Computing process is organized with the help of the tasks scheduler which during set time under the schedule connects required program modules.

Files are transferred in zip format (by the program pkzip). The name of a file is formed as follows:
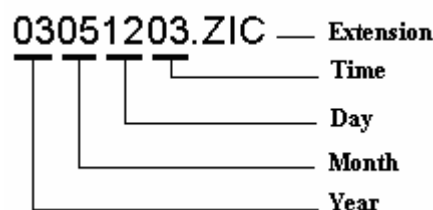
For unpacking of the file use the program pkunzip. After unpacking of the file with the same name and extension .ZOC - a text file (ASCII), containing time, coordinates and parameters of LD will be generated. The files fragment is submitted below:

!15C6!072444 7424897 0544256 1125110 863C 24 9 0   088
!15C6!073528 3205000 0565438 1044931 8662 34 5 0   088
!15C6!074043 9638235 0551102 1115127 -312C 27 7 0   088
!15C6!074312 6212213 0543444 1125654 1846 15 9 0   088

day month hours minutes seconds microseconds

time of LD   latitude   longitude   intensity of LD   administrative information

degrees minutes seconds   degrees minutes seconds

The station is consisted of the complex "VEREYA-LD" and coherent computer. The complex "VEREYA-LD" functions continuous registration of electromagnetic radiation from lightening discharges and calculation of their parameters. Functioning in the structure of the system the coherent computer transferees the information on parameters of the registered signals trough the LAN. The block diagram of the registration point's equipment is submitted in figure 3.

The coherent computer obtains data from the signals processing unit then the software The Bat! forms E-mail and transfers it to the processing center trough telephone liaison channel with use of the modem or by a local network up to the nearest server of the Internet.
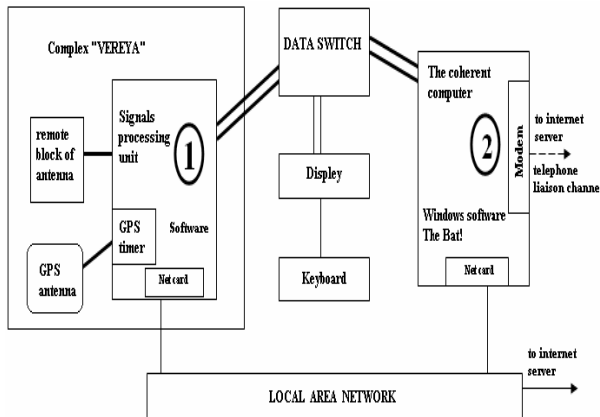
FIG. 3. The block diagram of the registration points equipment.

The complex "VEREYA-LD" is consisted of the remote block of antenna, GPS aerial, block of signals processing.

The block of the antenna is intended for reception, amplification and filtration of LD. The block of the antenna is designed for reception of vertical electric components H_z and two orthogonal horizontal magnetic component H_x, H_y of an electromagnetic field of LD in bandwidth 1 … 50 (150) kHz.

In the structure of the complex serial navigating receiver GPS such as ACI-3 or similar is applied. The receiver is intended for binding of signals of an electromagnetic field of LD to the scale of uniform time.

The block of signals processing functions the following tasks:

1). Transformation of signals to the digital form and their processing according to the fixed algorithm;

2). Formation of standard messages and their delivery in the communication line on external devices.

By a principle of construction the block of signals processing represents the digital automatic device with the fixed algorithm of work.

III. RESULTS AND CONCLUSION

In the figure 4 and 5 the result of modeling of the systems control zones of three and four points of registration are submitted. The areas of the control zones are submitted in the table 1.

TABLE I. Accuracy of definition within the control zone (3 and 4 RP).

Systems configuration (RP)	Deviation, km	Area, thousand km^2
Zabrat, Nakhchivan, Ganja	1.5	70.6
	5.0	216.5
	15.0	339.5
Zabrat, Nakhchivan, Ganja, Khudat	1.5	138.9
	5.0	270.4
	15.0	353.9

FIG 4. Systems control zones of three registration points (Zabrat, Nakhchivan, Ganja).

FIG 5. Systems control zones of four registration points (Zabrat, Nakhchivan, Ganja, Khudat).

IV. REFERENCES

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Ermakov V.I., Stozhkov Y.I. New mechanism of thundercloud and lightning production. // Proceedings of 11th International Conference on Atmospheric Electricity, Alabama, USA, 1999, 242-245.