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ON THE PREDICTION OF FLOODS CAUSED BY RAINFALL IN THE AREA OF ACTION OF THE METEOROLOGICAL RADAR "METEOR 735CDP10"

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Summary: *Meteorological radar "METEOR 735CDP10" manufactured by "SELEX" (Germany) has been used since 2015 in the operational work of the anti-hail service of Georgia (indication of radar parameters for active exposure to hail dangerous and hail clouds – maximum reflectivity of clouds, height of maximum reflectivity, maximum cloud height, the size of hailstones in the cloud, etc.). Work is carried out in the Kakheti region of Georgia. The working radius of the radar in this case is 100-120 km and covers the entire territory of Kakheti. Season of the anti-hail works continues from April to October. The radar also allows you to determine the intensity of liquid precipitation, and when fixing in its computer program the coordinates of the area where floods often occur during rainfall, it is possibility forecasting these floods. Moreover, out the season of anti-hail works, the radius of the radar can be increased to 200 km and almost cover almost the entire territory of Eastern Georgia.*

The paper provides a map of points with recurring floods during rainfall in Eastern Georgia and examples of comparing radar data on precipitation intensity with flood data at these points. The accumulation of this information will allow creating an algorithm for flood forecasting in Eastern Georgia based on the results of radar monitoring of the precipitation intensity.

Key Words: *Radar monitoring, prediction of floods.*

Introduction

Georgia – small mountain country with 15 climatic zones, on territory of which different forms of geophysical catastrophes happen from time to time (drought, hurricanes, lightning, hail damage, degree of frost, fogs, frosts, landslides, mudflows, snowy avalanches, sudden floods, earthquake). Therefore, special attention was always paid and is paid to the study of dangerous geophysical phenomena in Georgia. In recent years special attention was paid to the works on an estimation of risks and multi risks of natural catastrophes, including hydro-meteorological (thunderstorm, hail, fogs, avalanche, frosts, flood, gale wind, etc.). Territory of the Georgia was divided into districts according to the degree of hydro-meteorological danger, economic damage, etc. [1].

A significant quantity of catastrophes (flood, seasonal floods, flooding) is connected with thaw of snows, and also protracted or strong (usually into the warm half-year) atmospheric precipitations [2-4]. Thus, in Georgia in 2016-2018 about 80 days with the indicated hydro-meteorological phenomena were observed (Fig. 1).

In connection with that, both in the early periods of time and at present, significant number of works is devoted to a study of the time-spatial characteristics of atmospheric precipitations, their changeability in connection with climate change, and also to the prognostication of this changeability on the territory of Georgia [5-7]. In addition to this, meteorological radar has the ability to give us a short term prognostications of heavy atmospheric precipitation for the purpose of warning of different organizations and population about the possibility of the floods, seasonal floods, and floodings in the concrete localities. The meteorological radar existing in the anti-hail service was acquired because it has such applications [8-10].

Material and methods

Meteorological radar "METEOR 735 CDP 10 – Doppler Weather Radar" is established in the village Chotori of the Signagi municipality of Kakheti region of Georgia [8]. The products of radar are sufficiently varied [10, 11]. This work presents radar product MPPI (dBz), which makes it possible to determine precipitation intensity. In this case radius of action of radar is 200 km (distance, which practically covers the territory of eastern Georgia and the significant parts of the territories of Armenia, Azerbaijan, North Caucasus, Fig. 1, 2).

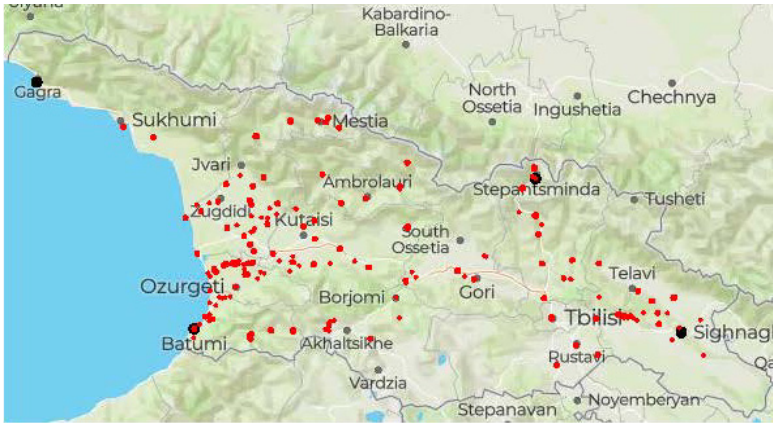

Fig. 1. Distribution of Heavy Rainfall, Floods and Floodings on the Territory of Georgia in 2016-2018.

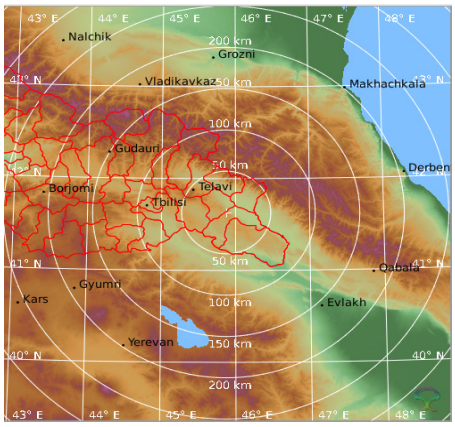

Fig. 2. Radar Coverage for Rainfall Measurement.

At present we are working on comparing radar data about the precipitation intensity with the cases of floods, seasonal floods and floodings on the territory of eastern Georgia, which in the first approximation, will make it possible to create the algorithm of the prognostication of these phenomena. Some examples of radar observations for the separate days with strong precipitations in eastern Georgia, which led to the indicated negative phenomena are given below.

Results and discussion

The results in Fig. 3-8 are shown.

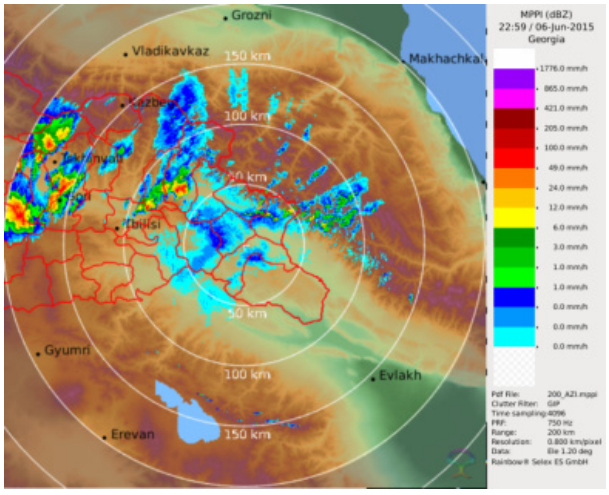

Fig. 3. Radar Picture of Precipitation Intensity in Gori on June 6, 2015

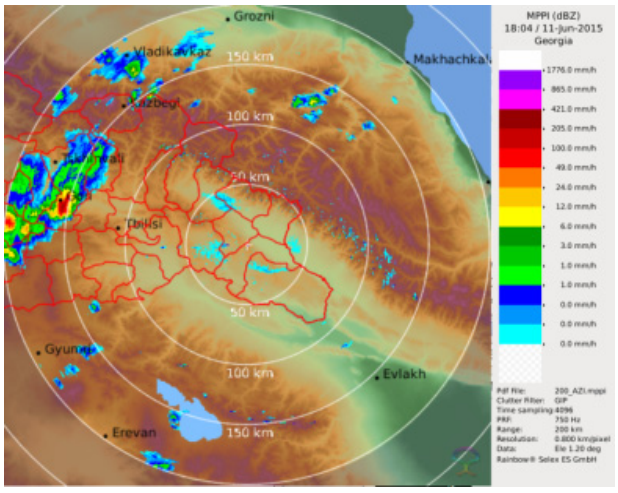

Fig. 4. Radar Picture of Precipitation Intensity in Gori on June 11, 2015

Fig. 3 depicts data of radar surveillance of the intensity of the precipitation of the city Gori on 6 June 2015 in 22:59 hours. Western process was observed during this day. Judging by the radar pictures, precipitation intensity in the Gori municipality reached 100 mm/h. Precipitations led to the flood. On the

night of 7 June 2015 as a result of four hour long intensive rain in the Gori municipality completely flooded more than 20 villages. To 100% were destroyed agricultural land in the populated areas of Olozi, Tsedisi and Bnavisi in the Aneni gorge. Mud-and-gravel that flowed from the mountains overlapped rural roads. The territory on which the refugees settled in Shavshvebi was flooded. Flood flows from the mountains flooded several apartment houses in the village of Akhaldaba. In the village of Skra the left coasts of the river of Skra destroyed the village water supply.

In five days on 11 June, as a result of pouring rains, waters of the left the coasts of river in the Ateni gorge flooded in the villages apartment houses, roads, homestead sections (rain continued for about 40 minutes). Poultry and small livestock perished, several houses tore away from the foundation and took away. The harvest of fruits and grapes was destroyed, water laid sowings. Flood flows in some places blocked the roads. Bridges were damaged. In the previous week Ateni gorge was already damaged by hail twice. Radar data surveillance of the intensity of precipitation over the city of Gori on 11 June 2015 on 18:04 hours are represented in Fig. 4. Western process were observed in both preceding case and during that day. Precipitation intensity reached 100 mm/h.

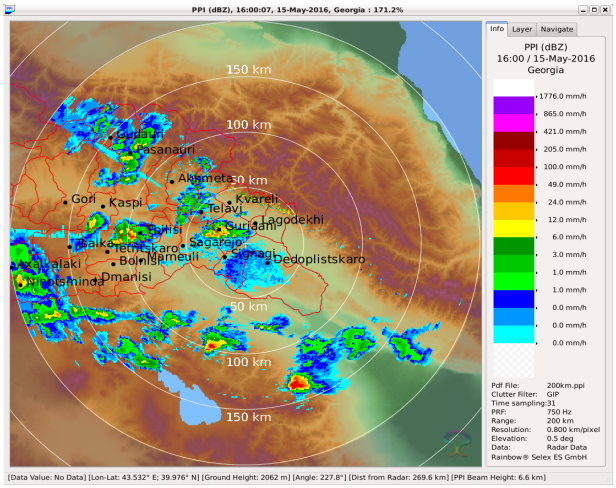

Fig.5. Radar Picture of Precipitation Intensity in Kakheti on May 15, 2016

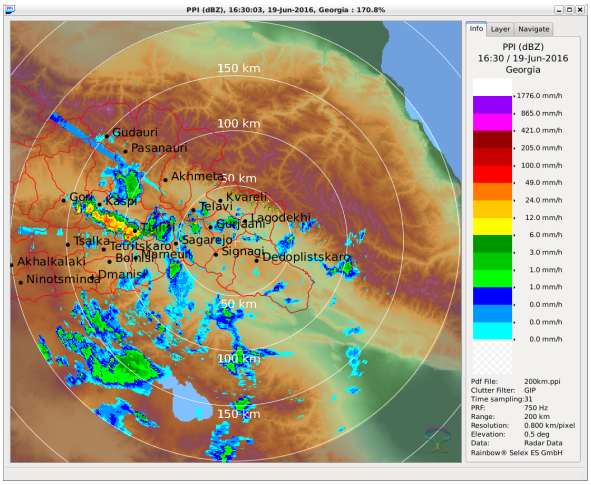

Fig. 6. Radar Picture of Precipitation Intensity in the Adigeni Municipality on May 29, 2016

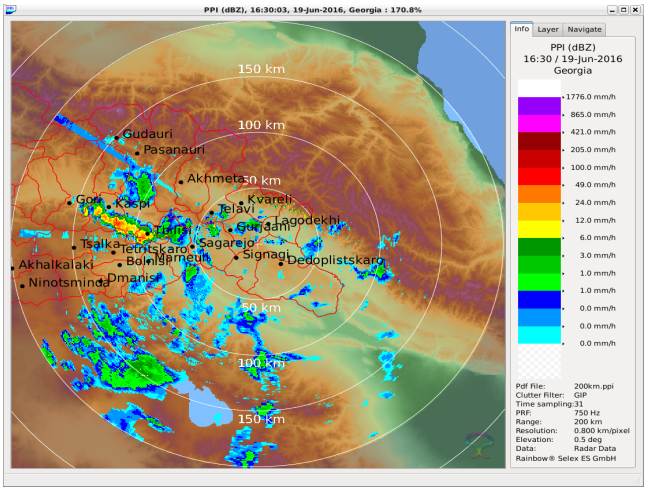

Fig. 7. Radar Picture of Precipitation Intensity in the Gori Municipality and Tbilisi on June 19, 2016

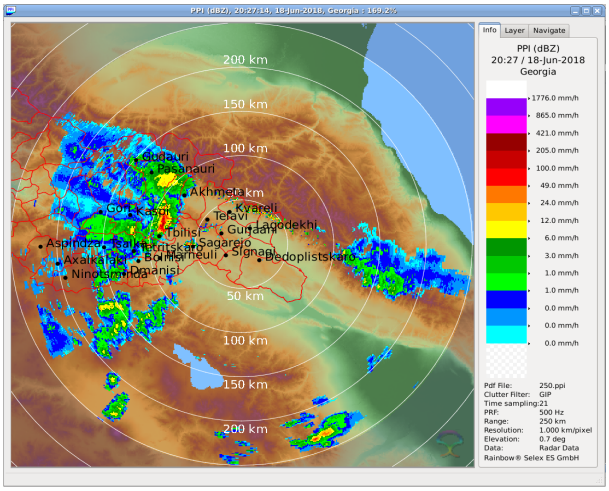

Fig. 8. Radar Picture of Precipitation Intensity in the Dusheti Municipality on June 18, 2018

On May 15, 2016, residential houses in the villages of Chayluri, Kakabeti, Burdiani were flooded in Kakheti (Fig. 5). This figure also demonstrates the possibility of radar monitoring of precipitation intensity outside of Georgia. 29.05.2016 the villages of Varhani, Benari, Arali and other settlements (Adigeni municipality) were affected, and cattle and poultry were washed away by streams of water (Fig. 6).

19.06.2016 (Fig. 7) flooded bridge in the center of Ruisi (Gori municipality), stopped traffic. Flooded Tsavkisi gorge (Tbilisi).

18.06.2018 in Dusheti (Fig.8), the basements of residential buildings were flooded, the crop were destroyed (rainfall up to 100 mm/hour). Fig.8, like Fig. 5, also demonstrates the possibility of radar monitoring of precipitation intensity outside Georgia.

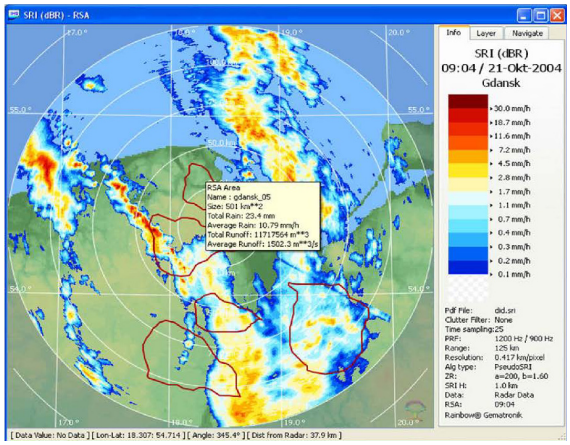

Fig. 9. Example of Radar Product – RSA RIVER SUBCATCHMENT ACCUMULATION to Determine the Degree of Flooding of a Specific Area [10].

Conclusion.

Subsequently, for the purpose increasing the accuracy of the radar measurements of precipitation intensity in real time, it is intended to place in the investigated region the network of the automatic precipitation gauges, remotely conjugated with radar. It is intended to also conduct a more detailed study of the connection of precipitation intensity according to the data of radar measurements with catastrophic processes (flood, landslides, torrents, avalanche), proceeding on the earth's surface. Additionally, the software of radar allows us to outline localities with the frequent floods, which will make possible to use a product RSA – RIVER OF SUBCHATCHYUMENT OF ACHCHUMULATION (Fig. 9), which increases the accuracy in forecasting of floods for the concrete places.

In perspective this will make it possible to build the regional model of the relation of the radar parameters with the indicated phenomena, which will make possible to conduct in advance (several ten minutes) warning of population and corresponding organs about the forthcoming dangerous hydro-meteorological processes.

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