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COMPARISON OF THE RADAR AND GROUND-LEVEL CHARACTERISTICS OF THE HAIL PROCESS ON 10 JUNE 2017 IN TBILISI

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Summary: *The data of the radar measurements of the maximum sizes of hailstones and horizontal area of a hail cell of a cloud with a hail diameter ≥ 0,5 cm during two hail processes on 10 June 2017 above Tbilisi are cited. Simultaneously the expected size of falling out to the earth's surface of hailstones taking into account the radar data about their diameter in the clouds was calculated. The satisfactory agreement of calculated and measured on the earth's surface of the sizes of hailstones is obtained.*

Key Words: *Meteorologycal radar, hail storm, hailstones size.*

Introduction

Georgia is one of the hail-dangerous countries of world [1]. Taking into account the significant economic damage, brought by hail damages, in Georgia in the beginning of the fifties of past century began works on the fight with the hail. These works continued until 1989 [2] and were renewed on a new technological basis in Kakheti region of Georgia in 2015 [3,4]. The anti-hail service is equipped with a modern meteorological radar, which in the future, in addition to anti-hail activities, is planned to be used for operational monitoring of dangerous hydrometeorological processes in eastern Georgia and adjacent to its territories. Below is an example of such use of radar outside the hail-protected territory in the case of the hail process in Tbilisi on June 10, 2017.

Material and methods

Information about hailstorms with the data obtained by a Weather Radar with a special software, operated by the State Military Scientific-Technical Center “DELTA” is received. The Anti-hail service is equipped with contemporary C-band, dual polarized Doppler meteorological radar “**METEOR 735 CDP 10 - Doppler Weather Radar”**, which is installed in the village Chotori (1090 m height from sea level) of the Signagi municipality of the Kakheti region of Georgia [5,6]. The products of radar are sufficiently varied [7-9]. For the anti-hail works the optimum radius of action of radar is 100-120 km.

In this work one radar products is used - HAILSZ (Size) [8,9]. This product the sizes of hailstones and a horizontal area of a hail cell of a cloud allows to define. The expected size of falling out to the earth's surface of hailstones taking into account the radar data about their diameter in the clouds according to [10] was calculated. The mass media information about the hail damages is used also.

The following designations will be used below: D_o – maximum hail diameter in cloud, cm; D – maximum hail diameter at the ground level, cm; $S_{\geq 0,5}$ - the horizontal area of a hail cell of a cloud with a hail diameter ≥ 0,5 cm, km^2; time designation, for example, 14 hour 33 min – 14:33, etc.

Results and discussion

The results of studies in figures 1-5 clearly are presented.

The first hailstorm process in the northern part of Tbilisi from 14:17 to 14:45 was observed. Values of $S_{\geq 0,5}$ changes from 12 to 53 km^2, and values of D_o – from 0,9 to 2,6 cm. Two fragments of radar observations of this process are shown in fig. 1, and all the data on the maximum sizes of hailstones - in fig. 3.

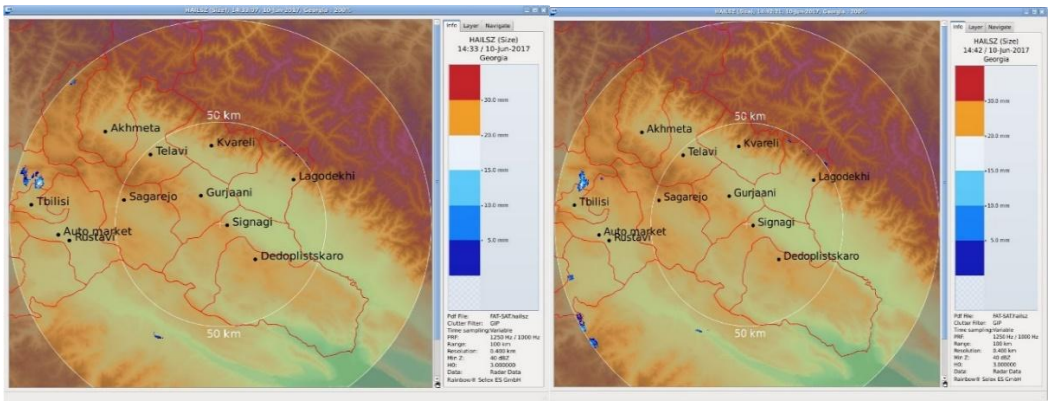

Fig. 1. Data of radar product HAILSZ about the first hail process in Tbilisi on 10 June 2017 in 14:33 (D_o = 1,5 cm;
$S_{\geq 0,5}$ = 30 km^2) and 14:42 (D_o = 1,9 cm; $S_{\geq 0,5}$ = 35 km^2) hour.

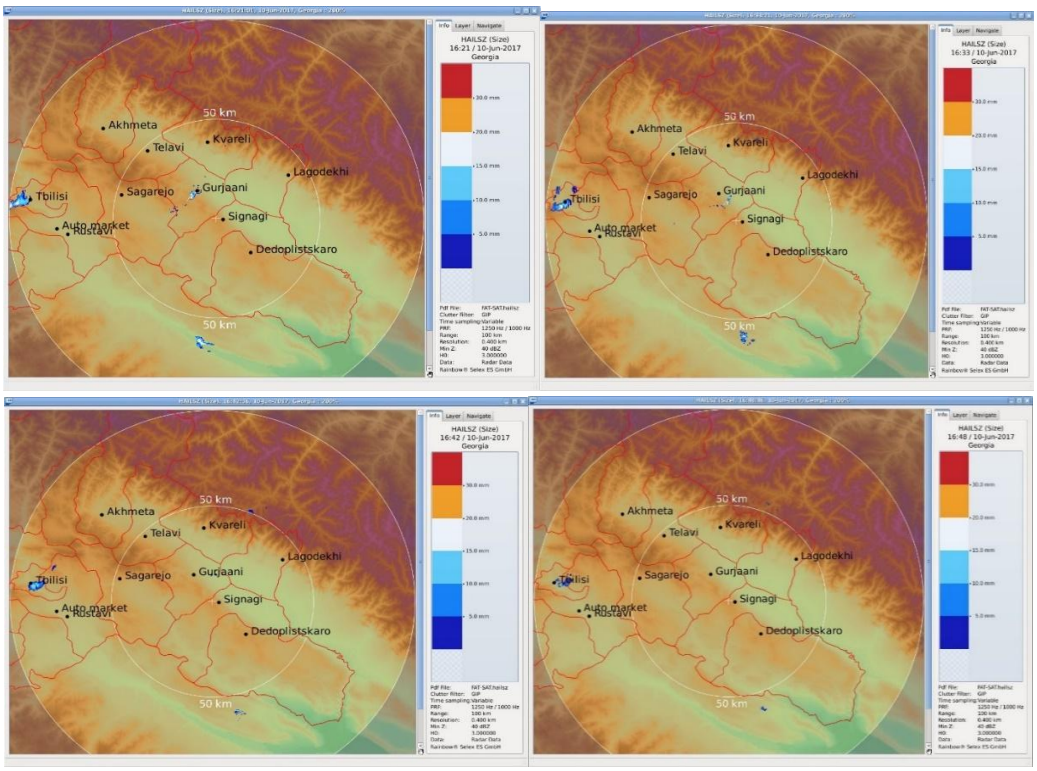

Fig. 2. Data of radar product HAILSZ about the second hail process in Tbilisi on 10 June 2017 in 16:21 (D_o = 2,6 cm;
$S_{\geq 0,5}$ = 50 km^2), 16:33 (D_o = 2,5 cm; $S_{\geq 0,5}$ = 60 km^2), 16:42 (D_o = 2,1 cm; $S_{\geq 0,5}$ = 31 km^2) and 16:48 (D_o = 1,9 cm; $S_{\geq 0,5}$ = 20 km^2).

The second hailstorm process in the central part of Tbilisi from 16:06 to 16:58 was observed. Values of $S_{\geq 0,5}$ changes from 5 to 63 km^2, and values of D_o – from 1,0 to 2,7 cm. Four fragments of radar observations of this process are shown in fig. 2, and all the data on the maximum sizes of hailstones - in fig. 4.

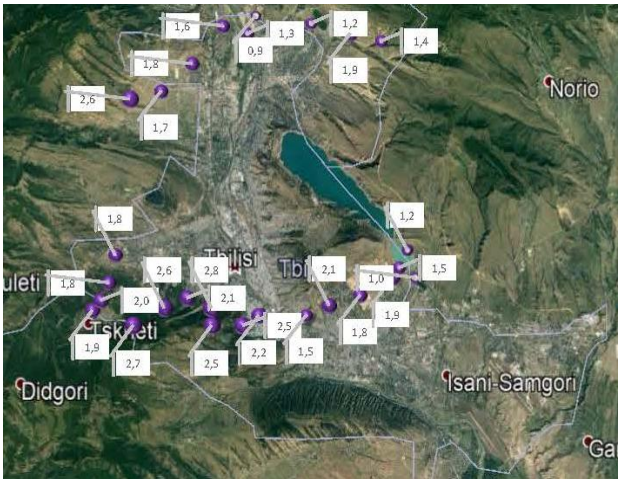

Fig. 3. Trajectory of the movement of the center of the two hail cells on 10 June 2017 over Tbilisi (numbers below - the maximum sizes of hailstones in clouds, cm)

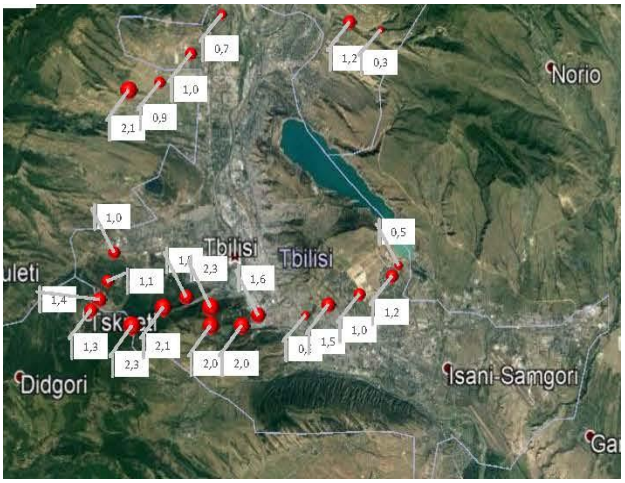

Fig. 4. Places of the falling hailstones and calculated values of their maximum size on the earth's surface in Tbilisi during two hail processes on 10 June 2017 (numbers below - sizes of hailstones, cm)

The places of the falling hailstones and calculated values of their maximum size on the earth's surface in Tbilisi during two hail processes on 10 June 2017 on the fig. 4 are presented. As follows from this fig. the values of D during first hailstorm process change from 0,3 to 2,1 cm, and during second process - from 0,5 to 2,3 cm.

Fig. 5. The hailstones sizes at the ground level in Tbilisi 10 June 2017. https://www.ambebi.ge/article/204240-kaklisodena-setqva-dazianebuli-avtomobilebi-da-datborili-kuchebi-dramatuli-potokadrebi-tbilisis-kuchebidan/

On the fig. 5 the hailstones sizes at the ground level in Tbilisi 10 June 2017 are presented (D ≈ 2-2,5 cm). As follows from fig. 4 and 5 the satisfactory agreement between calculated and measured on the earth's surface of the sizes of hailstones is obtained.

According to the TORRO Hailstorm Intensity Scale (http://www.torro.org.uk/hscale.php) haistones with diameter 2-3 cm lead to the following damage: severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored, as can be seen from Fig. 5.

Conclusion

At present, the anti-hail service carries out continuous radar monitoring of weather in eastern Georgia and adjacent territories of neighboring countries. The radar information is transmitted in parallel to the National Environmental Agency of Georgia. In the near future, it is planned to further improve the system of operative warning of the population about dangerous hydrometeorological phenomena.

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