

Radar Characteristics of the Hail Process on 10 June 2017 in Rustavi Municipality (Georgia)

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ABSTRACT

The data of some radar parameters of the convective cloud (maximum height of the radio-echo, maximum radar reflectivity, height of the center of maximum radar reflectivity, maximum sizes of hailstones and horizontal area of a hail cells of a cloud with a hail diameter ≥ 5 mm and ≥ 15 mm) during hail processes on 10 June 2017 above Rustavi municipality are cited. In particular it is shown that the diameter of hailstones in the cloud changed from 8 to 31 mm. From the fallen hail on the Rustavi auto-market to the different rate more than 5000 automobiles are damaged.

Key Words: Meteorological radar, hail storm, hailstones size.

Introduction

Georgia is known as to one of the hail-dangerous countries of world [1-7]. 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 [3,7-9] and were renewed on a new technological basis in Kakheti region of Georgia in 2015 [10-12]. 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 [13-18]. An example of such use of radar outside the hail-protected territory in the case of the hail process in Rustavi municipality on June 10, 2017, which was the continuation of the hail process above Tbilisi during the same day [19], is presented below.

Material and methods

We are going to complement the space data on precipitation with the data obtained by a Weather Radar with a special software, operated by the State Military Scientific-Technical Center "DELTA".

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 [13,16]. The products of radar are sufficiently varied [14,15]. For the anti-hail works the optimum radius of action of radar is 100-120 km, for monitoring of intensity of precipitation - 200 km (distance, which practically covers the territory of eastern Georgia and the significant parts of the territories of Armenia, Azerbaijan, North Caucasus). For the survey observations - more than 400 km [13,16].

In this work two radar products are used, MAX(dBZ) and HAILSZ (Size) [14]. The MAX product takes a polar volume set, converts it to a Cartesian volume, generates three sub images (N-S, W-E, TOP) and combines them to the displayed image. ZHAIL analysis the vertical reflectivity structure above the melting layer (0 degree Celsius isotherm). The height of this layer may be entered manually, or it is read from a data file [21,21]. The identified patterns are displayed by its hail probability value [14,15].

The mass media information about the hail damages is used also.

The following designations will be used below: H_{max} - maximum height of the radio-echo of cloud, Z_{max} - maximum radar reflectivity of cloud, $H_{z_{max}}$ - height of the center of maximum radar reflectivity of cloud, $S_{\geq 5 \text{ mm}}$ and $S_{\geq 15 \text{ mm}}$ - areas of a hail cells of a cloud with a hail diameter $\geq 5 \text{ mm}$ and $\geq 15 \text{ mm}$ respectively.

Results and discussion

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

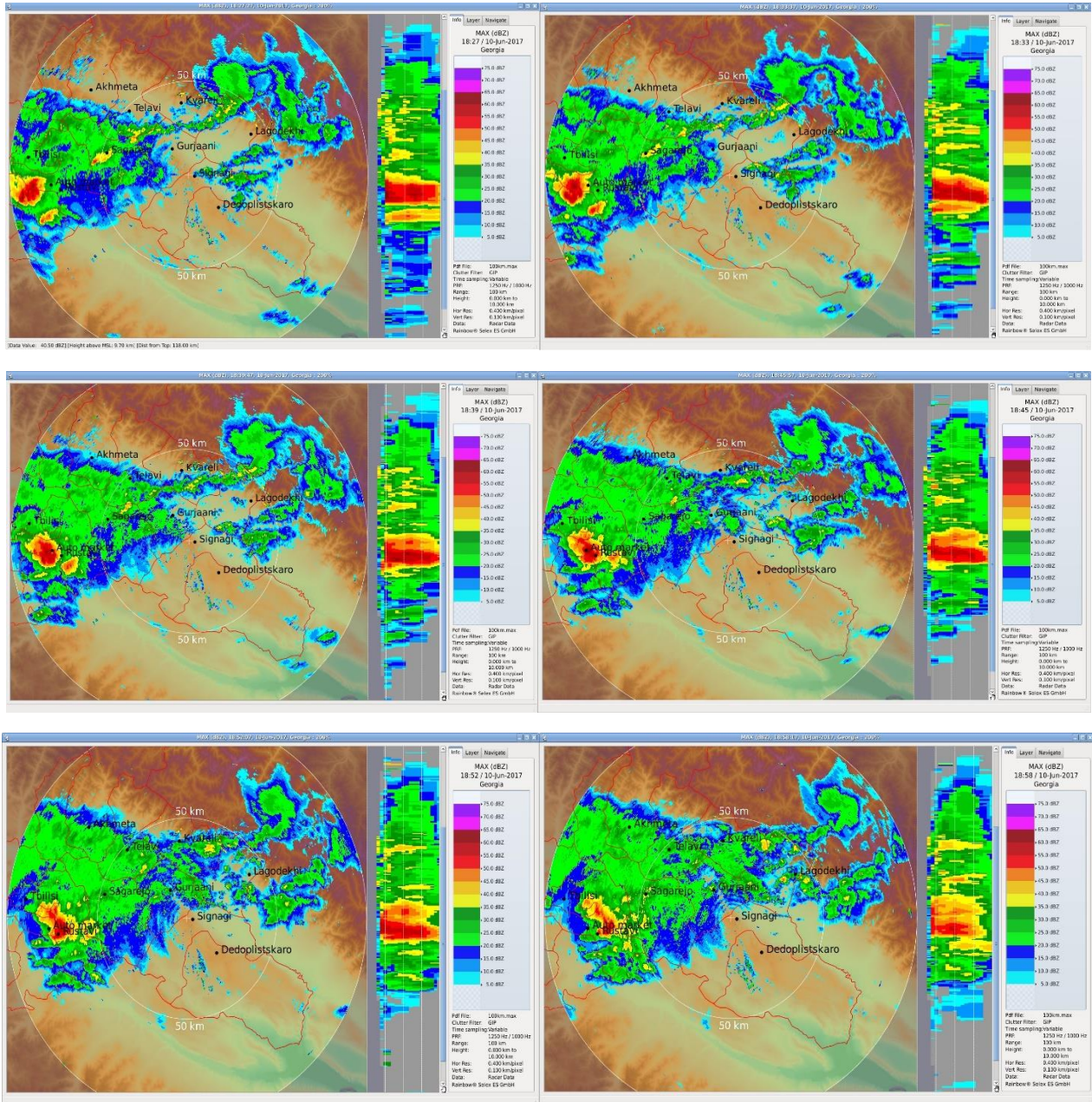


Fig. 1. Data of radar product MAX(dBZ) about the hail cloud on 10 June 2017 in Rustavi Municipality in 6 moments of time.

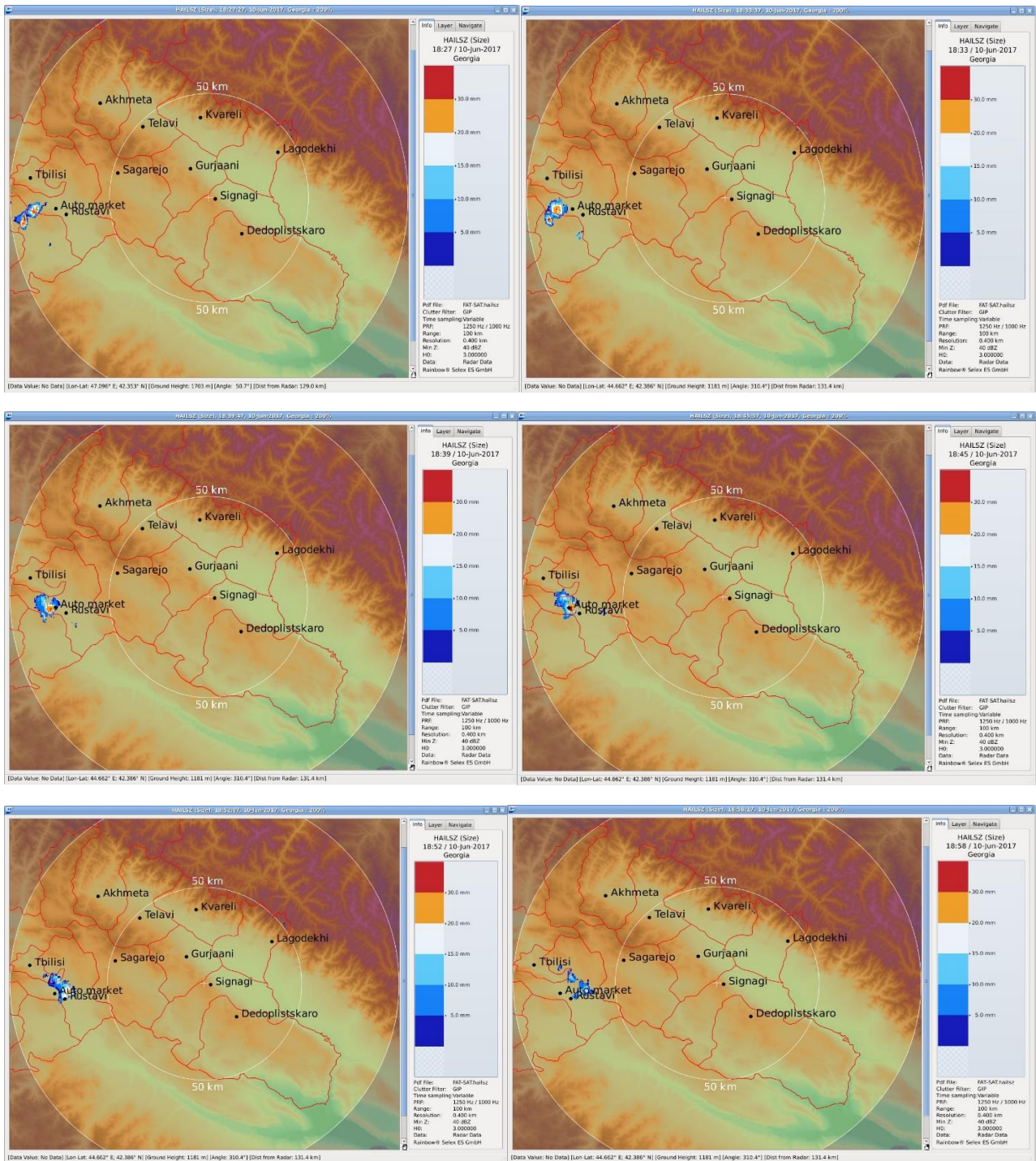


Fig. 2. Data of radar product HAILSZ about the hail cloud on 10 June 2017 in Rustavi Municipality in 6 moments of time.

As it follows from Fig. 1 and table from 18:30 to 18:58 values of H_{max} changed from 13.2 to 15.8 km, Z_{max} - from 56 to 67 dBZ, $H_{z_{max}}$ - from 4.9 to 7.9 km. Values of $S_{\geq 5 \text{ mm}}$ and $S_{\geq 15 \text{ mm}}$ changed from 75 to 126 km² and from 6 to 37 km² respectively (Fir. 2, table). Diameter of hailstones in the cloud changed from 8 to 31 mm (Fig. 3).

From the fallen hail on the Rustavi auto-market to the different rate more than 5000 automobiles are damaged (Fig. 4,5).

Some radar parameters of the hail cloud on 10 June 2017 in Rustavi Municipality in 6 moments of time according to Fig. 1-2

Time, hour:min	H_{max} , km	Z_{max} , dBZ	H_{zmax} , km	$S_{\geq 5}$ mm, km ²	$S_{\geq 15}$ mm, km ²
18:27	13.8	65	6.5	91	31
18:33	13.4	65	6.8	98	37
18:39	14.9	67	5.7	102	28
18:45	15.8	63	7.9	107	27
18:52	13.1	59	6.2	126	30
18:58	13.2	56	4.9	75	6



Fig. 3. Trajectory of the movement of the center of the hail cell on 10 June 2017 from 18 hours 12 min through 19 hours 13 min (numbers below - the maximum sizes of hail stones in mm, AM - Rustavi Auto Market)



Fig. 4. Hail in Rustavi on 10 June 2017

http://pimg.mycdn.me/getImage?disableStub=true&type=VIDEO_S_720&url=http%3A%2F%2Fvdp.mycdn.me%2FgetImage%3Fid%3D283836155197%26idx%3D30%26thumbType%3D47%26f%3D1%26i%3D1&signatureToken=ufmUSs5OxaX2MJAjRzMggA – Left
<https://i.ytimg.com/vi/xGS648MXzWw/maxresdefault.jpg> - Right



Fig. 5. Hail at the Rustavi Auto Market 2017 June 10. More than 5000 automobiles are damaged.
<https://sputnik-georgia.ru/video/20170202/234741271/rustavskiy-avtorinok-autopapa-v-poiskah-mashini-mechti.html>

Conclusion

In the near future, besides the anti-hail works, it is planned to further improve the system of operative warning of the population about dangerous hydrometeorological phenomena.

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2017 წლის 10 ივნისს რუსთავის მუნიციპალიტეტში (საქართველო) სეტყვიანობის რადიოლოკაციური მახასიათებლები

ნ.ჯავახიშვილი

რეზიუმე

წარმოდგენილია მონაცემები 2017 წლის 10 ივნისის სეტყვის პროცესის დროს რუსთავის მუნიციპალიტეტის თავზე კონვექტიური ღრუბლის ზოგიერთი რადიოლოკაციური მახასიათებლის შესახებ (რადიოექოს მაქსიმალური სიმაღლე, მაქსიმალური რადიოლოკაციური ამრეკვლადობის, მაქსიმალური რადიოლოკაციური ამრეკვლადობის ცენტრის სიმაღლე, ღრუბელში სეტყვის მარცვლის მაქსიმალური ზომა, ღრუბელში სეტყვის მარცვლების ≥ 5 მმ და ≥ 15 მმ ზომის მქონე უჯრედების ფართობები). ნაჩვენებია კერძოდ, რომ სეტყვის მარცვლის ზომები ღრუბელში იცვლებოდა 8–დან 31 მმ–დე. მოსული სეტყვის შედეგად რუსთავის ავტობაზრობაზე 5000 მეტმა ავტომანქანამ სხვადასხვა ხარისხის დაზიანება მიიღო.

Радиолокационные характеристики градобития 10 июня 2017 года в Руставском муниципалитете (Грузия)

Н.Р. Джавахишвили

Резюме

Представлены данные о некоторых радиолокационных характеристиках конвективного облака (максимальная высота радиозаха, максимальная радиолокационная отражаемость, высота центра максимальной радиолокационной отражаемости, максимальный размер града в облаке, площади градовых ячеек облака с диаметром града ≥ 5 мм и ≥ 15 мм) при градовом процессе 10 июня 2017 года над Руставским муниципалитетом. В частности показано, что диаметр града в облаке менялся от 8 до 31 мм. От выпавшего града на Руставском авторынке в разной степени пострадало более 5000 автомобилей.