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SOME RESULTS OF ANTI-HAIL WORKS IN KAKHETI INTO 2016-2019

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Summary: Some results of anti-hail works in Kakheti into 2016-2019 are presented**.** Period of observation: April-October, 2016-2019. The area of shielded from the hail territory - 800000 hectares, including total area of agricultural land - 565000 hectares. In particular, the mean annual values of some characteristics of hail processes and parameters of active action on them are following: number of days with the action on the hail processes – 46; number of clouds, subjected to action – 204; number of clouds, which gave hail damage – 16; quantity of the used rockets – 3176; area of the territories, damaged to 100% - 3069 hectares. In the investigated period of time most frequently they were observed the hail clouds of the third category (44% of cases), most rarely - clouds of first k category (6.7% of cases). The clouds of the fourth category were observed into 8.7 % of cases.

Key words: Weather modification.

Introduction

Kakheti is one of the hail-dangerous regions of the Georgia and world [1-4]. In 1967-1989 here was conducted the production work on the protection from the hail [5, 6], which were renewed in 2015 [7-9].

Anti-hail service is equipped with contemporary radar technology and means of action on the clouds [9-11]. Some results of the works of this service into 2016-2019 are represented below.

Study area, material and methods

Study area – Kakheti region of Georgia. Data of Anti-hail service of Georgia are used. Period of observation: April-October, 2016-2019. The area of shielded from the hail territory - 800000 hectares, including total area of agricultural land - 565000 hectares.

The categories of clouds (objects of action) in the correspondence with [3] were determined.

For the data analysis the standard statistical methods are used. The following designations will be used below: Mean – average values; R^2 – coefficient of determination; 99% Low and 99% Upp – 99% confidence interval of lower and upper calculated level accordingly; D_o – maximum diameter of hailstone in clouds, H_m - the maximum altitude of the radio echo of hail clouds.

Results and discussion

Results in table 1 and fig. 1-4 are presented.

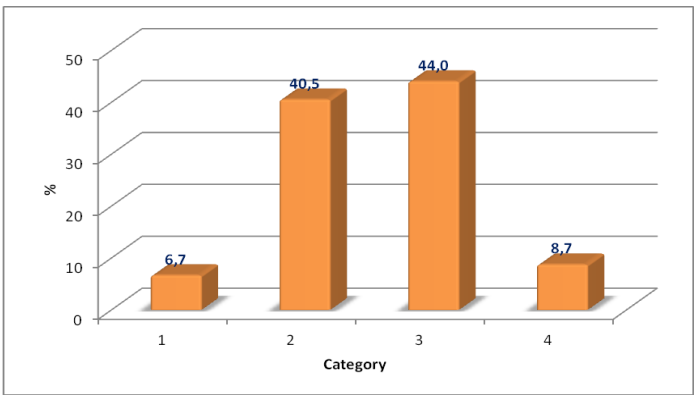

Fig. 1. Repetition of category of hail clouds in Kakheti in 2016-2019.

As it follows from fig. 1 in the investigated period of time most frequently they were observed the hail clouds of the third category (44% of cases), most rarely - clouds of first k category (6.7% of cases). The clouds of the fourth category were observed into 8.7 % of cases.

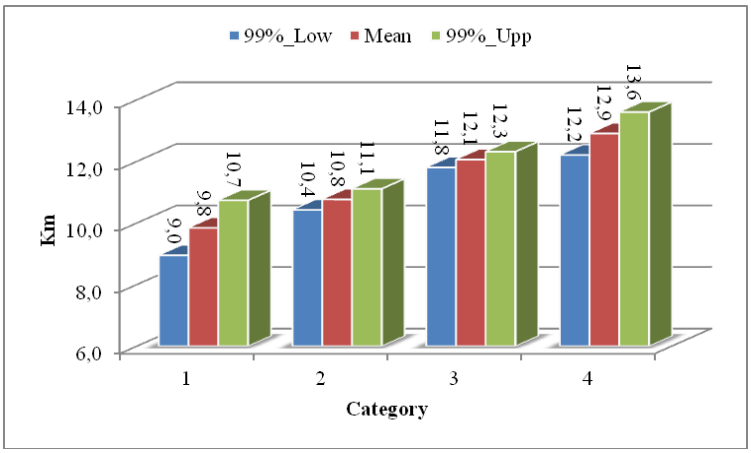

Fig. 2. Mean maximum altitude of the radio echo of clouds depending on their category.

With an increase in the category of cloud the value of the maximum altitude of their radio echo increases (fig. 2). Mean value of H_m changes from 9.8±0.8 km for the clouds of the first category to 12.9±0.7 km for the clouds of the fourth category.

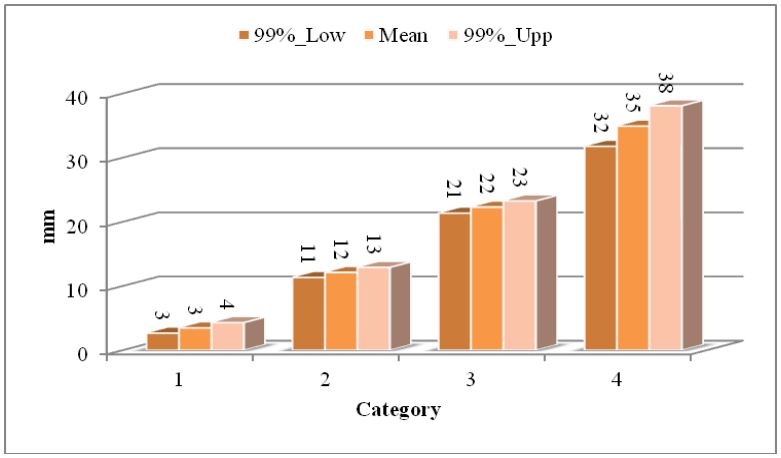

Fig. 3. Mean maximum diameter of hailstones in the clouds of different category.

It is analogous for the maximum size of hail stones (fig. 3). Mean value of D_o changes from 3÷4 mm for the clouds of the first category to 32÷38 mm for the clouds of the fourth category.

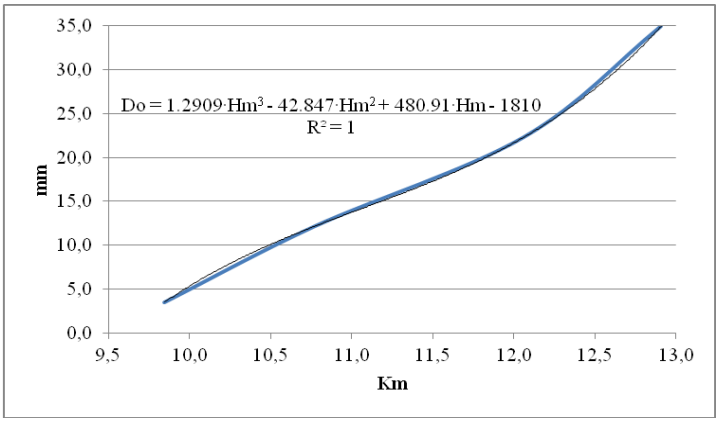

Fig. 4. Dependences of mean values of D_o on mean values of H_m.

Dependences of mean values of D_o on mean values of H_m has the form of the third power polynomial (fig.4).

Table 1. Characteristics of hail processes and parameters of active action on them in Kakheti into 2016-2019.

Parameter/Year	2016	2017	2018	2019	Mean
Number of days with the action on the hail	35	56	40	53	46
Number of clouds, subjected to action	168	274	200	174	204
Number of clouds, which gave hail damage	15	17	14	18	16
Quantity of clouds to 100000 hectares	21	34	25	22	26
Quantity of the used rockets	1262	3790	3227	4426	3176
Quantity of rockets to one cloud	8	14	16	25	16
Quantity of rockets to 100000 hectares	158	474	403	553	397
Number of days with the hail, which gave	14	14	11	10	12
Total area of the damaged territories	8468	8924	4360	6828	7145
Area of the territories, damaged to 100%	4039	3508	2039	2690	3069

In table 1 data about characteristics of hail processes and parameters of active action on them in Kakheti into 2016-2019 are presented.

In particular, as it follows from this table, the mean annual values of some characteristics of hail processes and parameters of active action on them are following: number of days with the action on the hail processes – 46; number of clouds, subjected to action – 204; number of clouds, which gave hail damage – 16; quantity of the used rockets – 3176; area of the territories, damaged to 100% - 3069 hectares.

Finally let us note that the physical effectiveness of action on the hail clouds in Kakheti into 2016-2019 composed 90-94%. Economic effectiveness (cost of the rescued harvest) composed at least 28 million GEL [12].

Conclusion

The comparative analysis of results of the work of anti-hail service in Kakheti with other analogous services of different countries in the near future will be carried out.

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