საერთაშორისო სამეცნიერო კონფერენცია „დედამიწასა და მის გარსებში მიმდინარე გეოფიზიკური პროცესები“
შრომები, ISBN 978-9941-36-147-0, თბილისი, საქართველო, 16-17 ნოემბერი, 2023 წ.
International Scientific Conference "Geophysical Processes in the Earth and its Envelopes"
Proceedings, ISBN 978-9941-36-147-0, Tbilisi, Georgia, November 16-17, 2023

STATISTICAL ANALYSIS OF THE NUMBER OF DAYS WITH HAIL AND DAMAGE TO AGRICULTURAL CROPS FROM IT IN KVEMO KARTLI (GEORGIA)

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Abstract: *A statistical analysis of data on the number of days with hail in the warm half of the year (from April to October) in 10 settlements of Kvemo Kartli (Georgia) - Bolnisi, Dmanisi, Gardabani, Manglisi, Marneuli, Rustavi, Sadakhlo, Shulaveri, Tetri Tskaro, Tsalka - is presented. The observation period is from 30 (Sadakhlo) to 93 (Bolnisi) years. In addition, an analysis of data on damaged areas of agricultural crops in 34 locations of the specified region in 1982, 1985-1989 is provided (total 56 cases with hail).*

In particular, the following results were obtained. The maximum number of days with hail in the warm half-year is observed in Manglisi (16), the minimum - in Rustavi and Sadakhlo (2 each). The maximum average number of days with hail is observed in Manglisi (4.6), the minimum - in Sadakhlo (0.2).

The maximum total area of agricultural crops damaged by hail was noted in Asureti (8.15 km²), the minimum in Tbisi (0.2 km²). The maximum area of agricultural crops damaged by hail by 100% was noted in Sadakhlo (6.18 km²), the minimum - in Tbisi (0.07 km²). In the whole region, for one incident with hail, the total area of damage to agricultural crops was 1.64 km², and for 100% - 0.95 km².

The results of this work will be used to construct a visual map of the distribution of hail cases and hail damage of agricultural on the territory of Kvemo Kartli.

Key words: *Number of days with hail, damage to agricultural crops.*

Introduction

As is known, Georgia is one of the hail-dangerous regions of the world [1-3]. Therefore, both earlier and in recent years, the problem of hail in our country has been and is being given special attention. Many works are devoted to this problem, covering a wide range of studies - from hail climatology and analysis of damage from it [3-12] to modeling the distribution of hailstones according to the average maximum size in the territory of Kakheti (Georgia) [13, 14], as well as the development of ways to influence on hail processes [15].

Currently, significant assistance in intensifying research on hail processes and damage from them in Georgia is provided by the creation of the first database on natural disasters (including hail damage) for this country, accessible to a wide range of scientists [16,17].

Below, using this database, the results of studies of hail processes in Shida Kartli are presented.

Study area, material and methods

Study area – Shida Kartli (Georgia).

Data on the number of days with hail in the warm half of the year (from April to October) in 10 settlements of Kvemo Kartli (Georgia) - Bolnisi, Dmanisi, Gardabani, Manglisi, Marneuli, Rustavi, Sadakhlo, Shulaveri, Tetri Tskaro, Tsalka, and data on damaged areas of agricultural crops in 34 locations of the specified region (Akhkerpi, Algeti, Asureti, Borbalo, Colm, Darbazi, Ganakhleba, Garisi, Gulbaghi, Imirasani, Iraga, Jorgiashvili, Kapanakhchi, Khojorni, Kirovisi, Kizilajlo, Kochuli, Koda, Kveshi, Marabda, Opreti, Pakhralo, Ratevani, Sabirkendi, Sadakhlo, Samgeeti, Samshvilde, Sarachlo, Shulaveri,Tamarisi, Tbisi, Tsereteli, Tsintskaro, Vashlovani) in 1982, 1985-1989 (total 56 cases with hail) are used [17].

In Fig. 1 locations of 10 meteorological on the territory of Shida Kartli and in Table 1 information on these stations are presented.

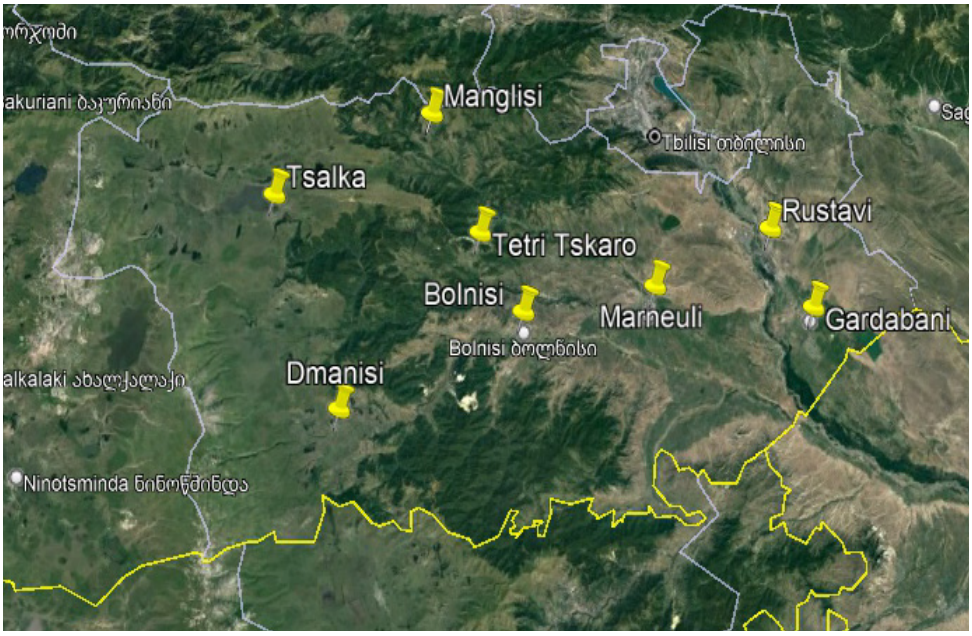

Fig. 1. Locations of 10 meteorological in Kvemo Kartli.

Table 1. Data on 10 meteorological stations on the territory of Shida Kartli.

Station	Bolnisi	Dmanisi	Gardabani	Manglisi	Marneuli
Latitude, N	41.45	41.33	41.45	41.7	41.48
Longitude, E	44.55	44.2	45.1	44.38	44.8
Altitude, s. l., meter	534	1309	300	1194	432
Period of observations, years	93	57	79	67	68
Station	Rustavi	Sadakhlo	Shulaveri	Tetri Tskaro	Tsalka
Latitude, N	41.55	41.25	41.32	41.55	41.6
Longitude, E	45.02	44.82	44.75	44.47	44.08
Altitude, s. l., meter	332	419	650	1151	1458
Period of observations, years	43	30	44	68	85

In particular, as follows from this Table, weather stations are located at altitudes from 300 (Gardabani) to 1458 (Tsalka) m above sea level, the observation period is from 30 (Sadakhlo) to 93 (93) years.

Note, that the altitude of the locations for which data on the areas of damage to crops was analyzed ranged from 308 (Kapanakhchi) to 1315 (Ganakhleba) meters above sea level.

In the proposed work the analysis of data is carried out with the use of the standard statistical analysis methods. The following designations will be used below: Mean – average values; Max - maximal values; Min – minimal values; 99%_Low and 99%_Upp - respectively 99% of the lower and upper levels of the average value.

Results and discussion

Results in Table 2 and Fig. 2-4 are presented.

Table 2 presents statistical characteristics of the number of days with hail in 10 settlements of Shida Kartli, and Figure 3, for clarity, presents data on the maximum number of days with hail for these settlements.

Table 2. Statistical characteristics of number of days with hail during the warm period on 10 meteorological stations of Shida Kartli.

Station	99%_Upp	Mean	99%_Low	Station	99%_Upp	Mean	99%_Low
Bolnisi	2.0	1.6	1.2	Rustavi	0.7	0.3	0.0
Dmanisi	4.1	3.4	2.7	Sadakhlo	0.4	0.2	0.0
Gardabani	1.1	0.7	0.4	Shulaveri	1.5	1.0	0.6
Manglisi	5.5	4.6	3.6	Tetri Tskaro	4.6	3.8	3.0
Marneuli	1.0	0.6	0.3	Tsalka	4.3	3.6	2.9

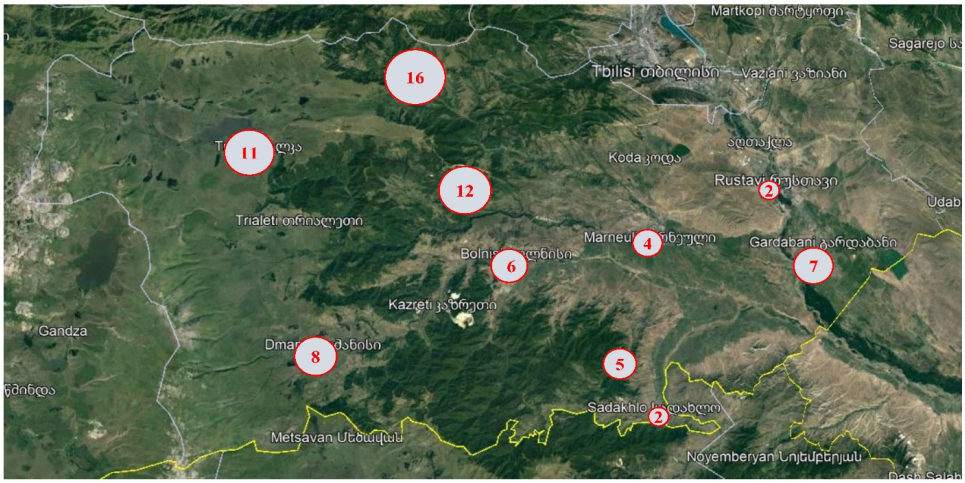

Fig. 2. Max days with hail in warm period of year on 10 meteorological stations of Shida Kartli.

In particular, Table 2 show, that the max average number of days with hail is observed in Manglisi (4.6), the min - in Sadakhlo (0.2). Fig. 2 show, that the max number of days with hail in the warm half-year is observed in Manglisi (16), the min - in Rustavi and Sadakhlo (2 each). Note, that the min number of days with hail for each station is 0.

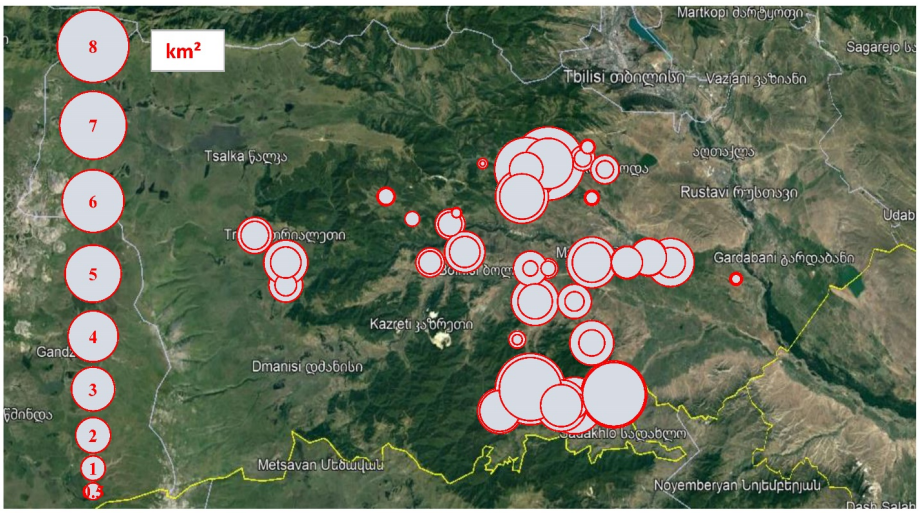

Fig. 3. Map of distribution of the total areas of agricultural crops damaged by hail and the areas damaged by hail by 100% on the territory of Kvemo Kartli.

In Fig. 3. map of distribution of the total areas of agricultural crops damaged by hail and the areas damaged by hail by 100% on the 34 locations of territory of Kvemo Kartli is presened.

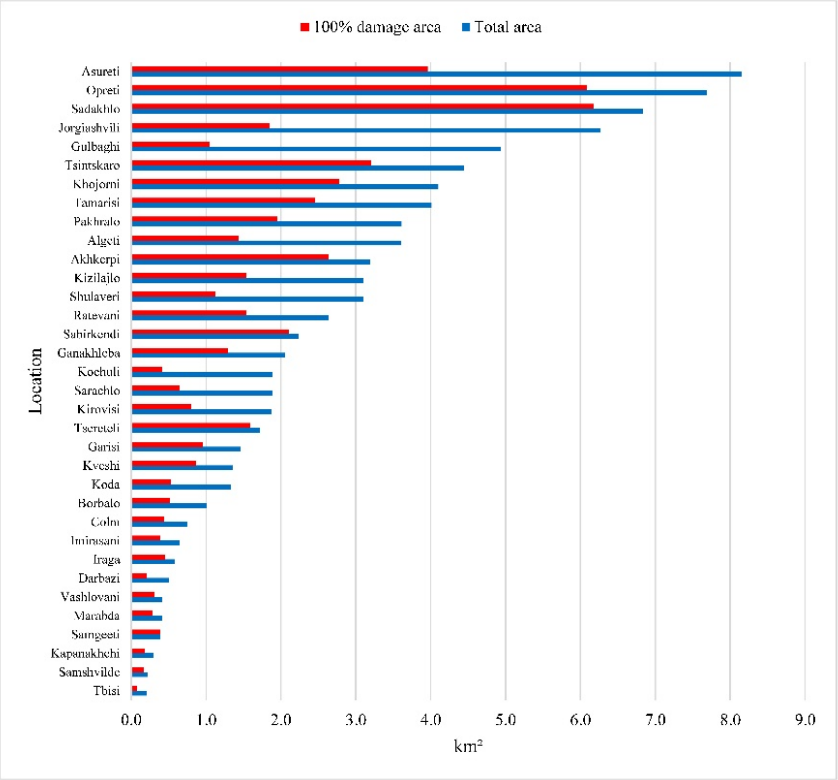

Fig. 4. Total areas of agricultural crops damaged by hail and the areas damaged by hail by 100% on the separate locations of Kvemo Kartli.

In Fig. 4 data about total areas of agricultural crops damaged by hail and the areas damaged by hail by 100% on each separate locations of Kvemo Kartli is presented.

As follows from Fig. 3 and 4 the max total area of agricultural crops damaged by hail was noted in Asureti (8.15 km²), the min in Tbisi (0.2 km²). The max area of agricultural crops damaged by hail by 100% was noted in Sadakhlo (6.18 km²), the min - in Tbisi (0.07 km²). In the whole region, for one incident with hail, the total area of damage to agricultural crops was 1.64 km², and for 100% - 0.95 km².

Conclusion

The results of this work will be used to construct a visual map of the distribution of hail cases and hail damage of agricultural on the territory of Kvemo Kartli.

Acknowledgments

The authors are grateful for the support of the „Natural hazards trends in Georgia: quantitative magnitude classification and hazard assessment“ project (grant agreement №FR-21-1808) funded by the Shota Rustaveli National Science Foundation (SRNSF).

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