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STATISTICAL CHARACTERISTICS OF THE DAILY MAX OF WIND SPEED IN KAKHETI IN THE DAYS WITH AND WITHOUT HAIL PROCESSES IN 2017-2019

[*]Amiranashvili A., [*]Chikhladze V., [,***]Gvasalia G., [**]Loladze D.**

[*]M. Nodia Institute of Geophysics of I. Javakhishvili Tbilisi State University,
e-mail:avtandilamiranashvili@gmail.com
[**]National Environmental Agency of Georgia
[***]State Military Scientific-Technical Center “DELTA”

Summary: The statistical analysis of the daily maximum speed of wind in the days without hail processes W(I) and in the days with hail processes W(II) for 13 points of Kakheti in the period from 1 April through 31 October 2017-2019 is represented. In particular, the following results are obtained: mean values of W(I) change from 1.3 m/sec to 8.3 m/sec, mean values of W(II) change from 1.6 m/sec to 8.8 m/sec (at the stations Tsnori and Sagarejo, respectively); the difference between the mean values of W(II) and W(I) change from 0.2 m/sec (Dzveli Anaga) to 1.9 m/sec (Naendrovali) and on the average in all stations this difference is 0.9 m/sec; the distributions of mean values of W(I) and W(II) in the territory of Kakheti has the uneven nature; the map of the distribution of mean values of W(II)-W(I) on the territory of Kakheti is given;between mean values of W(II) and W(I) on all station of Kakheti practically linear connection is observed; dependence of W(I) and W(II) from H has form of third power of polinomial.

Key words: Local climate, hail processes**,** max wind speed.

Introduction

In Georgia, as in other countries, to studies of the wind regime as the most important climate-forming factors is paid special attention [1,2]. High wind frequently leads to the essential damages of buildings, will be done damage to rural and forestry, it influences on the work of airports, it leads to human victims, etc. [3-5].

In Kakheti since 2015 is restored the anti-hail work [6,7]. During the estimation of damage from the hail damages frequently is also necessary the information about other associated extreme meteorological elements, including wind speed [8]. In addition to this, the data about the regime of extreme wind are necessary for the optimum distribution of the points of action on clouds, etc. [7,9].

In connection with that, as is was indicated in [10], was set the task of investigating the regime of maximum daily wind speed in Kakheti, the special features of its distribution in the investigated territory, the comparison of the wind regime in the days with the hail with the non hail days, developments the possible connection between the data about the extreme wind on the earth's surface with the data of the radar measurements of the wind speed on 2-2.5 km [11]. The detailed statistical analysis of the daily maximum wind speed for 13 points of Kakheti in the period from 1 January 2017 through 31 December of 2019 is presented in [10]. In this stage the comparison of the wind regime in the days with and without hail processes is carried out, whose results are represented below.

1. Study area, material and methods

Study area – 13 locations of Kakheti region of Georgia. Coordinates of these locations of wind speed measurements points in table 1 are presented.

Table 1. Coordinates of 13 meteorological stations in Kakheti.

Location	Location (Abbrev.)	Long., E°	Lat, N°	Height (H), m (a.s.l.)
Tsnori	Tsn.	45.993	41.612	501
Kindzmarauli- Khareba	Kindz.	45.810	41.612	360
Telavi (Wine Cellar)	Tel.	45.603	41.959	378
Saniore	San.	45.489	42.051	550
Vachnadziani-Khareba	Vachn.	45.657	41.867	496
Ruispiri	Ruisp.	45.401	41.964	550
Dzveli Anaga	Dz. An.	46.068	41.559	395
Bakurtsikhe	Bakur.	45.935	41.733	236
Zemo Kedi	Z. Kedi	46.381	41.421	681
Sagarejo	Sagar.	45.368	41.650	580
Khornabuji	Khorn.	46.181	41.513	251
Naendrovali	Naendr.	46.068	41.760	230
Kistauri	Kist.	45.269	42.005	519

The data of Georgian National Environmental Agency about the daily max values of wind speed (W) on 13 indicated stations are used. Period of observation: April 1- October 31, 2017- 2019.

In the proposed work the analysis of data is carried out with the use of the standard statistical analysis methods [12].

The following designations will be used below: Mean – average values; Min – minimal values; Max - maximal values; Range – Max-Min; St Dev - standard deviation; Cv – coefficient of variation, %; R^2 – coefficient of determination; St Err – standard error; 99%(+/-), 99% confidence interval of average; α - the level of significance; W(I) - the daily max values of wind speed in days without hail processes; W(II) - the daily max values of wind speed in days with hail processes; ΔW=W(II)-W(I). All analyzed 508 days without the hail processes and 134 days with the hail processes. The difference between the mean values was evaluated according to Student's criterion with the value of $\alpha \leq 0.05$.

Results and discussion

Results in table 2 and fig. 1-3 are presented.

As it follows from table 2, values of W(I) on all stations change from 0 m/sec (Tsn., Ruisp., Dz. An.) to 31.2 m/sec (Sagar.). Mean values of W(I) change from 1.3 m/sec (Tsn.) to 8.3 m/sec (Sagar.). Mean on all stations values of W(I) are the following: $W(I)_{Min}$ = of 1.2 m/sec; $W(I)_{Max}$ = of 14.4 m/sec; $W(I)_{Mean}$ = 4.1 m/sec.

Values of W(II) on all stations change from 0 m/sec (Tsn., Ruisp., Dz. An.) to 21.4 m/sec (Sagar.). Mean values of W(II) change from 1.6 m/sec (Tsn.) to 8.8 m/sec (Sagar.). Mean on all stations values of W(II) are the following: $W(II)_{Min}$ = 2.0 m/sec; $W(II)_{Max}$ = 12.0 m/sec; $W(II)_{Mean}$ = 5.0 m/sec.

The difference between the mean values of W(II) and W(I) change from 0.2 m/sec (Dz. An.) to 1.9 m/sec (Naendr.). On the average in all stations this difference is 0.9 m/sec.

From table 2 it is also follows that the distribution of W(I), W(II) and ΔW values on the territory of Kakheti has heterogeneous nature. For the clarity fig.1 gives the map of distribution of difference between mean values of W in Kakheti in days with and without hail processes in 2017-2019.

Table 2. Statistical characteristics of daily max of wind speed in Kakheti in days with and without hail processes in 2017-2019.

Location	Tsn.	Kindz.	Tel.	San.	Vachn.	Ruisp.	Dz. An.	Bakur.	Z. Kedi	Sagar.	Khorn.	Naendr.	Kist.
Pararm.	**I. Without Hail Processes, W(I)**												
Min	0.0	0.7	0.6	0.8	1.4	0.0	0.0	0.8	2.9	2.5	2.0	2.0	1.9
Max	9.3	12.5	10.1	13.4	10.9	11.3	9	10.4	16.3	31.2	16.8	20.8	15.2
Mean	1.3	2.6	3.0	3.2	3.0	3.5	2.5	2.5	6.5	8.3	6.4	5.1	5.7
Range	9.3	11.8	9.5	12.6	9.5	11.3	9.0	9.6	13.4	28.7	14.8	18.8	13.3
St Dev	1.0	1.4	1.4	1.2	1.2	1.6	1.3	1.3	2.0	4.3	2.1	2.3	2.3
Cv,%	77.3	55.9	47.1	36.9	39.5	44.1	52.5	52.7	31.7	51.3	33.2	45.4	40.6
St Err	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1
99%(+/-)	0.1	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.5	0.2	0.3	0.3
Param.	**II. With Hail Processes, W(II)**												
Min	0.0	1.6	1.0	1.8	2.2	0.0	0.0	1.3	3.9	4.3	4.2	2.7	3.0
Max	6.7	11.9	8.9	7.7	10.4	9.5	8.9	11.0	13.7	21.4	15.8	15.9	14.0
Mean	1.6	4.1	3.3	4.0	4.1	4.0	2.7	3.0	7.7	8.8	7.8	7.0	6.8
Range	6.7	10.3	7.9	5.9	8.2	9.5	8.9	9.7	9.8	17.1	11.6	13.2	11.0
St Dev	1.4	2.2	1.4	1.4	1.5	1.5	1.2	1.5	2.3	2.9	2.6	2.9	2.2
Cv,%	88.6	53.3	42.4	34.0	36.0	38.1	46.6	47.7	30.1	33.0	33.8	41.3	33.0
St Err	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.3	0.2
99%(+/-)	0.3	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.6	0.6	0.6	0.5
Differ. (II-I)	0.3	1.5	0.3	0.8	1.1	0.5	0.2	0.5	1.2	0.5	1.5	1.9	1.1

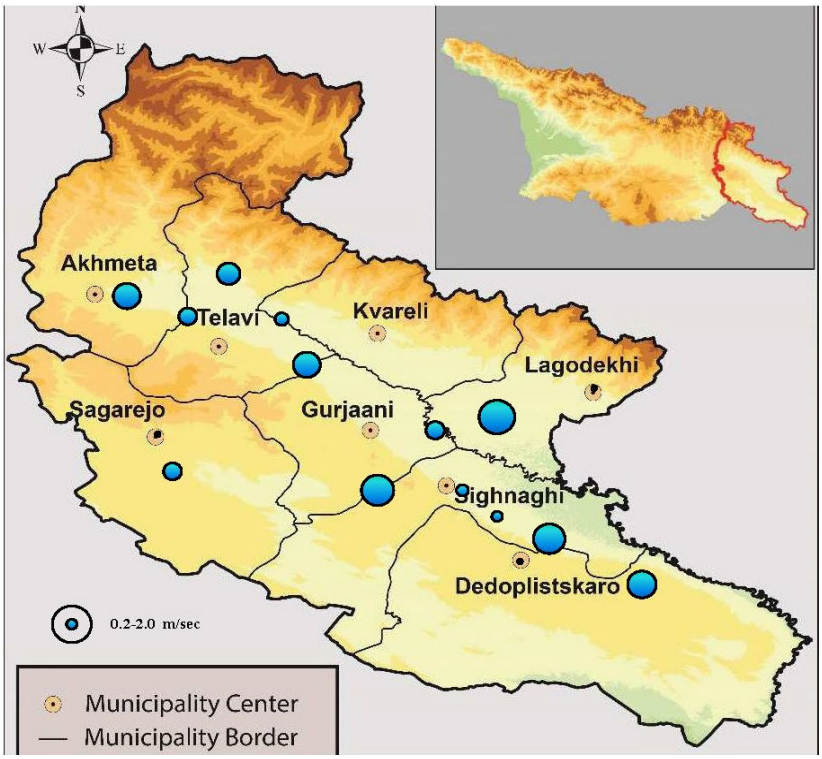

Fig.1. Distribution of difference between mean values of W in Kakheti in days with and without hail processes in 2017-2019.

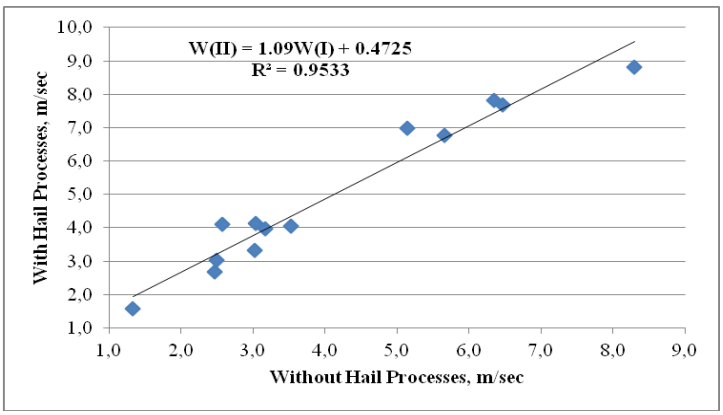

Fig.2. Linear correlation and regression between mean values of W(II) and W(I) on 13 station of Kakheti in 2017-2019.

Between mean values of W(II) and W(I) on all station of Kakheti practically linear connection is observed (fig. 2).

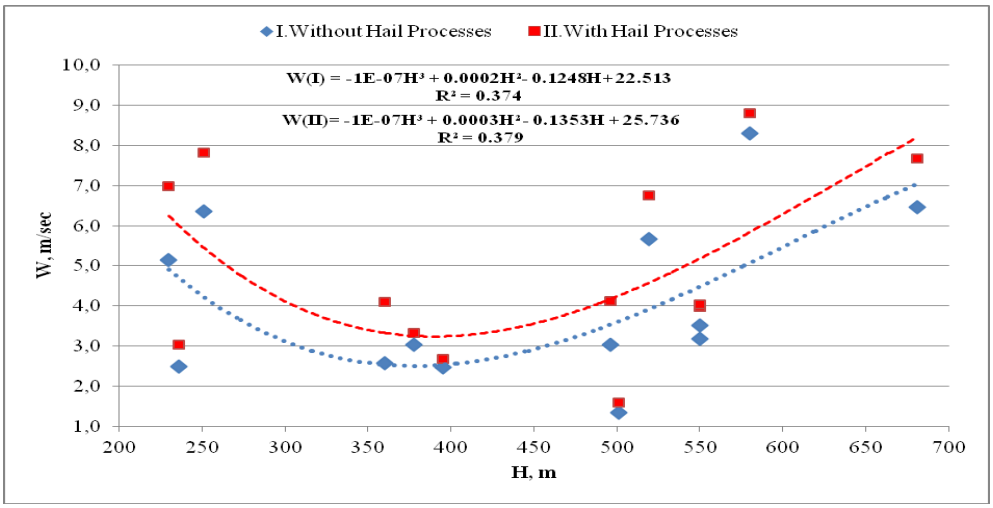

Fig.3. Vertical distribution of mean max wind speed in Kakheti for 13 stations in days with and without hail processes in 2017-2019, ((α(R^2) = 0.03).

In fig. 3 data about vertical distribution of mean max wind speed in Kakheti for all 13 stations in days with and without hail processes are presented. As follows from this figure dependence of W(I) and W(II) from H has form of third power of polinomial and as a whole with an increase of altitude of locality wind speed grows. It should be noted that dependence values of W(I) and W(II) from H analogously dependence of mean annual and mean half-year values of W from H, obtained in [10].

Conclusion

In the near future it is planned the continuation of works in this direction. In particular, developments the possible connection between the data about the extreme wind on the earth's surface with the data of the radar measurements of the wind speed on height 2-2.5 km.

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