International Scientific Conference „Natural Disasters in the 21st Century: Monitoring, Prevention, Mitigation“
Proceedings, ISBN 978-9941-491-52-8, Tbilisi, Georgia, December 20-22, 2021

ON THE REPRESENTATIVENESS OF DATA FROM METEOROLOGICAL STATIONS IN GEORGIA FOR ANNUAL AND SEMI-ANNUAL SUM OF ATMOSPHERIC PRECIPITATION AROUND OF THESE STATIONS

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Summary: *Results of study of the representativeness of data from 39 meteorological stations in Georgia for annual and semi-annual sum of atmospheric precipitation around of these stations are presented. Period of observation – from 1936 to 2015. In particular, it was found that in general for the year data of meteorological stations on precipitations are representative around these stations on distance from 19 km (Mta-Sabueti, Kobuleti) to 46 km (Gori); in cold period of year - from 13 km (Mta-Sabueti) to 49 km (Zugdidi); in warm period of year - from 20 km (Chokhatauri) to 43 km (Pasanauri).*

Key words: *Atmospheric precipitations, correlation and regression analysis, natural catastrophe, landslides.*

Introduction

Atmospheric precipitation is one of the most important components of the climate [1,2], bioclimate [3], the state of ecosystems [4]. Atmospheric precipitation often has an extremely negative impact on the human environment. Their deficiency leads to droughts, an excess can provoke floods, flooding, mudflows, landslides and other dangerous natural phenomena [4-9]. In particular, the time scale of the effect of atmospheric precipitation on provoking of different natural catastrophe (including landslides) has a wide range - from several tens of minutes to several days, months, and years (climatic time scale) [5-9]. Since the number of meteorological stations is usually limited, in order to study the impact of precipitation on the environment, it is necessary to have data on the representativeness of these stations depending on the distance from them.

Results of study of the representativeness of data from 39 meteorological stations in Georgia for annual and semi-annual sum of atmospheric precipitation around of these stations are presented below.

Study area, material and methods

Study area – territory of Georgia.

The data of Georgian National Environmental Agency about the annual and semi-annual sum of atmospheric precipitations for 39 meteorological stations are used. Period of observation: 1936-2015 (80 years). The locations of meteorological stations and their names are shown below (in fig. 1, 3 and table 1).

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: R^2 – coefficient of determination; R – coefficient of linear correlation; α - the level of significance; Year – period from January to December; Cold – period from October to March; Warm – period from April to September; a – coefficient of regression equation; L – distance around meteorological station, km.

The degree of correlation was determined in accordance with [10]: very high correlation ($0.9 \leq R \leq 1.0$); high correlation ($0.7 \leq R < 0.9$); moderate correlation ($0.5 \leq R < 0.7$); low correlation ($0.3 \leq R < 0.5$); negligible correlation ($0 \leq R < 0.3$).

Determination of the representativeness of data meteorological stations for sum of atmospheric precipitation around of these stations was carried out in two stages.

1. The linear correlation coefficient R of each meteorological station with all other stations on the sum of atmospheric precipitation was calculated.
2. The dependence of this correlation coefficient on distance L between meteorological station from all other stations was determined. This dependence for each station has the form: $L = (1-R)/a \cdot R$, $\alpha(R^2)<0.01$. A representative value of L was considered when R values were not less than 0.7 (high correlation).

Results and discussion

Results clearly shown from fig. 1-3 and table 1.

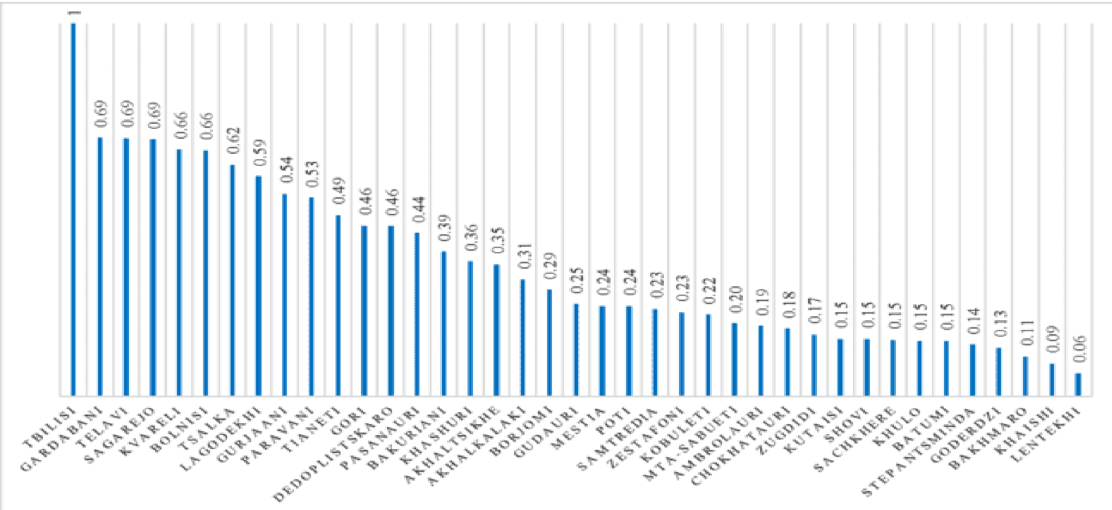

Fig.1. Example of linear correlation between annual sum of atmospheric precipitations in Tbilisi with annual sum of atmospheric precipitations on each meteorological stations in Georgia.

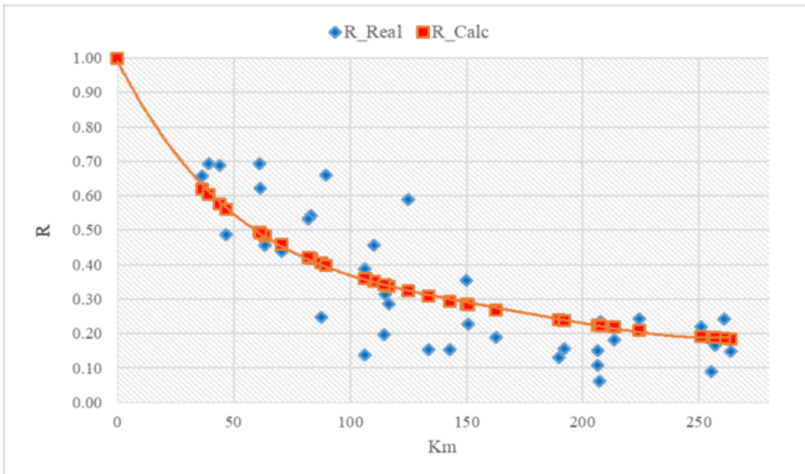

Fig.2. Dependency example of coefficient of linear correlation between annual sum of atmospheric precipitations in Tbilisi and annual sum of atmospheric precipitations on each of meteorological stations with distance for these stations.

Table 1. The values of the coefficients of the regression equation a between the linear correlation coefficient and the distance between an individual meteorological station with all the others. The radius of the circle L, within which the data of meteorological stations on the annual and semiannual precipitation amounts are applicable with a high level of representativeness. $L = (1-R)/a \cdot R$, $\alpha(R^2)<0.01$.

Season	Year		Cold		Warm		Year	Cold	Warm
Parameters	a	R^2	a	R^2	a	R^2	L, km		
Akhalkalaki	0.018193	0.45	0.018464	0.17	0.013727	0.66	24	23	31
Akhaltsikhe	0.010752	0.62	0.010053	0.51	0.011932	0.66	40	43	36
Ambrolauri	0.012694	0.78	0.010341	0.67	0.012614	0.81	34	41	34
Bakhmaro	0.018383	0.72	0.014404	0.74	0.018085	0.71	23	30	24
Bakuriani	0.012598	0.56	0.011032	0.41	0.012604	0.58	34	39	34
Batumi	0.017508	0.78	0.010375	0.76	0.02003	0.79	24	41	21
Bolnisi	0.017659	0.66	0.017376	0.55	0.014228	0.74	24	25	30
Borjomi	0.011612	0.72	0.012024	0.58	0.013012	0.74	37	36	33
Chokhatauri	0.017225	0.72	0.011347	0.71	0.021237	0.75	25	38	20
Dedoplistskar	0.018893	0.82	0.01299	0.75	0.015518	0.8	23	33	28
Gardabani	0.015331	0.87	0.019399	0.71	0.011177	0.85	28	22	38
Goderdzi	0.020563	0.78	0.016303	0.69	0.01747	0.83	21	26	25
Gori	0.009388	0.57	0.009232	0.2	0.012206	0.74	46	46	35
Gudauri	0.016302	0.65	0.012512	0.77	0.01653	0.76	26	34	26
Gurjaani	0.018205	0.77	0.012512	0.77	0.014824	0.77	24	34	29
Khaishi	0.011683	0.52	0.008834	0.54	0.019672	0.61	37	49	22
Khashuri	0.010981	0.71	0.012398	0.48	0.0136	0.79	39	35	32
Khulo	0.016729	0.53	0.015553	0.61	0.01491	0.77	26	28	29
Kobuleti	0.022229	0.72	0.013826	0.76	0.018158	0.72	19	31	24
Kutaisi	0.013413	0.79	0.010558	0.72	0.016546	0.86	32	41	26
Kvareli	0.012935	0.79	0.011184	0.73	0.010735	0.8	33	38	40
Lagodekhi	0.017227	0.64	0.01953	0.73	0.012371	0.72	25	22	35
Lentekhi	0.014129	0.68	0.011749	0.68	0.015871	0.74	30	36	27
Mestia	0.013416	0.67	0.011397	0.67	0.018976	0.46	32	38	23
Mta-sabueti	0.022931	0.57	0.033486	0.39	0.015417	0.67	19	13	28
Paravani	0.012469	0.35	0.012838	0.25	0.010318	0.57	34	33	42
Pasanauri	0.010785	0.55	0.010541	0.45	0.00986	0.65	40	41	43
Poti	0.017946	0.52	0.01207	0.7	0.015214	0.56	24	36	28
Sachkhere	0.012828	0.69	0.009654	0.61	0.014984	0.75	33	44	29
Sagarejo	0.015512	0.78	0.017009	0.71	0.011933	0.85	28	25	36
Samtredia	0.010364	0.79	0.009046	0.78	0.012541	0.79	41	47	34
Shovi	0.011859	0.63	0.009992	0.58	0.012529	0.67	36	43	34
Stepantsminda	0.017628	0.59	0.013294	0.48	0.017922	0.61	24	32	24
Tbilisi	0.016781	0.74	0.01491	0.65	0.01471	0.74	26	29	29
Telavi	0.013321	0.81	0.011367	0.77	0.010096	0.81	32	38	42
Tianeti	0.014262	0.61	0.0105	0.63	0.014458	0.71	30	41	30
Tsalka	0.014415	0.59	0.01519	0.48	0.012837	0.64	30	28	33
Zestafoni	0.015892	0.74	0.013046	0.64	0.019988	0.81	27	33	21
Zugdidi	0.010878	0.64	0.008682	0.62	0.012191	0.57	39	49	35

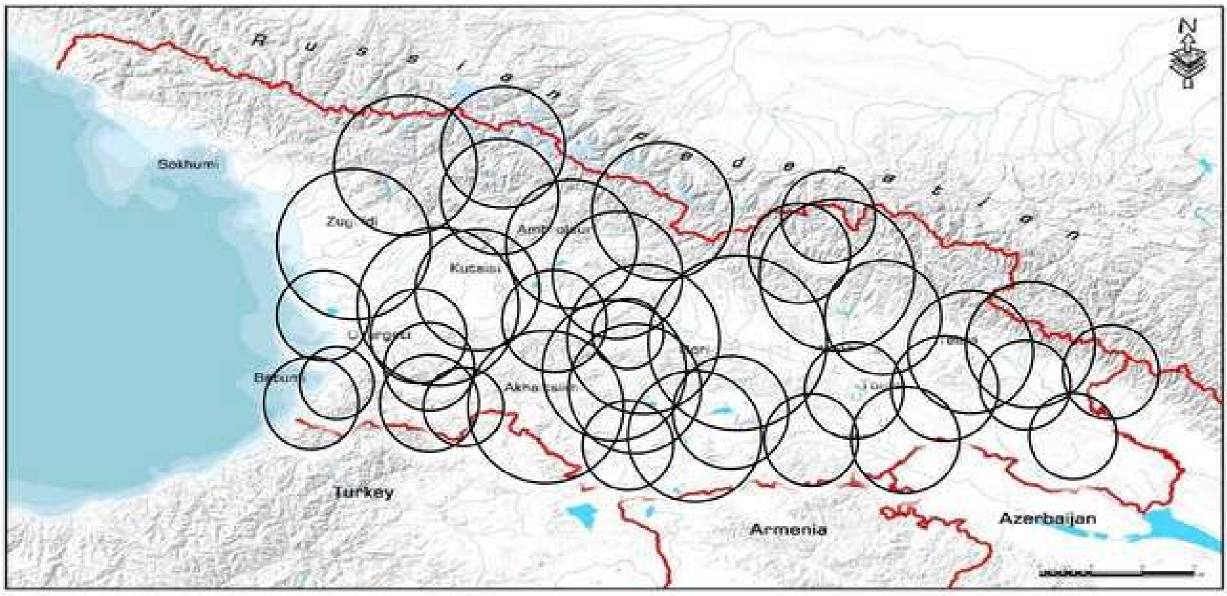

Fig. 3. Example of the areas of circles around meteorological stations within which the data of these stations on the annual sum of atmospheric precipitation with a high level of representativeness can be used.

In fig.1 the example of linear correlation between annual sum of atmospheric precipitations in Tbilisi with annual sum of atmospheric precipitations on each meteorological stations in Georgia is presented. As follows from this fig. coefficient of correlation for this case changes from 0.06 to 0.69.

In fig.2 the dependency example of coefficient of linear correlation between annual sum of atmospheric precipitations in Tbilisi and annual sum of atmospheric precipitations on each of meteorological stations with distance for these stations is presented. The distance L can be determined from the regression curve and in this case it is equal to 26 km.

Table 1 presents information for all 39 meteorological stations on the values of a and L in three periods of the year. In particular, in general for the year data of meteorological stations on precipitations are representative around these stations on distance from 19 km (Mta-Sabueti, Kobuleti) to 46 km (Gori); in cold period of year - from 13 km (Mta-Sabueti) to 49 km (Zugdidi); in warm period of year - from 20 km (Chokhatauri) to 43 km (Pasanauri).

Finally, for clarity in fig. 3 the example of the areas of circles around meteorological stations within which the data of these stations on the annual sum of atmospheric precipitation with a high level of representativeness can be used is presented.

Conclusion

In the future, these studies will be continued for monthly and daily data of atmospheric precipitation.

Acknowledgement

This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG), Grant number FR-19-8190, "Assessment of landslide and mudflow hazards for Georgia using stationary and satellite rainfall data".

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