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About the Representativeness of Data from Meteorological Stations in Georgia for Monthly Sum of Atmospheric Precipitation Around of These Stations

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ABSTRACT

Results of study of the representativeness of data from 39 meteorological stations in Georgia for monthly sum of atmospheric precipitation around of these stations are presented. Period of observation – from 1936 to 2015. In particular, it was found that the representativeness of these stations in terms of monthly precipitation varies from 14 km (Akhalkalaki, January) to 90 km (Akhaltsikhe, October).

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

Introduction

As is known, precipitation is one of the most important components of climate [1-3], bioclimate [3,4], and the state of ecosystems [5]. Atmospheric precipitation often has an extremely negative impact on the human environment. Their deficiency leads to droughts, while their excess can provoke floods, flooding, mudflows, landslides and other dangerous natural phenomena [5-10]. In particular, the time scale of the impact of atmospheric precipitation on provoking various natural disasters (including landslides) has a wide range - from several tens of minutes to several days, months and years (climatic time scale) [8-18]. Since the number of weather stations is usually limited, to study the impact of precipitation on the environment it is necessary to have data on the representativeness of these stations depending on their distance from them.

In [19] 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. 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).

This work is a continuation of the study [19]. Results of study of the representativeness of data from 39 meteorological stations in Georgia for monthly 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 monthly 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, 2-4 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; a – coefficient of regression equation; L – distance around meteorological station, km.

The degree of correlation was determined in accordance with [20]: very high correlation (0.9 ≤ R ≤ 1.0); high correlation (0.7 ≤ R < 0.9); moderate correlation (0.5 ≤ R < 0.7); low correlation (0.3 ≤ R< 0.5); negligible correlation (0 ≤ R < 0.3).

As in [19] 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 monthly 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·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 in Fig. 1-4 and Table 1 are presented.

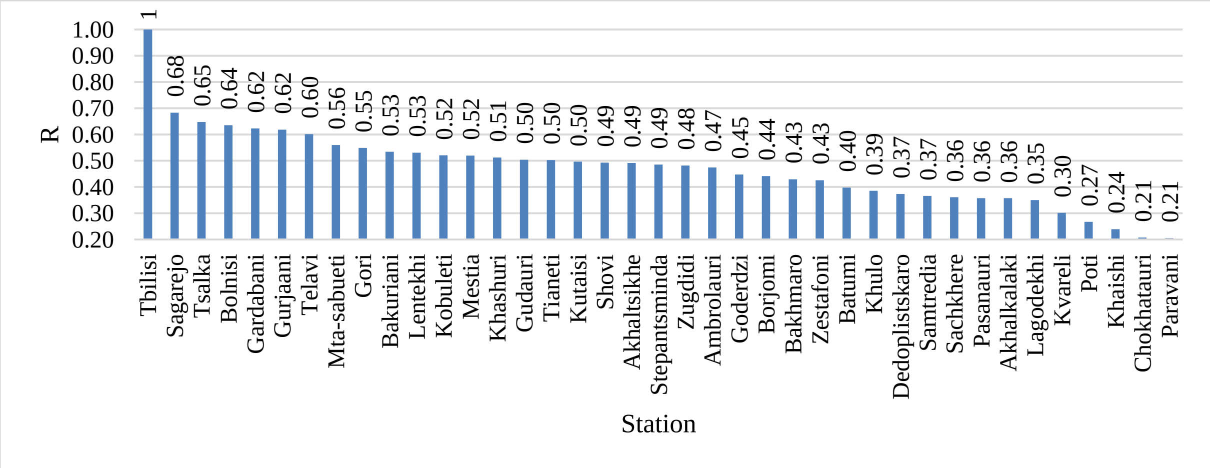

Fig.1. Example of linear correlation between monthly sum of atmospheric precipitations in Tbilisi with monthly sum of atmospheric precipitations on each meteorological stations in Georgia in July.

In Fig.1 the example of linear correlation between monthly sum of atmospheric precipitations in Tbilisi with monthly sum of atmospheric precipitations on each meteorological stations in Georgia in July is presented. As follows from this Fig. 1 coefficient of correlation for this case changes from 0.21 (Parvani, negligible correlation) to 0.68 (Sagarejo, moderate correlation).

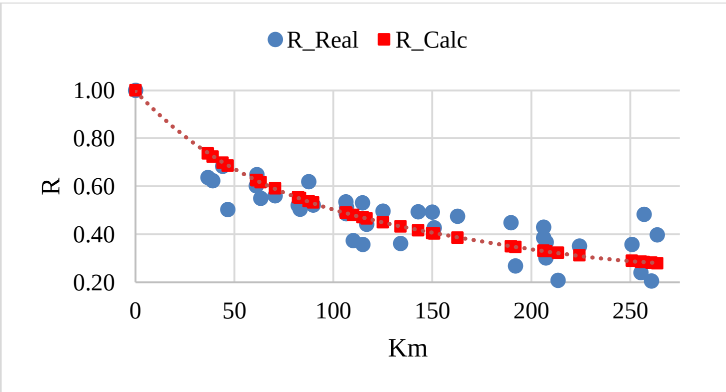

Fig. 2. Dependency example of coefficient of linear correlation between monthly sum of atmospheric precipitations in Tbilisi and monthly sum of atmospheric precipitations on each of meteorological stations with distance for these stations in July.

In Fig. 2 the dependency example of coefficient of linear correlation between monthly sum of atmospheric precipitations in Tbilisi and monthly sum of atmospheric precipitations on each of meteorological stations with distance for these stations in July is presented. The distance L can be determined from the regression curve and in this case it is equal to 44 km.

Table 1. The radius of the circle L, within which the data of meteorological stations on the monthly precipitation amounts are applicable with a high level of representativeness. $L = (1-R)/a \cdot R$, $\alpha(R^2)<0.01$.

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Akhalkalaki	14	35	28	48	27	17	19	26	39	79	69	27
Akhaltsikhe	40	49	37	50	31	17	33	31	44	90	59	55
Ambrolauri	42	34	36	64	33	29	35	43	36	70	73	52
Bakhmaro	33	32	29	41	33	27	38	21	35	53	55	34
Bakuriani	44	47	37	57	37	22	32	26	43	82	67	44
Batumi	61	58	47	52	46	25	51	23	52	68	89	41
Bolnisi	19	26	22	51	36	27	30	38	54	64	43	26
Borjomi	38	44	36	51	27	21	33	31	53	77	60	41
Chokhatauri	34	53	32	49	32	17	21	28	33	71	63	37
Dedoplistskaro	17	41	30	38	43	19	26	46	42	80	63	58
Gardabani	19	22	21	38	31	21	36	38	43	79	50	35
Goderdzi	38	36	23	43	31	19	36	23	39	55	68	40
Gori	49	51	52	44	34	27	32	31	42	69	61	60
Gudauri	39	44	29	39	28	26	34	42	50	87	57	53
Gurjaani	34	46	28	36	23	28	30	42	58	70	54	49
Khaishi	47	34	43	35	26	27	31	46	44	68	73	60
Khashuri	31	34	41	54	29	26	31	40	40	66	49	41
Khulo	44	35	29	55	38	21	31	26	38	53	64	43
Kobuleti	40	58	60	65	42	18	40	18	53	82	72	30
Kutaisi	49	42	41	52	31	20	24	29	32	67	46	57
Kvareli	31	52	38	57	26	28	28	33	53	84	56	60
Lagodekhi	30	55	33	42	37	23	36	33	39	81	53	44
Lentekhi	40	36	41	40	33	26	28	38	26	72	47	43
Mestia	41	35	53	37	23	19	28	61	34	83	73	44
Mta-sabueti	19	27	20	50	40	24	34	37	42	54	44	27
Paravani	42	52	31	47	28	25	31	34	43	74	60	34
Pasanauri	42	58	41	51	36	31	33	51	58	87	60	52
Poti	41	71	50	72	33	20	23	40	57	48	74	39
Sachkhere	44	40	47	62	30	25	25	39	40	77	71	54
Sagarejo	30	28	20	40	34	29	33	47	39	80	38	30
Samtredia	46	59	42	58	33	22	34	27	28	85	62	57
Shovi	44	42	38	42	29	26	41	47	38	79	54	47
Stepantsminda	30	50	25	34	25	23	38	44	22	59	50	33
Tbilisi	23	28	21	59	27	20	44	28	45	67	47	29
Telavi	33	39	32	57	38	27	33	42	56	72	67	52
Tianeti	49	50	41	47	21	26	21	44	39	76	55	58
Tsalka	23	28	16	33	29	24	37	38	34	62	47	26
Zestafoni	33	36	38	51	33	20	24	25	34	52	42	41
Zugdidi	58	48	53	70	33	22	49	42	28	57	79	79
Max	61	71	60	72	46	31	51	61	58	90	89	79
Min	14	22	16	33	21	17	19	18	22	48	38	26
Range	47	49	44	39	25	14	32	43	36	42	51	53
Mean	36.7	42.4	35.4	49.0	31.9	23.4	32.4	35.8	41.7	71.3	59.3	44.4
St Dev	10.9	11.2	10.6	10.0	5.6	3.8	7.0	9.4	9.2	11.3	11.5	12.2
C_v, %	29.8	26.4	30.0	20.5	17.6	16.2	21.7	26.1	22.1	15.8	19.3	27.4

Table 1 presents information for all 39 meteorological stations on the values of L for all months of year. In particular, the representativeness of these stations in terms of monthly precipitation varies from 14 km (Akhalkalaki, January) to 90 km (Akhaltsikhe, October).

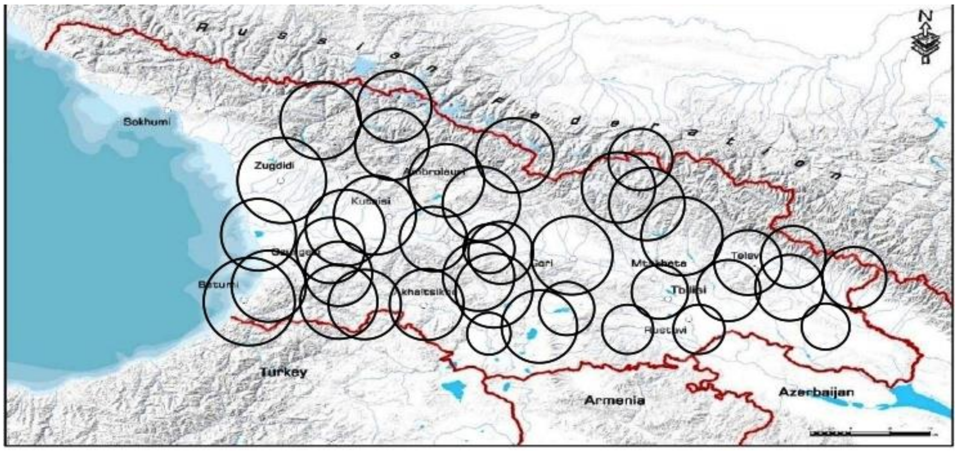

Fig. 3. Example of the areas of circles around meteorological stations within which the data of these stations on the sum of atmospheric precipitation in January with a high level of representativeness can be used.

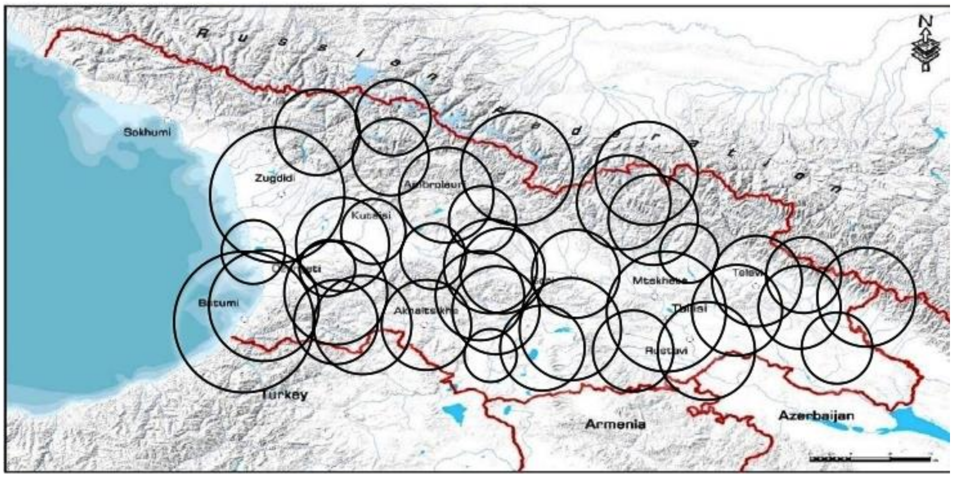

Fig. 4. Example of the areas of circles around meteorological stations within which the data of these stations on the sum of atmospheric precipitation in July with a high level of representativeness can be used.

Finally, for clarity in Fig. 3 and 4 examples of the areas of circles around meteorological stations within which the data of these stations on the monthly sum of atmospheric precipitation in January and July with a high level of representativeness can be used are presented.

Conclusion

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

Acknowledgments

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საქართველოს მეტეოროლოგიური სადგურების მონაცემების რეპრეზენტულობა ნალექების თვიური რაოდენობის მიხედვით ამ სადგურების ირგვლივ

ა.ამირანაშვილი, თ.ჭელიძე, დ.სვანაძე, თ.წამალაშვილი, ნ.ვარამაშვილი

რეზიუმე

წარმოდგენილია საქართველოს 39 მეტეოროლოგიური სადგურების მონაცემების რეპრეზენტულობა ამ სადგურების ირგვლივ ნალექების თვიური რაოდენობის მიხედვით კვლევის შედეგების გათვალისწინებით. დაკვირვების პერიოდი 1936 - 2015 წწ. კერძოდ, დადგინდა რომ ამ სადგურების რეპრეზენტულობა თვიური ნალექების მიხედვით მერყეობს 14 კმ-დან (ახალქალაქი, იანვარი) 90 კმ-მდე (ახალციხე, ოქტომბერი).

საკვანძო სიტყვები: ნალექი, კორელაციური და რეგრესიული ანალიზი, სტიქიური უბედურებები, მეწყერები.

О репрезентативности данных метеостанций Грузии по месячной сумме атмосферных осадков вокруг этих станций

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Резюме

Представлены результаты исследования репрезентативности данных 39 метеорологических станций Грузии по месячной сумме атмосферных осадков вокруг этих станций. Период наблюдений – с 1936 по 2015 годы. В частности, установлено, что репрезентативность этих станций по месячному количеству осадков варьирует от 14 км (Ахалкалаки, январь) до 90 км (Ахалцихе, октябрь).

Ключевые слова: атмосферные осадки, корреляционно-регрессионный анализ, природные катастрофы, оползни.