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STATISTICAL CHARACTERISTICS OF ANGSTROM FIRE INDEX FOR TELAVI (GEORGIA)

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Summary: The results of a statistical analysis of the daily values of the Angstrom Fire Index (I) for Telavi (Georgia) in the period 2010, 2012-2015 are presented. AFI = (R/20) + (27-T)/10, where R is the minimum relative humidity, T is the maximum air temperature. The gradations of the values of I are as follows: I. AFI> 4.0 - Fire occurrence unlikely, II.AFI = 4.0 ÷ 2.5 - Fire conditions unfavorable, III. AFI = 2.5 ÷ 2.0 - Fire conditions favorable, IY. AFI = <2.0 - Fire occurrence very likely. In particular, it was found that a high fire hazard in Telavi is observed on average within 67 days a year, and increased - within 43 days a year. The largest number of days with high fire hazard was observed in 2013 (98 days), the smallest - in 2012 (44 days). Further, it is planned to expand work on this issue (using other more complex fire hazard indices, studying their trends in connection with climate change, determining these indices for other points in Georgia, etc.).

Key Words: Angstrom Fire Index

Introduction.

The problem of fires, including forest fires, is actual for many countries of world [http://www.sasquatchstation.com/Fire_Weather.php; http://www.forestservice.gr/meteo/fwi1.html]. This problem is also important for Georgia, where forest fires are frequent [1, https://commersant.ge/ge/post/bolo-10-wlis-ganmavlobashi-saqartveloshi-xandzris-300-mde-shemtxveva - dafiqsirda-da-4-200-heqtari-ganadgurda]. For example, table 1 presents the data of Ministry of Environment Protection and Agriculture of Georgia about forest and field fires in Georgia in 2013-2018 [https://www.geostat.ge/ka].

Table 1. Forest and field fires in Georgia in 2013-2018.

Parameter	2013	2014	2015	2016	2017	2018
Number of fire cases (unit	48	69	83	51	87	23
Area covered by fire (hectare)	2 682	1 723	216	398	1 582	1 931

In recent years this problem is aggravated by the global and local climate warming [2-9] which facilitates an increase in the fire hazard [8,9]. For evaluating the fire hazard in locality the set of indices is developed. One of simple of these indices is the Swedish Angstrom Index [8-10]. For the first time in Georgia, data on AFI for Tbilisi in the period from 2014 to 2018 in [10] are presented.

In this work the results of a statistical analysis of the daily values of Angstrom Fire Index (AFI) for Kakheti (on the example of the capital of this region – Telavi) in the period 2010, 2012-2015 are presented.

Note that the forest area under the National Forestry Agency in this region is about 270000 hectares [https://www.geostat.ge/ka].

Study area, material and methods.

Study area is Telavi city. Data of the National Environmental Agency of Georgia [http://www.pogodaiklimat.ru/archive.php?id=ge] about daily maximum of air temperature T and minimum relative humidity R in the period 2010, 2012-2015 are used. The Swedish Angstrom Index calculated from the formula: AFI = (R/20) + (27-T)/10 [8, 9]. The gradations of the values of AFI are as follows: I. AFI> 4.0 - Fire occurrence unlikely, II. AFI = 4.0 ÷ 2.5 - Fire conditions unfavorable, III. AFI = 2.5 ÷ 2.0 - Fire conditions favorable, IY. AFI = <2.0 - Fire occurrence very likely.

The standard statistical methods are used. The following designations will be used below: Min – minimal values; Max - maximal values; St Dev - standard deviation; C_v - coefficient of variation (%).

Results and discussion.

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

Table 2. Statistical Characteristics of Monthly Values of Angstrom Fire Index in Telavi in 2010, 2012-2015.

Param.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	2.4	2.3	1.5	1.3	1.4	0.8	0.6	0.3	0.6	1.4	2.0	2.4
Max	7.4	7.5	6.4	6.1	5.8	4.7	4.9	5.2	5.2	6.2	7.1	7.4
Mean	4.9	5.0	3.9	3.5	3.0	2.2	2.0	1.6	2.5	3.7	4.2	4.6
St Dev	1.2	1.2	1.0	1.1	0.9	0.7	0.7	0.8	0.9	1.1	1.2	1.1
C_v,%	25.0	24.7	25.0	30.8	28.6	29.5	37.5	48.4	36.3	29.0	28.0	24.3

In table 2 and fig 1. the statistical characteristics of monthly values of Angstrom Fire Index in Telavi is presented. In particular, as follows from this table values of AFI changes from 0.3 (August, fire occurrence very likely) to 7.5 (February, fire occurrence unlikely). The greatest variations in the values of AFI are observed during August (C_v = 48.4 %), smallest - in December (C_v = 24.3 %). The mean values of Angstrom Fire Index (table 2, fig. 1) changes from 1.6 (August, fire occurrence very likely) to 5.0 (February, fire occurrence unlikely).

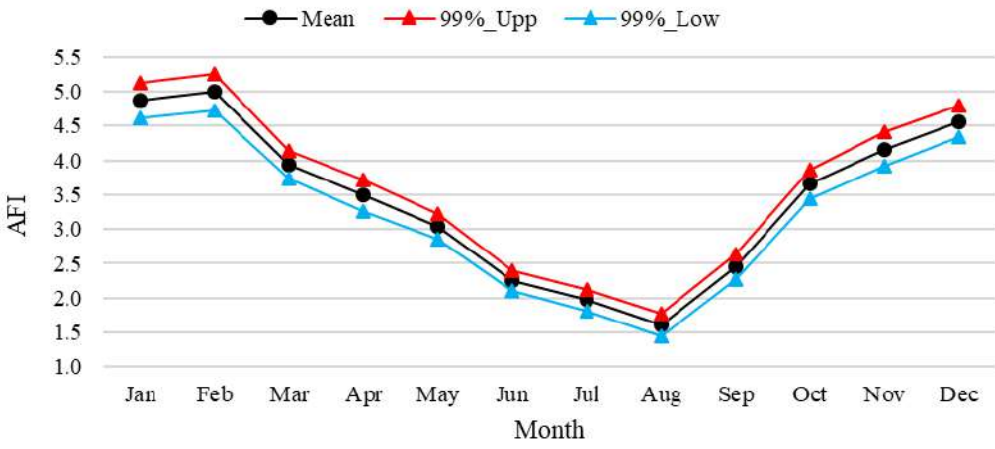
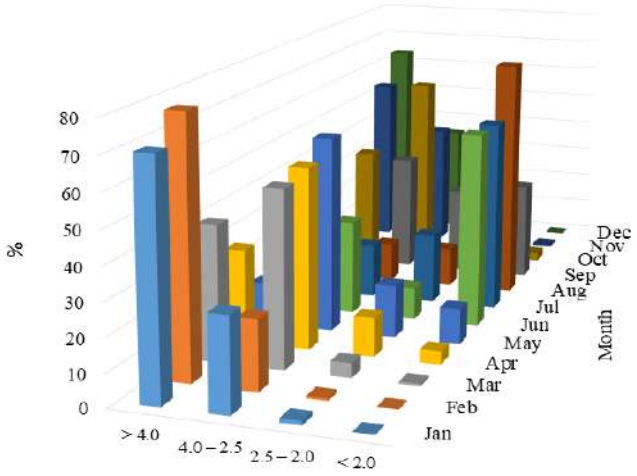


Fig. 1. Intra-annual distribution of AFI values in Telavi in 2010,2012-2015.

Table 3. Number of days with Angstrom Fire Index in Telavi for four gradations in 2010, 2012-2015.

Year	> 4.0	4.0 – 2.5	2.5 – 2.0	< 2.0
	Fire occurrence unlikely	Fire conditions unfavorable	Fire conditions favorable	Fire occurrence very likely
2010	117	137	33	78
2012	111	157	54	44
2013	91	138	38	98
2014	131	126	46	62
2015	142	123	45	55
Mean	118	136	43	67

In Table 3 data about number of days with Angstrom Fire Index in Telavi for four gradations in 2010, 2012-2015 is presented. In particular, as follows from this table a high fire hazard in Telavi is observed on average within 67 days a year (repetition – 18.5 %), and increased - within 43 days a year (repetition – 11.8 %). The largest number of days with high fire hazard was observed in 2013 (98 days, repetition – 26.6 %), the smallest - in 2012 (44 days, repetition – 12.0 %).



	> 4.0	4.0 – 2.5	2.5 – 2.0	< 2.0
Jan	70.3	28.4	1.3	0.0
Feb	78.0	21.3	0.7	0.0
Mar	41.3	53.5	4.5	0.6
Apr	28.7	55.3	12.0	4.0
May	12.9	60.0	16.1	11.0
Jun	0.7	29.3	10.0	60.0
Jul	1.9	16.8	21.9	59.4
Aug	0.6	12.3	12.3	74.8
Sep	5.3	36.7	27.3	30.7
Oct	33.5	59.4	4.5	2.6
Nov	54.7	39.3	5.3	0.7
Dec	63.9	34.8	1.3	0.0

Fig. 2. Repetition of AFI in Telavi in different months for four gradations

In fig. 2 data about repetition of AFI in Telavi in different months for four gradations is presented. As follows from fig. 2 on average in Telavi a high fire hazard from June to August is observed (repetition are 60.0, 59.4 and 74.8 % respectively). Sufficiently fire dangerous month is also September (repetition of AFI<2.0 - 30.7 %). From December to February the values of AFI<2.0 is not observed.

From November through February in the majority of the cases fire hazard is absent (repetition of AFI> 4.0 changes from 54.7 to 78.0 %).

Conclusion.

Further, it is planned to expand work on this issue (using other more complex fire hazard indices, studying their trends in connection with climate change, determining these indices for other points in Georgia, etc.).

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References

1. Amiranashvili A.G., Bliadze T.G., Chikhladze V.A. Assumed Ecological Consequences of Forest Fire in the Natural Preserve of Borjomi-Kharagauli During August 2008. // Trans. of the Institute of Hydrometeorology, vol. 115, ISSN 1512-0902, Tb., 2008, pp. 291 – 298, (in Russian).
2. Amiranashvili A., Matcharashvili T., Chelidze T. Climate Change in Georgia: Statistical and Nonlinear Dynamics Predictions. // Journ. of Georgian Geophysical Soc., Iss. (A), Physics of Solid Earth, vol.15a, Tbilisi, 2011-2012, pp. 67-87.
3. Amiranashvili A., Kartvelisjvili L., Khurodze T. Application of Some Statistic Methods for the Prognostication of Long-Term Air Temperature Changes (Tbilisi Case). // Trans. of the International Scientific Conference Dedicated to the 90th Anniversary of Georgian Technical University "Basic Paradigms in Science and Technology Development for the 21th Century", Tbilisi, Georgia, September 19-21, 2012, Part 2, ISBN 978-9941-20-098-4, Publishing House "Technical University", 2012, pp. 331-338, (in Russian).
4. Tavartkiladze K., Begalishvili N., Kharchilava J., Mumladze D., Amiranashvili A., Vachnadze J., Shengelia I., Amiranashvili V. Contemporary climate change in Georgia. Regime of some climate parameters and their variability. // Monograph, ISBN 99928-885-4-7, Tbilisi, 2006, 177 p., (in Georgian).
5. Amiranashvili A.G., Kartvelishvili L.G.,Trofimenko L.T., Khurodze T.V. The Statistical Evaluation of the Expected Changes of Air Temperature in Tbilisi and St.-Petersburg up to 2056 Years. Trans. of the Institute of Hydrometeorology, Georgian Technical University, ISSN 1512-0902, 2013, vol. 119, pp.58-622, (in Russian).
6. Amiranashvili A., Kartvelishvili L., Trofimenko L., Khurodze T. Statistical Structure of Mean Annual Air Temperature in Tbilisi and St.-Petersburg in 1850-2012. // Proc. of Int. Conf. "Modern Problems of Geography", Dedicated to the 80th Anniversary Since the Fondation of Vakhushti Bagrationi Institute of Geography, Collected Papers New Series, N 5(84), ISSN 2233-3347, Tbilisi, 2013, pp. 160-163, (in Russian).
7. Amiranashvili A. Changeability of Air Temperature and Atmospheric Precipitations in Tbilisi for 175 Years. // Int. Sc. Conf. "Natural Disasters in Georgia: Monitoring, Prevention, Mitigation". Proc., ISBN 978-9941-13-899-7, Publish House of Iv. Javakhishvili Tbilisi State University, December 12-14, Tbilisi, 2019, pp.189-192.
8. Skvarenina J., Mindas J., Holecy J., Tucek J. Analysis of the Natural and Meteorological Conditions During Two Largest Forest Fire Events in the Slovak Paradise National Park. // Forest fire in the wildland-urban interface and rural areas in Europe: an integral planning and management challenge. Athens. 2003.
9. Lukić T., Marić P., Hrnjak I., Gavrilov M.B., Mladjan D., Zorn M., Komac B., Milošević Z., Marković S.B., Sakulski D., Jordaan A., Đorđević J., Pavić D., Stojsavljević R. Forest Fire Analysis and Classification Based on a Serbian Case Study. // Acta Geographica Slovenica, 57-1, 2017, pp. 51–63.
10. Bliadze T., Kirkitadze D., Samkharadze I., Tsiklauri Kh. Statistical Characteristics of Angstrom Fire Index for Tbilisi. // Int. Sc. Conf. "Natural Disasters in Georgia: Monitoring, Prevention, Mitigation". Proc., ISBN 978-9941-13-899-7, Publish House of Iv. Javakhishvili Tbilisi State University, December 12-14, Tbilisi, 2019, pp.86-90.