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SPEED AND DIRECTION OF THE MAIN FLOW IN THE ATMOSPHERE ABOVE THE TERRITORY OF SHIDA KARTLI (GEORGIA) DURING THE ANTI-HAIL SEASON

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Summary: In the work the data of statistical analysis of the daily and monthly average values of the main flow speed and direction above the territory of Shida Kartli (Gori) for the period from 1 April to 31 October 2016 is presented. The results of the work will find practical application in the organization of the anti-hail system in this region.

Key words: aerological sounding of atmosphere, wind speed, wind direction, weather modification.

Introduction

Scientific and practical works on the weather modification (including anti-hail works) in many countries of world are conducted. Protection from the hail is achieved almost in 50 countries of world (Austria, Canada, China, Bosnia and Herzegovina, Germany, Georgia, Greece, Romania, Russian Federation, Serbia, etc.). The total area of the protected from the hail territory reaches 90 million hectares. [1,2; https://map.geoengineeringmonitor.org/].

Experimental, experimental-practical and practical work on the fight with the hail in 1960-1990 conducted in two regions of Georgia (Kakheti – 800 thousand hectares, southern Georgia - 400 thousand hectares). In 1989, these works were discontinued, and in 2015 restored in Kakheti [2-6].

In the future, it is planned to organize work to the weather modification throughout Georgia, and primarily to expand operations against hail in the territory of Eastern Georgia. In the near future it is planned to resume anti-hail operations in southern Georgia, as well as to create a new anti-hail polygon in Shida Kartli [4].

The normal functioning of anti-hail service is impossible without information about the vertical distribution of meteorological elements in the atmosphere [1,5,7]. In particular, the information about the speed and direction of the main flow in the atmosphere are necessary for planning of the arrangement of the points of active action on the hail clouds, conducting of this action, etc. [8-10].

Results of the statistical analysis of data of the speed and direction of the main flow in the atmosphere under the conditions of Shida Kartli, where the organization of works on the fight with the hail is outlined, are represented below

Material and methods

For investigating the wind regime in the free atmosphere above the territory of Shida Kartli (Gori) as in [7] the resources of http://ready.arl.noaa.gov/READYcmet.php were used.

Work gives the statistical data about the daily and monthly average values of the main flow speed (M.F.S.) and main flow direction (M.F.D.) from 1 April to 31 October 2016. The daily values of the

indicated parameters were averaged according to data for four periods of measurements of the wind vertical profile (04, 10, 16 and 22 hours on the Tbilisi time).

The analysis of data with the use of the standard statistical analysis methods is carried out. The following designations will be used below: Min – minimal values, Max - maximal values, Mean – average values, St Dev - standard deviation, St Err – standard error, Cv (%) - coefficient of variation, 99%(+/-) - 99% of confidence interval

Results and discussion

Results in table1,2 and fig. 1-3 are presented.

Table 1. Statistical characteristics of daily mean values of main flow spead above Gori from April to October.

Parameter	April	May	June	July	August	September	October
Min	5.5	3.0	2.5	2.3	2.5	3.8	4.5
Max	24.3	25.0	17.5	16.0	15.5	22.8	29.8
Mean	12.3	11.2	8.2	7.2	7.4	11.4	14.1
St Dev	5.7	5.5	4.0	3.7	3.2	4.7	7.2
Cv,%	103	184	159	164	128	124	161
St Err	1.1	1.0	0.7	0.7	0.6	0.9	1.3
99%(+/-)	2.7	2.6	1.9	1.7	1.5	2.2	3.4

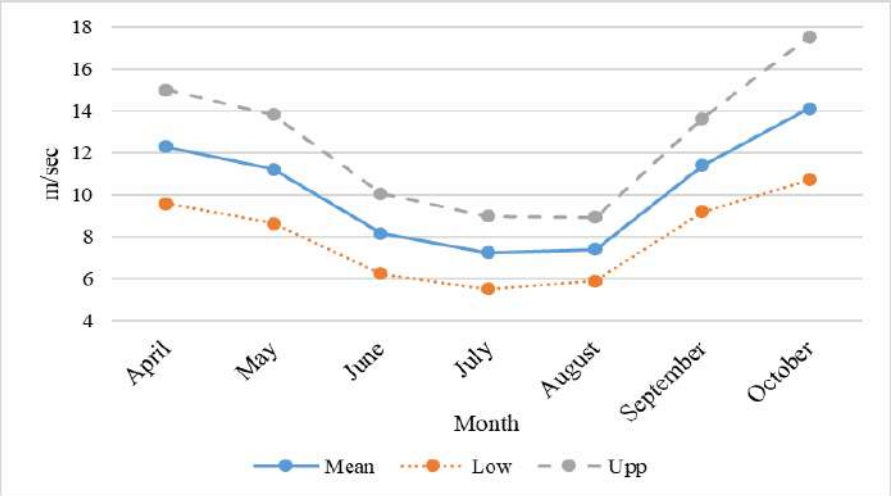

Fig. 1. Monthly variation of daily mean values of main flow speed and its 99% confidence interval above Gori.

As follows from fig. 1 and table 1 daily mean values of M.F.S. above Gori changes from 2.3 m/sec (July) to 29.8 m/sec (October). The largest variations of values of M.F.S. in May is observed (Cv=184 %), the smallest - in April (Cv=103 %). Monthly mean values of M.F.S. changes from 7.2 m/sec (July) to 14.1 m/sec (October). 99% confidence interval of mean values of M.F.S changes from ±1.5 m/sec (August) to ±3.4 m/sec (October).

From fig. 2 and table 2 follows, what daily mean values of M.F.D. above Gori changes from 58 degree (July) to 345 degree (April). The largest variations of values of M.F.D. in October is observed (Cv=141 %), the smallest - in September (Cv=9.5 %). Monthly mean values of M.F.D. changes from 210 degree (June) to 264 degree (September). 99% confidence interval of mean values of M.F.S changes from ±10 degree (September) to ±29 degree (June).

Table 2. Statistical characteristics of daily mean values of main flow direction above Gori from April to October.

Parameter	April	May	June	July	August	September	October
Min	101	179	91	58	125	230	35
Max	345	323	303	284	294	325	299
Mean	257	241	210	223	229	264	252
St Dev	49	30	62	52	35	22	49
Cv,%	48.8	16.5	67.5	90.9	27.6	9.5	141
St Err	9	5	11	10	6	4	9
99%(+/-)	24	14	29	25	16	10	23

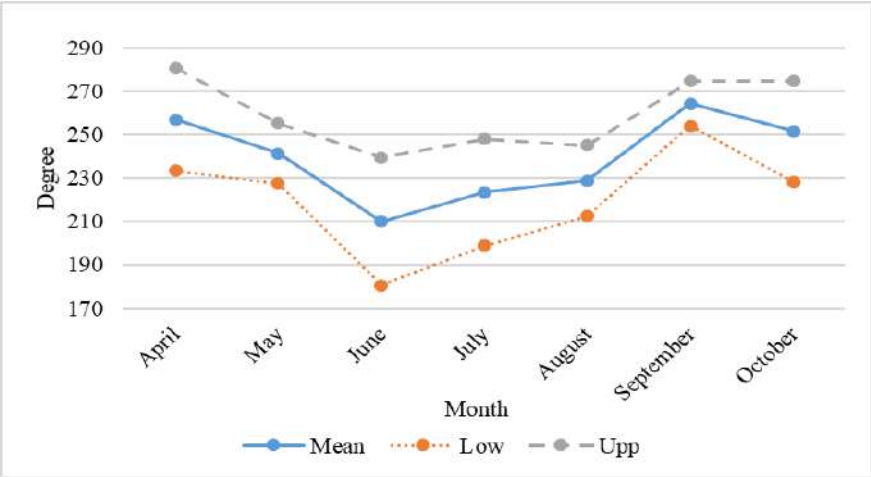

Fig. 2. Monthly variation of daily mean values of main flow direction and its 99% confidence interval above Gori.

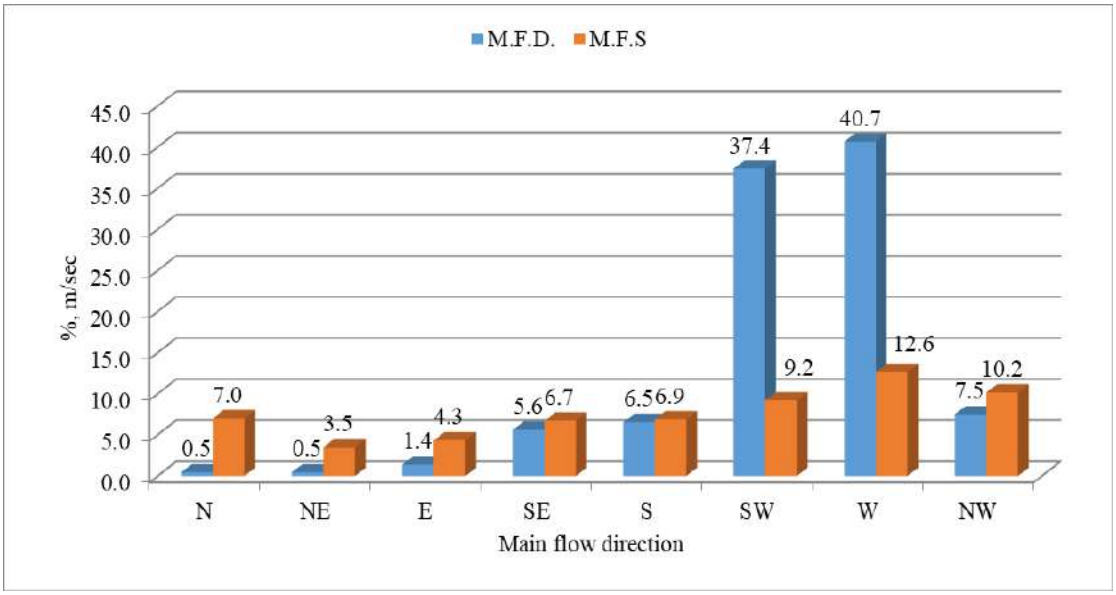

Fig. 3. Repetition of of main flow direction (M.F.D.) and mean values on main flow spead (M.F.S.) in each of direction above Gori.

The highest frequency of M.F.D. values have West direction (40.7%), the smallest - North and North - East direction (0.5% respectively). The maximum average values of M.F.S have West direction (12.6 m / s), the minimum - North - East (3.5 m / s), Fig. 3.

Conclusion

In the future, similar studies are planned for other regions of Georgia.

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References

1. Abshaev A.M., Abshaev M.T., Barekova M.V., Malkarova A.M. Rukovodstvo po organizacii i provedeniu protivogradovih rabot.// ISBN 978-5-905770-54-8, Nalchik, Pechatni dvor, 2014, 500 s, (in Russian).
2. Essays of the History of Weather Modification in the USSR and the Post-Soviet Territory.// ISBN 978-5-86813-450-0, St. Petersburg, RSHMU, 2017, 352 pp., ill., (in Russian), http://mig-journal.ru/toauthor?id=4644.
3. Amiranashvili A.G. History of Active Effects on Atmospheric Processes in Georgia. In the book: Essays of the History of Weather Modification in the USSR and the Post-Soviet Territory. // ISBN 978-5-86813-450-0, St. Petersburg, RSHMU, 2017, 352 pp., ill., pp. 234-254, (in Russian), http://mig-journal.ru/toauthor?id=4644.
4. Amiranashvili A., Chikhladze V., Dzodzuashvili U., Ghlonti N., Sauri I., Telia Sh., Tsintsadze T. Weather Modification in Georgia: Past, Present, Prospects for Development. // Int. Sc. Conf. "Natural Disasters in Georgia: Monitoring, Prevention, Mitigation". Proc., ISBN 978-9941-13-899-7, Publish Hous of Iv. Javakhishvili Tbilisi State University, December 12-14, Tbilisi, 2019, pp. 216-222.
5. Amiranashvili A., Dzodzuashvili U., Lomtadze J., Sauri I., Chikhladze V. Some Characteristics of Hail Processes in Kakheti. // Trans. of Mikheil Nodia Institute of Geophysics, ISSN 1512-1135, vol. 65, Tb., 2015, pp. 77 – 100, (in Russian).
6. Amiranashvili A.G., Chikhladze V.A., Dzodzuashvili U.V., Ghlonti N.Ya., Sauri I.P. Reconstruction of Anti-Hail System in Kakheti (Georgia). // Journal of the Georgian Geophysical Society, Issue B. Physics of Atmosphere, Ocean and Space Plasma, v.18B, Tbilisi, 2015, pp. 92-106.
7. Amiranashvili A. G., Berianidze N.T., Jamrishvili N. K., Tavidashvili Kh. Z. Statistical Characteristics of the Monthly Average Values of the Air Temperature in the Layer of Atmosphere 0.54-27 km above the Kakheti Territory (Georgia) in 2012-2016. // Journal of the Georgian Geophysical Society, ISSN: 1512-1127, Iss. B, Physics of Atmosphere, Ocean and Space Plasma, Tb., 2017, vol. 20B, pp. 24-42.
8. Amiranashvili A., Dzodzuashvili U., Lomtadze J., Sauri I., Chikhladze V. Means of Action on Atmospheric Processes in Kakheti. // Trans. of Mikheil Nodia institute of Geophysics, ISSN 1512-1135, vol. 65, Tb., 2015, pp. 113 – 120, (in Russian).
9. Amiranashvili A.G., Chikhladze V. A., Dzodzuashvili U. V., Jincharadze G. A., Pipia M. G., Sauri I. P., Telia Sh. O. On the Use of Anti-Hail Rockets "Trayal D 6- B" in the Work of Anti Hail System in Kakheti (Georgia). // Journal of the Georgian Geophysical Society, Issue B. Physics of Atmosphere, Ocean and Space Plasma, v.19B, Tbilisi, 2016, pp. 73-78
10. Amiranashvili A., Chikhladze V., Dzodzuashvili U., Sauri I., Telia Sh. About the Use of Anti-Hail Rockets "Loza-2" in the Work of Anti-Hail System in Kakheti (Georgia). // Journal of the Georgian Geophysical Society, ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 22(1), 2019, pp 30 - 37.