

Some results of synchronous temperature profile measurements made by two remote profilers MTP-5 and radiosonde sounding comparison.

Boikov N.A.Rybakov Y.V. Main Geophysical Observatory, St-Petersburg, Karbysheva, 7, Russia, 194021 tel./fax: +7-812-297-86-81 borrichik@mail.ru

The main subject of this article is comparative measurements of temperature of meteorological temperature profilers MTP-5 made by two different firms working synchronous and comparison their data with radiosonde data.

Introduction.

Now, the only device allowing continuously to measure by not contact method an atmosphere temperature profile in a layer of 0-1000 m is the meteorological temperature profiler MTP-5

MTP-5 provides:

- measurement of an atmosphere temperature profile in the range of heights 0-1000m
- automatic measurements of a temperature profile with frequency not less than 1 time 10 min.
- display to the screen of the computer current and storage of archive of the measured profiles.

Comparative measurements of temperature profilers MTP-5.

For the purpose of clarification of precision characteristics when using several MTP-5 in carried points, comparative measurements of two serial samples of the devices belonging to Federal State Budgetary Institution MGO were carried out.

Main objectives of comparative tests of profilers were:

- repeated comparative measurements of indications of devices at a unidirectional arrangement and synchronous work (fig. 1.);
- clarification of an average rejection of indications of devices at each separate height from indications of a radiosonde;



Fig. 1 Two profilers MTP-5 established on a roof of observatory in the item of Voeikovo.

Two series of measurements were carried out. The first series of measurements was carried out from the middle of February 2013 until the end of March 2013 during the parallel work on the Actinometry pavilion roof; the second series of measurements was carried out after MTP-5 N06 repair on a new place at optimum influence of shadows from local subjects (fig. 1).

By results of the first series of measurements it is possible to judge, both nature of collaboration of devices and about extent of coincidence of MTP-5 data with radiosonde data. Data on average deviations of these two MTP-5s from a weather balloon data on different heights were obtained and processed. Selection of the first series included profiles without inversion.

One of the characteristic profiles received in the period of measurements at the end of February – the beginning of March, 2013 is shown in fig. 2.

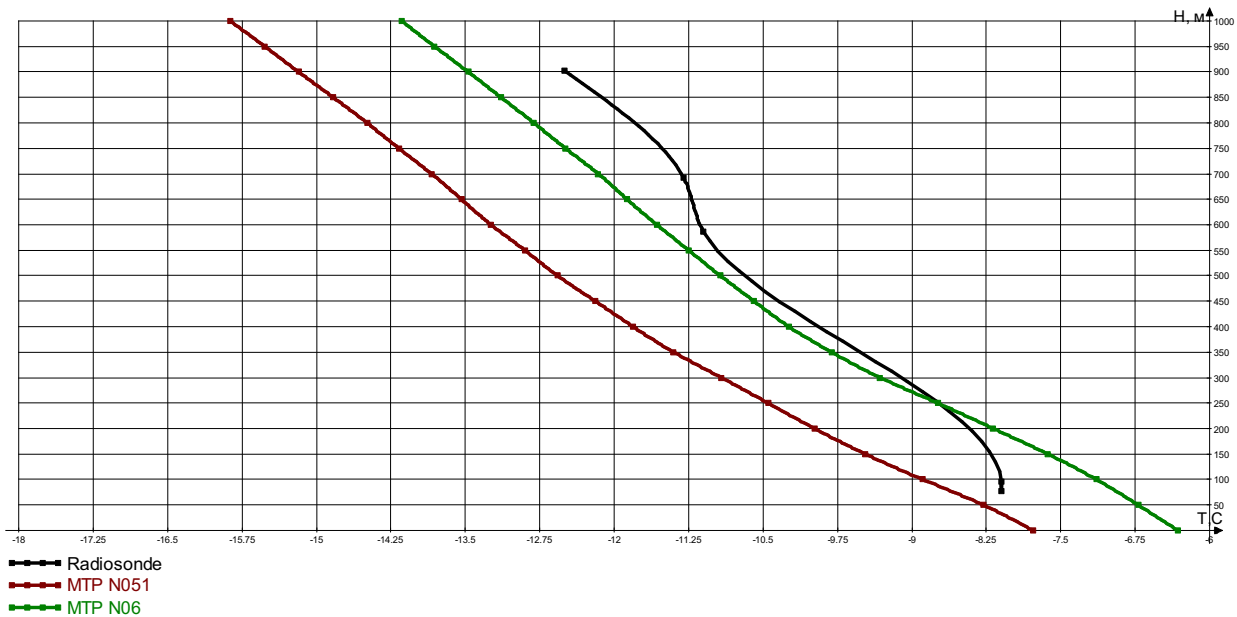


Fig. 2 The atmosphere temperature profile for 04.03.13 term 12(GMT):

In drawing characteristic additive divergences of device indications each of heights are visible. Values of average rejections of indications of devices are given in table 1 for each of heights in 7 days of February 2013.

Table 1. Divergence of indications of adjacent devices Δ =MTPN051- MTPN06.

H, m	Δ , °C	H, m	Δ , °C
0	-1,16	550	-1,41
50	-1,39	600	-1,4
100	-1,5	650	-1,41
150	-1,49	700	-1,42
200	-1,46	750	-1,44
250	-1,49	800	-1,47

300	-1,52	850	-1,5
350	-1,57	900	-1,53
400	-1,52	950	-1,54
450	-1,47	1000	-1,57
500	-1,43		

From data of table 1 it is visible that the existing systematic additive mistake between indications of two devices is almost identical on height.

It is easy to notice that at close nature of the results received from two profilers working synchronous, their indications can significantly differ from radiosonde data. Together with it, acceptance of new MTP-5s, and also checking of operating devices are carried out on coincidence, on the average, the MTP-5 profiles with data of radiosondes. This coincidence can be distorted considerably by qualitative discrepancy of profiles in separate days when there is an inversion in a profile (fig. 3), while on each of heights average divergences in operation of devices are quite stable (see tab. 3).

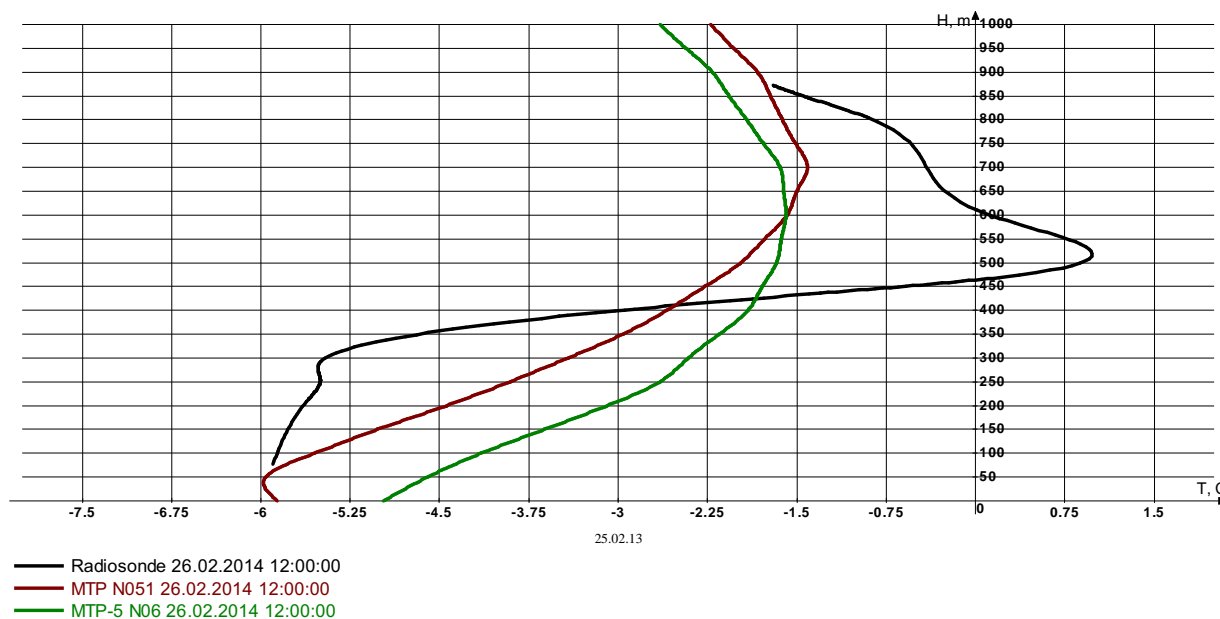


Fig. 3 The atmosphere temperature profile in day with inversion 26.02.13 term 12.

Table 3. Average rejections of indications of devices from each other for each of heights for the period of measurements in February (22.02.2013-28.02.2013).

H, m	$\Delta, ^\circ\text{C}$	H, m	$\Delta, ^\circ\text{C}$
0	0,90	550	1,25
50	1,06	600	1,23
100	1,19	650	1,22
150	1,29	700	1,19
200	1,36	750	1,19
250	1,38	800	1,19
300	1,38	850	1,19

350	1,34	900	1,19
400	1,30	950	1,20
450	1,28	1000	1,20
500	1,27		

Due to the last, it is advisable to acceptance to consider a question of a MTP-5 checking technique by comparison with rather permanently established and constantly operating model MTP-5 unlike the operating technique based on comparison of data of each MTP-5 with radiosonde data during time about 2 weeks (20 starts).

For the second series of measurements the new place with the optimum direction of vising was chosen.

Previously additional tests of one MTP-N051 device installed permanently were carried out. Tests began since the end of January, 2014 and proceed still. Selection of the first series includes profiles in 0 and 12 hours across Greenwich without inversion existence.

For the purpose of the received characteristics specification, comparison of MTP-5 indications was made with indications of a ground aerology that allowed to get a temperature data with a step of 100 m from ground to 1 km.

It is known [1] that at close connection of vertical profiles of any meteorological size among themselves, all of them will contain very little new information in comparison with one of them. And, therefore, the increase in number of realization in this case won't lead to noticeable specification of the received statistical characteristics. That is we have to investigate profiles in which there is no temporary communication.

So, in [2] on the example of calculation of temporary correlation function of ground temperature for the station Surgut it is established that supervision over temperature in three days become almost independent from each other. Similar results were received and for the free atmosphere of midlatitudes in work [3] in which it is shown that radiosonde supervision over temperature in the troposphere and the bottom stratosphere are independent from each other in 2-3 days.

Based on the aforesaid, it is necessary to include those starts which differ for 2-3 days, that is, approximately every fifth that can lead to serious increase in duration of supervision for the purpose of excess of a critical limit at 50-60 supervision below which, it agrees [4] in consideration, it is necessary to reckon with insufficient reliability of definition of statistical characteristics.

In addition, initial selection has to meet also a stationarity condition, i.e. not allow association in one set of supervision for the periods (for example, year or a season) during which defined statisticians undergo essential changes. Otherwise not accounting of an available annual course leads to considerable distortion of estimated statistical characteristics and in particular to overestimate of coefficient of correlation.

Similar distortion of climatic indicators can happen and at the expense of not accounting of a daily course of meteorological value, especially near a terrestrial surface. Therefore it would be advisable to carry out for the bottom troposphere a statistical assessment of opportunities of use in the analysis of meteorological fields of the main the statistician calculated on the general selection, including supervision for day and night terms.

Division of general selection into two separate selections has to be made taking into account an assessment of the importance and accident of a divergence of casual values of temperature,

and also taking into account an assessment of the importance or accident of a divergence of dispersions of temperature. Two criteria of t_s and T_H which, according to [4, 5] can be defined how are for this purpose used:

$$t_s = \frac{|\bar{\xi}_1 - \bar{\xi}_2|}{\sqrt{\sigma_1^2/n_1 + \sigma_2^2/n_2}} ;$$

$$T_H = \frac{\sigma_1^2}{\sigma_2^2},$$

where $\bar{\xi}_1, \bar{\xi}_2$ - average values of two compared selections; σ_1^2, σ_2^2 – selective dispersions corresponding to them; n_1, n_2 – volumes of compared selections.

In [1] the detailed analysis of a daily course of temperature for winter and summer months for stations Salekhard, Moscow and Odessa for day and night from which is submitted follows that in winter months in the most part of a considered layer the atmospheres used for calculation of climatic indicators of temperature differ incidentally and therefore can be carried to one general selection.

Thus, selection made in day and night terms during the period from the 23 of January 2014 to the 1 of March 2014 – 32 days on two starts – satisfies to a critical data set for the analysis, because from the aforesaid, we can unite two selections in one population, in which more than 50 measurements. At the same time, the available technique is based on two-week tests.

Results of researches are schedules of characteristic temperature profiles on heights, and also average rejections of MTP-5 data from radiosonde data.

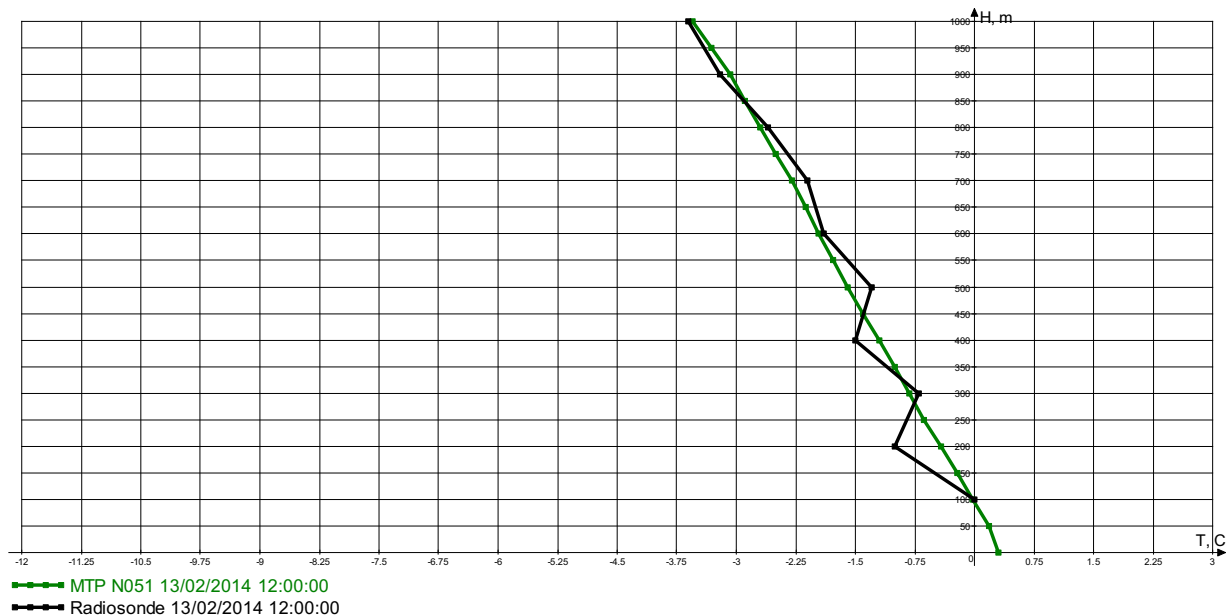


Fig. 3. The schedule of a temperature profile and radiosonde indications for 13.02.2014, term 12.

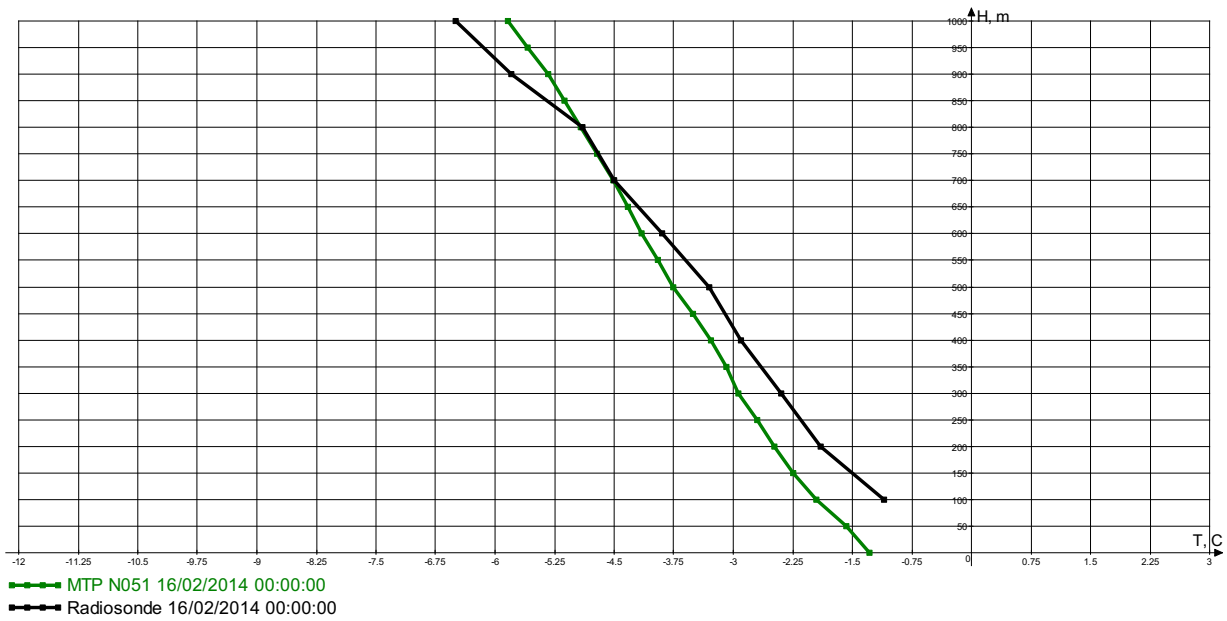


Fig. 4. The schedule of a temperature profile and indications radiosondes for 16.02.2014, term 00.

Table 4. Average divergences between indications of MTP-5 N051 and a radiosonde for day and night terms.

H, m	$\Delta, ^\circ\text{C}$ Radiosonde - MTP- N051 Day	$\Delta, ^\circ\text{C}$ Radiosonde - MTP-N051 Night
100	0,58	0,92
200	0,45	0,83
300	0,18	0,72
400	-0,11	0,59
500	0,02	0,5
600	0,04	0,31
700	-0,05	0,44
800	0,2	0,38
900	0,36	0,6
1000	0,69	0,76

From the provided data it is visible that MTP-5 N051 quite accurately, on the average, reflects reality, both in day, and in night terms, giving an average additive error of not exceeding 1 degree.

Comparative measurements of two devices which began on April 1 in the first two weeks (30 starts) showed serious differences in operation of devices in comparison with the first series.

In drawings schedules of joint tests of devices, and also the schedules of data of a radiosonde put on them are submitted. The most characteristic examples for 03.04.14 term 12 and 08.04.14 are presented

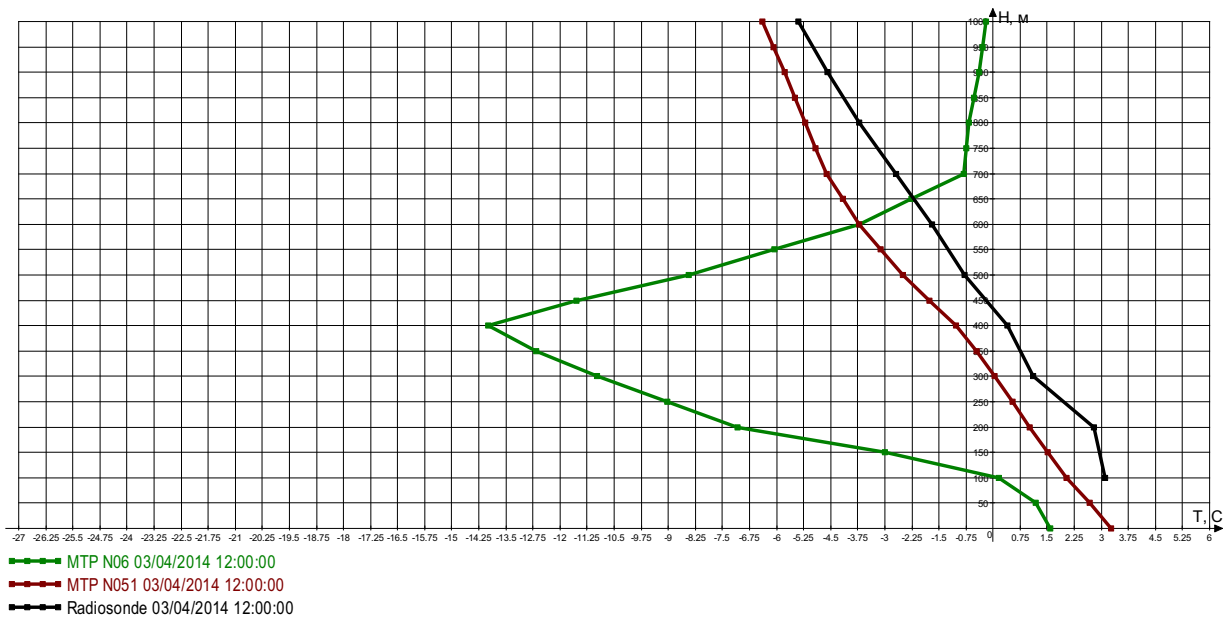


Fig. 6 Schedule of Dependence of Indications of Two Devices and Radiosonde 03.04.2014 term 12.

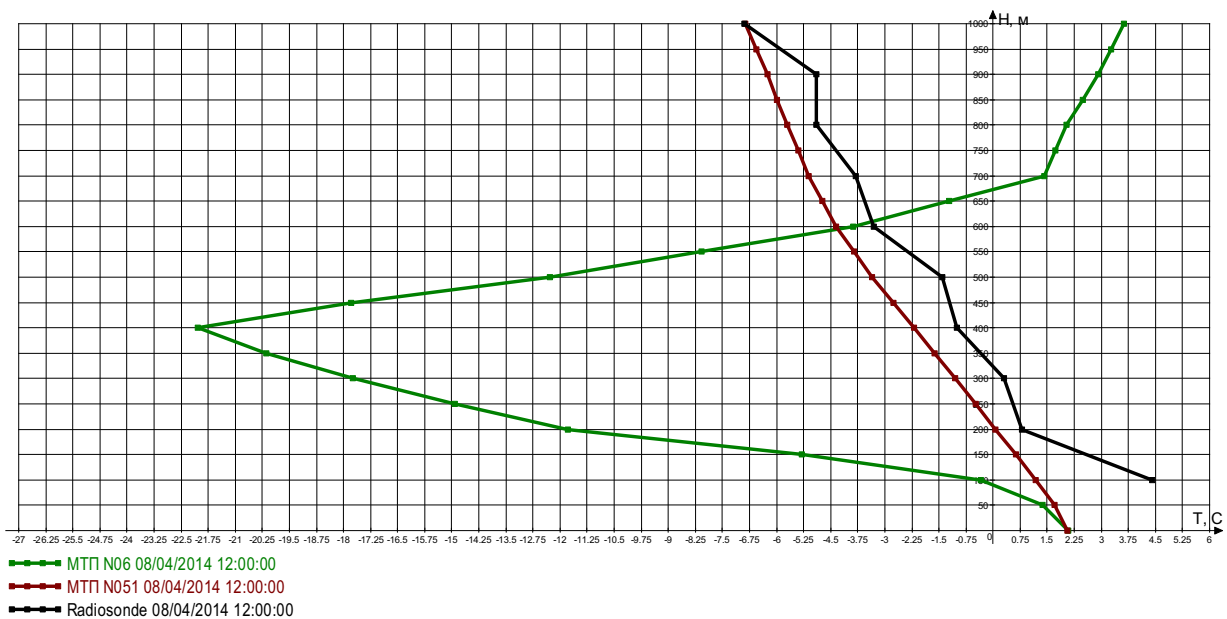


Fig. 7. Schedule of dependence of indications of two devices and radiosonde 08.04.2014 term 12.

From schedules it is visible, that even at small selection, it is possible to judge operability of the MTP-5 N06 device which indications sharply differ, both from indications of radiosonde sounding, and from MTP-5 N051 indications at once.

Proceeding from all aforesaid, Federal State Budgetary Institution MGO offers the new scheme of check of working capacity and possible checking of MTP-5 devices on the range of the item of Voeikovo at the Leningrad region. Also, the available platform allows to carry out checking of operability of devices and without the available permanently located device – according to the scheme offered and described above. This scheme is not finished at present taking into account an annual course of temperatures and seasonal changes, and also additional statistical methods.

Literature.

1. Zuyev V. E., Komarov V.S. Statistical models of temperature and gas atmosphere component. Leningrad, Gidrometeoizdat, 1986, page 50-69
2. Kagan R. L., Fedorchenko E.I. About application of the theory of emissions to research of temperature ranks. – Works MGO, 1970, vol. 267, page 146-172
3. Romanenko T.P. To a question of temporary statistical structure of air temperature in the troposphere and the bottom stratosphere. – On Saturday. : Application of statistical methods in meteorology. – Novosibirsk: WITH Academy of Sciences of the USSR, 1971 pages 122-128
4. Brooks C.E., Carruthers N. Yandbook of statistical methods in meteorology.- Her Majesty's Stationary Office, 1953. – 142p.
5. Rumishsky L.Z. Matematichesky processing of results of experiment. M.: Science, 1971. – page 193

This document was created with Win2PDF available at <http://www.win2pdf.com>.
The unregistered version of Win2PDF is for evaluation or non-commercial use only.
This page will not be added after purchasing Win2PDF.