METHOD AND TECHNICAL SOLUTIONS OF INFORMATIVITY INCREASE OF ACTINOMETRIC MEASUREMENTS

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The interpretation of actinometric information is considered as a parametric task of the analysis of the brightness components of the sky. With the purpose of its adequate solution. the constructive elements of spectrometers are proposed for manufacture of actinometric devices, realization and processing of measurement data in the course of natural experiments.

INTRODUCTION

Actinometric measurements allow to receive the most capacious information on optic conditions of the atmosphere in view of their regularity. At the same time there are some certain difficulties at one - valued interpretation of measurement data, mainly, because of obstacles of Forbs effect and optic instability of the atmosphere [1, 2].

At present at solution of these tasks, mainly in the field of ecological and climatological monitoring, there is a necessity of increase of exact actinometric information. It is connected with the possibility of research of space - time changeability and spectral structure of components of the day - time brightness of the sky.

This work proposes methods of unification of elements of actinometrics and the spectrophotometrics with the purpose of corresponding research on field brightness of a light radiation of the firmament, collection and treatment of actinometric information during realization of natural experiments.

SYSTEMATIC APPROACH

At research of the glow of the firmament the observed brightness is presented as a sum of additive components [2,4].

This allows to get various relationships, expressing the interrelation of consisting components of brightness of the sky.

The forming process of the field of glow radiation of firmament [3] is represented in the form of the diagramm on fig 1.

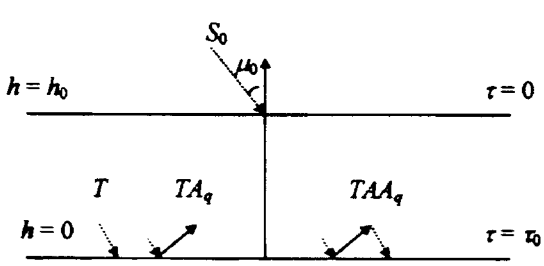

Fig. 1. The diagram of the forming of the glow radiation field of firmament.

Here h is the height, τ is the optic thickness of the atmosphere, S_0 is the solar constant; $\mu_0=cos\theta_0$ where θ_0 is the angle of incidence of the direct radiation, T is the transmission, A is the albedo of the atmosphere, A_q is the albedo of the land surface.

The atmospheric transmission can be written as

$$T=\frac{F}{\mu_0 S_0}=T_D+p^{m_0}. \quad (1)$$

where F is the incident radiation flux, T_D is the transmission for scattered radiation, $P=exp(-\tau)$ is the atmosphere transmittance, m_0 is the optic mass of atmosphere (for θ_0>30°: $m_0=sec\theta_0$ [1]).

Let's consider methods of analysis of nature characteristics p and T. On the input of the optic device the illumination S is determined according to formula [5]

$$S=\pi B sin^2\varepsilon, \quad (2)$$

where B is the brightness of the incident radiation, ε is the aperture angle in the space of objects.

Proportionality of values is supposed at calculations of the transparency of atmosphere:

$$\frac{S}{S_0}=\frac{F}{\mu_0 S_0} \quad (3)$$

Atmospheric transparency is investigated in accordance with the Buger curve [1]

$$ln\pi B_d=lnS_d+m_0 lnp, \quad (4)$$

where B_d is the brightness of the direct radiation.

Solution of the task on brightness of the day - time sky we will carry out in accordance with fig 1. We try to differ the repeated scattering of coming solar radiation, determined by the transmission T, and multiple reflection in the system of "atmosphere - layer of the surface" determined by the product AA_q.

In atmospheric windows of transparency, at neglect of absorption, one may think that $A=1-T$. Thus at certain values of the independent parameter A, the indicated task reduces to determination of the transmission T.

We can present the brightness of coming radiation as the sum:

$$B_t=B_s+B_m \quad (5)$$

where B_s is the brightness of single scattering and B_m is the brightness of multiple scattering, B_t is the brightness of total scattering.

Component B_s is most simply calculated in almucantar of the Sun (in points of the firmament system with the same zenith distance as the Sun) [2].

$$B_s = S_0 f(\theta) p^{m_\oplus} m_\oplus \, , \qquad (6)$$

where $f(\theta)$ is the indicatrix of scattering of atmosphere; θ is the angle of scattering.

Observations show that following relationship takes place in the almucant ar of the Sun

$$B_m = const\, B_s \, . \qquad (7)$$

Here the proportionality coefficient is of the order of ÷0.13 in accordance with theoretical assessment.

ELEMENTS OF APPARATUS COMPLEX

The above mentioned systematic approach is based on measurement of brightness of direct radiation, single scattered radiation in almucantar of the Sun, multiple scattered radiation in "atmosphere - land surface" system.

Measurements and processing of data are carried out in the course of natural experiments. The fig. 2 shows the block - diagram of measuring apparatus.

Measurements are carried out in the window of atmosphere transparency. For this purpose the disk cassettes are used with replaced glass light filters due to their stability during a long - time exploitation.

Filters are installed in the optic system uniting blends 1, 2, objectives 4, light guides 6, condensers 5, 7, 9. Blend 1 with diaphragms serves for receiving of direct or single scattered radiation, and blend 2 with shaded enclosure serves for receiving of multiple scattered radiation. Enclosure 3 is mobile and is used for vignetting of stream of a scattered radiation. Set of condensers is necessary for collecting, averaging and direction of a light stream along the axis of the optic system. It is important because light guides and photodiodes with small area of the receiving surface are used. Amplifier 11 is assembled on low - voltage combined microscheme for guarantee of the temperature stability and application of the low power feeding source (12).

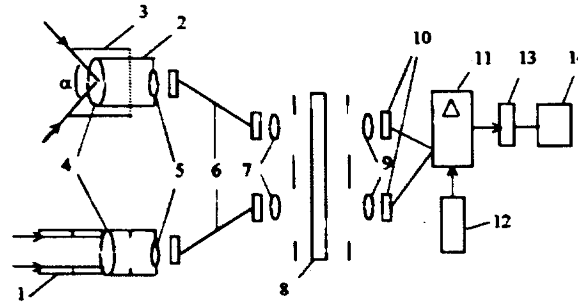

Fig. 2. Block - diagram of the measuring complex: 1, 2 are blends; 3 is the cylindrical enclosure; 4 are objectives; 5, 7, 9 are condenser lenses; 6 are light guides; 8 are cassettes with filters; 10 are photodiodes; 11 is the amplifier; 12 is the battery of amplifier feeding; 13 is the converter; 14 is the registration system.

Photo current is delivered to the personal ECM on lines of communication by means of converter (13).

Let's compare the characteristics of sensitivity of the optic system in fig. 2 by means of the table, using FD - 256 with actinometer and pyranometer. Because of low values of passage of optic systems the increase of sensitivity of all measuring system is supplied as a result of following factors:

1) equalization in accordance with fixing of sizes of lens blends 1, 2 with photo sensitive area of actinometer and pyranometer ;

2) use of the amplifier with no less than ten times magnification at the conservation of its temperature stability.

Table of comparison of sensitivity of optic system blends 1, 2, actinometer and pyranometer

Receiver	Integral sensitivity $\frac{mA}{Wt\ \ cm^2}$	Photo sensitivity area, cm^2	Transmittance of optic system	Diameter of input pupil, mm
Actinometer	4	5.3		38
Pyranometer	7	4		11
Optic system 1. Blends 1 2. Blends 2	9 ($\lambda = (0.4 \div 1.1)$ mcm)	$1.5 \cdot 10^{-2}$	0.3 - 0.5	11 19

CONCLUSION

1. The systematic base of actinometric measurements of spectral brightness of the firmament is developed.

2. The problems of realization of complex actinometric measurements are considered.

3. Constructive elements of spectrophotometers for elaboration of actinometric apparatus are proposed.

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AKTİNOMETRİK ÖLÇMƏLƏRİN İNFORMATİVLİYİNİN ARTIRILMASI METODİKASI VƏ TEXNİKİ HƏLLİ

İşdə aktinometrik məlumatların izahına səmanın parlaqlıq komponentləri arasındakı parametrik asılılığın analizi kimi baxılır. Məsələnin adekvat olaraq həll edilməsi üçün aktinometrik cihazların hazırlanmasında spektrometrlərin konstruktiv elementlərini istifadə edilməsi, ölçmələr toplusunun tədqiqatlar zamanı işlənməsi tövsiyə olunur.

Ф.И. Исмайлов

МЕТОДИКА И ТЕХНИЧЕСКИЕ РЕШЕНИЯ ПОВЫШЕНИЯ ИНФОРМАТИВНОСТИ АКТИНОМЕТРИЧЕСКИХ ИЗМЕРЕНИЙ

Интерпретация актинометрической информации рассматривается как параметрическая задача анализа компонент яркости небосвода. С целью ее адекватного решения предлагается использовать конструктивные элементы спектрометров для изготовления актинометрических приборов, проведение и обработку массива данных измерений в ходе натурных экспериментов.

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