solution was chosen to be that value of $\varphi(r)$, which satisfies the condition $\varphi(r) \geq 0$ and minimizes the variance ρ^2.

As a result of the reduction of the data obtained by multifrequency laser sounding with the systems "Lidar-2" and "Gloriya," we obtained the aerosol distribution density functions of the height h of the location of the layer, of the time of the day, and of the meteorological situation. Figures 1 and 2 show by way of example $\varphi(r)$ for the summer anticyclone (relative humidity $f=54\%$, obtained values n = 1.41, $\varkappa$ = 0.02) and for the cyclone ($f \approx 80\%$, n = 1.35, $\varkappa$ = 0.002).

In conclusion, we note the following main features: 1 — the apparatus and procedures developed make it possible to obtain information on aerosol particles with size up to several microns; 2 — organization is necessary of comprehensive experiments using contact measurement methods for the dimensions of the aerosol particles in order to determine the limit of applicability of the method of multifrequency sounding; 3 — further work is needed to optimize the algorithms of the data reduction so as to reduce the time of computation and analysis of the lidar-measurement data.

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CONSTRUCTION OF REGIONAL SEMIEMPIRICAL MODELS OF OPTICAL CHARACTERISTICS OF THE ATMOSPHERE

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By now, several models were developed capable of describing the spectral variation of the optical thickness of the atmosphere in the transparency windows [1-4]. A common shortcoming of these models, however, is that they are static. They reflect certain "average" conditions and do not take into account the real fluctuations of the optical density of the atmosphere, which are connected with variability of the synoptic processes.

A different approach to the construction of the model of the change of the optical thickness in the transparency windows was developed by the authors of the present communication. The proposed model of the optical state of the air layer next to the earth is based on a synthesis of the results of generalization of natural optical experiments performed under various weather conditions, and is free to a considerable degree of the shortcomings indicated above. This makes it possible to describe real changes of the transmission of the atmosphere in the transparency "windows."

When constructing a block model for the aerosol, the main stress should be on determining the optimum ensemble of criteria for identification of the optical state of the aerosol. The basic characteristics of the ensemble of the input parameters of the aerosol block are

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TABLE 1

Gradation of optical weather	Synoptic situation	Air temp. (℃)	Rel. humidity (%)	MV (km)	n_0	n_1	n_2
I.	Anticyclones of non-tropical latitudes	-20÷20	50-90	20-50	0,03	0,35	2,0
2.	Region of baric field to the north of the EEPF		30-50	I5-50	0,004	0,35	2,0
3.		-I2÷25	50-90	I0-20	0,09	0,44	I,45
4.			85-90 90-95	5-I0 I0-I5	0,07	0,54	I,06
5.			90-I00	5-I0	0,22	0,57	0,65
6.		-I2÷25	90-I00	I-5	0,06	0,79	0,4
7.	Anticyclones of subtropical latitudes, warm sectors of the cyclones	-I2÷25	60-90	5-I5	0,30	0,37	0,9
8.	Region of baric field to the south of the EEPF		90-I00	I-5	0,56	0,39	0,39
9.	Quasistationary anticyclones (crests) of above-tropical latitudes	-35÷ -I2	70-90	I÷5	0,56	0,39	0,39

TABLE 2

λ, µm	β_λ	λ, µm	β_λ	λ, µm	β_λ	λ, µm	β_λ
I,32	0	I,88	0,06	2,75	0,I92	3,65	0,036
I,34	0,005	I,92	0,I0	2,85	0,356	3,75	0,020
I,38	0,03	I,94	0,I3	2,95	0,30	3,85	0,005
I,40	0,05	I,96	0,I0	3,0	0,3I	3,95	0
I,42	0,07	2,0	0,02	3,I	0,I98	9,2	0
I,46	0,06	2,04	0	3,I5	0,I68	I0,0	0,035
I,50	0,0I5	2,4	0	3.25	0,I22	II,0	0,075
I,54	0	2,45	0,005	3,35	0,094	I2,0	0,II
I,80	0,0I	2,55	0,035	3,45	0,067	I3,0	0,I9
I,84	0,03	2,65	0,090	3,55	0,05I	I4,0	0,28

TABLE 3

λ, µm	I,06	I,63	3,97	8,63	I0,I	I2,0I
$K_{1\lambda}$, cm^{-I}atm^{-I}	0,0I	0,02	0,02-0,03	0,06-0,09	0,08-0,II	0,II
$K_{2\lambda}$, cm^{-I}atm^{-I}	0	0	0	0 ÷ 3	0 ÷ 3	7

the meteorological visibility (MV) S_M, the relative humidity f, and the temperature t of the air. In addition, the ensemble includes a synoptic criterion — the position of the Eastern European Polar Front (EEPF) relative to the region where the experiments are performed, which characterizes the geographic origin of the air mass.

The optical model of the aerosol describes various states of the optical weather, each of which is characterized by an ensemble of input parameters, and principally by a definite profile of the spectral dependence of the volume coefficients of the aerosol attenuation α_λ in the region $\lambda \in$ 0.4–12 µm. For an analytic description of α_λ within the framework of a singled-out state of the atmosphere, use is made of the relation

$$\alpha_\lambda = \alpha_{0.55}\left[n_0 + n_1 \lambda^{-n_2}\right], \tag{1}$$

where n_0, n_1, n_2 are empirical coefficients, $\alpha_{0.55}$ is the attenuation coefficient at λ = 0.55 μm ($S_M = 3.91/\alpha_{0.55}$). The values of n_0, n_1, n_2 with the corresponding gradations of the input parameters are listed in Table 1.

When solving radiation problems it is important to know the values of α_λ not only in the transparency windows, but also in the adjacent regions of the spectrum. In this case the attenuation in the absorption bands of the aerosol particles will be different from the values determined by (1). Special measurements performed by us have shown that, in the region of absorption bands of liquid water (condensate) in the natural atmosphere, there is always an increased attenuation α_λ^* compared with the neighboring sections. Therefore, the values of the attenuation coefficients correlate closely with the value of the attenuation coefficient in the visible region of the spectrum α (0.55 μm). This connection can be approximated by the linear relation

$$\alpha_\lambda^* = \alpha_{0.55}\ \beta_\lambda. \tag{2}$$

The values of the parameter β_λ are listed in Table 2.

No less important for the calculation of radiation transport in the atmosphere is the attenuation factor, which is connected with the continuous absorption of the radiation. Natural measurements performed by us enabled us to obtain statistically confirmed coefficients of the continual absorption K_λ, which are described by an expression of the type

$$K_\lambda = K_{1\lambda}\, P + K_{2\lambda} \cdot e\ , \tag{3}$$

where P is the total pressure in atm, e is the partial pressure of the water vapor in atm. The recommended values of the coefficients $K_{1\lambda}$ and $K_{2\lambda}$ are given in Table 3.

In general form, the optical thickness in the transparency "windows" of the atmosphere, due to the aerosol attenuation and to continuous absorption of the radiation by the water vapor, is determined by the expression

$$\sigma_\lambda = \left\{\alpha_{0.55}\left[n_0 + n_1 \lambda^{-n_2} + \beta_\lambda\right] + \left[K_{1\lambda}\, P + K_{2\lambda} \cdot e\right] \cdot \frac{21.67\, e}{273 + t^\circ C}\right\} \ell, \tag{4}$$

where ℓ is the length of the homogeneous optical path.

Relation (4) can be used as a basis for calculation of the radiation losses as the radiation propagates in the earth's atmosphere. The total error in the diagnostics of the optical thickness is estimated in accordance with the proposed model at 15-20%.

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