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# STUDY OF POLLUTION OF THE TERRESTRIAL ATMOSPHERE CAUSED BY COSMIC AND GEOLOGIC IMPACTS BY THE METHOD OF STELLAR SPECTROPHOTOMETRY

V.A. Cernobai*

**Abstract**

Using rich historical facts, the importance of optic methods and especially of spectrophotometer ones for the study of global atmospheric pollution as a result of cosmic and geological collisions it is shown. Anomalies of spectral transparence of terrestrial atmosphere as a result of volcano eruption it is discussed.

In this paper we wish to draw attention to the necessity of inclusion in geoinformational systems (GIS) of the information about geophysics and astronomic sources of the atmosphere pollution: volcanoes, earthquakes, sand-storms, meteors, meteorites, comets etc.

The importance of these studies is connected with the fact that pollution of atmosphere and especially of stratosphere results in decrease of insolation and therefore in climatic changes, sometimes disastrous ones [1,2].

The temperature variations on the ground, caused by flux modulation of solar light by atmosphere with 10%, are cca 1,5 °C and the modification of albedo of the terrestrial surface with 1% - cca 2 °C [1]. The first measurements of spectral transparence of the atmosphere after a natural impact were made because of the fall of the "Tunguska" meteorite on June 30, 1908. In 2 weeks after the impact the spectral measurements, made by the astronomer C. Allot at the Mount–Wilson observatory, California, have shown the decrease of atmospheric transparence for all wave distances, which were used ($\lambda_1 = 0,4\ \mu km$, $\lambda_2 = 0,45\ \mu km$, $\lambda_3 = 0,7\ \mu km$). But the connection of this anomaly with the "Tunguska" metheorite was established by Fesencov V.G. only in 1949! The dust from this impact reached California (the distance from explosion – 9.000 km) in 360 hours, which means that the speeds of stratospheric wind run up to 25 km/h.

Diverse and more various measurements of the modification of atmospheric transparence an temperature variation on the ground were made after the eruption of the volcanoes El Chichón (Mexico) on April 26, 1982 and Penatubo in June, 1991 [4,5].

In this paper are analyzed the anomalies of spectral transparence of the atmosphere, which we have observed in the summer of 1982 [6], and is explained their nature with the help of the optic effects, caused by the stratospheric aerosols, which were formed and transported as a result of explosion of the volcano El Chichón.

On basis of the spectral measurements ($\lambda_1 = 0,41\ \mu km$; $\lambda_2 = 0,49\ \mu km$, $\lambda_3 = 0,53\ \mu km$, $\lambda_1 = 0,69\ \mu km$) is appreciated the repartition of particles after

* S.C. "ASTRO-OPTICA International", Chisinau; e-mail: astro@mail.md

dimensions and the dynamics of its modification. The optic stratum of the aerosol atmosphere is determined according to the method, which we have described [6], and for estimation of light diffusion on a spherical particle with the refraction index $1,33 \leq n \leq 1,4$ (the solution of sulphuric acid with water) is used the theory of Mie [7].

According to the theory of Mie, the coefficient of light diffusion by a spherical particle it is expressed by the product of geometrical section with $K(\rho)$ – the efficiency factor of the diffusion, where the parameter $\rho = 2\pi a/\lambda$ ($a$ is the particle radius, $\lambda$ is the wave distance).

For particles of water with the refraction index $n = 1,33$ of the visible light $\lambda = 0.55\,\mu mm$ the main maximum of the function $K(\rho) \cong 4$ and it corresponds to the wave distances, comparable with the particle dimensions (excepting some particles with an imaginary part of the refraction index very big, for example, metallic shots).

For big values of the parameter $\rho$ the function $K(\rho)$ tends to the value 2 and this fact does not depend on the refraction index of the particles.

According to the same theory, in contrast to the Reley diffusion ($\rho \ll 1$), when the dispersion of light is symmetric relatively to the direction of propagation, for the particles of aerosol with $\rho = 1$ or bigger, it is observing a strong asymmetry of the diffusion forward [7].

In our paper [2] were mentioned specially the anomalies of the spectral extinction $\alpha(\lambda)$ of the terrestrial atmosphere in the nights of August 10/11, 1982: $\alpha(0.41) = 0.32$, $\alpha(0.53) = 0.35$, $\alpha(0.69) = 0.24$; September 6/7, 1982: $\alpha(0.41) = 0.36$, $\alpha(0.53) = 0.224$, $\alpha(0.69) = 0.175$; September 8/9, 1982: $\alpha(0.41) = 0.30$, $\alpha(0.53) = 0.22$, $\alpha(0.69) = 0.25$; September 16/17, 1982: $\alpha(0.41) = 0.42$, $\alpha(0.53) = 0.34$, $\alpha(0.69) = 0.13$.

These anomalies were observed after the most powerful eruption of the volcano El Chechen in July 1982. The main anomaly contains the exaggerated "transparence" of the terrestrial atmosphere for a wave distance $\lambda = 0,41\,\mu m$, for which the extinction is comparable with the extinction of the molecular diffusion (Reley diffusion) $\lambda(0,41) = 0.305$ and is very reduced relatively to the average extinction in the period from 1987–1988 $\lambda(0,41) = 0.55$. This phenomenon can be explained by a big abundance of aerosol particles with small values, $a \approx 0,4\,\mu m$, which disperses the light directed to the telescope.

The second type of anomaly in the night of August 10/11, 1982 lies in fact that the extinction $\lambda(0,53) = 0.35$ is bigger than $\lambda(0,41) = 0.32$, whereas the average $\alpha(\lambda)$ is totally inverse: $\alpha(0,41) = 0.55 > \alpha(0,53) = 0.301$. The explanation is the same as for the first case, but in the night of September 8/9, 1982 was recorded an anomaly of the second type for $\alpha(0,69) = 0.25 > \alpha(0,53) = 0.22$, whereas in the same night $\alpha(0,41) = 0.30 > \alpha(0,53) = 0.22$.

This talks about the evolution of the function of particle distribution after dimensions from small average dimensions to the bigger average dimensions.

It is clear that the anomalies of atmospheric spectral transparence were detected after several weeks from the most powerful eruption of the volcano El Chichón.

Having a set of observations between the years 1978–1988, we can study the phenomenon in detail. It is important to notice that the measurements of spectral transparence by stellar observation can provide us the data about the extinction dependence on height, thus about the aerosol particles distribution in dependence on height. It is already known that this repartition has two maximums: the first one at the height of 12 km and the second one much more clear at 20 km [8]. However, this representation is very instable, depending on more facts, including the volcanic activity [9]. As it was mentioned above, the atmospheric aerosol has a strong influence on the solar light transfer processes to the troposphere and the surface of Earth. Playing a significant role in the hidrometeorogic processes and in the processes of climateric changes, becomes clear the need of its systematic study both in time and in space [10].

A significant role for this study can have the studies of spectral transparence of terrestrial atmosphere by methods of Solar and stellar observations as well as of satellite ones. It is obvious that such studies involve multidisciplinary collaborations at the international level.

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