## On Analytic Representation of Cloud Drop Spectra

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Two-parameter Gamma distribution (with parameters, $\alpha$ and $r_0$) and three-parameter modified (with an additional parameter, $\gamma$) Gamma distribution (if $\gamma = 1$, the second distribution moves to the first distribution) are currently the most commonly used in cloud spectra approximations. In particular, the most popular cloud model, C1, has the following parameters: $\alpha = 6$, $\gamma = 1$. The adequacy of the real spectra description using these and other well-known distributions is not currently questioned. On the one hand, this is due to poor progress in the development of measurement equipment. On the other hand, current level of computer technology allows direct cloud spectra modeling within cloud physics tasks [1]. It is noteworthy that modeling of radiation interaction with clouds requires analytic representation of cloud spectra.

Experimental measurements of cloud spectra conducted in a cloud chamber of RPA Typhoon using cloud drops meter FIROK showed a qualitative difference between the measured spectra with Gamma distributions. It comprised the difference in the sign of skewness, $k_{as}$ – negative for experimental and positive for Gamma distribution. Negative $k_{as}$ values were observed in fog and stratus cloud spectra measured by the authors. Selection of parameters of the modified Gamma distribution for $\gamma > 3$ with negative skewness based on experimental data is not possible because of huge uncertainties in the relation between parameters $\alpha$ and $\gamma$. Note that the $\gamma > 3$' area is not used in the literature. To determine other suitable analytical expressions for the real spectra, a series of calculation studies using a numerical condensation model of cloud spectra formation and evolution, based on Sedunov monograph [2], has been conducted. The studies confirmed the fact of negative $k_{as}$ values for calculated spectra as well. The same situation was also obtained theoretically [3] when solving the set of differential equations of drop growth and moisture exchange between the growing and the evaporating drops during their evolution at a constant temperature.

The studies have shown that, at each of formation and evolution stages, the calculated spectra can be described by one of the three analytical distributions: modified Gamma with constant parameter $\alpha = 3$, mirror Gamma and mirror Smirnov. The two latters can be considered preferable for stationary clouds, as their structure is more consistent with analytical solutions of Lifshitz and Slezov. Selection of appropriate parameters shall be performed based on the maximum value of the approximated functions and the position of such maximum value, using the relations described herein. Parameters can be also selected based on a combination of the maximum value position and the relative spectrum width. The available experimental cloud spectra are also well approximated by the above analytical distributions. Selection of the optimal distribution form can be done based on the maximum concordance of skewness values.

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## Evaluation of Aerosol Optical Thickness (AOT) Influence on the Insolation from Direct Ground Observations at the ARG Station, Kishinev (Moldova)

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Data from direct measurements of global solar radiation on a horizontal surface (daily totals $Q_d$) and daily mean values of aerosol optical thickness <AOT@500> are used to show relationship between these parameters and to obtain quantitative estimates. All measurements were performed at the ground-based solar radiation monitoring station at the Institute of Applied Physics (IAP) of ASM, Kishinev (Moldova). Radiometric sensor CM-11 (300–2800 nm) was used to measure global solar radiation. AOT data at wavelength of 500 nm, AOT@500, were derived from measurements of direct solar radiation by using sunphotometer Cimel CE 318. These measurements of AOT are carrying out within the framework of the international program AERONET, NASA/GSFC since 1999. More detail information about the ground station, instrumentation used, measurement procedures and time series of measured parameters in graphical form is presented at the Atmospheric Research Group(ARG) site http://arg.phys.asm.md.

The evaluation procedure takes into account the simultaneous measurements of global solar radiation $Q_d$ and AOT@500, which were made under cloud-free atmosphere conditions for the period from 2004 to 2007. This was done to minimize the effect of clouds on measurement results. Data from a multiyear observations were grouped by months. A linear approximation of the dependence between the amount of daily total of global radiation $Q_d$ (MJ/m$^2$) and daily mean of <AOT@500> is presented as follows: $Q_d = a + b$ <AOT@500>, where ($a$, $b$) are the approximation coefficients; for daily totals of global radiation value $b < 0$. It was shown that with increasing values of <AOT@500>, as a parameter describing turbidity of the atmosphere, it was observed a reduction of insolation on the Earth's surface.

In the course of period of observation daily mean values of <AOT@500> ranged from 0.06 to 0.35, depending on the season. For example, in February daily mean values of <AOT@500> ranged as 0.06 -> 0.16 (case of transparent atmosphere), that corresponded to variation of daily insolation $Q_d$ in the range 13 MJ/m$^2$ -> 10 MJ/m$^2$; in July daily mean values of <AOT@500> ranged as 0.06 -> 0.34 (case of turbid atmosphere) and it corresponded to variation of daily insolation $Q_d$ in the range 30 MJ/m$^2$ -> 26 MJ/m$^2$. It should be mentioned that multiyear (1999–2011) mean value of AOT@500 at the IAP ASM ground-based station equals to ~ 0.21. The corresponding approximation coefficients $b$ [MJ/(m$^2$* unit-of-AOT)] for February and July were equal to ~ –24.4 and – 10.6, respectively. Thus, increasing of the contribution of the aerosol component (as the growth of AOT@500) in the atmosphere leads to a reduction of incoming global solar radiation on the Earth's surface, which was observed under the cloud-free conditions.

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## Results of Measurements of Optical and Microphysical Characteristics of Aerosol in the Arctic Region: Spitsbergen -2012

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The arctic region is an indicator of global climate changes on the Earth. An important role in dynamics of radiation balance is played by atmospheric aerosol coming to the Arctic through long-range transport from the continent due to numerous anthropogenic and natural pollution sources. In the spring and summer seasons of 2012, investigators of the Institute of Atmospheric Optics SB RAS and the Arctic and Antarctic Scientific Research Institute have continued the study of atmospheric aerosol characteristics near the Barentsburg Zonal Hydrometeorological Observatory (ZHMO) (78.1°N, 14.2° E) at the Svalbard archipelago (Spitsbergen). As in 2011, the following aerosol characteristics were measured in the atmospheric column and in the surface layer: aerosol optical thickness (AOT) of the atmospheric column in the wavelength range 0.34–2.14 µm, parameters $\alpha$ and $\beta$ of the Angstrom's formula, fine and coarse AOT components, mass concentrations of aerosol $M_A$ (µg·m$^{-3}$) and black carbon $M_{BC}$ (µg·m$^{-3}$), number density $N_A$ (cm$^{-3}$) and particle size distribution in the range 0.3–20 µm. The measurements were conducted with the