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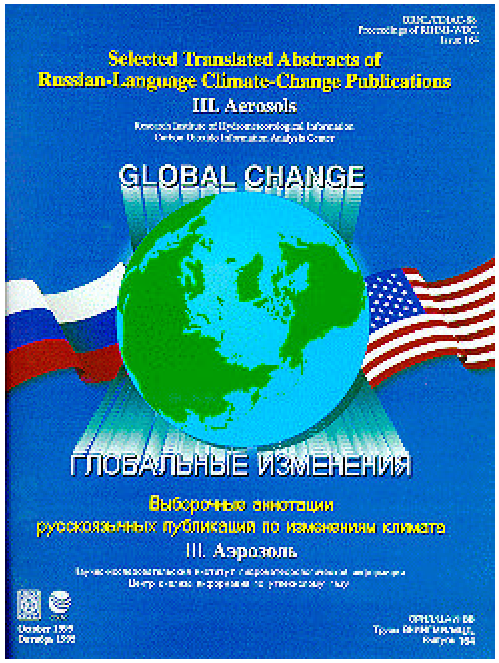
Abstract

Selected Translated Abstracts of Russian-Language Climate-Change Publications

III. Aerosols



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Contents

Abstract

Razuvaev, V. N., and S. G. Sivachok. 1995. Selected translated abstracts of Russian-language climate-change publications: III. Aerosols. ORNL/CDIAC-88. Proceedings of RIHMI-WDC Issue 164. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee. 85p.

This report presents abstracts (translated into English) of important Russian-language literature concerning aerosols as they relate to climate change. In addition to the bibliographic citations and abstracts translated into English, this report presents the original citations and abstracts in Russian. Author and title indexes are included to assist the reader in locating abstracts of particular interest.

Introduction

On May 23, 1972, Richard Nixon, President of the United States, and N. V. Podgorny, Chairman of the Presidium of the Supreme Soviet Socialist Republics, signed an Agreement on Cooperation in the Field of Environmental Protection between the United States of America and the USSR. This agreement was to be implemented for the following areas: air pollution, water pollution, environmental pollution associated with agricultural production, enhancement of the urban environment, preservation of nature and the organization of preserves, marine pollution, biological and genetic consequences of environmental pollution, influence of environmental changes on climate, earthquake prediction, Arctic and sub-Arctic ecological systems, and legal and administrative measures for protecting environmental quality.

Working Group VIII (WG VIII), established to address the issue of influence of environmental changes on climate, now includes five projects: climate change; atmospheric composition; radiative fluxes, cloud climatology, and climate modeling; data exchange management; and stratospheric ozone. The office of the Deputy Assistant Secretary for International Interests of the National Oceanic and Atmospheric Administration has been the coordinating agency for WG VIII projects in the U.S., and the Russian Federal Agency for Hydrometeorology has been the coordinating agency within the former USSR. The Carbon Dioxide Information Analysis Center (CDIAC) has been active in the WG VIII project on data exchange since 1990.

CDIAC's participation in WG VIII activities has been facilitated by its participation in the Quantitative Links initiative of the U.S. Department of Energy's Global Change Research Program (DOE/GCRP). CDIAC's role in this initiative has been to provide the quality-assured data sets needed to quantify the relationship between changes in atmospheric composition and changes in climate. In support of this role, CDIAC has been collaborating with research institutions in the former USSR to identify, quality assure, document, and package selected data sets as CDIAC numeric data packages (NDPs). In 1991, CDIAC published the NDP *Atmospheric* CO_2 *Concentrations from Flask Samples Collected at U.S.S.R.-Operated Sampling Sites* (ORNL/CDIAC-51, NDP-033), compiled by Thomas A. Boden of CDIAC, with data contributed by A. M. Brounstein, E. V. Faber, and A. A. Shashkov of the Main Geophysical Observatory (St. Petersburg, Russia). In 1993, CDIAC published the NDPs *Daily Temperature and Precipitation Data for 223 USSR Stations* (ORNL/CDIAC-56, NDP-040) compiled by Russell S. Vose of CDIAC, and *Six- and Three-Hourly Meteorological Observations from 223 U.S.S.R. Stations* (ORNL/CDIAC-66, NDP-048), compiled by Dale P. Kaiser of CDIAC; data for both were contributed by V. N. Razuvaev, E. G. Apasova, and R. A. Martuganov of the Research Institute of Hydrometeorological Information-World Data Center (Obnisk, Russia). CDIAC has also hosted visits by Russian scientists, and CDIAC staff have visited Russian geophysical research institutions and data centers.

CDIAC sent a survey to 172 researchers in 11 countries asking them to suggest data sets that (1) would be of particular importance to the quantification of the links between changes in atmospheric chemistry, the Earth's radiative balance, and climate but (2) were of limited usefulness because of problems with availability, documentation, or quality, or (3) did not currently exist but could be compiled from separate extant data sets. More than one hundred data sets were suggested, in areas ranging from climate and the cryosphere to the Earth's surface or cover and trace gas emissions and concentrations. This and a follow-up survey indicated that researchers in this area are especially interested in the Earth's surface budget, clouds, aerosols, and general circulation models.

To respond to the interest in these four areas, CDIAC and the All-Russian Research Institute of Hydrometeorological Information-World Data Center (RIHMI-WDC) in Obninsk, Russia, began a collaborative project to produce a series of dual-language bibliographies of Russian literature that had not previously been translated into English. As part of this work, CDIAC and RIHMI-WDC decided to evaluate new, computer-based translation and word-processing software. The first report in the series *Selected Translated Abstracts of Russian-Language Climate Change Publications*, published in 1992, was *Volume I. Surface Energy Budget* (ORNL/CDIAC-57; Proceedings, RIHMI-WDC 158); the second report, published in 1994, was *Volume II. Clouds* (ORNL/CDIAC-64; Proceedings, RIHMI-WDC 159). They are available on request from CDIAC, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6335, U.S.A.; telephone: 423-574-3645, fax: 423-574-2232, e-mail: cdiac@ornl.gov.

CDIAC and RIHMI-WDC agreed that the remaining volumes in this series would be prepared in Obninsk and published in Oak Ridge. For this purpose, CDIAC transferred to RIHMI-WDC the hardware and software that had been used in the preparation of the first two volumes. The current report, about aerosols, is the third volume in the series; it has been prepared by RIHMI-WDC in collaboration with CDIAC. A fourth volume, about general circulation models, is planned.

This report covers Russian literature that has not been translated into English. The reader is also referred to the English-language journals *Soviet Meteorology and Hydrology* and *Atmospheric and Oceanic Physics*, which consist of translations of the Russian-language journals.

Acknowledgments

On behalf of the Carbon Dioxide Information Analysis Center (CDIAC), the Research Institute of Hydrometeorological Information-World Data Center (RIHMI-WDC), Vuacheslav N. Razuvaev, Sergej G. Sivachok and Marvel D. Burtis, I would like to thank the following individuals who have contributed, either directly or indirectly, to the production of this report:

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Bob Etkins and Rene Tatusko of the Office of International Activities in the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (Silver Spring, Maryland), who have greatly facilitated scientific exchanges and visits between Russia and the United States under the auspices of WG VIII.

Paul Kanciruk of the Enviromental Information Analysis Program, Environmental Sciences Division (ESD), at Oak Ridge National Laboratory (ORNL), and the former director of CDIAC, who helped shape CDIAC's involvement in WG VIII activities and establish contacts between CDIAC and its sister institutions in Russia.

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Finally, I would like to thank all people of CDIAC and RIHMI-WDC, who participated in preparation of this report.

Robert Cushman
Director
Carbon Dioxide Information Analysis Center

October 1995

Bibliography

Abakumova, G. M., and **E. V. Yarkho.** 1992. Variations in aerosol optical thickness of the atmosphere over Moscow for the last 37 years. Meteorol. Hydrol. 11:107-113.

Variability of atmospheric aerosol optical thickness $T_{\alpha,\lambda 0}$ for λ_0=0.55 µm, determined by ground-based measurement data of direct integrated solar radiation at the Moscow State University Meteorological Observatory in 1955-1991 is examined. An impact evaluation of the last volcanic eruptions on $T_{\alpha,\lambda 0}$ is given.

Adgemyan, L. C., D. I. Busygina, and **A. P. Grinin**. 1985. Stratospheric aerosol transport simulation after the El Chichon eruption. Proc. Inst. Exp. Meteorol. 35(113):67-72.

Lower stratosphere aerosol spreading after El Chichon eruption is calculated on the basis of an analytical zonally averaged impurity transport model.

Alekseev I. M., S. A. Volovikov, Yu. G. Kaufman, M. P. Kolomeev, and **S. S. Khmelevtsov.** 1982. Two-level averaged-by-latitude model of stratospheric aerosol influence on surface temperature. Proc. Inst. Exp. Meteorol. 28(101):65-80.

A two-level energy balance model that calculates the surface temperature change in different latitude zones as stratospheric aerosol layer composition varies is described. The model considers aerosol dispersion and the absorption of solar and atmospheric heat radiations by aerosols as well as meridional heat transfer. Computation results are given on the basis of the model for particles of 75% sulfuric acid of radius 0.05-2.5 µm and for poly-dispersed aerosol with microstructure received from natural measurements in the stratosphere.

Alexandrov, V. V., and **G. L. Stenchikov.** 1985. Numerical impact evaluation of modern tropospheric aerosol on climate. Rep. Acad. Sci. USSR. 282(6):1324-1326.

The Earth climate hydrodynamical model, developed by the USSR Acadamy of Science Computer Centre, is used for estimating modern aerosol air pollution climate affects. Geographical distribution of air temperature variations at the surface is given. It is shown that tropospheric aerosol plays a marked role in Earth surface heat regime formation and the climate system as a whole.

Ardasenov, M. N., and **V. I. Shljakhov**. 1983. Spectral aerosol extinction of the solar radiation over mountain land. Proc. Central Aerol. Obs. 151:55-60.

Results of measuring spectral optical density of atmospheric aerosol in mountain area are presented. Measurements were taken in eight spectrum sectors in the field of 340-900 nm. According to performed measurements, spectral motion of optical density has marked maximum in the field of 370 nm. Altitude motion of spectral optical density is given. Spectrum of particles of atmospheric aerosol is calculated on the basis of spectral variation data of optical density. Significant variations in atmospheric aerosol were found using the data.

Asaturov, M. L. 1981. To the problem on stratospheric aerosol formation. Proc. State Hydrol. Inst. 271:113-122.

An equation system has been considered, which describes the turbulent transfer and oxidation of sulfurous gas in the atmosphere as well as the formation, flow rate, and transfer of sulfuric acid vapors, and is needed for source calculation of stratospheric aerosol sulphate. Calculations of sulfurous gas and sulfuric acid vapors vertical profiles are given.

Expression for velocity of condensation growth of stratospheric aerosol particles at the expense of absorption of sulfuric acid and water vapor has been derived. Quantitative estimates of characteristics at the time of condensation growth of aerosol particles in atmosphere by various quantities of relative air humidity are performed. On the basis of derived relations, the formation regularity of the stratospheric aerosol layer by various formation intensities of primary aerosol particles are analyzed.

Asaturov, M. L. 1984. A model of the stratospheric aerosol layer formation. Meteorol. Hydrol. 2:31-38.

A stratospheric aerosol layer formation model is developed in which, along with input and oxidation processes of sulfurous gases, sulfuric acid and water vapor condensation on aerosol particles, coagulations, sedimentations and vertical aerosol turbulent transfer nucleation from sulfuric acid and water vapor and condensation nuclei tropospheric sink are considered. Model calculations were compared with experimental data for the background stratospheric aerosol layer. The comparison permitted us to determine the parameter values which characterize the speed of condensation growth and formation of aerosol particles in the stratosphere.

Asaturov, M. L. 1984. Modeling of the stratospheric aerosol layer evolution after a volcanic eruption. Meteorol. Hydrol. 4:32-37.

On the basis of a developed model, evolution regularities of the stratospheric aerosol layer are studied after aerosol particles of different sizes and sulfur dioxide are introduced into the stratosphere by an explosive-type volcanic eruption. It is demonstrated that the input of sulfur dioxide into the atmosphere and the formation of the fine-disperse aerosol fraction from eruption products are responsible for a significant climatic reaction of a stratospheric aerosol layer after a powerful volcanic eruption.

Asaturov, M. L. 1984. Aerosol evolution regularities after large ejections into the stratosphere. Meteorol. Hydrol. 11:59-66.

On the basis of a developed model of stratospheric aerosol layer formation, regularities of its evolution are studied after the input of aerosol particles into the stratosphere in a wide range of quantities of their initial concentrations including very large ones (by 10^1-10^5 fold exceeding of the background level concentrations). It is demonstrated that when a considerable increase in aerosol concentration occurs in the stratosphere, the characteristic return time of mass and optical depth of the stratospheric aerosol layer to the background level substantially diminishes.

Asaturov, M. L. 1985. On the problem of stratospheric aerosol layer simulation. Proc. State Hydrol. Inst. 317:63-75

A physico-mathematical model of stratospheric aerosol layer formation is built. The following processes are considered: input and oxidation of sulfurous gases; sulfuric acid and water vapor condensation on aerosol particles; coagulations, sedimentations and vertical aerosol turbulent transfer; nucleation from sulfuric acid and water vapors; and tropospheric sink of condensation nuclei. It is shown that the last two processes could change the forecasting feature of the model. Quantitative regularities of anthropogenic growth of CSO impacts on the background aerosol content in the stratosphere and on the climate have been examined on the basis of the model. The climatic role of this factor will be insignificant up to the end of the century.

Asaturov, M. L. 1986. Volcanic emissions impact on stratospheric aerosol layer. Proc. State Hydrol. Inst. 320:38-50.

On the basis of a developed model, evolution regularities of the stratospheric aerosol layer have been examined after stratospheric input of products from explosive-type volcanic eruptions. It is shown that, at eruptions like El Chichon (1982), in the initial period following the eruption the formation of fine-dispersed fractions of sulphate aerosol from volcanic products makes a definite contribution to the impact of stratospheric aerosol on climate. A model assessment is performed of average global air-temperature decrease because of stratospheric aerosols after the El Chichon eruption.

Asaturov, M. L., M. I. Budyko, K. Ya. Vinnikov, P. Ya. Grojsman, A. S. Kabanov, I. L. Karol, M. P. Kolomeev, Z. I. Pivovarova, E. V. Rozanov, and **S. S. Khmelevtsov.** 1986. Volcanos, stratospheric aerosol and Earth`s climate. Leningrad, Hydrometeoizdat. 256 p.

This book is devoted to the detailed treatment of the effect of volcanic eruptions on the Earth`s climate--from a brief description of volcanic eruptions influence on the Earth`s climate up to the monitoring of stratospheric aerosol of volcanic and anthropogenic origin. Special attention is given to the genesis of stratospheric aerosols, its kinetics and dynamics, climate modeling and analysis of a volcanic eruptions' effect on the Earth`s climate on the basis of empiric data.

Asaturov, M. L. 1988. Accounting of vertical emission structure during evolution modeling of stratospheric aerosol after volcanic eruptions. Proc. State Hydrol. Inst. 340:83-91.

The influence of regularities in vertical emission structure on stratospheric aerosol evolution have been examined. It is shown that the vertical structure of volcanic emissions, as well as their horizontal structure, tends to an increase of the stratosphere cleaning rate after large explosive-type eruptions in comparison with the case when the same amount of injected material is evenly distributed throughout a hemisphere stratosphere. This effect is increasing as the volcanic emission mass increases in the stratosphere.

Asaturov, M. L. 1989. Stratospheric aerosol layer formation and its influence on the Earth temperature regime. Environ. Monitor. Protect. Probl. Proc. 1st Sov.-Canad. Symp., Tbilisi, 11-17 April, 1988. Leningrad, Gidrometeoizdat. 214-223.

The background stratospheric aerosol layer consists mostly of submicron drops of sulfuric acid. It is formed by photodissociation and oxidation of carbonylsulphide (CS), which is emitted during fuel burning and processing and has mainly an anthropogenic origin. The role of CS in stratospheric aerosol formation and the possible climatic effects of this process are considered.

Physico-mathematical modeling (earlier developed) of stratospheric aerosol layer has been used, but with condensation nucleus formation processes accounting. The author's nonstationary energy balance model has been used for change evaluations of thermal atmosphere regime, caused by the stratospheric aerosol content change. Augmentation of airborne emission of sulfurous gases may lead to an impact on climate commensurable in scale with the climatic effects of anthropogenic emissions of carbon dioxide, methane, and freon.

Beghanov, M., O. Kurbanmuradov, and **V. N. Lebedinets**. 1991. Semi-empirical models of upper atmosphere aerosol composition. III. Coagulation Model. Atmos. Optics. 4(9):921-926.

Formulation of a problem on the equilibrium concentration calculation of space aerosols at heights of 30 $\leq Z \leq 100$ km is given. Micrometeorite flux with masses of $10^{-17} \leq m \leq 10^{-8}$ g is specified by Z_{max} = 110 km, and meteoric matter vapor source has a Gaussian distribution on Z with a maximum of Z_0 = 95 km and a variance of ± 5 km. Space aerosol sink is assumed to be in the Yunge sulfuric-acid aerosol layer at Z_{min} = 20 km. Inflow of meteorite material is equal to 45 tons/day. Numerical calculations showed that vapor condensation of meteorite material took place at a height of 80-100 km. At altitudes below 50 km an intense formation of aerosol particles occurs with the mass of m 10^{-14} g caused by coagulation process, which are most effective in light scattering. As a result, a rapid increase of atmospheric turbidity $s = \sigma_a/\sigma_m$ takes place at the same time as the decrease of Z. Further aerosol coalescence increases sedimentation velocity and decreases S below 30 km. This gives, for the first time, the physical mechanism of light-scattering aerosol layer formation in the upper stratosphere, revealed during twilight observations.

Belan, B. D., and **G. O. Zadde.** 1986. On mesoscale aerosol clouds. Bull. USSR Sci. Acad. 290(6):1328-1331.

The article reports a new phenomenon discovered by the authors during an aircraft sounding-aerosol cloud formation in the atmosphere, during clear sky conditions. They've got typical sizes of 20-40 km horizontal, 400-1000 m vertical. Aerosol concentration in clouds is approximately an order of magnitude higher than in an ambient area. They are generally observed when the relative air humidity is less than 40%, at a height of more than 1000 m above the Earth's surface. In summary, a hypothesis for a mechanism of their formation is expressed.

Belan, B. D., G. O. Zadde, V. K. Kovalevsky, M. V. Panchenko, T. M. Rasskazchikova, S. A. Terpugova, G. N. Tolmachov, and **A. G. Tumakov.** 1988. On the nature of uncondensed aerosol clouds. Atmos. Optics 1(6):67-77.

General regularities of formation conditions, inner structure, and disperse composition of uncondensed aerosol clouds were found on the basis of analyses of chemical composition, optic and microphysical aerosol characteristics, in and out of a cloud meteorological parameters, and synoptic situation in the region of observations. A mechanism of formation of such clouds, consisting of the fact that, in some instances, nonconvective flows carry the aerosol through the inversion layer, is well founded.

Belan, B. D., G. O. Zadde, M. V. Panchenko, T. M. Rasskazchikova, S. A. Terpugova, A. G. Tumakov, and **V. Ya. Fadeev.** 1988. Seasonal factors in atmospheric aerosol variability in the height range of 0-5 km. Earth Atmos. Optic Properties. Tomsk. 45-51.

Results of an experimental submicron aerosol-fraction study, received in 1986 from an aircraft atmospheric sounding at a height of 0 to 5 km, are considered. From the aircraft, measurements of aerosol number concentration and aerosol scattering coefficient in the mixing layer are well identified, and, for monthly mean values, a correlation methodic allowing an introduction of objective height criteria of this layer is applicable. With a view to study the physical-chemical aerosol properties and their optic parameter measurements of aerosol scattering coefficients at artificial air, wetting from 0 to 95% and heating from 20° C to 250° C were conducted on board the aircraft-laboratory. On the basis of the received thermo- and gigrogramm parameter estimations of condensation activity, and total volatile substance content in dry aerosol base are made. Formation peculiarities of the mixing layer, as well as optic and microphysical aerosol characteristic dynamics in different seasons, have been examined.

Belan, B. D., A. I. Grishin, G. G. Matvienko, and **I. V. Samokhvalov**. 1989. Spatial variability of atmospheric aerosol characteristics. Novosibirsk, Nauka. 152 p.

In this monograph, the results of an experimental study of meteorologic processes impact on an aerosol state are generalized. Basic statistical characteristics of number concentration and the scattering coefficient of visible band optical radiation are derived. A defining effect of atmosphere turbulence on the formation of the heterogenity structure of aerosols was found. The applicability of conservative passive impurity hypothesis to aerosol is shown.

Belan, B. D., and **Zadde G. O.** 1990. Anthropogenic aerosol influence on solar radiation weakening above the USSR territory. Atmos. Optics. 3(7):703-705.

Anthropogenic aerosol contribution to spectral solar radiation weakening of the whole atmosphere thickness is qualitatively analyzed. It is shown that above the USSR west regions this contribution is noted throughout the year and in summer time above the east ones.

Belan, B. D., O. Yu. Luk'yanov, M. K. Mikushev, I. N. Plokhikh, and **N. A. Stepkin**. 1992. An automated archive of observational data obtained with an airborne sounding of the atmosphere. Atmos. Ocean Optics 5(10):1081-1087.

A computer-assisted archive structure and content that was created on the basis of the aircraft atmospheric-sounding results and that contains atmospheric aerosol concentration and chemical and gas composition data in different regions is described. A list of cities is given for which the data are available.

Budyko, M. I. 1983. Volcanic eruptions and climate. Meteorol. Hydrol. 1:98-99.

The possible effect of the El Chichon eruption on atmospheric processes is considered.

Budyko, M. I. 1984. The effect of volcanic eruptions on climate. Meteorol. Hydrol. 3:5-11.

A calculation is performed on the effect of stratospheric aerosol and carbon dioxide, resulting from volcanic eruptions, on the mean temperature of the lower air layer.

Budyko, M. I. 1988. Climatic catastrophes. Global Problems of Geograph. Sci. Moscow. 22-35.

Low air layer mean temperature dependence on aerosol particle mass in the stratosphere has been examined. The mass of optically active aerosol particles, which decreases the accumulated radiation by 1%, is equal to $0.8*10^{-6}$ g/cm^3 and results in reducing mean temperature at earth surface by 1.5° C. Mean air temperature reduction during natural aerosol catastrophes, caused by volcanic eruptions or meteorite fall, has been reaching 5-10° C. Such natural climatic catastrophes in geological past led to mass organism die-off. Evaluations indicate that after a nuclear conflict, because of aerosol emission in the stratosphere, mean air temperature decrease can be expected in the northern hemisphere of about 5-10° C, but at continents at 10-20° C, that could lead to heavy consequences for many living things. Humanity destruction as a result of direct effect of nuclear bombs, and because of ecological crisis, is possible. Such temperature decreases would be destructive to the agricultural manufacturing system.

Burlakov, V. D., A. V. El'nikov, V. V. Zuev, V. N. Marichev, and **V. L. Pravdin**. 1992. Pinatubo volcanic eruption traces in the stratosphere over Western Siberia (Tomsk, 56° N). Atmos. Ocean Optics. 5(6):602-604.

Analysis of aerosols in the stratosphere above Tomsk from lidar observations from the 6th of June 1991 to the 6th of March 1992 is given. The first traces of the Pinatubo eruption emerged above West Siberia in late June, slightly more than two weeks after the eruption, which agrees with speed and air mass trajectory on these altitudes and in this period of time. Maximum stratosphere filling by volcanic aerosol was registered on the 21st and 22nd of January 1992. Dispersion relations, determined during this period for the wavelength of 532 nm, have been receiving values of 9.5 at a height of 23.5 km. Such values were registered above Tomsk for the first time in the last 6 years of regular lidar observations.

Busygina, D.I. 1987. Volcanic eruptions product removal from the stratosphere. Proc. Inst. Experim. Meteorol. 43(128):79-84.

On the basis of a zonally averaged model of impurity transport from local source the dependence of typical lifetimes of various volcanic aerosol particles in the stratosphere from volcanoe location and emission height of its eruption products has been considered. It is shown that the lifetime of particles caght in stratosphere essentially depends on their source disposition latitude. Two typical zones (0-30° and 35-65° N) are outlined, for which this length of lifetime may be different by several times. Obtained evaluations can be used for analysis of the impact of volcanic eruptions on climate.

Bykova, L. P. 1991. One-dimensional nonstationary model of pollution influence on atmospheric thermal structure. Proc. Main Geophys. Observ. 533:17-29.

A model of vertical atmosphere thermal structure, which considers a diurnal run of boundary layer processes, is suggested. Optic and microphysical pollution parameters are representative for the urban aerosols. Calculations are realized for various values of aerosol haze densities and vertical length. Numerical experiments showed that aerosol pollution of the atmosphere boundary layer creates conditions for surface and surface air temperatures rising whereas during significant pollution of thick troposphere layers the surface layer climate varies in the direction of cooling.

Bykova, L. P., and **G. S. Bulanova**. 1992. Simulation of aerosol pollution impact on temperature and cloudiness fields. Proc. Main Geophys. Observ. 536:11-18.

Evaluations of temperature changes in the surface layer during abrupt pollution of the whole troposphere strata, considering the influence of cloudiness, are performed. Calculations are realized with the help of a one-dimensional unstationary radiative turbulence model. Numerical experiments show that the abrupt pollution of powerful troposphere layers creates conditions for temperature reduction. Intense cloud formation in low troposphere layers is promoting the significant decrease-of-cooling aerosol effect.

Dmitrieva-Arrago, L. R., and **T. N. Gorbunova.** 1980. Influence of stratospheric aerosol on scattered short-wave radiation upflow. Proc. Main Geophys. Observ. 410:96-102.

Upflows of scattered short-wave radiation with two aerosol layers in the atmosphere have been considered. Comparison with flows in the absence of a stratospheric aerosol layer is performed, as a result of which it is shown that the stratospheric aerosol at its real characteristics increases the scattered flow 1.5-2.0 times, which can influence radiative atmosphere energetics.

Dyshlevsky, S. V. 1984. Classification of aerosol atmosphere models. Proc. Inst. Appl. Geophys., 49:37-58.

It is recommended to classify models by type (nature) of the simulated characteristics and by level of the process description complexity. Three types and four levels of the existing aerosol models are outlined. The models are classified as structural, physicochemical, and optic. On the first level microphysical aerosol characteristics are considered. Models of the second level are based on empirical relations between average values of aerosol parameters. In the third level models, the space time transformation of aerosol characteristics is being considered. Models of the fourth level--forecasting--are in their beginning stages at the present time. The present state of aerosol models has been analyzed.

El'nikov, A. V., V. V. Zuev, and **V. N. Marichev.** 1991. Results of vertical aerosol stratification laser sounding above Western Siberia (1986-1989). Atmos. Optics. 4(6):631-637.

Results of stratospheric aerosol vertical distribution at wavelength λ = 532 nm during 1986-1989 are presented. Winter and summer scattering relation profiles for different years and time run of maximum aerosol layer height are given. Interannual profile features of the main seasons (winter and summer) scattering relation and seasonal changes of aerosol layer maximum, which coincide with the time run of tropopause height, were found. Good accordance of measuring results with literary data is observed.

Fejgelson, E. M. 1984. The effect of volcanic eruption products on the radiation regime of the climatic system. Meteorol. Hydrol. 5:5-11.

Brief information on the properties of the volcanic stratospheric aerosol and the methods and results from studies of its effect on radiation characteristics of the climatic system is presented.

Fejgelson, E. M. (Editor). 1986. Atmosphere optics and aerosol. Moscow, Nauka. 224 p.

A collection of articles, where complex investigation results of optic and microphysical properties, absorption capacity, chemical composition, and transformation processes of atmospheric aerosol, fulfilled by Prof. Rozenberg's pupils and collobrators, are presented. Methods and results of remote optical atmospheric sensing, aerosol impact on climate, and kinetic theory of fine-dispersed aerosol have been considered. A substantial part of the investigations have been conducted at the Atmospheric Physics Institute, USSR Academy of Sciences.

Ginzburg, A. S. 1989. Meteorological visibility range during large aerosol emissions. Atmos. Optics. 2(3):253-258.

It is shown that the presence of large quantities of strongly absorbing aerosol in the lower atmosphere the meteorological visibility range (MVR) depends not only on aerosol quantity in the sight line, but also on vertical layer thickness. As in this case, the lower layer part illumination could decrease to such an extent that the threshold contrast meaning is noticeably increased. This dependence makes it possible to estimate aerosol emission capacity.

Grigorjev, A. A., K. Ya. Kondratjev, and **O. M. Pokrovsky**. 1983. Atmospheric aerosol as observed from space. Proc. Main Geophys. Obs. 478:32-50.

On the basis of analysis of space images, new data evidences on powerful dust removals in different Earth areas are received. It has been found that dust removals spread to hundred and sometimes to thousand kilometers. Main spreading region of powerful dust removals is the West Sahara-Atlantic Ocean. Trajectories of dust clouds were found, which often follow from continent to continent (from Africa to the coast of the North, South, or Central America). Maps of powerful dust removal centers are studied and compiled, in particular, a center on the Northeast coast of the Aral Sea was found. A banded mesostructure of dust formations, due to both inhomogeneities of underlying surface and turbulence peculiarities of dust flow, is found. Reconstruction methods of aerosol microstructure parameters and vertical profiles of aerosol weakening coefficient in the stratosphere and lower mesosphere are discussed.

Grinin, A. P., F. M. Kuni, and **A. V. Mananenkova**. 1982. Evolution of aerosol height distribution in the lower stratosphere after a local emission. Proc. Inst. Exp. Meteorol. 28(101):45-51.

On the basis of a macroturbulent diffusion model, an analytical description of the evolution of aerosols in the lower stratosphere during some restriction at a height of emission is presented. The beginning of the aerosol disposal from the stratosphere and the time of which the number of aerosol particles in the stratosphere is decreased in two times were calculated for several meanings of parameters of the theory.

Grinin, A. P., and **F. M. Kuni.** 1985. Large-scale aerosol transport in the lower stratosphere. Proc. Inst. Exp. Meteorol. 35(113):52-66.

An analytical solution of a simplified aerosol transport equation in the lower stratosphere has been completed. The equation allows us to describe the significant evolution stage of stratospheric aerosol layers. Simple formulae for aerosol bulk concentration fields and total particle numbers on the various heights are obtained.

Gorchakov, G. I., A. S. Emilenko, A. A. Isakov, D. M. Metreveli, M. A. Sviridenkov, and **V. N. Sidorov**. 1986. Surface aerosol properties. In: Atmosphere Optics and Aerosol. Moscow. 42-64.

A review of experimental study results of surface aerosol optic characteristics and their dependencies on relative air humidity is presented. Temporal variability of optic and microphysical parameters of natural aerosol and its dry basis has been analyzed.

Gushchin, G. P., and **T. A. Pavlyuchenkova.** 1991. On atmospheric aerosol spectral transparency and optical density variations in the territory of the USSR. Proc. Main Geophys. Observ. 533:62-66.

Observation data of spectral atmospheric transparency and atmospheric aerosol optical density, collected from the USSR network. Seventeen years average data of spectral transparency and an aerosol attenuation index at 11 USSR stations are given.

Ivanov, V. V., and **B. Ya. Kutsenko.** 1989. Influence of strongly absorbing solar radiation aerosol on the atmospheric temperature regime. Proc. Main Aerolog. Observ. 174:68-75.

The possible modifications of thermal atmosphere regime due to solar radiation adsorption by strongly absorbing artificially created aerosols are quantitatively estimated on the basis of the solution of the radiation transfer equation taking into consideration multiple scattering. Heating peculiarities in aerosol layers, according to its concentration and solar zenith angle, are analyzed. The possibilities of obtaining uniform heating of the whole aerosol layer during large time intervals are discussed.

Ivlev, L. S. 1982. Atmospheric aerosols chemical composition and structure. Leningrad. Leningrad Univ. 368 p.

In this monograph major aerosol material sources, sink distribution and transformation mechanisms of the aerosol particles in the air environment have been considered. The review of aerosol structure and chemical content experimental data in clean and contaminated atmosphere is presented and aerosol atmospheric models are suggested.

Ivlev, L. S., and **S. D. Andreev**. 1986. Atmospheric aerosol optical properties. Leningrad: Leningrad Univ. 360 p.

The optical characteristics of aerodispersed systems in the spectrum region 0.3-15.0µm are investigated in the monograph. On the basis of natural experiments and model calculations from microphysical measurement data, the regularities of physical and meteorological processes impacts on atmospheric aerosol optical properties are being revealed, which makes it possible to correctly solve the inverse problems of scattering medium optics, essentially cutting the area of possible solutions.

Ivlev, L.S. 1988. A diurnal run model of tropospheric aerosol optical characteristics. Earth Atmos. Optic Properties. Tomsk 20-24.

Experimental results of structure and optical aerosol characteristics in the atmospheric surface layer and troposphere are discussed. In the summer, the diurnal runs of the modal radius $r_{01} < 0.2$ µm and $r_{03} \geq 1.0$ µm for different observation regions are presented supposing that the corresponding modes are described by inverse gamma functions. The change rates of organic aerosol material are given, by means of which one can also define the change of r_{02} during the day. Maximum values of r_{02} are observed at 18-20 hours and correspond with 0.4-0.6µm. Modal values of number concentrations in the surface layer and troposphere for different times of day are calculated. The data allow simulations of the diurnal variations of tropospheric aerosol optical characteristics for wavelengths from 0.3 to 15.0 µm.

Ivlev, L. S., V. M. Zhukov, V. A. Ivanov, and **V. I. Kudryashov.** 1991. The study of stratospheric aerosol structure and element composition by the impactor method during the Soviet-American experiment in 1987. Proc. Main Geophys. Observ. 534:137-145.

Results of the Soviet-American stratosphetic aerosol research experiment in 1987 are given. Data for aerosol concentration and, its chemical composition up to the height of 30 km are presented.

Ivlev, L. S., V. A. Ivanov, and **V. M. Zhukov.** 1991. Evolution of stratospheric aerosol morphological structure. Proc. Main Geophys. Observ. 534:146-153.

Evolution data of morphological stratospheric aerosol structure received during impactor balloon launchings are presented. A comparison is made of the aerosol structure before and after the El Chichon eruption.

Karol, I. L., and **Ye. V. Rozanov**. 1982. Radiative-convective models of climate. Bull. USSR Sci. Acad., Atmos. Ocean Phys. 18(11):1179-1191.

Major assumptions are reviewed concerning the components and methods for calculating the vertical profile of radiative equilibrium temperature, allowing for convective adjustment for cases of supercritical temperature lapse rate in the horizontally homogeneous atmosphere. There is a brief description of ways to incorporate feedback mechanisms into the radiative-convective models and an assessment of their sensitivities to changes in the external parameters. Perspectives of radiative-convective models development in the global climate theory is discussed.

Karol, I. L. 1984. Radiation effects of El Chichon eruption products. Meteorol. Hydrol. 3:102-104.

A brief review is given of preliminary research results of an El Chichon volcanic eruption in spring in Southern Mexico and its possible climatic effects.

Karol, I. L., and **E. V. Rozanov**. 1984. Influence of volcanic emissions on the atmospheric thermal structure. Meteorol. Hydrol. 6:105-107.

Different changes of lower stratospheric gas and aerosol composition connected with volcanic activity have been considered. Estimates of their influence on the atmospheric thermal structure are made with the help of a one-dimensional radiative-convective model.

Kaufman, Yu. G., M. P. Kolomeev, and **S. S. Khmelevtsov.** 1982. Stratospheric aerosol and its impact on the Earth`s climate. Bull. USSR Sci. Acad., Atmos. Ocean. Phys. 18(12):1256-1261.

A two-level energy balance model for the Earth`s thermal regime has been used to estimate the role of background stratospheric aerosol in climate formation in the year 2000. The annual, mean, globally averaged surface temperature has been shown to fall by 0.6° K by 2000 if the present growth rates of background aerosol continues.

Kaufman, Yu. G., M. P. Kolomeev, and **S. S. Khmelevtsov.** 1982. On the climatic stratospheric aerosol monitoring by lidar method. Proc. Inst. Exp. Meteorol. 28(101):92-99.

On the basis of currently available experimental and theoretic information on the influence of stratospheric aerosol on Earth's climate, a conclusion is made on the need for a stratospheric aerosol monitoring organization. It is shown that it is best to realize stratospheric aerosol monitoring with the

help of a lidar station network, spaced uniformly along the latitude zones and supplied with direct balloon measurement tools to carry out single calibration observations.

Kaufman, Yu. G., M. P. Kolomeev, and **S. S. Khmelevtsov.** 1983. Modeling of the stratospheric aerosol effect on climate. Meteorol. Hydrol. 6:5-12.

A stationary model of the stratospheric aerosol effect on surface air temperatures in different latitudinal zones is presented. The model takes into account the redistribution of solar and thermal radiation by aerosol particles. Calculations of surface temperature changes, caused by the aerosol with characteristics that conform with the natural stratospheric aerosol ones, are performed. It is shown that stratospheric particles with the radius $0.05 < R < 1.30$ µm are cooling the Earth, whereas the stratospheric particles which are outside this range are heating the Earth. A latitudinal relationship is derived of temperature change for an aerosol, homogeneously distributed over latitudes, as well as for the case when the aerosol is available only in the zone 20-90° N.

Kaufman, Yu. G., and **M. P. Kolomeev.** 1985. Calculation of stratospheric aerosol influence on latitudinal run of average annual albedo of Earth-atmosphere system. Proc. Inst. Exp. Meteorol. 35(113):45-52.

Methods for calculating the albedo change in the Earth-atmosphere system at various latitudes, caused by stratospheric aerosols, are suggested. The methods consider Earth albedo dependence from incident radiation angle. Albedo change computations are given for 10-degree latitude zones of the Northern hemisphere for the stratospheric aerosol layer for the particles that are 75% sulfuric acid.

Khmelevtsov, S. S. 1981. Monitoring of stratospheric aerosol and its climatic effect. "Integrated global monitoring of environment pollution." Proc. 2nd Intern. Symp., Tbilisi, 12-17 October, 1981. 338-343

The importance of monitoring stratospheric anthropogenic and volcanic aerosol for forecasting its climatic effect is noted. The necessity of organizing a global monitoring network of 8-13 stations in the Northern hemisphere is shown.

Khmelevtsov, S. S., and **Yu. G. Kaufman**. 1987. Climatic monitoring of the global stratospheric aerosol layer. Rev. RIHMI-WDC. Meteorol. (2):1-42.

Generalized research results are outlined for the creation of a system of stratospheric aerosol layer climatic monitoring. Necessary information is given about the stratospheric aerosol layer and its Earth climatic effects. The analysis of various determination methods of structure and characteristics of a stratospheric aerosol layer of volcanic origin is given. Climatic monitoring with the help of ground-based laser sounding is described.

Khmelevtsov, S. S. 1987. Stratospheric aerosol mass determination from data for volcanic aerosol and gas emissions. Proc. Inst. Exp. Meteorol. 43(128):3-12.

A method is suggested for determining stratospheric aerosol mass from data for emissions of sulfurous gases and fine- dispersed tephra, obtained by calculations based on information about the total weight of erupted material. Comparisons were conducted with data obtained with the help of alternative methods.

Khmelevtsov, S. S. 1988. Climate study using energy balance models. Leningrad, Hydrometeoizdat. 149 p.

With the help of climate energy balance models, the research results of climate variability, its response to different external and internal impacts, and its uniqueness and stability are generalized. Climate system characteristics are given as an object of energy balance and thermodynamic modeling. Thermodynamic and energy balance models hierarchy and a number of their usage results for climate variability investigations are described. Climate and its thermal regime response to aerosol air pollutants was studied and the information about statistical modeling of the Earth's climate is given.

Khmelevtsov, S. S., Yu. G. Kaufman, A. M. Vdovenkov, and **V. G. Sorokovikov.** 1990. About stratospheric aerosol monitoring by lidar method. Proc. Inst. Exp. Meteorol. 21:78-83.

Results of stratospheric aerosol lidar sounding conducted by the Goskomhydromet network in Obninsk, Minsk, and Teploklyuchenka stations are presented. Stratospheric aerosol mass is considerably higher than the background level, observed in 1978-1979. Measuring aerosol results at a height of 30-40 km are analyzed.

Kolomeev, M. P., S. A. Volovikov, and **S. S. Khmelevtsov.** 1984. Modeling the impact of the El Chichon volcano eruption on climate. Meteorol. Hydrol. 7:49-55.

A nonstationary energy balance model is developed which permits calculating seasonal changes of surface air temperature in six zones of the Northern Hemisphere: arctic and tropical as well as over land and ocean in middle and subtropical latitudes. The above model was used to calculate the lowering of temperature in various zones, which appeared after the El Chichon volcano eruption due to the stratospheric aerosol layer. The maximum decrease of the hemispheric temperature of 0.5° C is attained in the model approximately one year after the eruption.

Kondrat'ev, K. Ya. 1980. Radiative factors of the contemporary global climate change. Leningrad, Hydrometeoizdat.
279 p.

Most important external factors of present-day climate change (solar constant variations, change of gaseous and aerosol composition of the atmosphere) are discussed. The monograph is focused on properties of atmospheric aerosols and their potential impact on climate as well as the anthropogenic influence on the ozone layer (halocarbons, their products and other components) and climatic consequences of this influence.

Kondrat'ev, K. Ya., and **V. I. Binenko** (Editors). 1981. Polar aerosol, extensive cloudiness and radiation. The First Global Experiment GARP. Leningrad, Hydrometeoizdat. (2):149 p.

The publication considers the cloudiness-radiation interaction as one of the main mechanisms which governs the climate. The experiment was accomplished in May-June 1979 in the East Arctic region under the GAREX program within the framework of the Second Observational Period of the Global Weather Experiment.

The papers discuss the theoretical and experimental studies of clouds, the radiative characteristics of the atmosphere and the underlying surface on the basis of aircraft and satellite measurements made over NP-22 drifting station.

Kondrat'ev, K. Ya. 1981. Stratosphere and climate. Sci. and Technol. Summ. Meteorology and climatology. VINITI, Acad. Sci. USSR. Moscow. Vol. 6. 224 p.

Review of a current state of research on problem "stratosphere and climate." The review discusses the following aspects: 1) extra atmospherical isolation and solar activity impact mechanisms on climate; 2) optically active trace gas components, their contribution to atmosphere greenhouse effect formation and to paleoclimate evolution; 3) numerical modeling of the effect of atmosphere gas composition changes on climate; and 4) volcanic eruptions, stratospheric volcanic aerosol formation, and its climate effect.

Kondrat'ev, K. Ya., and **D. V. Pozdnyakov.** 1981. Aerosol atmospheric models. Moscow, Nauka. 104 p.

Results of investigations, fulfilled in the course of the first stages of GARP and the Soviet-American collaboration within the framework of a two-sided agreement, made in 1972, in the field of environmental protection, have been considered. Problems of formation of major types of tropospheric and stratospheric aerosols and their physical-chemical properties are covered. Formalization problems of radiation characteristics of aerosol with the aim of working out adequate optic aerosol atmospheric models are discussed.

Kondrat'ev, K. Ya., N. I. Moskalenko, V. Ph. Terzi, and **S. Ya. Skvortsova.** 1981. Modeling of optical property of industrial aerosol. Rep. Acad. Sci. USSR. 259(4):814-817.

A model is suggested of the optical properties of industrial aerosols. This model considers high absorption capacity and microstructure complexity of aerosols, which can be described by gamma distribution superposition. The use of this distribution makes it possible to take into consideration high concentrations of a fine-dispersed aerosol fraction. Data about coefficient absorption and indicatrix of diffusion are presented and compared to analogous data for a contamination- free atmosphere. Results of calculations of the intensity of atmosphere counterradiation for conditions of polluted and clear atmosphere have been compared.

Kondrat'ev, K. Ya., N. I. Moskalenko, V. Ph. Terzi, and **S. Ya. Skvortsova**. 1981. Models of optical characteristics of atmospheric aerosol above continents. Reps. Acad. Sci. USSR 260(1):56-59.

Models of optical characteristics of aerosol above continents, generalizing results of available observations, are suggested. These models are based on the consideration that optical characteristics are shaped as specified ones by combination of characteristics of submicron, coarse-disperse, and dust aerosol fractions. The example of construction of a microphysical aerosol model above a subarid region in a zone of active turbulent displacement is discussed. In particular, aerosol evolution during dust storm development was considered. Parameters are given for summer, winter, and autumn conditions in middle latitudes.

Kondrat'ev, K. Ya., N. I. Moskalenko, V. Ph. Terzi, and **S. Ya. Skvortsova.** 1981. Modeling of optical characteristics of atmospheric aerosol above sea water areas. Rep. Acad. Sci. USSR 261(6):1329-1332.

Models of optical property of atmospheric aerosol above sea water areas are suggested. The models consider an aerosol multicomponent conditioned by three independent mechanisms: removal of continental soil-erosion aerosol, aerosol generation in the process of chemical reactions in gases and formation of sea aerosol, and being the particles of sea-salts or drops of their water solutions. Calculations of the optical characteristics of different aerosol varieties above ocean are made for superpositions of aerosol fractions weighted on concentration and optical density. Results of calculations of possible vertical profiles of aerosol optical density and spectral coefficient motion of general weakening are displayed.

Kondrat'ev, K. Ya., N. I. Moskalenko, and **V. Ph. Terzi.** 1982. Modeling of optical characteristics of atmospheric aerosol in coastal zones. Rep. Acad. Sci. USSR 262(3):577-580.

Using the regional division of the globe suggested earlier by the authors, a model of atmospheric aerosol optical characteristics in coastal areas, where aerosol properties are defined by joint land and sea action, has been developed. Data on spectral coefficients of weakening for various fractions of sea, continent and background aerosols, as well as vertical profiles of optical density of various aerosol fractions, formed with due regard for circulation of continental and sea air masses and climatic zone are calculated. Characteristics of chemical composition and microstructure of basic aerosol fractions are given.

Kondrat'ev, K. Ya., N. I. Moskalenko, and **V. Ph. Terzi.** 1982. Modeling of optical characteristics of stratospheric aerosol. Rep. Acad. Sci. USSR 262(5):1092-1095.

Literary information about chemical composition, microstructure, and complex refractive index of particles of stratospheric aerosol is generalized. This information forms the basis for calculating typical vertical profiles of optical density of aerosols; the totality of which characterizes an optical model of the stratospheric aerosol.

Kondrat'ev, K. Ya., N. I. Moskalenko, and **D. V. Pozdnyakov.** 1983. Atmospheric aerosol. Leningrad. Gidrometeoizdat. 224 p.

Information on microphysical and optical properties of atmospheric aerosols is summarized. Analysis of available aerosol models is attempted and design of new models is realized, taking into consideration the influence of specificity of global aerosol optical properties, due to distinction of generation and sink mechanisms of tropospheric and stratospheric aerosols. On the basis of the developed models of global aerosol, numerical modeling with the aim to analyze the effect of aerosol on spectral distribution and spatial structure of fields of short-wave and long-wave radiation is realized. The problems of radiation heat transfer in cloudy atmosphere are discussed.

Kondrat'ev, K. Ya. 1983. Earth radiation budget. Aerosol and clouds. Science and Technique Results. VINITI. Meteorol. Climatol. Vol. 10. 316 p.

Contents:

Ch. I. Atmospheric aerosol: aerosol and climate, dust and atmospheric formations on data analysis of space images, reduction of aerosol characteristics from data of space spectrophotometry.

Ch. II. Cloud cover: cloud cover climatology; determination of cloud amount; temperature, altitude of upper bound, and layer thickness of cloudiness; atmosphere and cloud moisture and water content.

Ch. III. Earth radiation budget: interpretation methods and data analysis of satellite measurements of incoming radiation for the purpose of definition of radiation balance components, short-wave incoming radiation and the system albedo, incoming long-wave radiation, long-wave radiation balance of atmosphere, earth radiation budget, regeneration of radiation balance of underlying surface and atmosphere.

Kondrat'ev, K. Ya., and **M. A. Prokof'ev.** 1984. Characterization of atmospheric aerosols to assess its climatic effects. Bull. USSR Sci.Acad., Atmos. Ocean Phys. 20(5):339-348.

Models of atmospheric aerosols applicable to GCM studies in assessment of its climatic impact are reviewed. Principal microphysical and radiative characteristics of stratospheric and tropospheric aerosols and their different types are discussed. The model of the atmospheric aerosol optical properties by the International Working Group "Aerosols and Climate" is presented in detail.

Kondrat'ev, K. Ya., F. S. Moskalenko, S. Ya. Skvortsova, A. R. Zakirova, F. S. Yakupova, and **S. V. Gusev.** 1984. Global modeling of atmospheric aerosol optic characteristics. Rep. Acad. Sci. USSR 280(5):1090-1093.

The global modeling system of atmospheric aerosol optic characteristics (spectral coefficients, dispersion absorptions of indicatrixes of diffusion) on computer is suggested. It is based on global landscape maps, earth surface or surface air layer temperature fields, and wind velocity fields. Background aerosol, stratospheric layer, dust removals, and volcanic aerosol are taken into account in the model. The greatest optical depth $\mathbf{T}^a$, = 0.3-0.4) was observed in the hot season and in the warmest latitudes, where the zone of active turbulent exchange reaches 4 km. Atmosphere is most transparent in the cold period and in polar regions, where ($\mathbf{T}^a$ drops to 0.01-0.03. To account for volcanic aerosols, dust storms and dust removals, the dynamic models considering atmosphere circulation are worked out.

Kondrat'ev, K. Ya. 1985. Volcanos and climate. Res. Sci. and Techn. VINITI. Meteorol. Climatol. Vol. 14. 204 p.

Earth radiation budget changes caused by volcanic aerosols are an important climate formation factor. Observed variability of air temperature averages for the Northern Hemisphere in the 20th century, as well as in the Little Ice Age, was evidently defined to a great extent by the impact of volcanic eruptions on radiation balance change.

Physicochemical mechanisms of volcanic aerosol formation, and its microphysical and optical properties are discussed. A capability review of remote indicators of stratospheric aerosol content and properties is made. Results of meteorological observations, allowing judgments about volcanic eruptions impact on climate, have been considered; results of numerical climate modeling with a view to stratospheric volcanic aerosol climate impact evaluations are analyzed.

Kondrat'ev, K. Ya. 1986. Natural and anthropogenic climate changes. Sci. and Technol. Summ. VINITI, Acad. Sci. USSR. Meteorol. Climatol. Moscow. Vol. 16. 352 p.

Recent analyses of natural and anthropogenic climate change factors are summarized. Due to the attention attracted to estimates of possible atmospheric and climate impacts of nuclear war, the analysis of these evaluations and assumptions, put in the basis of these evaluations, as well as the present state of knowledge of observed climate change is performed. The latest data available on surface air temperature trends are given, illustrating the partition of natural and anthropogenic climate factors input and estimates uncertainties, based on accounting such external climate impacts, as the increasing carbon dioxide concentration and volcanic eruptions. The examples, testifying to the importance of internal climate system variability accounting in different time scales and numerous feedbacks, exerting critically important influences on climate formation, have been considered. Priority directions of further research trends are identified.

Kondrat'ev, K. Ya. 1986. Anthropogenic impacts on Arctic atmosphere. All-Union Geogr. Soc. News

118(3):193-202.

Studies of the Arctic atmosphere pollution arising every year in late winter-early spring by means of the transport impact of natural and anthropogenic aerosol from middle to high latitudes are reviewed. The chemical composition of arctic haze formed in high latitudes, has been considered, and the considerations of its possible effect on Arctic radiation regime and climate are presented.

Kondrat'ev, K. Ya., N. I. Moskalenko, S. Ya. Skvortsova, Yu. I. Fedorov, F. S. Yakupova, and **S. V. Gusev.** 1987. Soot aerosol optical characteristics modeling. Bull. Acad. Sci. USSR 296:314-317.

An optic characteristic model of anthropogenic soot aerosol, which appears to be an important climate forming factor due to its high absorbed capacity, is justified. Microstructure evolution of aerosols formed as a result of gas phase reactions and corresponding changes of their optical properties have been analyzed. Numerical modeling results illustrating variability of soot aerosol optical characteristics are given.

Kondrat'ev, K. Ya., V. F. Zhvalev, V. A. Ivanov, M. A. Prokof'ev, and **N. E. Ter-Markaryants.** 1986. Investigation of aerosol-radiative factors of contemporary climate variations (Global aerosol-radiative experiment). Proc. Main Geophys. Obs. 509:24-33.

Results of natural experiments under the programs CENEX, GATE, and GAREX are given. Experimental data of quantitative aerosol characteristics, peculiarities of aerosol's vertical structure above a desert, and vertical profiles of radiative heat inflow components during dust removal are presented. A regeneration method is suggested that uses data of single actinometric aircraft measurements for a space-time run of integrated short-wave radiation flux densities in cloudless atmosphere. Evaluations of total diurnal radiative heat inflows in cloudless atmosphere above various characteristic types of underlying surface are obtained. Variability of the aerosol component of solar radiation attenuation in the atmosphere depending on air masses change is traced.

Kondrat'ev, K. Ya., N. I. Moskalenko, S. V. Gusev, S. Ya. Skvortsova, F. S. Yakupova, and **Yu. I. Fedorov.** 1988. Impact simulation of the condensation factor on atmospheric aerosol optical properties. Bull. Acad. Sci. USSR 299(5):1102-1105.

Numeric simulation experiments using a dependency analysis of atmospheric aerosol optical characteristics (spectral attenuation coefficients, absorption and dispersion, indicatrix of dispersion) from relative air humidity varying in the lower tropospheric layer are described. Computation results that demonstrate, in particular, significant disagreement with earlier received analogous results are considered. These discrepancies can be explained by an incorrect account of humidity impact on an aerosol microstructure.

Kondrat'ev, K. Ya. 1990. Atmospheric chemistry and climate. Earth Atmos. Photochem. Processes

Moscow. 123-133.

A Review. The present state of knowledge of the climate formation problem and its changes is described. Anthropogeneous climate impacts are discussed, in particular, the role of minor, optically active gaseous components and carbon dioxide gas in greenhouse effect formation. A reliable forecast of anthropogenic climate changes in the next 50-100 years is not possible due to uncertainty in the forecast of industrial development, lack of global carbon cycle understanding, and absence of reliable climate theory. The problem of the various component cycles in the biosphere as a climate formation factor has been considered in detail. Problematic aspects of climate change studies are stated. Atmospheric aerosol and its climatic effect (aerosol classification by composition and sources, natural and anthropogenic aerosol, photochemical and chemical mechanisms of aerosol formation, aerosol radiation regime impact) are discussed in detail. Prospects of further developments in aerosol investigations as a climate forming factor are outlined.

Kondrat'ev, K. Ya. (Editor). 1991. Aerosol and climate. Leningrad, Hydrometeoizdat. 541 p.

The monograph has been prepared in accordance with the decision of the Joint Soviet-American Commission on collaboration in the field of environment and is devoted to investigating the impact of aerosols on climate. Techniques and instrumentation needed to study atmospheric aerosol have been considered in the book. Special attention has been paid to the classification of natural and anthropogenic atmospheric aerosol depending on its composition and sources and to the consideration of the chemical composition and physical characteristics of aerosol particles. In separate chapters, various problems have been discussed connected with soil, marine, stratospheric, and anthropogenic aerosols. Substantial parts of the book have been devoted to the impact of aerosols on radiation transfer as well as the interaction between aerosol and climate and climatic effects of aerosols. An important part of the monograph contains a discussion of the role of aerosols in numerical climate modeling.

Kondrat'ev, K. Ya. 1993. Complex monitoring of Pinatubo volcanic eruption. Earth Res. from Space 1:111-122.

A review of the first observation experiment the consequences of the Pinatubo eruption using a complex monitoring system. The system consisted of satellites, aircraft, balloons, and ground-based observation facilities. Evaluations of the eruption's global climatic effects, arising from volcanic changes of aerosol and gas stratosphere composition, have been made.

Krekov, G. M., and **R. Ph. Rakhimov.** 1982. Optical-radar model of continental aerosol. Novosibirsk, Nauka. 198 p.

Results of modern investigations of microphysical and optical characteristics of atmospheric aerosol are systematized; calculation methods are presented, and a number of original numerical investigations of vertical stratification of optical-radar parameters of continental aerosol are realized. Data calculations embrace a wide spectral band of visible and infrared radiation. Examples and recommendations for practical use of model assessments are given.

Krupchatnikov, V. N., and **L. I. Kurbatskaya**. 1990. Long-wave radiation response to aerosol injection. Hydrodynam. Environ. Models. Computer Center of Siberian Branch Acad. Sci. USSR. Novosibirsk. 60-67.

The influence of atmospheric aerosol on long-wave radiation is analyzed. In this case the same assumptions are accepted, as made during the examination of aerosol influence on short-wave radiation; aerosol dispersion and absorption are the basic processes, dispersion absorption coefficients are normalized relative to the coefficient at (λ = 0.55 µm, long-wave spectrum was divided on three spectral ranges, in each of them the optical characteristics are given by averages. Desert aerosols and aerosols raised by air flows on a certain height and forming a dust cloud render the strongest influence on the long-wave radiation. For the calculation of long-wave flows, Eddington and two-stream approximations are used. Computation results have been compared with similar calculations of other scientists. Discrepancies have been analyzed. Aerosol influence on long-wave flows is shown through the change of efficient flows at the Earth's surface.

Loginov, V. F., Z. I. Pivovarova, and **E. G. Kravchuk.** 1983. Evaluation of the contribution of natural and antropogenic factors into the variability of solar radiation on the Earth's surface. Meteorol. Hydrol. 8:55-60.

A long-term series (1883-1981) of direct solar radiation observational data derived at 20 stations in the Northern Hemisphere is given. From the change of solar radiation at plain and mountain stations for synchronous time periods (during 1958-1981), an approximate evaluation is given of the influence of anthropogenic factors and volcanic activity upon radiation attenuation. The contribution of volcanic eruptions in the formation of direct radiation variability during the recent two decades is varying (in dependence on the assumed techniques of evaluation) in the 3.8-1.9% range. The decrease of direct radiation due to anthropogenic factors is essentially less, and the average trend is 0.1% over each year during the period under consideration.

Loginov, V. F. 1984. Volcanic eruptions and climate. Leningrad, Gidrometeoizdat. 64 p.

The variability of direct solar radiation, integral atmospheric transparency, and temperature of the Northern Hemisphere in connection with volcanic eruptions are estimated. The results obtained indicated that the contribution to the variability of the climatic system in the northern hemisphere temperature is greater than the variability due to volcanic eruptions. The book is intended for specialists in atmosphere physics and for climatologists.

Marshunova, M. S., and **A. A. Mishin.** 1988. Monitoring of atmospheric transparency in polar regions. Arctic Climate Monit. Leningrad. 132-140.

From data of actinometric observations in different Arctic and Antarctic regions the change of atmospheric transmittance in the last 20-30 years is considered. The water vapor and atmospheric aerosol contribution to total solar radiation attenuation is estimated. Decreasing tendencies of atmospheric transmittance and, accordingly, of the increasing tendency of solar radiation attenuation aerosol component in the Arctic Region during the last 10-15 years is noted.

Marov, M. Ya., V. P. Shari, and **L. D. Lomakina**. 1989. Optical characteristics of simulated earth atmosphere aerosols. Moscow. Appl. Math. Inst. 229 p.

In a tabulated and graphic form the numerical computation results of a complete set of single light scattering optical characteristics (bulk coefficients and angular dependencies of phase matrix elements) for the typical lower earth atmosphere aerosol model, recommended by the Radiation Commission of the International Meteorology and Atmospheric Physics Association, are given. Results are received in a wide-wave band range of visible and IR bands from 0.2 to 40.0 µm considering the spectral dependence of complex particle refractive index for basic aerosol components: dust and water soluble particles, carbon anthropogenic aerosol, and particles of oceanic origin. For troposphere and atmospheric surface layer models of continental and marine aerosols for clear atmosphere conditions, composed of these components, and so called urban aerosol model for the polluted atmosphere of the boundary surface layer have been considered. Results can be used for the role evaluation of aerosol component in radiation transfer, when analyzing corresponding climatic effects and recent ecology problem.

Petryanov-Sokolov, T. V., and **A. G. Sutugin**. 1989. Aerosols. Moscow. Nauka. 142p.

This book, intended for a broad range of readers, is devoted to the quickly developing field of aerosol studies. The knowledge of aerosol properties, their formation, and behavioral laws is necessary for pure air, water, and soil conservation (industry emissions due to technology backwardness amount to 99% of extracted raw material mass). Book chapters:

1. Aerosol properties.
2. Aerosol formation.
3. How are aerosols investigated?
4. Aerosols in the environment.
5. Aerosols are friends.
6. Aerosols are enemies.
7. Aerosols are killers.
8. Protection facilities against aerosols.
9. Astrosols.

Appendix. Natural environmental protection (wasteless technology).

Rakhimov, R. F. 1991. Model assessments of post-volcanic relaxation of stratospheric layer optical characteristics. Atmos. Optics. 4(6):645-652.

A numerical modeling method of stratospheric aerosol optic location characteristics variability during post-volcanic relaxation of the layer is discussed. Model assessments of the combined influence on optical properties of eruptive cloud gravitational subsidence and the macroturbulent dispersion factor are presented.

Rozenberg, G. V. 1983. The formation and development of atmospheric aerosol-parameters caused by kinetics. Bull. Acad. Sci. USSR, Atmos. Ocean Phys. 19(1):21-35.

Aerosol is considered as a nearly stationary process of particle formation, development, and scavenging. Notions of background aerosol, aerosol weather, and aerosol climate as an ensemble of aerosol states and transformation processes are introduced. A scheme for basic processes is formulated, that is, the synthesis of vapor of aerosol-forming substances (VAFS) and clusters and the heterogeneous condensation, coagulation, humidization, and scavenging of thin-dispersive particles. On the basis of kinetic theory, each process is described for stationary conditions that lead to a chain of relationships determining the basic parameters of an aerosol system if two external parameters are known, e.g., the concentration of VAFS and the characteristic life-time of the submicron fraction. The scheme developed is proposed as a kinetic model of tropospheric aerosol.

Rozenberg, G. V. 1982. Fine-dispersion aerosol and climate. Bull. Acad. Sci. USSR, Atmos. Ocean Phys. 18(11):1192-1198.

Fine-dispersion aerosol is sensitive to climatic conditions and, in turn, has a profound and diverse influence on the climate. This influence is not only connected with the direct participation in the radiative heat exchange and varies for different aerosol components.

Savchenko, A. V., V. V. Smirnov, and **A. D. Uvarov.** 1989. Surface aerosol microstructure and its physical modeling. Proc. Inst. Exp. Meteorol. 48(138):3-15.

Results of natural and model studies of aerosol characteristic variabilities in the surface air layer are presented. Spectral aerosol variability is shown to have a unified form for many regions and meteorological situations. The possibility of formation of aerosol atmospheres with microstructural and condensation characteristics close to those of the atmospheric surface layer in aerosol chambers by volume of 3200 m^3 is examined.

Shifrin, K. S., A. M. Kokorin, K. S. Lamden, I. N. Salganik, and **A. V. Smirnov.** 1983. Effect of the stratospheric aerosol layer on the global radiation. Meteorol. Hydrol. 4:61-66.

The effect of the stratospheric dust layer on radiation is considered. Estimations of possible variations in the radiation regime and air temperature due to variations of the stratospheric aerosol layer on the basis of contemporary experimental data on the layer's structure are derived.

Tarasova, T. A., and **E. M. Fejgelson.** 1981. On the aerosol effects in the radiative heat exchange. Bull. Acad. Sci. USSR. Atmos. Ocean Phys. 17(1):18-26.

The sensitivity of the atmospheric albedo and absorptivity is studied in relation to the aerosol parameters: real and imaginary parts of the complex refractive index and geometric mean and standard deviation of particle size distribution. A simple model with two input parameters is proposed for estimation of the aerosol heating effect. The parameters are the total number of aerosol particles and the excess of absorbing particles over their background concentration.

Timerev, A. A., and **S. A. Egorov**. 1991. Spatial-temporal variability of surface inversions in Arctic. Meteorol. Hydrol. 7:50-56.

The spatial-temporal variability of surface inversions, main characteristics is considered on the basis of aerological sounding data of drifting (1954-1988) and stationary Soviet and foreign stations (1961-1970). January and July distribution maps of monthly average means of surface inversions in the northern polar region are given for the first time. To specify the region with the maximum concentration of surface aerosols, the Arctic regions with maximum surface inversion frequency and capacity were found.

Tsvetkova, V. N. 1983. On variability of atmospheric aerosol optical density. Proc. Main Geophys. Observ. 499:145-153.

Average daily values of atmospheric aerosol optical density received from the State Hydrometeorological Committee stations network are considered. Data are represented as frequency differential distributions by gradations for 5 stations.

Timofeev, Yu. M., and **S. P. Obraztsov.** 1984. The effect of aerosol on the formation of the outgoing thermal radiation. Bull. Acad. Sci. USSR, Atmos. Ocean Phys. 20(10):947-956.

On the basis of the solution of an integrodifferential equation of radiative transfer, the effect of aerosol on the formation of outgoing thermal radiation in the 400-2685 cm^{-1} spectral region has been examined for various aerosol models. The effect of aerosol in terms of the radiation brightness temperature is shown to constitute 0.1-0.4 K for a clean atmosphere and can reach 2.0-4.0 K for a turbid atmosphere. The contribution of aerosol scattering to the formation of outgoing thermal radiation can amount to 5-10%. An approximate method of accounting for the effect of aerosol is proposed.

Tyul'teva, L. V., B. I. Ogorodnikov, and **V. I. Skitovich.** 1992. Investigation of sulphate aerosol disperse composition. Background Environ. Pollut. Monit. Leningrad. 7:165-168.

With the help of multilayer filters and X-ray fluorescence analysis, the sulphate aerosol disperse composition in industrial emission plumes is determined. Methodological work has been performed to create reference filters for X-ray fluorescence analysis.

Volnistova, L. P., A. S. Drofa, and **A. L. Usachev**. 1988. Aerosol light scattering characteristics in atmospheric hazes. Proc. Inst. Exp. Meteorol. 45(135):138-150.

Computation results of for the visible wavelength range are given for light-scattering characteristics of atmospheric haze of continental and marine origin in the atmospheric surface layer. The influence of the aerosol material refraction index and relative air humidity on the light-scattering characteristics of atmospheric haze (scattering indicatrix and its integral characteristics, weakening index, survival probability of photons, lidar relation) is examined. On the basis of computation results, the empirical dependencies have been obtained, taking into consideration the influence of geophysical and meteorological atmospheric parameters on scattering light characteristics in hazes and, in particular, on the characteristics of optical image transmission quality through hazes.

Volovikov, S. A., M. P.Kolomeev, S. S. Khmelevtsov, and **Yu. K. Gormatyuk.** 1987. The impact of volcanic eruptions on surface temperature. Proc. Inst. Exp. Meteorol. 43(128):33-45.

An unstationary, seasonal Earth-energy balance climate model that includes volcanic aerosol and calculates surface temperature in the latitudinal zones is developed. Climate system inertia is considered by encompassing seasonal and main thermocline in the oceanic model block of the upper quasi-homogeneous ocean layer. On the basis of observation data and calculations of climate sensitivity to stratospheric aerosol, a volcanic aerosol model is suggested. Computation results are given of surface temperature change in response to volcanic eruptions in the 20th century.

Zhvalev, V. F., D. A. Zhukovsky, and **V. A. Ivanov.** 1991. X-ray fluorescence analysis application for element composition determination of atmospheric aerosol samples. Proc. Main Geophys. Observ. 534:114-123.

A modern nuclear-physical definition method of th element composition of aerosol particles is described. A general presentation of X-ray fluorescence analysis and certain peculiarities of its engineering realization is given. Perspective trends of the method's development are given. The authors' own results on certain metal content determination in aerosol particles near automobile roads with the help of crystal-diffraction and energy-dispersed equipment are given.

Zuev, V. E., and **G. M. Krekov.** 1986. Optical models of the atmosphere. Modern Probl. Atmos. Opt. Leningrad. Hydrometeoizdat. Vol. 2. 256 p.

This monograph is concerned with the problem of constructing optical models of the atmosphere on the basis of statistically valid composition data. The analysis of the problem is given both for the dispersed media (such as hazes, clouds, mists, precipitation) taking into account the specific features of their microphysics (concentration, particle size spectrum, coefficients of material refraction), and for gas composition of the atmosphere based on modern views on its altitude variations in the atmosphere. The authors concentrate on the problem of the effect of reference microphysical and meteorological data on the reliability of model evaluations.

Extensive information is presented on high-altitude and spectral behavior of the basic optical parameters of dispersed and gaseous atmospheric fractions. Some applications of these subjects are discussed in the problems on laser sounding of the atmosphere.

Zuev, V. E., and **M. V. Kabanov**. 1987. Atmospheric aerosol optics. Modern problems of atmospheric optics. Leningrad. Hydrometeoizdat. Vol. 4. 254 p.

Different aspects of atmospheric aerosol optics are discussed, including the theoretical basis of optical radiation interaction with separate particles and a particle system, atmospheric aerosol optical properties and their connection with meteorological conditions, the spreading in the atmospheric aerosol of optical radiation of various character--continuous and pulsed, short- and long-wave, and coherent and incoherent.