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Notes on the contributors

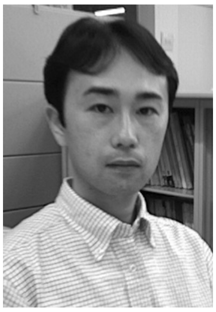
Before entering the field of atmospheric science **Anthony J. Baran** was actively engaged in various other fields such as astrophysics, theoretical laser-plasma physics and stochastic theory applied to wind energy. In 1990 he joined the Met Office, England, and in 1995 further studied for a Ph.D. in the atmospheric sciences at University College London, London University, on the radiative and remote sensing properties of cirrus, which he gained in 1997. Since then he has remained at the Met Office. His research interest covers the areas of scattering and absorption from non-spherical ice crystals, cirrus remote sensing and radiative transfer. Dr Baran has actively been engaged in research covering those three principal areas of interest. More lately, he has become interested in relating the macrophyscal properties of cirrus to their scattering properties, very high resolution measurements of cirrus in the far IR, and polarimetric measurements of cirrus. Dr Baran has also been the principal investigator of airborne cirrus campaigns. He has authored and co-authored over 50 peer-reviewed publications.

Howard Barker obtained his Ph.D. from McMaster University in 1991. His thesis work addressed solar radiative transfer for inhomogeneous cloudy atmospheres above reflecting surfaces. Since then he has worked as a research scientist in the Global Climate Modelling and Cloud Physics Research Divisions of Environment Canada. His current scientific interests deal with modelling radiative transfer for realistic cloudy atmosphere–surface systems for the purposes of climate modelling and remote sensing of Earth.

Leonid P. Bass is senior scientist at the Keldysh Institute of the Applied Mathematics (KIAM) of Russian Academy of Sciences. He graduated from Moscow Geodesic Institute in 1956. Dr Bass received the M.S. degree from Moscow State University, where he studied at the Department of Mechanics and Mathematics. Dr Bass obtained Ph.D. at Keldysh Institute of Applied Mathematics in Moscow, Russia, in 1976. Since 1960 he has worked at the KIAM with problems connected to the physics of reactors and radiation shielding. His main efforts were aimed at the development of effective computational methods for the estimation of radiation fields in different media with complicated structures such as nuclear reactors and similar power plants. For example, he has participated in the development of the special software for the solution of the multi-group steady-state transport equation for neutrons and gamma quanta in two- and three-dimensional geometries by the discrete ordinates method. Dr Bass is well-known as an expert in the field of parallel algorithms for supercomputers. Current interests include the calculation of solar radiation fields in spatially non-uniform media for the estimation of atmospheric parameters.

The scientific activity of **Professor T. Germogenova** (10.04.1930–27.02.2005) was associated with the solving of mathematical, physical and computational problems of radiation transport theory and reactor physics. She started working on transport theory problems in 1953 during the postgraduate course of the Physical Department of Moscow State University. Professor E. S. Kuznetsov was her postgraduate work supervisor. T. Germogenova was a staff member of the Institute of Applied Mathematics of the Russian Academy of Sciences for almost 50 years. Her Ph.D. thesis (1957) was dedicated to the solution of the transport equation for highly peaked phase functions. In 1962 she proved the principle of maximum for the linear transport equation. This quite general result can be used, particularly, in the study of convergence properties of some difference schemes for transport equation. Her Doctor of Mathematical Sciences degree thesis (1972) was dedicated to boundary problems of the transport equation and local properties of its solutions. The results obtained by T. Germogenova in the mathematical study of resolvability, smoothness properties and singularities of the transport equation solutions in dependence on medium and source properties are collected in her monograph, 'The Local Properties of Transport Equation Solutions' (1986, in Russian). T. Germogenova has been involved in the solution of a number important atmospheric optics problems (e.g. 3D radiative transport in cloudy media). She proved that the set of physically realizable states of polarized light in the Stokes–Poincaré representation is a cone in an appropriate functional space of four-dimensional vector-functions (1978). Next, this property was used for strict formulation both the 'non-negativity' property of the scattering matrix and the mathematical theory of the characteristic equation for the polarized light transport equation. T. Germogenova also has derived the set of asymptotical approximations for transport problems in optically thick inhomogeneous finite size regions (1961). Some of them are used for solving remote sensing and inverse atmospheric problems. She also developed a number of widely used numerical and analytical techniques, such as, the method of averaged fluxes for acceleration of inner iterations convergence (1968, 1969), Fourier analysis of stability of the WDD scheme, accuracy and stability analysis of the family of weighted nodal schemes (1994), and eigenfunctions of the finite moments method analysis (1996). Under her guidance a set of codes for 1D, 2D and 3D transport calculations has been developed for serial and parallel computers.

Otto Hasekamp obtained his Ph.D. in physics from the Free University of Amsterdam in 2002. His PhD work concentrated on radiative transfer theory and inverse problems in the context of ozone profile retrieval from satellite measurements of backscattered sunlight. He extended the forward-adjoint radiative perturbation theory with the inclusion of polarization, and proposed a new instrument concept for measuring tropospheric ozone using polarization measurement. His current work at the Netherlands Institute for Space Research (SRON) is focused on the retrieval of aerosol properties from satellite measurements of intensity and polarization. He developed a novel approach to the retrieval of aerosol properties, including a linearization of vector radiative transfer with respect to microphysical aerosol properties. Additionally he is involved in several other research projects related to GOME and SCIAMACHY, such as the retrieval of cloud properties and the retrieval of ozone profiles.



Hironobu Iwabuchi graduated from the Faculty of Science of Tohoku University, Japan, in 1996. He received a Doctor of Science degree in Geophysics from Tohoku University in 2001. His Ph.D. work examined three-dimensional radiative effects on satellite-based remote sensing of cloud properties. He is now a research scientist at the Frontier Research Center for Global Change of the Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan. His main research interests are modelling of three-dimensional radiative transfer and its applications in meteorology and in the remote sensing of gases, aerosols and clouds.

Alexander A. Kokhanovsky graduated from the Physical Department of the Belarusian State University, Minsk, Belarus, in 1983. He received his Ph.D. in optical sciences from the Institute of Physics, National Academy of Sciences of Belarus, Minsk, Belarus, in 1991. The Ph.D. work was devoted to modelling the light scattering properties of aerosol media and foams. Alexander Kokhanovsky is currently a member of the SCIAMACHY/ENVISAT algorithm development team (Institute of Environmental Physics, University of Bremen). His research interests are directed towards modelling light propagation and scattering in the terrestrial atmosphere. Dr Kokhanovsky is the author of the books *Light Scattering Media Optics: Problems and Solutions* (Chichester: Springer-Praxis, 1999, 2001, 2004), *Polarization Optics of Random Media* (Berlin: Springer-Praxis, 2003), and *Cloud Optics* (Berlin: Springer, 2006). He has published more than one hundred papers in the field of environmental optics, radiative transfer, and light scattering. Dr Kokhanovsky is a member of the European and American Geophysical Unions and also he is a member of the Belarusian Physical Society.

Victor S. Kuznetsov graduated from the Theoretical Physics Department of the Moscow Engineering and Physics Institute in 1965. Since 1976 he has worked at the Russian Research Center 'Kurchatov Institute' as senior scientist. His work is concerned with particle transport in different reactors plants, their safety and radiation shielding. Recently he developed the Discrete Ordinates Method algorithms for the solar radiation transport through the atmosphere and for radiation transport from different sources with singularities.

Jochen Landgraf is senior scientist at the Netherlands Institute for Space Research (SRON) and his research is focused on atmospheric radiative transfer, inverse modelling and photochemistry modelling. He obtained a Ph.D. at the Max-Planck Institute for Chemistry in Mainz, where he developed a module for efficient online calculations for photodissociation rates, which is implemented in several three-dimensional chemistry models. In addition, he has been involved in studying the effects of 3D radiative transport in inhomogeneous cloud fields and their relevancy for global chemistry modelling. His recent research has focused on remote sensing from satellite measurements, particularly from GOME and SCIAMACHY observations. He is involved in several national and international research projects, which are related to stratospheric and tropospheric ozone profile retrieval, aerosol retrieval, modelling of inelastic Raman scattering in atmospheric radiative transfer, and the development of a linearized radiative transfer model.

Aleksey Malinka graduated from the Belarusian State University, Department of Physics, in 1997. Since 1997 he has been a researcher in the B. I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus in Minsk. He received a Ph.D. for his work on the theory of Raman lidar sounding with account for multiple light scattering effects in 2005. Dr Malinka's studies are aimed at the better understanding of light scattering phenomena in various natural environments. He is also active in oceanic and atmospheric lidar sounding research.

Olga V. Nikolaeva received the B.A. and M.S. degrees in applied mathematics from the Moscow State University, Russia, in 1993, and the Ph.D. degree in radiation transport investigation from Keldysh Institute of Applied Mathematics in 2002. Her research interest is focused on the simulation of radiation propagation and scattering in complicated multidimensional regions by parallel computers and investigation of discrete ordinates methods schemes for the transport equation. She is a member of I3RC group.

Alexei V. Rozanov graduated from the Physical Department of St. Petersburg State University, Russia, in 1994. He received a Ph.D. degree in natural sciences from the Institute of Environmental Physics, University of Bremen, Germany, in 2001. His Ph.D. work was devoted to the modelling of radiative transfer through a spherical planetary atmosphere and also to the retrieval of vertical distributions of atmospheric trace gases from occultation and limb measurements of backscattered solar light. Alexei Rozanov is currently a member of the SCIAMACHY/ENVISAT algorithm development team at the Institute of Environmental Physics of the University of Bremen, where he is active in the development of radiative transfer models and retrieval algorithms intended to obtain vertical distributions of atmospheric trace gases from satellite measurements. He has contributed to the publication of more than thirty scientific papers in the field of radiative transfer modelling and the remote sensing of the Earth's atmosphere.

Vladimir V. Rozanov graduated from the University of St. Petersburg, Russia, in 1973. He received his Ph.D. degree in physics and mathematics from the University of St. Petersburg, Russia, in 1977. From 1973 until 1991 he was a research scientist at the Department of Atmospheric Physics of the University of St. Petersburg. In 1990–1991 he worked at the Max-Planck Institute of Chemistry, Mainz, Germany. In July 1992 he joined the Institute of Remote Sensing at the University of Bremen, Germany. The main directions of his research are atmospheric radiative transfer and remote sensing of atmospheric parameters (including aerosols, clouds and trace gases) from space-borne spectrometers and radiometers. He is author and co-author of about one hundred papers in peer-reviewed journals.

Thomas Wriedt has been the head of the Particle Technology and Particle Characterization Department at the Institut für Werkstofftechnik, Bremen, Germany, since 1989. He studied Electrical Engineering at the University of Applied Science, Kiel, and also at the University of Bremen, and obtained his Dr.-Ing. degree on the numerical design of microwave antennas and components in 1986. From 1986 to 1989 he did research on signal processing with phase Doppler anemometry at the University of Bremen. His current research is mainly focused on optical particle characterization and light scattering theory.

Preface

Light scattering is used in many applications, ranging from optical particle sizing of powders to interstellar dust studies. At the moment there is no a specialized journal aimed at studies of exclusively light scattering problems. Instead, different aspects of the problem and also different applications are considered in a variety of specialized journals covering several scientific disciplines such as chemistry, physics, biology, medicine, astrophysics, and atmospheric science, to name a few.

The Light Scattering Reviews (LSR) series started in 2006 with the aim of facilitating interaction between different groups of scientists working in diverse scientific areas but using the same technique, namely light scattering, for solution of specific scientific tasks. This second volume of LSR is devoted mostly to applications of light scattering in atmospheric research. The book consists of eight contributions prepared by internationally recognized authorities in correspondent research fields.

The first paper prepared by Howard Barker deals with the recent developments in solar radiative transfer in the terrestrial atmosphere and global climate modelling. In particular, methods to compute radiative transfer characteristics needed for numerical global climate models are discussed in a great depth. Their deficiencies are addressed as well. The problem of 3D radiative transfer in cloudy atmospheres, a hot topic in modern climate modelling, is also considered.

Anthony Baran prepared a comprehensive review aimed to studies of radiative characteristics of cirrus clouds. The global coverage of these clouds is quite large – up to 30% (70% in tropics). So cirrus plays an important but poorly defined role in the climate system. Methods of computing local optical characteristics of cirrus such as extinction coefficient, single scattering albedo, phase function and phase matrix, are given as well. He outlined traditional and novel methods to probe cirrus using airborne and satellite measurements.

Hironobu Iwabuchi addresses an important question of 3D radiative transfer in satellite cloud remote sensing. Up-to-date cloud remote sensing operational satellite remote sensing techniques are based on the model of a homogeneous cloud layer, which is never the case in reality. Clouds are inhomogeneous on all scales. Therefore, it is of importance to quantify errors, which are due to the use of 1D theory in retrievals. More importantly, new techniques must be developed, which account for 3D effects in retrieval procedures and also use 3D effects (e.g., shadows, cloud brightening and darkening) for the development of new aerosol/cloud remote sensing techniques. The paper of Hironobu Iwabuchi is an important step in this direction.

Aleksey Malinka reviews the physical principles and ideas behind Raman lidar remote sensing of clouds and other geophysical media. The scattered light frequency can shift to the value, equal to an eigenfrequency of a scattering substance molecule. This allows the establishing of the presence of substances whose eigenfrequencies correspond to lines in the measured spectrum. The review is focused on techniques to account for Raman multiple light scattering in inverse problems of light scattering media optics. The described approximate analytical theory has an important advantage in terms of speed of calculations and no doubt will be used in future for a number of applications in different branches of light scattering media optics. In particular, a solution which explicitly relates the Raman lidar return to the medium local optical characteristics and the lidar parameters is derived. This is of importance for the solution of inverse problems.

Otto Hasekamp and Jochen Landgraf consider the application of the forward-adjoint perturbation theory for the solution of selected inverse problems of atmospheric optics taking account of the polarization of scattered light. In particular, the authors perform an analytical linearization of the vector radiative transfer equation with respect to atmospheric scattering parameters. Based on the developed approach, the authors describe a very effective approach to retrieve microphysical aerosol characteristics from spectral measurements of multiply scattered light intensity and polarization. The proposed theoretical technique has a potential for applications beyond the area of atmospheric research (e.g., in ocean and tissue optics).

Vladimir Rozanov and his co-authors demonstrate the role of derivatives of scattered light intensity in the formulation and solution of inverse problems. In particular, a relationship between the partial and variational derivatives of the intensity of radiation with respect to atmospheric parameters and the weighting functions is described. The basic equations for the direct and adjoint radiative transfer are reviewed. The solutions of these equations are used for the calculation of the weighting functions needed for the determination of atmospheric parameters from backscattered solar light measurements.

The last part of the book is aimed to the description of advanced numerical techniques of light scattering media optics. In particular, Thomas Wriedt describes the null-field method with discrete sources widely used for the calculation of scattering and absorption characteristics of scatterers having nonspherical shapes (spheroids, fibres, disks, Cassini ovals, hexagonal prisms, clusters of spheres, etc.). The method was originally developed to solve the stability problems in the standard T-matrix technique for the case of elongated and flat scatterers.

Olga Nikolaeva and co-workers review numerical grid schemes of the 3D radiative transfer equation solution. In particular, RADUGA code designed for multiprocessor computations is described. The code can be used to study light scattering and transport in finite light scattering objects of complicated shapes such as broken clouds and aerosol plumes.

This volume of Light Scattering Reviews is dedicated to the memory of Yoram Kaufman (01.06.1948–31.05.2006) and Kirill Ya. Kondratyev (14.06.1920–01.05. 2006), who made extremely valuable contributions to modern atmospheric research.

Bremen, Germany
October, 2006

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