Michael I. Mishchenko

NASA Goddard Institute for Space Studies
2880 Broadway, New York, NY 10025, USA
Tel: (212) 678 5590; Fax: (212) 678 5552
michael.i.mishchenko@nasa.gov
http://www.giss.nasa.gov/staff/mmishchenko/mishchenko.html

Research interests

Atmospheric radiation and remote sensing • Polarimetry • Electromagnetic scattering by morphologically complex particles and particle groups • Aerosols and clouds • Ocean optics • Optical particle characterization • Physics of climate

Education

- PhD with honors (Physics), Ukrainian National Academy of Sciences, Kyiv, 1987
- MS (Physics), Moscow Institute of Physics and Technology, 1983

Professional employment

1997–present	Senior Scientist, NASA Goddard Institute for Space Studies, New York
1996–2001	Associate Adjunct Professor, SUNY/Stony Brook
1996–1997	Senior Research Scientist, SUNY/Stony Brook
1992–1996	Senior Scientist, STX/SSAI @ NASA Goddard Institute for Space Studies, New York
1987–1992	Senior Scientist, Ukrainian National Academy of Sciences, Kiev, Ukraine

Projects

- Project Scientist for the NASA Glory Satellite Mission (2003–2011) (http://glory.giss.nasa.gov). Responsibilities included the following:
  - scientific justification of the mission, formulation of measurement requirements, justification of the instrument design, and programmatic publications;
  - working with and reporting to NASA HQ on all aspects of the Mission;
  - participation in numerous technical and scientific reviews of the Mission;
  - management of the Glory Science Team and its budget;
  - organization of Glory Science Team meetings;
  - representation of the Mission at conferences and working with media;
  - managing the Glory Reflight Review requested by NASA HQ and editing its final report.
- Project Manager for the NASA/GEWEX Global Aerosol Climatology Project (1998–2002). For four years this program coordinated efforts of 33 research groups worldwide to improve the knowledge of aerosol properties related to aerosol direct and indirect effects on climate. Among the products of this program were three Science Team meetings and a 540-page special issue of the *Journal of the Atmospheric Sciences* edited by M. Mishchenko, J. Penner and D. Anderson (http://gacp.giss.nasa.gov).
- Principal Investigator and Co-Investigator on numerous NASA, DOE, DOD, and NPOESS research projects

Editorial Activities

- **Editor** of **3** monographs
- **Guest Editor** of **19** special journal issues (1999–2020)
- **Editor-in-Chief**, *Physics Open* (2019–present)

- **Editor-in-Chief**, *Journal of Quantitative Spectroscopy and Radiative Transfer* (2006–present)
- Editorial Board Member, *Space Science and Technology* (2019–present)
- Editorial Advisory Board Member, *Springer Series of Monographs in Light Scattering* (2017–present)
- Advisory Board Member, *Physics Procedia* (2013–2017)
- **Topical Editor** on scattering theory and meteorological optics, *Applied Optics* (2000–2006)
- Editorial Board Member, *Advances in Astronomy and Space Physics* (2012–present)
- Editorial Board Member, *Waves in Random and Complex Media* (2004–present)
- Editorial Board Member, *Kinematics and Physics of Celestial Bodies* (2003–present)
- Associate Editor, *Journal of the Atmospheric Sciences* (1999–2004)
- Associate Editor, *Journal of Quantitative Spectroscopy and Radiative Transfer* (1995–2005)
- Editorial Board Member, *Journal of Electromagnetic Waves and Applications* (1991–1992)

Other professional activities

- Co-Convener, 2nd International Workshop on Advancement of Polarimetric Observations: Calibration and Improved Aerosol and Cloud Retrievals (Lille, November 2019)
- Co-Convener, 18th Conference on Electromagnetic & Light Scattering (Zhejiang University, Hangzhou city, Zhejiang province, China, 2019)
- Co-Convener, 17th Conference on Electromagnetic & Light Scattering (College Station, TX, March 2018)
- Co-Convener, 1st International Workshop on Advancement of Polarimetric Observations: Calibration and Improved Aerosol Retrievals (Hefei, China, October 2017)
- Co-Convener, 16th Conference on Electromagnetic & Light Scattering (College Park, MD, March 2017)
- Co-Convener, 15th Conference on Electromagnetic & Light Scattering: Celebrating 150 Years of Maxwell's Electromagnetics (Leipzig, Germany, June 2015)
- Director, NATO Advanced Study Institute on "Special Detection Technique (Polarimetry) and Remote Sensing" (Kiev, Ukraine, September 2010)
- Member, American Geophysical Union Fellows Committee, Atmospheric Sciences Section (2007–2012)
- Convener, 10th Conference on Electromagnetic & Light Scattering (Bodrum, Turkey, June 2007)
- Co-organizer, NATO Advanced Study Institute on "Photopolarimetry in Remote Sensing" (Yalta, Crimea, September 2003)
- Convener, International Conference on "Light Scattering by Nonspherical Particles" sponsored by AMS, AGU, and OSA (New York, September 1998)
- Organizer and chair of >20 conference sessions
- Member of NASA formulation study teams for the ACE and CLARREO Decadal Survey missions
- Member of NASA (1998, 2004, 2005, 2007, 2010, 2013, 2014, 2016 (twice), 2017 (twice)), NSF/NOAA (2000), NPOESS (2002–06), and DOE (2014, 2015) review panels
- Supervisor of 4 PhD students and 7 postdocs

Professional honors and awards

- François Arago Award in Polarimetric Remote Sensing (2019)
- NASA Performance Award (2019)
- NASA Performance Award (2018)
- NASA Twenty Year Service Award (2017)
- NASA Performance Award (2017)
- NASA Performance Award (2016)
- NASA Performance Award (2015)
- NASA Performance Award (2014)
- Hendrik C. Van de Hulst Award from Elsevier (2013)
- NASA GSFC Performance Award (2013)

- NASA Exceptional Scientific Achievement Medal (2012)
- NASA GSFC Special Act Award (2012)
- NASA Fifteen Year Service Award (2012)
- NASA Group Achievement Award (CLARREO Mission Concept Team, 2012)
- NASA GSFC Special Act Award (2011)
- NASA Group Achievement Award (Glory Mission, 2011)
- NASA Group Achievement Award (Earth Science Constellation Red Team, 2011)
- National Prize of Ukraine in Science and Technology (2010)
- Basic Sciences Book Award of the International Academy of Astronautics (2010)
- *JQSRT* Milestone Paper Award from Elsevier (2010)
- NASA Quality Increase Award (2010)
- NASA Special Act Award (2010)
- Asteroid 22686 (1998 QL_{53}) named "Mishchenko" by the International Astronomical Union (2009)
- NASA Exceptional Scientific Achievement Medal (2008)
- Honorary Doctoral Degree, National Academy of Sciences of Ukraine (2008)
- NASA Quality Increase Award (2008)
- NASA Ten Year Service Award (2007)
- NASA Performance Award (2007)
- NASA GSFC Special Act Award (2007)
- Arthur S. Flemming Award, George Washington University (2006)
- Elected Fellow of the American Meteorological Society (2006)
- NASA GSFC Special Act Award (2006)
- Elected Fellow of The Institute of Physics, UK (2004)
- NASA GSFC Special Act Award (2004)
- Elected Fellow of the American Geophysical Union (2003)
- Elected Fellow of the Optical Society of America (2003)
- NASA Quality Increase Award (2003)
- NASA Group Achievement Award (CRYSTAL-FACE Project, 2002)
- NASA GISS Peer Award (2001)
- NASA GSFC Special Act Award (2001)
- NASA GSFC Job Performance Award (2000)
- Henry G. Houghton Award of the American Meteorological Society (1999)
- Elected Fellow of the Ukrainian Academy of Arts and Sciences in New York (1997)
- NASA GSFC Job Performance Award (1997)
- *Letter of Commendation* from the Editor of *Icarus* (1996)
- N. P. Barabashov Astronomy Award of the Ukrainian National Academy of Sciences (1993)

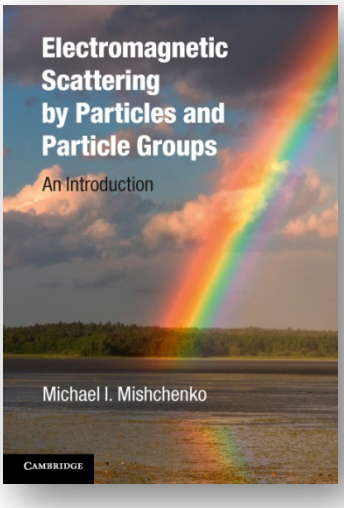
Peer-reviewed publications and citations

- **4** first-authored monographs
- **3** edited monographs
- **23** peer-reviewed book chapters (**13** first-authored)
- **311** peer-reviewed journal papers (**158** first-authored)
- Google Scholar *h*-index = **81** (see http://scholar.google.com/citations?user=Q5-7dVYAAAAJ&hl=en)
- First-author Google Scholar *h*-index = **59**
- **29 500** Google Scholar citations in **927** different journals
- **17 800** Google Scholar citations of first-authored publications

Michael I. Mishchenko

Peer-Reviewed Publications

Authored Books


Electromagnetic Scattering by Particles and Particle Groups
An Introduction
Michael I. Mishchenko
CAMBRIDGE

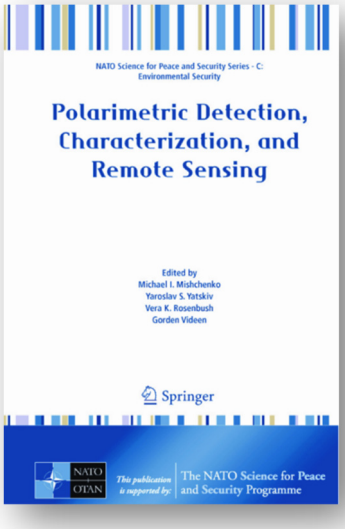
[1] **Mishchenko, M. I.**, 2014: *Electromagnetic Scattering by Particles and Particle Groups: An Introduction*, Cambridge University Press, Cambridge, UK. (Cited **181** times)*

[2] **Mishchenko, M. I.**, V. K. Rosenbush, N. N. Kiselev, D. F. Lupishko, V. P. Tishkovets, V. G. Kaydash, I. N. Belskaya, Y. S. Efimov, and N. M. Shakhovskoy, 2010: *Polarimetric Remote Sensing of Solar System Objects*, Akademperiodyka, Kyiv. (Available at http://arxiv.org/abs/1010.1171) (Cited **85** times)

[3] **Mishchenko, M. I.**, L. D. Travis, and A. A. Lacis, 2006: *Multiple Scattering of Light by Particles: Radiative Transfer and Coherent Backscattering*, Cambridge University Press, Cambridge, UK. (Cited **665** times)

[4] **Mishchenko, M. I.**, L. D. Travis, and A. A. Lacis, 2002: *Scattering, Absorption, and Emission of Light by Small Particles*, Cambridge University Press, Cambridge, UK. **Revised Chinese edition: National Defense Industry Press, Beijing, 2013.** (Cited **2353** times)

Edited Books


NATO Science for Peace and Security Series - C: Environmental Security
Polarimetric Detection, Characterization, and Remote Sensing
Edited by
Michael I. Mishchenko
Yaroslav S. Yatskiv
Vera K. Rosenbush
Gorden Videen
Springer
NATO OTAN
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[1] **Mishchenko, M. I.**, Ya. S. Yatskiv, V. K. Rosenbush, and G. Videen (Eds.), 2011: *Polarimetric Detection, Characterization, and Remote Sensing*, Springer, Dordrecht, The Netherlands.

[2] Videen, G., Ya. Yatskiv, and M. Mishchenko (Eds.), 2004: *Photopolarimetry in Remote Sensing*, Kluwer Academic Publishers, Dordrecht, The Netherlands.

[3] **Mishchenko, M. I.**, J. W. Hovenier, and L. D. Travis (Eds.), 2000: *Light Scattering by Nonspherical Particles: Theory, Measurements, and Applications*, Academic Press, San Diego. (Cited **1436** times)§

Edited Special Journal Issues

[1] Bi, L., and M. I. Mishchenko (Eds.), 2019–2020: Electromagnetic and light scattering by nonspherical particles XVIII. *J. Quant. Spectrosc. Radiat. Transfer*, virtual special issue.

[2] Dubovik, O., Z. Li, and M. I. Mishchenko (Eds.), 2018–2019: The First International Workshop on "Advancement of POLarimetric Observations: calibration and improved aerosol retrievals" (APOLO-2017). *J. Quant. Spectrosc. Radiat. Transfer*, virtual special issue.

[3] Yang, P., P. Stegmann, and M. I. Mishchenko (Eds.), 2018–2019: Electromagnetic and light scattering by nonspherical particles XVII. *J. Quant. Spectrosc. Radiat. Transfer*, virtual special issue.

[4] Berg, M. J., J. D. Eversole, L. Kolokolova, M. I. Mishchenko, and G. Videen (Eds.), 2017–2018: Electromagnetic and Light Scattering by Nonspherical Particles XVI. *J. Quant. Spectrosc. Radiat. Transfer*, virtual special issue.

[5] Kholtygin, A. F., M. I. Mishchenko, and D. I. Nagirner (Eds.), 2016: Viktor Sobolev and His Scientific

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* According to Google Scholar.

§ This number does not include citations of the individual chapters.

Legacy. *J. Quant. Spectrosc. Radiat. Transfer* **183**, 1–167.

[6] Macke, A., and M. I. Mishchenko (Eds.), 2016: Electromagnetic and Light Scattering by Nonspherical Particles XV: Celebrating 150 Years of Maxwell's Electromagnetics. *J. Quant. Spectrosc. Radiat. Transfer* **178**, 1–431.

[7] Videen, G., W. Sun, M. Kocifaj, K. Kai, K. Kawamoto, H. Horvath, and M. Mishchenko (Eds.), 2015: Topical Issue on Optical Particle Characterization and Remote Sensing of the Atmosphere: Part II. *J. Quant. Spectrosc. Radiat. Transfer* **153**, 1–143.

[8] Videen, G., M. Kocifaj, W. Sun, K. Kai, K. Kawamoto, H. Horvath, and M. Mishchenko (Eds.), 2015: Topical Issue on Optical Particle Characterization and Remote Sensing of the Atmosphere: Part I. *J. Quant. Spectrosc. Radiat. Transfer* **150**, 1–180.

[9] Dubovik, O., L. Labonnote, P. Litvinov, F. Parol, and M. I. Mishchenko (Eds.), 2014: Electromagnetic and Light Scattering by Nonspherical particles XIV. *J. Quant. Spectrosc. Radiat. Transfer* **146**, 1–548.

[10] **Mishchenko, M. I.**, M. Kahnert, D. W. Mackowski, and T. Wriedt (Eds.), 2013: Peter C. Waterman and His Scientific Legacy. *J. Quant. Spectrosc. Radiat. Transfer* **123**, 1–218.

[11] **Mishchenko, M. I.**, G. Videen, V. K. Rosenbush, and Ya. S. Yatskiv (Eds.), 2011: Polarimetric Detection, Characterization, and Remote Sensing. *J. Quant. Spectrosc. Radiat. Transfer* **112**, 2041–2247.

[12] **Mishchenko, M. I.**, L. S. Rothman, M. P. Mengüç, and J. Stoop (Eds.), 2010: 50 Years of JQSRT. *J. Quant. Spectrosc. Radiat. Transfer* **111**, 1455–1876.

[13] **Mishchenko, M. I.**, G. Videen and M. P. Mengüç (Eds.), 2008: X Conference on Electromagnetic and Light Scattering by Non-Spherical particles. *J. Quant. Spectrosc. Radiat. Transfer* **109**, 1335–1548.

[14] Stam, D., and M. I. Mishchenko (Eds.), 2006: Light in Planetary Atmospheres and Other Particulate Media: A Tribute to Professor Joop W. Hovenier. *J. Quant. Spectrosc. Radiat. Transfer* **101**, 381–556.

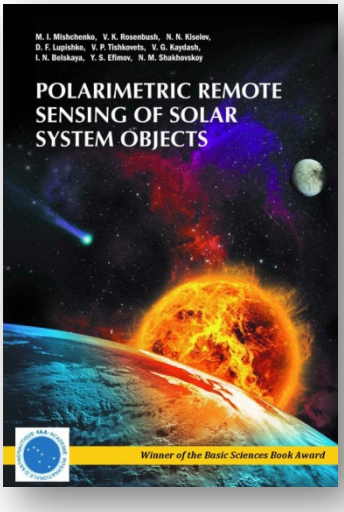
[15] Videen, G., Ya. S. Yatskiv, and M. I. Mishchenko (Eds.), 2004: Photopolarimetry in Remote Sensing. *J. Quant. Spectrosc. Radiat. Transfer* **88**, 1–406.

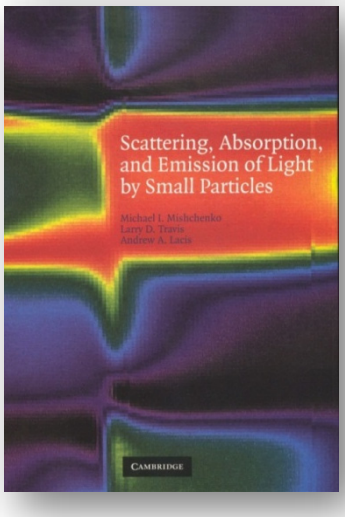
[16] Kolokolova, L., B. Å. S. Gustafson, M. I. Mishchenko, and G. Videen (Eds.), 2003: Electromagnetic and Light Scattering by Nonspherical Particles 2002. *J. Quant. Spectrosc. Radiat. Transfer* **79/80**, 491–1198.

[17] **Mishchenko, M.**, J. Penner, and D. Anderson (Eds.), 2002: Global Aerosol Climatology Project. *J. Atmos. Sci.* **59**, 249–783.

[18] **Mishchenko, M. I.**, L. D. Travis, and J. W. Hovenier (Eds.), 1999: Light Scattering by Nonspherical Particles '98. *J. Quant. Spectrosc. Radiat. Transfer* **63**, 127–737.

[19] **Mishchenko, M. I.**, L. D. Travis, and J. W. Hovenier (Eds.), 1999: Electromagnetic Scattering by Nonspherical Particles. *J. Geophys. Res.* **104**, 31,671–31,808.





Peer-Reviewed Book Chapters

[1] **Mishchenko, M. I.**, 2015: Measurement and modeling of electromagnetic scattering by particles and particle groups. In *Polarimetry of Stars and Planetary Systems* (L. Kolokolova, J. Hough, and A.-C. Levasseur-Regourd, Eds.), Cambridge University Press, Cambridge, pp. 13–34.

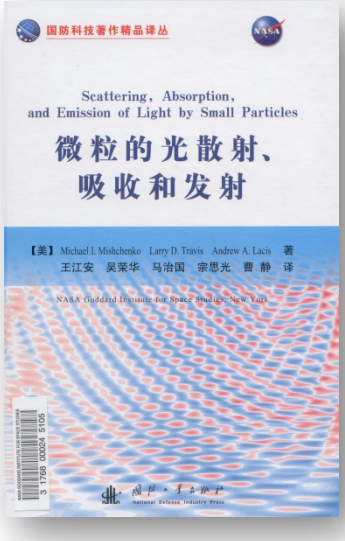
[2] **Mishchenko, M.**, L. Travis, and A. Lacis, 2015: Scattering. In *Encyclopedia of Atmospheric Sciences, Vol. 5* (G. R. North, Ed.), Elsevier, Amsterdam, pp. 27–36.

[3] **Mishchenko, M. I.**, 2013: 125 years of radiative transfer: enduring triumphs and persisting misconceptions. In *Radiation Processes in the Atmosphere and Ocean (IRS2012)* (R. F. Cahalan and J. Fischer, Eds.), AIP Publishing, Melville, NY, pp. 11–18.

[4] Lenoble, J., M. I. Mishchenko, and M. Herman, 2013: Absorption and scattering by molecules and particles. In *Aerosol Remote Sensing* (J. Lenoble *et al*., Eds.), Springer, Berlin, pp. 13–51. (Cited **62** times)

[5] Kiselev, N. N., and M. I. Mishchenko, 2011: Astrophysical polarimetry in Ukraine. In *Polarimetric Detection, Characterization, and Remote Sensing* (M. I. Mishchenko, Ya. S. Yatskiv, V. K. Rosenbush, and G. Videen, Eds.), Springer, Dordrecht, The Netherlands, pp. 233–260.

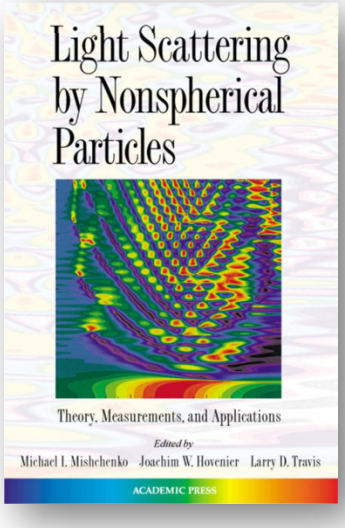
[6] Litvinov, P., O. Hasekamp, B. Cairns, and M. Mishchenko, 2011: Semi-empirical BRDF and BPDF models applied to the problem of aerosol retrievals over land: testing on airborne data and implications for modeling of top-of-atmosphere measurements. In *Polarimetric Detection, Characterization, and Remote Sensing* (M. I. Mishchenko, Ya. S. Yatskiv, V. K. Rosenbush, and G. Videen, Eds.), Springer, Dordrecht, The Netherlands, pp. 313–340.



[7] Rosenbush, V. K., and M. I. Mishchenko, 2011: Opposition planetary phenomena in planetary astrophysics: observational results. In *Polarimetric Detection, Characterization, and Remote Sensing* (M. I. Mishchenko, Ya. S. Yatskiv, V. K. Rosenbush, and G. Videen, Eds.), Springer, Dordrecht, The Netherlands, pp. 409–436.

[8] **Mishchenko, M. I.**, 2007: Radiative transfer: a new look of the old theory. In *Radiative Transfer–V* (M. P. Mengüç and N. Selçuk, Eds.), Begell House, New York, pp. 1–30.

[9] Battaglia, A., C. Simmer, S. Crewell, H. Czekala, C. Emde, F. Marzano, M. I. Mishchenko, J. R. Pardo, and C. Prigent, 2006: Emission and scattering by clouds and precipitation. In *Thermal Microwave Radiation: Applications for Remote Sensing* (C. Mätzler, Ed.), IET Press, London, pp. 101–223.



[10] Tishkovets, V., P. Litvinov, E. Petrova, K. Jockers, and M. Mishchenko, 2004: Backscattering effects for discrete random media. In *Photopolarimetry in Remote Sensing* (G. Videen, Ya. Yatskiv, and M. Mishchenko, Eds.), Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 221–242.

[11] **Mishchenko, M. I.**, and L. D. Travis, 2004: Maxwell's equations, electromagnetic waves, and Stokes parameters. In *Photopolarimetry in Remote Sensing* (G. Videen, Ya. Yatskiv, and M. Mishchenko, Eds.), Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 1–44.

[12] **Mishchenko, M. I.**, 2003: Radiative transfer theory: from Maxwell's equations to practical applications. In *Wave Scattering in Complex Media: From Theory to Applications* (B. A. van Tiggelen and S. E. Skipetrov, Eds.), Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 367–414.

[13] **Mishchenko, M. I.**, and L. D. Travis, 2003: Electromagnetic scattering by nonspherical particles. In *Exploring the Atmosphere by Remote Sensing Techniques* (R. Guzzi, Ed.), Springer-Verlag, Berlin, pp. 77–127.

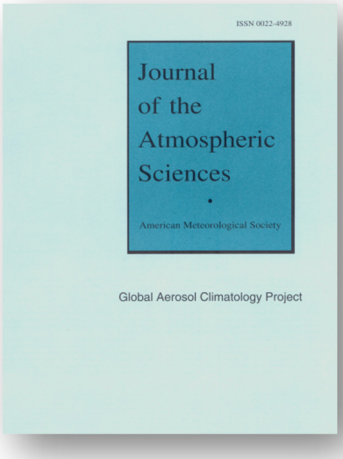
[14] **Mishchenko, M. I.**, L. D. Travis, and A. A. Lacis, 2003: Radiative transfer: scattering. In *Encyclopedia of Atmospheric Sciences* (J. R. Holton, J. Pyle, and J. A. Curry, Eds.), Academic Press, San Diego, pp. 1882–1891.

[15] **Mishchenko, M.**, V. Tishkovets, and P. Litvinov, 2002: Exact results of the vector theory of coherent backscattering from discrete random media: an overview. In *Optics of Cosmic Dust* (G. Videen and M. Kocifaj, Eds.), Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 239–260.

[16] Rosenbush, V., N. Kiselev, V. Avramchuk, and M. Mishchenko, 2002: Photometric and polarimetric phenomena exhibited by solar system bodies. In *Optics of Cosmic Dust* (G. Videen and M. Kocifaj, Eds.), Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 191–224. (Cited **66** times)

[17] Kinne, S., …, M. Mishchenko, …, and A. Higurashi, 2001: How well do aerosol retrievals from satellites and representation in global circulation models match ground-based AERONET aerosol statistics? In *Remote Sensing and Climate Modeling: Synergies and Limitations* (M. Beniston and M. M. Verstraete, Eds.), Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 103–158.

[18] Penner, J. E., *et al*., 2001: Aerosols, their direct and indirect effects. In *Climate Change 2001: The Scientific Basis* (J. T. Houghton *et al*., Eds.), Cambridge University Press, Cambridge, pp. 289–348. (Cited **590** times)



[19] **Mishchenko, M. I.**, and L. D. Travis, 2000: Polarization and depolarization of light. In *Light Scattering from Microstructures* (F. Moreno and F. Gonzalez, Eds.), Springer-Verlag, Berlin, pp. 159–175.

[20] **Mishchenko, M. I.**, J. W. Hovenier, and L. D. Travis, 2000: Concepts, terms, notation. In *Light Scattering by Nonspherical Particles: Theory, Measurements, and Applications* (M. I. Mishchenko, L. D. Travis, and J. W. Hovenier, Eds.), Academic Press, San Diego, pp. 3–27.

[21] **Mishchenko, M. I.**, W. J. Wiscombe, J. W. Hovenier, and L. D. Travis, 2000: Overview of scattering by nonspherical particles. In *Light Scattering by Nonspherical Particles: Theory, Measurements, and Applications* (M. I. Mishchenko, L. D. Travis, and J. W. Hovenier, Eds.), Academic Press, San Diego, pp. 29–60. (Cited **84** times)

[22] **Mishchenko, M. I.**, L. D. Travis, and A. Macke, 2000: *T*-matrix method and its applications. In *Light Scattering by Nonspherical Particles: Theory, Measurements, and Applications* (M. I. Mishchenko, L. D. Travis, and J. W. Hovenier, Eds.), Academic Press, San Diego, pp. 147–172. (Cited **76** times)

[23] Lacis, A. A., and M. I. Mishchenko, 1995: Climate forcing, climate sensitivity, and climate response: a radiative modeling perspective on atmospheric aerosols, in *Aerosol Forcing of Climate* (R. Charlson and J. Heintzenberg, Eds.), Wiley, New York, pp. 11–42. (Cited **241** times)

Peer-Reviewed Journal Papers

2020

[1] **Mishchenko, M. I.**, 2020: Comprehensive thematic *T*-matrix reference database: a 2017–2019 update. *J. Quant. Spectrosc. Radiat. Transfer*, in press.

2019

[2] **Mishchenko, M. I.**, M. A. Yurkin, and B. Cairns, 2019: Scattering of a damped inhomogeneous plane wave by a particle in a weakly absorbing medium. *OSA Continuum* **2**, 2362–2368.

[3] L. Liu and M. I. Mishchenko, 2019: A modeling study of scattering and absorption properties of tar-ball aggregates. *Appl. Opt*. **58**, in press.

[4] **Mishchenko, M. I.**, and J. M. Dlugach, 2019: Multiple scattering of polarized light by particles in an absorbing medium. *Appl. Opt.* **58**, 4871–4877.

[5] **Mishchenko, M. I.**, J. M. Dlugach, A. A. Lacis, L. D. Travis, and B. Cairns, 2019: Retrieval of volcanic and man-made stratospheric aerosols from orbital polarimetric measurements. *Opt. Express* **27**, A158–A170.

[6] Yang, P., J. Ding, R. L. Panetta, K.-N. Liou, G. W. Kattawar, and M. Mishchenko, 2019: On the convergence of numerical computations for both exact and approximate solutions for electromagnetic scattering by nonspherical dielectric particles. *Prog. Electromagn. Res.* **164**, 27–61.

[7] Doicu, A., and M. I. Mishchenko, 2019: Electromagnetic scattering by discrete random media. IV: Coherent backscattering. *J. Quant. Spectrosc. Radiat. Transfer* 236, 106565.

[8] Doicu, A., and M. I. Mishchenko, 2019: Electromagnetic scattering by discrete random media. III: The vector radiative transfer equation. *J. Quant. Spectrosc. Radiat. Transfer* **236**, 106564.

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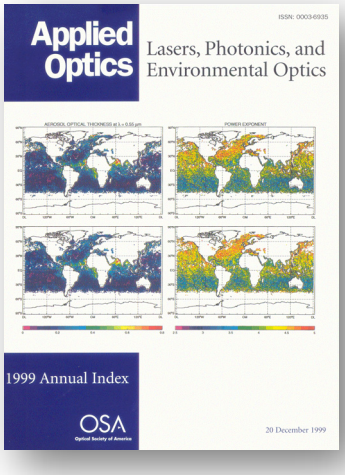

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