

A Decadal Strategy for Solar and Space Physics (Heliophysics)

Committee

Daniel N. Baker

Chair

DANIEL N. BAKER (NAE) is director of the Laboratory for Atmospheric and Space Physics at the University of Colorado, Boulder, where he also holds appointments as professor of astrophysical and planetary sciences and as a professor of physics. His primary research interest is the study of plasma physical and energetic particle phenomena in planetary magnetospheres and in the Earth's vicinity. He conducts research in space instrument design, space physics data analysis, and magnetospheric modeling. He currently is an investigator on several NASA space missions including the MESSENGER mission to Mercury, the Magnetospheric MultiScale mission, the Radiation Belt Storm Probes mission, and the Canadian ORBITALS mission.

Dr. Baker has published more than 700 papers in the refereed literature and has edited six books on topics in space physics. In 2010, Dr. Baker was elected to the NAE for leadership in studies, measurements, and predictive tools for the Earth's radiation environment and its impact on U.S. security. He is a fellow of the American Geophysical Union (AGU), the International Academy of Astronautics, and the American Association for the Advancement of Science. Among his other awards are the 2007 University of Colorado's Robert L. Stearns Award for outstanding research, service, and teaching; the 2010 American Institute of Aeronautics and Astronautics' James A. Van Allen Space Environments Award for excellence and leadership in space research; and his selection in 2004 as a National Associate of the NAS (2004). Dr. Baker served as president of the Space Physics and Aeronomy section of the AGU (2002-2004) and he presently serves on advisory panels of the U.S. Air Force and the National Science Foundation.

Dr. Baker is a National Associate of the National Research Council. He served as chair of the NRC Committee on Solar and Space Physics and the co-chair of the NRC Committee on Assessment of Interagency Cooperation on Space and Earth Science Missions. He is also a member of the Space Studies Board. He was a member of the steering committee for the NRC's 2003 decadal survey in solar and space physics and was a member of the 2006 Decadal Review of the U.S. National Space Weather Program and the 2006 Committee on an Assessment of Balance in NASA's Science Programs. He earned his Ph.D. in physics from the University of Iowa.

Steven J. Battel

Member

STEVEN J. BATTEL is president of Battel Engineering, providing engineering, development, and review services to NASA, the DOD, and university and industrial clients. Mr. Battel was a member of the Hubble Space Telescope External Readiness Review Team for SM-2, SM3A and SM3B, the AXAF/Chandra Independent Assessment Team, the TDRS-H/I/J Independent Review Team, the Mars Polar Lander Failure Review Board and the Jet Propulsion Laboratory Genesis Failure Review Board. Prior to becoming president of Battel Engineering, he worked as an engineer, researcher, and manager at the University of Michigan, the Lockheed Palo Alto Research Laboratory, The University of California, Berkeley, and the University of Arizona Lunar and Planetary Laboratory. His areas of specialization include program management, systems engineering, advanced technology development, spacecraft avionics, power systems, high voltage systems, precision electronics, and scientific instrument design. Mr. Battel is a graduate of the University of Michigan. He has served on the NRC Committee on NASA Astrophysics Performance Assessment, and the Committee on Assessment of Options for Extending the Life of the Hubble Space Telescope. He is a member of the Space Studies Board and also currently serves on the Committee on Decadal Survey on Astronomy and Astrophysics 2010 and on the Space Studies Board standing Committee on Earth Studies.

J. T. Hoeksema

Member

J. TODD HOEKSEMA is a senior research scientist in the W.W. Hansen Experimental Physics Laboratory at Stanford University. His professional experience includes research administration, system and scientific programming, and the design, construction, and operation of instruments to measure solar magnetic and velocity fields from both ground and space. He is co-investigator and magnetic team lead for the Helioseismic and Magnetic Imager on NASA's Solar Dynamics Observatory and the instrument scientist for the Michelson Doppler Imager instrument on the Solar and Heliospheric Observatory that was launched by NASA and the European Space Agency. He has been associated with the Wilcox Solar Observatory at Stanford for three sunspot cycles. His primary scientific interests include the physics of the Sun and the interplanetary medium, solar-terrestrial relations, the large-scale solar and coronal magnetic fields, solar velocity fields and rotation, helioseismology, and education and public outreach. Dr. Hoeksema was chair of the Solar Physics Division of the American Astronomical Society, and has served on the heliophysics subcommittee of the NASA Advisory Council Science Committee. He has served for 4 years as a solar physics discipline scientist at NASA. Dr. Hoeksema led NASA's Heliophysics Roadmap team in 2005. He has been awarded the NASA distinguished public service medal and is a member of the AAS, American Geophysical Union (AGU), International Astronomical Union, American Scientific Affiliation, and American Association for the Advancement of Science. In addition, for several years Dr. Hoeksema was the vice-chair of Commission E.2 of the Committee on Space Research. He earned his Ph.D. in applied physics from Stanford University. He recently served on the NRC's Astro2010 Panel on Optical and Infrared Astronomy from the Ground.

Thomas J. Immel

Member

THOMAS J. IMMEL is an associate research physicist and senior fellow at the Space Sciences Laboratory at the University of California, Berkeley. His expertise lies in interpretation of remote-sensing data and modeling of physical processes in the upper atmosphere and ionosphere. Dr. Immel's work has included ultraviolet imaging observations from four NASA missions: Dynamics Explorer, Polar, Imager for Magnetopause-to-Aurora Global Exploration (IMAGE), and Thermosphere, Ionosphere Mesosphere Energetics and Dynamics (TIMED). He served on the NASA Heliophysics 2009 Roadmap Team, and is currently serving on the NSF-CEDAR Science Steering Committee and the NASA Geospace Mission Operations Working Group. Dr. Immel received his Ph.D. in Physics from the University of Alaska Fairbanks.

Brian J. Anderson

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BRIAN J. ANDERSON is a physicist at the Johns Hopkins University Applied Physics Laboratory. Dr. Anderson has management experience with a number of missions, including serving as instrument scientist for NEAR Magnetometer, instrument scientist for MESSENGER Magnetometer, MESSENGER advance science planning lead/deputy project scientist, and SRP magnetic fields section supervisor. He has extensive experience in space magnetometry, spacecraft magnetics, and basic space plasma physics with concentrations in pulsations, currents, wave-particle interactions and geomagnetic storms. Dr. Anderson has conducted data analysis of AMPTE/CCE magnetic field data and data validation and was the archiving, and data processing and analysis lead for UARS magnetic field data. Dr. Anderson holds a Ph.D. in physics from the University of Minnesota. Previously he has served on the NRC's Panel on Solar Wind-Magnetospheric Interactions.

James F. Drake, Jr.

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JAMES F. DRAKE, JR. is a professor of Physics at the University of Maryland, College Park. After completing his doctorate, Dr. Drake received a position as a post-doctoral scholar at the University of California, Los Angeles and then moved to the University of Maryland first as a post-doctoral scholar and then as a member of the teaching faculty in the Department of Physics and the Institute for Physical Science and Technology. Dr. Drake has worked on a very broad range of topics in the general area of theoretical plasma physics using both analytical and numerical techniques. His work has applications spanning a variety of physical systems, including the solar corona, the earth's magnetosphere and ionosphere, magnetically confined plasma, and the interaction of intense lasers with plasma. His present focus is on magnetic reconnection with space physics applications and turbulence and transport with applications to the magnetic fusion program. In recognition for his contributions to the field of plasma physics, he was granted fellowship status in the American Physical Society and was awarded a Humboldt Senior Scientist Research Award. He received his Ph.D. in theoretical physics from the University of California, Los Angeles. Dr. Drake is currently a member of the Board on Physics and Astronomy, and has served on numerous NRC studies, including the Panel on Theory, Computation, and Data Exploration from the 2003 Decadal Survey on Solar and Space Physics. Dr. Drake is also a National Associate of the National Academies.

Lennard A. Fisk

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LENNARD FISK (NAS) is the Thomas M. Donahue distinguished university professor of space science in the department of Atmospheric, Oceanic, and Space Sciences at the University of Michigan. Dr. Fisk was previously the associate administrator for Space Science and Applications and chief scientist at NASA. He has served as professor of physics and vice president for research and financial affairs at the University of New Hampshire. He is a member of the board of directors of the Orbital Sciences Corporation and co-founder of the Michigan Aerospace Corporation. He is an active researcher in both theoretical and experimental studies of the solar atmosphere and its expansion into space to form the heliosphere. Dr. Fisk received his Ph.D. in applied physics from the University of California, San Diego. His prior NRC service includes chair of the Space Studies Board and membership on the Committee on Scientific Communication and National Security, the Committee on Fusion Science Assessment, the Committee on International Space Programs, the Air Force Physics Research Committee, and the Committee on Solar and Space Physics.

Sarah Gibson

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SARAH GIBSON is presently a scientist at the High Altitude Observatory (HAO) at the National Center for Atmospheric Research in Boulder, Colorado. Dr. Gibson's jobs prior to her arrival at HAO included a one year visit to Cambridge University in England as a NATO/NSF post-doctoral fellow, and nearly four years at NASA Goddard Space Flight Center--first as an National Research Council (NRC) associate, and then as a research assistant professor at The Catholic University of America. Her primary interest is in the magnetic structure and dynamic evolution of coronal mass ejections (CMEs), and she uses theoretical CME models to explain a wide variety of space and ground-based observations of CMEs from pre-eruption, through initiation and eruption, to their post-eruption state. A particular focus is observations and models of coronal prominence cavities, which represent dynamic equilibrium states that store magnetic energy, and Dr. Gibson leads an ISSI international working group to study coronal cavities. Dr. Gibson is also a leader of the Whole Sun Month and Whole Heliosphere Interval international coordinated observing and modeling efforts to characterize the 3-dimensional, interconnected solar-heliospheric-planetary system. Dr. Gibson was the recipient of the AAS-SPD 2005 Karen Harvey Prize. She is a scientific editor for the Astrophysical Journal and serves on the Heliophysics Subcommittee of the NASA Advisory Council, on the AURA Solar Observatory Council and as a member of the ATST Science Working Group. She has obtained her Ph.D. in astrophysics from the University of Colorado-Boulder. She has served on the NRC's Committee on Solar and Space Physics, the Committee on Distributed Arrays of Small Instruments for Research and Monitoring in Solar-Terrestrial Physics: A Workshop and the Astro2010 Panel on Radio, Millimeter, and Submillimeter from the Ground.

Michael Hesse

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MICHAEL A. HESSE is an astrophysicist and the Director of the Community Coordinated Modeling Center at the Laboratory for Solar and Space Physics at the NASA Goddard Space Flight Center (GSFC). Dr. Hesse has also served as acting branch head for the Geospace Physics Branch and as the project scientist for Theory and Modeling for NASA's Living With a Star Program. Prior to his work at GSFC, Dr. Hesse was a principal scientist at Hughes System Corporation and a postdoc at Los Alamos National Laboratory. His professional interests include research into fundamental physical processes in space plasmas, particularly studies of magnetospheric, solar physical and astrophysical problems. He has been a recipient of a NASA Group Achievement Award for the Community Coordinated Modeling Center and of eleven GSFC performance awards. He was a participant of the NASA Sun-Earth Connection Roadmap. Dr. Hesse earned his Ph.D. in theoretical physics from Ruhr-Universität, Bochum, Germany. Previously, Dr. Hesse has served on the NRC Panel on Solar Wind-Magnetospheric Interactions of the Committee on Solar and Space Physics: A Community Assessment and Strategy for the Future as well as on a transition to operations working group.

Mary K. Hudson

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MARY K. HUDSON is the Eleanor and A. Kelvin Smith Distinguished Professor of Physics and served for eight years as chair of physics and astronomy at Dartmouth College. Hudson has served as one of the principal investigators with the NSF-funded Center for Integrated Space Weather Modeling (CISM), where researchers study the weather patterns that originate from a solar eruption, following the energy and mass transfer through the interplanetary medium, all the way to the earth's ionosphere. Current areas of investigation include the evolution of the radiation belts; how the ionized particle outflow known as the solar wind and the magnetic field of the sun interact with the magnetic field of the earth, producing electrical currents in the ionosphere; and the effects of solar cosmic rays on radio communications near the earth's poles. Dr. Hudson is also funded by NASA's Supporting Research and Technology program, studying related effects of the Earth's space radiation environment which can affect both astronaut safety and satellite systems. Along with her students and postdoctoral research staff, she is modeling sudden changes in relativistic electron fluxes and solar cosmic rays at and inside the 24-hr orbital period of many communication and navigation satellites, and effects of global oscillations of the Earth's magnetic field, associated with changes in solar wind conditions which have their origins at the sun. She has served as chair of the NSF Geospace Environment Modelling program, and is funded for research in that program on geomagnetic 'storms'. Dr. Hudson received her Ph.D. in physics from the University of California, Los Angeles. Dr. Hudson was the chair of the Atmosphere-Ionosphere-Magnetosphere Interactions panel from the NRC's 2003 Decadal Survey in Solar and Space Physics the Committee on Solar and Space Physics and the Plasma Science Committee.

David L. Hysell

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DAVID L. HYSELL is a professor in the Department of Earth and Atmospheric Sciences at Cornell University. As a graduate student there, he worked as a post-doctoral researcher with space plasma physics. He has also worked at Clemson University as an associate professor in the physics department. Dr. Hysell's research interests are in the area of upper atmospheric physics, space plasmas, and radar remote sensing. His research also focuses on theoretical and experimental investigations of space plasmas in the Earth's ionosphere between 80 and 1500 km altitude. Dr. Hysell has designed and built a number of small, portable coherent scatter radars for studying plasma instabilities and irregularities in the Earth's ionosphere at low, middle, and high latitudes. Using radar interferometry and imaging techniques similar to those applied in radio astronomy and medicine, Dr. Hysell uses these radars to observe the growth, propagation, and decay of ionospheric plasma irregularities in three spatial dimensions and in time. He received his Ph.D. in physics from Cornell University. His NRC committee experience includes serving on the U.S. National Committee for the International Union of Radio Science.

Justin Kasper

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JUSTIN KASPER is an astrophysicist in the in the Solar and Stellar X-Ray Group in the High Energy Astrophysics Division of the Harvard-Smithsonian Center for Astrophysics and a lecturer in the Department of Astronomy at Harvard University. He is also a visiting scholar at the Boston University Center for Space Physics. He has worked on the development, construction, and analysis of instrumentation for the in-situ and remote measurement of particles and fields, including space-based plasma probes and particle telescopes such as the Faraday Cups on Wind, and ground based radio telescopes including the Mileura Wide-Field Array Low Frequency Demonstrator (MWA-LFD). Currently, he is leading the design and operation of the Faraday Rotation Subsystem for MWA-LFD and participating in the radio transients, sky survey, and ionospheric calibration efforts. Dr. Kasper studies the flow of energy in astrophysical plasmas, including the solar corona, the solar wind, and planetary magnetospheres. His research focuses on the role of non-thermal velocity distribution functions, plasma micro-instabilities, magnetic reconnection, turbulence, and dissipation in the physical processes of heating, bulk acceleration, collisionless shocks, energetic particle acceleration, and radio emission. He was a member of the US organizing and instrumentation committees for the 2007 International Heliophysical Year and the project scientist for the Cosmic Ray Telescope for the Effects of Radiation (CRaTER), on the Lunar Reconnaissance Orbiter. Dr. Kasper received his Ph.D. in physics from the Massachusetts Institute of Technology.

Judith L. Lean

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JUDITH L. LEAN (NAS) is senior scientist for Sun-Earth System Research in the Space Science Division of the Naval Research Laboratory. After completing her Ph.D. she worked for CIRES at the University of Colorado, Boulder, from 1980 to 1986, joining the US Naval Research Laboratory in 1988. She is the recipient of a number of NASA research grants, in collaboration with other SSD and US scientists, and is currently a co investigator on the SORCE, TIMED/SEE, SDO/EVE and GLORY/TIM space missions. The focus of her research is to understand the Sun's variability using measurements and models, and determining the impact of this variability on the Earth system, including climate change, the ozone layer and space weather. She has published over 100 papers in journals and books, and delivered over 250 presentations documenting her research. A member of the AGU, IAGA, AAS/SPD and AMS, Dr. Lean was elected a Fellow of the American Geophysical Union in 2002 and a member of US National Academy of Sciences in 2003. She has served on a variety of NASA, NSF, NOAA and NRC advisory committees. She has a Ph.D. in atmospheric physics from the University of Adelaide, Australia. Prior NRC service includes serving as Chair of the Working Group on Solar Influences on Global Change and, most recently, and the Committee on a Strategy to Mitigate the Impact of Sensor De-scopes and De-manifests on the NPOESS and GOES-R Spacecraft.

Ramon E. Lopez

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RAMON LOPEZ is a professor of physics at the University of Texas at Arlington. He is the co-director for diversity for the Center for Integrated Space Weather Modeling, a science and technology center funded by NSF. His current research focuses on solar wind-magnetosphere coupling, magnetospheric storms and substorms, and space weather prediction. Dr. Lopez is also active in education research involving student perception and interpretation of images and visualizations. In 2003, he was elected vice chair of the American Physical Society Forum on Education and served as chair in 2005. Dr. Lopez has also served various education-related committees of the American Geophysical Union, and as a member of the board of directors of the Society for Advancement of Chicanos/Latinos and Native Americans in Science. Dr. Lopez is a fellow of the American Physical Society and was awarded the Nicholson Medal for Humanitarian Service. He received his Ph.D. in space physics from Rice University. Dr. Lopez's previous NRC service includes membership on the Committee on Solar and Space Physics, the Committee on Strategic Guidance for NSF's Support of the Atmospheric Sciences, the Committee on Undergraduate Science Education, and the Steering Committee on Criteria and Benchmarks for Increased Learning in Undergraduate Science, Technology, Engineering and Mathematics (STEM).

Howard J. Singer

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HOWARD J. SINGER is chief of the science and infusion branch at the NOAA Space Weather Prediction Center. Previously he served as the chief of the research and development division of the Space Environment Center (SEC) and as the project leader for the current and future NOAA Space Environment Monitor instruments on the GOES spacecraft and the responsible scientist for the GOES spacecraft magnetometers. Prior to joining SEC, Dr. Singer was with the Air Force Geophysics Laboratory where he was the principal experimenter for the fluxgate magnetometer on the joint AF-NASA Combined Release and Radiation Effects satellite (CRRES). Dr. Singer's research is in the area of solar-terrestrial interactions, ultra low frequency waves, geomagnetic disturbances, storms, and substorms. He has received awards from the Air Force, NASA, and NOAA, including the prestigious Department of Commerce Gold Medal for Leadership. He received his Ph.D. in space physics and geophysics from the University of California, Los Angeles. He has served on various NASA, NSF, and NRC committees, including recent service on the NASA Living with a Star Geospace Mission Definition Team. Dr. Singer is currently on the NSF Geospace Environment Modeling Steering Committee and the Editorial Advisory Board of Space Weather: The International Journal of Research and Applications. He served on the NRC Solar and Space Physics Survey Panel on Atmosphere-Ionosphere-Magnetosphere Interactions.

Harlan E. Spence

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HARLAN E. SPENCE is a professor of physics and director of the Institute for the Study of Earth, Oceans and Space at the University of New Hampshire (UNH). Prior to UNH, Dr. Spence was a professor and department chair of the department of astronomy and a member of the Center for Space Physics at Boston University. Dr. Spence has also served as a senior member of the technical staff at The Aerospace Corporation. Dr. Spence's research interests include theoretical and experimental space plasma physics, cosmic rays and radiation belt processes, and physics of the heliosphere, planetary magnetospheres, and the aurora. He has served on multiple NASA and NSF advisory panels including the NASA Living with a Star Management Operations Working Group and the NASA Earth-Sun System Subcommittee. Dr. Spence received his Ph.D. in geophysics and space physics from the University of California-Los Angeles. He previously served on the NRC's Panel on Solar Wind-Magnetospheric Interactions, the Panel on Space Sciences and the Committee on Solar and Space Physics.

Edward C. Stone

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EDWARD C. STONE (NAS) is the David Morrisroe professor of physics at the California Institute of Technology (Caltech) and vice provost for special projects. He is a former director of the Jet Propulsion Laboratory, has served as chair of Caltech's division of physics, Mathematics, and Astronomy, and oversaw the development of the Keck Observatory as vice president for Astronomical Facilities and chairman of the California Association for Research in Astronomy. Since 1972, Dr. Stone has been the project scientist for the Voyager Mission at the Jet Propulsion Laboratory, coordinating the scientific study of Jupiter, Saturn, Uranus, and Neptune and Voyager's continuing exploration of the outer heliosphere and search for the edge of interstellar space. Following his first instrument on a Discoverer satellite in 1961, Dr. Stone has been a principal investigator on nine NASA spacecraft and a co-investigator on five other NASA missions for which he developed instruments for studying galactic cosmic rays, solar energetic particles, and planetary magnetospheres. Dr. Stone is a member of the National Academy of Sciences and the American Philosophical Society, president of the International Academy of Astronautics, and a vice president of COSPAR. Among his awards and honors, Stone received the National Medal of Science from President Bush, the Magellanic Premium from the American Philosophical Society, and Distinguished Service Medals from NASA. In 1996, asteroid (5841) was named after him. Dr. Stone received his Ph.D in physics from the University of Chicago. He is currently serving on the NRC Planning Committee for a Workshop on "Sharing the Adventure with the Public" – Communicating the Value and Excitement of "Grand Questions" in Space Scienc and has also served on the Committee on the Scientific Context for Space Exploration and the Space Studies Board.

Thomas H. Zurbuchen

Vice Chair

THOMAS H. ZURBUCHEN is a professor of space science and engineering in the Department of Atmospheric, Oceanic, and Space Sciences and the associate dean for entrepreneurship in the College of Engineering at the University of Michigan (UM). At UM, Dr. Zurbuchen is leading the Solar and Heliospheric Research Group, which focuses on solar and space physics through novel experiments, data analysis, and theoretical methods. This group has been actively involved in ACE, WIND, Ulyssees, MESSENGER, and Solar Orbiter. Dr. Zurbuchens research interests include instruments that measure the composition of plasmas in the heliosphere, new particle detection technologies suitable for future space missions, theoretical concepts and experimental exploration methods of interaction between the heliosphere and local interstellar medium, and developing and analyzing space mission architectures for various exploration and commercial applications. Dr. Zurbuchen is a recipient of a Presidential Early Career for Scientists and Engineers Award. He served on the NRC Panel on the Sun and Heliospheric Physics, the Plasma Science Committee, and the Workshop Organizing Committee on Solar Systems Radiation Environment and NASA's Vision for Space Exploration. Dr. Zurbuchen served as vice chair of the Committee on Solar and Space Physics. He earned his Ph.D. in physics from the University of Bern, Switzerland.

Marvin A. Geller

Member

MARVIN A. GELLER is professor of Atmospheric Sciences at the School of Marine and Atmospheric Sciences at Stony Brook University. His research deals with atmospheric dynamics, middle and upper atmosphere, climate variability, and aeronomy. He became the fourth Stony Brook professor sharing the 2007 Nobel Peace Prize with Al Gore for his participation in the Inter-Governmental Panel on Climate Change (IPCC). Dr. Geller received the congratulatory letter from the United Nations Environment Programme on January 22, 2008, for his contribution in the assessment of stratospheric ozone depletion and climate change that lead to the Montreal Protocol. Dr. Geller has served on many national and international advisory committees on atmospheric science, the upper atmosphere, and near-space environment and is currently president of the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP); He has served as co-chair of the World Climate Research Programme's SPARC (Stratospheric Processes and Their Role in Climate) project, president of the American Geophysical Union's (AGU's) Atmospheric Sciences section, chair of NASULGC's Board on the Oceans and Atmosphere, and president of ICSU's SCOSTEP (Scientific Committee on Solar-Terrestrial Physics). He is a fellow of the American Meteorological Society and the AGU and past president of the AGU's Atmospheric Sciences Section. He earned his Ph.D. in meteorology from the Massachusetts Institute of Technology. He has served on numerous NRC panels and committees, including the BASC Committee on Solar-Terrestrial Research, which he chaired from 1993-1997, and the Board on Atmospheric Sciences and Climate, which he served as a member from 1995-2000. He is currently a member of the NRC Board on International Scientific Organizations.