

Atmospheric Chemistry And Physics From Air Pollution To Climate Change

Comprehensive overview of research on clouds and their role in our present and future climate, for advanced students and researchers.

This introduction to the principles of atmospheric physics and chemistry has been designed for physics or chemistry undergraduates with no prior knowledge of the subject. All aspects of the lower and middle atmospheres are treated as ultimate consequences

Describes the physical, plasma and chemical processes controlling ionospheres, upper atmospheres and exospheres, for researchers and graduates.

Based on more than 20 years of research and lecturing, Jordi Vil...-Guerau de Arellano and his team's textbook provides an excellent introduction to the interactions between the atmosphere and the land for advanced undergraduate and graduate students and a reference text for researchers in atmospheric physics and chemistry, hydrology, and plant physiology. The combination of the book, which provides the essential theoretical concepts, and the associated interactive Chemistry Land-surface Atmosphere Soil Slab (CLASS) software, which provides hands-on practical exercises and allows students to design their own numerical experiments, will prove invaluable for learning about many aspects of the soil-vegetation-atmosphere system. This book has a modular and flexible structure, allowing instructors to accommodate it to their own learning-outcome needs.

Atmospheric Science, Second Edition, is the long-awaited update of the classic atmospheric science text, which helped define the field nearly 30 years ago and has served as the cornerstone for most university curricula. Now students and professionals alike can use this updated classic to understand atmospheric phenomena in the context of the latest discoveries, and prepare themselves for more advanced study and real-life problem solving. This latest edition of Atmospheric Science, has been revamped in terms of content and appearance. It contains new chapters on atmospheric chemistry, the Earth system, the atmospheric boundary layer, and climate, as well as enhanced treatment of atmospheric dynamics, radiative transfer, severe storms, and global warming. The authors illustrate concepts with full-color, state-of-the-art imagery and cover a vast amount of new information in the field. Extensive numerical and qualitative exercises help students apply basic physical principles to atmospheric problems. There are also biographical footnotes summarizing the work of key scientists, along with a student companion website that hosts climate data; answers to quantitative exercises; full solutions to selected exercises; skew-T log p chart; related links, appendices; and more. The instructor website features: instructor's guide; solutions to quantitative exercises; electronic figures from the book; plus supplementary images for use in classroom presentations. Meteorology students at both advanced undergraduate and graduate levels will find this book extremely useful. Full-color satellite imagery and cloud photographs illustrate principles throughout Extensive numerical and qualitative exercises emphasize the application of basic physical principles to problems in the atmospheric sciences Biographical footnotes summarize the lives and work of scientists mentioned in the text, and provide students with a sense of the long history of meteorology Companion website encourages more advanced exploration of text topics: supplementary information, images, and bonus exercises Expanded and updated with new findings and new features New chapter on Global Climate providing a self-contained treatment of climate forcing, feedbacks, and climate sensitivity New chapter on Atmospheric Organic Aerosols and new treatment of the statistical method of Positive Matrix Factorization Updated treatments of physical meteorology, atmospheric nucleation, aerosol-cloud relationships, chemistry of biogenic hydrocarbons Each topic developed from the fundamental science to the point of application to real-world problems New problems at an introductory level to aid in classroom teaching

Atmospheric Chemistry provides readers with a basic knowledge of the chemistry of Earth's atmosphere, and an understanding of the role that chemical transformations play in this vital part of our environment. The composition of the 'natural' atmosphere (troposphere, stratosphere and mesosphere) is described in terms of the physical and chemical cycles that govern the behaviour of the major and the many minor species present, and of the atmospheric lifetimes of those species. An extension of these ideas leads to a discussion of the impacts of Man's activities on the atmosphere, and to an understanding of some of the most important environmental issues of our time. One thread of the book explains how living organisms alter the composition and pressures in the atmosphere, modify temperatures, and change the intensity and wavelength-distribution of light arriving from the Sun. Meanwhile, the living organisms on Earth have depended on these very same environmental conditions being satisfactory for the maintenance and evolution of life. There thus appear to be two-way interactions between life and the atmosphere. Man, just one species of living organism, has developed an unfortunate ability to interfere with the feedbacks that seem to have maintained the atmosphere to be supportive of surface life for more than 3.5 billion years. This book will help chemists to understand the background to the problems that arise from such interference. The structure of the book and the development of the subject deviate somewhat from those usually encountered. Important and recurring concepts are presented in outline first, before more detailed discussions of the atmospheric behaviour of specific chemical species. Examples of such themes are the sources and sinks of trace gases, and their budgets and lifetimes. That is, the emphasis is initially on the principles of the subject, with the finer points emerging at later points in the book, sometimes in several successive chapters. In this way, some of the core material gets repeated exposure, but in new ways and in new contexts. The book is written at a level that makes it accessible to undergraduate chemists, and in a manner that should make it interesting to them. However, the material presented forms a solid base for those who are extending their studies to a higher level, and it will also provide non-specialists with the background to an understanding of Man's several and varied threats to the atmosphere. Well-informed citizens can then better assess measures proposed to prevent or alleviate the potential damage, and policy makers more realistically formulate the necessary controls on a sound scientific foundation.

Cloud physics has achieved such a voluminous literature over the past few decades that a significant quantitative study of the entire field would prove unwieldy. This book concentrates on one major aspect: cloud microphysics, which involves the processes that lead to the formation of individual cloud and precipitation particles. Common practice has shown that one may distinguish among the following additional major aspects: cloud dynamics, which is concerned with the physics responsible for the macroscopic features of clouds; cloud electricity, which deals with the electrical structure of clouds and the electrification processes of cloud and precipitation particles; and cloud optics and radar meteorology, which describe the effects of electromagnetic waves interacting with clouds and precipitation. Another field intimately related to cloud physics is atmospheric chemistry, which involves the chemical composition of the atmosphere and the life cycle and characteristics of its gaseous and particulate constituents. In view of the natural interdependence of the various aspects of cloud physics, the subject of microphysics cannot be discussed very meaningfully out of context. Therefore, we have found it necessary to touch briefly upon a few simple and basic concepts of cloud dynamics and thermodynamics, and to provide an account of the major characteristics of atmospheric aerosol particles. We have also included a separate chapter on some of the effects of electric fields and charges on the precipitation-forming processes.

The extraordinary growth and development of atmospheric sciences during the last decades, and the concern for certain applied problems, such as those related to the environment, have prompted the introduction of college and university courses in this field. There is consequently a need for good textbooks. A few appropriate books have appeared in the last few years, aimed at a variety of levels and having different orientations. Most of them are of rather limited scope; in particular, a number of them are restricted to the field of dynamics and its meteorological applications. There is still a need for an elementary, yet comprehensive, survey of the terrestrial atmosphere. This short volume attempts to fill that need. This book is intended as a textbook that can be used for a university course at a second or third year level. It requires only elementary mathematics and such knowledge of physics as should be acquired in most first-year general physics courses. It may serve in two ways. A general review of the field is provided for students who work or plan to work in other fields (such as geophysics, geography, environmental sciences, space research), but are interested in acquiring general information; at the same time, it may serve as a general and elementary introduction for students who will later specialize in some area of atmospheric science.

On the occasion of the 50th anniversary of the Institute of Atmospheric Physics of the German Aerospace Center (DLR), this book presents more than 50 chapters highlighting results of the institute's research. The book provides an up-to-date, in-depth survey across the entire field of atmospheric science, including atmospheric dynamics, radiation, cloud physics, chemistry, climate, numerical simulation, remote sensing, instruments and measurements, as well as atmospheric acoustics. The authors have provided a readily comprehensible and self-contained presentation of the complex field of atmospheric science. The topics are of direct relevance for aerospace science and technology. Future research challenges are identified.

"[...] an interesting and well-written overview of the current status of our knowledge of the composition of the middle atmosphere and the basic radiative, dynamical and photochemical processes which maintain it." (Bulletin American Meteorological Society)

Clouds affect our daily weather and play key roles in the global climate. Through their ability to precipitate, clouds provide virtually all of the fresh water on Earth and are a crucial link in the hydrologic cycle. With ever-increasing importance being placed on quantifiable predictions – from forecasting the local weather to anticipating climate change – we must understand how clouds operate in the real atmosphere, where interactions with natural and anthropogenic pollutants are common. This textbook provides students – whether seasoned or new to the atmospheric sciences – with a quantitative yet approachable path to learning the inner workings of clouds. Developed over many years of the authors' teaching at Pennsylvania State University, *Physics and Chemistry of Clouds* is an invaluable textbook for advanced students in atmospheric science, meteorology, environmental sciences/engineering and atmospheric chemistry. It is also a very useful reference text for researchers and professionals.

This book contains texts by the Nobel laureate Paul J. Crutzen who is best known for his research on ozone depletion. It comprises Crutzen's autobiography, several pictures documenting important stages of his life, and his most important scientific publications. The Dutch atmospheric chemist is one of the world's most cited scientists in geosciences. His political engagement makes him a tireless ambassador for environmental issues such as climate change. He popularized the term 'Anthropocene' for the current geological era acknowledging the enduring influence of humankind on planet Earth. This concept conceives humans to be a geologic factor, influencing the evolution of our globe and the living beings populating it. The selection of texts is representing Paul Crutzen's scientific oeuvre as his research interests span from ozone depletion to the climatic impacts of biomass burning, the consequences of a worldwide atomic war – the Nuclear Winter - to geoengineering and the Anthropocene.

New edition of introductory textbook, ideal for students taking a course on air pollution and global warming, whatever their background. Comprehensive introduction to the history and science of the major air pollution and climate problems facing the world today, as well as energy and policy solutions to those problems.

This book is an introductory course to the physics and chemistry of the atmosphere and to climate dynamics. It covers the basics in thermodynamics, fluid dynamics, radiation, and chemistry and explains the most intriguing problems that currently exist in the study of the atmospheres of the Earth and planets. A particular effort is made to approach the different topics intuitively. Among the themes covered are the most recent evolution concerning the chemistry of polluted troposphere, the global warming problem, and chaos and nonlinear theory. The book is almost completely rewritten in comparison to the previous edition, with a more logical organization of the chapters. The fundamentals of thermodynamics, radiation, fluid dynamics and chemistry are introduced in the first six chapters, including a new chapter on remote sensing. Also there is an additional chapter

on geoengineering. A significant addition to the new edition, at the end of each chapter, are examples where the topics introduced in the chapter are further discussed with application to classical problems or new research items. Many of these examples are accompanied by computer programs. The most important updates deal with the theory of the general circulation, the methods to evaluate GCM, the detailed discussion of the urban troposphere and the chaos and nonlinear phenomena.

A fundamental treatment of all aspects of the physical and chemical behavior of air pollutants. Provides a clear analysis of the chemistry of atmospheric pollutants, an extensive treatment of the formation, thermodynamics and dynamics of atmospheric aerosols, and an elementary discussion of atmospheric diffusion with commonly used atmospheric diffusion formulas derived from first principles. Also contains comprehensive coverage of atmospheric removal processes, including wet and dry deposition; statistical distributions of atmospheric concentrations, and a discussion of acid rain. Numerous problems enable students to evaluate their understanding. All major chapters contain up-to-date bibliographies.

Thoroughly restructured and updated with new findings and new features The Second Edition of this internationally acclaimed text presents the latest developments in atmospheric science. It continues to be the premier text for both a rigorous and a complete treatment of the chemistry of the atmosphere, covering such pivotal topics as: * Chemistry of the stratosphere and troposphere * Formation, growth, dynamics, and properties of aerosols * Meteorology of air pollution * Transport, diffusion, and removal of species in the atmosphere * Formation and chemistry of clouds * Interaction of atmospheric chemistry and climate * Radiative and climatic effects of gases and particles * Formulation of mathematical chemical/transport models of the atmosphere All chapters develop results based on fundamental principles, enabling the reader to build a solid understanding of the science underlying atmospheric processes. Among the new material are three new chapters: Atmospheric Radiation and Photochemistry, General Circulation of the Atmosphere, and Global Cycles. In addition, the chapters Stratospheric Chemistry, Tropospheric Chemistry, and Organic Atmospheric Aerosols have been rewritten to reflect the latest findings. Readers familiar with the First Edition will discover a text with new structures and new features that greatly aid learning. Many examples are set off in the text to help readers work through the application of concepts. Advanced material has been moved to appendices. Finally, many new problems, coded by degree of difficulty, have been added. A solutions manual is available. Thoroughly updated and restructured, the Second Edition of Atmospheric Chemistry and Physics is an ideal textbook for upper-level undergraduate and graduate students, as well as a reference for researchers in environmental engineering, meteorology, chemistry, and the atmospheric sciences. Click here to Download the Solutions Manual for Academic Adopters: <http://www.wiley.com/WileyCDA/Section/id-292291.html>

This work offers a broad coverage of atmospheric physics, including atmospheric thermodynamics, radiative transfer, atmospheric fluid dynamics and elementary atmospheric chemistry.

Understanding the composition and chemistry of the Earth's atmosphere is essential to global ecological and environmental policy making and research. Atmospheric changes as a result of both natural and anthropogenic activity have affected many of the Earth's natural systems throughout history, some more seriously than others, and such changes are ever more evident with increases in both global warming and extreme weather events. Atmospheric Chemistry considers in detail the physics and chemistry of our atmosphere, that gives rise to our weather systems and climate, soaks up our pollutants and protects us from solar UV radiation. The development of the complex chemistry occurring on Earth can be explained through application of basic principles of physical chemistry, as is discussed in this book. It is therefore accessible to intermediate and advanced undergraduates of chemistry, with an interdisciplinary approach relevant to meteorologists, oceanographers, and climatologists. It also provides an ideal opportunity to bring together many different aspects of physical chemistry and demonstrate their relevance to the world we live in. This book was written in conjunction with *Astrochemistry: From the Big Bang to the Present Day*, Claire Vallance (2017) World Scientific Publishing. Request Inspection Copy

Liberal sprinkled with humor, these lessons will fascinate beginning physics students and other readers with chapters titled "On a Clear Day You Can't See Forever" and "Physics on a Manure Heap."

A multitude of processes that operate in the upper atmosphere are revealed by detailed physical and mathematical descriptions of the interactions of particles and radiation, temperatures, spectroscopy and dynamics.

Mathematical modeling of atmospheric composition is a formidable scientific and computational challenge. This comprehensive presentation of the modeling methods used in atmospheric chemistry focuses on both theory and practice, from the fundamental principles behind models, through to their applications in interpreting observations. An encyclopaedic coverage of methods used in atmospheric modeling, including their advantages and disadvantages, makes this a one-stop resource with a large scope. Particular emphasis is given to the mathematical formulation of chemical, radiative, and aerosol processes; advection and turbulent transport; emission and deposition processes; as well as major chapters on model evaluation and inverse modeling. The modeling of atmospheric chemistry is an intrinsically interdisciplinary endeavour, bringing together meteorology, radiative transfer, physical chemistry and biogeochemistry, making the book of value to a broad readership. Introductory chapters and a review of the relevant mathematics make this book instantly accessible to graduate students and researchers in the atmospheric sciences.

Ice and snow on Earth modulate and modify the climate, chemistry and fate of air and water pollutants. Climate change is drastically impacting Nature and extent of the cryosphere, with attendant feedbacks on atmospheric composition and climate. These changes are happening at a rate that outpaces the development of fundamental knowledge of processes that occur within/on the surfaces of ice and snow, confounding our ability to develop a predictive capability for future states of the Earth environment. This set, comprising 17 chapters, written by world experts on these topics, are thus intended to document the current state of understanding of the structure, physical properties, abundance, and chemical and microbiological processes that occur within/on ice and snow in all Earth environments in which it exists, and to express needs for improvement of that understanding. This, only comprehensive treatise/collection that covers environmentally relevant chemistry and related physical aspects of snow and ice in the Earth system, and the connections to climate change, will be accessible to those with introductory college-level understanding of chemistry and physics.

Atmospheric Chemistry and Physics From Air Pollution to Climate Change John Wiley & Sons

The reader may be surprised to learn that the word "aeronomy" is not found in many of the standard dictionaries of the English language (for example, Webster's International dictionary). Yet the term would appear to exist, as evidenced by the affiliations of the two authors of this volume (Institut d'Aeronomie, Brussels, Belgium; Aeronomy Laboratory, National Oceanic and Atmospheric Administration, Boulder, CO, USA). Perhaps part of this obscurity arises because aeronomy is a relatively new and evolving field of endeavor, with a history dating back no farther than about 1940. The Chambers dictionary of science and technology provides the following definition: "aeronomy (Meteor.). The branch of science dealing with the atmosphere of the Earth and the other planets with reference to their chemical composition, physical properties, relative motion,

This fully revised and expanded version of John H. Seinfeld's successful Atmospheric Chemistry and Physics of Air Pollution provides a rigorous, comprehensive treatment of the

chemistry of the atmosphere. With new chapters on such important topics as cloud physics, nucleation, and wet deposition, this book offers a truly up-to-date examination of atmospheric chemistry today, including chemistry of the stratosphere and troposphere; formation, growth, dynamics, thermodynamics, and properties of aerosols; meteorology of air pollution; transport, diffusion, and removal of species in the atmosphere; formation and chemistry of clouds; interaction of atmospheric chemistry and climate; radiative and climatic effects of gasses and particles; and formulation of mathematical chemical/transport models of the atmosphere. The reference is an ideal resource for both students and professionals in all areas of engineering as well as atmospheric science.

This book presents current knowledge on chemistry and physics of Arctic atmosphere. Special attention is given to studies of the Arctic haze phenomenon, Arctic tropospheric clouds, Arctic fog, polar stratospheric and mesospheric clouds, atmospheric dynamics, thermodynamics and radiative transfer as related to the polar environment. The atmosphere-cryosphere feedbacks and atmospheric remote sensing techniques are presented in detail. The problems of climate change in the Arctic are also addressed.

Newly revised and updated, Basic Physical Chemistry for the Atmospheric Sciences provides a clear, concise grounding in the basic chemical principles required for modern studies of atmospheres, oceans, and earth and planetary systems. Undergraduate and graduate students with little formal training in chemistry can work through the chapters and the numerous exercises within this book before accessing the standard texts in the atmospheric chemistry, geochemistry, and the environmental sciences. The book covers the fundamental concepts of chemical equilibria, chemical thermodynamics, chemical kinetics, solution chemistry, acid and base chemistry, oxidation-reduction reactions, and photochemistry. In a companion volume entitled Introduction to Atmospheric Chemistry (2000, Cambridge University Press) Peter Hobbs provides an introduction to atmospheric chemistry itself, including its applications to air pollution, acid rain, the ozone hole, and climate change. Together these two books provide an ideal introduction to atmospheric chemistry for a variety of disciplines.

Technology has propelled the atmospheric sciences from a fledgling discipline to a global enterprise. Findings in this field shape a broad spectrum of decisions--what to wear outdoors, whether aircraft should fly, how to deal with the issue of climate change, and more. This book presents a comprehensive assessment of the atmospheric sciences and offers a vision for the future and a range of recommendations for federal authorities, the scientific community, and education administrators. How does atmospheric science contribute to national well-being? In the context of this question, the panel identifies imperatives in scientific observation, recommends directions for modeling and forecasting research, and examines management issues, including the growing problem of weather data availability. Five subdisciplines--physics, chemistry, dynamics and weather forecasting, upper atmosphere and near-earth space physics, climate and climate change--and their status as the science enters the twenty-first century are examined in detail, including recommendations for research. This readable book will be of interest to public-sector policy framers and private-sector decisionmakers as well as researchers, educators, and students in the atmospheric sciences.

Here is the most comprehensive and up-to-date treatment of one of the hottest areas of chemical research. The treatment of fundamental kinetics and photochemistry will be highly useful to chemistry students and their instructors at the graduate level, as well as postdoctoral fellows entering this new, exciting, and well-funded field with a Ph.D. in a related discipline (e.g., analytical, organic, or physical chemistry, chemical physics, etc.). Chemistry of the Upper and Lower Atmosphere provides postgraduate researchers and teachers with a uniquely detailed, comprehensive, and authoritative resource. The text bridges the "gap" between the fundamental chemistry of the earth's atmosphere and "real world" examples of its application to the development of sound scientific risk assessments and associated risk management control strategies for both tropospheric and stratospheric pollutants. Serves as a graduate textbook and "must have" reference for all atmospheric scientists Provides more than 5000 references to the literature through the end of 1998 Presents tables of new actinic flux data for the troposphere and stratosphere (0-40km) Summarizes kinetic and photochemical data for the troposphere and stratosphere Features problems at the end of most chapters to enhance the book's use in teaching Includes applications of the OZIPR box model with comprehensive chemistry for student use

Our world is changing at an accelerating rate. The global human population has grown from 6.1 billion to 7.1 billion in the last 15 years and is projected to reach 11.2 billion by the end of the century. The distribution of humans across the globe has also shifted, with more than 50 percent of the global population now living in urban areas, compared to 29 percent in 1950. Along with these trends, increasing energy demands, expanding industrial activities, and intensification of agricultural activities worldwide have in turn led to changes in emissions that have altered the composition of the atmosphere. These changes have led to major challenges for society, including deleterious impacts on climate, human and ecosystem health. Climate change is one of the greatest environmental challenges facing society today. Air pollution is a major threat to human health, as one out of eight deaths globally is caused by air pollution. And, future food production and global food security are vulnerable to both global change and air pollution. Atmospheric chemistry research is a key part of understanding and responding to these challenges. The Future of Atmospheric Chemistry Research: Remembering Yesterday, Understanding Today, Anticipating Tomorrow summarizes the rationale and need for supporting a comprehensive U.S. research program in atmospheric chemistry; comments on the broad trends in laboratory, field, satellite, and modeling studies of atmospheric chemistry; determines the priority areas of research for advancing the basic science of atmospheric chemistry; and identifies the highest priority needs for improvements in the research infrastructure to address those priority research topics. This report describes the scientific advances over the past decade in six core areas of atmospheric chemistry: emissions, chemical transformation, oxidants, atmospheric dynamics and circulation, aerosol particles and clouds, and

biogeochemical cycles and deposition. This material was developed for the NSF's Atmospheric Chemistry Program; however, the findings will be of interest to other agencies and programs that support atmospheric chemistry research.

Consisting mainly of hands-on experiments, this work is designed specifically to give students of diverse academic backgrounds an opportunity to explore and understand the underlying physical principles of meteorology.

Introduction to Atmospheric Chemistry is a concise, clear review of the fundamental aspects of atmospheric chemistry. In ten succinct chapters, it reviews our basic understanding of the chemistry of the Earth's atmosphere and discusses current environmental issues, including air pollution, acid rain, the ozone hole, and global change.

Written by a well-known atmospheric science teacher, researcher, and author of several established textbooks, this book is an introductory textbook for beginning university courses in atmospheric chemistry. Also suitable for self instruction, numerous exercises and solutions make this textbook accessible to students covering atmospheric chemistry as a part of courses in atmospheric science, meteorology, environmental science, geophysics and chemistry. Together with its companion volume, Basic Physical Chemistry for the Atmospheric Sciences (second edition 2000; Cambridge University Press), Introduction to Atmospheric Chemistry provides a solid introduction to atmospheric chemistry.

Encyclopedia of Atmospheric Sciences, 2nd Edition is an authoritative resource covering all aspects of atmospheric sciences, including both theory and applications. With more than 320 articles and 1,600 figures and photographs, this revised version of the award-winning first edition offers comprehensive coverage of this important field. The six volumes in this set contain broad-ranging articles on topics such as atmospheric chemistry, biogeochemical cycles, boundary layers, clouds, general circulation, global change, mesoscale meteorology, ozone, radar, satellite remote sensing, and weather prediction. The Encyclopedia is an ideal resource for academia, government, and industry in the fields of atmospheric, ocean, and environmental sciences. It is written at a level that allows undergraduate students to understand the material, while providing active researchers with the latest information in the field. Covers all aspects of atmospheric sciences—including both theory and applications Presents more than 320 articles and more than 1,600 figures and photographs Broad-ranging articles include topics such as atmospheric chemistry, biogeochemical cycles, boundary layers, clouds, general circulation, global change, mesoscale meteorology, ozone, radar, satellite remote sensing, and weather prediction An ideal resource for academia, government, and industry in the fields of atmospheric, ocean, and environmental sciences

This comprehensive introduction to the physics and chemistry of Earth's atmosphere explains the science behind some of the most critical and intensely debated environmental controversies of our day. In it, one of the world's leading experts on planetary environments presents the background necessary to assess the complex effects of human activity on our atmosphere and climate. Unique in its breadth and depth of coverage, The Atmospheric Environment includes a survey of Earth's climatic history to provide a context for assessing the changes underway today. It is written for--and will be of lasting value to--a varied audience, including not only students but also professional scientists and others seeking a sophisticated but readable introduction to the frontiers of contemporary research on biogeochemistry, depletion of stratospheric ozone, tropospheric air pollution, and climatology. The book covers both the chemistry and physics of the atmosphere with an account of relevant aspects of ocean science, treats atmospheric science and the climate as an integrated whole, and makes explicit the policy implications of what is known. Its critical account of steps taken by the international community to address the issue of climatic change highlights the challenge of dealing with a global issue for which the political and economic stakes are high, where uncertainties are common, and where there is an urgent need for clear thinking and informed policy. The book also sketches key gaps in our knowledge, outlining where we need to go to fully understand the impact of our actions on the climate. Thorough, timely, and authoritative, this is the book to consult for answers about some of the thorniest and most pressing environmental questions that we face.

Atmospheric chemistry is one of the fastest growing fields in the earth sciences. Until now, however, there has been no book designed to help students capture the essence of the subject in a brief course of study. Daniel Jacob, a leading researcher and teacher in the field, addresses that problem by presenting the first textbook on atmospheric chemistry for a one-semester course. Based on the approach he developed in his class at Harvard, Jacob introduces students in clear and concise chapters to the fundamentals as well as the latest ideas and findings in the field. Jacob's aim is to show students how to use basic principles of physics and chemistry to describe a complex system such as the atmosphere. He also seeks to give students an overview of the current state of research and the work that led to this point. Jacob begins with atmospheric structure, design of simple models, atmospheric transport, and the continuity equation, and continues with geochemical cycles, the greenhouse effect, aerosols, stratospheric ozone, the oxidizing power of the atmosphere, smog, and acid rain. Each chapter concludes with a problem set based on recent scientific literature. This is a novel approach to problem-set writing, and one that successfully introduces students to the prevailing issues. This is a major contribution to a growing area of study and will be welcomed enthusiastically by students and teachers alike.

Understanding the composition and chemistry of the Earth's atmosphere is essential to global ecological and environmental policy making and research. Atmospheric changes as a result of both natural and anthropogenic activity have affected many of the Earth's natural systems throughout history, some more seriously than others, and such changes are ever more evident with increases in both global warming and extreme weather events. Atmospheric Chemistry: from the Surface to the Stratosphere considers in detail the physics and chemistry of our contemporary planet, and in particular its atmosphere, explaining the chemistry and physics of the air that we breathe, that gives rise to our weather

systems and climate, soaks up our pollutants and protects us from solar UV radiation. The development of the complex chemistry occurring on Earth can be explained through application of basic principles of physical chemistry, as is discussed in this book. It is therefore accessible to intermediate and advanced undergraduates of chemistry, with an interdisciplinary approach relevant to meteorologists, oceanographers, and climatologists. It also provides an ideal opportunity to bring together many different aspects of physical chemistry and demonstrate their relevance to the world we live in. This book was written in conjunction with *Astrochemistry: From the Big Bang to the Present Day*, Claire Vallance (2017) Grant Ritchie, @World Scientific Publishing.

Textbook that uniquely integrates physics and chemistry in the study of atmospheric thermodynamics for advanced single-semester courses.

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