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This book offers an overview of advanced techniques to study atmospheric dynamics by numerical experimentation. It is primarily intended for scientists and graduate students working on interdisciplinary research problems at the intersection of the atmospheric sciences, applied mathematics, statistics and physics. Scientists interested in adopting techniques from the atmospheric sciences to study other complex systems may also find most of the topics covered in the book interesting. The specific techniques covered in the book

have either proven or potential value in solving practical problems of atmospheric dynamics.

John Green presents his unique personal insight into the fundamentals of fluid mechanics and atmospheric dynamics.

Interest in the meteorology of the stratosphere and mesosphere has been simulated in the past few years by concerns over possible depletion of the ozone layer as a result of reactions involving pollutants introduced by human activities. Concurrently there has been an upsurge in research on various aspects of the meteorology of

the stratosphere. This monograph provides an account of the fundamental dynamical processes which control the general circulation of the stratosphere and mesosphere and are thus responsible for the transport of trace substances in that region of the atmosphere. Principles necessary for understanding the dynamics of large-scale motions in the stratosphere and mesosphere are systematically developed so that this monograph should prove useful not only as a reference work for research scientists, but as a textbook for courses in dynamic meteorology of the upper atmo-

sphere.

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.

This book presents selected mathematical problems involving the dynamics of a two-dimensional viscous and ideal incompressible fluid on a rotating sphere. In this case, the fluid motion is completely governed by the barotropic vorticity equation (BVE), and the viscosity term in the vorticity equation is taken in its general form, which contains the derivative of real degree of the spherical Laplace operator. This work builds a bridge between basic concepts and concrete outcomes by pursuing a rich combination of theoretical, analytical and numerical approaches, and is recommended for specialists developing mathematical methods for application to problems in physics, hydrodynamics, meteorology and geophysics, as well for upper undergraduate or graduate students in the areas of dynamics of incompressible fluid on a rotating sphere, theory of functions on a

sphere, and flow stability.

Introduction to Atmospheric Modelling explores the power of mathematics to help us understand complex atmospheric phenomena through mathematical modelling. The author has thoughtfully chosen a path into and through the subject that gives the reader a glimpse of the dynamics underlying phenomena ranging from a sea breeze through mid-latitude cyclonic disturbances to Rossby waves, mainly through the lens of scaling analysis. Written for students with backgrounds in mathematics, physics and engineering, this book will be a valuable resource as they begin studying atmospheric science. Dynamic meteorology is the study of those motions of the atmosphere that are associated with weather and climate. The science of dynamic meteorology continues its rapid advance, and its scope has broadened considerably. There continue to be important new developments in the analysis and prediction of extratropical synoptic-scale systems. Important progress has been made in the understanding of mesoscale storms, in tropical dynamics, in the dynamics of climate, and in the dynamics of the middle atmosphere. An Introduction to

Dynamic Meteorology, Third Edition reflects the full scope of modern dynamic meteorology, while providing a coherent presentation of the fundamentals. The text emphasizes physical principles rather than mathematical elegance. \* Presents a cogent explanation of the fundamentals of meteorology\* Explains storm dynamics for weather-oriented meteorologists\* Discusses climate dynamics and the implications posed for global change\* Features a new chapter on mesoscale dynamics\* Includes updated treatments of climate dynamics, tropical meteorology, middle atmosphere dynamics, and numerical prediction\* Instructor's manual is available

Mathematical Models of Life Support Systems is a component of Encyclopedia of Mathematical Sciences in which is part of the global Encyclopedia of Life Support Systems (EOLSS), an integrated compendium of twenty one Encyclopedias. The Theme is organized into several topics which represent the main scientific areas of the theme: The first topic, Introduction to Mathematical Modeling discusses the foundations of mathematical modeling and computational experiments, which are formed to support new methodologies of

scientific research. The succeeding topics are Mathematical Models in - Water Sciences; Climate; Environmental Pollution and Degradation; Energy Sciences; Food and Agricultural Sciences; Population; Immunology; Medical Sciences; and Control of Catastrophic Processes. These two volumes are aimed at the following five major target audiences: University and College students Educators, Professional practitioners, Research personnel and Policy analysts, managers, and decision makers and NGOs.

Atmosphere-Ocean Dynamics deals with a systematic and unified approach to the dynamics of the ocean and atmosphere. The book reviews the relationship of the ocean-atmosphere and how this system functions. The text explains this system through radiative equilibrium models; the book also considers the greenhouse effect, the effects of convection and of horizontal gradients, and the variability in radiative driving of the earth. Equations in the book show the properties of a material element, mass conservation, the balance of scalar quantity (such as salinity), and the mathematical behavior of the ocean and atmo-

sphere. The book also addresses how the ocean-atmosphere system tends to adjust to equilibrium, both in the absence and presence of driving forces such as gravity. The text also explains the effect of the earth's rotation on the system, as well as the application of forced motions such as that produced by wind or temperature changes. The book explains tropical dynamics and the effects of variation of the Coriolis parameter with latitude. The text will be appreciated by meteorologists, environmentalists, students studying hydrology, and people working in general earth sciences.

This book deals with the main principles of large-scale atmospheric dynamics on the basis of adiabatic motion constants. It can be considered as an introduction to the theory of quasi two-dimensional fluid motion concentrating primarily on nearly horizontal fluid parcel displacements in a stably stratified compressible fluid. A thorough mathematica

During the past decade, the science of dynamic meteorology has continued its rapid advance. The scope of dynamic meteorology has broadened considerably. Much of the material is based on a two-term course

for seniors majoring in atmospheric sciences. This book presents a cogent explanation of the fundamentals of meteorology and explains storm dynamics for weather-oriented meteorologists. It discusses climate dynamics and the implications posed for global change. The new edition has added a companion website with MATLAB exercises and updated treatments of several key topics. Provides clear physical explanations of key dynamical principles Contains a wealth of illustrations to elucidate text and equations, plus end-of-chapter problems Holton is one of the leading authorities in contemporary meteorology, and well known for his clear writing style Instructor's Manual available to adopters  
**NEW IN THIS EDITION** A companion website with MATLAB® exercises and demonstrations Updated treatments on climate dynamics, tropical meteorology, middle atmosphere dynamics, and numerical prediction

The final orbit of Venus by the Magellan spacecraft in October 1994 brought to a close an exciting period of Venus reconnaissance and exploration. The scientific studies resulting from data collected by the Magellan, Galileo, and Pioneer mis-

sions are unprecedented in their detail for any planet except Earth. Venus II re-evaluates initial assessments of Venus in light of these and other spacecraft missions and ground-based observations conducted over the past 30 years. More than a hundred contributors summarize our current knowledge of the planet, consider points of disagreement in interpretation, and identify priorities for future research. Topics addressed include geology, surface processes, volcanism, tectonism, impact cratering, geodynamics, upper and lower atmospheres, and solar wind environment. The diversity of the coverage reflects the interdisciplinary nature of Venus science and the breadth of knowledge that has contributed to it. A CD-ROM developed by the Jet Propulsion Laboratory accompanies the book and incorporates text, graphics, video, software, and various digital products from selected contributors to the text. A multimedia interface allows users to navigate the text and the extensive databases included on the disk. Venus II is the most authoritative single volume available on the second planet. Its contents will not only help shape the goals of future Venus missions but will also enhance our unders-

tanding of current Mars explorations.

This textbook is intended for both undergraduate and graduate courses in meteorology and atmospheric sciences, as well as for researchers working on theoretical and numerical aspects of weather and climate or on geophysical fluid dynamics. The treatment is concise, thorough, and self-contained. All necessary concepts are introduced, and the reader is given explicit guidance on all mathematical steps. The book begins with a derivation of the equations of motion. These are then used to discuss fundamental aspects of weather and climate. The mechanisms behind vortical motions, that are known from the daily weather map, are discussed. Shallow-water theory is introduced as a tool for an efficient analysis of key concepts, such as atmospheric waves and synoptic-scale vortices. Quasigeostrophic theory is described and then used to explain the occurrence and mechanisms of extratropical weather by means of baroclinic instability. The specific properties of the atmospheric boundary layer are discussed, with a focus on the interaction between turbulence and mean flows. This is followed by a detailed

look at the global atmospheric circulation, highlighting its control by Rossby waves and gravity waves. At the same time, the reader is introduced to essential concepts that find applications in the field, such as balance by geostrophic and hydrostatic equilibrium, the role of entropy and potential temperature, potential vorticity, the Kelvin theorem, instability theory, the Reynolds equations, Eliassen-Palm and pseudo-momentum flux, multi-scale asymptotics, WKB theory, wave action, the transformed Eulerian mean, critical layers, and wave refraction. The text is supplemented by appendices on important mathematical concepts and further elaborations of the main text. Chapter summaries and reading recommendations help the reader not merely to keep focus on the essentials, but just as well to broaden the horizon.

Mesoscale Meteorology in Mid-Latitudes presents the dynamics of mesoscale meteorological phenomena in a highly accessible, student-friendly manner. The book's clear mathematical treatments are complemented by high-quality photographs and illustrations. Comprehensive coverage of subjects including boundary layer mesos-

cale phenomena, orographic phenomena and deep convection is brought together with the latest developments in the field to provide an invaluable resource for mesoscale meteorology students. Mesoscale Meteorology in Mid-Latitudes functions as a comprehensive, easy-to-use undergraduate textbook while also providing a useful reference for graduate students, research scientists and weather industry professionals. Illustrated in full colour throughout Covers the latest developments and research in the field Comprehensive coverage of deep convection and its initiation Uses real life examples of phenomena taken from broad geographical areas to demonstrate the practical aspects of the science

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 Spatiale, Brussels, Belgium; Aeronomy Laboratory, National Oceanic and Atmospheric Administration, Boulder, CO, USA). Perhaps part of this obs-

curity 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, and reactions to radiation from outer space" This seems to us an appropriate description, and it is reflected throughout the content of this volume. The study of the aeronomy of the middle atmosphere experienced rapid growth and development during the 1970's and 1980's, particularly due to concern over the possibility of anthropogenic perturbations to the state of the middle atmosphere and its protective ozone layer. As a result, much has been learned regarding both the natural behavior of the atmosphere and the impact of man's activities upon it. In this book we shall attempt to describe the current state of the art as we see it.

The vigorous stirring of a cup of tea gives rise, as we all know, to interesting fluid dynamical phenomena, some of which are

very hard to explain. In this book our "cup of tea" contains the currents of the Earth's atmosphere, oceans, mantle, and fluid core. Our goal is to understand the basic physical processes which are most important in describing what we observe, directly or indirectly, in these complex systems. While in many respects our understanding is measured by the ability to predict, the focus here will be on relatively simple models which can aid our physical intuition by suggesting useful mathematical methods of investigation. These elementary models can be viewed as part of a hierarchy of models of increasing complexity, moving toward those which might be usefully predictive. The discussion in this book will deal primarily with the Earth. Interplanetary probes of Venus, Mars, Jupiter and Saturn have revealed many exciting phenomena which bear on geophysical fluid dynamics. They have also enabled us to see the effect of changing the values of certain parameters, such as gravity and rotation rate, on geophysical flows. On the other hand, satellite observations of our own planet on a daily and hourly basis have turned it into a unique laboratory for the study of fluid motions on a scale never

dreamt of before: the motion of cyclones can be observed via satellite just as wing tip vortices are studied in a wind tunnel.

The past decade has been characterized by remarkable advances in meteorological observation, computing techniques, and data-visualization technology. Mesoscale Synoptic Meteorology links theoretical concepts to modern technology and facilitates the meaningful application of concepts, theories, and techniques using real data. As such, it both serves those planning careers in meteorological research and weather prediction and provides a template for the application of modern technology in classroom and laboratory settings.

This book is an introductory text on dynamic meteorology and is the result of Professor Riegel's long years of teaching experience. The approach is very pedagogical. Many examples are provided to illustrate basic concepts and ideas. The text is suitable for a one- or two-semester course. Request Inspection Copy

For advanced undergraduate and beginning graduate students in atmospheric, oceanic, and climate science, Atmosphere, Ocean and Climate Dynamics is an intro-

ductory textbook on the circulations of the atmosphere and ocean and their interaction, with an emphasis on global scales. It will give students a good grasp of what the atmosphere and oceans look like on the large-scale and why they look that way. The role of the oceans in climate and paleoclimate is also discussed. The combination of observations, theory and accompanying illustrative laboratory experiments sets this text apart by making it accessible to students with no prior training in meteorology or oceanography. \* Written at a mathematical level that is appealing for undergraduates and beginning graduate students \* Provides a useful educational tool through a combination of observations and laboratory demonstrations which can be viewed over the web \* Contains instructions on how to reproduce the simple but informative laboratory experiments \* Includes copious problems (with sample answers) to help students learn the material. The weather can be a cause of disruption, despair and even danger everywhere around the world at one time or another. Even when benign it is a source of constant fascination. Applied Atmospheric Dynamics connects this interest with the the-



oretical underpinnings of fluid dynamics; linking real physical events as diverse as Hurricane Katrina and the strong katabatic winds of Antarctica, with quantitative conceptual models of atmospheric behaviour. Assuming only basic calculus the book provides a physical basis for understanding atmospheric motions around the globe as well as detailing the advances that have led to a greater understanding of weather and climate. The accompanying supplementary CD-ROM features colour graphics, maps, databases, animations, project materials, as well as weather data tips. Covers the standard theoretical principles of atmospheric dynamics and applies the theory to global real world examples Assumes only non-vector based calculus Features supplementary CD-ROM with electronic versions of all figures, case study data and possible term projects An invaluable text for students of Meteorology, Atmospheric Science, Geography and Environmental Science A Solutions Manual is also available for this textbook on the Instructor Companion Site [www.wileyurope.com/college/lynch](http://www.wileyurope.com/college/lynch) The book discusses the basic of atmospher-

ic dynamics where the curved surface of the earth and its rotation around its own axis plays very important roles. The emphasis is on basic physical concepts and the interpretation of equations and the different terms therein. Note: T&F does not sell or distribute the hardback in India, Pakistan, Nepal, Bhutan, Bangladesh and Sri Lanka.

An Introduction to Dynamic Meteorology, Fourth Edition presents a cogent explanation of the fundamentals of meteorology, and explains storm dynamics for weather-oriented meteorologists. This revised edition features updated treatments on climate dynamics, tropical meteorology, middle atmosphere dynamics, and numerical prediction. It contains a wealth of illustrations to elucidate text and equations, plus end-of-chapter problems. This book is recommended for senior and graduate students in meteorology and atmospheric science, as well as atmospheric scientists desiring a broad overview of dynamical meteorology. Provides clear physical explanations of key dynamical principles Contains a wealth of illustrations to elucidate text and equations, plus end-of-chapter problems Holton is one of the leading au-

thorities in contemporary meteorology, and well known for his clear writing style NEW IN THIS EDITION Updated treatments on climate dynamics, tropical meteorology, middle atmosphere dynamics, and numerical prediction

This book introduces mathematicians to the fascinating mathematical interplay between ideas from stochastics and information theory and practical issues in studying complex multiscale nonlinear systems. It emphasizes the serendipity between modern applied mathematics and applications where rigorous analysis, the development of qualitative and/or asymptotic models, and numerical modeling all interact to explain complex phenomena. After a brief introduction to the emerging issues in multiscale modeling, the book has three main chapters. The first chapter is an introduction to information theory with novel applications to statistical mechanics, predictability, and Jupiter's Red Spot for geophysical flows. The second chapter discusses new mathematical issues regarding fluctuation-dissipation theorems for complex nonlinear systems including information flow, various approximations, and illustrates applications to various mathematical models.

The third chapter discusses stochastic modeling of complex nonlinear systems. After a general discussion, a new elementary model, motivated by issues in climate dynamics, is utilized to develop a self-contained example of stochastic mode reduction. Based on A. Majda's Aisenstadt lectures at the University of Montreal, the book is appropriate for both pure and applied mathematics graduate students, post-docs and faculty, as well as interested researchers in other scientific disciplines. No background in geophysical flows is required. About the authors: Andrew Majda is a member of the National Academy of Sciences and has received numerous honors and awards, including the National Academy of Science Prize in Applied Mathematics, the John von Neumann Prize of the Society of Industrial and Applied Mathematics, the Gibbs Prize of the American Mathematical Society, and the Medal of the College de France. In the past several years at the Courant Institute, Majda and a multi-disciplinary faculty have created the Center for Atmosphere Ocean Science to promote cross-disciplinary research with modern applied mathematics in climate modeling and prediction. R.V. Abramov is a

young researcher; he received his PhD in 2002. M. J. Grote received his Ph.D. under Joseph B. Keller at Stanford University in 1995.

Mankin Mak's textbook provides a self-contained course on atmospheric dynamics. The first half is suitable for senior undergraduates, and develops the physical, dynamical and mathematical concepts at the fundamental level. The second half of the book is aimed at more advanced students who are already familiar with the basics. The contents have been developed from many years of the author's teaching at the University of Illinois. Discussions are supplemented with schematics, weather maps and statistical plots of the atmospheric general circulation. Students often find the connection between theoretical dynamics and atmospheric observation somewhat tenuous, and this book demonstrates a strong connection between the key dynamics and real observations. This textbook is an invaluable asset for courses in atmospheric dynamics for advanced students and researchers in atmospheric science, ocean science, weather forecasting, environmental science, and applied mathematics. Some background in mathematics,

physics and basic atmospheric science is assumed.

This book gives a coherent development of the current understanding of the fluid dynamics of the middle latitude atmosphere. It is primarily aimed at post-graduate and advanced undergraduate level students and does not assume any previous knowledge of fluid mechanics, meteorology or atmospheric science. The book will be an invaluable resource for any quantitative atmospheric scientist who wishes to increase their understanding of the subject. The importance of the rotation of the Earth and the stable stratification of its atmosphere, with their implications for the balance of larger-scale flows, is highlighted throughout. Clearly structured throughout, the first of three themes deals with the development of the basic equations for an atmosphere on a rotating, spherical planet and discusses scale analyses of these equations. The second theme explores the importance of rotation and introduces vorticity and potential vorticity, as well as turbulence. In the third theme, the concepts developed in the first two themes are used to give an understanding of balanced motion



in real atmospheric phenomena. It starts with quasi-geostrophic theory and moves on to linear and nonlinear theories for mid-latitude weather systems and their fronts. The potential vorticity perspective on weather systems is highlighted with a discussion of the Rossby wave propagation and potential vorticity mixing covered in the final chapter.

Encyclopedia of Atmospheric Sciences, Second Edition, Six Volume Set 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 stu-

dents 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 exciting text provides a mathematically rigorous yet accessible textbook that is primarily aimed at atmospheric science majors. Its accessibility is due to the text's emphasis on conceptual understanding. The first five chapters constitute a companion text to introductory courses covering the dynamics of the mid-latitude atmosphere. The final four chapters constitute a more advanced course, and provide insights into the diagnostic power of the quasi-geostrophic approximation of the equations outlined in the previous

chapters, the meso-scale dynamics of the frontal zone, the alternative PV perspective for cyclone interpretation, and the dynamics of the life-cycle of mid-latitude cyclones. Written in a clear and accessible style. Features real weather examples and global case studies. Each chapter sets out clear learning objectives and tests students' knowledge with concluding questions and answers. A Solutions Manual is also available for this textbook on the Instructor Companion Site [www.wileyurope.com/college/martin](http://www.wileyurope.com/college/martin). "...a student-friendly yet rigorous textbook that accomplishes what no other textbook has done before... I highly recommend this textbook. For instructors, this is a great book if they don't have their own class notes - one can teach straight from the book. And for students, this is a great book if they don't take good class notes - one can learn straight from the book. This is a rare attribute of advanced textbooks." Bulletin of the American Meteorological Society (BAMS), 2008

This book is intended for graduate students in middle atmosphere dynamics courses and will be useful to all research workers in meteorology, aeronomy, and at-

ospheric chemistry. Furthermore, many of the basic dynamical and physical processes discussed also have broad applicability in other branches of atmospheric dynamics, and will be of interest to those studying such areas as climate dynamics and planetary atmospheres.

This is a modern, introductory textbook on the dynamics of the atmosphere and ocean, with a healthy dose of geophysical fluid dynamics. It will be invaluable for intermediate to advanced undergraduate and graduate students in meteorology, oceanography, mathematics, and physics. It is unique in taking the reader from very basic concepts to the forefront of research. It also forms an excellent refresher for researchers in atmospheric science and oceanography. It differs from other books at this level in both style and content: as well as very basic material it includes some elementary introductions to more advanced topics. The advanced sections can easily be omitted for a more introductory course, as they are clearly marked in the text. Readers who wish to explore these topics in more detail can refer to this book's parent, Atmospheric and

Oceanic Fluid Dynamics: Fundamentals and Large-Scale Circulation, now in its second edition.

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, Fluid dynamics is fundamental to our understanding of the atmosphere and oceans. Although many of the same principles of fluid dynamics apply to both the atmosphere and oceans, textbooks tend to

concentrate on the atmosphere, the ocean, or the theory of geophysical fluid dynamics (GFD). This textbook provides a comprehensive unified treatment of atmospheric and oceanic fluid dynamics. The book introduces the fundamentals of geophysical fluid dynamics, including rotation and stratification, vorticity and potential vorticity, and scaling and approximations. It discusses baroclinic and barotropic instabilities, wave-mean flow interactions and turbulence, and the general circulation of the atmosphere and ocean. Student problems and exercises are included at the end of each chapter. Atmospheric and Oceanic Fluid Dynamics: Fundamentals and Large-Scale Circulation will be an invaluable graduate textbook on advanced courses in GFD, meteorology, atmospheric science and oceanography, and an excellent review volume for researchers. Additional resources are available at [www.cambridge.org/9780521849692](http://www.cambridge.org/9780521849692).

General circulation models (GCMs), which define the fundamental dynamics of atmospheric circulation, are nowadays used in various fields of atmospheric science such as weather forecasting, climate predictions and environmental estimations. The

Second Edition of this renowned work has been updated to include recent progress of high resolution global modeling. It also contains for the first time aspects of high-resolution global non-hydrostatic models that the author has been studying since the publication of the first edition. Some highlighted results from the Non-hydrostatic ICosahedral Atmospheric Model (NICAM) are also included. The author outlines the theoretical concepts, simple models and numerical methods for modeling the general circulation of the atmosphere. Concentrating on the physical mechanisms responsible for the development of large-scale cir-

ulation of the atmosphere, the book offers comprehensive coverage of an important and rapidly developing technique used in the atmospheric science. Dynamic interpretations of the atmospheric structure and their aspects in the general circulation model are described step by step.

This compact introduction to the ordinary differential equations and their applications is aimed at anyone who, in their studies, is confronted voluntarily or involuntarily with this versatile subject. Numerous examples from physics, technology, biomathematics, cosmology, economy and optimization allow a quick and motivating approach - abstract proofs and unneces-

sary formalism are avoided as far as possible. In the foreground is the modelling of ordinary differential equations of the 1st and 2nd order as well as their analytical and numerical solution methods, in which the theory is briefly dealt with before the application examples. In addition, codes show exemplarily how even more demanding questions can be answered and meaningfully represented with the help of a computer algebra system. In the first chapter the necessary previous knowledge from integral and differential calculus is treated. A large number of exercises including solutions round off the work.