Atmosphere And Ocean A Physical Introduction

The increase in levels of population and human development in coastal areas has led to a greater importance of understanding atmosphere-ocean interactions. This second volume on atmosphere-ocean interactions aims to present several of the key mechanisms that are important for the development of marine storms.

The goals of these lecture notes, based on courses presented by the author at the Courant Institute of Mathematical Sciences, are to introduce mathematicians to the fascinating and important area of atmosphere/ocean science (AOS) and, conversely, to develop a mathematical viewpoint on basic topics in AOS of interest to the disciplinary AOS community, ranging from graduate students to researchers. The lecture notes emphasize the serendipitous connections between applied mathematics and geophysical flows in the style of modern applied mathematics, where rigorous mathematical analysis as well as asymptotic, qualitative, and numerical modeling all interact to ease the understanding of physical phenomena. Reading these lecture notes does not require a previous course in fluid dynamics, although a serious reader should supplement these notes with material such as additional information on geophysical flows, as suggested in the preface. The book is intended for graduate students and researchers working in interdisciplinary areas between mathematics and atmosphere/ocean science.

This book is unique in bringing together the diverse concepts and ideas of meteorologists, atmospheric physicists and oceanographers into a single coherent account of the fluid environment, with emphasis on their physical properties and inter-dependence rather than on the mathematics. It provides an up-to-date appreciation of the subject area with reference to major research programmes in Oceanography and Meteorology, and an invaluable combined perspective for undergraduates who tend to compartmentalise themselves. It also shows the way the subject is currently developing and suggests possible future research.

This fully-revised comprehensive fourth edition covers the whole field of physical geography including climate and atmosphere, geomorphology, biogeography, hydrology, oceans, Quaternary, environmental change, soils, remote sensing and GIS. This new edition reflects developments in the discipline during the last decade, with the expert advisory group providing an international perspective on the discipline of physical geography. Over 2000 entries that are self-contained or cross-referenced include 200 that are new to this edition, over 400 that are rewritten and updated, and new supporting references and additional recommended reading in many others. Entries removed from the last edition are available in the online resource. This volume is the essential reference point for students of physical geography and related environmental disciplines, lecturers and interested individuals alike.

This volume contains the ten most cited articles that have appeared in the journal Atmosphere-Ocean since 1995. These articles cover a wide range of topics in meteorology, climatology and oceanography. Modelling work is represented in five papers, covering global climate model development; a cumulus parameterization scheme for global climate models; development of a regional forecast modelling system and parameterization of peatland hydraulic processes for climate models. Data rehabilitation and compilation in order to support trend analysis work on comprehensive precipitation and temperature data sets is presented in four papers. Field studies are represented by a paper on the circumpolar lead system. While the modelling studies are global in their application and applicability, the data analysis and field study papers cover environments that are specifically, but not uniquely, Canadian. This book will be of interest to researchers, students and professionals in the various sub-fields of meteorology, oceanography and climate science.

This book counteracts the current fashion for theories of ?chaos? and unpredictability by describing a theory that underpins the surprising accuracy of current deterministic weather forecasts, and it suggests that further improvements are possible. The book does this by making a unique link between an exciting new branch of mathematics called ?optimal transportation? and existing classical theories of the large-scale atmosphere and ocean circulation. It is then possible to solve a set of simple equations proposed many years ago by Hoskins which are asymptotically valid on large scales, and use them to derive quantitative predictions about many large-scale atmospheric and oceanic phenomena. A particular feature is that the simple equations used have highly predictable solutions, thus suggesting that the limits of deterministic predictability of the weather may not yet have been reached. It is also possible to make rigorous statements about the large-scale behaviour of the atmosphere and ocean by proving results using these simple equations and applying them to the real system allowing for the errors in the approximation. There are a number of other titles in this field, but they do not treat this large-scale regime.

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

A concise introduction to climate system dynamics Climate Dynamics is an advanced undergraduate-level textbook that provides an essential foundation in the physical understanding of the earth's climate system. The book assumes no background in atmospheric or ocean sciences and is appropriate for any science or engineering student who has completed two semesters of calculus and one semester of calculus-based physics. Describing the climate system based on observations of the mean climate state and its variability, the first section of the book introduces the vocabulary of the field, the dependent variables that characterize the climate system, and the typical approaches taken to display these variables. The second section of the book gives a quantitative understanding of the processes that determine the climate state—radiation, heat balances, and the basics of fluid dynamics. Applications for the atmosphere, ocean, and hydrological cycle are developed in the next section, and the last three chapters of the book directly address global climate change. Throughout, the textbook makes connections between mathematics and physics in order to illustrate the usefulness of mathematics, particularly first-year calculus, for predicting changes in the physical world. Climate change will impact every aspect of life in the coming decades. This book supports and broadens understanding of the dynamics of the climate system by offering a much-needed introduction that is accessible to any science, math, or engineering student. Makes a physically based, quantitative understanding of climate change accessible to all science, engineering, and mathematics undergraduates Explains how the climate system works and why the climate is changing Reinforces, applies, and connects the basic ideas of calculus and physics Emphasizes fundamental observations and understanding An online illustration package and solutions manual for professors is available

The two chapters of this book originally appeared in "Air Sea Exchange of Gases and Particles", edited by P.S. Liss and W.G.N. Slinn. We wrote them as a general introduction to the physical processes in the atmosphere and ocean which govern the transport of gases and particles in and between the two media. Our audience was to be graduate students in physical chemistry of air and sea, and research workers wishing to get started in this or a related field. It was Dr. Alan Longhurst, Director-General of the Atlantic Region, Canada Department of Fisheries and Oceans, who pointed out that our introduction had a far wider audience: in fact, anyone with a scientific background who needs a basic under standing of the physics of the atmosphere and ocean. Dr. D.J. Larner of Reidel agreed, and this book is the result. Since we expended considerable effort to satisfy the demands of the physical chemists, and also discussed the explanations much with our colleagues at home, we expect the reader will find the two parts to be complementary and useful as a unified reference text. On the other hand, since it was designed as background material for a text on air-sea gas exchange and trans port, the more experienced reader will be aware that the picture presented emphasizes transport and exchange processes while it ignores others. No mention is made, for example, of weather forecasting; neither is large-scale ocean modelling considered.

Chapter 7: Atmospheric Pressure and Wind of the eBook Understanding Physical Geography. This eBook was written for students taking introductory Physical Geography taught at a college or university. For the chapters currently available on Google Play presentation slides (Powerpoint and Keynote format) and multiple choice test banks are available for Professors using my eBook in the classroom. Please contact me via email at Michael.Pidwirny@ubc.ca if you would like to have access to these resources. The various chapters of the Google Play version of Understanding Physical Geography are FREE for individual use in a non-classroom environment. This has been done to support life long learning. However, the content of Understanding Physical Geography is NOT FREE for use in college and university courses in countries that have a per capita GDP over $25,000 (US dollars) per year where more than three chapters are being used in the teaching of a course. More specifically, for university and college instructors using this work in such wealthier countries, in a credit-based course where a tuition fee is accessed, students should be instructed to purchase the paid version of this content on Google Play which is organized as one of six Parts (organized chapters). One exception to this request is a situation where a student is experiencing financial hardship. In this case, the student should use the individual chapters which are available from Google Play for free. The cost of these Parts works out to only $0.99 per chapter in USA dollars, a very small fee for my work. When the entire textbook (30 chapters) is finished its cost will be only $29.70 in USA dollars. This is far less expensive than similar textbooks from major academic publishing companies whose eBook are around $50.00 to $90.00. Further, revenue generated from the sale of this academic textbook will provide “the carrot” to entice me to continue working hard creating new and updated content. Thanks in advance to instructors and students who abide by these conditions. IMPORTANT - This Google Play version is best viewed with a computer using Google Chrome, Firefox or Apple Safari browsers.

This book presents a unique and comprehensive view of the fundamental dynamical and thermodynamic principles underlying the large circulations of the coupled ocean-atmosphere system Dynamics of The Tropical Atmosphere and Oceans provides a detailed description of macroscale tropical circulation systems such as the monsoon, the Hadley and Walker Circulations, El Niño, and the tropical ocean warm pool. These macroscale circulations interact with a myriad of higher frequency systems, ranging from convective cloud systems to migrating equatorial waves that attend the low-frequency background flow. Towards understanding and predicting these circulation systems. A comprehensive overview of the dynamics and thermodynamics of large-scale tropical atmosphere and oceans is presented using both a “reductionist” and “holistic” perspectives of the coupled tropical system. The reductionist perspective provides a detailed description of the individual elements of the ocean and atmospheric circulations. The physical nature of each component of the tropical circulation such as the Hadley and Walker circulations, the monsoon, the incursion of extratropical phenomena into the tropics, precipitation distributions, equatorial waves and disturbances described in detail. The holistic perspective provides a physical description of how the collection of the individual components produces the observed tropical weather and climate. How the collective tropical processes determine the tropical circulation and their role in global weather and climate is provided in a series of overlapping theoretical and modelling constructs. The structure of the book follows a graduated framework. Following a detailed description of tropical phenomenology, the reader is introduced to dynamical and thermodynamical constraints that guide the planetary climate and establish a critical role for the tropics. Equatorial wave theory is developed for simple and complex background flows, including the critical role played by moist processes. The manner in which the tropics and the extratropics interact is then described, followed by a discussion of the physics behind the subtropical and near-equatorial precipitation including arid regions. The El Niño phenomena and the monsoon circulations are discussed, including their covariance and predictability. Finally, the changing structure of the tropics is discussed in terms of the extent of the tropical ocean warm pool and its relationship to the intensity of global convection and climate change. Dynamics of the Tropical Atmosphere and Oceans is aimed at advanced undergraduate and early career graduate students. It also serves as an excellent general reference book for scientists interested in tropical circulations and their relationship with the broader climate system.

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

This textbook introduces fundamental dynamics of tropical atmosphere and ocean useful for advanced graduate courses in atmospheric and climate sciences. It presents an overview of simple atmospheric and oceanic models, as well as the observed phenomena associated with major climate modes in the tropics. It provides students with an up-to-date understanding of the dynamics of tropical climate and weather phenomena. A particular focus is given to scale interactions and atmosphere-ocean interactions associated with tropical mean climate (such as ITCZ asymmetry and annual cycles), synoptic-scale variability (such as synoptic wave trains, easterly waves and tropical cyclones), intraseasonal oscillations (such as Madden-Julian Oscillation and boreal summer intraseasonal oscillation), and interannual variability (such as El Niño-Southern Oscillation and Indian Ocean Dipole). Theoretical and conceptual models are presented for better understanding of physical mechanisms behind the observational phenomena. This book aims to motivate graduate students in atmospheric sciences and oceanography by providing them with the key methods and tools necessary to conduct research.

With both the growing importance of integrating studies of air-sea interaction and the interest in the general problem of global warming, the appearance of the second edition of this popular text is especially welcome. Thoroughly updated and revised, the authors have retained the accessible, comprehensive expository style that distinguished the earlier edition. Topics include the state of matter near the interface, radiation, surface wind waves, turbulent transfer near the interface, the planetary boundary layer, atmospherically-forced perturbations in the oceans, and large-scale forcing by sea surface buoyancy fluxes. This book will be welcomed by students and professionals in meteorology, physical oceanography, physics and ocean engineering.

How the Ocean : Atmosphere System Is Driven -- Transfer of Properties between Atmosphere and Ocean -- Properties of a Fluid at Rest -- Equations Satisfied by a Moving Fluid -- Adjustment under Gravity in a Nonrotating System -- Adjustment under Gravity of a Density-Stratified Fluid -- Effect of Rotation -- Gravity Waves in a Rotating Fluid -- Forced Motion -- Effects of Side Boundaries -- The Tropics -- Mid-Latitudes -- Instabilities, Fronts, and the General Circulation -- Units and Their SI Equivalents -- Useful Values -- Properties of Seawater -- Properties of Moist Air.

The National Academies' Board on Atmospheric Sciences and Climate (BASC) held a workshop to explore and evaluate current efforts to model physical processes of coupled atmosphere-land-ocean (A-L-O) models. Numerical models of the atmosphere and ocean are central to weather prediction, research, and education. Although great strides have been made over the past few decades in understanding the atmosphere and ocean, modeling capabilities, and numerical A-L-O simulations, some unresolved processes in the models do not adequately represent knowledge of the underlying physics. Moreover, there is evidence that further progress in numerical simulations is being impeded by the slow pace of improvement in the representation of key physical processes in the models and the fact that geophysical flow models are not receiving the attention needed to make these tools more useful and accurate. These models often are used to predict future events, so it is imperative that their underlying physical processes be represented as robustly as possible. During the workshop, the parameterization of physical processes in A-L-O models was addressed, including associated errors, testing, and efforts to improve the use of parameterizations. Participants also examined intellectual and scientific challenges in modeling and highlighted the idea that some of the key impediments to progress in representing physical processes are primarily cultural in nature.

The Atmosphere and Ocean is a fully revised and updated student friendly physical introduction to the atmosphere and ocean. Now in its Third Edition, the book continues to provide students with an accessible description of the atmosphere and ocean with emphasis on their physical properties and inter-dependence. Clearly structured throughout, the book demonstrates that the atmosphere and ocean are both subject to the influence of the earth's rotation and therefore they have a common dynamical basis. The author clearly demonstrates the fundamental differences between the two environments and provides the reader with a much better understanding of the atmosphere and the ocean and an appreciation of their closest interactive relationship. There have been many developments in the field over the past ten years and this latest edition of a highly successful textbook brings together new material on the ocean-atmosphere system and climate, the observed circulation of the atmosphere and ocean and radiation in the atmosphere and ocean.

Fully revised and updated 3rd Edition of student friendly physical introduction to the atmosphere and ocean. Now includes new chapters on observed circulation of the atmosphere and ocean, energy flows in the ocean atmosphere system, modeling the ocean and atmosphere, the ocean atmosphere system and climate. Well structured and

written in an authoritative yet accessible style suitable for 2nd and 3rd year students taking courses in meteorology, oceanography and related Earth Sciences or as an introduction for graduate students. Emphasis placed on physical properties and inter-dependence of the ocean and climate. Part of the RMetS (Royal Meteorological Society) book series, Advancing Weather and Climate Science

The goals ofthe Symposium were to highlight advances in modelling ofatmosphere and ocean dynamics, to provide a forum where atmosphere and ocean scientists could present their latest research results and learn ofprogress and promising ideas in these allied disciplines; to facilitate interaction between theory and applications in atmosphere/ocean dynamics. These goals were seen to be especially important in view ofcurrent efforts to model climate requiring models which include interaction between atmosphere, ocean and land influences. Participants were delighted with the diversity ofthe scientific programme; the opportunity to meet fellow scientists from the other discipline (either atmosphere or ocean) with whom they do not normally interact through their own discipline; the opportunity to meet scientists from many countries other than their own; the opportunity to hear significant presentations (50 minutes) from the keynote speakers on a range ofrelevant topics. Certainly the goal ofcreating a forum for exchange between atmosphere and ocean scientists who need to input to create realistic models for climate prediction was achieved by the Symposium and this goal will hopefully be further advanced by the publication ofthese Proceedings.

The author has sought to incorporate in the book some of the fundamental concepts and principles of the physics and dynamics of the atmosphere, a knowledge and understanding of which should help an average student of science to comprehend some of the great complexities of the earth-atmosphere system, in which a thr- way interaction between the atmosphere, the land and the ocean tends to maintain an overall mass and energy balance in the system through physical and dynamical processes. The book, divided into two parts and consisting of 19 chapters, introduces only those aspects of the subject that, according to the author, are deemed essential to meet the objective in view. The emphasis is more on clarity and understanding of physical and dynamical principles than on details of complex theories and ma- ematics. Attempt is made to treat each subject from ?rst principles and trace its development to present state, as far as possible. However, a knowledge of basic c- culus and differential equations is sine qua non especially for some of the chapters which appear later in the book.

This book is a collection of the lectures, held at the International Summer School ISSAOS-2000 in L'Aquila (Italy), given by invited lecturers coming from both Europe and the USA. The goal of the book is to provide a broad panorama of spaceborne remote sensing techniques, at both microwave and visible-infrared bands and by both active and passive sensors, for the retrieval of atmospheric and oceanic parameters. A significant emphasis is given to the physical modeling background, instrument potential and limitations, inversion methods and applications. Topics on international remote sensing programs and assimilation techniques into numerical weather forecast models are also touched. The main purpose of the book is to offer to young scientists, Ph.D. or equivalent students, and to all who would like to have a broad-spectrum understanding of spaceborne remote sensing capabilities, introductory material to each remote sensing topic written by the most qualified experts in the field.

This is an interdisciplinary conference. Topics include: Molecular Spectroscopy and Atmospheric Radiative Process; Optical Propagation in the Atmosphere and Ocean; Optical Investigation of the Atmosphere and Ocean; Physical Phenomena in the Thermosphere and Ionosphere;, Structure and Dynamics of the Middle Atmosphere; and Dynamics of the Atmosphere and Climate of the Asian Region.

The new edition of this widely respected text provides comprehensive and up-to-date coverage of the effects of biological–physical interactions in the oceans from the microscopic to the global scale. considers the influence of physical forcing on biological processes in a wide range of marine habitats including coastal estuaries, shelf-break fronts, major ocean gyres, coral reefs, coastal upwelling areas, and the equatorial upwelling system investigates recent significant developments in this rapidly advancing field includes new research suggesting that long-term variability in the global atmospheric circulation affects the circulation of ocean basins, which in turn brings about major changes in fish stocks. This discovery opens up the exciting possibility of being able to predict major changes in global fish stocks written in an accessible, lucid style, this textbook is essential reading for upper-level undergraduates and graduate students studying marine ecology and biological oceanography

Wallace and Hobbs' original edition of Atmospheric Science helped define the field nearly 30 years ago, and has served as the cornerstone for most university curriculums. Now students and professionals alike can use this updated classic to understand atmospheric phenomena in the context of the latest discoveries and technologies, and prepare themselves for more advanced study and real-life problem solving. Atmospheric Science, Second Edition, has been completely revamped in terms of content and appearance. It contains new chapters on atmospheric chemistry, the Earth system,climate, and the atmospheric boundary layer, as well as enhanced treatment of atmospheric dynamics, weather forecasting, radiative transfer, severe storms, and human impacts, such as global warming. The authors illustrate concepts with colorful state-of-the-art imagery and cover a vast amount of new information in the field. They have also developed several online materials for instructors who adopt the text. With its thorough coverage of the fundamentals, clear explanations, and extensive updates, Wallace & Hobbs' Atmospheric Science, Second Edition, is the essential first step in educating today's atmospheric scientists. * 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

Introduction to Satellite Remote Sensing: Atmosphere, Ocean and Land Applications is the first reference book to cover ocean applications, atmospheric applications, and land applications of

remote sensing. Applications of remote sensing data are finding increasing application in fields as diverse as wildlife ecology and coastal recreation management. The technology engages electromagnetic sensors to measure and monitor changes in the earth’s surface and atmosphere. The book opens with an introduction to the history of remote sensing, starting from when the phrase was first coined. It goes on to discuss the basic concepts of the various systems, including atmospheric and ocean, then closes with a detailed section on land applications. Due to the cross disciplinary nature of the authors’ experience and the content covered, this is a must have reference book for all practitioners and students requiring an introduction to the field of remote sensing. Provides study questions at the end of each chapter to aid learning Covers all satellite remote sensing technologies, allowing readers to use the text as instructional material Includes the most recent technologies and their applications, allowing the reader to stay up-to-date Delves into laser sensing (LIDAR) and commercial satellites (DigitalGlobe) Presents examples of specific satellite missions, including those in which new technology has been introduced

This scarce antiquarian book is a facsimile reprint of the original. Due to its age, it may contain imperfections such as marks, notations, marginalia and flawed pages. Because we believe this work is culturally important, we have made it available as part of our commitment for protecting, preserving, and promoting the world's literature in affordable, high quality, modern editions that are true to the original work.

Global Physical Climatology is an introductory text devoted to the fundamental physical principles and problems of climate sensitivity and change. Addressing some of the most critical issues in climatology, this text features incisive coverage of topics that are central to understanding orbital parameter theory for past climate changes, and for anthropogenic and natural causes of near-future changes-- Key Features * Covers the physics of climate change * Examines the nature of the current climate and its previous changes * Explores the sensitivity of climate and the mechanisms by which humans are likely to produce near-future climate changes * Provides instructive end-of-chapter exercises and appendices

In this way, an excellent overview is obtained of the relations between the results of the different models within the hierarchy. Mechanistic description of the physics of the results is provided and, where possible, links with results of state-of-the-art models and observations are sought. The reader is expected to have a background in basic incompressible fluid dynamics and applied mathematics, although the level of the text is mixed and sometimes quite introductory. Each of the chapters is rather self-contained and many details of derivations are provided.

This book is written so that a reader who is only vaguely aware of 3D climate models will be able to gain an understanding of what the models are attempting to simulate, how the models are constructed, what the models have succeeded in simulating, and how the models are being used.

Provides a foundation of the theoretical and practical aspects of radiative transfer, for the atmospheric, oceanic and environmental sciences.

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This textbook develops a fundamental understanding of geophysical fluid dynamics by providing a mathematical description of fluid properties, kinematics and dynamics as influenced by earth’s rotation. Its didactic value is based on elaborate treatment of basic principles, derived equations, exemplary solutions and their interpretation. Both starting graduate students and experienced scientists can closely follow the mathematical development of the basic theory applied to the flow of uniform density fluids on a rotating earth, with (1) basic physics introducing the "novel" effects of rotation for flows on planetary scales, (2) simplified dynamics of shallow water and quasi-geostrophic theories applied to a variety of steady, unsteady flows and geophysical wave motions, demonstrating the restoring effects of Coriolis acceleration, earth’s curvature (beta) and topographic steering, (3) conservation of vorticity and energy at geophysical scales, and (4) specific applications to help demonstrate the ability to create and solve new problems in this very rich field. A comprehensive review of the complex geophysical flows of the ocean and the atmosphere is closely knitted with this basic description, intended to be developed further in the second volume that addresses density stratified geophysical fluid dynamics.

Introductory Physics of the Atmosphere and OceanSpringer

This highly relevant text documents the first international meeting focused specifically on high-resolution atmospheric and oceanic modeling. It was held recently at the Earth Simulator Center in Yokohama, Japan. Rather than producing a standard conference proceedings volume, the editors have decided to compose this volume entirely of papers written by invited speakers at the meeting, who report on their most exciting recent results involving high resolution modeling.

One of the major experiments in earth science at the present time is about to begin: the World Climate Research Program (WCRP). The objectives of WCRP are to determine the extent to which climate change can be predicted, and the extent to which human activities (such as increasing the level of CO) can influence our climate. 2 To understand and possibly to predict climate change, one needs a good understanding of the dynamics of the ocean, the atmosphere, and the processes by which they are coupled. Two major programs are being developed within WCRP: TOGA (Tropical Oceans, Global Atmosphere) and WOCE (World Ocean CirculatIon Experiment). The success of these programs will depend on many things, not least of which is the existence of a pool of active young researchers. This NATO Advanced Study Institute brought together students and young scientists from 13 countries, most of them from Europe and North America. The objective was to provide them with a background in the perceived state of knowledge of atmosphere and ocean dynamics, and to mediate a flavour of the problems presently concerning scientists active in climate related dynamics. In the past, the two disciplines of oceanography and meteorology have largely been carried out separately. But for climate research both disciplines must interact strongly, and another ob jecti ve of this school was to bring together both oceanographers and meteorologists. To promote an integrated approach, the lecture presentations were divided into two formats.