Preface

The intent of *Introduction to Geophysical Fluid Dynamics—Physical and Numerical Aspects* is to introduce its readers to the principles governing air and water flows on large terrestrial scales and to the methods by which these flows can be simulated on the computer. First and foremost, the book is directed to students and scientists in dynamical meteorology and physical oceanography. In addition, the environmental concerns raised by the possible impact of industrial activities on climate and the accompanying variability of the atmosphere and oceans create a strong desire on the part of atmospheric chemists, biologists, engineers, and many others to understand the basic concepts of atmospheric and oceanic dynamics. It is hoped that those will find here a readable reference text that will provide them with the necessary fundamentals.

The present volume is a significantly enlarged and updated revision of *Introduction to Geophysical Fluid Dynamics* published by Prentice-Hall in 1994, but the objective has not changed, namely to provide an introductory textbook and an approachable reference book. Simplicity and clarity have therefore remained the guiding principles in writing the text. Whenever possible, the physical principles are illustrated with the aid of the simplest existing models, and the computer methods are shown in juxtaposition with the equations to which they apply. The terminology and notation have also been selected to alleviate to a maximum the intellectual effort necessary to extract the meaning from the text. For example, the expressions planetary wave and stratification frequency are preferred to Rossby wave and Brunt-Väisälä frequency, respectively.

The book is divided in five parts. Following a presentation of the fundamentals in Part I, the effects of rotation and of stratification are explored in Parts II and III, respectively. Then, Part IV investigates the combined effects of rotation and stratification, which are at the core of geophysical fluid dynamics. The book closes with Part V, which gathers a group of more applied topics of contemporary interest. Each part is divided into relatively well-contained chapters to provide flexibility of coverage to the professor and ease of access to the researcher. Physical principles and numerical topics are interspersed in order to show the relation of the latter to the former, but a clear division in sections and subsections makes it possible to separate the two if necessary.

Used as a textbook, the present volume should meet the needs of two courses, which are almost always taught sequentially in oceanography and meteorology curricula, namely Geophysical Fluid Dynamics and Numerical Modeling of Geophysical Flows. The integration of both subjects here under a single cover makes it possible to teach both courses with a unified notation and clearer connection of one part to the other than the traditional use of two textbooks, one for each subject. To facilitate the use as a textbook, a number of exercises are offered at the end of every chapter, some more theoretical to reinforce the understanding of the physical principles and others requiring access to a computer to apply the numerical methods. An accompanying Web site (http://booksite.academicpress.com/9780120887590/) contains an assortment of data sets and MATLAB™ codes that permit instructors to ask students to perform realistic and challenging exercises. At the end of every chapter, the reader will also find short biographies, which together form a history of the intellectual developments of the subject matter and should inspire students to achieve similar levels of distinction.

A general remark about notation is appropriate. Because mathematical physics in general and this discipline in particular involve an array of symbols to represent a multitude of variables and constants, with and without dimensions, some conventions are desirable in order to maximize clarity and minimize ambiguity. To this end, a systematic effort has been made to reserve classes of symbols for certain types of variables: Dimensional variables are denoted by lowercase Roman letters (such as u, v, and w for the three velocity components), dimensional constants and parameters use uppercase Roman letters (such as H for domain height and L for length scale), and dimensionless quantities are assigned lowercase Greek letters (such as α for an angle and ϵ for a small dimensionless ratio). In keeping with a well established convention in fluid mechanics, dimensionless numbers credited to particular scientists are denoted by the first two letters of their name (e.g., Ro for the Rossby number and Ek for the Ekman number). Numerical notation is borrowed from Patrick J. Roache, and numerical variables are represented by tildas ($\tilde{}$). Of course, rules breed exceptions (e.g., g for the gravitational acceleration, ω for frequency, and ψ for streamfunction).

We the authors wish to acknowledge the assistance from numerous colleagues across the globe, too many to permit an exhaustive list here. There is one person, however, who deserves a very special note of recognition. Prof. Eric Deleersnijder of the Université catholique de Louvain, Belgium, suggested that the numerical aspects be intertwined with the physics of Geophysical Fluid Dynamics. He also provided significant assistance during the writing of these numerical topics. An additional debt of gratitude goes to our students, who provided us not only with a testing ground for the teaching of this material but also with numerous and valuable comments. The following people are acknowledged for their pertinent remarks and suggestions made on earlier versions of the text, all of which have improved the clarity and accuracy of the presentation: Aida Alvera-Azcárate, Alexander Barth, Emmanuel Boss, Pierre Brasseur, Hans Burchard, Pierre Lermusiaux, Evan Mason, Anders Omstedt, Tamay Özgökmen, Thomas Rossby, Charles Troupin, and Lars Umlauf. We also would like to thank our wives Mary and Françoise for their patience and support.

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January 2011