Ocean Dynamics

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Preface

This book is directed to graduate students of physical oceanography and neighboring fields like meteorology, geophysics or general physics, and to anybody interested in a thorough discussion of ocean dynamics. Based on the well-known fundaments of fluid mechanics, thermodynamics, and wave theory, the first three parts of the book provide a detailed derivation of the basic physical laws describing the motions in the ocean, common approximations which are made to simplify the discussion of e. g. the large-scale fluid dynamics of the ocean, and a comprehensive treatment of linear wave theory. The following part on the theory of turbulence in the ocean attempts to reach for newer results, in particular regarding the role of eddies for the large-scale dynamics. In the next part, classical concepts and models of ocean circulation are combined with newer material. Finally, an appendix reviews some of the needed mathematical tools and the models which are used in the book. While far from being complete, we have included as much as possible of what we think is important to understand the physics of the ocean, aiming for a high accuracy both in physical argumentation and mathematical derivation.

In the last decades, increasing interest in climate change has fostered research with respect to the role of the ocean in the climate system and has changed the field of physical oceanography from a small group of largely ignored academical experts, into a highly recognized arena of scientific discussion, which sometimes even takes place in the media. At the same time, the increasing performance of computers allowed more and better resolved integrations of numerical ocean models. In this book we have not addressed the field of numerical ocean modeling. However, we believe that for both, the scientific discussion and a thorough interpretation of numerical models, knowledge of the material presented in this book should be of value.

The book is based on material from a series of lectures to graduate oceanography students at the University Kiel and to graduate physics students at Bremen University which has evolved over the years. While the reader of this book does not need any prior knowledge about physical oceanography, we assume a sound physical and mathematical basis comparable to that of a Bachelor in physics. In the notation we mostly follow the conventions in the oceanographic literature. Relevant variables are generally introduced when they arise in the context of the discussion; a list of symbols and their meaning is given in Appendix .

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