Book Review: Introductory Dynamical Oceanography

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Abstract (Book Review)

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About the Book
The book entitled ‘Introductory Dynamical Oceanography’ written by Professor Stephen Pond and Professor George L. Pickard, Department of Oceanography, University of British Columbia, Vancouver, Canada, is a unique and pioneer contribution to the field of physical oceanography in general and in descriptive, synoptic, dynamical and instrumental oceanography in particular. It throws light on the various issues and mathematical models related to in-situ and ex-situ physical processes operative within ocean as well as ocean-atmospheric system drive worldwide ocean circulation. Oceanographers and coastal geomorphologist pays attention on mathematics, as the essence of the dynamical approach is to deduce quantitative information about the movements and circulations of the ocean water from mathematical statements of the basic principles of physics (aspects of fluid mechanics) when applied to ocean waters and inland river systems.

Review of the Book
The most laudable of the present study is the intricacies of physics of the ocean circulation in local as well as regional scale or worldwide. The concern of this book is to establish the facts regarding the spatio-temporal interactions within ocean and ocean atmospheric system in terms of exchange and flow of mass and energy at various scales of oceanography. The work highlights the recent changes as well as modern trends in the arena of dynamical physical oceanography.

In this book the author(s) explain and seek to introduce the field to physicist intending to specialize in physical oceanography, to help oceanographers and learners in other disciplines to gather enough knowledge about the physics of the ocean circulation. The book deals with the aspects which the physical oceanographers need to understand for their own work, and it also gives those in allied fields an appreciation of what the dynamical oceanographer is trying to do in contributing to our overall knowledge of the ocean waters.

The Authors have introduced the Practical Salinity Scale 1978 as the basic definition of this quantity and the International Equation of State 1980 as the most up-to-date statement of the relations between salinity, temperature, pressure and density of the water. A section on the beta spiral (method for determining absolute velocities from the density field), mixed layer model, eddy resolving numerical models and formation of waves and tides have been substantially presented.

For researchers in physical oceanography the book should serve as a basic introduction, to be supplemented either by lectures or by references to the literature. Topics like turbulence, vorticity, celerity, equatorial circulation, boundary layers, thermocline and thermohaline circulation theories, as well as mechanism of waves and tides have been linked to original volume of literature for reading reference.

The authors have specially focused on different processes related to the large scale average circulation of ocean water and much attention has also been paid to demonstrate variability of those processes. For examples, eddies in open oceans and those of smaller scale in coastal areas have been well explained. Justification of such treatment lies in the fact that, in many situations, small scale or short term variations in those processes may be larger than those of long term means.

The authors have taken absolute care for elaborating explanations to many of the most common ocean circulation problems that often create ambiguities among the readers when tried to conceptualize from many other available text. The reasons behind mid latitude oceanic circulations to be clock wise in northern hemisphere and counter clock wise in the southern hemisphere are clearly explained. The concentrated and swift flow of water along western margin of the oceans and broad and slow flow elsewhere have been well taken care off. The eastward circulation in southern ocean around Antarctica and the complicated equatorial flow patterns have been so lucidly demonstrated that a reader with elementary knowledge in oceanography may be facilitated to develop a clear understanding about those phenomena. The distributional pattern of ocean currents across the depth has been vividly

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demonstrated with diagrams and mathematical statements of the physics involved. Abstract concepts like mechanism of transfer of momentum and energy between atmosphere and ocean have been presented in a comprehensive manner that has really made the publication distinctly different from other titles on the subject brought out so far. In dealing with the surface and internal waves their origin; factors behinds this origin and modifications; nature in open and shallow sea; impacts in macro and micro scale circulations etc. have been widely managed in the text. In this context submarine earthquakes and generation of tsunami waves are justifiable accommodated in the discussion.

The book illustrated conspicuously the properties of sea water relevant to dynamical oceanography, and a summary of basic physical laws or principles which will be used. The principle of conservation of mass is used in the form of conservation of volume which, for the incompressibility approximation used, places mild restrictions on the possible motions. Different static stability is presented and discussed, and possibility of double diffusive instability is mentioned. Then the forces which may be acting in the sea are classified and some simple examples are given. Following this analysis and occupying a large part of the present exposition is a discussion of the application of Newton’s Second Law of Motion to relate the forces acting to the resulting motion of the sea water on rotating earth—the field of geophysical fluid dynamics. Because of analytical difficulties in solving some of the forms the equations of motion, numerical methods for solving the equations are increasingly being applied; the basic principles, successes and limitations of those techniques are summarized. Some aspects of the longer period or shorter period time-varying motions and their interactions with the large-scale flow are discussed.

This book deals with a brief account of ideas related to the thermohaline circulation which are presented in short, mainly in descriptive manner. Accounts of the characteristics of surface and internal waves and tide are given.

Finally, some analysis and discussion is offered on topics which appear to be the presently active and related to future areas of research in the field of dynamical oceanography. It has been found that the materials covered in this book will make it complete enough for non-physicist and also usable as an introduction to all geoscientist.

Therefore, this analytical text possesses immense indented values which should certainly satisfy the scientists and academicians to get distinct and elaborative discourse and different aspects of dynamic character of oceans waters.

References