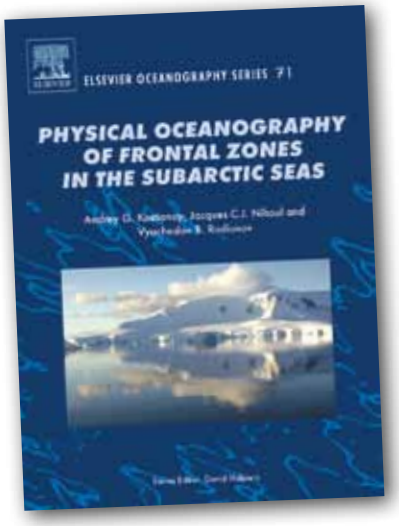
Physical Oceanography of Frontal Zones in the Subarctic Seas



By Andrey G. Kostianoy, Jacques C.J. Nihoul, and Vyacheslav B. Rodionov, Elsevier Science Ltd., 2004, 316 pages
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REVIEWED BY PETER WADHAMS

Fronts and frontal zones form natural boundaries in the oceans. Their effects are sometimes dramatic when seen from deck level, such as the massive changes in marine life, bird life, and ocean color seen on crossing the Antarctic Polar Front. But they are difficult to locate and costly to study using ships alone, and their intense investigation did not begin until the 1970s with the advent of satellites that could display sea-surface-temperature patterns at high resolution.

Originally fronts were thought to be fairly static boundaries between water masses. With the more intensive investigations from the 1970s onwards, they are now seen as a dynamic phenomenon with self-supporting characteristics that form one link in the energy cascade chain from the global circulation down to small-scale phenomena. In addition to climatically driven fronts along the edges of major ocean currents, there is a wide variety of smaller-scale fronts associated with coastal currents, such as small gyres, eddies, upwelling zones, and river-discharge plumes. Instabilities in these fronts themselves lead to eddies and jets that exchange water and energy across the front. For all these reasons, it is important to understand the nature and anatomy of fronts wherever they are found.

Physical Oceanography of Frontal Zones in the Subarctic Seas deals with fronts in the subarctic seas, encompassing principally the Nordic Seas of Northwest Europe (Norwegian, Greenland, Barents) and the Bering Sea. Based mainly on observational data, this text is very useful because no such single compendium of frontal observations exists. For the euro-Arctic, most of the observations described are Russian in origin and are based on an earlier book *Ocean Fronts of the North-European Basin Seas* (1998) written in Russian by two of the authors, Radionov and Kostianoy. The core of fieldwork that generated the data was the 25th expedition of R/V *Professor Molchanov* by the USSR Hydrometeorological Service (Hydromet) in 1989. Nihoul has joined the authorship to bring in the results of five years of survey work in the northern Bering Sea supported by the National Science Foundation Inner Shelf Transfer and Recycling (ISHTAR) program. He has interpreted those data with the help of direct and inverse three-dimensional models developed at the University of Liège in Belgium.

The book begins with basic definitions of fronts and the parameters used to describe them, followed by a summary of modern investigative techniques. Chapter 2 contains a brief history of exploration of the eastern and western Arctic seas, with many references to Russian expeditions that are little known in the west. This is brought up to date with a "state-of-the-art" section on recent oceanographic research in the frontal zones, which includes projects of the 1980s such as the Marginal Ice Zone Experiment (MIZEX), but stops at 1991 and does not mention recent European efforts in the Greenland Sea such as ESOP (European SubPolar Ocean Programme) of 1994-1999 and its successors.

Chapter 3 begins a systematic account of frontal zones in the Norwegian and Greenland Seas, defining and naming nine distinct frontal zones and showing typical examples of temperature and salinity structure across the fronts. Chapter 4 does the same for the White and Barents Seas and Chapter 5 for the Bering Sea, in this case with some mathematical simulations shown, too, and some consideration of the effect of fronts on the ecosystem dynamics. Chapter 6 looks more deeply into the structure of the fronts, including the thermohaline structure and vertical fine structure. Chapter 7 examines the fascinating phenomena of meanders, eddies, and jets that arise

along fronts, and deals with their structure, shapes (the double mushroom is my favorite), and the cross-frontal exchange processes that these phenomena allow.

In all, this is a very useful book. The emphasis on Russian work in the Nordic Seas means that we are exposed to the results of a great deal of systematic oceanographic work that is not generally known in the West. On the other hand, much western work, especially on eddies and other mesoscale structures, is not present. There is no color here; all of the numerous maps are contoured in black and white, which I must admit I find refreshing (and also more informative) after the mass of color-coded maps that now dominate oceanography.

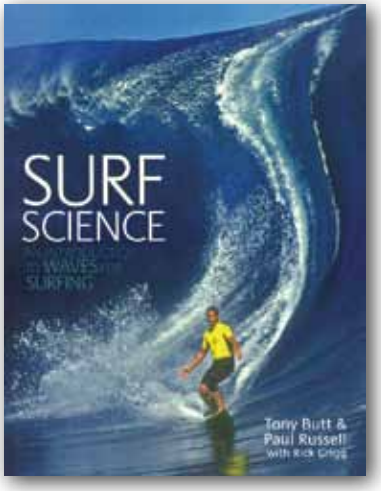
Anyone interested in the subarctic seas of the Atlantic and Pacific will find this book useful, and it is written at a level that can be understood by the non-specialist, although the style does retain a few signs of its Russian language origin.

Peter Wadhams *(pw11@damtp.cam.ac.uk) is Professor of Ocean Physics, Department of Applied Mathematics and Theoretical Physics, University of Cambridge, UK.*

Surf Science
An Introduction to Waves for Surfing

By Tony Butt and Paul Russel with Rick Grigg, The University of Hawaii Press, 2004, 144 pages
Paperback: ISBN 0824828917, $32 US

REVIEWED BY DAVID F. NAAR



Reading and reviewing this book is one of my more memorable moments as a scientist and a surfer. I actually read it while flying over the Pacific Ocean and going to sea on the R/V *Atlantis* from Easter Island to Tahiti. I had plenty of opportunities to look at the ocean and relate to the descriptions provided, such as crossing ground swells, short period seas, and capillary waves forming on a calm, glassy sea. As a professor in oceanography and a surfer, I thought I had a pretty good understanding of how swells and waves formed before I read this book. Now I realize that there is much more to know and that details related to the transfer of wind energy to ocean swell energy are still not understood.

This paperback clearly reaches out to both surfers and those interested in the surf, which makes it an ideal introductory textbook. It has great color graphics and color photos. The text is written in a qualitative, but accurate style. There are self-contained boxes with equations, informative diagrams, and a good mix of text and images. The equations are generally followed by sufficient references where the reader can find more detailed information. In addition, there is a nice "Glossary and Further Reading" section. Thus, this book could also serve as a starting base for a more detailed graduate course.

The book is well-written and well-organized into eight self-contained chapters. These chapters describe the formation of a wave from start to finish, including such things as the global wind patterns and changing weather patterns; the book ends by discussing how waves move sediment. The remaining six chapters deal with specifics of certain types of waves, winds, water temperature, tides, global wave characteristics, and finally, how to forecast waves (along with a useful list of world wide web pages related to surf forecasting).

Another attractive aspect of this book is the historical perspective provided regarding wave research. There is enough qualitative information in the book that surfers who want to have a better understanding about surf forecasting will benefit from this book, but may not appreciate some of the details provided. Those well trained in physics or mathematics will benefit from the real-world examples of the processes defined by the math-