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BOOK REVIEW

Kostianoy, A.G., J.C.J. Nihoul and V.B. Rodionov. 2004. – ***Physical oceanography of the frontal zones in the sub-arctic***. Elsevier Oceanographic Series, 71. The Netherlands, 316 pp.

This book is an important contribution to the knowledge of a relevant natural phenomenon, the *marine frontal zones*, where waters with different characteristics enter in contact. This phenomenon is very complex and can be observed in a broad range of spatio-temporal scales. Frontal marine zones are especially interesting from the point of view of both fundamental and applied science.

The objective of this book is to analyze the physical processes that take place in the sub-artic frontal zones located in the Norwegian, Greenland, Barents and Bering Seas. The results presented are based on the results of previous studies on oceanic frontal zones carried out by Professor Konstantin N. Fedorov and published in his fundamental work *The Physical Nature and Structure of oceanic fronts*. Several hypotheses proposed by Fedorov have been developed, improved and confirmed by Kostianoy, Nihoul and Rodionov using results from in situ observations, numerical modelling and laboratory simulations.

Chapter 1 is dedicated to defining the frontal zone and describing its physical characteristics, related terminology and research methods.

The spatio-temporal multiscale complexity of the frontal zone, often with an associated current that at the same time divides and connects different water masses, complicates defining this phenomenon. Introducing clear physical concepts such as horizontal gradients of temperature and salinity, the angle of inclination of the frontal interface in the temperature, salinity and density fields, and the spatial distribution of density relationship allows the authors to describe the phenomenon three-dimensionally. This parameterization also allows them to compare frontal zones located in different seas, to describe the relationship between several types of marine fronts at different scales that are located within the frontal zone, and analyze the fine structure observed in the associated vertical profiles of temperature and salinity.

The North Polar Frontal Zone (NPFZ) is situated in the Norwegian, Greenland and Barents Seas. NPFZ is a climatic frontal zone generated by two elements of planetary circulation interacting: relatively warm and salty waters of the Atlantic Ocean, which displace from South to North, and colder fresher waters, which displace from Polar areas to the South. This zone is maintained quasistationary by winter cooling, ice melting and multiscale mixing processes.

Through a brief history of the exploration and study of the sub-artic seas, Chapter 2 shows how the research focus has changed to the study of the frontal zones that determine the oceanographic regime of the described sub-arctic seas. The complete list of methods that have been used during the observations, the objectives of scientific programs and research projects in these seas, prepares the reader for the future detailed description of the phenomenon.

Chapters 3, 4 and 5 are dedicated to analyzing the sub-arctic frontal zones. Each sea has its own description of geographic and oceanographic conditions, followed by a detailed study of the observed multifrontal structure. The analysis is based on a combination of published results, historical data sets, and in situ observations made by the authors during oceanographic campaigns. In the case of the Bering Sea (Chapter 5) the three-dimensional model of GHER is used to improve the analysis of the regional ecosystem.

The analysis of the physical structure of temperature and salinity fields within the frontal zones, presented in Chapter 6, deserves special attention. The multifrontal structure of the North Polar Frontal Zone is described based on satellite observations. The data obtained from in situ observations during different oceanographic campaigns by Russian and western institutions, allow the authors to describe the important details of the frontal interfaces and determine the characteristic mesoscale structures located within this zone. The analysis of the fine structure of temperature and salinity profiles obtained in the frontal zone allows them to determine the structure forming processes and study the mechanisms that maintain the heat and salt cross frontal exchange.

Chapter 7 presents the analysis of mesoscale processes which generate the internal structure of the frontal zones. Mesoscale phenomena like eddies, frontal meanders and frontal instabilities have been analyzed and compared using well-known hydrodynamic dimensionless parameterizations.

The book demonstrates the importance of the Arctic Ocean and sub-arctic seas as components of the global climate system and shows them to be the most sensitive regions to climate change. Physical processes that take place in these regions influence regional and global circulation, and heat and mass transfer through water exchange between sub-arctic areas and the Atlantic and Pacific Oceans. One of the overall objectives of the Arctic and sub-arctic oceanographic research is to gain a better understanding of the mesoscale physical and biological processes in these seas.

The correct implementation of numerous global climate models and regional Arctic Ocean models depends heavily on good quality background data, as well as validation and interpretation of the simulation results. Besides salinity and temperature distributions, density stratification, etc., these should include data on the mesoscale structure and dynamics of the oceanic frontal zones and fronts. Such information has been, until recently, sparse in temporal and spatial coverage.

A lot of figures, satellite images, schemes and tables with the results of the observations and calculations provide a good support to the vivid language of the book, making it easy to understand.

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