

year to year even with long-term trends and also with differences from one region to another. ii) It can be noted that the Southern Ocean is not radially symmetrical but many circulations and water mass features vary markedly with longitude and are also dependent on topographical influences viz. ridges, mounts and islands. iii) A special aspect is the appearance of El Nino (Southern oscillations) events which are likely to influence the Southern Ocean. This influence is not yet well understood. iv) Developments in one region have direct consequence for the other sectors.

Thus, the situation about the magnitude of interdependence between environmental conditions and biological productivity, processes in the relatively less explored Southern Ocean still remains far from explicit. The understanding of Antarctic Ocean living resource variability, still poses a challenge to oceanographers and marine scientists.

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Mathematical modelling of ocean circulation, by G.I. Machuk & A.S. Sarkisyan, (Springer-Verlag: Berlin), 1988, pp.xv + 292, 62 Figs, 655 g, Hard cover, DM 198
[ISBN 3-540-18925-4]

Mathematical modelling is the creative and intellectual act of representing complicated phenomena or processes under consideration in mathematical forms and of predicting its future behaviour. Mathematical modelling in oceanography is a new area of research compared to its sister science meteorology. Due to significant developments in related branches of sciences, physical oceanography also has undergone qualitative changes from a purely descriptive study to an applied subject during the last 2 decades. Sophisticated mathematical and hydrodynamical-numerical models are now being developed to understand and predict specific ocean dynamic characteristics. A number of monographs on mathematical modelling of ocean dynamic characteristics, written by eminent scientists from outside the Soviet bloc, have appeared in recent past. However, there are very few publications of the translation of Russian works in English language, despite the fact that a number of such monographs in Russian language are being published in USSR. The present monograph, is one of the latest publications in modelling in the field of ocean dynamics which really reflects the advanced level of scientific research in USSR.

The monograph contains 5 chapters that include fundamental equations of ocean dynamics, efficient numerical methods for solving stationary and non-stationary problems and analysis of results of calculations.

Chapter 1 is devoted to the general formulation of the problem, transformation of basic equations and their simplification, estimation of characteristic values and detailed descriptions of diagnostic and quasi-geostrophic models for the computation of ocean currents. The authors have emphasised that it is absolutely essential to consider the baroclinicity of seawater even in simple ocean circulation models.

Chapter 2 is devoted to various methods of difference approximations, construction of finite difference mesh and the solution of ocean thermohydrodynamic equations. These methods include the well known directed difference method, method of enhancing the approximation order, the Fiadeiro-Veronis method and others. The authors have applied these methods for calculating sea surface topography at ocean basins boundary and solving equations of quasi-geostrophic models and equations of non-linear models.

In Chapter 3, a number of correct formulations of non-stationary problems of ocean circulation and methods of their solution are given. In particular, the authors have considered a non-linear problem for the calculation of ocean thermohydrodynamic characteristics without including turbulence and have successfully proved the uniqueness of the formulated problems in this chapter. In addition, the absolute stability of splitting schemes of the second order by all co-ordinates has also been proved.

Chapter 4 is devoted to stationary problems of ocean dynamics. The modelling of steady state circulation of ocean is the first stage of development of coupled ocean atmosphere models for the prediction of weather and climate on larger time scale. First, it is necessary to simulate the stationary (climatic) state of the ocean using climatic oceanologic fields and then, choosing everytime, climatic oceanic condition as initial data' and using actual data on weather conditions near the sea surface, to generate the perturbations of ocean circulation under the influence of meteorological conditions. The constructed fields of hydrological elements can be used as "initial data" for weather prediction problems. In this chapter, (i) a linearised formulation of oceanic climatic state taking into consideration turbulence, (ii) ocean dynamic model taking into account wind driven currents, (iii) solution of difference equations of ocean dynamic baroclinic component, (iv) simple models of ocean dynamics taking into account non-linear turbulent exchange.

(v) problems of non-stationary adjustment of flow fields to atmospheric disturbance and (vi) formation of thermocline in the ocean, are discussed.

The last chapter (chapter 5) is devoted to the performance of determined algorithms for the calculation of stationary and seasonal currents in various parts of the world ocean. Diagnostic calculations at one degree grids have been done for world ocean using temperature and salinity as input data. The maps of horizontal and vertical currents at various levels for all 4 seasons as well as sea surface topography are presented in the monograph. The results obtained are compared with available maps and atlases of currents and the realistic character of the results obtained is brought out in this chapter.

The present monograph is a very important reference volume for all those engaged in mathematical modelling and modelling of oceanic and atmospheric processes. In general, the monograph is well written. Many more monographs and research papers in oceanography, written by Soviet authors, should be published in English for the benefit of oceanographic community the world over.

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Pollution of the North Sea: An assessment, edited by W. Salomons, B.L. Bayne, E.K. Duursma & U. Förstner, (Springer-Verlag: Berlin), 1988, pp. xi + 687, 238 figs, 1280 g, Hard cover, DM 198 [ISBN 3-540-19288-3]

As the title suggests, the book provides a comprehensive review on the fate, distribution and effects of pollutants in the North Sea which is a shallow water body (av. depth 60 m), dominated by S₂-tides and open to the Atlantic Ocean at both the ends.

The contents of the book, presented in 4 parts, include a total of 40 contributions from well known scientists who have given a very comprehensive coverage of the upto-date scientific data and analysis on the status of the North Sea.

A lot of careful thought has gone into the layout of the book; specially the flow of the topics which are: 'The North Sea system: physics, chemistry, biology'—this is covered in 10 contributions in part I. Part II, covers 'input and behaviour of pollutants'. In this part the behaviour of all types of pollutants including sewage, radioactive substances, etc. is discussed along with the application of mathematical modelling for

assessment and prediction of pollution. Part III consisting of 9 contributions, deals with 'impacts on selected areas and by human activities' and finally the last part—part IV—rightly deals with 'biological effects of monitoring'. In short, the sequence of topics is well set—the topics progressing logically from fundamental to practical aspects.

All the contributions in the book have been written in simple English and the reading has been made light and enjoyable. For example, while pointing out to the lack of primary papers on North Sea nutrients after 1975, the author remarks—"with the advance of automated analyses it seems that thinking has come to a halt"—such remarks, besides making the reading light, call upon the scientists to come out with fresh contributions in the field.

The book embodies a wealth of background information for future work in the North Sea. Besides including all the up-to-date information on the topics in relation to the North Sea, scope and need for further research have also been listed wherever possible. Thus the book is a useful link between the earlier, the present and the future work in the North Sea. The book should at the same time be a valuable addition to the library of oceanographic institutions at large. It also provides good guidelines for future applications of similar type for other seas of the world.

The topics of special interest are: geobiological effects on the mobility of contaminants in marine sediments, 'distribution and fate of heavy metals in the North Sea' and the discussion of analytical quality of data and data evaluation in the topic 'accumulation of pollutants by fish'. This discussion clearly mentions how a biologist has to be careful about the validity of the pollutant data before interpreting its effects on a species.

Organised oceanographic research globally was initiated in this water body towards the end of the last century leading to the founding of the International Council for the Exploration of the Seas (ICES) in 1901. ICES has always been promoting cooperative research in the North Sea. With the advancement of industrialization in the surrounding countries and the discovery of oil under it, problems of pollution are becoming more and more acute in the North Sea. Studies in this area are the best example of cooperative effort to keep the environment clean and suggest periodic remedial measures using high-quality data obtained by repeated and continuing inter-calibration exercises.

This book should be a useful source of information and guideline to all the scientists involved in marine pollution studies all over the globe.