

Preface

Because its characteristics resemble those of global oceans, the East Sea (Japan Sea) has long been studied and explored. Marine expeditions in the East Sea date back to the mid-1800s, and investigations of some important aspects of its oceanographic characteristics, especially water masses and surface circulation, were begun in the early 1900s. With the advent of computer resources as a powerful tool for numerical model simulations, together with modern methods of investigation such as satellite altimetry, Argos drifters, ARGO floats, and moored current measurements, the study of the East Sea has accelerated during the past two decades. In particular, major scientific achievements have flourished since the late 1990s. Six special issues of major international journals were published from 1999 to 2009 containing results from international programs and workshops dedicated to the East Sea. Two important events contributed to this scientific advancement: CREAMS and PAMS. CREAMS (Circulation Research of the East Asian Marginal Seas) began in 1993 as a comprehensive observational program organized by scientists from Japan, Korea, and Russia, the three countries bordering the East Sea. Many joint international cruises have been carried out over the entire East Sea, thus accelerating our understanding of the Sea. Joint cruises are still ongoing, and CREAMS is now an official program of the North Pacific Marine Science Organization (PICES). The special issues mentioned above were publications of results from CREAMS that were presented in related workshops and symposia. PAMS is an acronym for Pacific-Asian Marginal Seas and refers to a biennial workshop that provides a venue for scientists to present knowledge and share ideas about PAMS, and promote international cooperation in PAMS. The first workshop convened in 1981 with the initial name of JECSS (Japan and East China Seas Study), and its first 10 years PAMS exclusively focused on the physical and chemical oceanography of the East Sea and the East China Sea. The region of interest eventually broadened to include other northwestern Pacific marginal seas, and its name was changed to PAMS/JECSS in 1993 and finally to PAMS in 2009. Regular PAMS workshops have subsequently led to the publication of papers in 11 special issues, including books.

One of the major scientific topics relating to the East Sea oceanography is its own thermohaline circulation, similar to that occurring in the North Atlantic. Sill depths of the straits connecting the East Sea with adjacent seas and the North Pacific are shallower than 200 m, and subsurface waters below about 300 m constitute the Proper Water of the East Sea, first named by the famous Japanese oceanographer, Prof. Michitaka Uda in 1934. The Proper Water and intermediate water masses occupy more than 90 % of the East Sea water volume. They are formed in the northern East Sea, discharged to the south, and modified within the East Sea. Another unique property of the East Sea is its high biological productivity, especially in its southwestern part, the Ulleung Basin, where the nutrient-depleted Kuroshio branch, the Tsushima Warm Current, prevails. The primary productivity in the Ulleung Basin is as high as that of the ocean's major upwelling regions. Coastal upwelling, large- and meso-scale circulation are thought to play a role in maintaining this high productivity. Thus the East Sea is an ideal place to address the calibration of a wide range of proxies for ocean ventilation and productivity based on present oceanic conditions, as well as down-core records of the past. The evidence for rapid changes of physical and biogeochemical properties in the East Sea is compelling. Despite its long history of observations and studies, a comprehensive understanding of the ongoing changes and future projections of the East Sea is yet to be provided.

This book was written as a monograph summarizing current knowledge in the various field of oceanography of the East Sea, with the editors' hope that it will provide a useful compilation of previous important studies on each topic, and thus serve as a reference for anyone interested in the East Sea as well as providing motivation for more in-depth, future studies.

The book consists of 18 chapters, covering physical oceanography in Chaps. 2–5, chemical oceanography in Chaps. 6–9, biological and fisheries oceanography in Chaps. 10–15, and geological oceanography in Chaps. 16–18, together with a general introduction and details of the CREAMS program in Chap. 1. Each chapter serves as a stand-alone article addressing a specific topic in the form of a single scientific paper, including its own list of references. Interdisciplinary discussions of processes, such as physical-biological coupling, are somewhat scattered throughout various chapters. Editors and authors of each chapter have made a special effort to include prior publications exhaustively, though not completely, especially non-English papers. A list of abbreviations and a subject index will help readers to understand terminology specific to the East Sea and to use this book as a reference handbook. Readers are also recommended to refer to Chaps. 1 and 4 for topographic features and names, and basin- and meso-scale upper circulation features of the East Sea, which are often mentioned in other chapters.

We gratefully acknowledge financial support provided by the Korean Society of Oceanography. Our appreciation is also extended to external reviewers who read manuscripts critically and suggested valuable comments. Last but not least, we wish to express our sincere gratitude to Dr. Jong Yup Han at the Korea Institute of Ocean Science and Technology for his assistance with the production of this book.

Kyung-Il Chang
Chang-Ik Zhang
Chul Park
Dong-Jin Kang
Se-Jong Ju
Sang-Hoon Lee
Mark Wimbush

Oceanography of the East Sea (Japan Sea)

Chang, K.-I.; Zhang, C.-I.; Park, C.; Kang, D.-J.; Ju, S.-J.;

Lee, S.-H.; Wimbush, M. (Eds.)

2016, XVI, 460 p. 150 illus., 68 illus. in color., Hardcover

ISBN: 978-3-319-22719-1

Editors

Kyung-Il Chang
Research Institute of Oceanography
School of Earth and Environmental Sciences
Seoul National University
Seoul
Republic of Korea

Chang-Ik Zhang
Division of Marine Production
System Management
Pukyong National University
Busan
Republic of Korea

Chul Park
Department of Oceanography and Ocean
Environmental Sciences
Chungnam National University
Daejeon
Republic of Korea

Dong-Jin Kang
Marine Chemistry and Geochemistry Division
Korea Institute of Ocean Science
and Technology
Ansan
Republic of Korea

Se-Jong Ju
Deep-Sea and Seabed Resources
Research Center
Korea Institute of Ocean Science
and Technology
Ansan
Republic of Korea

Sang-Hoon Lee
Korean Seas Geosystem Research Unit
Korea Institute of Ocean Science
and Technology
Ansan
Republic of Korea

Mark Wimbush
Graduate School of Oceanography
University of Rhode Island
Rhode Island
USA

ISBN 978-3-319-22719-1 ISBN 978-3-319-22720-7 (eBook)
DOI 10.1007/978-3-319-22720-7

Library of Congress Control Number: 2015946090

Springer Cham Heidelberg New York Dordrecht London
© Springer International Publishing Switzerland 2016

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Cover Image: The image shows a distribution of chlorophyll *a* concentration over the East Sea derived from Geostationary Ocean Color Imager (GOCI) observations taken in September, 2011. It reveals various ocean surface features such as fronts, plumes, filaments and eddies. Natural color composite is shown on the land.

GOCI, the first ocean color instrument operated on geostationary orbit, is collecting ocean color radiometry data since July, 2010. GOCI has an unprecedented capability to provide eight images a day with a 500 m resolution for the North East Asian seas around Korean peninsula.

Printed on acid-free paper

Springer International Publishing AG Switzerland is part of Springer Science+Business Media
(www.springer.com)

Contents

1	General Introduction	1
	Kyung-Ryul Kim, Sang Hoon Lee, Kyung-Ae Park, Jong Jin Park, Young-Sang Suh, Dong-Kyu Lee, Dong-Jin Kang and Kyung-Il Chang	
2	Forcings	33
	Kyung-Ae Park, Kyung-Il Chang, Hanna Na and Uk-Jae Jung	
3	Water Masses and Their Long-Term Variability	59
	Jong Jin Park, Kyung-Ae Park, Young-Gyu Kim and Jae-Yul Yun	
4	Circulation	87
	Dong-Kyu Lee, Young Ho Seung, Yun-Bae Kim, Young Ho Kim, Hong-Ryeol Shin, Chang-Woong Shin and Kyung-Il Chang	
5	High-Frequency Variability: Basin-Scale Oscillations and Internal Waves/Tides	127
	SungHyun Nam, Jae-Hun Park and Jong Jin Park	
6	Dissolved Oxygen and Nutrients	149
	TaeKeun Rho, Tongsup Lee and Soonmo An	
7	Natural and Anthropogenic Carbon Cycling	169
	Il-Nam Kim, Kitack Lee and Jeomshik Hwang	
8	Uranium Series Radionuclides	191
	Tae-Hoon Kim, Jeonghyun Kim and Guebuem Kim	
9	Distribution of Chemical Elements in Sediments	201
	Hyun Ju Cha	

10	Phytoplankton and Primary Production.	217
	Joong Ki Choi, Jae Hoon Noh, Tatiana Orlova, Mi-Ok Park, Sang Heon Lee, Young-Je Park, Seunghyun Son, Inna Stonik and Dong Han Choi	
11	Microbial Ecology and Biogeochemical Processes in the Ulleung Basin	247
	Jung-Ho Hyun	
12	Zooplankton.	297
	Chul Park, Hae-Lip Suh, Young-Shil Kang, Se-Jong Ju and Eun-Jin Yang	
13	Fish and Fisheries	327
	Suam Kim and Chang-Ik Zhang	
14	Benthic Animals.	347
	Jin-Woo Choi	
15	Marine Mammals	373
	Kyum Joon Park	
16	Physiography and Late Quaternary Sedimentation	389
	Sang Hoon Lee, Jang Jun Bahk, Seong-Pil Kim and Jun-Yong Park	
17	Crustal Structure and Tectonic Evolution of the East Sea	415
	Gwang Hoon Lee and Han-Joon Kim	
18	Stratigraphy.	431
	Seok Hoon Yoon	
	Index.	451

Oceanography of the East Sea (Japan Sea)

Chang, K.-I.; Zhang, C.-I.; Park, C.; Kang, D.-J.; Ju, S.-J.;

Lee, S.-H.; Wimbush, M. (Eds.)

2016, XVI, 460 p. 150 illus., 68 illus. in color., Hardcover

ISBN: 978-3-319-22719-1

Editors

Kyung-Il Chang
Research Institute of Oceanography
School of Earth and Environmental Sciences
Seoul National University
Seoul
Republic of Korea

Chang-Ik Zhang
Division of Marine Production
System Management
Pukyong National University
Busan
Republic of Korea

Chul Park
Department of Oceanography and Ocean
Environmental Sciences
Chungnam National University
Daejeon
Republic of Korea

Dong-Jin Kang
Marine Chemistry and Geochemistry Division
Korea Institute of Ocean Science
and Technology
Ansan
Republic of Korea

Se-Jong Ju
Deep-Sea and Seabed Resources
Research Center
Korea Institute of Ocean Science
and Technology
Ansan
Republic of Korea

Sang-Hoon Lee
Korean Seas Geosystem Research Unit
Korea Institute of Ocean Science
and Technology
Ansan
Republic of Korea

Mark Wimbush
Graduate School of Oceanography
University of Rhode Island
Rhode Island
USA

ISBN 978-3-319-22719-1 ISBN 978-3-319-22720-7 (eBook)
DOI 10.1007/978-3-319-22720-7

Library of Congress Control Number: 2015946090

Springer Cham Heidelberg New York Dordrecht London
© Springer International Publishing Switzerland 2016

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Cover Image: The image shows a distribution of chlorophyll *a* concentration over the East Sea derived from Geostationary Ocean Color Imager (GOCI) observations taken in September, 2011. It reveals various ocean surface features such as fronts, plumes, filaments and eddies. Natural color composite is shown on the land.

GOCI, the first ocean color instrument operated on geostationary orbit, is collecting ocean color radiometry data since July, 2010. GOCI has an unprecedented capability to provide eight images a day with a 500 m resolution for the North East Asian seas around Korean peninsula.

Printed on acid-free paper

Springer International Publishing AG Switzerland is part of Springer Science+Business Media
(www.springer.com)