

Coastal Informatics: Web Atlas Design and Implementation

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Information Science
REFERENCE

INFORMATION SCIENCE REFERENCE
Hershey • New York

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Printed at: Lightning Source

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: <http://www.igi-global.com>

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Library of Congress Cataloging-in-Publication Data

Coastal informatics : web atlas design and implementation / Dawn Wright, Ned Dwyer, and Valerie Cummins, editors.
p. cm.

Includes bibliographical references and index. Summary: "This book examines state-of-the-art developments in coastal informatics (e.g., data portals, data/ metadata vocabularies and ontologies, metadata creation/ extraction/ cross-walking tools, geographic and information management systems, grid computing) and coastal mapping (particularly via Internet map servers and web-based geographical information and analysis)"-- Provided by publisher. ISBN 978-1-61520-815-9 (hardcover) -- ISBN 978-1-61520-816-6 (ebook) 1. Coasts--Geographic information systems. 2. Coastal mapping. 3. Management information systems. I. Wright, Dawn J., 1961- II. Dwyer, Ned. III. Cummins, Valerie, 1974- GC10.4.R4C63 2010
526.0914'6--dc22

2009052431

British Cataloguing in Publication Data

A Cataloguing in Publication record for this book is available from the British Library.

All work contributed to this book is new, previously-unpublished material. The views expressed in this book are those of the authors, but not necessarily of the publisher.

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Section 1 Principles

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Dawn J. Wright, Oregon State University, USA
Valerie Cummins, University College Cork, Ireland
Edward Dwyer, University College Cork, Ireland

General introduction to the entire book, including definition of a coastal web atlas and key issues surrounding it uses. The chapter also identifies the intended audience and gives a brief overview of topics and importance for all remaining chapters.

Chapter 2

Coastal Web Atlas Features.....	12
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Elizabeth O’Dea, Washington State, USA
Tanya C. Haddad, Oregon Coastal Management Program, USA
Declan Dunne, University College Cork, Ireland
Kuuipo Walsh, Oregon State University, USA

This chapter features an overall summary with more detailed descriptions of common coastal web atlas features and the forms/functions they may take. This includes an extensive discussion of the various types of tools that one might find in a web atlas.

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Coastal Web Atlas Implementation.....	33
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Tanya Haddad, Oregon Coastal Management Program, USA
Elizabeth O’Dea, Washington State Department of Ecology, USA
Declan Dunne, University College Cork, Ireland
Kuipo Walsh, Oregon State University, USA

Following on the previous chapter, which describes what the basic features of a coastal web atlas are, this chapter goes on to present considerations and recommendations for actually implementing an atlas (i.e., design, development, deployment). This chapter includes lists of the advantages/disadvantages and applicability/execution challenges for various technical resources. And finally, it includes helpful information on open source versus proprietary software, as well as various technology standards.

Chapter 4

Coastal Atlas Interoperability	53
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Yassine Lassoued, University College Cork, Ireland
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Luis Bermudez, Southeastern University Research Association, USA
Karen Stocks, University of California San Diego, USA
Eoin O’Grady, Marine Institute, Ireland
Anthony Isenor, Defense R&D Canada – Atlantic, Canada
Paul Alexander, Marine Metadata Interoperability Initiative & Stanford Center for Biomedical Informatics Research, USA

This chapter provides a general definition of interoperability is the ability of diverse systems and/or organizations to work together, especially in the use and exchange of information. This chapter is about interoperability between computer systems, especially those systems that underlie a coastal web atlas. It reviews the relevant standards for interoperability between coastal web atlases, and gives practical guidelines on how to make atlases interoperable through the use of standards, web services, vocabulary words and ontologies. It concludes with a description of the International Coastal Atlas Network’s interoperability prototype under development.

Section 2

Coastal Web Atlas Case Studies around the World

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Overview of Coastal Atlases.....	80
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Dawn J. Wright, Oregon State University, USA
Gabe Sataloff, NOAA Coastal Services Center, USA
Tony LaVoi, NOAA Coastal Services Center, USA
Andrus Meiner, European Environment Agency, Denmark
Ronan Uhel, European Environment Agency, Denmark

This chapter provides a brief overview of various coastal web atlas projects around the world, providing a contextual bridge to the atlas case studies of Chapters 6-14. A summary of the policy context within which many European atlases operate is followed by a summary of other efforts emerging in Australia, the Western Pacific, Africa, and the Caribbean.

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Oregon, USA..... 91

Tanya C. Haddad, Oregon Coastal Management Program, USA

Robert J. Bailey, Oregon Coastal Management Program, USA

Dawn J. Wright, Oregon State University, USA

Case study for the U.S. state of Oregon, focusing on the Oregon Coastal Atlas in action. This atlas, along with the Marine Irish Digital Atlas, has been online and in constant development for a long period of time, and therefore one of the more mature coastal atlases on the Internet. Each case study chapter describes the situation in country or state regarding the accessibility of coastal information, the motivation for the producing the atlas, the knowledge gap that it is trying to fill, the intended audience for the atlas, and where possible, how is it financed. Case study chapters also identify issues of data collection, system design, usage and associated statistics, strengths and weakness of approaches to date, and future plans, including its relationship to ICAN.

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Edward Dwyer, University College, Ireland

Kathrin Kopke, University College Cork, Ireland

Valerie Cummins, University College Cork, Ireland

Elizabeth O’Dea, Washington State, USA

Declan Dunne, University College Cork, Ireland

Case study for Ireland focusing on the Marine Irish Digital Atlas in action. This atlas, along with the Oregon Coastal Atlas, has been online and in constant development for a long period of time, and therefore one of the more mature coastal atlases on the Internet. The case study follows the “template” of topics as described for Chapter 6.

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Virginia and Maryland, USA 131

Marcia Berman, College of William and Mary, USA

Catherine McCall, Maryland Chesapeake and Coastal Program, Maryland Department of Natural Resources, USA

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<i>Hannelore Maelfait, Coordination Center on Integrated Coastal Zone Management, Belgium</i>	

Case study for Belgium, focusing on the Belgian Coastal Atlas, which was first published as a hardcopy book but then transitioned to the web. The case study follows the “template” of topics as described for Chapter 6.

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<i>Greg Reed, Australian Ocean Data Center Joint Facility, New South Wales, Australia</i>	

Case study for the continent of Africa, focusing on the African Marine Atlas. The case study follows the “template” of topics as described for Chapter 6.

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Case study for the Caribbean region, focusing on the Caribbean Marine Atlas. The case study follows the “template” of topics as described for Chapter 6.

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<i>David R. Green, University of Aberdeen, UK</i>	

Case study for the United Kingdom, providing a brief overview of the origins and evolution of coastal web atlases throughout the country. The case study follows the “template” of topics as described for Chapter 6.

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<i>José Ojeda-Zújar, University of Seville, Spain</i>	
<i>José Manuel Moreira-Madueño, Government of Andalusia, Spain</i>	

Case study for Spain, focusing on the SIGLA (Sistema de Información Geografica del Litoral Andaluz or Coastal Information System of Andalusia). The case study follows the “template” of topics as described for Chapter 6.

Section 3 Coastal Web Atlas Management and Governance Issues

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The International Coastal Atlas Network.....	229
<i>Dawn J. Wright, Oregon State University, USA</i>	
<i>Valerie Cummins, University College Cork, Ireland</i>	
<i>Edward Dwyer, University College Cork, Ireland</i>	

This chapter transitions from coastal web atlas (CWA) case studies to atlas management and governance issues, by way of a summary of the International Coastal Atlas Network (ICAN). ICAN is a newly-founded informal group of over 30 organizations from over a dozen nations who have been meeting over the past two years to scope and implement data interoperability approaches to CWAs. Most of the atlases profiled in Section 2, Case Studies, are members of ICAN.

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<i>Roger Longhorn, Info-Dynamics Research Associates Ltd., Belgium</i>	
<i>Andrus Meiner, European Environment Agency, Denmark</i>	
<i>Ronan Uhel, European Environment Agency, Denmark</i>	
<i>Dawn J. Wright, Oregon State University, USA</i>	
<i>Edward Dwyer, University College Cork, Ireland</i>	

This chapter summarizes key projects and initiatives that are being implemented on very large scales (national/international) by national governments and commissions to build coastal spatial data infrastructures (SDIs). These include SDI efforts in the U.S. and Europe that are closely related to ICAN, and as such are of great value to its mission of developing interoperable atlases, providing along the way solutions for the integration of not only technologies, but people, institutions, and institutional objectives.

Chapter 17

Creating a Usable Atlas..... 256

Timothy Nyerges, University of Washington, USA

Kathy Belpaeme, Coordination Center on Integrated Coastal Zone Management, Belgium

Tanya Haddad, Oregon Coastal Management Program, USA

David Hart, University of Wisconsin Sea Grant Institute, USA

Having covered some overarching management and governance issues for coastal web atlases, the book returns to the user level with 3 concluding chapters that guide the reader on how to create an atlas that is the most usable for its audience, how to make that seed effort grow, and how to maintain it. This chapter provides guidelines on how to better understand coastal web atlas users, how to undertake user-centered design and development for improved web site usability, and how to avoid major pitfalls with web interfaces.

Chapter 18

Improving a Growing Atlas 267

Tanya C. Haddad, Oregon Coastal Management Program, USA

Declan Dunne, University College Cork, Ireland

This chapter covers aspects of atlas monitoring via web server statistics, user surveys, and other sorts of feedback mechanisms, and how to obtain improvement over time. Also covered are issues of scalability (how to accommodate increasing datasets and users), and the latest in reviewing/updating technology.

Chapter 19

Supporting a Successful Atlas..... 275

Roger Longhorn, Info-Dynamics Research Associates Ltd., UK

Dawn J. Wright, Oregon State University, USA

Kathy Belpaeme, Coordination Center on Integrated Coastal Zone Management, Belgium

This concluding chapter of the book is about to maintain a successful coastal web atlas. It discusses issues relating to securing long-term support for an atlas and provides guidance based on existing practice and experience with atlas developments at national and international levels. Specific topics include institutional capacity, institutional support, partnerships, funding, governance, and continued promotion. Also included is a discussion of data and metadata ownership issues, intellectual property rights, and the legal protection of atlas content.

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Foreword

Coasts, seas and oceans are being threatened by an unprecedented range of pressures including land-based coastal and marine pollution due to poorly managed sewage and industrial waste and agricultural run-off, fragmentation and habitat loss through unsustainable extraction practices and industrial zoning, over-exploitation of marine resources, invasive species infestations and climate change.

The impacts of these pressures have been widespread and generally adverse: over the past 50 years we have observed declines in the abundance of many high-profile, commercially important marine species, loss of genetic diversity, detected alterations in ecosystem functioning and reductions in critical habitats such as coral reefs, coastal wetlands and mangroves. Some 30% of coral reefs – which often have higher levels of biodiversity than tropical forests – have been seriously damaged through fishing, pollution, disease and coral bleaching. Some 35% of mangroves have disappeared over the past two decades and in some cases up to 80% have been lost nationally through conversion to aquaculture and storms. More than 50% of wild marine fisheries are fully exploited, with a further 25% over-exploited.

And yet, coasts are the home of 50% of the world's population whilst more than a billion people rely on fisheries as their main source of protein. In addition, the newly established evidence of a rapid acidification of our oceans starts bringing large-scale disruptions to key components of the food sources.

The damaged resilience and adaptive capacities of our coasts is informed by observations, science and continuity in information systems, such as coastal atlases. The whole point here though is that the “patient science” of relatively slow ecological and biological cycles of such complex systems can easily escape the attentions of fast public news gatherers. Let’s face it: the proliferation of the www. and 24-hour news outlets, of scores of television and radio channels, and of personalized modes of receiving and delivering data and opinions has revolutionized the media through which complex science must pass to reach a multiplicity of publics. Dumbing down of much of the media and the seemingly shortening attention span of audiences is reducing the capacity to communicate complex science like that relating people to their dependency on coastal assets resources?

However, the problems arising from the new media technologies and configurations are accompanied by opportunities. For example, people with local and practical knowledge of coastal resources often experience and know about the reality of hazards well before the experts recognize them. They and citizen journalists can report on what’s happening in their communities using new means of communication to get their knowledge out to wider publics in ways that were not possible just a decade ago. At the EEA we believe that if we are to tackle our environmental problems we need to move beyond conventional systems of data collection and management and adopt approaches such as the coastal web atlases described in this book. If we want to stimulate a change to the way we all live and confront natural processes it is no longer sufficient to develop passive lists or reports to “inform” citizens. Information is still too

often made available as lists of figures or spreadsheets that only experts can interpret. Imagine if all the statistics that inform our evening weather forecasts were presented in this way, or all the data that drives popular software like Google or Facebook – do you think they would continue to be as popular – and be able to draw the benefits from participation?

We believe that the current achievements and future activities in relation to coastal web atlases will provide useful operational services to a large community of practitioners and users across the world. To encourage participation we need to present our information in a way everyone can understand; the environmental monitoring and reporting systems designed in the 20th century will not be able to cope with this increasing demand for higher quality, faster access, cost efficient systems to respond to today's emerging complex issues, e.g., climate change at our coastal door-step. Producers and providers of environmental data will have to move from centralized information management towards distributed data and information systems, both at a geographical scale, from local to global, as well as thematic integration. This book shows practical examples of how that is being achieved.

The EEA therefore looks forward to ongoing cooperation in these developments towards interoperable coastal information systems. This book will be tremendously useful in this regard, especially in view of services such as the methodological outcomes and content-based information, so as to help actions in the field of coastal zone integrated assessments, including coastal zone use potentials, vulnerabilities and adaptation needs to environmental changes.

Prof. Jacqueline McGlade
Executive Director
European Environment Agency

Professor Jacqueline McGlade became Executive Director of the European Environment Agency on June 1 2003. Prior to this she was Natural Environment Research Council Professorial Fellow in Environmental Informatics in the Mathematics Department of University College London where her main areas of research included spatial data analysis and informatics, expert systems, environmental technologies and the international politics of the environment and natural resources. Previous appointments have included Director of the UK's Centre for Coastal & Marine Sciences, Director of Theoretical Ecology at the Forschungszentrum Jülich Germany, Associate Professor at the Honda funded International Ecotechnology Research Centre, Senior Scientist in the Federal Government of Canada and in the USA, Adrian Fellow at Darwin College, Cambridge and Professorships at Warwick University and Aachen. Professor McGlade has won various prizes including the Minerva Prize, the Swedish Jubileum Award and the Brno University Gold Medal. She also has Honorary degrees from Wales (Bangor) Kent and is a Fellow of the Linnean Society and the Royal Society for the Encouragement of Arts, Manufacture & Commerce. Professor McGlade has worked extensively in North America, south-east Asia and West Africa; she has published more than 100 research papers, written popular articles, presented and appeared in many radio and television programmes, including her own BBC series *The Ocean Planet* and *Learning from Nature* and more recently *Our Arctic Challenge*, a film about sport and tourism in Greenland. She has given public lectures worldwide on sustainable development, conflicts over environmental impacts of industrial and natural activities, environmental technologies and the use of multimedia in developing countries. Professor McGlade was Chairman of The Earth Centre and a Board Member of the Environment Agency. She is currently a Trustee of the Natural History Museum, and a member of the Environment Advisory Committee of the European Bank for Reconstruction and Development, UK-China Forum and UK-Japan 21st Century Group. She is also Director of the software company, View the World Ltd. Recent books: *Advanced Ecological Theory* (Blackwell 1999); *The Gulf of Guinea Large Marine Ecosystem* (Elsevier 2002).

Preface

This book is based on the results of two international workshops jointly funded by the US National Science Foundation and the National Development Program of Ireland. They brought together key experts from Europe, the United States, Canada Africa, and Australia to examine state-of-the-art developments in coastal informatics (e.g., data portals, data/ metadata vocabularies and ontologies, metadata creation/ extraction/ cross-walking tools, geographic and information management systems, grid computing) and coastal mapping (particularly via Internet map servers and web-based geographical information and analysis). The first workshop, held in Cork, Ireland in July 2006, enabled participants to examine state-of-the-art developments in coastal web atlases (CWAs), and to assess the potential and the limitations of selected CWAs from the United States and Europe. Participants also shared several case studies and lessons learned, and established key issues and recommendations related to the design, data requirements, technology and institutional capacity needed for these atlases. This necessitated an examination of best practices for achieving interoperability between CWAs, which led international participants to a second workshop entitled “Coastal Atlas Interoperability,” and held on the campus of Oregon State University in July 2007. At this second workshop, expert participants learned how to use controlled vocabularies and ontologies in order to build a common approach to managing and disseminating coastal data, maps and information, and concluded with the aim of designing and developing a demonstration interoperability prototype using the metadata catalogs of two mature atlases (the Oregon Coastal Atlas and the Marine Irish Digital Atlas).

The technical experts, scientists, decision makers and practitioners of the workshops in Ireland and Oregon decided to informally organize under the International Coastal Atlas Network (ICAN) and sought to continue the momentum with a third workshop. Based on the success of the group to this point, the European Environment Agency (EEA) sponsored and hosted this third event in 2008, at its headquarters in Copenhagen, Denmark, under the theme: “Federated Atlases: Building on the Interoperable Approach.” Workshop participants discussed the progress-to-date on the ICAN interoperability prototype and agreed upon future technical activities. The relevant policy context within which ICAN must operate was presented, along with an overview of a number of related coastal and marine information management projects that could inform ICAN developments. In addition, the workshop took place around a two-day conference on Coastal Atlas Development, organized by the EEA itself, whose objective was to inform EEA partners about the development of coastal atlases and the emergence of ICAN in light of relevant European policy developments in the maritime sphere.

By this time, CWAs in general and ICAN in particular had captured the interest of scores of local, state and national governments, non-governmental organizations, research institutes, and universities, as well NOAA, certainly the EEA, and the UNESCO Intergovernmental Oceanographic Commission.

Workshop participants therefore discussed ways of disseminating some of the wealth of knowledge and expertise that had been growing within the ICAN group (which now stands at over 35 organizations from over 10 countries). It was decided that one effective way to do this would be through the publication of a book to review and present the latest developments in the new emerging field of coastal web atlases, to share best practices and lessons learned through a series of case studies, to give practical guidance on geographic data management and documentation through standards-based metadata, as well as guidance on how to make underlying geographic databases interoperable. This current publication is the result. We hope that readers will find this book of practical use in web atlas design, development and implementation, and will thus improve their spatial thinking in the coastal context. Hence, rather than a lengthy theoretical treatise on basic and futuristic research questions and problems, the book has been prepared more as a concise, ready reference, with collections of subject-specific instructions where appropriate.

The prime audience for the book is coastal resource managers and consultants, coastal scientists, coastal technologists (e.g., information technologists, GIS specialists, software developers), government researchers, and graduate students. The book should be especially valuable to coastal resource managers who need to tackle such topic-based issues (explaining environmental concepts to the public and reaching them with current information has always been a difficult task).

The book may also be suitable for intermediate, advanced courses in coastal/marine GIS or coastal zone management (i.e., courses toward a related BS/BSc, MS/MSc or PhD degree, in the classroom, but also potentially for distance education as well). The material in the book and the dedicated website should allow students to familiarize themselves with what CWA (web GIS) technology is, what are the basics of related disciplines, and how to use physical environmental and biological data available in the atlases in order to develop specific GIS applications and models. Course instructors may use the contents of the dedicated website either to present ready-to-use applications or to use the variety of included data for building new GIS applications.

Further expected contributions of the book include:

- Wide data dissemination to enhance scientific and technological understanding. The book should be of great interest not only to the coastal/marine research and management community, but also to libraries, high schools, and outreach sites. Linkages in the book are made to parallel research in geographic information science, digital library development, and computer science. The presentation of lessons learned should help guide the development of new national and regional atlases, and improve decision-support systems.
- Advancing discovery and understanding; promoting teaching, training and learning through integration of research and education. The book may be useful as additional content to faculty course materials and to graduate research. We anticipate a number of student research topics and projects at both the M.S./M.Sc. and Ph.D. levels that may be aided by this book.
- Benefiting society. With the release of the Pew and U.S. Ocean Commission reports as well as the European Union Integrated Maritime Policy there is growing public awareness of the critical state of our coastal zones and fisheries. The book poses informatics solutions that seek to improve management practices and decision-making. Mapping plays a critical role in issues of national sovereignty, resource management, maritime safety, and hazard assessment.

This book is also accompanied by a dedicated website (International Coastal Atlas Network, <http://ican.science.oregonstate.edu>) which includes links to mature CWAs, and is building templates for CWA

design, snippets of scripts and programming routines to achieve interoperability with partner atlases, and several other resources mainly for online GIS developments and online data providers. We hope that you find it useful!

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Handbook of Coastal Informatics: Web Atlas Design and Implementation

ACKNOWLEDGMENTS

We are very grateful to the US National Science Foundation (Award #0527216), the Marine Institute of Ireland's Marine RTDI Networking and Technology Transfer Initiative under the National Development Plan, the Coastal and Marine Resources Centre of University College Cork (CMRC), Ireland, Oregon State University, which provided initial funding to bring together key experts from Europe, the United States, Canada and Africa to begin discussions, and collaborations that led to the *idea* for this handbook. We also thank the European Environment Agency, with additional support from the European Topic Centre on Land Use and Spatial Information (ETC-LUSI), the European Environmental Information and Observation Network (EIONET), SeaZone Solutions Limited, the European Platform for Coastal Research (ENCORA), and the Marine Institute, for additional funding to bring key international experts together for further discussions and collaborations that ultimately led to the *production* of this handbook. The additional support of the NOAA Coastal Services Center, and US National Science Foundation Award #0921950 is also gratefully acknowledged. We thank the many external reviewers whose careful comments and suggestions greatly improved the chapters, as well as our External Advisory Board for their support throughout this project. And finally, we extend a special thanks to Kathrin Kopke of the CMRC and Joel Gamon of IGI-Global for editorial assistance, as well as to Dawn's pet dog Lydia for moral support during the final stages of the project.