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Book Review: Arc Marine - GIS For A Blue Planet

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A few year's ago I was reporting from the ESRI International Educational User Conference in San Diego. One of the speaker's at the time was Dawn J. Wright, a professor of Geography and Oceanography at Oregon State University. At the time she said, "we know more about space and the moon, than we do about our oceans." Wright would go on to explain how that observation came about, delivering a presentation that left me inspired, interested and inquisitive about the world's oceans and marine studies in general.

Arc Marine: GIS for a Blue Planet

Dawn J. Wright

Michael J. Blongewicz

Patrick N. Halpin

Joe Breman

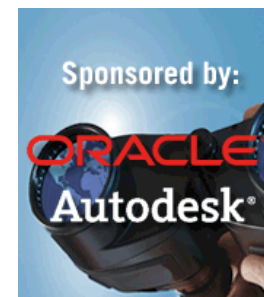
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Review by Jeff Thurston

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I was subsequently surprised when the new book *Arc Marine: GIS for a Blue Planet* arrived at my doorstep. The book includes a foreword by Jane Lubchenco. For the last week I have been reading this book all across Europe during my travels - from the Berlin Hauptbahnhof to Zurich and on to Stratford-Upon-Avon in the United Kingdom.

This book is interesting from start-to-finish. It takes the reader into the world of the oceanography and marine studies, explaining topics that are often considered complex, in an easy-to-understand manner. This is not an simple task, since, marine research, marine data models and the coupling of geographic information systems (GIS) to them, is a considerable challenge. Yet, the book slices through complexity, using examples to provide readers with an understanding of marine environments, thus an appreciation as to how and why data models are being designed the way they are - for the Arc Marine data model.

The opening Introduction explains how oceanography and marine studies are predominately 3D in nature. The authors explain how certain processes in the ocean do not lend themselves to 2D representation and how the changing temporal nature of the oceans are important to understand. In some ways, right from the start, readers are acquainted with the concepts of 3D systems and the very large numbers and different types of sensors used to monitor and study oceans. The term marine in this book refers to deep oceans and coasts, whereas previously, they were often separated.

This book attempts to address the issue of understanding marine processes through the application and use of Arc Marine - a model. Because of the complex processes involved, and their large number, Arc Marine recognizes the significance of the 'geodatabase' more commonly associated with ArcGIS. Unlike the shapefile, the geodatabase is much more robust in terms of including process functions pertaining to locations. In other words, Arc Marine points in the direction as to how and why geodatabases are integral to pursuing knowledge on a topic.

To understand marine studies requires collaboration and an appreciation for the multi-disciplinary nature of ocean life and functioning. No one discipline reigns supreme and it is with this basic understanding that this book and the Arc

Marine model is written and presented. The authors provide the Common Marine Data Types in the second chapter, describing Arc Marine Data Model in detail and include a table of the layers involved.

For readers to grasp and understand the model, it is important to understand oceans are dynamic and volumetric processes that are continually changing. Designing a Data Model that can encapsulate all of the processes presented a challenge. The authors recognized early on that not all marine related organizations or interested parties enter the topic similarly, yet, they all draw on pieces of similar information. Consequently, the Arc Marine Model is built on collaboration, accessibility, open access and with multi-disciplinary use in mind. "The core data types are the core building blocks" which any user can assemble dependent upon their particular need. The model itself exists in Unified Modeling Language (UML) and the schema is presented in the ArcCatalog application. Users simply invoke CASE (computer-aided software engineering) tools in ArcGIS.

It is interesting to note that the authors have attempted to model features that are new to many users. Why? Because of the unique nature of marine studies. For example, there are different types of Marine Points with Subtypes. There are Marine Lines with 4 Subtypes and there are Marine Areas and Marine Raster Grids/Meshes as well as derived placeholders. The book explains each type well and provides examples for each.

Marine Survey remains at the heart of marine science. Just as we might say the cadastral survey is at the heart of terrestrial surveying. A description of survey types is included for those unfamiliar with marine surveying.

Slowly the book begins to build the model by describing to the reader how the data pieces are collected and assembled. This approach is sure to help readers understand the extents of the model as well as how the data is entered into GIS data tables for application building and analysis.

In Chapter 4, the book introduces marine animal data collection and five case studies are provided which I found fascinating because of their uniqueness and differences. These include,

- 1) Cetacean surveys
- 2) Marine protected areas
- 3) Sea turtle tagging
- 4) Sea turtle dive profiles
- 5) Seal haul-outs

Each of these describes the different data types in use as well as the nature of the sea-life movements. The authors even describe where they think deficiencies in data are present.

Chapter 5 discusses the implementation of time series data and measurements and the main case study originates from the Galway, Ireland Marine Institute and is further supported by ESRI Ireland. For those wondering; the Irish marine area covers 220 million acres and employs more than 44, 000 people to the tune of 3 billion Euros each year. Using this model, questions such as "What is the average temperature of Galway Bay?" or, "Is there any correlation between algal bloom events in Cork Harbour and variations in water temperature?" can all be discovered and determined. A full example of how the model is implemented at the Galway Institute is provided.

Nearshore and coastal waters and environments are described in Chapter 6. Common Marine Data Types for lines are described in the chapter and two case studies are provided, one for nearshore fish species around the 8 Hawaiian Islands and the other with respect to implementing the Arc Marine Data Model for geodatabase standards and protocols. There are several good maps for the Hawaiian Islands showing the regions under study. Although readable, the font sizes within the legends of the maps could be slightly larger, making them easier to read. Having said that, the graphics are crisp and clear. The descriptions for these studies are superb. Reading this kind of material in this format, causes me to wonder just how many young adults this book will cause to want to choose marine studies as a career – it is so intriguing.

Model Meshes are the topic in Chapter 7, providing a foundation for understanding and implementing marine modeling and applications. The concept of three-dimensional stacked 2D is presented. This caused me to scratch my head a few times, since, GIS data by nature consists of a series 2D layers. Think on this one a moment and ponder how and why you think this can exist. It becomes clear, as the author's outline that they are talking about what I would call nested layers within layers. Each of these having a slice of space through the ocean depths. Imagine, for example, a road network that exists within different conventional terrestrial layers. It is for this reason the book is so intriguing, as it describes the unique spatial nature of the marine environment, causing one to explore new ways of thinking and understanding marine processes. The reader becomes learner, discoverer and explorer through reading.

Multidimensional GIS is outlined in Chapter 8. The concepts of 3D and 4D visualization are investigated in the chapter and the processes of capturing, transforming and creating visualizations are provided. Data become images and volumetric representations. Interpolation techniques are described and tessellation discussed.

Common Data Format (netCDF) is a format used for the management and sharing of scientific information. Datasets that use netCDF tend to be scientific in content and multidimensional in nature. Oceanographic data often uses netCDF format and the Arc Marine data model is built for this purpose. The chapter outlines what netCDF is, how it relates to oceanographic data and the connection to ArcGIS, which is netCDF enabled. Scientists and others interested in handling large datasets in this format, or considering its use, will find the discussion in this chapter useful.

An epilogue is included in the book and extends discussion toward the future of data modeling for marine GIS. This includes topics like semantics, interoperability, Geographic Markup Language (GML) and the wider topic of metadata vocabulary.

This book is very interesting. It can excite people about oceanography, helping them to understand what oceanography is and how it is studied. The book has avoided the trap of becoming solely academic in tone. Instead, it allows the beginner and the professional, to both enter into the world of oceanography and the study of GIS data models for marine environments. Bridging two complex fields of study into one easy-to-understand book is seldom accomplished.

This book is not only valuable to oceanographer's interested in connecting GIS to marine data, but also to students and the general public. It is also a treat to read.

If there is one book you read this year on the topic of marine environments and GIS, this should be the book.

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