publication of programs and of data. No form of dissemination is discounted, and prospective authors are invited to suggest whatever primary form of publication and support material they think is appropriate.

The editorial board

 These people have been invited for their experience in the field, of monograph writing, and for their geographic and subject diversity. Members may also be involved later in the process with particular monographs.

Future submissions

Anyone who is interested in preparing a Research Monograph, should contact either of the editors. Advice on how to proceed will be available from them, and is treated on a case by case basis.

For now we hope that you find this, the sixth in the series, a worthwhile addition to your GIS bookshelf, and that you may be inspired to submit a proposal too.

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Foreword

Michael F. Goodchild

This is a book about the two-thirds of the Earth's surface that is covered by salt water, and about the interface between this marine environment and the terrestrial one that occurs along the world's coastlines. As a linear feature, the coastline in principle occupies no area, yet it has enormous significance given its proximity of the vast majority of the world's population; its role in biodiversity; and its importance as the source of much marine degradation. The book is also about geographic information systems, a rather vague term attached to software that is used for handling, displaying, analysing, and modelling information about the locations of phenomena and features on the Earth's surface. Finally, the book is about geographic information science, defined as the set of issues of fundamental importance that arise in the development and application of geographic information systems.

We know a great deal about how to apply computers to information about the terrestrial surface. Our landmasses are covered with highly accurate geodetic control networks, from which the locations of features can be surveyed with high accuracy. Our satellites collect abundant information about the radiative properties of the surface, and from these remotely sensed images, we construct detailed maps of vegetation, mineral resources, and population distribution. We use aerial photographs to construct detailed maps of landforms, cities, and land ownership, and GPS to record accurately the locations of roads, railroads, and other features. Information stored in digital form can be shared between users over electronic networks, analysed to discern patterns and anomalies, used to make predictions about future patterns, and used to support complex spatial decisions by planners and politicians.

When it comes to the marine and coastal environment, however, things are much less straightforward. Although the location of the coastline remains largely fixed (but affected daily by tides), there are no fixed features in the marine environment except at on the ocean floor, and very little of a static nature that can be mapped except for ocean depth. The tradition of multiscale mapping at public expense that has dominated the production of geographic data about the terrestrial surface simply has no equivalent for the remaining two-thirds of the Earth. Even the coastline is beset with definitional problems, and there are many instances of the same coastline being mapped by different agencies using different definitions.

The terrestrial surface provides the perfect Newtonian frame, a rigid co-ordinate system that can be used to position any feature (minor problems of crustal movement and the wobbling of the Earth's rotational axis aside). In the ocean, however, the lack of a rigid frame and the mobility of many features of interest open the possibility of representations that are object-centred, and models that are Lagrangian rather than Eulerian. The marine environment suggests interesting possibilities for radically different ways of representing spatial phenomena that avoid the dependence on an absolute co-ordinate system so characteristic of GIS.

GIS is also founded on the assumption that the two horizontal dimensions are essentially equivalent, that representations are rotationally invariant. Coastlines challenge this assumption, since there are clearly major differences between what happens transverse to the shoreline, and what happens along it. Spatial resolutions can be very different, since the detail needed to represent processes and forms transverse to the shore tends to be much greater than the detail needed to represent variation along the shore. In the three-dimensional marine environment, there is comparable dissimilarity between the horizontal and vertical dimensions.

At the same time, the marine environment presents all of the problems familiar to students of geographic information science: problems of scale and accuracy, the representation of time-varying information, the persistence of objects through time, and issues of generalisation. Many of these are explored in this book in a marine and coastal setting, adding usefully to what we already know from terrestrial applications.

One of the most difficult impediments to greater use of GIS in marine and coastal applications, besides the fundamental issues of representation, has been the comparative lack of data. The sensors that could provide detailed, four-dimensional data about the dynamic marine environment generally do not exist, although enormous improvements in sensing technology have occurred in the past decade. Such data would inevitably require massive storage, and would still challenge the capacities of today's computing systems, despite the improvements in price and performance that have occurred recently. In the past, cartographers and others developed sophisticated methods of generalisation and abstraction to deal with precisely this problem, at a time when technology was unable to handle the volume of two-dimensional detail available about static, terrestrial features. Perhaps recent developments in technology are opening up a new research arena that will focus on generalisation methods for four-dimensional (dynamic, three-dimensional) data.

Marine and coastal environments also present a rich set of problems of a societal and institutional nature. Concepts of land ownership had much to do with the development of primitive methods of mapping, measurement, and geometry among early agrarian societies, and the cadaster remains the most fundamental and detailed of GIS layers. But the marine environment challenges many of these ancient notions, and several chapters in the book address applications of GIS that

have to do with resolving jurisdictional disputes, conflicts over resources, and preservation of diminishing marine fish stocks.

From the perspective of geographic information science, the growing interest in marine and coastal applications is enormously fascinating. Much can be learned from efforts to apply existing software in this novel and challenging environment. Several chapters of the book deal also with designs for new software that can handle the special requirements of these applications, by modelling with dynamics, moving objects, unequal resolutions, linear systems, depth, etc., and by providing associated methods of visualisation and analysis. Fundamentally, the book is about taking a technology that evolved to deal with problems on dry land, and stimulating its further evolution to deal with a new set of applications that has many similarities, but also many substantial differences. Just as fish adapted to the terrestrial environment by evolving into amphibians, so GIS must adapt to the marine and coastal environment by evolution and adaptation. This book provides a first glimpse of what that evolution may entail, and what software systems will eventually emerge to handle the spatial information needs of marine and coastal scientists and managers.