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Book reviews

Regional Science in Business. Edited by G. CLARKE and M. MADDEN. (Berlin: Springer Verlag, 2001). [Pp. viii + 363]. ISBN: 3-540-41780-X. Price €74.95 Hardback.

Regional science is not a sunrise discipline. Its central quest, as defined by the Regional Science Association International (RSAI), is to study 'those social, economic, political and behavioural phenomena which have a spatial dimension' (http://rsai.geography.ohio-state.edu/rsai/HomePage.htm). As such, it has shared concerns with GIS in spatial science but, unlike GIS, today probably accounts for a smaller real share of intellectual activity in the area than was the case ten, 20 or 30 years ago. The founding concept of the region, as many GIS researchers will tell you, is scientific quicksand, for regions rarely have any theoretical or functional integrity beyond getting a particular job done at a particular point in time. Yet this and many other practicalities of application in the messy real world have tended to pass regional scientists by, and some regional scientists get no closer to real world applications than their grant proposal forms for still further mathematical refinements of Central Place Theory. Although ostensibly inter-disciplinary, in practice the dominant disciplinary perspectives of regional scientists depend very much on where they live: in North America and the Far East, they tend to be (somewhat dry) economists; in Southern Europe a loose assemblage of social scientists practice variants of 'regional studies'; and in the UK and Northern Europe the field is dominated by geographers, planners and applied economists. Despite its explicit spatial focus, GIS does not figure as a major activity in the pages of the main regional science journals, though the sustained efforts of some editors are belatedly trying to change this. In demographic terms, regional scientists tend to be old or old at heart. The governing politburo of the RSAI oversees a number of very large and successful international conferences, but these tend to be set piece affairs rather than informal exchanges of new scientific approaches, new ideas and new thinking.

So, readers of this journal might take in an occasional regional science conference or two, but what does the discipline have to offer that is not fresher, more fleet-footed, more applied and relevant in GIS? My own impression is that the kind of spatial science promulgated in GIS is altogether more interactive, inductive and interdisciplinary than in its regional science forebear. The tide of scientific practice is certainly flowing the way of GIS: regional science, by contrast, seemingly remains mired in rather introspective self-doubt. In important respects, then, the aspiring young scholar today might see regional science and GIS as polar opposites. GIS is much more of the world than removed from it; it is motivated by application not introspection; and it seems altogether more exciting, racy and relevant. Yet regional science retains a number of important enduring virtues, and Clarke and Madden's edited collection comes as an important attempt to arrest the sunset over the discipline.

The editors' very lively opening chapter is very engaging, setting out as it does a vibrant policy agenda for regional science, developing a perceptive appraisal of the changing scientific setting to academic research and documenting the emergence of 'third leg' (consultancy) activities in university life. But a fair bit of what follows is more likely to sustain adherents than proselytise converts. This is not a book that really seeks to show the reader 'how to', and, at the end of the day, we are not presented with an entirely convincing gallery of applications that evidently manifests the core organising principles of regional science. If regional scientists appear a tad ineffective at actively exploiting the core of their own discipline, then neither do they appear particularly reactive to wider developments in communication and end-user interaction, to new computer environments and computer architectures, to new types of analytical models and (perhaps most of all) to the advent of better data. We do not even get the impression that many of the authors have been able to 'put something extra in

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[their] back pockets' (p. 5)–there is more than a whiff of 'soft' consultancy to some of the chapters. In all of these respects, regional science clearly still has some way to go and can learn from GIS, where applications seem to have developed more in a spirit of humility than conviction, and where real world applications have always been central to the development of science.

But what can GIS learn from regional science? Some of the contributors certainly succeed in reinvigorating established techniques with fresh real world applications: Hewings (chapter 2) for example presents a model which is true to one of the mainstays of regional science, input-output modelling, and applies it in a convincing setting. Others are less successful in these respects: Oppewal and Timmermans (Chapter 6), for example, present a very standard (and largely aspatial) review of discrete choice modelling and relate it to a rather tepid application. There is, then, a sense that some old techniques are being mined for yet another edited collection–but few new rich seams of ideas seem apparent. Many of the chapters are interesting, but there is an evident public sector bias to the 'business' applications, apart from some of the applications created within and around the GMAP consultancy at the University of Leeds. There is a geography to authorship, too, with just two of the chapters originating from North America, three from Continental Europe and none from the Pacific.

The standard of editing is good, though some of the contributors might have been encouraged to redraw artwork rather than supply PowerPoint slides. Springer books in this series are hardly renowned for their lavish production qualities or their tempting price tags, and what is presented here is par for the course for the 25+ titles in the **Advances in Spatial Science** series. In sum, this is a welcome book: at its best it begins to realise some of the dormant vitality of the regional science discipline, and it marks a break with the introspective self-evaluations of the past. But there is still some way to go!

Paul A. Longley
Department of Geography and Centre for Advanced Spatial Analysis
University College London, UK

Distributed Hydrologic Modelling Using GIS. (Water Science and Technology Library Volume 38). By Baxter E. Vieux (Dordrecht: Kluwer, 2002). [Pp xvi + 293]. ISBN 0-7923-7002-3. Price £59.00 Hardback.

The stated aim of this book is to '*set out principles for modelling hydrologic processes in space and time using the geographic information system*'. The presentation is closely geared to the *r.water.fea* routines for the GRASS GIS (and the equivalent *arc.water.fea* for ArcView) developed by the author for the US Corps of Engineers. In doing this, he hopes that he has '*not built just another model but have significantly advanced the state of hydrologic modelling for both researchers and practitioners*'.

So what is so new about *r.water.fea*? In fact it has much in common with many other distributed surface runoff models. It is a raster based model that considers only (Green-Ampt) infiltration excess runoff generation and routes that runoff, using a 1-d finite element approximation of the kinematic wave equations, only in the direction of greatest slope on the hillslope and along reaches of the channel network. Variants of this type of model date back at least to Huggins and Monke in 1969 (or even the model of Merrill Bernard in 1937 in the pre-digital computer era). Modern variants include KINEROS, CASC-2D, QPBRRM and many others. There are also other more complete distributed models that also consider subsurface flows and saturation excess runoff generation such as SHE, IHDM, THALES and InHM. Some of these models are also closely linked to GIS and avoid the use of raster representations of hillslope topography. Thus, it is perhaps better to consider the presentation of *r.water.fea* more as a representative of this genre of distributed models rather than a significant advance in hydrological modelling.

As such, the presentation of some of the issues involved in such models is done well. There are useful chapters on the techniques and problems of generating a digital elevation model, with much practical advice; the input of different types of rainfall data (though with an emphasis on US radar rainfall data); and the use of US soils and hydraulic roughness databases. There is also a chapter on model calibration with an interesting section on the

adjoint calibration method. The book concludes with a number of case studies based on the Illinois River (2400 km^2) on the Oklahoma/Arkansas border, a glossary, and an extended appendix demonstrating the use of *arc.water.fea*.

Some of the difficulties of this type of model are played down however. It is a surface runoff only model; it therefore requires some (non-physical) technique of baseflow separation (a line of constant slope is used in the examples). Nowhere in this book is there any real consideration that runoff generation might be other than by an infiltration excess mechanism. Has the author really seen extensive infiltration excess overland flow in storms of 30 mm in this catchment? Are the saturated hydraulic conductivities really everywhere lower than 12 mm hr^{-1} (as stated) in a catchment with 44% forest cover?

The difficulties of calibrating distributed models are also played down. It is assumed that the basic estimates of parameter values for the model will come from soil and land use data bases for infiltration and roughness parameters respectively. Adjustments using multiplicative or additive factors while preserving the spatial pattern of parameter values (as derived from GIS) are recommended. In the Illinois River, the calibrated model systematically overpredicts peak discharges (having been calibrated primarily on runoff volumes). The author suggests that this is because off-channel storage effects are not included in the kinematic routing algorithm, but this should also raise the question as to whether the runoff generation is also being predicted by the right mechanism and with the right timing characteristics (there is one sentence on p.235 allowing that this might be the case with respect to saturation excess surface runoff, but no recognition at all of the possibility of subsurface stormflow). Nowhere are examples given of independent tests of the model predictions at sub-catchment scales or even at the catchment scale for events not used in calibration.

There is some discussion of uncertainties in parameter estimation, but the only formal analysis given is a suggestion that a standard first order linear error analysis might be used to propagate the expected variability of soil texture variables through a pedo-transfer function to give a variance of estimation for the Green-Ampt infiltration parameters. Leaving aside the fact that this could be done more easily by considering the standard error of estimation for the pedo-transfer regressions (that would reflect both the variability and error of estimation with respect to the original observations), no attempt at all is made to then propagate these errors through to the (nonlinear) predictions of the model. Similarly, there is extensive discussion of the effects of lumping of spatial units in a chapter on Information Content and Spatial Variability, including mention of kriging and fractals, but no indication as to how this analysis might help in assessing the (nonlinear) scale dependence of the effective parameter values needed by the model. It seems to be an implicit assumption that the derivation of parameters from the GIS soil maps, associated soil texture information and pedo-transfer functions will provide useful information for the effective parameters required at the 30 m model grid scale (for the Illinois River), at least with a bit of later calibration. But the measurements that were originally used to derive the STATSGO pedotransfer functions for hydraulic conductivity, for example, were made on fist-sized fragments of soil without any consideration of the effects of macropores and other larger scale effects of sub-grid variability.

Finally, in the application of the model to the Illinois River, the author gives some comparisons of discharge predictions made with *r.water.*fea using distributed model parameters with those using lumped model parameters and different grid sizes. The 'degraded' models are shown to produce poorer results, with the conclusion that taking spatial variability into account is therefore important. However, as far as can be seen, while the fully distributed model has been allowed some calibration of its parameters (and still shows significant inaccuracies in the prediction of peak flows), the degraded models have not been allowed such calibration. The conclusion may be correct, but it is not adequately demonstrated here.

So, does the *r.water.fea* approach to hydrological modelling represent the significant advance suggested? Not, I think, on the basis of the evidence presented here. The ease of application of the model using GIS databases is well demonstrated, but this is simply a function of modern computational capabilities, not of added hydrological understanding. It is known that infiltration excess runoff is not the dominant mechanism of runoff generation in many catchments. The model still requires calibration to compensate for all the potential kinds of representational errors, and the spatial predictions have not been verified in any way. The continuing work of Keith Loague and his co-workers in trying to represent the response of the small R5 catchment at Chickasha (also in Oklahoma) adequately, even with extensive observations of infiltration rates and soil properties, is evidence of the difficulties of such

distributed modelling approaches. It seems quite remarkable that the only paper of this R5 series referred to in this volume is the earliest one in 1985. For a wider view of the current state of the art, the reader might want to refer to the recent books edited by Vijay Singh and Donald Frevert (2002a, 2002b) or the special issue of *Hydrological Processes* arising from the Leuven Workshop on the Future of Distributed Modelling (**16**, p. 2002).

Some parts of this book can be highly recommended. It primary value is as a detailed introduction to *r.water.fea* and *arc.water.fea*. The discussion of the generation of raster digital elevation models in chapter 3 is particularly useful, although the discussion of the derivation of flow directions and network delineation in chapter 7 is not up to date. There is so much, however, that is still missing: an appreciation for the limits of validity of the infiltration excess approach to runoff generation; an assessment of the predictive uncertainty of the approach in practical applications; any attempt to show that the spatial predictions are meaningful; any attempt to show that calibrated parameter values might be useful in other applications for the same soil types. These are the real advances that are needed in distributed hydrological modelling.

KEITH BEVEN
Department of Environmental Science
Lancaster University, UK

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Java Programming for Spatial Sciences. By Jo WOOD. (London: Taylor & Francis, 2002). [Pp xii + 320]. ISBN 0-415-26098-1. Price £24.99 Paperback.

As this book is aimed at spatial scientists who want to become programmers, rather than the reverse, it is perhaps appropriate to examine why people are currently drawn to Java, and why so many companies are currently outlaying so much on training non-programmers in the language. A recent straw poll of GIS Masters alumni found that 90% believed Java was an attractive skill given their jobs or recent applications, however, of those who could program, only 5% regularly did—employers want not only programmers, but also spatial scientists who *can understand what programmers are talking about*. It is clear then that there are two themes such a book needs to deal with: the first, obviously, is the language itself, however, there is also a broader need to understand programming generally. It is pleasing to see that this book tackles both, while simultaneously conveying the basics of spatial data handling.

The book makes a welcome start on the programming side, instilling Object Orientated principals from the first. It uses excellent examples in the first three chapters to clearly introduce classes, objects, and inheritance, while the language and Graphical User Interface (GUI) basics are covered using code examples. Chapters Four and Five then cover the control of program flow. Three chapters follow which collate information in a novel but useful manner: the first deals with code sharing, and covers not only packages, but also sharing variables and documentation. This is followed by a chapter on grouping objects in useful collections, while the 'Controlling Dynamic Events' chapter covers programs doing simultaneous jobs and responding to buttons pushes etc. While many Java books would consider these subjects of widely different complexity, Jo's grouping seems intuitive, and his confident handling gives the material as light a feel as possible. The final two chapters cover communication: files, including writing objects to files (again, nicely conveyed), followed by applets and markup, including code to use XML.

The book also makes a sound attempt to tackle broader programming issues: it covers the Unified Modelling Language (UML) (though information on diagrams other than the Class Diagram would be welcome), XML, HTML, code elegance and documentation, as well as sections on Turing Machines, Object Orientation, and different programming styles. However, it would have been good to also see overviews of GUI design, patterns, user testing, and the development process.

The book contains numerous examples, introducing useful code that can be built on by beginners and experts alike. The main code presentation is in two case studies: a basic raster and vector GIS, and an ant modelling, agent based, system containing a genetic algorithm. These two examples are re-introduced throughout the book, showing the use of code developed in each chapter. Both are skilfully constructed, however, if there is one criticism of the book, it is probably that these are introduced 'too complex, too soon'. There will always be a need to skip some knowledge on the basis that it will be explained later (usually the `main` declaration and `System.out.println()` with Java), however, many parts of the case studies slip in code not covered by the point at which they are introduced. Beginners will need to understand that they can't type in all the examples and expect them to work as-is. Once, however, they accept that associated code will be explained in future chapters or is on the book's website, the case studies are both useful and well developed.

The covering of material through the development of examples has led to some minor omissions which may frustrate beginners—they may want to search out more on the `null` value, and the command syntax for running a packaged class, as they are both used in the examples, and the `throws` keyword is not explored. However, most such omissions are not fatal (it would, for example, have been nice to see larger sections on images and primitive wrapper classes like `Double`, but the salient information is given).

The book itself is pleasantly written and laid out, uses UML throughout, contains a good glossary, and a concise and pertinent list of locations for further information. It is a shame the publishers have used the Royal Octavo format, as the book will sit as an uneasy, and somewhat academic looking colleague against the more standard 7″ by 9″ US format of most beginners books, and it deserves to be picked up. The associated website (http://www.soi.city.ac.uk/jpss) is a set-piece in web design, and currently includes a well-developed set of knowledge-testing quizzes which give excellent feedback. The downloadable code includes files easing their use with BlueJ, the free programming environment for learning Java. There is also coming information on resources and coding exercises which should enhance the learning process—it will be interesting to see whether these rely on the rather complex case studies. Most importantly, there are two sample chapters online so you can check out the book and see if it matches your preferences.

In summary, the book gives a good introduction to Java and some of the thinking that goes into handling spatial data with bespoke programs. For the revising programmer, the GIS and agent based case studies are both interesting and useful. The beginner may have to accept that the case studies are a set of examples to read rather than a series of applications they can develop *as* they read, and that they need some effort to understand while working through the early chapters, however the book introduces complex ideas for the most part with a light and confident touch.

Learning Java gives you a direct insight into modern computing, a sound basis for understanding almost any other programming language, and develops a skill which is to be recommended to anyone dealing daily with complex datasets and programs. However, Java is also a vast and occasionally capricious language, and conveying it to beginners is a difficult undertaking. To take this problem, and add to it that of teaching a basic understanding of spatial data handling is brave indeed, and it is an indication of Jo Woods' skills as both a programmer and an educator that he manages to convincingly tackle both areas in this book.

Andrew Evans
Centre for Computational Geography,
University of Leeds, Leeds, UK

Spatial Technology and Archaeology: The Archaeological Applications of GIS. By David Wheatley and Mark Gillings. (London: Taylor & Francis, 2002). [Pp xiii + 269]. ISBN 0-415-24639-3, Price £50.00 Hardback. ISBN 0-415-24640-7, Price £17.99 Paperback.

This book is a very welcome addition to the burgeoning literature on archaeological applications of GIS. Over the last decade or so a large number of edited collections of conference papers and individual research papers have appeared resulting in a body of information that

is confusing and difficult to access. David Wheatley and Mark Gillings have provided an invaluable service to archaeology by producing an overview of the technologies, their application, and wider issues, which will become an essential first port-of-call for anyone working in this area. The book is logically structured and contains a wealth of information and technical detail while remaining readable and accessible.

Sensibly, the book does not attempt to be software specific but rather concentrates on methods and techniques illustrated through entirely appropriate examples of archaeological applications. Chapters 2 and 3 are thorough introductions to constructing a spatial database and acquiring and integrating different sorts of data. These should be essential initial reading for any archaeologist approaching GIS work for the first time (although I would recommend them to more experienced users as well). Fundamental aspects such as geo-referencing, projection systems, data structures, topology, accuracy and precision and metadata are covered with enough detail (and references) to enable the book to successfully operate as a 'manual' while at the same time offering more reflective discussion. There should, perhaps, be a more explicit mention of the ADS *GIS Guide to Good Practice* at the very beginning of chapter 2 as a useful compliment to be used in conjunction with this book.

This three-pronged approach of practical information, considered discussion and appropriate applications is maintained throughout the rest of the core chapters of the book. Chapter 4 is where, in the authors' words, the fun starts with data manipulation and analysis covering searching, summaries, transformations and modelling as a basis for the more detailed functionality of later chapters. Chapter 5 is a discussion of elevation and its importance within archaeological analysis and also the procedures involved in producing different kinds of elevation models and associated issues such as the affects of different algorithms.

Chapter 6, essentially on spatial analysis, and to a certain extent Chapter 9 on trend surface and interpolation, are the two less satisfactory chapters in the book although I do sympathise with the problem that confronted the authors and they are explicit in enunciating it (p. 146). They are correct to say that both of these areas need to be included while at the same time they are both large enough to warrant (and have) books in their own right. The coverage offered here is enough of an introduction to be viable although I suspect that most archaeologists will fail to make the connections between these two chapters and their own work, mainly because many of these techniques are not well-integrated into popular software or the popular disciplinary perception of GIS applications in archaeology.

More in the mainstream of interest will be chapters 7 and 10 on sites, territories and distance and visibility analysis respectively. These cover important areas of archaeological applications and both offer a thorough grounding in the techniques and their applications. However, because both of these authors have been leading proponents in the move to theorise GIS applications in archaeology and have published important contributions, there is, a slight feeling of lost opportunity here which renders both of these chapters a little disappointing. The scene is set, albeit briefly, in chapter 1 which introduces the GIS in archaeology dilemma of objective, quantified space juxtaposed with humanised, culturally constituted place. The arguments are expanded in chapter 8, although again fairly briefly, within the context of predictive modelling which is entirely appropriate considering the amount of discussion there has been surrounding this and the 'return to environmental determinism' debate. Here the theoretical tensions are acknowledged and the reader left to decide, whereas in chapters 7 and 10 the theoretical issues surrounding the humanisation of cost surfaces and visualisation are mentioned but not pursued in any depth. This imbalance is at the expense of recent discussions on humanised movement and more sensitive visualisation techniques in favour of the more standard methods such as buffering and viewsheds.

The analytical chapters of the book are biased towards research-led archaeology rather than Cultural Resource Management despite the latter probably being a larger application area in terms of usage and resources. Of course, certain chapters such as 2 and 3 are relevant to both application areas and chapter 11 attempts to address the imbalance by presenting CRM issues together with two well chosen case-studies. Again though, it must be accepted that this chapter is rather brief and adds to the occasional feeling throughout the book that the authors were up against a tight word limit considering the size of the subject area. The final chapter, future directions, introduces the three areas of Object-Oriented GIS, 3D-GIS and Temporal GIS within a context of their potential for archaeology.

Overall the book is nicely produced and very well illustrated with appropriate figures and tables. The bibliography is extensive and current although there is no mention of web-based resources which is surprising with there being so much on-line. Despite the minor reservations outlined above this is an excellent introduction to the use of GIS in archaeology and the authors are to be congratulated on condensing a massive body of information and presenting it in such an accessible manner.

Gary Lock
Institute of Archaeology
University of Oxford, UK.

Geographic Information Systems in Oceanography and Fisheries. By Vasilis D. Valavanis (London: Taylor & Francis, 2002). [Pp xviii + 209]. ISBN 0-415-28463-5. Price £45.00 Hardback.

The science and practice of oceanography are normally broken down into several major subdisciplines, depending on the nature of an investigation: (1) geological oceanography or marine geology (rocks, sediments, shape of the ocean floor); (2) marine geophysics (rock structure and properties): (3) physical oceanography (ocean currents and air-sea interactions); (4) chemical oceanography (composition of seawater and processes altering this composition); (5) biological oceanography or marine biology (organisms within the ocean and ecological interactions); and (6) ocean engineering (design and construction of instruments, vehicles, and associated technologies to assess and monitor the oceans). *Geographic Information Systems in Oceanography and Fisheries* is largely concerned with applications of GIS to biological and physical oceanographic problems. It was conceived within the timeframe of an international workshop on GIS and fisheries that was a satellite meeting to the Millennium Cephalopod Conference of the Cephalopod International Advisory Committee (for the uninitiated, cephalopods include octopi, squid, cuttlefish, and the like). The book is especially timely with the recent explosion of worldwide interest in and applications of GIS to fisheries management, including stock assessments, marine species population dynamics, species life history, habitat characterization, and marine protected area design.

The book includes four main sections, all extremely well referenced with regard to the burgeoning literature of geographical information science and marine/coastal applications of GIS. The author did his homework well.

An excellent foreword, by noted fisheries GIS researcher Geoff Meaden, provides an excellent introduction that summarizes the main purpose of the book in addressing how GIS can contribute to fisheries management and the understanding of related physical oceanographic processes (with the accompanying challenges of 3-D and 4-D ocean environment that push the envelope of geographical information science), but places special emphasis as well on how important this is now, given the poor environmental management practices that pervade the world's oceans. Fisheries stocks are declining due to over fishing, various forms of pollution threatens habitats, and we still lack sufficient knowledge of the ocean environment to protect and manage it.

Chapter 1 provides a basic overview of GIS principles including the main components of most marine GIS projects, the crucial link between GIS and remote sensing for understanding the air-sea interface and water column, and the emergence of the Internet as a mean for data distribution and project collaboration. Included is an excellent summary and table identifying major international and national GIS consortia, which oceanographers lacking a background in geography should find helpful. Pursuant to this, there is also an excellent section on spatial thinking, which draws on recent literature in spatial cognition. Why and how should oceanographers, regardless of subdiscipline, develop the ability to think spatially, and what are the primary marine spatial questions as one attempts to understand the nature and dynamics of marine processes? These are discussed at length and identified in a table, a very useful resource for students and researchers alike. As 3- and 4-D processes are so crucial for the ocean, the chapter concludes with a savvy discussion of GIS and scientific visualization systems, summarizing studies that have incorporated them, and providing a review of various software packages.

Chapter 2 is most impressive in terms of how comprehensively it reviews studies that have incorporated GIS in all the major subdisciplines of oceanography. Included are descriptions of published studies of GIS as applied to marine geology, coastal and ocean management, coastal zone dynamics, coastal hazards (including coastal flood assessment and marine oil spills), sea level rise, natural and artificial reefs, wetlands and watershed, submerged aquatic vegetation, upwelling events, temperature and chlorophyll fronts, circulation gyres, sea surface classifications of temperature, salinity, air pressure, wind speed, and other environmental parameters; and seafloor mapping, including benthic habitat characterization. Worldwide oceanographic initiatives are reviewed, as well as web sites that provide data, online tools, and online mapping. Data collection and sampling methods of physical oceanographers are described next, with information on all of the major satellites, their sensors, and web URLs where one may download data from the sensors. Table 2.2 includes several pages listing the web addresses of major oceanographic data providers.

Chapter 3 is structured in a similar matter but is specifically focused on fisheries, thereby providing an extensive showcase of fisheries GIS applications for monitoring seasonal essential habitats, species life history, migration corridors, spawning grounds, etc., their data sources, organizations via web sites. Ideas for further developments in these areas are presented in chapter 4.

Two appendices are comprised of ESRI Arc Macro Language (AML) scripts that provide many useful avenues for downloading, converting, processing, and manipulating sonar, satellite and water column data. While the inclusion of these scripts is an excellent idea and most laudable, their presence in print form only is unfortunate. In order for them to be implemented the reader must retype them from scratch into their computer, which can be a tremendous source of error and frustration. Perhaps for a second printing of the book the publisher might consider providing these on an anonymous ftp site. For now the reader is better off contacting the author directly to obtain digital copies of the AMLs.

This book is highly recommended as a reference book for physical and biological oceanographers, fisheries biologists, marine and coastal geographers, coastal resource managers and consultants, marine technologists, and government researchers. Rather than introducing new results and interpretations, it does an excellent job of summarizing and synthesizing what has recently been published. And although the author states in the book's final chapter that the time is ripe for someone to produce a marine GIS textbook, it appears that *Geographic Information Systems in Oceanography and Fisheries* has made an excellent start. So until a formal marine GIS text is produced, this book will certainly be suitable as a supplementary text for undergraduate or graduate students in a marine fisheries, marine resource management, or GIS applications course, with laboratory exercises provided by the instructor. Indeed, as stated in the last sentence of the final chapter, '…to make the most out of GIS, mix it with water!'

Dawn J. Wright
Department of Geosciences
Oregon State University
Corvallis, Oregon, USA