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# Book Review

"Geocomputation - A practical primer" is a timely book whose content will look obvious in a few years time but would have probably seemed unusual, at least, just a few years ago. Its publication coincides with many substantial changes and shifts occurring in the world of computation, science and geographic data. Althought those are subject for a different discussion, a few examples will help contextualize the moment in which this book has come about. Computing has been moving away from the desktop for a few years now: lighter, everyday, tasks are pushed into ever smaller devices (tablets, smartphones, wearables...), while more heavy-duty jobs are reserved for servers, data-wharehouses or somewhere else, all of it blurred through the convenience of the cloud. At time the scientific endavour is experiencing a crisis of public trust and reliability, more open and reproducible approaches are being proposed as the best way to keep science credible and useful for society (Peng, 2011). The data deluge produced by the digital era we live in is shifting the interest from classical statistical methods designed for "reliable little data" to machine learning and pattern recognition techniques created for "messy big data". Closer to Geography, there is a strong push to take cartography from static publication-ready formats into the web, opening the door for rich interactive features and much richer presentations. How these and other changes will affect geocomputation is unclear. Some will probably pass and be forgotten soon while some others will foreseably remain with us and, in the process, redefine the way we understand the discipline. With such uncertainty ahead, the temptation to write a "classical" book, one that relies on the topics, methods and approaches we have "known and loved" for decades, is very strong. Fortunately, that was not the route chosen by Brunsdon and Singleton.

Instead, the editors took a braver approach by reconciling some of the classical themes in the field that will arguably remain relevant in the future (as they represent the core upon which much of the new approaches build), and blended them with more recent approaches that only few would have seen coming just a few years ago. The book is structured around four blocks of three to four chapters each, revolving around common broad topics but mixing more theoretical approaches with eminently practical articles. The

first part, "Describing how the world looks", considers geocomputational approaches to represent the world, from the very micro-level, such as the one on 3D geosimulation (Torrens, Ch. 2), to very macro-level views on rank size and power laws (Batty, Ch. 3). "Exploring movements in space", part two, considers several approaches to the blend of space and time, as well as dynamic modeling. Topics like the combination of agent-based modeling and GIS (Crooks, Ch. 4), or microsimulation (Harland & Birkin, Ch. 5) find their place in this part of the book, but also more general overviews about circular statistics (Rohde & Corcoran, Ch. 7) or about storage, management and analysis of large space-time datasets (Miller, Ch. 6). In part three, "Making geographical decisions", the editors have compiled a set of geocomputational techniques used in real-world applications to solve specific problems. This comprises geodemographics (Alexiou & Singleton, Ch. 8), self-organizing maps (Spielman & Folch, Ch. 9), kernel densities (Ch. 10, Lewis), and location-allocation models (Tomintz, Clarke & Alfadhi, Ch. 11). These are usually illustrated with a practical application, rather than merely described in abstract terms, which makes the reading much more intuitive and serves as a good starter for the non-experienced reader interested in discovering the "big picture" of the technique. The fourth block, "Explaining how the world works", delves into confirmatory approaches that seek to provide insight into underlying social or natural processes. Two good examples are Chapter 12 on Geographically Weighted GLM's (Nakaya) and Chapter 13 on spatial interaction models (Morrisey). The final part, "Enabling interactions", covers several examples of new avenues for geocomputation that would have not been part of a more traditional book. Topics like the use of crowd-sourced datasets (Brunsdon & Comber, Ch. 16) or public participation through GIS (Kingston, Ch. 18) can be found here.

In addition to these thematic blocks, a most welcome feature of the book is the series of chapters inteligently inserted in each block that cover aspects of geocomputation referring to tools and software. In particular, it is refreshing to see how all of these relate to open-source projects freely available to use. The landscape where the only choices to perform geocomputational analyses were proprietary, desktop, point-and-click, GIS programs, or custom routines in low-level languages such as C or FORTRAN is no longer the norm. Instead, an entire ecosystem of open-source software, more flexible than traditional desktop GIS and more accessible than low-level computer programming has emerged. Just a few years ago, it was not very clear, one day, it would be possible to carry out serious reseach in geocomputation using only free and/or open-source software. That the field has evolved in this direction to a point where there is a full stack of tools Rey (2009) that realize such vision is greatly inspiring and it is something that the larger community of researchers who have made it possible should feel proud of. The book contains an overview of open-source software for GIS (O'Brien, Ch. 17), and two other chapters are devoted to the most common programming

languages used in geocomputation, R (Cheshire & Lovelace, Ch. 1) and Python (Rey, Ch. 14). An additional chapter (Ch. 15) by Brunsdon & Singleton ellaborates on the idea of reproducibility, describing the concept, why it should be adopted, and how it can be reallistically implemented. This bit echoes a larger debate that relates to the very core of what Science is about and how to keep it serving society in the XXIst Century, and its inclusion in the book is a reassuring sign of the forward-looking attitude of the editors.

There is much to like in this book. For a discipline so wide, diverse, and eclectic as geocomputation, the selection of topics does a remarkable job at capturing some of key themes, applications, and domains where geocomputational approaches are used and useful. This is further enhanced by the fact that the text lives up to the "practical" in its title: instead of delving into the thorough math underlying many of these techniques, each chapter presents the intuition and application, making it a very suitable companion for a graduate seminar in social sciences (e.g. economics, sociology), or for researchers from different disciplines with an interest in what geocomputation has to offer to them. Part of this success in meeting its own goals is undoubtedly related to the fact the authors are among the key leaders in the field they are writing about, and thus are particularly well placed to write introductory texts that get to the essence without much of the underlying math. However, this is nicely complemented by a short section at the end of each chapter with a few key references for the interested reader to continue learning about the topic. Most of these do include some of the equation-heavy books and articles required to master these techniques, making the book a perfect introduction –a primer afterall– with a clear path forward for the interested minds.

At a more global level, the book recognizes and embraces many of the "big picture" shifts occurring in the field and accomodates them throughout the book. In addition to the already mentioned new approaches to geocomputational software and tools, there is an explicit recognition that the data landscape is changing, and this will require adaptation to be able to extract the most value and knowledge. This is very clear in parts of the book, like Chapter 9 (Miller), that recognize the need to accomodate and properly represent these new forms of data. But it is also more subtly present in the choice of methods reviewed. For example, the inclusion of a chapter on self-organizing maps, a machine learning technique to reduce data dimensionality and visualize large complex datasets, is very much in that same spirit. Very welcome is also the role given by the editors to visualization. One could argue that graphics have always been an essential part of GIS and, by extension, geocomputation. However, it is easy to get lost in the complexity and computational aspects of some of the methodologies and assume that, because the results come from very complicated techniques, the presentation of such results is of secondary importance. The book takes a clear stance at this and recognizes not only its importance, but its non-triviality, including chapters that walk the reader through some of the

cutting-edge tools such as R, Python, or JavaScript libraries for the web.

As much as there is to praise about this edited volume, one can always wish for more. Arguably, the following are a reflection of my own interests and preferences, but I do think they would have made the book a slightly more complete and consistent one. I have two main remarks, one relating to the structure and the other one to the content. I think there could have been a bit more consistency in the structure of each chapter. While some chapters are practical applications of a particular method, others are a more conceptual overview. To some extent, this is unavoidable in an edited volume with so many and varied authors, and some would argue even desirable as it exposes the reader to a larger range of approaches and ways of understanding the field, and I agree. However, I think a more consistent presentation of different methods provides a better way to introduce the unfamiliar reader to a family of new techniques. I would have also enjoyed some discussion of how geocomputation does or should engage with the nascent discipline of data science. Data science is in some ways a buzz term around which there is much hype and, in that sense, it is correct not to give it much attention as the risk of the fashion fading soon is too high. However, the strong emphasis it places on practical applications and the use of data and quantitative techniques in industry and policy warrant some respect. A chapter on how geocomputation fits into the field of data science and how this can help make the discipline even more useful and valuable would have been very welcome.

Geocomputation is a vibrant field that is constantly reimagining and reinventing itself, influenced by several technological and scientific advances, but also feeding back into those arenas. Because of that, the discipline should be of interest not only for experts on these computational techniques, but also to a wide variety of students and researchers in the natural and social sciences. Particularly for those, the book is an excellent introduction that will provide a good overview of what is on offer, and how to make the most out of it.

## References

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