

# **Lecture Notes in Geoinformation and Cartography**

## **Series editors**

William Cartwright, Melbourne, Australia

Georg Gartner, Wien, Austria

Liqu Meng, München, Germany

Michael P. Peterson, Omaha, USA

### *About the Series*

The Lecture Notes in Geoinformation and Cartography series provides a contemporary view of current research and development in Geoinformation and Cartography, including GIS and Geographic Information Science. Publications with associated electronic media examine areas of development and current technology. Editors from multiple continents, in association with national and international organizations and societies bring together the most comprehensive forum for Geoinformation and Cartography.

The scope of Lecture Notes in Geoinformation and Cartography spans the range of interdisciplinary topics in a variety of research and application fields. The type of material published traditionally includes:

- proceedings that are peer-reviewed and published in association with a conference;
- post-proceedings consisting of thoroughly revised final papers; and
- research monographs that may be based on individual research projects.

The Lecture Notes in Geoinformation and Cartography series also includes various other publications, including:

- tutorials or collections of lectures for advanced courses;
- contemporary surveys that offer an objective summary of a current topic of interest; and
- emerging areas of research directed at a broad community of practitioners.

More information about this series at <http://www.springer.com/series/7418>

Jamal Jokar Arsanjani  
Alexander Zipf  
Peter Mooney  
Marco Helbich  
Editors

# OpenStreetMap in GIScience

Experiences, Research, and Applications

 Springer

*Editors*

Jamal Jokar Arsanjani  
GIScience Research Group  
Institute of Geography  
Heidelberg University  
Heidelberg  
Germany

Peter Mooney  
Department of Computer Science  
Maynooth University  
Maynooth, Co. Kildare  
Ireland

Alexander Zipf  
GIScience Research Group  
Institute of Geography  
Heidelberg University  
Heidelberg  
Germany

Marco Helbich  
Department of Human Geography and  
Spatial Planning  
Utrecht University  
Utrecht  
The Netherlands

ISSN 1863-2246

ISSN 1863-2351 (electronic)

Lecture Notes in Geoinformation and Cartography

ISBN 978-3-319-14279-1

ISBN 978-3-319-14280-7 (eBook)

DOI 10.1007/978-3-319-14280-7

Library of Congress Control Number: 2014958977

Springer Cham Heidelberg New York Dordrecht London

© Springer International Publishing Switzerland 2015

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Printed on acid-free paper

Springer International Publishing AG Switzerland is part of Springer Science+Business Media  
([www.springer.com](http://www.springer.com))

# Foreword

## OpenStreetMap Studies and Volunteered Geographical Information

This book comes at an apt time to reflect on the growing role of OpenStreetMap (OSM) in Geographical Information Science. This summer, the OpenStreetMap project celebrated ten years of operation, which began on the date of the domain name registration. I first heard about the project when it was in its very early stages and, with the support of the Royal Geographical Society, carried out the first research project that focused on OpenStreetMap, with an attempt to develop a mobile data collection tool on an early GPS-enabled phone. As a result, I found myself writing, together with Patrick Weber, what is now the most cited paper on the project (Haklay and Weber 2008). This early exposure to the project provided me with opportunities to watch, with astonishment, how it has become an important source of geographical information, as well as the explosive growth in academic research with and about it.

Of course, in the early years the project was small, with an unclear future and too localised to have a wider impact. It is, therefore, unsurprising that, so far as academic publications indexing reveals, Nelson et al. (2006) ‘Towards development of a high quality public domain global roads database’ and Taylor and Caquard (2006) ‘Cybercartography: Maps and Mapping in the Information Era’ are the first peer-reviewed papers that mention OpenStreetMap. Yet, it is interesting that, within two years of establishment, researchers in Canada and the United States heard about it and realised its potential. Moreover, many chapters in the current volume attest to the foresight that these two papers demonstrated.

Since 2006, OpenStreetMap has received plenty of academic attention. As of August 2014, more ‘conservative’ academic search engines such as ScienceDirect or Scopus find 286 and 236 peer-reviewed papers (respectively) that mention the project. The ACM digital library finds 461 papers in the areas that are relevant to computing and electronics, while Microsoft Academic Research finds only 112. Google Scholar, probably the most expansive of the search engines, lists over

9000 (!). Even with the most conservative version from Microsoft, we can see an impact on fields ranging from social science to engineering and physics. In short, OpenStreetMap has facilitated major contributions to knowledge beyond producing maps.

The link between OpenStreetMap and the concept of Volunteered Geographical Information is also long-standing. Michael Goodchild, in his seminal paper from 2007 that defined Volunteered Geographic Information (VGI), mentioned OpenStreetMap as an example. Since then the literature frequently conflates OSM and VGI. In some recent papers statements such as ‘OpenStreetMap is considered as one of the most successful and popular VGI projects’ or ‘the most prominent VGI project OpenStreetMap’ are common<sup>1</sup> and, to some degree, the boundary between the two is being blurred. I also admit to be part of the problem—for example, with the title of my 2010 paper ‘How good is volunteered geographical information? A comparative study of OpenStreetMap and Ordnance Survey datasets’. However, upon reflection on the characteristics of OpenStreetMap and other VGI projects, I became uncomfortable with the equivalence between OSM and VGI. The stance that Neis and Zielstra (2014) offer is, I suggest, more accurate: ‘One of the most utilized, analyzed and cited VGI-platforms, with an increasing popularity over the past few years, is OpenStreetMap (OSM).’

The reason that it is valuable to differentiate between focusing on the OpenStreetMap project (what we can call OSM studies) and the more generic VGI research is partly due to the volume of papers specifically about the project, and what they reveal about the project. Over the years, several types of research papers that can be classified as OSM studies have emerged.

First, there is a whole set of research projects that use OSM data because it is easy to use and free to access (for example, in computer vision or even string theory). For these projects, OSM is just data to be used (see “[Data Retrieval for Small Spatial Regions in OpenStreetMap](#)” and “[The Next Generation of Navigational Services Using OpenStreetMap Data: The Integration of Augmented Reality and Graph Databases](#)”, which arguably fall into this category). Second, there are studies of OSM data: quality, the history and evolution of objects in the database, what we can learn about the nature of the data and other aspects. The majority of this volume falls under this category (see “[Assessment of Logical Consistency in OpenStreetMap Based on the Spatial Similarity Concept](#)”—“[Inferring the Scale of OpenStreetMap Features](#)”, “[Route Choice Analysis of Urban Cycling Behaviors Using OpenStreetMap: Evidence from a British Urban Environment](#)”, “[Building a Multimodal Urban Network Model Using OpenStreetMap Data for the Analysis of Sustainable Accessibility](#)”—“[Using Crowd-Sourced Data to Quantify the Complex Urban Fabric—OpenStreetMap and the Urban–Rural Index](#)”). Third, there are studies that also look at the interactions between patterns of contribution and the data—for example, in trying to infer trustworthiness (see “[Spatial Collaboration Networks of OpenStreetMap](#)”). Fourth, there are studies that look at the wider

---

<sup>1</sup> These are deliberately unreferenced so as not to argue that specific authors are to blame.

societal aspects of OpenStreetMap—for example, what the spatial and social implications of data coverage are (see “[Social and Political Dimensions of the OpenStreetMap Project: Towards a Critical Geographical Research Agenda](#)”). Finally, there are studies of the social practices in OpenStreetMap as a project (see “[The Impact of Society on Volunteered Geographic Information: The Case of OpenStreetMap](#)”).

In short, there is a significant body of knowledge regarding the nature of the project, the implications of what it produces, and ways to understand the information that emerges from it. Clearly, we now know that OSM produces good data and is aware of the patterns of contribution. What is also clear is that many of these patterns are specific to OSM. Because of the importance of OSM to so many application areas (including illustrative maps in string theory!), these insights are very important. Some of these insights are expected to be also present in other VGI projects but making such analogy needs to be done carefully, and only when there is evidence from other projects that this is the case. In short, we should avoid conflating VGI and OSM—and this volume provides a clear demonstration why this is the case.

November 2014

Prof. Mordechai (Muki) Haklay  
Professor of Geographical Information Science  
Department of Civil, Environment and Geomatic Engineering  
University College London (UCL), UK

## References

- Goodchild M (2007) Citizens as sensors: the world of volunteered geography. *GeoJournal* 69(4):211–221
- Haklay M, Weber P (2008) OpenStreetMap: user-generated street maps. *IEEE Perv Comput* 7(4):12–18
- Haklay M (2010) How good is volunteered geographical information? A comparative study of OpenStreetMap and ordnance survey datasets. *Environ Plan B* 37(4):682–703
- Neis P, Zielstra D (2014) Recent developments and future trends in volunteered geographic information research: the case of OpenStreetMap. *Future Int* 6, 1:76–106
- Nelson A, de Sherbinin A, Pozzi F (2006) Towards development of a high quality public domain global roads database. *Dat Sci J*, 5:223–265
- Taylor DRF, Caquard S (2006) Cybertography: maps and mapping in the information era. *Cartographica* 41(1):1–6

# Contents

<b>An Introduction to OpenStreetMap in Geographic Information Science: Experiences, Research, and Applications . . . . .</b>	<b>1</b>
Jamal Jokar Arsanjani, Alexander Zipf, Peter Mooney and Marco Helbich	
<b>Part I Data Management and Quality</b>	
<b>Assessment of Logical Consistency in OpenStreetMap Based on the Spatial Similarity Concept . . . . .</b>	<b>19</b>
Peyman Hashemi and Rahim Ali Abbaspour	
<b>Quality Assessment of the Contributed Land Use Information from OpenStreetMap Versus Authoritative Datasets . . . . .</b>	<b>37</b>
Jamal Jokar Arsanjani, Peter Mooney, Alexander Zipf and Anne Schauss	
<b>Improving Volunteered Geographic Information Quality Using a Tag Recommender System: The Case of OpenStreetMap . . . . .</b>	<b>59</b>
Arnaud Vandecasteele and Rodolphe Devillers	
<b>Inferring the Scale of OpenStreetMap Features. . . . .</b>	<b>81</b>
Guillaume Touya and Andreas Reimer	
<b>Data Retrieval for Small Spatial Regions in OpenStreetMap . . . . .</b>	<b>101</b>
Roland M. Olbricht	



## Part II Social Context

<b>The Impact of Society on Volunteered Geographic Information: The Case of OpenStreetMap . . . . .</b>	125
Afra Mashhadi, Giovanni Quattrone and Licia Capra	
<b>Social and Political Dimensions of the OpenStreetMap Project: Towards a Critical Geographical Research Agenda . . . . .</b>	143
Georg Glasze and Chris Perkins	
<b>Spatial Collaboration Networks of OpenStreetMap . . . . .</b>	167
Klaus Stein, Dominik Kremer and Christoph Schlieder	

## Part III Network Modeling and Routing

<b>Route Choice Analysis of Urban Cycling Behaviors Using OpenStreetMap: Evidence from a British Urban Environment . . . . .</b>	189
Godwin Yeboah and Seraphim Alvanides	
<b>The Next Generation of Navigational Services Using OpenStreetMap Data: The Integration of Augmented Reality and Graph Databases . . . . .</b>	211
Pouria Amirian, Anahid Basiri, Guillaume Gales, Adam Winstanley and John McDonald	
<b>Building a Multimodal Urban Network Model Using OpenStreetMap Data for the Analysis of Sustainable Accessibility . . . . .</b>	229
Jorge Gil	

## Part IV Land Management and Urban Form

<b>Assessing OpenStreetMap as an Open Property Map . . . . .</b>	255
Mohsen Kalantari and Veba La	
<b>Investigating the Potential of OpenStreetMap for Land Use/Land Cover Production: A Case Study for Continental Portugal . . . . .</b>	273
Jacinto Estima and Marco Painho	

**Using Crowd-Sourced Data to Quantify the Complex Urban Fabric—OpenStreetMap and the Urban–Rural Index . . . . . 295**  
Johannes Schlesinger

**Part V Outlook**

**An Outlook for OpenStreetMap . . . . . 319**  
Peter Mooney