

SpringerBriefs in Computer Science

Series Editors

Stan Zdonik

Shashi Shekhar

Jonathan Katz

Xindong Wu

Lakhmi C. Jain

David Padua

Xuemin (Sherman) Shen

Borko Furht

V.S. Subrahmanian

Martial Hebert

Katsushi Ikeuchi

Bruno Siciliano

Sushil Jajodia

Newton Lee

More information about this series at <http://www.springer.com/series/10028>

Eric Hardin • Helena Mitasova • Laura Tateosian
Margery Overton

GIS-based Analysis of Coastal Lidar Time-Series

 Springer

Eric Hardin
Department of Physics
North Carolina State University
Raleigh, NC, USA

Helena Mitasova
Department of Marine, Earth
and Atmospheric Sciences
North Carolina State University
Raleigh, NC, USA

Laura Tateosian
Center for Geospatial Analytics
North Carolina State University
Raleigh, NC, USA

Margery Overton
Department of Civil, Construction
and Environmental Engineering
North Carolina State University
Raleigh, NC, USA

ISSN 2191-5768

ISBN 978-1-4939-1834-8

DOI 10.1007/978-1-4939-1835-5

Springer New York Heidelberg Dordrecht London

ISSN 2191-5776 (electronic)

ISBN 978-1-4939-1835-5 (eBook)

Library of Congress Control Number: 2014947349

© The Author(s) 2014

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. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.

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.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Contents

1 Introduction	1
1.1 Mapping Coastal Terrain Change	1
1.2 GRASS GIS and Sample Data Set	3
1.3 Organization of This Book	5
References	6
2 Processing Coastal Lidar Time Series	7
2.1 General Workflow	7
2.2 Analysis of Lidar Point Clouds	9
2.3 Computing DEMs	11
2.3.1 Masking Surveyed Areas	11
2.3.2 Binning	13
2.3.3 Spline Interpolation	14
2.4 Eliminating Water Surface Features	19
2.5 Correcting Systematic Errors	20
References	25
3 Raster-Based Analysis	27
3.1 Core and Envelope, Dynamic Layer	27
3.2 Time-of-Minimum and Time-of-Maximum	29
3.3 Per-Cell Univariate Statistics	30
3.4 Per-Cell Regression Analysis	32
References	34
4 Feature Extraction and Feature Change Metrics	35
4.1 Shorelines and Shoreline Migration Range	35
4.2 Foredune Features	36
4.2.1 Foredune Ridge Line	37
4.2.2 Foredune Toe Line	39
4.3 Crescentic and Parabolic Dune Features	42

4.4	Generating Transects	46
4.4.1	Transects at Uniform Locations	46
4.4.2	Transects at Optimized Locations	47
4.5	Measuring Line Feature Change	51
4.5.1	Shoreline Change	52
4.6	Mapping Location and Change of Built Structures	55
4.7	Derived Parameters: Storm Vulnerability Scale	59
	References	61
5	Volume Analysis	63
5.1	DEM Differencing	63
5.2	Landscape Segmentation into Bins	64
5.2.1	Long-Shore Partitioning	64
5.2.2	Cross-Shore Segments	65
5.3	Volume Estimation for Segments	67
5.4	Volume Change Metrics	68
	References	70
6	Visualizing Coastal Change	71
6.1	Color and Relief Shading	71
6.2	Perspective Views of 3D Surfaces	74
6.3	Comparing Multiple Surfaces: Map Swipe and 3D Cross-Sections ...	74
6.4	Animations in 2D and 3D Space	75
6.5	Visualization with Space-Time Cube (STC)	76
	References	79
	Appendix	81
1	Sample Datasets	81
2	Color Tables	82