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# Geo-Spatial Knowledge and Intelligence

5th International Conference, GSKI 2017  
Chiang Mai, Thailand, December 8–10, 2017  
Revised Selected Papers, Part II

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## Preface of GSKI 2017

The 5th 2017 International Conference on Geo-Spatial Knowledge and Intelligence (GSKI 2017) was held in Chiang Mai, Thailand, during December 8–10, 2017. The conference aims to bring together researchers, engineers, and students working in the areas of geo-spatial knowledge and intelligence. GSKI 2017 featured a unique mix of topics including smart city, spatial data acquisition, processing and management, modeling and analysis, and recent applications in the context of building a healthier ecology and resource management. The conference provided a forum for sharing experiences and original research contributions on these topics. Researchers and practitioners alike were invited to submit their contributions to GSKI 2017.

We received 579 submissions from various parts of the world. The International Program Committee worked very hard to have all papers peer-peer reviewed before the review deadline. The final program consisted of 142 papers. There were five keynote speeches. All the keynote speakers are internationally recognized leading experts in their research fields, who have demonstrated outstanding proficiency and have achieved distinction in their profession. The proceedings were published as two volumes in Springer's *Communications in Computer and Information Science* (CCIS) series. Some excellent papers were selected and recommended to the special issue of *Journal of Environmental Science and Pollution*, a Science Citation Index Expanded journal. We would like to mention that, owing to the limitation of the conference venue capacity, we were not able to include many fine papers in the program. Our apology goes to these authors.

We would like to express our sincere gratitude to all the members of international Program Committee and organizers for their enthusiasm, time, and expertise. Our thanks also go to many volunteers and staff for the long hours and hard work they generously contributed to GSKI 2017. We are very grateful to Professor Thomas Blaschke and Professor Shihong Du for their support in making GSKI 2017 possible. The generous support from Beijing Institute of Technology is greatly appreciated. Finally, we would like to thank all the authors, speakers, and participants of this conference for their contributions to GSKI 2017.

May 2018

Hanning Yuan  
Jing Geng  
Chuanlu Liu  
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# **Keynote Speakers of GSKI 2017**

# Geospatial Data Science and Knowledge Discovery in Environmental Health Research

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Prof. F. Benjamin Zhan is Professor of Geographic Information Science in the Department of Geography at Texas State University. He was the founding director of the Texas Center for Geographic Information Science, and served as director of the center from 2003 to 2015. Among other honors, Professor Zhan was recipient of the Presidential Award for Excellence in Scholarly/Creative Activities at Texas State University, and held a Chang Jiang Scholar Guest Chair Professorship at Wuhan University in China from 2008 to 2011.

**Abstract.** There are over 80, 000 chemicals lurking in the environment and in everyday items. How some of these chemicals affect human health, particularly human reproductive health, remains unknown. The availability of geographically referenced environmental monitoring data and health outcome data makes it possible to examine the associations between maternal exposure to some of these chemicals and health issues in offspring. This presentation reports a data-driven approach for investigating these associations. The presentation first outlines the components of geospatial data science to support environmental health research. It then reports the datasets, analysis procedures, and results of two case studies based on large geographically referenced datasets. The first case study examines the association of maternal residential proximity to industrial facilities with toxic air emissions and birth defects in offspring. The second case study investigates the association of maternal residential exposure to some chemicals in the environment and low birth weights in offspring. Results from the two case studies demonstrate the power and potential of using geospatial data science to support environmental health research.

# Spatial Data Mining: Theory and Application

Shuliang Wang  
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Shuliang Wang, PhD, a scientist in data science and software engineering, is a professor at the Beijing Institute of Technology in China. His research interests include spatial data mining and software engineering. For his innovatory study of spatial data mining, he was awarded the Fifth Annual InfoSci-Journals Excellence in Research Awards of IGI Global, IEEE Outstanding Contribution Award for Granular Computing, and one of China's National Excellent Doctoral Thesis Prizes.

URL: <http://www.springer.com/gp/book/9783662485361#aboutAuthors>

He is Guest Editor of:

- (1) *International Journal of Systems Science*
- (2) *International Journal of Data Warehousing and Mining*
- (3) *Lecture Notes in Artificial Intelligence*

**Abstract.** The talk offers a systematic and practical overview of spatial data mining, which combines computer science and geo-spatial information science, allowing each field to profit from the knowledge and techniques of the other. To address the spatiotemporal specialties of spatial data, the authors introduce the key concepts and algorithms of the data field, cloud model, mining view, and Deren Li methods. The data field method captures the interactions between spatial objects by diffusing the data contribution from a universe of samples to a universe of population, thereby bridging the gap between the data model and the recognition model. The cloud model is a qualitative method that utilizes quantitative numerical characters to bridge the gap between pure data and linguistic concepts. The mining view method discriminates between the different requirements by using scale, hierarchy, and granularity in order to uncover the anisotropy of spatial data mining. The Deren Li method performs data preprocessing to prepare it for further knowledge discovery by selecting a weight for iteration in order to clean the observed spatial data as much as possible. In addition to the essential algorithms and techniques, the contribution provides application examples of spatial data mining in geographic information science and remote sensing. The practical projects include spatiotemporal video data mining for protecting public security, serial image mining on nighttime lights for assessing the severity of the Syrian crisis, and the applications in the government project “The Belt and Road Initiatives.”

# The Development of Geomatics Systems Based on Government Policy for Driving Thailand 4.0

Nopasit Chakpitak  
Chiang Mai University, Thailand

Chakpitak Nopasit is Dean of the International College Chiang Mai University, Thailand. He was Dean of the College of Arts, Media and Technology, Chiang Mai University between 2004 and 2011. He was then promoted to be an assistant to the president, academic and international affairs, Chiang Mai University during 2011–2014. Before working at Chiang Mai University, he was responsible for many projects related to electronic engineering. His research interests lie in knowledge engineering and AI application in the power industry. Moreover, he collaborates and organizes conferences that linked to European and Asian countries.

**Abstract.** Thailand is an agricultural country which provides a huge amount of cultivation information. However, there is no system to properly organize and analyze this information. With the rapid growth of technology, geomatics systems are playing an important role in helping the Ministry of Agriculture and Cooperatives with decision-making. The Thai government's policy is to improve the economy, termed "Thailand 4.0." Tourism part is the most important factor to drive the Thai economy. The government has launched the 12th National Development Plan for the period 2017–2021, which involves the wealth of the nation and focuses on agriculture, light industry, heavy industry, and industry for the future. In the past, Thailand has had a middle-income trap, an inequality trap, and an imbalance trap. Thus, the government's policy encompasses the best practices that can be improved by three engines: the productive growth engine, the inclusive growth engine, and the green growth engine. Therefore, the national development plan can help Thailand to accomplish the goal of prosperity, security, and sustainability.

# Smart Knowledge-Based Remote Sensing Analysis

Thomas Blaschke  
University of Salzburg, Austria

Professor Blaschke's research interests include methodological issues of the integration of GIS, remote sensing, and image processing including aspects of participation and human–environment interaction. He has held several lecturer, senior lecturer, and professor positions in Germany, Austria, and the UK as well as temporary affiliations as guest professor and visiting scientist in Germany and the USA, including about 115 journal publications. He is author, co-author, or editor of 17 books, has received several academic prizes and awards including the Christian Doppler Prize in 1995 and was elected as a corresponding member of the Austrian Academy of Sciences in 2015. He has been project leader in various international and national research projects and serves on various editing boards of international journals, conference committees, and a dozen national research councils.

Publications: <https://scholar.google.at/citations?user=kMroJzUAAAAJ&hl=de>

**Abstract.** In response to the ever-increasing amount of spaceborne imaging sensors, a research group at the University of Salzburg developed a methodology for “smart” (knowledgeable), effective, and efficient Earth observation (EO) image-content extraction. It utilizes content-based image retrieval systems. The methodology is based on a priori 4D spatiotemporal scene domain knowledge to be mapped onto the image domain in terms of 2D image features and spatial constraints. This 4D to 2D mapping capability holds the solution to the vision problems, where the semantic gap from sensory data to high-level information products must be filled in. Another pivotal component is the concept of (geographic) object-based image analysis – GEOBIA or OBIA in short. OBIA aims for the generation of geographic information (in GIS-ready format) from which new spatial knowledge can be obtained. I will outline how OBIA methods and methodologies can structure the complexity of our environment and, likewise, the complexity of measurements into scaled representations for further analysis and monitoring tasks.

# Segmentation Scale Selection in Geographic Object-Based Image Analysis (GEOBIA)

Shihong Du  
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Shihong Du is currently Associate Professor of GIScience in the School of Earth and Space Sciences at Peking University and the vice director of the Institute of Remote Sensing and GIS. His research interests include spatial knowledge representation and reasoning, as well as intelligent mining and understanding of geospatial data including GIS and remote sensing data. He authored/co-authored over 80 journal articles and two books, and was awarded the New Century Excellent Talents in University and Second Place Award of National Science and Technology Progress in Surveying and Mapping.

**Abstract.** Geographic object-based image analysis (GEOBIA) with very-high-resolution (VHR) images plays an important role in geographical investigations, but its uncertainty in segmentation scale significantly affects the accuracy and reliability of GEOBIA results, e.g., object segmentations and classifications. Therefore, a scale-selection method is needed to determine the optimal scale for GEOBIA, which, however, can be influenced by three factors, i.e., categories, surrounding contrasts, and internal heterogeneities of objects. Thus, if we want to select the optimal scale, the three factors should be totally considered. The existing scale selections including supervised and unsupervised methods partly considered these three factors, but could not resolve all of them, thus, this issue is still open and needs further study. This report reviews five kinds of scale-selection methods, compares their advantages and disadvantages, and discusses the future direction of scale selections.



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