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Remote Sensing Technologies and Applications in Urban Environments

**Thilo Erbertseder
Thomas Esch
Nektarios Chrysoulakis**
Editors

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Contents

vii	<i>Authors</i>
ix	<i>Conference Committee</i>
xi	<i>Introduction</i>

SESSION 1 URBAN AIR QUALITY

10008 02	Improved MODIS aerosol retrieval in urban areas using a land classification approach and empirical orthogonal functions (Invited Paper) [10008-1]
10008 03	Pollutant monitoring of aircraft exhaust with multispectral imaging [10008-2]
10008 04	Estimation of turbulence production by nocturnal low level jets in Sao Paulo (Brazil) [10008-3]
10008 06	High-grade, compact spectrometers for Earth observation from SmallSats (Invited Paper) [10008-6]

SESSION 2 SMART CITIES

10008 07	Gas detection by using transmittance estimation and segmentation approaches [10008-5]
10008 08	Aerial thermography for energy efficiency of buildings: the ChoT project [10008-7]
10008 09	Assessing the urban solar energy resource potential of Davao City, Philippines, using LiDAR Digital Surface Model (DSM) and GRASS GIS [10008-8]
10008 0A	The measurement of carbon dioxide levels in a city canyon [10008-9]
10008 0B	Spatio-temporal analysis of preterm birth in Portugal and its relation with environmental variables [10008-10]

SESSION 3 URBAN CLIMATE

10008 0C	Anthropogenic heat flux estimation from space: results of the first phase of the URBANFLUXES project (Invited Paper) [10008-11]
10008 0D	Study on urban heat island effect and its response to the vegetation eco-environmental quality [10008-12]
10008 0E	Dynamics of thermal inertia over highly urban city: a case study of Delhi [10008-13]

SESSION 4	URBAN LAND COVER AND BIODIVERSITY
10008 OH	Extraction of urban vegetation with Pleiades multiangular images [10008-16]
10008 OI	Evaluation of bispectral LIDAR data for urban vegetation mapping [10008-17]
10008 OJ	Identifying pure urban image spectra using a learning urban image spectral archive (LUISA) [10008-18]
10008 OK	Use of multispectral satellite imagery and hyperspectral endmember libraries for urban land cover mapping at the metropolitan scale [10008-20]
10008 OL	Spectral unmixing of urban land cover using a generic library approach [10008-21]
SESSION 5	URBAN MORPHOLOGY AND INFRASTRUCTURES I
10008 OM	Effective delineation of urban flooded areas based on aerial ortho-photo imagery [10008-39]
10008 ON	Airborne SAR on circular trajectories to reduce layover and shadow effects of urban scenes [10008-23]
10008 OO	An improved automated procedure for informal and temporary dwellings detection and enumeration, using mathematical morphology operators on VHR satellite data [10008-47]
SESSION 6	URBAN MORPHOLOGY AND INFRASTRUCTURES II
10008 OP	Systematic infrared image quality improvement using deep learning based techniques [10008-24]
10008 OQ	Building block extraction and classification by means of Markov random fields using aerial imagery and LiDAR data [10008-48]
10008 OR	ICARE-HS: atmospheric correction of airborne hyperspectral urban images using 3D information [10008-27]
10008 OS	Incremental road discovery from aerial imagery using curvilinear spanning tree (CST) search [10008-28]
10008 OT	Automatic pole-like object modeling via 3D part-based analysis of point cloud [10008-42]
SESSION 7	URBAN MORPHOLOGY AND INFRASTRUCTURES III
10008 OU	Galaxy: a new state of the art airborne lidar system [10008-29]
10008 OV	Identification and correction of road courses by merging successive segments and using improved attributes [10008-30]

- 10008 OW **Detection of asphalt pavement cracks using remote sensing techniques** [10008-31]
- 10008 OX **Tunable mechanical monolithic sensors for real-time broadband monitoring of large civil infrastructures** [10008-32]
- 10008 OY **Vehicle detection from very-high-resolution (VHR) aerial imagery using attribute belief propagation (ABP)** [10008-33]

POSTER SESSION

- 10008 OZ **Investigation of air pollution and regional climate change due to anthropogenic aerosols** [10008-36]
- 10008 10 **Landcover change and light pollution in Kota Bandarlampung** [10008-37]
- 10008 11 **Improvement of retrieval algorithms for severe air pollution** [10008-38]
- 10008 13 **Impacts of urban growth and heat waves events on the urban heat island in Bucharest city** [10008-43]
- 10008 14 **Synergy use of satellite remote sensing and in-situ monitoring data for air pollution impacts on urban climate** [10008-44]
- 10008 15 **Software for hyperspectral, joint photographic experts group (.JPG), portable network graphics (.PNG) and tagged image file format (.TIFF) segmentation** [10008-45]
- 10008 16 **Optimization and evaluation of the human fall detection system** [10008-46]

Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Agapiou, Athos, 0W	He, Liu, 0T
Alzubi, Hadeel, 16	Heiden, Uta, 0J
Alzubi, Raid, 16	Hermey, Martin, 0L
Amira, Abbes, 16	Hong, Gang, 0M
Ang, Ma. Rosario Concepcion, 09	Huang, Yuchun, 0S, 0T, 0Y
Barone, F., 0X	Hubert-Moy, Laurence, 0H, 0I
Berkson, Emily E., 03	Iordache, Marian-Daniel, 0L
Bernardes, J., 0B	Jack, James, 0A
Berwal, Shivesh, 0E	Jansen, R., 06
Beu, Cassia M. L., 04	Jenerowicz, Małgorzata, 0O
Boyd, Jenny, 0A	Jilge, Marianne, 0J
Bratsolis, Emmanuel, 0Q	Juergens, Carsten, 0J
Briottet, Xavier, 0R	Kemper, Thomas, 0O
Bruno, L. S., 15	Kitchin, Matthew, 0P
Budinov, Daniel, 0A	Klostermann, Judith, 0C
Bulatov, Dimitri, 0V	Kumar, Dinesh, 0E
Canter, Frank, 0K	Kumar, Krishan, 0E
Casaseca-de-la-Higuera, Pablo, 0P	Kumar, Ritesh, 0E
Ceamanos, Xavier, 0R	Lague, Dimitri, 0I
Çetin, Yasemin Yardımcı, 07	Landier, Lucas, 0C
Charou, Eleni, 0Q	Landulfo, Eduardo, 04
Chrysoulakis, Nektarios, 0C	LaRocque, Paul E., 0U
Conte, Paolo, 08	Launeau, Patrick, 0I
Corpetti, Thomas, 0H, 0I	Lefebvre, Antoine, 0H
Courty, Nicolas, 0H	Levitan, Nathaniel, 02
Cui, Bei, 0D	Li, Ying, 0Y
Degerickx, Jeroen, 0L	Lindberg, Fredrik, 0C
de Goeij, B. T. G., 06	Lucio, A. de C. Jorge, 15
Del Frate, Fabio, 0C	Luo, Chunbo, 0P
Dida, Adrian I., 13	Mandanici, Emanuele, 08
Esch, Thomas, 0C	Marconcini, Mattia, 0C
Feigenwinter, Christian, 0C	Marques, Márcia T. A., 04
Freitas, A., 0B	Mende, André, 0J
Gabey, Andy, 0C	Messinger, David W., 03
Gastellu-Etchegorry, Jean-Philippe, 0C	Mettas, Christodoulos, 0W
Gibson, Ryan, 16	Michon, Cyril, 0I
Gilardy, Hugo, 0R	Mitraka, Zina, 0C
Giordano, G., 0X	Monge-Alvarez, Jesus, 0P
Gonçalves, H., 0B	Moreira, A. C. de C. A., 04
Grimmond, C.S.B., 0C	Mukai, Sonoyo, 0Z, 11
Gross, Barry, 02	Nabucet, Jean, 0H, 0I
Guindon, Bert, 0M	Nakaema, Walter M., 04
Gür, Yusuf, 07	Nakata, Makiko, 0Z, 11
Habermeyer, Martin, 0J	Neocleous, Kyriacos, 0W
Hadjimitsis, Diofantos G., 0W	Okujeni, Akpona, 0K, 0L
Hafidz, Muhammad, 10	Oliveira, M., 0B
Hartsell, Daryl, 0U	Olofson, Frans, 0C
Häufel, Gisela, 0V	Ömrüzün, Fatih, 07
Hazairin, Azra Q., 10	Oosterling, J. A. J., 06

Özisik Baskurt, Didem, 07
 Palm, Stephan, 0N
 Pandey, Alok Kumar, 0E
 Parlow, Eberhard, 0C
 Parmley, Andrew, 0P
 Pintor, Ben Hur, 09
 Pohl, Melanie, 0V
 Pohl, Nils, 0N
 Priem, Frederik, 0K
 Quenol, Herve, 0I
 Ramzan, Naeem, 16
 Raymond, Don, 0M
 Riadini, Fitri, 10
 Robinson, Iain, 0A
 Rodrigo, B. P., 15
 Rohman, Akmal F., 10
 Roussel, Guillaume, 0R
 Sakagami, Yoshiaki, 04
 Sano, Itaru, 0Z, 11
 Santos, Pedro A. A., 04
 Savastru, Dan M., 13, 14
 Savastru, Roxana S., 13, 14
 Shahriar, Hasan, 16
 Sigelle, Marc, 0Q
 Singh, Vinay Pratap, 0E
 Snijders, B., 06
 Sola, Eula Fae, 09
 Somers, Ben, 0L
 Sommer, Rainer, 0N
 Stilla, Uwe, 0N
 Teodoro, Ana C., 0B
 Teves, Justine, 09
 Themistocleous, Kyriacos, 0W
 Tripp, Jeffrey, 0U
 van der Linden, Sebastian, 0K, 0L
 van der Wal, L. F., 06
 Wang, Guozhi, 0S
 Wang, Qi, 0P
 Wang, Yanli, 0Y
 Xie, Rongchang, 0S
 Xu, Saiping, 0D
 Yang, Haoxiang, 0T
 Yin, Kai, 0D
 Zhang, Hongchang, 0S
 Zhang, Huaizhong, 0P
 Zhang, Li, 0Y
 Zhang, Xiupeng, 0D
 Zhang, Ying, 0M
 Zhao, Qianjun, 0D
 Zoran, Maria A., 13, 14

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- 4 Urban Land Cover and Biodiversity
Nektarios Chrysoulakis, Foundation for Research and
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Thilo Erbertseder, Deutsches Zentrum für Luft- und Raumfahrt e.V.
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- 6 Urban Morphology and Infrastructures II
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- 7 Urban Morphology and Infrastructures III
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Introduction

The global urbanization constitutes an epochal transformation of the Earth. Since 2007, for the first time in human history more people have lived in cities than in the countryside. According to the United Nations in 2050, around 75% of the worldwide population will be living in cities. The population density, traffic and infrastructure, environmental and energy problems, climate change, migration, demographic change, aspects of vulnerability and sustainability, new forms of mobility and sharing - unprecedented challenges and opportunities are continuously arising. In any case, the urban environment plays a major role in the development of humanity and the quality of life of the individual citizen.

In respond to this high-interest topic, the conference on Remote Sensing Technologies and Applications for Urban Environments was launched within the SPIE Remote Sensing Symposium held in Edinburgh from 26-29 September 2016. It comprises papers related to advanced remote sensing technologies, applications and information that push beyond the state-of-the-art with respect to urban air quality and climate, urban land cover and biodiversity as well as urban morphology and infrastructures. In 31 oral presentations and 8 posters it was demonstrated that remote sensing offers a wealth of possibilities and opportunities to monitor the urban environment, to support planning processes, to enhance the availability of relevant information, to shape the sustainable city and to improve the quality of life of citizens. The outcome of the conference is documented by the volume of proceedings at hand.

Remote sensing has become a viable technology to monitor and analyze urban air quality and climate, either by space-borne, airborne or ground-based instruments. As an example of the better exploitation of existing instruments, Levitan and Gross present an improved MODIS aerosol retrieval over urban areas, while Mukai et al. show an enhanced algorithm for severe aerosol pollution events. Van der Wal et al. outline a new concept for modular, compact spectrometers and SmallSats designed to monitor urban air pollution at a high spatial resolution. In order to track unburned hydrocarbon emissions from aircraft engine exhaust plumes, Berkson and Messinger propose a multispectral imaging system, while Beu et al. highlight the use of a wind doppler LiDAR to measure the turbulence kinetic energy of low-level jets in Sao Paulo, Brazil. The suitability of Earth Observation data to link air pollution and climate change is shown for East Asian cities (Nakata et al.) and Bucharest, Romania (Savastru et al.). Finally, the need for space-based air pollution data is formulated to better enable epidemiological studies (Oliviera et al.).

The capabilities of remote sensing technologies to make cities smarter and healthier are demonstrated for energy efficiency of buildings (Mandanici and Conte), gas detection (Baskurt et al.), human fall detection (Alzubi et al.) and

solar energy resource potential (Teves et al.). Boyd et al. present results of measuring carbon dioxide levels in the street canyons and public transport in Edinburgh. The high three-dimensional variability of the gas demonstrates the need for complementary information on air pollution levels in hot spots using mobile devices, micro sensor networks and crowd sourcing. With respect to urban climate, Earth Observation enables a better estimation of the anthropogenic heat flux (Chrysoulakis et al.), the quantification of the urban heat island effect (Xu et al.; Berwal et al.) and the analysis of the impact of urban growth on heat weaves in cities (Zoran et al.).

Advanced urban planning for sustainable and resilient cities relies on information on urban land cover and biodiversity. Latest advances on vegetation mapping in cities are presented by Levebre et al. using Pleiades multi-angular imagery and Nabucet et al. evaluating a bispectral lidar. The importance of spectral unmixing and the related generic spectral libraries of the endmembers for urban land cover mapping are emphasized in the three papers of Jilge et al., Priem et al. and Degerickx et al.. A neural network is developed for the segmentation of hyperspectral images acquired by drones (Bruno et al.). The relation of land cover change and light pollution is investigated by Rohman et al..

A large number of applications are presented regarding latest results on urban morphology and infrastructures. Remote sensing enables an improved delineation of urban flooded areas (Zhang, Y. et al.), the three-dimensional mapping of buildings and infrastructures by circular synthetic aperture radar (Palm et al.), the mapping of informal and temporal dwellings (Jenerowicz and Kemper), the identification and correction of road courses (Wang et al.; Bulatov et al.) and the detection of asphalt pavement cracks (Mettas et al.). The benefits of synergistic data use are demonstrated by Ceamanos et al. for atmospheric correction of airborne hyperspectral information using a digital surface model and by Bratsolis et al. for building block classification combining aerial imagery and lidar data. While the latter use Markov random fields, attribute belief propagation is used by Wang et al. to detect vehicles in very-high-resolution aerial imagery. A deep learning technique is applied to improve the quality of infrared imagery (Zhang, H. et al.). For the automatic pole-like object modeling a 3D part-based analysis is introduced by He et al. Considering latest developments in remote sensing technology, a sensor for monitoring large civil infrastructures is presented (Barone and Giordano) as well as a new state-of-the-art airborne lidar system (Hartsell et al.).

We, the conference chairs, wish to thank the authors for their valuable contributions, the programme committee for their reviews, and the organizers of the SPIE Remote Sensing 2016 for making this conference possible. A special thank goes to Prof. Klaus Schäfer and Dr. Bob Hainsey for encouraging us to initiate the Conference on Remote Sensing Technologies and Applications for Urban Environments.

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