PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 11149

, "Front Matter: Volume 11149," Proc. SPIE 11149, Remote Sensing for Agriculture, Ecosystems, and Hydrology XXI, 1114901 (11 December 2019); doi: 10.1117/12.2554500

Event: SPIE Remote Sensing, 2019, Strasbourg, France

PROCEEDINGS OF SPIE

Remote Sensing for Agriculture, Ecosystems, and Hydrology XXI

**Christopher M. U. Neale
Antonino Maltese**
Editors

**9–11 September 2019
Strasbourg, France**

Sponsored by
SPIE

Cooperating Organisations
European Optical Society
ISPRS—International Society for Photogrammetry and Remote Sensing
EARSeL—European Association of Remote Sensing Laboratories (Germany)

Published by
SPIE

Volume 11149

Proceedings of SPIE 0277-786X, V. 11149

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Remote Sensing for Agriculture, Ecosystems, and Hydrology XXI, edited by Christopher M. U. Neale,
Antonino Maltese, Proc. of SPIE Vol. 11149, 1114901 · © 2019 SPIE
CCC code: 0277-786X/19/\$21 · doi: 10.1117/12.2554500

Proc. of SPIE Vol. 11149 1114901-1

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in *Remote Sensing for Agriculture, Ecosystems, and Hydrology XXI*, edited by Christopher M. U. Neale, Antonino Maltese, Proceedings of SPIE Vol. 11149 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

ISSN: 0277-786X
ISSN: 1996-756X (electronic)

ISBN: 9781510630017
ISBN: 9781510630024 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445
SPIE.org

Copyright © 2019, Society of Photo-Optical Instrumentation Engineers.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$21.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/19/\$21.00.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.

SPIE. DIGITAL LIBRARY
SPIDigitalLibrary.org

Paper Numbering: *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

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

SESSION 1 SENTINEL-1 AND SENTINEL-3

11149 02	Grassland monitoring based on Sentinel-1 [11149-1]
11149 03	Evaluation of Sentinel-1 and -2 time series to derive crop phenology and biomass of wheat and rapeseed: northern France and Brittany case studies [11149-2]
11149 04	Temporal analysis of Sentinel-1 coherence images [11149-3]
11149 05	Spatiotemporal surface water mapping using Sentinel-1 data for regional drought assessment [11149-5]

SESSION 2 SENTINEL-2

11149 06	Use of chlorophyll index-green and the red-edge chlorophyll index to derive an algorithm for estimating gross primary production capacity [11149-6]
11149 07	Automated monitoring of small grains in the Middle East and North Africa for food security early warning [11149-7]
11149 08	Comparison of ecosystem functional type patterns at different spatial resolutions in relation with FLUXNET data [11149-8]
11149 09	Sample period dependent classification approach for the cartography of crops in the Haouz plain, Morocco [11149-9]

SESSION 3 UAV, HYPERSPECTRAL, AND HIGH SPATIAL RESOLUTION

11149 0B	Classification of oil palm diseases via spectral unmixing and convolutional neural networks [11149-11]
11149 0D	Investigating impacts of calibration methodology and irradiance variations on lightweight drone-based sensor derived surface reflectance products (Best Student Paper Award) [11149-13]

11149 OE **Soil fertility status assessment using hyperspectral remote sensing [11149-14]**

SESSION 4 SENTINEL-1 & -2 PRECISION FARMING

11149 OF **A comparison of retrieval approaches for estimating the seasonal dynamics of rice leaf area index from simulated Sentinel-2 data [11149-18]**

SESSION 5 PRECISION FARMING I

11149 OH **Determining crop phenology for different varieties of barley and wheat on intensive plots using proximal remote sensing [11149-19]**

11149 OI **Modelling the ground-LAI to satellite-NDVI (Sentinel-2) relationship considering variability sources due to crop type (*Triticum durum* L., *Zea mays* L., and *Medicago sativa* L.) and farm management [11149-20]**

11149 OK **Retrieval and scale effect analysis of LAI over typical farmland from UAV-based hyperspectral data [11149-22]**

SESSION 6 PRECISION FARMING II

11149 OL **Particle swarm optimization for assimilation of remote sensing data in dynamic crop models [11149-23]**

11149 OM **Wheat ear temperature estimation using a thermal radiometric camera [11149-24]**

11149 ON **The influence of shallow groundwater on the actual transpiration flux of irrigated fields using satellite observations [11149-25]**

11149 OO **Porosity effects on red to far-red ratios of light transmitted in natural sands: implications for photoblastic seed germination [11149-26]**

SESSION 7 MACHINE LEARNING, DEEP LEARNING, AND CLASSIFICATION

11149 OP **Multi-temporal crop classification with machine learning techniques [11149-28]**

11149 OQ **Texture-based analysis of hydrographical basins with multispectral imagery [11149-29]**

11149 OS **Farming systems monitoring using machine learning and trend analysis methods based on fitted NDVI time series data in a semi-arid region of Morocco [11149-31]**

11149 OT **Application of remote sensing and GIS in wetland monitoring and management using Landsat images [11149-32]**

SESSION 8 FOREST

- 11149 0U **Fire-severity classification across temperate Australian forests: random forests versus spectral index thresholding [11149-34]**
- 11149 0X **A new Copernicus high resolution layer at pan-European scale: small woody features [11149-37]**

SESSION 9 HYDROLOGY I

- 11149 0Z **Investigating the performance of bias correction algorithms on satellite-based precipitation estimates [11149-39]**
- 11149 10 **Comparison of two datasets from two different satellite sensors at @490 nm in the same space-temporal window over the Gulf of California area [11149-40]**
- 11149 11 **Towards using vegetation greening and browning patterns obtained from time series of remote sensing observations for irrigation water management [11149-41]**

SESSION 10 HYDROLOGY II

- 11149 12 **Karst investigation program guided by synthetic aperture radar [11149-42]**
- 11149 13 **Investigating added value of improved DEM, river geometry, and model parameter definitions on flood inundation mapping [11149-43]**
- 11149 14 **Variations of simulated water use efficiency over 2000-2016 and its driving forces in Northeast China [11149-44]**
- 11149 15 **Remote sensing to assess surface water quantity scenarios using normalized difference water index in the lesser Himalayan region [11149-45]**
- 11149 16 **Assessment of spatial variation of soil moisture during maize growth cycle using SAR observations [11149-46]**

SESSION 11 AGRICULTURE AND ECOSYSTEMS

- 11149 18 **Mixed model estimation of rice yield based on NDVI and GNDVI using a satellite image [11149-48]**
- 11149 19 **Carbon sequestering using remote sensing [11149-49]**
- 11149 1B **Analysis of land surface temperature on pastureland areas with different management using Landsat 8 data [11149-51]**

- 11149 1C **Early detection of pink bollworm *Pectinophora gossypiella* (Saunders) using remote sensing technologies [11149-53]**

POSTER SESSION

- 11149 1G **Precision arboriculture: a new approach to tree risk management based on geomatics tools [11149-16]**
- 11149 1H **Remotely sensed data to support insurance strategies in agriculture [11149-17]**
- 11149 1I **Assessing the spatiotemporal dynamic of NPP in desert steppe and its response to climate change from 2003 to 2017: a case study in Siziwang banner [11149-52]**
- 11149 1J **Spectral texture classification of high-resolution satellite images for the state forest inventory in Russia [11149-56]**
- 11149 1L **Comparison between NDVI and CWSI for waxy corn growth monitoring in field soil conditions [11149-58]**
- 11149 1M **Prospects of protective sprays with the use of unmanned aerial vehicles of helicopter type [11149-59]**
- 11149 1Q **Identification of plant species of interest for beekeeping in a volcanic landscape [11149-63]**
- 11149 1T **Application of remote sensing for detecting plant disease using color and morphological features [11149-66]**
- 11149 1U **Crop identification using superpixels and supervised classification of multispectral CBERS-4 wide-field imagery [11149-67]**
- 11149 1W **Agroecosystem zone mapping as a baseline for land suitability evaluation based on remote sensing image processing and geographic information systems in Temanggung regency, Central Java province [11149-69]**
- 11149 1X **Landscape changes at Chernobyl [11149-70]**
- 11149 1Y **The use of Sentinel-1 and -2 data for monitoring maize production in Rwanda [11149-72]**
- 11149 23 **Combining remote sensing data and ecosystem modeling to map rooting depth [11149-78]**
- 11149 26 **Satellite remote sensing detection of forest vegetation land cover changes and their potential drivers [11149-82]**
- 11149 27 **Application of remote sensing data for monitoring of forest vegetation on the territory of nature park "Blue Stones," Bulgaria [11149-83]**
- 11149 28 **Using optical and radar images to study the thermal pollution from the waste disposal site around Vidin area [11149-84]**

- 11149 29 **Application of spectral indices and spectral transformation methods for assessment of winter wheat state and functioning** [11149-85]
- 11149 2A **Climate change influence on Vegetation Indices (VIs) dynamics upon application of interim ecological monitoring (IEM) based on remote sensing data** [11149-86]

Conference Committee

Symposium Chairs

Christopher M. U. Neale, University of Nebraska Lincoln (United States)

Karsten Schulz, Fraunhofer-Institut für Optronik, Systemtechnik und
Bildauswertung (Germany)

Conference Chairs

Christopher M. U. Neale, University of Nebraska Lincoln (United States)

Antonino Maltese, Università degli Studi di Palermo (Italy)

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five 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.

Adeluyi, O. A., 0F	De Peppo, M., 0I
Alonso, Andrea, 1Q	De Petris, S., 1G, 1H
Anderson, Karen, 0D	Desclée, Baudouin, 0X
Aponte, C., 0U	Dhanya, C. T., 0Z
Arafat, S. M., 1C	Dmitriev, Egor V., 1J
Araus, José Luis, 0M	Domingo-Marimon, C., 08
Arbelo, Manuel, 1Q	Donskoi, Sergey A., 1J
Argüello, Francisco, 0Q	Dragoni, F., 0I
Arguello, Henry, 0B	Elias, Deevena, 0T
Asovsky, Valery P., 1M	Empson, William, 12
Avetisyan, Daniela, 29	Ezzahar, J., 09
Baranoski, Gladimir V. G., 0O	Farg, E., 1C
Bascoy, Pedro G., 0Q	Faucqueur, Loic, 0X
Baudry, Jacques, 03	Fawcett, Dominic, 0D
Beach, Robert, 1Y	Fernandez-Gallego, Jose A., 0M
Ben Asher, Jiffah, 1T	Figueiredo, Gleyce K. D. A., 1B
Benabdelouahab, T., 0S	Filipponi, F., 0I
Beneke, Carly, 07	Foster, T., 0F
Bennett, L. T., 0U	Gamil, Walaa E., 1C
Berretti, R., 1G	Gamm, Sarah, 12
Betbeder, Julie, 03	García-Haro, F. J., 23
Boratyński, Z., 1X	Garea, Alberto S., 0Q
Borgogno-Mondino, E., 1G, 1H	Georgiev, Nikolay, 27, 28
Borisova, Denitsa, 27, 28, 29	Ghosh, Jayanta Kumar, 0E
Boudhar, A., 0S	Giannini, V., 0I
Bovolo, F., 08	Gigova, Iliyana, 27, 2A
Brito, Yeray, 1Q	Gilabert, M. A., 23
Bruzzo, L., 08	González-Piqueras, J., 0H
Buchailot, Ma. Luisa, 0M	Gül, Ali, 13
Calera, A., 0H	Gururaj, Punithraj, 16
Campos-Taberner, M., 23	Gutiérrez, Nieves Aparicio, 0M
Casas, Enrique, 1Q	Hadria, R., 0S
Catalão, João, 04, 0P	Harris, A., 0F
Chand, Tara, 0T, 15	Hartmann, S., 02
Chartrand, Rick, 07	Hashimoto, N., 18
Chaudhary, Shushobhit, 0Z	Hegarty-Craver, Meghan, 1Y
Chen, Hao, 14	Heras, Dora B., 0Q
Chiesi, M., 23	Hernández, D., 0H
Clay, G., 0F	Hitiou, A., 0S
Cohen, David, 12	Hubert-Moy, Laurence, 03
Cristóbal, J., 08	Hugé, Justine, 0X
Cvetanova, Galya, 29	Ishida, R., 18
Dahi, H. F., 1C	Iwanchyshyn, Mark, 0O
Dancheva, Adlin, 28	Jara, F., 0H
Dazin, Fabrice, 0X	Jiménez-Escalona, José Carlos, 10
De Jeu, Richard, 0N	Kefauver, Shawn C., 0M
Delbarre, Hervé, 1J	Kenner, Clémence, 0X
den Besten, Nadja, 0N	Khder, Ghada A., 1C
Denize, Julien, 03	Kimmel, Bradley W., 0O

Kontgis, Caitlin, 07
 Kopeika, Natan S., 1T
 Kozoderov, Vladimir V., 1J
 Kuzmenko, Alla S., 1M
 Lahrouni, A., 09
 Lamparelli, Rubens A. C., 1B
 Lapidus, Daniel, 1Y
 Lebrini, Y., 0S
 Lee, Dong-Ho, 1L
 Leroux, Vincent, 03
 Li, Chuanrong, 0K, 1I
 Lionboui, H., 0S
 López, H., 0H
 López-Urrea, R., 0H
 Ma, Lingling, 0K
 Mantino, A., 0I
 Marchetti, Francesca, 1Q
 Martínez, B., 23
 Masci, Olimpia, 04
 Maselli, F., 23
 Masse, Antoine, 0X
 Melnik, Petr G., 1J
 Mercier, Audrey, 03
 Mira, Nuno Cirne, 04, 0P
 Mohite, Jayantrao, 05, 1I
 Morin, Nathalie, 0X
 Moumni, A., 09
 Muramatsu, Kanako, 06
 Najjar, Mohamed, 13
 Nedkov, Roumen, 28, 29, 2A
 Nguyen Xuan, A., 0I
 Nico, Giovanni, 04, 0P
 Nieto-Taladriz, María Teresa, 0M
 Oliveira, Julianne C., 1B
 O'Neil, Margaret, 1Y
 Oppelt, Natascha, 0L
 Ordóñez, Álvaro, 0Q
 Ottilé, C., 08
 Pandit, Ankur, 1I
 Panidi, Evgeny, 04
 Pappula, Srinivasu, 05, 1I
 Park, Jong-Hwa, 1L
 Patel, Ajay Kumar, 0E
 Pesquer, L., 08
 Peylin, P., 08
 Pinto, Jhon E., 0B
 Piso, Gloria, 1Q
 Polly, Jason, 1Y
 Poom-Medina, José Luis, 10
 Radeva, Kameliya, 2A
 Ragaglini, G., 0I
 Ramírez, Juan M., 0B
 Redl, S., 02
 Remy, Pierre-Yves, 0X
 Reshef, Yaniv, 1T
 Rich, Dylan, 07
 Rineer, James, 1Y
 Rocha Rodrigues, Eduardo, 1U
 Roger, Jean-Luc, 03
 Rotko, Daniel, 19
 S, Sigit Heru Murti B, 1W
 Sánchez, J. M., 0H
 Sánchez-Ruiz, S., 23
 Sannier, Christophe, 0X
 Santos, P. P., 1X
 Santos, Roberto B., 1B
 Sarvia, F., 1G, 1H
 Savastu, Dan M., 26
 Savastu, Roxana S., 26
 Sawant, Suryakant, 05, 1I
 Schellekens, Jaap, 0N
 Sebbar, B., 09
 Shetty, Amba, 16
 Siegmund, R., 02
 Sillero, N., 1X
 Simonneaux, V., 09
 Sokolov, Anton A., 1J
 Spasova, Temenuzhka, 28
 Spicher, Fabien, 03
 Stoyanov, Andrey, 27
 Stupar, Danijela, 19
 Surapaneni, Priyanka, 1I
 Tanase, M. A., 0U
 Tang, Lingli, 0K, 1I
 Taramelli, A., 0I
 Taravat, Alireza, 0L
 Temple, Dorota S., 1Y
 Teodoro, A. C., 1X
 Tomato, A., 0I
 Tran, N. B., 0U
 Umesh, Pruthviraj, 16
 Valentini, E., 0I
 Van der Zaag, Pieter, 0N
 Varsa, Petri, 0O
 Velizarova, Emiliya, 2A
 Villa-Martinez, Hector Antonio, 10
 Villodre, J., 0H
 Volpi, I., 0I
 Wagner, M., 02
 Wagner, Matthias P., 0L
 Worsham, Baron, 12
 Yadav, Rahul, 15
 Yamamoto, T., 18
 Yarborough, Sean, 12
 Yawata, K., 18
 Yones, M. S., 1C
 Yoshikawa, H., 18
 Zhang, Wanchang, 14
 Zhu, Xiaohua, 0K, 1I
 Zilberman, Arkadi, 1T
 Zoran, Maria A., 26
 Zortea, Maciel, 1U

Introduction

This proceedings volume contains papers presented during the Remote Sensing for Agriculture, Ecosystems, and Hydrology XXI conference. The conference was part of the SPIE Remote Sensing symposium held 9–12 September 2019 at the Palais de la Musique et des Congrès in Strasbourg, France. Approximately 40 oral and 20 poster papers were presented during this year's conference, covering a broad range of topics in the field of remote sensing applications for environmental science.

The program was organized into 11 sessions according to major themes, namely, Sentinel-1 and Sentinel-3; Sentinel-2; UAV, Hyperspectral, and High Spatial Resolution; Sentinel-1 and Sentinel-2 Precision Farming; Precision Farming I; Precision Farming II; Machine Learning, Deep Learning, and Classification; Forest; Hydrology I; Hydrology II; and Agriculture and Ecosystems.

The conference Best Student Paper Award was given to the paper, "Investigating impacts of calibration methodology and irradiance variations on lightweight drone-based sensor derived surface reflectance products," by Dominic Fawcett and Karen Ander from the Environment and Sustainability Institute at the University of Exeter (United Kingdom).

The poster presentations also had good representation from the above-mentioned session themes. The presentations described both fundamental and applications-based research activities including modelling, laboratory and field experiments, and operational applications.

Our appreciation and gratitude go to the presenters for their efforts, and to the participants for their insightful questions and discussions. Special thanks are also due to the host city for the excellent venue, and to the SPIE staff for their support prior to, during, and after the symposium.

We look forward to an even more successful conference in 2020 in Edinburgh, UK.

Christopher M. U. Neale
Antonino Maltese