

SPECTRUM

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FORESIGHT

**ISPRS WG II/2
and 10 Joint
Workshop :**
Multidisciplinary
Remote Sensing for
Environmental
Monitoring

IFOV

Dr. Isabel Rosa
Lecturer in Environmental
Data and Analysis
BANGOR UNIVERSITY,
UNITED KINGDOM

the Fellowship of the green

SPOTLIGHTS

REMAP: APP Helps Ecologists Map
Vulnerable Ecosystems within Minutes

Monitoring threatened wetlands with
spatial technology at Indawgyi Lake

Photo by Indochina Charm

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NEWSLETTER

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The threats to our environment is undeniable. Forests are declining and degrading, and many species are on the brink of extinction. The death of the last male North white rhino, fondly called Sudan, is a wake up call to humanity - to protect and preserve life on Earth.

Remote sensing and geographic information systems have been utilized in various applications, including ecology and conservation. From mapping the global forests to determining animal movement, the advancement in these technologies has allowed us to understand life on the planet. The role of geospatial information in protecting the environment and conservation has never been more recognized and explored through various applications.

In this issue, we share with you the different applications of remote sensing and GIS and the many discoveries that follow. We sincerely hope that you will be inspired by Dr. Rosa's research experience and the value of the different projects she has been working on. We have also tapped Fauna & Flora International, an international conservation organization, to share one of their projects in Myanmar and how remote sensing and field patrols help in monitoring threatened wetlands. REMAP is a free and online mapmaking tool, which can be used by ecologists, foresters and citizen scientists.

We hope that this issue on ecology and conservation can encourage you in multidisciplinary research and can help you appreciate the importance of remote sensing and GIS in other disciplines. Happy reading!

FROM THE BOARD

Sheryl Rose Reyes
Chair, ISPRS Student Consortium

THE FELLOWSHIP OF THE GREEN

Where are we and what are we doing in this quest of knowing our forests and protecting them?

Written by Sheryl Rose Reyes



Still from Jackson, P. The Lord of the Rings: The Two Towers (2002)

“Don’t be hasty.”

These are the words of Treebeard, the oldest of the Ents or tree shepherds from J.R.R Tolkien’s Lord of the Rings legendarium. I can still remember the very first time I watched the Two Towers, the second installment in the Lord of the Rings trilogy, and how gently Treebeard carried the two hobbits, Merry and Pippin, as they walk through the forest after being captured by the Orcs. The Orcs are the miserable and hateful creatures that comprise the army of darkness. I have always been fascinated by trees and the dense, lush forests that characterize a significant part of life on Earth. Treebeard, his fellow Ents and the Fangorn Forest, are fictional, but we as tree shepherds and the dense forests that surround us are not. Have we been hasty?

Revealing the Mysteries of the Forest

Science and technology have revealed so much about the forests of the world, including their spatial distribution and change over the years [1]. Recently, the [Carnegie Airborne Observatory \(CAO\)](#) [2] discovered the [tallest tropical rainforest tree](#) [3] in the island of Borneo and was measured to be taller than the Statue of Liberty. The CAO has been pioneering research in conservation, using advanced imaging technology such as Light Detection and Ranging

(LiDAR) and high fidelity imaging spectroscopy, so that we can take not just a closer look at our forests, but as well as to get to know their personalities. The forests are just green through the visible spectrum, but if we look at them in a different perspective, we will see their varying colors – how their chemical compositions differ, how do these changing colors characterize biodiversity, and how they can provide clues in learning more about the planet we live in.

Moreover, CAO has been gathering data about forest canopies and building a library based on the observations and investigations they have carried out in various forests around the world. These spectral chemical libraries provide a deeper understanding of the composition of the forests and how it can assist in further studies on conservation and biodiversity. This approach known as spectranomics, aims to maximize the use of advanced imaging technology to fully map the traits of the forests worldwide.

Furthermore, recent studies have revealed medieval cities hidden beneath the jungles. Through the use of high resolution airborne laser scanning technology, archaeologists unearthed what could possibly be [the remains of an ancient city in Cambodia](#) [4], not too far from the famous Angkor Wat and was estimated to be much larger than the country’s capital, Phnom Penh.

A cultural expedition in the Honduran Rain Forest also paved the way to discovering the “White City” or more popularly recalled in the legends as the “The City of the Monkey God.” Demystifying these legends and their connections to ancient civilizations showed how the forests and humankind have coexisted in the past generations.

Breathing with the Forests

Have you seen the forests breathe [5]? In 2014, the National Aeronautics and Space Agency, or NASA as we fondly call it, posted an ultra-high resolution computer model that simulated how carbon dioxide (CO₂) travels through the Earth’s atmosphere. In this short clip, you will see how forests absorb CO₂ during the different seasons and how amazing these forests aid in regulating the processes in the atmosphere. CO₂ and other greenhouse gases are key players in climate change and global warming.

Scientists have been observing the Earth’s breathing patterns through the launch of several satellite missions. NASA has been monitoring CO₂ emissions from space through the Orbiting Carbon Observatory-2 (OCO-2) [6] and the Japan Aerospace Exploration Agency (JAXA), with its Greenhouse gases Observing SATellite (GOSAT) [7]. How forests breathe is as complex as how we breathe. By observing these processes, we gain a better understanding of how our forests act as natural sinks or absorbers of CO₂ emissions and how we can manage these emissions. Now that the Paris Agreement is in place, we must take a step forward in collaborating with our forests to reduce greenhouse gas emissions.

In the Mighty Service of Humankind

The possibility of living on Earth is not only credited to the air we breathe, but what contributes to our human wellbeing [8]. The forests have been providing us with a number of services that allow us to thrive and contribute to society. Collectively known as ecosystem services, the forests have been one of the major suppliers of mankind’s daily necessities.

Ecosystem services have four (4) components: supporting, provisioning, regulating, and cultural [9]. We are probably more aware of the provisioning services – forests provide us with food, fresh water, materials, and fuel, to mention a few. These components have linkages to our wellbeing

which, “arises from what a person has, what they can do and how they think and feel about what they both have and can do.” Even at the spiritual and emotional level (the cultural component), forests have always been there for us.

Some forests are unlike the others. Mangrove forests are comprised of those small trees that you usually find along the coasts or brackish water. It is noteworthy to be reminded of their heroic deed during Typhoon Haiyan, one of the most devastating typhoons ever recorded in history. Known as Super Typhoon Yolanda when it made its landfall in the Philippines, these highly resilient mangrove forests protected communities [10] from the storm surge that could have further intensified the damages and casualties brought by this Category 5 hurricane.

To be an Ent or an Orc?

Even before Treebeard was introduced in the Two Towers, the Fellowship of the Ring gave us a glimpse on how the Orcs were uprooting trees to build Saruman’s army. Treebeard had no intentions of participating in the war, but when he saw how much of Fangorn forest has been destroyed and how many of his friends died because of greed and desire for power, he can no longer just sit around and wait until the Orcs wipe out the entire forest.

As the world keeps on changing, the population increasing and with climate change at hand, we all know that our forests play a very important role in preserving the Earth. But have we been as kind to our forests as they have been to us? Have we ever tried to spend a few hours pondering how much of everything we use on a daily basis come from the forests we often neglect? Forest degradation and deforestation have been evident in the past years and we humans, are accountable for the rapid decline of our forest resources. Illegal and unsustainable logging, agricultural conversion, livestock farming, infrastructure development, and overpopulation are just some of the major drivers of why our forests are slowly disappearing.

Some movies do leave an imprint in our minds and hearts, especially when it comes from a classic book that challenged our human imagination for generations. Being so fascinated with the Ents made me realize that we, as human beings and planetary stewards, may have an Ent or an Orc, inside us. We are all part of this fellowship – the quest to be one with the Earth, once and for all.



The Orcs ripping down the trees to build Saruman's army. (Lord of the Rings: The Two Towers, screencap)

It is a continuous battle of looking after or consuming the forests. And the big question that comes to my mind, "Am I an Ent or an Orc?" As I try to figure out the answer to this question, the words that resonated in my mind comes from the parable of the two wolves – "It is the one you feed."

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REMAP:

APP HELPS ECOLOGISTS MAP VULNERABLE ECOSYSTEMS WITHIN MINUTES

by Dr. Nicholas Murray,
University of New South Wales, Australia

A mapmaking app created by University of New South Wales (UNSW) scientists harnesses the power of Google and NASA to empower ecologists to create a view on ecosystems without any specialist equipment.



REMAP is a free online mapmaking tool that allows users to detect environmental change over time using satellite images (Credit: REMAP-app.org)

UNSW scientists have created a mapmaking app that can fast-track large-scale ecosystem analysis from months to minutes, giving conservationists a way to monitor decades of human impact, hotspots of biodiversity and vulnerable ecosystems.

Less than a year after its launch, REMAP – a free online mapmaking tool that allows users to detect environmental change over time using satellite images – has been used in 140 countries and is now applied in a range of contexts. The app is now an integral part of an international effort to map Myanmar’s ecosystems.

Dr Nicholas Murray, at the UNSW School of Biological Earth and Environmental Sciences created the app because he saw the potential of harnessing remote sensing data to support land conservation and mapping ecosystem loss. Remote sensing refers to

techniques for observing earth from space or air to obtain information about it.

“We wanted to empower people to map just how much the ecosystems around them have been changing,” says Dr Murray.

“The fundamental motivation that led to the app was to allow people to create maps of their environment to identify what ecosystem types occur there, and how they’ve changed over the last 15 to 20 years.”

The UNSW scientists built the program to allow quick analyses of Landsat satellite data gathered by NASA and the US Geological Survey. Landsat is a series of satellites imaging the whole Earth every two weeks since the 1970s and is one of the longest continuous space-based record of global change. The database of images is free, and when pieced together forms an intricately detailed image mosaic of the Earth.



*Mangrove ecosystem classification results from REMAP
(Credit: REMAP-app.org)*

Dr Murray explains that just half a decade ago, building a map from raw satellite data from scratch required extensive work.

“In the past it has been a technical process to produce high-quality maps suitable for tracking environmental change such as deforestation and ecosystem loss. It really has been sitting in the hands of experts,” says Dr Murray.

“We aimed to remove the technical steps required to monitor ecosystems from space. Now, if I want to map an area the size of Sydney using satellite data that would require a fraction of the time in REMAP.”

REMAP was designed to be user-friendly, making it accessible for everyone at the frontline of environment conservation, from national park rangers and ecologists to citizen scientists. The program gives users a high level of control and ability to map an ecosystem type, analyse specific areas and even the timeframe of their choosing.

The app uses machine learning to develop a map: users train REMAP to classify specific ecosystem types by identifying a few pixels from Google Earth, or by uploading their own field data. From that little bit of data, REMAP can apply that information to recognise ecosystems in a selected area and then returns results that let users know the final extent of the ecosystem and how much it has changed over time. It is possible to tailor the program to detect ecosystem changes, such as witnessing the boundaries of forests shrink over the decades due to deforestation.

Generous access to the Google Earth Engine gave the team access to sufficient computing power to process the high volume of Landsat images and run the machine learning analyses that are the foundation of REMAP.

The team has also joined forces with the Wildlife Conservation Society to map Myanmar’s ecosystems. According to the IUCN, Myanmar is a strategic country in terms of biodiversity conservation but does not have a lot of data to identify critically endangered ecosystems.

The country is home to 10% of the world’s freshwater turtles and tortoises on just over 1% of the world’s land area, and at least 250 mammal species and more than 1,000 bird species. Its forests are some of the most extensive and intact in Southeast Asia.

Dr Murray is a member of the team that developed the IUCN Red List of Ecosystems, a single global standard for assessing environmentally threatened ecosystems for policy-makers and scientists around the globe. In 2015 the IUCN Red List of Ecosystems team was awarded the NSW Office of Environment and Heritage Eureka Prize for Environmental Research.

“People all around the world are going to be able to make really high-quality maps with the right data and identify places that are changing – for the worse or for the better.”

Dr Murray and his team developed REMAP at UNSW with conservation biologist Professor David Keith and Professor Richard Lucas, a remote sensing scientist. Recently, the team published their first scientific paper about the app in *Methods in Ecology and Evolution*. Since REMAP was publicly released in December 2017, over 6500 people from more than 140 countries have used the program.

“We are at an exciting time on earth where we really have the computing power to do this. This application makes the world’s best practice remote sensing method accessible to everyone,” says Dr Murray.

“People all around the world are going to be able to make really high-quality maps with the right data and identify places that are changing – for the worse or for the better.”

Monitoring threatened wetlands with spatial technology at Indawgyi Lake

By Carl Reeder

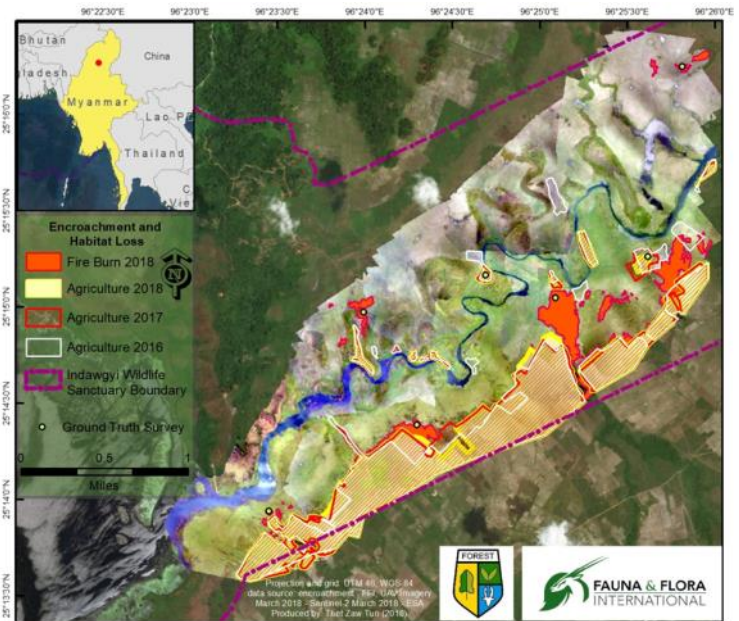
Land Use Planning, GIS & RS Specialist;
and Thet Zaw Tun

GIS officer of Fauna & Flora International – Myanmar

Management of a wildlife sanctuary requires continuous monitoring to track changes in habitat and threats to the wildlife species. In the case of Indawgyi Wildlife Sanctuary in northern Myanmar, rangers are challenged with the task of monitoring and enforcing conservation policy across 133,715 hectares, an area larger than Hong Kong. The scale of the sanctuary area and impact of the threats pose challenges for rangers to implement the effective monitoring and enforcement required. The sanctuary rangers have partnered with Fauna & Flora International (FFI) to use a suite of spatial technologies to measure and monitor the sanctuary. Through a combination of remote sensing data, UAV surveys, and field patrols, the teams are able to monitor rare environments, focus the efforts of the rangers and consequently amplify their impact.

Indawgyi Wildlife Sanctuary was designated a UNESCO Biosphere reserve in 2017 due to the rare wetland habitats throughout the lake basin. Over 20,000 migratory birds use the Sanctuary as a wintering site and many bird species reside year-round in the unique wetland ecosystem, such as the Sarus crane, classified as Vulnerable on the Red List. A significant population of the endangered hog deer also resides in the shrinking grasslands. The wetland species face increasing competition from agriculture and grazing, which destroys nesting sites and crowds out deer habitat. To support wildlife in the Sanctuary, Rangers and teams from FFI commit to joint monitoring of the grassland landscape.

The team's first step is to establish a baseline map. Satellite imagery from Landsat and Sentinel sensors are used to build a story of past and current land cover. The temporal resolution and scale of these images can identify forest cover for the entire sanctuary, which enable the tracking forest loss due to mining, agricultural expansion and illegal logging. A supervised classification method returns accurate results for forest, bare earth, and recently burned grassland because these classes have distinct spectral signatures. However, differentiating areas of grassland and agriculture presents challenges; a supervised pixel-based classification is problematic because the two classes are spectrally similar, especially when measured at Landsat resolution of 30 meters. Compounding this issue are the boundaries of house-hold scale agricultural fields. Many of these boundaries are indistinguishable even at the 10meter resolution of



2018 Encroachment survey by FFI and Wildlife Sanctuary staff

Sentinel imagery. To work around this resolution constraint, the teams conduct targeted UAV surveys in the most critical habitat. The UAV surveys focus on the flooded grasslands along the Indawchaung River outlet, which drains from Indawgyi Lake to the north-east during the monsoon season.

The team uses a DJI phantom 3 pro UAV to fly missions to cover the section of the Indawchaung River protected by the sanctuary. More than 10 missions are necessary to cover more than 1,400 hectares of the sanctuary. Once collected from the field, the UAV imagery is linked together through photogrammetric processing to develop a continuous image layer. Using visual interpretation, the image is then manually digitized for areas of agriculture encroachment. The UAV data is collected at a sub-meter resolution, which is sufficient to visually identify both the fine-scale agriculture boundaries and distinguish between grassland and encroaching agriculture. Not only do the UAV surveys provide enhanced detail to classify the fields, but they allow the team to monitor sections of the river inaccessible to ground survey teams. Where the grassland is accessible, ground truth points, to corroborate the visual assessment, are collected by a ground survey.

With a combination of the UAV classification, the macro-level classification, and direct field observation, the analysts and rangers can better understand encroachment into the sanctuary. Figure 1 shows the results of three years of agricultural monitoring. Evidence from the three survey years tells a story of expansion and dispersal of the agriculture and burning dispersed across the grassland area. These results provide support for rangers when they must decide how to best patrol and enforce the wildlife sanctuary effectively.

This work was made possible by support from ASEAN Centre for Biodiversity, KfW group, and the Helmsley Charitable Trust.

Learn more about FFI projects in Myanmar:
<https://www.fauna-flora.org/countries/myanmar>



Questions prepared by Angelica Kristina Monzon and Sheryl Rose Reyes

Dr. Isabel Rosa

Lecturer in Environmental Data and Analysis

Bangor University, United Kingdom

Your work encompasses biodiversity, ecosystem services, land use and ecological modelling. Can you briefly share with us your background, research interests and current projects/work?

I did a BSc in Forestry and a MSc in Natural Resources Management at the University of Lisbon (Portugal) before moving to the UK to do a PhD in Computational Ecology at the Imperial College of London. Since my masters I've become very interested in spatial data and spatial analyses so I decided to do a professional certification in GIS as well. Since then, I've been working with spatial data pretty much on a daily basis in all projects I'm involved. I've been particularly interested in modeling land use and land cover change in the tropics, where land conversion has occurred rapidly in the last couple of decades as a response to the increasing demand in agricultural products. My current research interests are in modeling land cover change and understand its impacts on biodiversity and ecosystem services. For instance, I'm currently working on a project to model future deforestation in Colombia in this post- peace agreement era, and understand potential consequences for this biodiversity-rich country.

Can you share with us your perspectives on how you think Remote Sensing and GIS have changed the way the world address biodiversity and nature conservation agendas? What are the possible roles of geospatial information and technology in the future of addressing and understanding biodiversity and conservation?

As humans, we have been modifying the surface of the earth (land cover) for centuries. The practices we do (land use) have important consequences for biodiversity (species living there) and the ability for the landscape to provide us with important resources (provisioning, regulation and cultural services). Being able to monitor this changes is critical to examine how certain practices may be more damaging than others,



how fast we are converting the surface and where our conservation and/or restoration efforts should be placed. Remote Sensing and GIS are incredible sources of data and tools that more and more conservationists around the globe use. Importantly, from a remote sensing perspective, our ability to monitor at much higher resolutions (spatial, thematic and temporal) is rapidly increasing, which makes the future quite exciting. Further, given the variety of sensors and data fusion approaches we are learning to monitoring more and more dimensions of human-nature interactions. For instance, there are global initiatives for monitoring biodiversity (see GEO BON) that do an amazing job at bringing together the Remote Sensing and biodiversity scientists communities to work together towards the next generation of data and tools to help us monitor the status of biodiversity worldwide. Of course, there are still important limitations, and there will always be certain dimensions (e.g. soil biodiversity) that we won't be able to monitor from space, thus the importance of continued investment in more traditional monitoring methods (field sampling) and other approaches (meta-barcoding).

“ From a remote sensing perspective, our ability to monitor at much higher resolutions (spatial, thematic and temporal) is rapidly increasing, which makes the future quite exciting. ”

Can you tell us more about your work on land use modelling and scenarios? Can you give insights on the significance of Remote Sensing and GIS in improving models and scenarios for nature futures?

The models that I develop, for instance to predict the probability of deforestation in the Brazilian Amazon, are mostly fed by spatial information that is derived from Remote Sensing products, such as Landsat. I then use several GIS tools to process this data before include it in the model. Moreover, I use spatial analyses to investigate historical rates and patterns of deforestation, and its relation to socio-economic dynamics, to ensure that the model is representing, to the best of its ability (and data availability) the processes observed on the ground. GIS-based models, fed by remote sensing data, are critical to produce spatially-explicit scenarios of how the future might look like if certain trajectories are to be follow.

Is there any current specific project, activity or initiative that you are particularly excited about? Can you briefly describe what it is, its contributions to the scientific community and for the general public?

I'm very excited about my collaboration with the Humboldt Research Institute (Bogotá, Colombia) because it will be the first counterfactual modeling study to show how the armed conflict impacted natural resources, and the consequences for the local biodiversity. Further, by working directly with the Humboldt I'm able to discuss the outputs of my research with local decision makers and get the necessary feedback to make sure the outputs of my model are both useful and used to ensure a long-term sustainability management of the forest landscapes in Colombia.

Can you tell us how you started working on biodiversity and conservation issues and spatial information science? Can you cite challenges about working on multidisciplinary issues and how you overcame them?

As mentioned above, I started working with spatial information science since my masters, where I estimate the greenhouse gases emissions from rural fires in Portugal over an almost 20-year period. My research started to become more and more interdisciplinary over time, when I expanded my network of collaborators to include others with very different backgrounds (social scientists, economists, biodiversity and ecosystem services scientists). I find

multidisciplinary studies quite interesting as we are able to analyse a certain problem using very different lenses. Sometimes there are challenges, especially regarding concepts and their meaning over different fields, but all in all it works well, and it is more and more demanded by funding agencies, which tells you a lot about its importance. With IPBES, for example, interdisciplinarity comes naturally in all works that we do regarding modeling and future scenarios.

Lastly, what are you most passionate about? What's your advice to students in discovering (or developing) their passions and how it can be beneficial pursuing a career track in the area of conservation and spatial information science?

I'm very passionate about using my research (and teaching) to inform real-life decisions that will contribute to a more sustainable future, and an improved relationship between humans and nature. My advice would be to try and find what you love to do, and work hard to get a job that allows you to do exactly that. If that job is in academia (or even if not), prepare to be resilient, to be strong in face of adversity and to make sure you stand up after you fall. We all fail, we all fail multiple times, those who succeed are able to get up and try again, without fearing failure again. If you have that chance invest in your education (there are lots of free online courses these days), invest in broadening your horizons (internet allows to do that without leaving your room but if you have a chance, travel!), be tolerant, be kind and be a great team player. Success will follow!

“ We all fail, we all fail multiple times, those who succeed are able to get up and try again, without fearing failure again. ”



ISPRS Technical Commission III WG III/2, 10 Joint Workshop

MULTIDISCIPLINARY REMOTE SENSING FOR ENVIRONMENTAL MONITORING

March 12-14, 2019 Kyoto, Japan



Workshop Topics and Themes

The themes include but are not limited to:

- Microwave Remote Sensing (WG III/2)
- Agriculture and Natural Ecosystems Modelling and Monitoring (WG III/10)
- Landuse and Landcover Monitoring
- Disaster Monitoring
- Civil Infrastructure Monitoring

Prospective authors are invited to submit papers dealing with original and unpublished research on themes related to the workshop. Submitted papers will be refereed for quality, originality and relevance by the Scientific Committee.

1. Accepted papers will be published in one of two categories

- The International Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences
- The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences

2. Process

- Full papers submitted for the Annals are assessed using a double-blind peer review process.
- Papers submitted for the Archives are accepted on an abstract review process, which, if accepted, are followed by a full paper.

3. All abstracts should be written in English comprising 250 – 500 words and containing sufficient details for evaluation (including the approach, results, concepts, reasons why it should be considered and why it would

be interesting for the audience).

4. All papers should be formatted as per ISPRS author’s guidelines that can be accessed at

<http://www.isprs.org/documents/orangebook/app5.aspx>.

Important Dates

Paper for Archives based on abstract review:

Submission of abstract: Sep. 30, 2018

Notification of acceptance: Nov. 15, 2018

Submission of camera ready papers: Dec. 25, 2018

Paper for Annals based on double-blind peer reviewed:

Submission of full paper: Sep. 30, 2018

Notification of acceptance: Nov. 15, 2018

Submission of camera ready papers: Dec. 25, 2018

	Before Oct. 31, 2018	After Oct. 31, 2018
Participants	25,000 JPY	30,000 JPY
Full time students & seniors	15,000 JPY	20,000 JPY
Accompanying persons	15,000 JPY	20,000 JPY

Contact Information

Dr. Junichi Susaki

Graduate School of Engineering, Kyoto University
C1-1-206, Kyotodaigaku-katsura, Nishikyo-ku, Kyoto,
615-8540, JAPAN

E-mail: ISPRS.ComIII.Kyoto.ws[at]gmail.com

Website: <http://www.jsprs-w.org/ISPRS/>

01 JANUARY 2019

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UPCOMING EVENTS 2019

06-08 Feb 2019

- 11th EARSeL Imaging Spectroscopy Workshop**
 SITE: Brno, CZECH REPUBLIC
 CONTACT: Lucie Homolová
 earsel2019@czechglobe.cz

06-08 Feb 2019

- ISPRS WG II/8: 8th International Workshop - 3D ARCH**
3D Virtual Reconstruction and Visualization of Complex Architectures
 SITE: Bergamo, ITALY
 CONTACT: Francesco Fassi
 +39 02 2399 6532
 francesco.fassi@polimi.it

10-13 Feb 2019

- ISPRS IC WG III/IVb: International Geoinformatics Conference 2019**
 SITE: Riyadh, SAUDI ARABIA
 CONTACT: Ali Abdullah Aldosari
 +966114678798
 adosari@KSU.EDU.SA

18-20 Feb 2019

- ISPRS WG III/10: International Workshop on Earth Observations for Agricultural Monitoring**
Followed by
 21-22 Feb 2019
Tutorial on Advances in Remote Sensing for Agriculture
 SITE: New Delhi, INDIA
 CONTACT: Shibendu Shankar Ray
 + 91 11 2584 3224
 +91 11 2584 3225 shibendu.ncfc@nic.in;
 shibendu.ray@gmail.com

12-14 Mar 2019

- ISPRS WG III/10 & III/2: ISPRS Technical Commission III WG III/2, 10 Joint Workshop**
Multidisciplinary Remote Sensing for Environmental Monitoring
 SITE: Kyoto, JAPAN
 CONTACT: JUNICHI SUSAKI
 +81-3-5722-7653
 +81-3-6412-2593
 MAIRTU1698@PASCO.CO.JP;
 SUSAKI.JUNICHI.3R@KYOTO-U.AC.JP

18-21 Mar 2019

- RSCy2019: Seventh International Conference On Remote Sensing and Geo-Information of the Environment**
 SITE: Paphos, CYPRUS

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Mabuhay!



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