

THE OFFICIAL NEWSLETTER OF THE ISPRS STUDENT CONSORTIUM

SPECTRUM

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UAS FOR ENVIRONMENTAL MONITORING

**THE ISPRS SC LEADERSHIP AND
SERVICE MENTORING PROGRAMME**

**CITIZEN SCIENTISTS FLY UAVs
TO MONITOR BEACH EROSION**

iHabiMap: Habitat Mapping, Assessment, & Monitoring using High-Resolution Imagery

See Cucumbers: *How can we quantify sea cucumbers from high up in the sky?*

How Low Can You Go?
Detecting Underwater Algae & Plants
with an Aerial Drone

Investigation of the **Moisture Expansion**
as a **Deterioration Factor** of an Ancient Sandstone Buddha
in Nakhon Ratchasima, Thailand

GeoNADIR:
*USING DRONES TO PROTECT MOTHER EARTH'S
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Special Feature on **ASPRS SAC**

I F O V:
Dr. Karen Joyce
Dr. Monica Rivas Casado
Prof. Salvatore Manfreda

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ENGAGE *WITH OUR GLOBAL NETWORK OF EXPERTS AND BE EMPOWERED*



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MESSAGE FROM THE BOARD

Dear ISPRS SC Newsletter readers,

Welcome to the 4th issue of SpeCtrum (Volume 14), the official Newsletter of the ISPRS Student Consortium!

I am very pleased to present this Newsletter issue featuring articles and interviews on Unoccupied Aerial Systems (UASs) and how these remote sensing technologies are being utilized to monitor our environment. It is indeed an honour to have interviewed Dr. Karen Joyce from James Cook University (Australia), Dr. Monica Rivas-Calsado from Cranfield University (United Kingdom), and Dr. Salvatore Manfreda from University of Naples Federico II (Italy), who shared with us their professional experiences and incredible passion for their research. Make sure to read our IFOV section for advice and inspiration from the experts and take some time to reflect on the current and future challenges in this field of research.

Also, let me share some of the very exciting research related to our theme. These include developing analytical approaches to determine if and how drones can map, monitor and assess natural habitats in Ireland (Project iHabiMap), “seeing” sea cucumbers, underwater algae and plants from drone imagery using machine learning techniques, monitoring beach erosion by engaging citizen scientists to fly drones, and utilizing UAS - derived photogrammetric products to observe the flow direction of rain and moisture expansion into an ancient site in Thailand. We’ve also been given an opportunity to introduce the Geoinformatics Research Group of Suranaree University of Technology in Thailand.

It is also our great pleasure to feature GeoNadir – an online global drone data repository. Join this worldwide community and take this opportunity to help protect our most at-risk ecosystems by sharing your drone images. Know more about the American Society for Photogrammetry and Remote Sensing Student Advisory Council (ASPRS SAC) and their activities. It has been a wonderful experience working with the ASPRS SAC Team and our partners for the GeoMixer events.

On behalf of the ISPRS SC Board of Directors and the Newsletter Team, I would like to sincerely express my gratitude to all the contributors who responded to our invitation and submitted great articles and interviews for this special issue. I am incredibly privileged to work on the publication of this Newsletter. Thank you very much!

To all of you, I hope that you will enjoy reading this issue.



Charmaine Cruz

NEWSLETTER EDITOR-IN-CHIEF
ISPRS STUDENT CONSORTIUM

A Note from the President

In this special issue, I would like to acquaint you with the use of the word “unoccupied,” replacing “unmanned” for the terminologies UAV or UAS. I was introduced to this term by Dr. Karen Joyce, one of the leading experts in the field and featured in our IFOV. I read about the use of this term and encountered this [article \[1\]](#) from Annual Reviews that encourages the use of the term “**unoccupied**,” to reduce the gender bias that continues to exist in the scientific community and to inspire more female participation in this field of research.. I would like to bring your attention further to a recently published editorial by none other than Dr. Joyce, together with Dr. Karen Anderson and Dr. Renee Bartolo, entitled, “[Of Course We Fly Unmanned—We’re Women!](#)” Let me borrow a line from this editorial:

“

... we do have the capacity to change the terms used within our scientific writing, and so we suggest that the time has come to change our practices.

”

*- Joyce, K., Anderson, K., & Bartolo, R. (2021).
Of Course We Fly Unmanned—We’re Women! Drones, 5(1), 21*

I personally believe that the adoption of gender-neutral terms play a key role in making our scientific community more inclusive and diverse, as thoroughly explained in the above-mentioned editorial. In our own ways, we can raise awareness and contribute to making academia and workplaces better for women and many underrepresented groups.



Sheryl Rose Reyes

ISPRS STUDENT CONSORTIUM
PRESIDENT

[1] Johnston, David W. “Unoccupied aircraft systems in marine science and conservation.” Annual review of marine science 11 (2019): 439-463.

[2] Joyce, Karen E., Karen Anderson, and Renee E. Bartolo. “Of Course We Fly Unmanned—We’re Women!” (2021): 21.

THE ISPRS STUDENT CONSORTIUM LEADERSHIP AND SERVICE MENTORSHIP PROGRAMME



About the Programme

The International Society of Photogrammetry and Remote Sensing Student Consortium (ISPRS SC, the Consortium) represents a constituency of the students and the young professionals with shared interests and goals within the ISPRS (the Society) in the areas of photogrammetry, remote sensing, and spatial information science. The Consortium shall act as a liaison and provide a communications forum for and between all interested members on important issues and affect their relationship with the Society. In the organization of the Society, the Consortium directly reports to the ISPRS Council via an Advisory Committee (AC) appointed by the ISPRS Council.

The main purpose of the Consortium is to link students, young researchers, and professionals worldwide, interested in photogrammetry, remote sensing, and spatial information science, to promote their scientific and professional developments as well as advocate imaging and geospatial science for informed, scientifically valid, and technologically sound observations of Earth conditions and trends that lead to improved and effective decision-making.

The ISPRS SC is led by the Board of Directors, composed of six officers: The President, Vice President, Newsletter Editor-in-Chief, Website Administrator, Social Media Coordinator and Newsletter Designer. The ISPRS Student Consortium Leadership and Service Mentorship Programme primarily aims to train and familiarize qualified individuals with the responsibilities of the position they are interested in and about the activities of the Consortium. In addition, this programme nistrator, Social Media Coordinator and Newsletter Designer. Each is elected for a maximum of four (4) years which end at the subsequent ISPRS Congress, where new officers are elected. Due to the current pandemic, the tenure of the current Board of Directors will end during the XXIV ISPRS Congress 2021 in Nice, France.

The Board of Directors perceives this extension as an opportunity to train and mentor future leaders of the Consortium. The ISPRS aims to provide skills necessary not only on the professional level but also skills that can contribute to one's personal growth through cooperation and coordination of activities and development of ideas to foster the career advancement and professional progress of the members of the Consortium. Currently, they are involved and immersed in the actual work done by the current Board of Directors and are given a set of milestones that must be achieved by the end of the programme.

At the end of this programme, individuals who excelled in achieving their milestones and exemplified dedication and enthusiasm in working for the Consortium will be personally nominated by the Board of Directors for the next term.

On behalf of the ISPRS SC Board of Directors, I would like to introduce the programme's very promising mentees.



LAXMI THAPA

Survey Officer

Survey Department,
Government of NEPAL

Research Interests:

LIDAR Technology, UAV
Photogrammetry, AI in Earth
Observation & Geospatial Technologies.

I have a bachelor's degree in Geomatics Engineering and a master's degree in Geospatial Technologies. I have been actively engaged in various activities related to GIS/Photogrammetry/RS fields, personally and professionally, since the last 8 years. A laptop, earphones and sound internet connection are my all-time favourites, but hiking/biking are taking some space in the gadget-life lately.



NIMISHA WAGLE

Survey Officer

Survey Department,
Government of NEPAL

Research Interests:

Remote sensing, Landcover/use
change analysis, hydrology

I am currently working as a survey officer in the government of Nepal. I am interested in regional scale earth observation and climate change analysis, for example mapping seasonal surface water and forest change, annual land use/cover dynamics, and natural disaster modelling in the Himalayas. I believe in hardwork and achieving something by getting out of your comfort zone.



NICOLAS PUCINO

Ph.D. Student

Deakin University,
AUSTRALIA

Research Interests:

Citizen Science photogrammetry,
hyperspectral imaging, coastal
morphodynamic remote sensing

Nicolas is an Italo-Swiss student who obtained a bachelor's degree in physical geography at the University of Lausanne, Switzerland, then moved to the University of Wollongong, Australia, to obtain his master's degree with distinction on coastal science. Currently, he is pursuing a PhD in optical remote sensing of coastal morphodynamics at Deakin University, with a particular interest in satellite and UAV-based hyperspectral imaging of beach sediment properties.



SUNNI KANTA PRASAD KUSHWAHA

Ph.D. Research Scholar

Indian Institute of Technology
- Roorkee, INDIA

Research Interests:

LiDAR and Photogrammetry

A researcher from the Geomatics Group, Indian Institute of Technology Roorkee, India. He is currently doing his research on classification and segmentation of LiDAR and photogrammetry datasets.



VASALA SAICHARAN

Ph.D. Scholar

National Institute of Technology
Karnataka (NITK), INDIA

Research Interests:

Remote Sensing of Water
resources assessment

My name is Saicharan, and I'm currently pursuing my PhD in remote sensing from National Institute of Technology Karnataka (NITK), India. I'm a first-generation graduate student in my family. I'm interested in applying remote sensing in the water resources domain. My current research focuses on water resources assessment in tropical regions using remote sensing. I have a bachelor's degree in civil engineering and a master's degree in geoinformatics and surveying technology. I want to help the smallest stakeholders by conducting my research on remote sensing applications in water resources.



YOGENDER YADAV

M.Sc. Student

Faculty of ITC, University of
Twente, Enschede, NETHERLANDS

Research Interests:

Photogrammetry, LiDAR and
UAV remote sensing

I am currently pursuing my M.Sc. in Geoinformation Science and Earth Observation Science at Faculty of ITC, University of Twente, Enschede, Netherlands. I have completed my bachelor's degree in civil engineering from the National Institute of Technology, Kurukshetra. I work in the integration of multi-source datasets. I am enthusiastic to learn new things and challenge myself. I believe in transparency and hard work, if you have the right intentions and work in the right direction, then success will be all yours.



GABRIELE CANDELA

Ph.D. in Civil and
Environmental Engineering
Mediterranea University of
Reggio Calabria, ITALY

CAN YOU NAME THE PERSON YOU ADMIRE MOST IN REMOTE SENSING/ PHOTOGRAMMETRY/SPATIAL INFORMATION SCIENCE? WHY?



I admire the active engagement of Emeritus Prof. Dr. Armin Gruen the most, as I have always seen him involved in knowledge sharing and motivating younger generations towards the Photogrammetry/RS field. Also, his contributions to these fields are highly recognized and his proactiveness even at his age now has highly impressed me.

The person I admire most is Micheal A. Wulder. He is a Research Scientist in the Canadian Forest Service. I am hugely inspired by his works on Landsat and remote sensing. His works on land cover change and forestry have a high impact on our field.



My hero is Greg Asner. My passion for remote sensing started when I watched his TED talk about airborne LiDAR and hyperspectral sensors to map lions' predatory tactics and damaged trees by elephants in the savannahs. Now, he maps the world's corals with those sensors and Planet satellites, which fascinates me.

Juha Hyyppä. He is the director of the Centre of Excellence in Laser Scanning Research (Academy of Finland), director of National Land Survey of Finland and member of Remote Sensing and Photogrammetry (Finnish Geospatial Research Institute, FGI). He works with LiDAR and photogrammetry datasets. He has published many research papers and articles answering many critical issues in his research works.



I admire Pisharoth Rama Pisharoty, the father of remote sensing in India. He is my role model. He worked under the guidance of Nobel Laureate, C. V. Raman, and he is the founding director of Indian Institute of Tropical Meteorology (IITM). He was the first person to use remote sensing and successfully use it in India.

Out of the numerous people I know in the field of remote sensing, I always look up to my graduate college professor Dr. Mahesh Pal, Professor, Department of Civil Engineering, National Institute of Technology (NIT), Kurukshetra. He always guided me in my projects and internships in my career through all thick and thin.



WHAT MOTIVATED OR INSPIRED YOU TO JOIN THE LEADERSHIP AND SERVICE MENTORING PROGRAMME OF THE ISPRS STUDENT CONSORTIUM?



When I got the chance to participate in ISPRS Congress in 2016, I was highly influenced by the activities of ISPRS. The visit of President Christian Heipke to Nepal has left an unforgettable impression on me and his leadership in ISPRS has inspired me to come to the front position to contribute in any way I can. So, I wanted to be involved in the activities of ISPRS SC and this Leadership and Service Mentoring Programme comes as the perfect opportunity for me to understand how ISPRS SC functions behind the scenes to connect like-minded young people in the Photogrammetry/RS domain.

I have been abroad attending training and summer schools from which I am always motivated to meet and develop professional connections with students and professionals mainly in my field of geomatics and remote sensing. It gives me a different perspective and enhances my understanding of a given subject matter. I wanted to improve my leadership and communication skills, and also, always wanted to build strong connections with different geospatial professionals all around the world. So, these are the reasons that motivated me to join this program.



I am an ambitious researcher and I am deeply in love with my discipline, remote sensing. I believe the best way to help my career while also helping the discipline at large, starts by being an active member of the legendary ISPRS. We, students, are the future of our discipline, thus, I really want to do my part in helping students to feel united, connected and part of this scientific community. The future is ours, and we need to make sure we do all our best to kickstart our careers confident and empowered.

I started following ISPRS in 2016, during the first year of my masters. Slowly, I learned about the different events they offer like summer schools, conferences, etc. Then, I got to know that by being a part of the ISPRS SC, one can really get a chance to interact with many experts and researchers from all parts of the globe. We can also make good collaborations with the friends we meet along the way of our journey as a part of the Leadership and Service Mentoring Programme of the ISPRS Student Consortium.



I joined in Leadership and Service Mentoring Programme of the ISPRS Student Consortium because it gives an opportunity to learn from superior people from worldwide, improve communication skills and gain professional and personal experiences by working with peers in remote sensing. I benefitted by attending the ISPRS SC Virtual Rooms last year, so I joined this programme to be part of the organization and help other students and scholars to reach their goals.

Actually, I have been guided in the domain of remote sensing and GIS by very close seniors and professors. This is how I started to gain a deep interest to proceed in this domain. ISPRS SC is dedicated to building networks among students and experts and is a knowledge sharing platform. I have a long path to take as I am still a master's student and there are a lot of things I have to learn technically. I also need to learn management skills to organize seminars, conferences, webinars, summer school, etc., and I believe this is the right platform for me to grow along with my support to the Consortium.



WHAT DO YOU SEE YOURSELF DOING IN FIVE YEARS?



In five years, I see myself involved actively in the activities of ISPRS SC as one of the members of the Board of Directors. I see myself involved in research/promotional activities of Photogrammetry/RS fields and their applications in addressing real world challenges.

My application for a PhD has been accepted in Brown University. I will join Brown University this August. I will be working under guidance of Prof. Laurance Smith in Northern Change Research Laboratory for 5 years. I will be working on the Cal/Val of NASA SWOT mission. After 5 years, I would have completed my PhD and after my PhD, I see myself pursuing a NASA fellowship and postdoc.



I have always hated this question in interviews! I can tell you in 15 years I will be a professor researching global scale coastal dynamics with multiple space-borne sensors, living in a tropical location with my wife, two dogs and 3-4 kids. In 5 years is difficult, but I will definitely be a principal investigator of a major project I designed and got funds for on a wide scale hyperspectral imaging, based somewhere in the world (warm climate, I hope), I will be part of ISPRS, I will have one kid and finally married my girlfriend!

Currently I am doing my PhD, so I would be either doing my Postdoc or by God's grace and as a result of my hard work, I would be working as a remote sensing and GIS scientist at a reputable organization.



I want to complete my PhD with good publications and try to implement my research in helping/guiding local farmers. After my PhD, I want to start working in research institutions/organisations, where I can apply my research skills and help the needy. I want to do my part in ISPRS SC by trying to reach every geospatial student and institutions in all corners of the world. I want to actively participate/conduct ISPRS and ISPRS SC events to help students and scholars in remote sensing.

I see myself in the final years of my PhD after five years under a good supervisor. Hopefully, I would have learnt a lot from the Consortium members and other experts, and would be applying and sharing the knowledge I attained with others in a positive manner.



WHAT DO YOU THINK IS THE CONTRIBUTION OF INTERNATIONAL ORGANIZATIONS LIKE THE ISPRS SC IN THE PERSONAL AND PROFESSIONAL DEVELOPMENT OF STUDENTS AND YOUNG RESEARCHERS?



In my opinion, international organizations like ISPRS SC act as the bridge to bring together students and young researchers around the globe to share their research and professional ideas, to explore and promote the profession in the concerned domains. Personally, the young minds can develop their skills, including interpersonal skills like communication and technical knowledge advancement by participating in different events and training. Professionally, such organization can be a platform for the younger generations to offer the opportunities of international networking, collaboration and interaction with scholars/scientists well-established in the fields; supporting and speaking globally on behalf of this generation as a common voice to raise any issues arising in the field, discussing and sharing the innovative ideas/research to bigger communities through media like newsletters, journal articles, conference proceedings, etc These are some examples on how international organizations can contribute to engage younger minds in their fields with high motivation.

Through international organizations like the ISPRS SC, students will be able to build connections with highly reputed professionals and also students will get a chance to build their organizational skills and also can get opportunities to share their knowledge and publish their findings.



Major contribution. People who decides to be part of these organisations care about their future and the future of their discipline. ISPRS SC is the medium which allows to connect students that share the same passion, world experts and also 'gurus' that seem otherwise unreachable from a student standpoint. People learn to be part and the importance of acting in a scientific community to improve our field. If one complains about something without acting to change it, nothing happens. Here, ISPRS SC has the power to listen, act and improve world students' academic life. Why not be part of it?

The contribution of international organizations like the ISPRS SC is certainly playing a major role in networking and providing the best platform for knowledge sharing among the young researchers and senior experts in the domain. It is also a platform to learn new things beyond the domain of remote sensing and GIS and has a curiosity in these fields. The best part is that students get a chance to know experts and their topics, which can help increase their chances of getting a M.Sc., PhD, Postdoc or research positions.



International academic/scientific organizations create the platform to amalgamate people from all cultural backgrounds and from countries of varying incomes for the inclusive growth of science. It thrives in the personal and technical progress of its members and the society. Career development and technical sessions conducted by these organizations will shape the growth of students. Even grants provided by these organizations, help students to present their works and conduct their research. It will adopt new technologies in the field and conduct workshops to enlighten young professionals.

I believe the main contribution of the International organisations should be free knowledge sharing and guiding towards the right opportunities in the domain of remote sensing and GIS. Exploring all the remote sensing techniques rather than confining towards the best aware techniques





ABOUT GEOMIXER

The GeoMixer monthly event is a new opportunity to network with other remote sensing scientists at all career stages from around the world! This virtual mixer supports networking with other participants that you may not have otherwise met by assigning participants into a series of small breakout rooms in Zoom. This event is inspired by the International Association for Landscape Ecology - North America (IALE-NA) 2020's Student Mixer and the successful first GeoMixer event at Google's Geo for Good Summit 2020.

This event is organized by the [Ladies of Landsat](#), [Sisters of SAR](#), [MSIEEE-GRSS](#), [IEEE-GRSSIDEA](#), [ASPRS Student Advisory Council](#), the [Asian Association on Remote Sensing](#) and the [ISPRS Student Consortium](#)!

The kick-off event was led by the Ladies of Landsat and was hosted last January 6 and we were joined by about 47 attendees from different countries in Asia, North America, South America, Africa and Europe. The next event was hosted by the Sisters of SAR last February 17 and we were joined by about 45 attendees. Our participants were composed of students and early career researchers to senior scientists, as well as participants from the ISPRS and ISPRS White Elephant Club.

The GeoMixer is an incredible opportunity to make new friends in the remote sensing community, find other researchers working in the same geographical study area, topic or using similar remote sensing techniques and expand your professional networks. This event demonstrates the potential of positive collaborations among organizations in remote sensing and is a place where you can meet some of the rising stars in remote sensing and geospatial information, professors and members of the academia, industry experts, students and early career researchers.

The last GeoMixer event was held on March 18 and it's the ISPRS SC was the host!



MY STORY

I would like to take this opportunity to share thoughts on this event. The interesting side of this event is that no one knows in advance with whom he/she will get into the same breakout room. Everything happens by chance.

On that day, I found time on one of the busiest working days in the office and did not miss this opportunity to participate in this interesting and at the same time entertaining event. At the beginning of the meeting, I was glad to see so many familiar faces. It would be worth noting that I know most of the participants virtually, but despite this, it was so inspiring and motivating to see like-minded people and meet new ones, share experiences, just communicate, to be friends, because we already have a common language, but that same geo-language. :)

I got into the first room with Mary and Nicolas. And of course, we all remember Nicolas from Virtual Rooms of ISPRS SC. For those who don't know him, he was one of the most active participants in these events. Currently, he is participating in the Leadership and Service Mentoring Programme of ISPRS SC. I believe that he has a good opportunity to be one of the great leaders of the future Board of Directors of the ISPRS SC. I was glad to know Mary, unfortunately, she had an internet connection issue, and we were unable to communicate well. I remembered that Mary is from Garoua and she is a student at the University of Buea. In the next virtual room, I met Aman from Nepal. He is a student at Tribhuvan University. He is working with optical satellite remote sensing data and he would like to learn SAR data, too. And of course, I have already known one of the participants in this room. Yes, he was Charles, Vice-President of our team in the ISPRS SC. :)

Participation in this event allows you to expand the professional network, which in turn has a great effect on self-development and growth. In addition to all these, these monthly events also affect our mood, since we lack in person meetings, and these virtual social meet ups help us cope.

As a whole, all these events allow us to understand that we are all human beings as one whole, and thanks to such events, boundaries become invisible. It's just a miracle, otherwise, you can't name it.

I hope that organizing such events in real life will be held in the near future, and by that time we will already be one whole, we will already know each other. At the same time, I am incredibly happy to live right now, to be here and learn new things every day and meet people even if virtually. I wish everyone all the best. Be healthy and safe, and all the rest of it will definitely be!

If you would like to meet new people, either to make friends or make professional connections, don't forget to join us again on April 22, 2PM UTC! Register here: buff.ly/3cJ8us6 For more information about the upcoming GeoMixers, please visit the following websites

<https://geomixer.wixsite.com/event>
<http://sc.isprs.org/links/geomixer.html>

**The About the GeoMixer was originally written by Sheryl Rose Reyes, from content provided by the organizers of the GeoMixer and has been published in the ISPRS eBulletin.*

iHabiMap: Habitat Mapping, Assessment, and Monitoring using High-Resolution Imagery



Figure 1. Dr. Philip Perrin of BEC Consultants is recording vegetation cover during the field campaign in May 2020

The European Union (EU) Habitats Directive (HD) requires that natural habitats listed in Annex I of the Directive are monitored to assess habitat condition, extent, and range. This monitoring provides a basis for EU countries to prepare a conservation status report, which must be submitted to the European Commission every six years. Implementation of this reporting obligation involves detailed baseline data of the location, extent, and quality of the habitats within their territories. In Ireland, much of the survey work conducted for habitat mapping and monitoring is carried out by qualified ecologists during field visits. Ecological field surveys often take place in remote and relatively inaccessible environments, which can be demanding and time-consuming. The *Habitat Mapping, Assessment, and Monitoring using High-Resolution Imagery Project* or iHabiMap is a four-year research project funded by the Environmental Protection Agency (EPA). It is a part of Ireland's initiative to support the detailed assessment of its Annex I habitats using ultra high-resolution images acquired from Unoccupied Aerial Vehicles (UAVs).

One of the aims of the project is to develop automated assessment procedures to facilitate the classification of large amounts of imagery acquired from UAVs. Machine learning techniques have been designed and implemented to assess the usability of UAV data for targeted mapping and assessment to aid national scale habitat mapping. This research focuses on assessing

imagery from three habitat types - coastal, grassland and upland habitats. Five study sites were chosen in discussions with the iHabiMap ecology team (BEC, botanicalenvironmental.com), who have carried out much of the Irish HD work in the past and conducted previous surveys on the sites. This in-depth ecological knowledge of these sites is vital to the success of this project.

The UAV image acquisition protocol varies with each ecosystem that is studied. The study sites with plant communities that change more during the growing season, such as grasslands, have three to four times image acquisitions throughout the growing season to capture intra-annual variability in the habitats. Whereas the plant communities that are deemed to change less during the growing season, such as upland heath and blanket bog may require less image acquisitions. This project will test the effect that temporal resolution has on monitoring accuracy for each habitat. Extensive ecological field surveys have been carried out by the iHabiMap ecology team to collect training samples to calibrate the model and validate the results. The aim is to acquire ground-truth data immediately after each UAV survey to obtain the actual state of the recorded vegetation.

The iHabiMap methodology was initially implemented using the Random Forest (RF) machine learning algorithm to classify four dune Annex I habitats:



2120 - Marram dunes; 2130 - Fixed dunes; 2170 - Dunes with creeping willow; 2190 - Dune slacks, in the Maharees site located in County Kerry, in the southwest of Ireland. Other common habitats present on the UAV image (i.e., shingle and gravel shores, sandy shores, exposed sand, and recolonizing bare ground) were also classified.

Overall, this research aims to develop and test a methodological framework that integrates remote sensing data, ground-based ecological surveys, and machine learning technologies to support the monitoring and mapping of Annex I habitats within Ireland.

Twitter handle: @iHabiMap



Figure 2. Fergal McCarthy (Drone Services Ireland) operating a DJI Phantom 4 RTK drone to collect multispectral images in one of the upland sites



Figure 3. Drone image captured by Fergal McCarthy (Drone Services Ireland)

About the Project Members



Dr. John Connolly | Project Investigator
john.connolly@tcd.ie
Assistant Professor, Trinity College Dublin

Dr. Connolly is The Kinsella Assistant Professor in Geographical Information Systems and Remote Sensing and leads the Trinity Geospatial Research Group. He joined Trinity College Dublin in September 2020. He teaches GIS and remote sensing at both undergraduate and postgraduate levels. John's research uses GIS and Earth Observation to study the terrestrial environments including landscape carbon dynamics; land use change; solar mapping and habitat assessment using EO.

Dr. Connolly is currently the Principal Investigator for the EPA funded [iHabiMap project](#) (2019 - 2023). He is a Co-PI on several projects including the EPA funded [SmartBog project](#) (2019-2023); the DAFM funded GENENET project (2020-2022) and the SFI funded Enable [SolarMap Project](#) (2020-2021). He is also an international collaborator on the Boston University led [GLanCE Project](#) (2019-2024). He has co-ordinated several national and international research proposals including FP7, H2020, EPA, DAFM and a Google Earth Engine Research Award. He collaborates widely and has active collaborations with colleagues in Ireland, Germany, UK, Sweden, USA, Canada, and Brazil. Prior to joining Trinity College Dublin, Dr. Connolly held positions at Dublin City University, Lund University, University College Cork, and University College Dublin.



Dr. Jim Martin
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Dr. Martin is the Managing Director of BEC Consultants. He completed his Ph.D. thesis at the Botany Department of Trinity College Dublin in 1998 and then commenced a one-year post-doctoral position with Teagasc. Before taking up his current position he spent two years at the National Agricultural Research Institute (NARI) in Guyana, South America, and six months working on the raised bog designations team at the National Parks and Wildlife Service (NPWS). During his time with BEC Consultants, he has successfully led a number of large-scale national ecological projects including the [National Survey of Native Woodland](#) (2003-2008), the [Irish Semi-natural Grasslands Survey](#) (2007-2013), and the [Monitoring and Assessment of three EU Habitats Directive Annex I grassland habitats](#) (2015-2018). Dr. Martin is an accomplished ecologist and is experienced in habitat mapping and GIS. He is currently working on iHabiMap Project and has also worked on projects in the areas of restoration ecology, Environmental Impact Assessment Reports (EIAR), Ecological Impact Assessments (Ecia), [Appropriate Assessments](#) (AA), the preparation of [Natura Impact Statements](#) (NIS), and alien invasive species surveys. Dr. Martin is a full member of the [Chartered Institute of Ecology and Environmental Management \(MCIEEM\)](#).



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Dr. O'Connell is the Managing Director and co-founder of ProvEye (proveye.ie). He has 12 years of experience in developing image processing methods for remote sensing. He has worked with a host of commercial institutes and organizations including NASA, World Bank, University of New York, University of Leeds, STFC, COST and Gorta SHA.



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Charmaine Cruz is currently a Ph.D. student at the Department of Geography, Trinity College Dublin, Ireland. She finished her B.Sc. in Geodetic Engineering and M.Sc. in Geomatics Engineering (Remote Sensing) at the University of the Philippines Diliman, Philippines. Her research interests include applications of geospatial technologies for natural resource management (e.g., mapping habitat distribution and biomass as well as habitat condition).

She has more than eight years of academic and professional experience related to remote sensing and geographic information system in various environmental applications. She was involved as a researcher in the first nationwide LiDAR mapping project in the Philippines, the [Disaster Risk and Exposure Assessment for Mitigation \(DREAM\)](#). From 2014 to 2019, she worked as a lead researcher in various remote sensing projects in the Philippines - [CoastMap](#) (2014 - 2017), [BlueCARES/IAMBlueCECAM](#) (2018), and [Geospatial Assessment and Modelling of Urban Heat Islands in the Philippine Cities](#) (2019). Ms. Cruz is also currently serving as the Newsletter Editor-in-Chief of the [International Society for Photogrammetry and Remote Sensing Student Consortium \(ISPRS SC\)](#).



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Dr. Perrin joined BEC Consultants in 2003. He is an experienced botanist specializing in woodlands, uplands, and saltmarshes. He was the project coordinator for the SAMFHIRE project and is currently working on the [Irish Vegetation Classification](#). His main roles previously were lead ecologist for the [National Survey of Upland Habitats](#) (2009-2014), [National Survey of Native Woodlands](#) (2003-2008) and the [Ancient and Long-established Woodland project](#) (2009-2010). He is skilled in statistical analysis of vegetation data using ordination and clustering techniques and has developed national scale vegetation classification systems for Irish native woodlands, semi-natural grasslands, and upland habitats. Dr. Perrin is a full member of the [Chartered Institute of Ecology and Environmental Management \(MCIEEM\)](#) and a [Chartered Environmentalist \(CEnv\)](#).

HOW LOW CAN YOU GO?

Detecting Underwater Algae & Plants with an Aerial Drone



Figure 1: The unoccupied aerial vehicle (UAV) used for aerial image collection in this study.

Throughout the last two decades, drones have ushered in a new way to see the world, including the underwater world from above. Aerial imagery has amplified aquatic research related to studies involving marine fauna [1,2], algal blooms [3], and ecohydrology [4]. Although drones have performed particularly well in identifying underwater plants and algae in shallow environments [5], few studies have tested the efficacy of drones in deeper environments where the ability to have a bird's eye view can greatly improve the safety, cost, and extensibility of the research conducted. How far can a drone see underwater? This question depends on several factors including water clarity and the amount of sunlight hitting the water's surface (calculated by solar angle). This study analyzes these variables and provides a methodology for aquatic managers to identify and quantify benthic (riverbed) primary producers (such as aquatic plants and algae) in deep and clear bodies of water using an inexpensive drone [6].

An RGB camera on a Phantom 4 Pro (<\$1500 USD) drone (Figure 1) was used during the summer of 2019 to survey benthic algae and aquatic plants at over thirty locations along the Klamath River in northern California (Figure 2). As the drone flew over each site, in situ riverbed surveys were conducted by swimming and snorkeling to provide validation on the depth and type of algae and aquatic plants that were captured in the aerial imagery. Drone photos were then classified using a pixel-based supervised classification method, Random Forest, to identify benthic algae and aquatic plants at various depths (0 - 9 m) within the river and

at various times of the day (38 - 71 degrees solar angle). To inform river managers on the extent of primary producers throughout the river, this study also quantified the percent cover of algae and aquatic plants after they had been classified (Figure 3). Estimating the percent cover of primary producers is important in this ecosystem because several large dams are projected for removal in the upcoming decade, and managers are interested in understanding how dam removal will impact these communities.

Findings demonstrated that a standard RGB camera on an inexpensive drone is effective (82% overall accuracy) in identifying benthic algae and aquatic plants down to about 2 m underwater in a clear (Secchi depth > 2 m) and deep river. This method improves the ability to map greater extents of rivers at very high resolution (< 3 cm) and provides a safe and cost-effective alternative to current in situ survey methods. Furthermore, this study found that the best river photos with the least amount of solar reflection were taken between 52 to 57 degrees solar angle (avoiding solar noon). To replicate this study in another region, solar angle can be calculated here: <http://solardat.uoregon.edu/SunChartProgram.html>. This study provides a low-budget, easily accessible methodology intended to assist river and lake managers in identifying and quantifying primary producers that provide structural and ecological benefits to aquatic ecosystems. Finally, if anyone is interested in learning more about drone flights, mission planning, and data processing, come to virtual Drone Camp this summer (<http://igis.ucanr.edu/dronecamp/>)!



Figure 2: An aerial drone photo taken near Seiad Valley along the Klamath River.

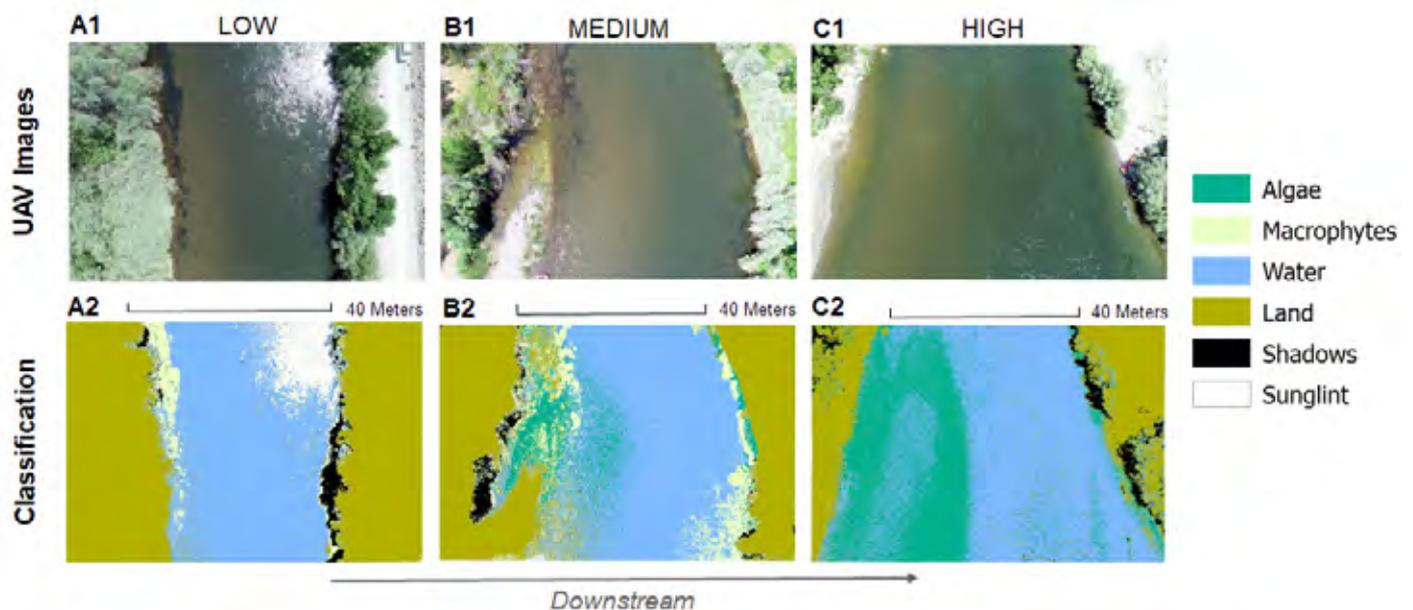


Figure 3: Examples of low, medium, and high algae and aquatic plant percent cover in original UAV images (top row) and Random Trees classification results (bottom row).

About the Author

Chippie Kislik is a Ph.D. student in the Environmental Science, Policy, and Management Department at University of California, Berkeley. As a previous manager of the DEVELOP Program at the NASA Ames Research Center, as well as a Fulbright researcher in Ecuador, Chippie has utilized satellite imagery and GIS to conduct studies related to harmful algal blooms, forest health, and fire risk. Her current research focuses on how unoccupied aerial vehicles (UAVs, also known as drones) and high-resolution satellite imagery can detect algae and aquatic plants in freshwater systems of California. She is a recipient of the NSF Graduate Research Fellowship Program (GRFP), and a trainee of the NSF-funded Data Science for the 21st Century (DS421) program. Chippie enjoys engaging in environmental education, as well as hiking, whistling, speaking Spanish, and watching Wes Anderson films.



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- Hodgson A, Kelly N, Peel D. Unmanned aerial vehicles (UAVs) for surveying marine fauna: a dugong case study. *PLoS One*. 2013;8: e79556.
- Johnston DW. Unoccupied Aircraft Systems in Marine Science and Conservation. *Ann Rev Mar Sci*. 2019;11: 439-463.
- Kislik C, Dronova I, Kelly M. UAVs in Support of Algal Bloom Research: A Review of Current Applications and Future Opportunities. *Drones*. 2018;2: 35.
- Vivoni ER, Rango A, Anderson CA, Pierini NA, Schreiner-McGraw AP, Saripalli S, et al. Ecohydrology with unmanned aerial vehicles. *Ecosphere*. 2014;5: art130.
- Flynn KF, Chapra SC. Remote Sensing of Submerged Aquatic Vegetation in a Shallow Non-Turbid River Using an Unmanned Aerial Vehicle. *Remote Sensing*. 2014;6: 12815-12836.
- Kislik C, Genzoli L, Lyons A, Kelly M. Application of UAV Imagery to Detect and Quantify Submerged Filamentous Algae and Rooted Macrophytes in a Non-Wadeable River. *Remote Sensing*. 2020;12: 3332.

SeeCucumbers: How can we quantify sea cucumbers from high up in the sky?

Sea cucumbers (*Holothuroidea* or *holothurians*) are dusty-sausage-like creatures crawling slowly or lying quietly on the seafloor. If they're not moving or resting, they spend most of the time eating and pooping sand. This doesn't sound very scenic, right? Then why do we want to know more about them? It turns out that although sea cucumbers might not be the most eye-catching organisms you see underwater, they have been attracting researchers' interests constantly. Certain species of holothurians are considered a delicacy in some cultures (*bêche-de-mer*), thus, their market value in the fishery industry is substantial. Apart from their economic roles, holothurians are also playing crucial ecological roles, including nutrient recyclers, bioturbation agents and hosts for many biotic associates in the ecosystem. Their help to maintain biodiversity, increase primary production and improve sediment health could be substantial over long timescales given high abundance (Purcell et al. 2016; Uthicke 1999). As a result, more researchers have begun to study the ecological roles of sea cucumbers.

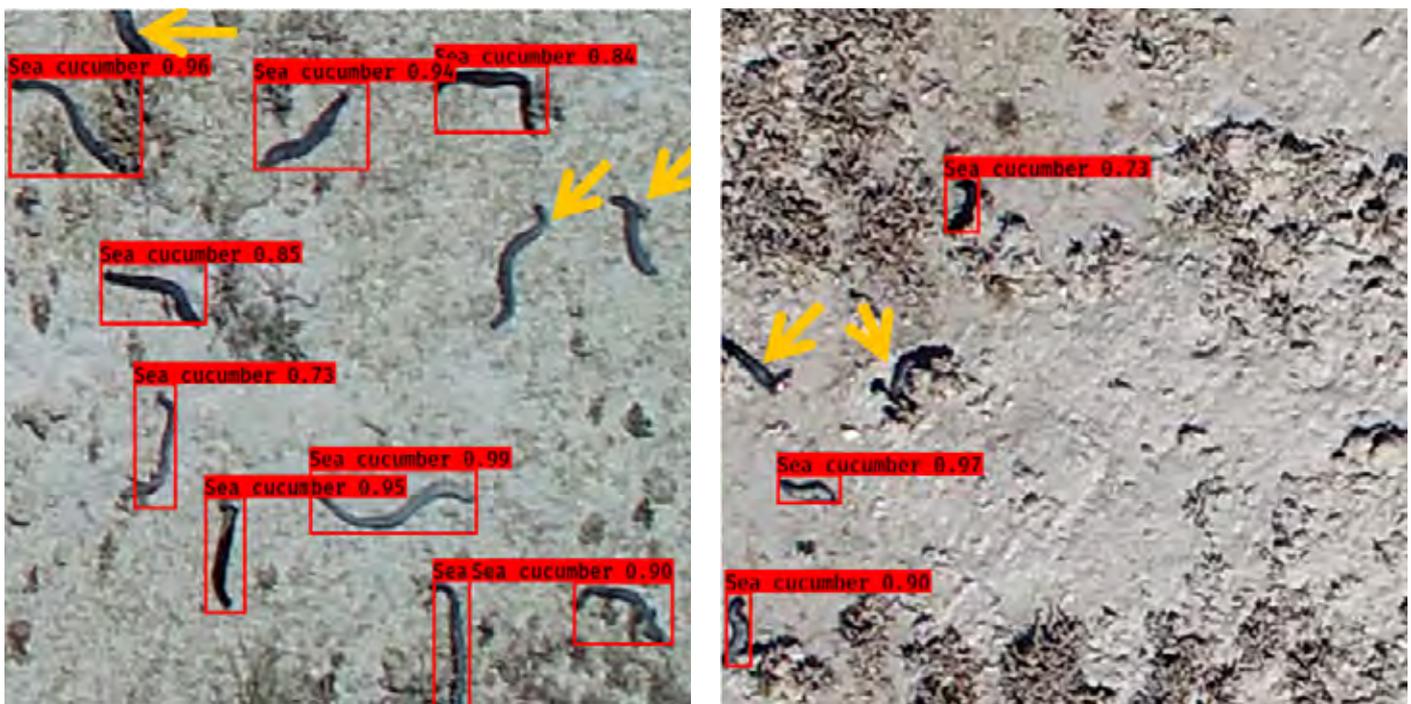


Figure 1. Detection result from a preliminary deep learning object detection model. The red boxes show the location of each sea cucumber. The number on top is the confidence score generated by the detector automatically showing the certainty of the results (from 0 to 1, i.e., from not confident to very confident). The yellow arrows are the sea cucumbers that the detector missed.

Due to advances in remote sensing and photogrammetry, the methods that people use to study sea cucumbers are also improving. Conventional research methods usually consist of counting the holothurians along transect lines or quadrats by walking, snorkelling, SCUBA diving or during manta tows (Bonham & Held 1963; Da Silva, Cameron & Fankboner 1986; Jontila, Balisco & Matillano 2014; Uthicke & Benzie 2001). These in situ surveys are laborious, time consuming and not scalable to large areas. Since the typical length of an adult sea cucumber is around 30 cm (Purcell, Samyn & Conand 2012), the required spatial resolution for successful identification is at most 2 - 4 cm. Small and affordable unoccupied aerial vehicles (UAV or drones) allow researchers to cover a broader spatial scale in a short amount of time with a high level of detail. For instance, a DJI Phantom 4 Pro can easily achieve a ground sampling

distance (GSD) less than 1cm at 20m altitude. An exemplary study conducted by Williamson et al. (2021) successfully estimated the sea cucumber population around Heron Island in Australia with drone imagery. However, manually counting or identifying targets of interest can still be tedious and inefficient for large datasets and may also introduce inconsistency and faulty results due to human error and fatigue. This has driven the development of automated or semi-automated approaches which have already been tested for similar tasks, including taxa identification and annotation, benthic type classification and so on (Beijbom et al. 2012; Chabot & Francis 2016). So why not for sea cucumbers? Instead of making estimations by extrapolation from small spatial areas, we can use deep learning object detection algorithms to help us locate individual sea cucumbers on drone images or maps and actually say "See (Sea), cucumbers!".

In order to achieve this goal, I have proposed to train and deploy deep learning algorithms to detect sea cucumbers from drone imagery. Object detectors have already become widely adopted in computer science and engineering for tasks such as car-plate recognition, self-driving cars and so on. As shown in Figure 1, a pilot study using the state-of-the-art YOLOv3 object detector was trained to predict the location of sea cucumbers within cropped drone images. Although not all sea cucumbers can be detected, the model could improve overtime with different algorithms or more robust datasets, and what's more, the computer won't be tired! Since all drone images are geo-tagged, this preliminary result has shown the potential of implementing object detection algorithms to help develop a faster and more automated locating process for distribution analysis. Not only can researchers develop a new workflow for reef monitoring, the coordinates and counts of target objects can be further combined to other information (e.g., benthic habitat maps) to gain more insights. We may unlock new knowledge that we couldn't discover before at a small spatial range.

Note: This work has been published in the [Multidisciplinary Digital Publishing Institute \(MDPI\) Drones](#). The dataset and source code pertaining to this work will be made open source and available on [GitHub](#) and [GeoNadir](#).

About the Author

"I believe technology is the key to unlocking the potential of science. I enjoy comparing different research methods before jumping to any conclusion. I am currently a Master of Science student at James Cook University majoring in marine biology. During my studies, I worked on a project to detect sea cucumbers from drone images using computer vision. Thus, I have developed a keen interest in machine learning, mapping and other cutting-edge technology in the field. At the same time, I also joined Tropical Marine Water Quality and Impacts: Microplastics Research group at Australian Institute of Marine Science to optimize the protocol for microplastics extraction from chitin-rich crustaceans (which is also a methodological study!)."



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References:

Bejjbom, O, Edmunds, PJ, Kline, DI, Mitchell, BG & Kriegman, D 2012, 'Automated annotation of coral reef survey images', in 2012 IEEE Conference on Computer Vision and Pattern Recognition, pp. 1170-7 DOI: 10.1109/CVPR.2012.6247798.

Bonham, K & Held, EE 1963, 'Ecological observations on the sea cucumbers *Holothuria atra* and *H. leucospilota* at Rongelap Atoll, Marshall Islands'.

Chabot, D & Francis, CM 2016, 'Computer-automated bird detection and counts in high-resolution aerial images: A review', *Journal of Field Ornithology*, vol. 87, no. 4, pp. 343-59.

Da Silva, J, Cameron, JL & Fankboner, PV 1986, 'Movement and orientation patterns in the commercial sea cucumber *Parastichopus californicus* (Stimpson) (Holothuroidea: Aspidochirotida)', *Marine & Freshwater Behaviour & Phy*, vol. 12, no. 2, pp. 133-47.

Jontila, JBS, Balisco, RAT & Matillano, JA 2014, 'The Sea cucumbers (Holothuroidea) of Palawan, Philippines', *Aquaculture, Aquarium, Conservation & Legislation*, vol. 7, no. 3, pp. 194-206.

Purcell, SW, Conand, C, Uthicke, S & Byrne, M 2016, 'Ecological Roles of Exploited Sea Cucumbers', *Oceanography and Marine Biology*, vol. 54, pp. 367-86, DOI: 10.1201/9781315368597-8.

Purcell, SW, Samyn, Y & Conand, C 2012, 'Commercially important sea cucumbers of the world'.

Uthicke, S 1999, 'Sediment bioturbation and impact of feeding activity of *Holothuria* (*Halodeima*) *atra* and *Stichopus chloronotus*, two sediment feeding holothurians, at Lizard Island, Great Barrier Reef', *Bulletin of Marine Science*, vol. 64, no. 1, pp. 129-41.

Uthicke, S & Benzie, J 2001, 'Effect of bêche-de-mer fishing on densities and size structure of *Holothuria nobilis* (Echinodermata: Holothuroidea) populations on the Great Barrier Reef', *Coral Reefs*, vol. 19, no. 3, pp. 271-6.

Williamson, JE, Duce, S, Joyce, KE & Raoult, V 2021, 'Putting sea cucumbers on the map: projected holothurian bioturbation rates on a coral reef scale', *Coral Reefs*, pp. 1-11.



Citizen scientists fly UAVs to monitor beach erosion



Figure 1: Citizen Scientists (centre and right) are in St. Leonards to survey the beach with UAVs and smart ground control points. Research Assistant (University of Melbourne) Karina Sorrel is supervising the volunteers for this flight, to assure strict protocol adherence and minimise inter-group bias.

Being at the interface between water and land, the coastal zone is a very dynamic and valuable environment where economic interests combine with ecological values. There, sandy beaches are not only an important source for tourism revenue, but amongst the various ecosystem services they offer, they dissipate wave energy and protect inland properties from coastal erosion. Recent findings report alarming rates of global coastal erosion, which puts local governments and coastal communities at risk. Planners must act locally to mitigate coastal erosion, which often starts by identifying large-scale erosional hotspots and focusing on monitoring local beach changes through time. Unfortunately, obtaining reliable topographic data at high temporal and spatial resolutions for several erosional hotspots across a state is expensive. Recently, consumer-grade Unmanned Aerial Vehicles (UAVs) are emerging as cost-effective platforms to obtain multitemporal coastal imagery to process into digital surface models (DSMs) and orthophotos with Structure from Motion algorithms, but still, researchers' time constraints have so far limited its application to monitoring a single (or few) site(s).

In Victoria, Australia, a pioneering initiative is

engaging more than 150 citizen scientists (Figure 1) to autonomously fly UAVs on 15 locations, every 6 weeks, for 3 years, providing researchers with invaluable 3D data time series to study sediment behaviour and volume dynamics across a state.

This project, primarily funded by the Victorian Department of the Environment, Wildlife, Land and Planning and co-funded by Deakin University and The University of Melbourne, is part of a major project called Victorian Coastal Monitoring Program, which started in 2018 and is still running. So far, citizen scientists have conducted more than 300 surveys, producing 2.5 Tb of imagery of DSMs and orthophotos. These unprecedented datasets provide unique possibilities for researchers to study beach change at a spatiotemporal resolution that was previously unachievable, in sensitive locations that were lacking volumetric monitoring.

However, some questions must be answered before using the data, for instance, how accurate is the data collected by citizen scientists compared to professional researchers in similar environments? Is there a data quality bias between groups of citizen scientists across locations?



Figure 2: PhD Student (Deakin University) Nicolas Pucino and his girlfriend Alice Piazzoli collecting independent RTK-GPS checkpoints in Warrnambool to test the vertical accuracy of the DSM generated by citizen scientists.

We studied data accuracy by comparing modelled elevation values with independently collected checkpoints, which were not used to process the 3D model (Figure 2). Our findings show that for an operational scenario, a 0.089 m rmse can be expected.

This error is only 3 cm greater than the median accuracy reported in the coastal UAV scientific literature (rmse = 0.059). However, considering a more appropriate and robust outliers metric (normalised median absolute deviation), a 0.048 m vertical error should be expected. These errors are of the same order of magnitude with the ones reported by professional researchers across the world, proving that citizen scientists provide reliable and accurate data similar to us, the academic scientists. And what about bias? Is data accurate and consistent among different groups of volunteers/locations?

In order to minimise bias prior and during the UAV surveys, we implemented a strict protocol which standardises survey parameters and procedures. However, spatial bias could be introduced by giving the volunteers the freedom to decide where to place ground control points (GCPs), which ultimately affect the 3D scene reconstruction and georeferencing accuracy. Thus, we investigated bias in the spatial dispersion of the GCPs, their X, Y and Z positional

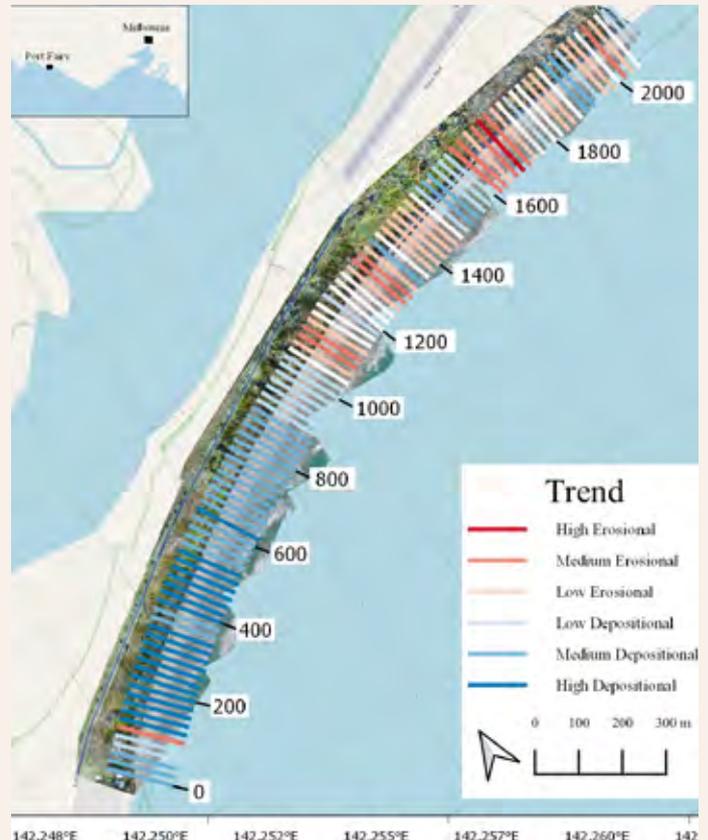


Figure 3: Transect-level behavioural regime (*r*-BCD index, see full paper for more info) in Port Fairy East Beach derived from three-dimensional change timeseries of sand-only points, highlighting the expected erosional hotspots at the end (up-drift) of the rockwall.

variances at the time and duration of marking and recording, image georeferencing accuracies, and limit of detections between locations. We found non-significant ($p=0.05$) differences in GCP spatial dispersion and limit of detections between groups. GCPs positional variances and images georeferencing errors have significant differences among groups, which cannot be attributed to citizen scientists as the error magnitudes are below the reported precision of the GCPs (10 mm and 20 mm for horizontal and vertical precisions).

Therefore, our protocol guides citizen scientists in providing virtually unbiased and quality data, which can be used with confidence to monitor sediment dynamics at the site and transect level.

With this information at hand, we were able to monitor multi-scale (at the site and cross-shore transect scales) seasonal volumetric and altimetric changes in 10 locations simultaneously, finding for instance that exposed beaches had mean elevation changes three times greater than embayed ones.

Moreover, we also conceived an innovative set of indices called Beachface Cluster Dynamics indices that leverage the high temporal resolution of beach topographic data to model sediment behavioural

regime on the subaerial beachface, which goes from the swash zone (where waves wash up on the shore, preventing a photogrammetric reconstruction) to the backdune. With these indices, we were able to distinguish between accelerated and slowed-by-intervention (nourishment) erosional modes, then, scaling down the analysis at the single transect level, we assessed beach nourishment efficiency in Apollo Bay, a tourist gateway along the iconic Great Ocean Road. Figure 3 demonstrates this approach in Port Fairy East Beach, where the behavioural regime is color-coded based on dominant process (erosion or deposition) as computed from the totality of topographical change time series of sand-only points extracted from transects in nine surveys. This highlights a distinct behavioural change at around 1,000 m, approaching a rockwall which protects the foredune from further erosion (from 1300 m to 1640 m alongshore).

Beside coastal environments, citizen scientists with

UAVs could transform the way we study and monitor other environments too, such as mudflats, badlands, rivers, open-pit mines or agricultural watersheds. Once we acknowledge the limitations of this method and address them, the potentials of engaging communities in the data collection effort are great, not only from the scientists perspective, but also from a societal standpoint. In fact, by democratising scientific engagement access we enhance environmental awareness and transform volunteers into key stakeholders within an adaptive and proactive environmental management. We put taxpayers in the centre of the decision-making process, closing the loop which benefits governments, scientists and communities, potentially, all over the world.

If you are interested in data and collaborations, get in touch! Or, for more information, here is the open-access publication : www.nature.com/articles/s41598-021-83477-6, or the project website : <https://www.marinemapping.org/vcmp-citizen-science>

About the Author

Nicolas is an Italo-Swiss student who obtained a bachelor's degree in physical geography at the University of Lausanne, Switzerland, then moved to the University of Wollongong, Australia, to obtain his master's degree with distinction on coastal science. Currently, he is pursuing a PhD in optical remote sensing of coastal morphodynamics at Deakin University, with a particular interest in satellite and UAV-based hyperspectral imaging of beach sediment properties.



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Investigation of the moisture expansion as a deterioration factor of an ancient sandstone Buddha in Nakhon Ratchasima, Thailand

An enormous ancient reclining Buddha is enshrined in a temple, Wat Thammachak Semaram, Nakhon Ratchasima, Thailand. As excavated by archeologists and proved, it was built with many large sandstones assembled in the Dvaravati period, around the 15th century. The most prominent ancient sandstone Buddha in Thailand, 13.3 m. length and 2.8 m. height aligns in the North to South, faces in the east in the open hall, built more than twenty years ago.



Figure 1: Ancient sandstone reclining Buddha in Wat Thammachak Semaram, Nakhon Ratchasima, Thailand

It was proved by many archeologists of the Fine Arts Department whether the lower part of the sandstone statue has heavily weathered due to moisture and humidity. Moisture expansion from the ground towards sandstone is an essential contributing factor for sandstone deterioration (1). Regular wet and dry repeating period triggers the weathering faster than all-year round dried sandstone (2). For this reason, seven IoT sensors (red points) were installed around the statue in November 2020 to measure temperature and humidity on the soil surface to confirm the humidity level in the open hall.



Figure 2. Temperature and humidity measurement sensors installed over the soil surface around the foundation of the ancient sandstone Buddha

The data from seven IoT temperature and humidity measurement sensors have been collected every 30 minutes all day and night from November 2020 to February 2021. Considering the average humidity over three months, it shows that the humidity of the east side of the sandstone Buddha is higher than the westside significantly. Also confirmed by a study (3), sandstone is subjected to humidity oscillations from 20%RH to 98%RH during six-hour periods causes intensive weathering.

The consistent difference of humidity in the east and west sides implies a meaningful characteristic of the topography. The High-resolution map was acquired as a master key in this project. The DJI-4 flew over sixty-meter altitude to take hundreds of aerial photos over the historical site and adjacent area on 5th November 2020, created by Pix4D program with the GSD = 2.67 cm. and Digital Surface Model (DSM), shown in Fig 6.

Regarding the profile topography (Fig 7), it shows that there are embankments on the east and west



Figure 4: Layout and locations of IoT temperature and humidity measurement sensors

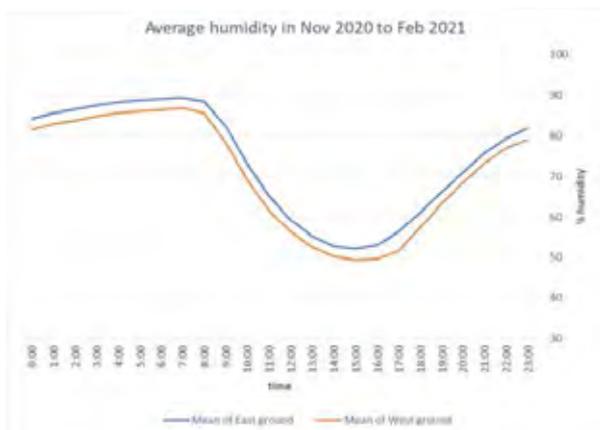


Figure 5: Average humidity on the soil surface from the IoT sensors installed on the eastside and the westside of the ancient sandstone Buddha

next to the sandstone Buddha. Focusing on the slope interpolated from the Digital Terrain Model (DTM) on the east is steeper than on the west. For this reason, the amount of water and moisture could drain from the east embankment then accumulate underneath the sandstone Buddha conveniently. Furthermore, the evaporation of water from porous sandstone can take place at the surface, then the water enriched in soluble salts flows towards the surface, evaporation increases the salt concentration, which later crystallization is observed when the water is regularly supplied to the surface (2).

It can be concluded that applying the high-resolution image from the UAV integrated with the DSM and DTM can provide the fine details of the terrain, generate high quality of image and data, and interpolate slope and contour lines. The exploration of this study can answer the moisture expansion response to the humidity level



Figure 6: High-resolution image of the ancient site and adjacent area

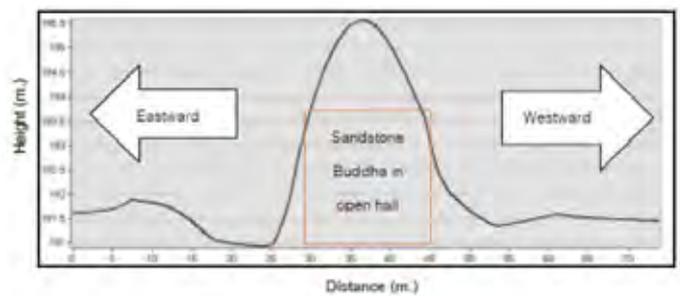


Figure 7: Topographical profile generated from DSM of the ancient site

collected from the IoT sensors. As a result of this study, it can be used to plan the conservation tasks to mitigate the deterioration of the ancient sandstone Buddha.

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References:

1. Ruedrich J, Bartelsen T, Dohrmann R, Siegesmund S. Moisture expansion as a deterioration factor for sandstone used in buildings. *Environ Earth Sci.* 2011(63):1545-64.
2. Stambolov T, van Asperen de Boer JRJ. *The deterioration and conservation of Porous Building Materials in Monuments, A review of the Literature.* Rome: International center for the study of the preservation and the restoration of cultural property; 1976.
3. Masato S, Tsuyoshi H. A laboratory experiment on salt weathering by humidity change: salt damage induced by deliquescence and hydration. *Progress in Earth and Planetary Science.* 2018;5(84):1-10.



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We are a group of geoinformatics researchers studying advanced technology and techniques in geoinformatics to serve the special issues of the government and non-government missions. Our projects involve national defense by using AI and image processing on the UAV map, drought mitigation, car accident mapping, web GIS for vehicle robbery tracking, and high-resolution mapping for public disaster prevention and monitoring. Our mission is not limited to only the application of Geoinformatics technology but also invent some advanced techniques and programme to enhance the capacity of geoinformatics. Although we are a small group of geoinformatics researcher, we have had several strong connections with 2/3 top-ranked universities in Thailand and more than 20 mega-enterprises over Thailand. We have a strong belief that working together in a pleasant environment, being positive and flexible could build creativity and achieve in applying Geoinformatics upon rigid fundamental.

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Remote sensing and geospatial science

DR. KAREN JOYCE



“ I believe there’s a science for everyone, you just need to know where to look! I share my experiences drawn from more than 20 years as a geospatial scientist in academia, military, industry, and small business to help people discover science beyond lab coats and test tubes. But I have an ulterior motive. I am passionate about how we can use drones and geospatial technology to watch over our environment and how it changes over time. So the more people I can inspire to join me, the faster we can put plans in place to help keep our environment healthy into the future. ”

Can you tell us how you started working on using UASs for environmental monitoring? What was your motivation, and what did you find the most interesting in this research field? What are the knowledge gaps and major challenges in this research field?

I became interested in remotely piloted aircraft back in 2004 through my time in the Australian Army. I realized the potential of using drones for mapping, even though that wasn’t their purpose at the time and unfortunately, it was very difficult to convince those in the Artillery Corps that they could be beneficial within survey (engineers) and intelligence. Many years later, I met colleagues from NASA who were starting to use drones in California to monitor wildfires and so I became interested once more. In 2013, I spent several months in NASA Ames on sabbatical from my academic position at Charles Darwin University and came home with a plan to get started with drones in northern Australia. I was successful in applying for some funding through the Australian Research Council in 2014 to set up a drone capability and I’ve had a lot of fun (and made lots of mistakes!) with them ever since.

Can you share with us any current specific project, activity, or initiative that you are particularly excited about?

I’m most excited to work on my latest project – GeoNadir – which I believe exemplifies the next steps forward in my discipline. GeoNadir is an online drone data repository built with FAIR principles (findable, accessible, interoperable, and reusable) where drone operators can collaborate with scientists to help protect our world’s most at-risk ecosystems. I know that we can achieve great things when we all work together and GeoNadir is a fantastic way to facilitate that (www.geonadir.com).

What are some of the areas of research you’d like to see tackled over the next ten years?

As I work a lot with drone data, I see the huge potential for its use in environmental monitoring, but I don’t think that we have yet cracked the workflows required to fully exploit the data for the information it can provide. I’m looking forward to seeing increased research in using deep learning and cloud platforms to process these highly detailed datasets, and ways in which to automate the workflows for real-time analyses.

Can you share with us your perspectives and experiences on how UAS remote sensing has changed the way the world addresses environmental monitoring and conservation agendas? What do you think is the role of remote sensing and geospatial information science in achieving a sustainable environment?

Quite simply, drones have democratized remote sensing data capture. In many ways, this is exciting as people around the world now have access to a tool they can use to map, monitor, and manage their local environments. This is particularly important in many parts of the world where local communities



do not have the capacity or funds to support traditional aircraft surveys. They are now able to capture these data when and how they need it.

However, decentralized data capture also presents challenges in terms of data quality and consistency. As with any type of data and models that might be created from them, we see that garbage in really does equate to garbage out. So the remote sensing community faces a challenge once again where some people would like to see – and indeed are communicating – that drones are the silver bullet for addressing environmental mapping concerns. We need to take care to manage expectations, to not over promise and under deliver.

Drones are just one part of the integrated solution for achieving environmental sustainability into the future. When coupled with other earth observation platforms and geospatial technologies, they allow us to document the world’s ecosystems and how they change over time. It is these critical datasets that help us quantitatively measure natural and anthropogenic impacts on the earth as well as to objectively assess our role in climate change.

“ Drones are just one part of the integrated solution for achieving environmental sustainability into the future. When coupled with other earth observation platforms and geospatial technologies, they allow us to document the world’s ecosystems and how they change over time. ”

■ What are some of the biggest challenges you face (or have you faced) as a scientist in your field? Are there any common misconceptions about this area of research?

I am fortunate to be a scientist on a platform of considerable privilege. I am white, cisgender, able bodied, English speaking, and well-educated. Yes, I have faced – and continue to face – challenges as a woman in a diversity deficient discipline that favours the white male normative, and unfortunately, has many gatekeepers that do not necessarily always act in the best interest of science and society. So my continuing challenge is to conduct and advocate for science that is diverse and inclusive as I believe this is the only way to achieve the most creative, innovative, and effective solutions to some of the world’s largest problems

■ Finally, what are you most passionate about? What is your advice to students and young professionals who are pursuing research on UAS remote sensing and environmental protection, and nature conservation?

Do what you love and the rest will come naturally

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Full Name: Dr. Monica Rivas Casado

cranfield.ac.uk

Current Position - Affiliation:

Senior Lecturer - Cranfield University

Research Interests and Expertise:

Integrated Environmental Monitoring /
Systems Engineering

**DR.
MONICA
RIVAS
CASADO**



Dr Monica Rivas Casado is a Senior Lecturer in Integrated Environmental Monitoring with expertise in the application of statistics to environmental data. Her academic career has been built around the integration of emerging technologies, advanced statistics and environmental engineering for the design of robust monitoring strategies.

Monica is currently leading Research Council (RCUK) and industry funded projects on the use of emerging technologies and statistical science for robust environmental monitoring. This includes the use of drones for jellyfish and seaweed bloom monitoring near coastal nuclear power plants (EPSRC/EDF Energy), drones for flood and catastrophe extent mapping and damage assessment (NERC/EPSRC), autonomous on-water vehicles for robust hydromorphological characterisation (EPSRC) and floodplain forest restoration monitoring (EPSRC). Further research activity includes underwater vehicles for coral reef habitat identification and ecosystem service quantification.

Previously, she has led research activity on geostatistical science for the design of monitoring programmes for mycotoxins and successfully contributed and delivered RCUK research on ecosystem services science (EnergyScapes, NERC). She was the Cranfield Lead for the Building Resilience Into Risk Management (BRIM) EPSRC Grand-Challenge network (2015-2019). She has collaborated with a vast array of user organisations on: (i) the design of biodiversity monitoring programmes within Integrated Biodiversity Delivery Areas, (ii) the quantification of the effect of forest management practices on soil carbon sequestration and (iii) the assessment of land use dynamics in Europe, amongst others. Her work has been used as a reference for best practice guideline development and policy implementation.

During her 10 month secondment with the Government (Department for Business Innovation and Skills, Government for Science, 2014-2015), she provided advice and guidance on emerging technologies to different Ministerial Departments, including the Cabinet Office.

Can you tell us how you started working on using UASs for environmental monitoring? What was your motivation, and what did you find the most interesting in this research field? What are the knowledge gaps and major challenges in this research field?

I believe the first project was a pilot study on the combined use of UAVs and AI for river mesohabitat assessment. We had multiple publications on this topic. I have listed them below:

- Rivas Casado, Ballesteros R, Ortega JF, Leinster P & Wright R (2017) Towards a transferable UAV-based framework for river hydromorphological characterization, *Sensors*, 17 (10) Article No. 2210.
- Rivas Casado M, Ballesteros Gonzalez R, Wright R & Bellamy P (2016) Quantifying the effect of aerial Imagery resolution in automated hydromorphological river characterisation, *Remote Sensing*, 8 (8) Article No. 650.
- Rivas Casado M, Ballesteros Gonzalez R, Kriechbaumer T & Veal A (2015) Automated identification of river hydromorphological features using UAV high resolution aerial imagery., *Sensors*, 15 (11) 27969-27989.

I learnt many lessons from my experience in these projects. One of them was how difficult it was to get everything right the first time one sets an experiment in the field! I also learnt it is always good

to have spare clothing in your rucksack should it rain unexpectedly. The motivation behind this first project was to enhance the existing monitoring practices and methods for freshwater ecosystems. I thought that by combining AI and drone technology, we could characterize rivers faster and more accurately. There were lots of interesting outcomes... Perhaps the most surprising was that the AI algorithms were extremely good at characterizing habitats. Sometimes, they were better than surveyors! Perhaps in the future, we can just rely on the combined UAV – AI technology to assess the quality of our rivers.

I think the knowledge gaps on this topic at the moment are around the transferability of such approaches to rivers of different spatio-temporal scales, for example, from the river Great Ouse in England to the Amazon!

I then took all the lessons learnt in these projects to push the boundaries of UAV use and application, and focus on the use of UAVs for flood extent and impact assessment, and their use for emergency response.

Can you share with us any current specific project, activity, or initiative that you are particularly excited about?

We are currently working on a wide range of projects around the use of UAVs for environmental monitoring. We are using them for:

- flood damage and impact assessment [Remote Sensing | Free Full-Text | The Use of Unmanned Aerial Vehicles to Estimate Direct Tangible Losses to Residential Properties from Flood Events: A Case Study of Cockermouth Following the Desmond Storm \(mdpi.com\)](#);
- jellyfish detection near nuclear power plants to build an early warning system for marine ingress- [JellyNet: The convolutional neural network jellyfish bloom detector - ScienceDirect](#)
- to assess the impact of the MV Wakashio oil spill in Mauritius (project web page to follow shortly)
- to quantify greenhouse gas emissions from wastewater treatment plants (project web page to follow shortly)

These are some examples but there are so many more that we are exploring at the moment! This technology does not seem to have an end to it!

What are some of the areas of research you'd like to see tackled over the next ten years?

I would like scientists to think about the quality and the robustness of the data that goes into their models and analysis. One of the things that became very clear in some of our studies was that data quality (e.g., resolution) can have a very significant impact on the final assessment that we make of our systems. I think there is a need to think carefully about how we need to collect and analyse data.

Can you share with us your perspectives and experiences on how UAS remote sensing has changed the way the world addresses environmental monitoring and conservation agendas? What do you think is the role of remote sensing and geospatial information science in achieving a sustainable environment?

Over the last decade, we have seen more and more applications of UAVs for environmental surveying tasks. The shift towards a cost-effective and rapid deployment technology has been noticeable. The level of detail provided by the technology is unprecedented and enables us to look at environmental challenges from a different perspective and at different scales. It also democratizes data collection and access due to the rapid, easy and cost-effective use of the technology. UAVs also de-risk surveying tasks from a health and safety perspective as they allow data collection in areas where access is compromised or dangerous. Many conservation organisations are now including UAVs as part of their routine programmes for the reasons listed above. We have significantly increased the quality and quantity of environmental information as a result. This in turn, will enable us to make more informed management decisions about our environment, thus contributing to governmental sustainability agendas.

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What are some of the biggest challenges you face (or have you faced) as a scientist in your field? Are there any common misconceptions about this area of research?

UAVs are one of the emerging technologies identified by the Government to have a significant impact in the next 5 to 10 years. The key challenges I faced are those present around the use of any disruptive technology and include lack of social acceptance, technology distrust and rapid development pace. The projects we have delivered offered a new application of UAV technology within different research domains. There was no documentation in the public domain reporting anything similar. Therefore, we always had to come up with a very well thought plan in each occasion to ensure each mission and application was a success. We also had to work hard to demonstrate to people that the technology could be pushed to the boundaries we wanted. We managed and there is more to come!

With regard to misconceptions, UAVs have generally been seen as something dangerous used in belic conflicts or to generate disruption near airports. However, they also have applications within other areas but these are less well known. I think that perhaps there is a need to promote how the technology can be used for good.

Finally, what are you most passionate about? What is your advice to students and young professionals who are pursuing research on UAS remote sensing and environmental protection, and nature conservation? Which areas in this research field remain understudied and should be considered for future research?

To students and young professionals...I would suggest they explore the boundaries of technology and encourage them to pursue their ideas. The potential of UAVs for environmental surveying is still significantly unexplored. Many applications are yet to be discovered and multiple barriers need to be overcome before the technology is socially accepted. We need young professionals to open these doors so that we can preserve our environment more effectively. Perhaps one of the areas that has not been fully explored yet is the use of UAVs for environmental restoration tasks (e.g., planting trees). There are UAV companies able to reforest large areas of bare land. I would like to see more studies and applications around the potential to integrate UAVs in environmental restoration projects of all scales and magnitudes. Any volunteers?

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To students and young professionals...I would suggest they explore the boundaries of technology and encourage them to pursue their ideas.

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Full Name: Prof. Salvatore Manfreda

www.salvatoremanfreda.it | @Sal_Manfreda

Current Position - Affiliation:

Full Professor in Hydraulic Construction and Hydrology - Department of Civil, Architectural and Environmental Engineering, University of Naples Federico II, Italy

Research Interests and Expertise:

Distributed modeling, flood risk, stochastic processes in hydrology, ecohydrology, image velocimetry, and UAS-based monitoring.



Salvatore Manfreda is a Full Professor of Water Management, Hydrology, and Hydraulic Constructions at the University of Naples Federico II. He had several international experiences starting with a PostDoc at the University of Princeton in 2004-2005. He has been appointed as Visiting Professor at the Mediterranean Agronomic Institute of Chania (MAICh), Greece (2008-2010). His research focuses primarily on hydrology and water resources. Topics of interest are distributed modelling, flood risk, stochastic processes in hydrology, ecohydrology, image velocimetry, and UAS-based monitoring. In the last few years, his activities have been concentrated on the use of Unmanned Aerial Systems (UAS) for river basin monitoring. In this context, new algorithms and tools for environmental monitoring have been developed to improve the resolution and accuracy of hydrological measurements. His research activity led to a significant production, posing him at the 98th percentile of the researchers in Water Science (Ioannidis et al., PLOS Biology 2020).

Can you tell us how you started working on using UASs for environmental monitoring? What was your motivation, and what did you find the most interesting in this research field? What are the knowledge gaps and major challenges in this research field?

I have always been interested in spatial patterns of natural ecosystems. Nature is able to create an incredible diversity of elements that have been inspiring for all of us. The driving processes that produce such patterns are open questions stimulating many of my studies. In this context, UAS offers the opportunity to explore such patterns at a level of detail that was unimaginable a few years ago. Therefore, I envisaged the possibility to use this tool to tackle my research questions in the field of hydrological and ecohydrological science.

Can you share with us any current specific project, activity, or initiative that you are particularly excited about?

I'm particularly proud to be the Chair of the COST Action "Harmonization of UAS techniques for agricultural and natural ecosystems monitoring - HARMONIOUS", which includes more than 100 scientists from 36 countries. The HARMONIOUS Action is one of the biggest Actions funded by COST Organization (<https://www.cost.eu>) focusing on the development of guidelines for the use of UAS applied for hydrological monitoring. Members of the HARMONIOUS Action are now focusing on the preparation of a book edited by Elsevier providing more detailed guidelines for UAS applications in hydrology, which will be one of the main deliverables of the project.

More details about the project activities can be found on the web-page: <https://www.costharmonious.eu/>

What are some of the areas of research you'd like to see tackled over the next ten years?

UAS offers the opportunity of acquiring high-resolution data for monitoring environmental processes, bridging the gap between traditional field studies and satellite remote sensing [An important paper in this context is <https://doi.org/10.3390/rs10040641>]. Their versatility, adaptability, and flexibility may allow the implementation of new strategies to support the validation of satellite products, which are systematically adopted in a series of operational weather and hydrological models. This may help to develop an integrated global monitoring system of higher accuracy and precision.

Can you share with us your perspectives and experiences on how UAS remote sensing has changed the way the world addresses environmental monitoring and conservation agendas? What do you think is the role of remote sensing and geospatial information science in achieving a sustainable environment?

With the evolution of drone technologies over the last decade, UAS became an inexpensive way of mapping environmental processes for forestry planning, tracking landslides, river monitoring and precision agriculture. Environmental agencies and civil protection are increasingly adopting UAS-photogrammetry, but there are an enormous number of additional information that may be retrieved by UAS (e.g., stream flow, morphological evolution, soil moisture, state of vegetation, among others). It is our responsibility to simplify the use of UASs and make their products accessible to anyone.

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What are some of the biggest challenges you face (or have you faced) as a scientist in your field? Are there any common misconceptions about this area of research?

It is common to underestimate the complexity associated with the use of these tools. UAS requires a large number of competencies and knowledge that should be implemented in clear protocols in order to transform the huge amount of data acquired to useful information. Therefore, one challenge is represented by the standardization of procedures adopted for UAS surveys in different operating configurations and environmental conditions. In this context, the members of the HARMONIOUS COST Action have published some preliminary studies to support this process [see the manuscript <https://doi.org/10.3390/rs12061001>].

Finally, what are you most passionate about? What is your advice to students and young professionals who are pursuing research on UAS remote sensing and environmental protection, and nature conservation? Which areas in this research field remain understudied and should be considered for future research?

I believe that UAS remote sensing will evolve in the coming years, offering new monitoring opportunities. One of the main limitations that we are encountering right now in the description of hydrological processes is represented by the limited extent of UAS imagery. There is a pressing need to extend the limits of surveyed areas in order to have intercomparison between UAS and satellite data. This may help to define downscaling procedures for the estimation of environmental variables at high resolution and over large scales. This will be possible with the use of long range UAS or with swarms of drones which will be fundamental for future advances in remote sensing.

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APR 2021

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GEOMIXER

10AM NEW YORK | 2PM UTC | 4PM BERLIN | 10PM SINGAPORE | 12AM (+1 day) SYDNEY

The GeoMixer monthly event is a new opportunity to network with other remote sensing scientists at all career stages from around the world!

This virtual mixer will support networking with other participants that you may not have otherwise met by assigning participants into a series of small breakout rooms in Zoom. This event is inspired by IALE-NA 2020's Student Mixer and our successful first GeoMixer event at Geo for Good 2020.

Register here ➔ <https://bit.ly/39l6yE4>

ORGANIZERS



Inspire, Develop, Empower, Advance (IDEA) Program /
Mato Grosso do Sul Studies Branch Chapter

Background image downloaded from NASA Earth Observatory Image of the Day for February 23, 2021 - "From Russia with Questions" (<https://earthobservatory.nasa.gov/images/147703/from-russia-with-questions>)
➔ NASA Earth Observatory images by Joshua Stevens, using Landsat data from the U.S. Geological Survey
Additional resources for the cover from Flickr.com and Freepik.com

ISPRS is also launching the Virtual Keynote Speaker Program!



In 2019, the **ISPRS Keynote Speaker Programme** was initiated to provide an opportunity for ISPRS Ordinary, Associate, and Regional Members to enhance the scientific quality of their events and to attract more participants by inviting top quality international experts to speak.

Due to the ongoing pandemic, the programme has unfortunately come to a halt. Therefore, ISPRS has decided to host a monthly virtual Keynote Speech, and invites you to attend. The first Keynote Speaker is **Jan Dirk Wegner**, from the University of Zurich and ETH Zurich, who will talk about **deep learning for global vegetation analysis** on **Tuesday April 27** at **8-10 am EDT, 2-4pm CEST**.

For more information, please go to ow.ly/MgAI50EqMwf



2021

XXIV ISPRS CONGRESS

Imaging today,
foreseeing tomorrow.

KEY DATES

1 FEBRUARY 2021	Deadline for Abstracts & full papers: technical sessions and young investigators
8 FEBRUARY 2021	Deadline for submission to grants
5 MARCH 2021	Notification of authors for abstracts: technical sessions and young investigators
5 APRIL 2021	Notification of authors for full papers: technical sessions, young investigators, technical sessions
12 APRIL 2021	Deadline for <i>early bird</i> registrations Deadline for registration payment for papers to be included in proceedings Deadline for camera ready papers
7 MAY 2021	Final program release
14 JUNE 2021	Deadline for <i>regular</i> registrations
3 JULY 2021	Deadline for <i>late</i> registration

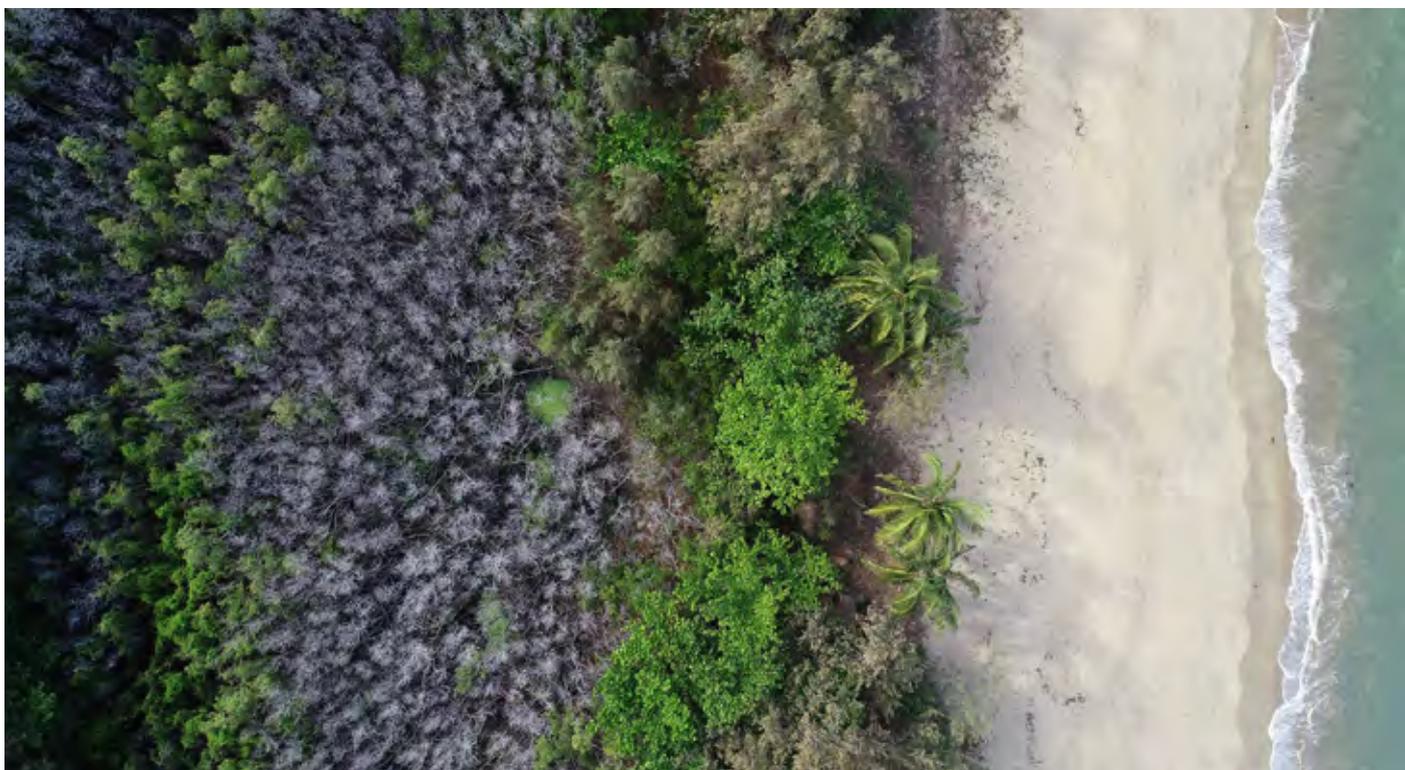


GEONADIR – USING DRONES TO PROTECT MOTHER EARTH'S MOST AT-RISK ECOSYSTEMS



Satellites have provided us with earth observation data for decades at local, regional, national, and even global scales. However, a fundamental trade off exists with data covering large areas – it lacks detail. Conversely, drones (also called unoccupied aircraft systems – UAS) provide highly detailed imagery, but only in localised areas. Using drones, we can map and monitor at-risk ecosystems to assess the impacts of urbanization, deforestation, and coral reef degradation, to name a few. Taking the coastal environment as an example, drones can help us understand shoreline changes, erosion and deposition, wave energy, debris, coastal vegetation, and other coastal habitats. Yet with more than one million kilometres of coastline globally, it would take a long time to map them by drone! Or would it?

Drone data capture is limited by battery life, and the operator's ability to keep the drone within visual line of sight. So what if we had lots of drones and many operators instead? The United States alone has more than 1.75 million drones registered and more than 200,000 pilots certified! Imagine if every one of those pilots drone-mapped just one kilometer of the world's coastlines – we'd even have some overlap! Ok, so there's a challenge with distributing them around the world (especially during COVID), but hopefully it's clear that it's not a drone supply problem, nor a pilot supply problem!



How would we manage the vast amount of drone data collected in coastal and other ecosystems around the world? We're glad you asked, because we'd like to introduce you to GeoNadir – our online global drone data repository created based on open and FAIR principles (findable, accessible, interoperable, and reusable). We're collecting and archiving drone data from operators around the world to map and monitor our most at-risk ecosystems, and we'd love you to join our mission (www.geonadir.com).

AMERICAN SOCIETY FOR PHOTOGRAMMETRY AND REMOTE SENSING STUDENT ADVISORY COUNCIL

SAC MISSION

Since its inception in 2006, the Student Advisory Council (SAC) has offered great leadership opportunities for geospatial students to build confidence, step outside their comfort zones, and grow from their experiences. The SAC is part of the American Society of Photogrammetry and Remote Sensing (ASPRS), a long-standing scientific association dedicated toward the ethical usage of geospatial technology, learning, certification, and advancement.

Currently, we at the SAC have been expanding our social media presence towards building an engaged student community. To this end, we are also working to connect all the ASPRS student chapters (which are spread across the United States). Furthermore, we are currently crafting a mentor-mentee program that will connect students with geospatial professionals who can help to guide them as they navigate academic and professional spheres!



MEMBERS

The SAC has many wonderful members (shown below). While there are official SAC positions, folks can also join the SAC as a general member simply by attending meetings and participating in our work! You can apply for official positions each year in the Spring. If you would like to learn more, please reach out to Youssef Kaddoura at sac@asprs.org.

2020-2021 OFFICIAL POSITIONS:

Chair: Youssef Kaddoura, Deputy Chair: Evan Vega, Networking: Austin Stone, Deputy Networking: Victoria Scholl, Education and Professional: Jason McLoughlin, Deputy Education: Gerardo Rojas, Communications: Terra McKee, Deputy Communications: Jeff Pu, ECPC Liaison: David Luzader, Social Media: Madison Fung, Student Chapters: Lauren McKinney-Wise



EVENTS

During the pandemic, the SAC has been focusing on bringing free and open digital content and networking opportunities to students.

Our most recent event, a geospatial leadership webinar, featured two geospatial professionals discussing their career paths while also providing advice for students as they enter the professional world. You can view this webinar [here](#).

Furthermore, SAC works with ASPRS student chapters in advertising student chapter events! A recent example being a web-mapping webinar put on by the Portland Community College ASPRS student chapter. You can view this webinar [here](#).

JOIN US

1 <https://www.facebook.com/asprs.sac.391>

2 <https://www.linkedin.com/in/asprs-sac-2310131b1/>

3 <https://twitter.com/SacAsprs>

PHD Scholarships & Fellowships

- ▶ **PhD in Modeling and Predicting the Resilience of Ecosystems with Software Engineering and Machine Learning**
University of Luxembourg
Luxembourg
Deadline: 30 April 2021
Link: <https://is.gd/jXGEyN>
- ▶ **PhD in Machine Learning and Harmful Phytoplankton, IFREMER**
France
Deadline: 02 May 2021
Link: <https://is.gd/NdVS1f>
- ▶ **PhD in Boundary Ecotone Vegetation Mapping using Satellite and Airborne Platforms**
University of Basel,
Published Date: 01 April 2021
Link: <https://bit.ly/3xoS6oP>
- ▶ **PhD in Earth Science & MSc in Petroleum Geoscience**
Department of Earth Sciences, Khalifa University
Deadline: 02 May 2021
Link: <https://bit.ly/3gEdost>
- ▶ **PhD position "When computational physics meets observations: using machine learning to bridge the gap"**
LabEx LIO, University of Lyon
France
Deadline: 01 May 2021
Link: <https://is.gd/YxcFLd>
- ▶ **PhD in Forest Management**
Inland Norway University of Applied Sciences (INN)
Deadline: 09 May 2021
Link: <https://bit.ly/3nn1RPV>

Masters Scholarships

Orange Knowledge Programme by the Dutch government. Tenable at Dutch institutions
Deadline: Several | Link: <https://is.gd/1OGipo>

PostDoc Opportunities

- ▶ **Leveraging 3D observation to modernize growth and yield forecasting**
Faculty of Forestry, University of British Columbia (Post Doctoral Fellow)
Deadline: 15 May 2021
Link: <https://bit.ly/3xoptYJ>
- ▶ **NASA postdoctoral program**
Deadline: 01 July 2021
Link: <https://bit.ly/2QZGYy5>
- ▶ **Post-Doctoral Fellowship, Forrest Foundation 2022**
University of Western Australia
United Kingdom
Deadline: 16 May 2021
Link: <https://bit.ly/2QZGYy5>
- ▶ **Post-doctoral research assistant position on high resolution 3D habitat mapping**
4D Ocean Research Lab, Marine Institute
Deadline: Until filled
Link: <https://bit.ly/3xjbQdz>

Job Opportunities

- ▶ **PhD Graduate Research Assistant in Water Resources and Remote Sensing**
University of Florida ESSIE, United States
Deadline: 16 May 2021
Link: <https://bit.ly/3viDUM5>
- ▶ **(Senior) Project Co-ordinator/Manager in the Field of Forest and Climate Change at GAF AG**
Germany
Deadline: 30 April 2021
Link: <https://is.gd/FGZQPo>
- ▶ **Research Fellow/ Senior Research Fellow in Spatial Information Fusion**
RMIT University, Australia
Deadline: 19 May 2021
Link: <https://bit.ly/2PmGQbk>
- ▶ **Instructor in Environmental Science at University of Louisiana**
USA
Deadline: 30 April 2021
Link: <https://is.gd/eANODt>
- ▶ **Geospatial data analyst for the ERC-funded Dissident Networks Project**
Centre for the Digital Research of Religion - Masaryk University - Faculty of Arts
Deadline: 30 April 2021
Link: <https://bit.ly/3nlOXRU>



**Apr
02-04**

UASG-2021 -SECOND INTERNATIONAL CONFERENCE ON UNMANNED AERIAL SYSTEMS IN GEOMATICS-2021 (HYBRID MODE BOTH ONLINE AND OFFLINE)
GREATER NOIDA, INDIA
<https://new.iitr.ac.in/uasg2021/>

**Apr
19-30**

EGU21
ONLINE
<https://www.egu21.eu/>

**Apr
22-23**

GEOPYTHON 2021
ONLINE
<https://2021.geopython.net/>

**Apr
02-04**

GEOIGNITE 2021 ONLINE: CANADIAN LEADERSHIP & GEOSPATIAL INTELLIGENCE
VIRTUAL
<http://geoignite.ca/>

**Apr
26-28**

PSBB - 4TH INTERNATIONAL WORKSHOP ON "PHOTOGRAMMETRIC AND COMPUTER VISION TECHNIQUES FOR VIDEO SURVEILLANCE, BIOMETRICS AND BIOMEDICINE"
(HYBRID MODE BOTH ONLINE AND OFFLINE)
MOSCOW, RUSSIA
<http://technicalvision.ru/ISPRS/PSBB21/>

**May
05-06**

2ND INTERCONTINENTAL GEOINFORMATION DAYS (IGD)
ONLINE TECHNICAL SESSIONS AND WORKSHOPS
MERSIN, TURKEY
<http://igd.mersin.edu.tr/2020/>

**Jun
06-09**

FOSSGIS CONFERENCE 2021
ONLINE
<https://www.fossgis-konferenz.de/2021/>

**Jun
07-10**

40TH EARSEL SYMPOSIUM 2020
WARSAW, POLAND
<http://symposium.earsel.org/40th-symposium-Warszaw/home/>

**Jun
21-24**

42ND CANADIAN SYMPOSIUM ON REMOTE SENSING A HYBRID EVENT
YELLOWKNIFE, NORTHWEST TERRITORIES, CANADA
<https://crss-sct.ca/conferences/csrs-2021/>

**Jun 25
to
Jul 05**

XXITH INTERNATIONAL SCIENTIFIC GEOCONFERENCE SGEM 2021
ALBENA, BULGARIA
<https://www.sgem.org/org/40th-symposium-Warszaw/home/>

**Jul
05-09**

GI_FORUM 2021 | RE.CONNECTING SPATIALLY (VIRTUAL CONFERENCE)
SALZBURG, AUSTRIA
<http://www.gi-forum.org/>

**Jul
06-08**

12TH INTERNATIONAL SYMPOSIUM ON DIGITAL EARTH (ISDE12)
SALZBURG, AUSTRIA
<https://digitalearth2021.org/>

**Jul
04-10**

XXIV ISPRS CONGRESS
VIRTUAL
<http://www.isprs2020-nice.com/>

**Aug
24-26**

GEOSMART INDIA 2021
HYDERABAD, INDIA
<https://geosmartindia.net>

**Sept
06-09**

20TH ANNIVERSARY INTERNATIONAL SCIENTIFIC AND TECHNICAL CONFERENCE | FROM IMAGERY TO DIGITAL REALITY: ERS & PHOTOGRAMMETRY
IRKUTSK, RUSSIA
<http://conf.racurs.ru/conf2020/eng/%20>

**Oct
20-22**

GEOSPATIAL WORLD FORUM 2021
AMSTERDAM, THE NETHERLANDS
<https://geospatialworldforum.org/>

APR
MAY
JUN
JUL
AUG
SEP
OCT

2021

UPCOMING EVENTS

IN THE HORIZON 41





Please visit our ISPRS SC web page

sc.isprs.org 

where you will find more information about Student Consortium, our previous Newsletter issues, SC activities, photo galleries from previous Summer Schools, interesting links etc.

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SPECTRUM

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