THE OFFICIAL NEWSLETTER OF THE ISPRS STUDENT CONSORTIUM

SPECTRUM

VOL . NO. 14 ISSUE NO. 3 | DECEMBER 2020

Assessing SAR C-band data to effectively distinguish modified land uses in a heavily disturbed Amazon forest

TRILOGY OF VEGETATION INDICES:
Unlocking the Potential to Map Crop Condition with Radar Polarimetry

I F O V:
Dr. Masanobu Shimada
Dr. Gopika Suresh
Prof. Michael Schmitt

SAR HELPS MAP VEGETATION IN ECOTONES OF TROPICAL FORESTS

Featured Images:
#WhereonSAREarth

Special Feature on **Sisters of SAR**

CONTENTS

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

Join the ISPRS Student Consortium today!

Follow us on:

groups/isprssc

@ISPRS_SC

@ISPRSSC

JOIN the SPECTRUM TEAM!

We are constantly in search for passionate volunteers to be part of the ISPRS-SC Newsletter team. If you are a student or a young professional (ages 20–35 years old), willing to lend your time and skills with the passion to tell stories, share knowledge and experiences, then join us as a CONTRIBUTOR to the Spectrum.

Have a passion for design, layouts and infographic?
Be one of the volunteers of our CREATIVE DESIGN TEAM
and help us tell stories through pictures and images.

Take the opportunity to work with an international array of experts to bring the latest stories and developments in the field of Remote Sensing, Geomatics and Photogrammetry.

Click **here** to register as a **Volunteer** today!

Or you can email us at **sc@isprs.org**

Vincent **AZUCENA**
Raymond **BALA**
Amihan **MANUEL**
Sandra **PULMANO**
DESIGN TEAM

Andre Jonathan **OBIDOS**
PROOF READER

Charmaine **CRUZ**
EDITOR-IN-CHIEF

SPECIAL THANKS TO OUR CONTRIBUTOR

DR. PEDRO **RODRÍGUEZ-VEIGA**
#WhereonSAREarth

@pedro_biomass pedro.rodriguez@leicester.ac.uk

Research Interests:
Earth Observation of the land surface from satellite and airborne instruments, Forest Inventory, GIS, Statistical Modelling, Spatial Analysis, and Carbon Dynamics in Forest Ecosystems

Affiliation:
NERC National Centre for Earth Observation (NCEO)
Centre for Landscape and Climate Research
School of Geography, Geology and the Environment
University of Leicester, University Road, Leicester, LE1 7RH, UK

Dear ISPRS SC Newsletter readers,

Welcome to the 3rd issue of Spectrum (Volume 14), the official Newsletter of the ISPRS Student Consortium!

We are finally saying goodbye to 2020 - a year that might be called the "pandemic year". The world has never encountered such a pandemic in the last century. As of this writing, global COVID-19 deaths have reached 1.6 million, according to the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. Many of us have been affected by the disease itself and its effects on our society. This year saw us locked up in our homes, forced to change our daily habits and lifestyle in extraordinary ways. We all experienced restrictions, lockdowns, and other disruptions. Almost all of us have had to work and collaborate online - this year we saw Zoom and other video conferencing applications, well, zoom up in popularity and use. International conferences and meetings have also been conducted virtually online. While it can be said that there are some advantages to a "virtual" working lifestyle - people get to save on transportation costs and global carbon emissions have dropped - it prevents us from having more personal interactions with our friends and colleagues. Nevertheless, we must all count ourselves as fortunate that we have survived the worst of the pandemic. Relief is finally on the horizon, as COVID-19 vaccines are starting to be distributed.

I am very pleased to present to you our latest newsletter featuring articles on SAR (Synthetic Aperture Radar) Remote Sensing. SAR sensors have a unique capability for imaging the earth surface day/night and in all weather conditions. Furthermore, it provides complementary information to the optical sensors (i.e., passive sensors) because of SAR-specific properties such as side-looking viewing geometry and being placed in the microwave region in the electromagnetic spectrum. Since the SeaSat, the first-ever spaceborne synthetic aperture radar (SAR) system, launched in 1978 by NASA/JPL, Synthetic Aperture Radar technology showed unprecedented speed in developments of Earth Observation Systems. Therefore some people say, "we have entered the golden age of SAR."

In this issue, we have rich and interesting articles covering the different applications of SAR Remote Sensing, including SAR, Polarimetric SAR (PolSAR), and Interferometric SAR (InSAR) from agriculture to forestry and natural hazards, in our SPOTLIGHTS section. We are greatly privileged to have interviewed Dr. Masanobu Shimada, a Professor of Remote Sensing at Tokyo Denki University, Dr. Gopika Suresh, a research fellow in SAR Remote Sensing at Asian School of the Environment and Dr. Michael Schmitt, a Professor for Applied Geodesy and Remote Sensing at Munich University of Applied Sciences in our IFOV section. We are also delighted to feature the "Sisters of SAR" (@SistersofSAR), which is a great initiative in promoting, supporting, and sharing the accomplishments of "#WomeninSAR" and "#WomeninRemoteSensing" worldwide on Twitter. Also, don't miss out on the upcoming activities and exciting opportunities for you in the Foresight, Into Horizon sections of this Newsletter. We would also like to acknowledge Dr. Pedro Rodríguez-Veiga for his awesome #WhereonSAREarth images featured in this Newsletter.

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 and readers of SpeCtrum. I hope you would enjoy reading this fantastic issue of fully covering SAR Remote Sensing.

I wish you all a happy, fruitful, and peaceful New Year!

Cheers!

Mustafa Ustuner, PhD
SOCIAL MEDIA COORDINATOR
ISPRS STUDENT CONSORTIUM

6TH IEEE GRSS YOUNG PROFESSIONALS AND ISPRS STUDENT CONSORTIUM SUMMER SCHOOL & THE 41ST ASIAN CONFERENCE ON REMOTE SENSING

By: Sheryl Rose Reyes
ISPRS Student Consortium President

The ISPRS Student Consortium continued with its activities in the second half of 2020, amidst the continuing global health crisis to support the youth across the globe. In the last months, the Consortium participated in a conference and organized a summer school.

With the hard work and efforts of the local organizers from Brazil, the 6th edition of the IEEE GRSS Young Professionals and ISPRS Student Consortium Brazil Summer School was converted to an online event, composed of a series of lectures delivered every week from October to December 2020 under the theme "Emerging Trends in Remote Sensing Science and Applied Machine Learning." A total of 12 lectures were organized with speakers from different countries covering the topics of photogrammetry, remote sensing, machine learning and current and upcoming satellite missions. The summer school was well-received by the members of the Consortium, with the first lecture garnering a total of about 2,600 views on the ISPRS SC YouTube Channel (https://www.youtube.com/c/ISPRSSC/videos). On top of these regular lectures, a special session was also hosted in the 10th edition of the Remote Sensing for Defense Applications (Portuguese: Simpósio de Sensoriamento Remoto de Aplicações em Defesa, SERFA 2020), entitled "Empowering Scientific Writing Skills," featuring three incredible speakers, namely, Dr. Jack Schuenemeyer (University of Delaware and Southwest Statistical Computing, LLC), Dr. Alejandro Frery (Victoria University of Wellington, Australia) and Dr. Evlyn Novo (Brazilian Institute for Space Research, INPE), who talked about the scientific writing process, the ethics of technical writing and gave valuable advice to the audience about publishing your research.

The Asian Conference on Remote Sensing (ACRS 2020) organized annually by the Asian Association on Remote Sensing (AARS) and this year, together with Chinese National Committee for Remote Sensing (CNCRS), arranged a special panel discussion related to the roles of international academic societies during this pandemic. Ms. Sheryl Rose Reyes, President of the ISPRS SC, participated in this panel discussion together with Dr. Christian Heipke, Dr. Paolo Gamba and Dr. Gu Xingfa and the session was moderated by Dr. Kohei Cho. The ISPRS SC President held a presentation on the challenges that many of the Consortium members faced at the onset of the pandemic and provided several examples of the activities developed and hosted by the organization in order to support the youth at this challenging time. You can visit the official AARS website for the presentations in this panel discussion:

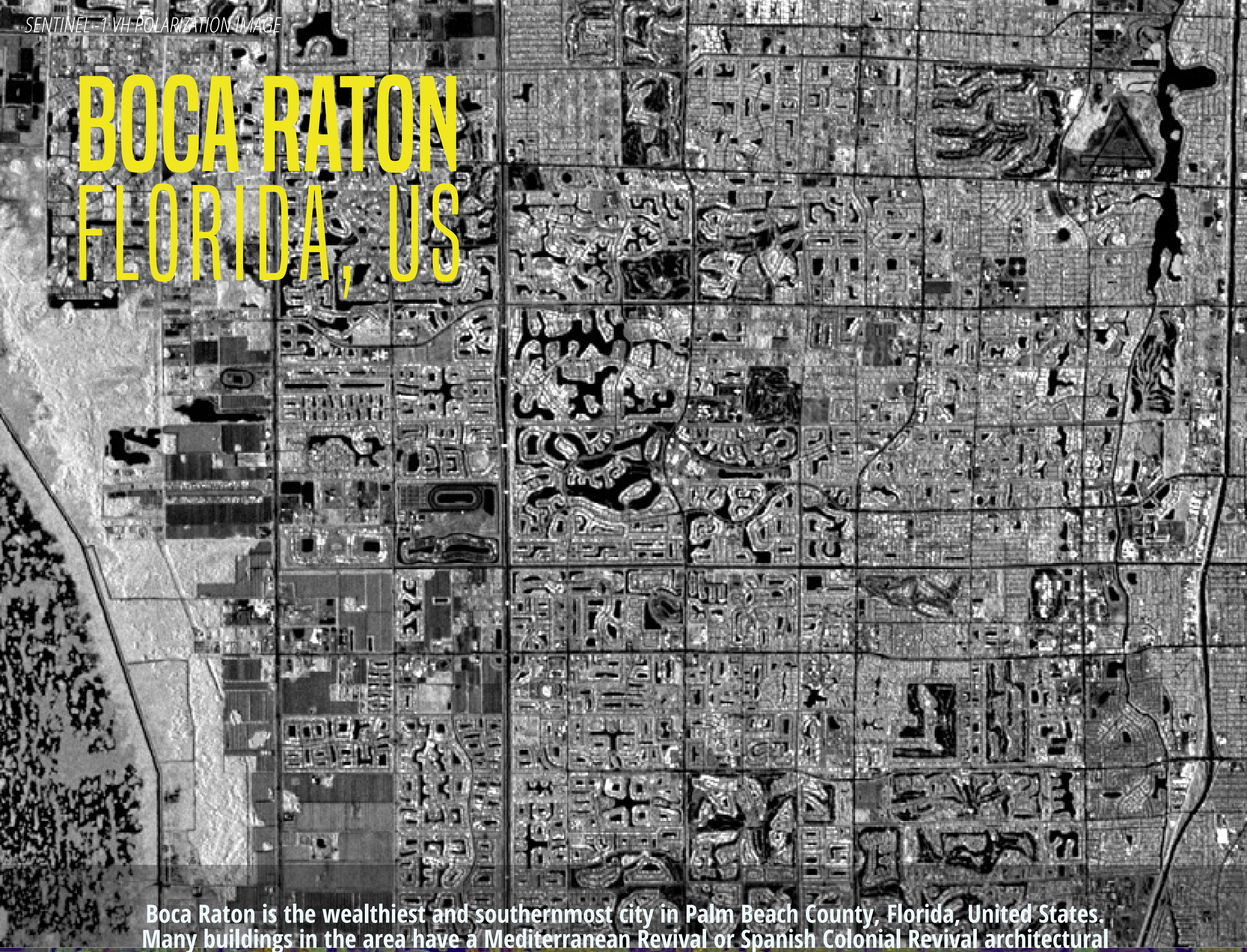
https://a-a-r-s.org/2020/12/14/the-panel-session/

To everyone who participated in our recently concluded activities, our deepest thanks and we hope to see you again in the very near future!

Figure 1. The speakers for the 6th IEEE GRSS Young Professionals and ISPRS SC Student Consortium Summer School.

Figure 2. The special session in SERFA 2020 on "Empowering Scientific Writing Skills."

Figure 3. The panel discussion in ACRS 2020 on the roles of international academic societies in the pandemic.

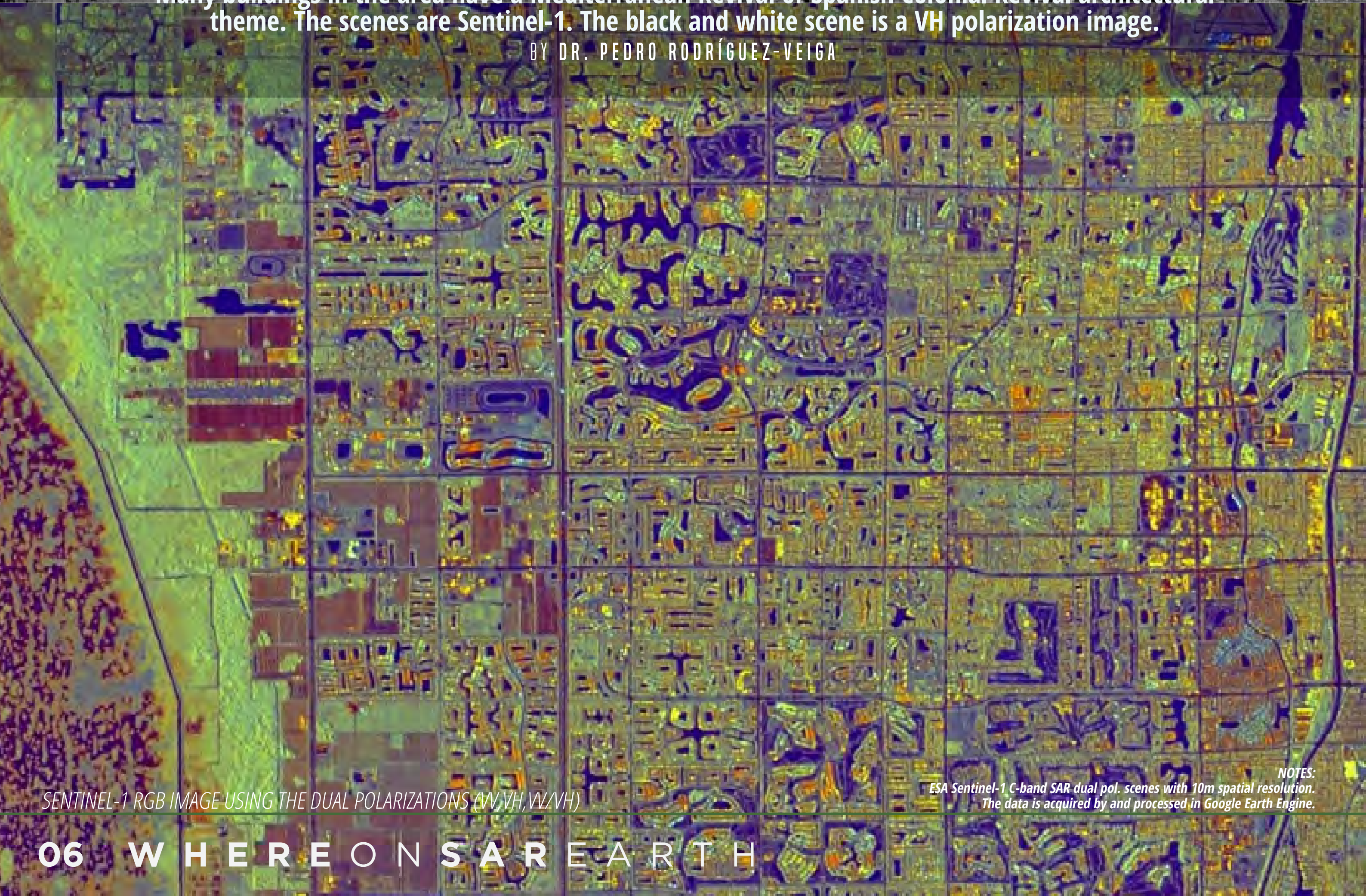


SENTINEL-1 VH POLARIZATION IMAGE

BOCA RATON FLORIDA, US

Boca Raton is the wealthiest and southernmost city in Palm Beach County, Florida, United States. Many buildings in the area have a Mediterranean Revival or Spanish Colonial Revival architectural theme. The scenes are Sentinel-1. The black and white scene is a VH polarization image.

BY DR. PEDRO RODRÍGUEZ-VEIGA



SENTINEL-1 RGB IMAGE USING THE DUAL POLARIZATIONS (VV,VH,VV/VH)

NOTES:
ESA Sentinel-1 C-band SAR dual pol. scenes with 10m spatial resolution. The data is acquired by and processed in Google Earth Engine.

Assessing SAR C-band data to effectively distinguish modified land uses in a heavily disturbed Amazon forest

The Amazon is the largest expanse of tropical rainforest globally and deforestation resulting from land use changes poses a major concern for sustainable resource management. Synthetic Aperture Radar (SAR) has all-weather and all-day capability, and thus SAR data is well-suited for mapping land use land cover (LULC) in tropical regions, which are seasonally influenced by cloud cover. Understanding modified land uses and drivers of deforestation is fundamental for the development of policies and measures to reduce emissions and for developing forest reference levels. Sentinel-1 C-band SAR data present unprecedented opportunities for this purpose since the observations are free and openly available and, for the first time, provide regular and standardized SAR data.

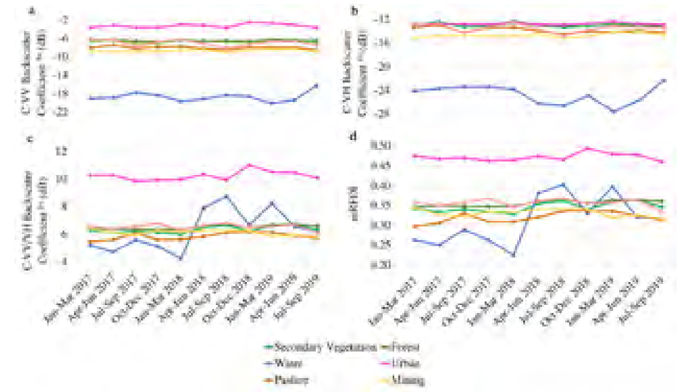


Figure 1: Temporal backscatter profile of classes at (a) VV polarization, (b) VH polarization, (c) VV/VH, (d) mRFDI

The authors analyzed the applicability of Sentinel-1 RTC data for LULC classification to differentiate modified land uses, which is a current need for early-warning deforestation systems. The study area covers a deforestation frontier in the Madre de Dios region of the Peruvian Amazon where the landscape is characterized by a mosaic of LULC types. Collect Earth Online was used for reference LULC data collection, and seven classes were defined for this study: forest, secondary vegetation, agriculture, pasture, urban, mining, and water. Amplitude γ^0 time-series spanning 2017-2019 were analyzed along with statistical metrics for each class (Figure 1), and a pixel-based classification decision tree was developed in Google Earth Engine. A modified version of the Radar Forest Degradation Index (mRFDI), described for the first time, and Separability Index were used to assist in the classification decision tree creation.

The resultant LULC map (Figure 2) from this decision tree showed a low overall accuracy (52%) based on high resolution imagery from Planet and Digital Globe (Maxar). The results show high user's accuracy for forest and water classification, but there was a lot of confusion between agriculture, secondary vegetation, and forest due to the different successional stages of agricultural activities and similarities in structure of certain croplands and vegetation from regrowth. We suggest that the polarization ratio VV/VH is useful for pasture classification (user's accuracy = 77%) and confirm that the orientation of streets in an urban environment has a large influence on backscattering response (Figure 3).

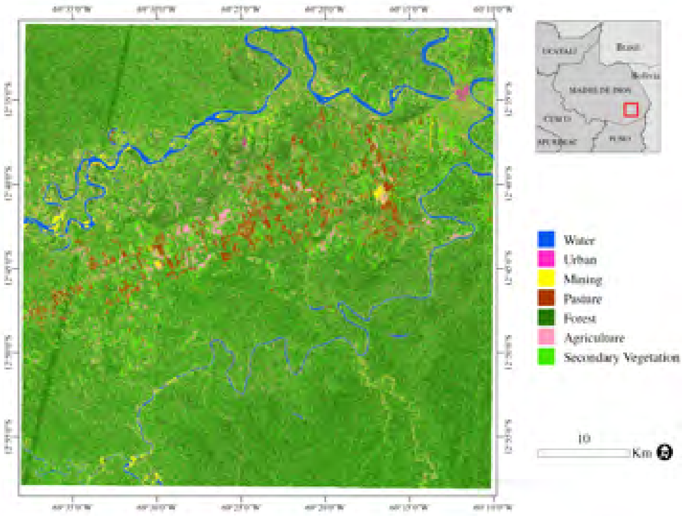
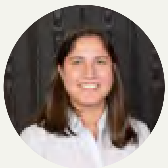


Figure 2: Spatial distribution of Sentinel-1-based land use land cover classes in the study area.

This research provides information for future research on LULC and the identification of drivers in deforestation monitoring systems that could result in additional actionable information for decision-making. Further studies may expand existing deforestation monitoring systems by combining optical and SAR imagery to identify drivers of forest change.

Figure 3: Visualization of the city of Puerto Maldonado (a) Digitized streets (Streets were digitized utilizing ESRI ArcMap 10.6), (b) Sentinel-1 composite of images from July (02, 14, 26) and August (08) of 2019 (Red: C-VV, Green: C-VH, Blue: C-VV/VH), (c) RGB PlanetScope image from July 30, 2019.

About the Authors



Andrea Puzzi Nicolau
an0052@uah.edu | @puzzinicolau
SERVIR-Mekong Regional Science Associate
University of Alabama in Huntsville / NASA SERVIR Science Coordination Office

Andrea Nicolau is a Research Associate at the Earth System Science Center at the University of Alabama in Huntsville (UAH), and serves as the Mekong Regional Science Associate at the NASA SERVIR Science Coordination Office. Andrea is a Brazilian national with a background in Environmental Engineering. She received her M.S. from UAH in 2019 where she worked as a Graduate Research Assistant for the SERVIR-Amazonia hub. Her work has focused on monitoring land cover and land use dynamics and drivers of deforestation in the Peruvian Amazon utilizing both optical and SAR imagery. She has contributed to the SAR Handbook initiative mainly by porting scripts from Jupyter Notebooks to Google Earth Engine (GEE) and Colab, and she has conducted capacity building training on GEE and SAR in the Amazon region.

Robert Griffin
robert.griffin@uah.edu
Associate Dean
University of Alabama in Huntsville / NASA SERVIR Science Coordination Office

Dr. Robert Griffin is an applied Earth scientist, environmental anthropologist, and a remote sensing and GIS specialist. He received his Ph.D. from Penn State University in 2012 having received a graduate fellowship from NASA, and he is certified as both a GIS Professional through GISCI and a Certified Mapping Scientist in Remote Sensing (CMS/RS) through ASPRS.

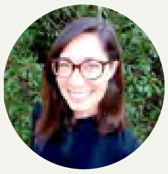
His research interests span across disciplinary boundaries and focus on the use of technology (geographic information systems and satellite remote sensing) to solve complex problems and build end-user capacity. Dr. Griffin has received research funding from NASA, NSF, and WCS, and he has conducted fieldwork on human-environment interactions across Latin America. He principally serves as the Science and Educational Partnerships Lead and PI for the NASA SERVIR UAH science team, the Science Advisor for the NASA DEVELOP at Marshall Space Flight Center, the Science and Missions Operations Director for the Sally Ride ISS EarthKAM project, and as the PI for the NSF REU Site, Remote Sensing of Land-Atmosphere Systems.

Dr. Griffin teaches a range of courses at UAH, from introductory survey courses to advanced graduate level coursework. He encourages and supports student research, mentors students through professional development, and actively funds both graduate and undergraduate students. He serves the local community as a board member for both GEOHuntsville and the Huntsville Air Pollution Control Board, and as a founder and director of the Alabama Remote Sensing Consortium (ARSC), an industry-higher education consortium focused on innovation in advanced satellite remote sensing. In addition to teaching courses, conducting research, and performing service, Dr. Griffin also consults with local industry in the area of geospatial information analysis.

LINK TO OUR PAPER

Africa Flores-Anderson
africa.flores@nasa.gov
SERVIR-Amazonia Regional Science Coordination Lead
University of Alabama in Huntsville / NASA SERVIR Science Coordination Office

Africa I. Flores-Anderson is a research scientist at the Earth System Science Center at the University of Alabama in Huntsville. She is passionate about developing technical capacities in geospatial technologies for societal benefit. She is a National Geographic Explorer and is working to forecast harmful algae blooms in Lake Atitlán using artificial intelligence. She also works with SERVIR, a joint NASA and USAID initiative, where she leads the Land Cover Land Use Change and Ecosystems thematic portfolio and is the SERVIR-Amazonia science coordination lead. Flores' research focuses on forest monitoring, the use of SAR in ecosystem applications, water quality, and ecological forecasting.



Kelsey Herndon
kelsey.e.herndon@nasa.gov
SERVIR-Amazonia Regional Science Associate
University of Alabama in Huntsville / NASA SERVIR Science Coordination Office

Kelsey is the SERVIR Amazonia Regional Science Associate at the SERVIR Science Coordination Office at the NASA Marshall Space Flight Center in Huntsville, AL. Her research interests focus on the human dimension of remote sensing science for decision making. Her current work addresses land use change in the Amazon and the long term dynamics of ephemeral water bodies in the Nigerien Sahel, including the implications of political and cultural practices for managing these natural resources. She also has a background in archaeology, where she focused on human-environment interactions through excavations in Central America and the Southeastern United States.

Franz J. Meyer
fjmeyer@alaska.edu
Professor, University of Alaska Fairbanks
Chief Scientist, NASA Alaska Satellite Facility DAAC

Dr. Meyer is Professor for Radar Remote Sensing at the University of Alaska Fairbanks (UAF), one of the world's leading universities for Arctic research. He is also the Chief Scientist of the Alaska Satellite Facility, NASA's prime Distributed Active Archive Center (DAAC) for radar remote sensing data. Dr. Meyer has published more than 130 papers on the theory and application of synthetic aperture radar (SAR), five of which received best paper awards. He is the 2011 winner of the IEEE GRSS GOLD Early Career award, and received the Terris and Katrina Moore Prize in 2014 for his research work in radar remote sensing. Together with a small team of SAR researchers, he is the winner of the 2019 NASA / USAID SERVIR Collaboration Award for his efforts in strengthening the NASA SERVIR network's SAR capacity. Meyer currently holds several leadership positions in internationally recognized professional organizations, including IEEE (Institute of Electrical and Electronics Engineers), ISPRS (International Society for Photogrammetry and Remote Sensing), and CEOS (Committee on Earth Observation Satellites).

TRILOGY OF VEGETATION INDICES:
Unlocking the Potential to Map Crop Condition with Radar Polarimetry

by Dipankar Mandal, Avik Bhattacharya, and Yalamanchili S. Rao

Vegetation indices are often used as a proxy for plant growth. While appreciating the potential of vegetation indices derived from optical remote sensing sensors, regional to global products have been supported for operational uses. Unfortunately, optical imaging is limited during the monsoon season due to cloud cover over lower latitude regions. Lately, the Earth Observation (EO) community is relying upon Synthetic Aperture Radar (SAR) imaging technology due to its all-weather imaging capability and its other advantages. The radar images are presently processed by several downstream users and are more frequently interpreted by non-radar specialists. This shift in paradigm makes radar-derived vegetation indices easily available and, thus, helps achieve the goal of Analysis Ready Data (ARD) products.

Ready solution and fast implementation:

Recently, we proposed three vegetation indices, namely GRVI (Generalized Radar Vegetation Index) [1], CpRVI (Compact-pol Radar Vegetation Index) [2], and Dual-pol Radar Vegetation Index (DpRVI) [3]. In principle, the GRVI and CpRVI utilize the concept of a geodesic distance between observations and volume scattering models for full and compact polarimetric SAR data, respectively. On the other hand, DpRVI is motivated by the depolarization of the transmitted wave by its interaction with crop canopy. The loss of polarization in the scattered wave by any natural target is possibly due to the randomness of the scatterers. The vegetation index derived from SAR data could provide complementary information about the geometric and dielectric variations that occur during crop development. These vegetation indices are easy to interpret as they are bounded between 0 and 1. For a smooth bare soil condition, these three VIs are close to 0, and it approaches 1 for completely developed crop canopy. As plant canopy advances from early leaf development to fully vegetative stage, the VIs increase from 0 to 1. We have included these VIs in our developed QGIS Plugin - **'SAR tools'**, which supports downstream users to generate polarimetric descriptors from SAR data.

The assessment with C-band SAR data over wheat and soybean fields suggest that the GRVI and CpRVI follows well with the crop growth variables (Figure 1) like vegetation water content (VWC) and plant area index (PAI) with reasonable correlation (r>0.75). On the contrary, the DpRVI has shown less correlation (r=0.65 to 0.70) although sensitive to accumulation of biomass, which is likely due to less polarimetric information content in the dual-pol mode of SAR data. The most interesting part of this trilogy is that these three indices can be analyzed quickly by users.

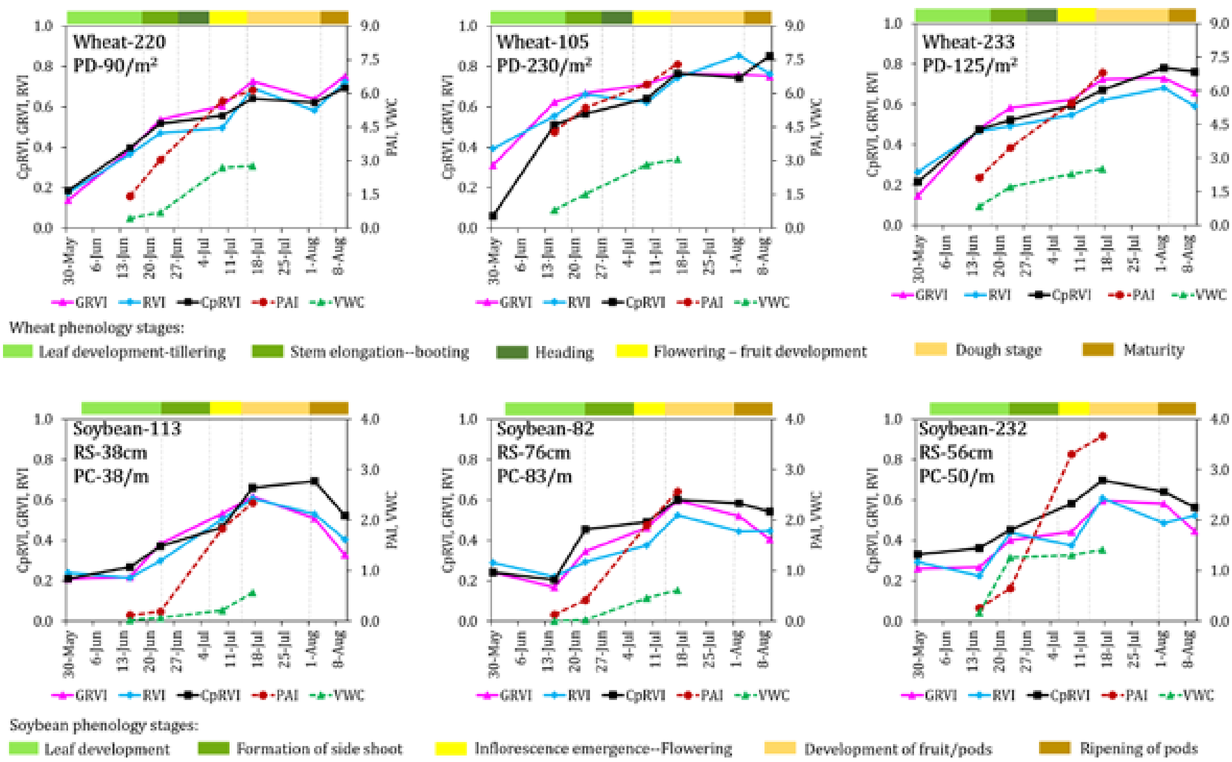
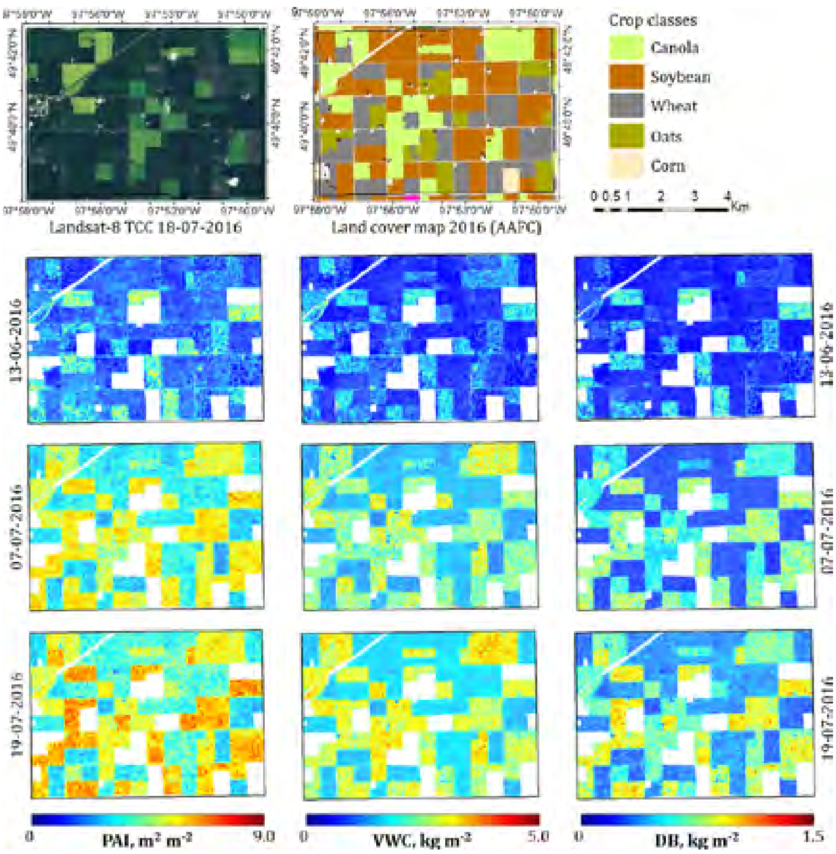


Figure 1. Temporal pattern of vegetation indices (CpRVI, RVI, and GRVI) for wheat and soybean fields.

The vegetation indices have also indicated an opportunity to directly estimate biophysical parameters from VI images with fitted models. The retrieval of biophysical parameters from SAR observations is of vital importance for in-season monitoring of crop growth. The PAI, VWC and dry biomass are valuable indicators of crop condition. The validation results for biophysical parameters indicated high correlation and low error estimates (RMSE and MAE)



within admissible range. The ranges of biophysical parameters for specific acquisition dates for each crop can be observed in the derived biophysical parameter maps, shown in Figure 2.

Notably, the proposed DpRVI for dual-pol SAR data and the CpRVI holds significant interest from an operational perspective for the Sentinel-1 Copernicus mission, the RADARSAT Constellation Mission (RCM) and other upcoming SAR missions, such as NASA-ISRO SAR mission (NISAR). These missions provide data across larger spatial extents with short revisit time. For example, end-users might be interested in weekly vegetation condition products from an operational mission like Sentinel-1, particularly in regions where cloud cover obscures the Earth to optical satellite acquisitions.

Figure 2. Plant Area Index (PAI), Vegetation Water Content (VWC), and Dry Biomass (DB) maps over the test site for three acquisitions dates (13-06-2016, 07-07-2016, and 19-07-2016). The land cover map (produced by AAFC) and Landsat-8 True Colour Composite (TCC) image (acquired on 18-07-2016) over the subset area are highlighted.

References:

[1] Mandal D, Kumar V, Ratha D, Lopez-Sanchez JM, Bhattacharya A, McNairn H, Rao Y S, Ramana K (2020), "Assessment of rice growth conditions in a semi-arid region of India using the Generalized Radar Vegetation Index derived from RADARSAT-2 polarimetric SAR data," *Remote Sensing of Environment*, 237:111561.
[2] Mandal D, Ratha D, Bhattacharya A, Kumar V, McNairn H, Rao Y S, Frery A C (2020) , "A Radar Vegetation Index for Crop Monitoring Using Compact Polarimetric SAR Data," *IEEE Transactions on Geoscience and Remote Sensing*, 58 (9), pp. 6321-6335.
[3] Mandal D., Kumar V., Ratha D., Dey S., Bhattacharya A., Lopez-Sanchez J. M., McNairn H., Rao Y. S. (2020), "Dual Polarimetric Radar Vegetation Index for Crop Growth Monitoring Using Sentinel-1 SAR Data," *Remote Sensing of Environment*, 247: 111954.

ABOUT THE AUTHORS

Dipankar Mandal | dipankar_mandal@iitb.ac.in; dipankar.agrilengg@gmail.com
Researcher, Microwave Remote Sensing Lab, Centre of Studies in Resources Engineering, Indian Institute of Technology Bombay, India 400076

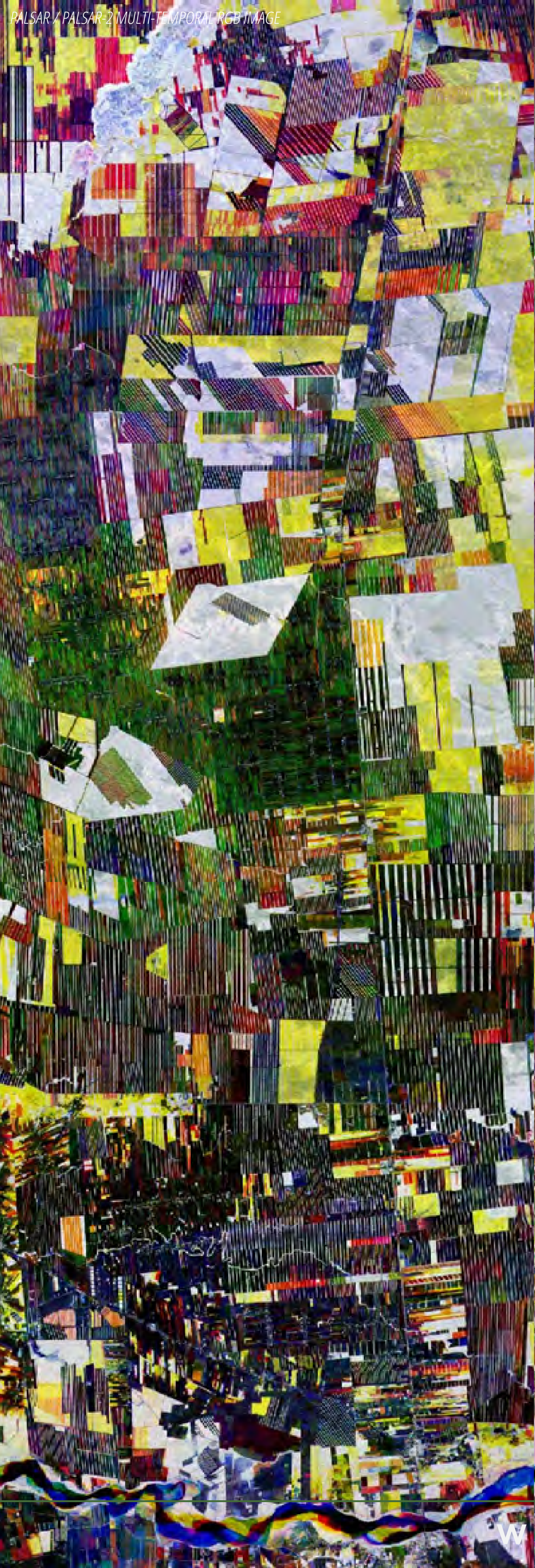
Dr. Dipankar Mandal (ISPRS IM'16) received the joint M.Tech/Ph.D. degree in Geoinformatics and Natural Resource Engineering from Indian Institute of Technology Bombay (IIT Bombay), Mumbai, India in 2020. He completed the B.Tech. degree in Agricultural Engineering from Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, India, in 2015. During his doctoral programme, Dr. Mandal received the Shastri Research Student Fellowship 2018 Award from the Shastri Indo-Canadian Institute, India and served as a visiting researcher to Carleton University, and Agriculture and Agri-Food Canada (AAFC), Ottawa, Canada, from October 2018 to February 2019. As a Visiting Researcher, he contributed to the synthetic aperture radar (SAR) intercomparison experiment for crop biophysical parameter estimation within the Joint Experiment for Crop Assessment and Monitoring (JECAM) network of GEO Global Agricultural Monitoring. His research interests include applications of SAR polarimetry for crop classification, vegetation biophysical parameter estimation, deriving vegetation indices, and yield forecasting.

Avik Bhattacharya | avikb@csre.iitb.ac.in
Associate Professor, Microwave Remote Sensing Lab, Centre of Studies in Resources Engineering, Indian Institute of Technology Bombay, India 400076

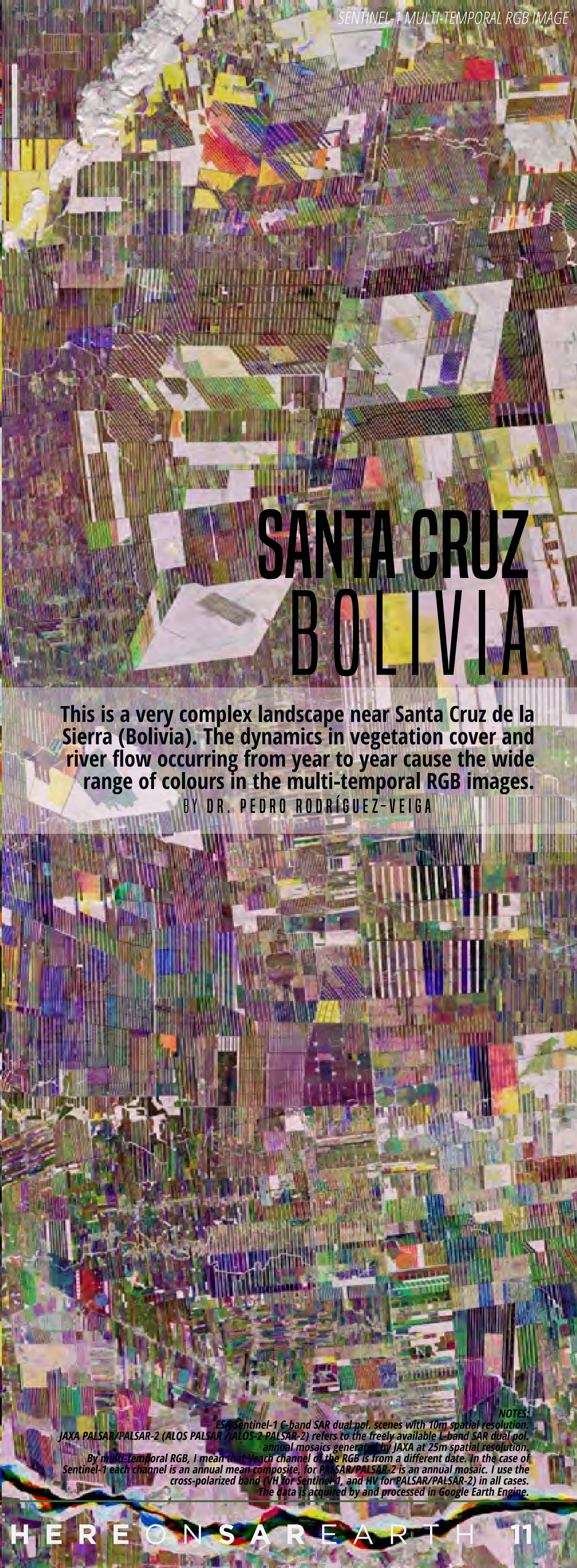
Dr. Avik Bhattacharya received the integrated M.Sc. degree in mathematics from IIT Kharagpur, Kharagpur, India, in 2000, and the Ph.D. degree in remote sensing image processing and analysis from Télécom ParisTech, Paris, France, and the Ariana Research Group, Institut National de Recherche en Informatique et en Automatique (INRIA), Nice, France, in 2007. He was a Canadian Government Research Fellow with the Canadian Centre for Remote Sensing (CCRS), Ottawa, ON, Canada. He is currently an Associate Professor with the Centre of Studies in Resources Engineering, IIT Bombay (CSRE, IITB), Mumbai, India, where he is also leading the Microwave Remote Sensing Laboratory. His research interests include synthetic aperture radar (SAR) polarimetry, statistical analysis of polarimetric SAR images, and applications of radar remote sensing in agriculture, cryosphere, urban, and planetary studies. Dr. Bhattacharya received the Natural Sciences and Engineering Research Council of Canada Visiting Scientist Fellowship from the Canadian National Laboratories, from 2008 to 2011. He was an Associate Editor of the IEEE GEOSCIENCE AND REMOTE SENSING LETTERS (GRSL). Currently he is the Editor-in-Chief of the IEEE GEOSCIENCE AND REMOTE SENSING LETTERS (GRSL).

Yalamanchili S. Rao | ysrao@csre.iitb.ac.in
Professor, Microwave Remote Sensing Lab, Centre of Studies in Resources Engineering, Indian Institute of Technology Bombay, India 400076

Dr. Y. S. Rao received the M.Sc. degree in physics from Andhra University, Visakhapatnam, India, in 1982, and the Ph.D. degree in passive microwave remote sensing of soil moisture from IIT Bombay, Mumbai, India, in 1992. From 2005 to 2009, he was a Senior Research Scientist and then Associate Professor from 2009 to 2014. He was engaged in both passive and active microwave remote sensing for several applications viz., soil moisture, crop monitoring, flood mapping, and land use/land cover. He joined the Centre of Studies Resources Engineering, IIT Bombay in 1985 as a Senior Research Assistant, and then as a Research Scientist in 1999. He is currently a Professor with IIT Bombay. He has participated in several spaceborne campaigns for collecting synchronous ground-truth data and has experience in handling various data sets for several applications. His research interests include the application of polarimetry for bio-geophysical parameter retrieval and synthetic aperture radar (SAR) interferometry for digital elevation model (DEM) and displacement map generation.



PALSAR / PALSAR-2 MULTI-TEMPORAL RGB IMAGE



SENTINEL-1 MULTI-TEMPORAL RGB IMAGE

SANTA CRUZ BOLIVIA

This is a very complex landscape near Santa Cruz de la Sierra (Bolivia). The dynamics in vegetation cover and river flow occurring from year to year cause the wide range of colours in the multi-temporal RGB images.

BY DR. PEDRO RODRÍGUEZ-VEIGA

NOTES:
ESA Sentinel-1 C-band SAR dual pol. scenes with 10m spatial resolution.
JAXA PALSAR/PALSAR-2 (ALOS PALSAR / ALOS-2 PALSAR-2) refers to the freely available L-band SAR dual pol. annual mosaics generated by JAXA at 25m spatial resolution.
By multi-temporal RGB, I mean that Veach channel of the RGB is from a different date. In the case of Sentinel-1 each channel is an annual mean composite, for PALSAR/PALSAR-2 is an annual mosaic. I use the cross-polarized band (VH for Sentinel-1, and HV for PALSAR/PALSAR-2) in all cases.
The data is acquired by and processed in Google Earth Engine.

SAR HELPS MAP VEGETATION IN ECOTONES OF TROPICAL FORESTS

The use of synthetic-aperture radar (SAR) images has grown in recent years, especially after the launch of the satellite Sentinel 1 (C-Band) as part of European Union's Copernicus programme and its offer of images free of charge. The important advantages of active sensors (e.g. SAR) are the capability of the radiation to penetrate through cloud cover and to provide a better analysis of the geometrical properties of vegetation cover due to the higher wavelengths made available compared to optical sensors. These are important advantages when the study area is located in dense forest, such as tropical forest, especially in regards to biomass estimation. This is especially important to the exploration of the ecotones.

The ecotones are transition regions between two biomes and are very rich in biodiversity because they hold characteristics of both biomes. Unfortunately, this property also makes them very sensitive to climate change. Therefore, the identification and mapping of these regions is of great importance, not only in the context of carbon sequestration, but also for the preservation of biodiversity. Nevertheless, these regions are very complex to map due to dynamics that can change over the course of a year, such as the ecological success process. Additionally, they have an extensive gradient of different vegetation types.

The importance of ecotones together with the challenge of mapping these regions aroused my curiosity to work in this region. An ecotone of great importance for climate change can be found between the Cerrado and the Amazon biomes (Figure 1), which covers parts of the arc of deforestation (AOD). The AOD accounts for 75% of the deforestation in the Brazilian Amazon and the largest agricultural area (INPE, 2011).

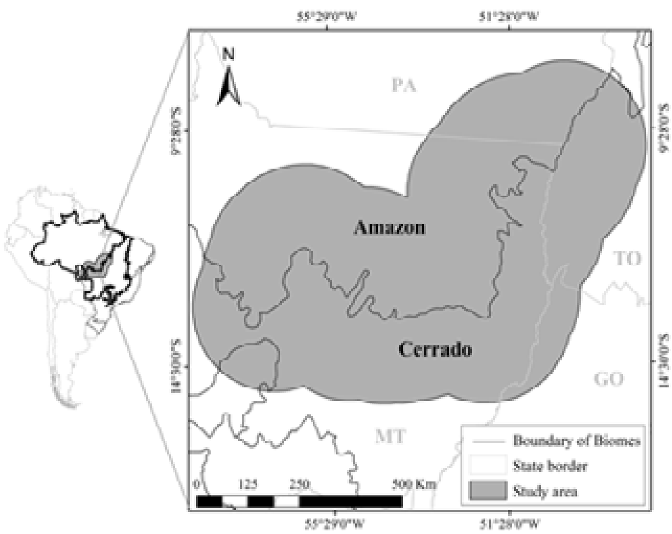


Figure 1. Part of the Cerrado/Amazon ecotone. Source: Marques et al. 2019.

The use of SAR can contribute in mapping the type of vegetation, because it has the geometrical properties of vegetation cover. This characteristic makes its use even more advantageous for ecotones, but why not use SAR and optical images instead of just SAR or optical? The first publication of my PhD, therefore, aimed to evaluate the use of optical and radar remote sensing for mapping the different types of vegetation in the transitional area between the Cerrado and Amazon biomes (Figure 2).

In order to analyze the use of optical and radar sensors to map the vegetation type in our study area, we used images from the Multispectral Instrument (MSI) on-board Sentinel-2A, Sentinel-1A IW Ground Range Detected (GRD) Level-1 product, dual and full polarization images from ALOS-PALSAR 2 and TanDEM-X. This set of images was used to identify the four dominant vegetation types that are prevalent in the Cerrado/Amazon ecotone (i.e., Cerrado denso, Cerradão, gallery forest, and secondary forest). We extracted features from both sources of data such as intensity (Sentinel 1A, TanDEM-X and ALOS-PALSAR 2 dual/full polarimetric), grey level co-occurrence matrix (Sentinel 1A), coherence (TanDEM-X), and polarimetric decompositions (ALOS-PALSAR 2 full polarimetric) during the dry and rainy season of 2017 (Figure 3).

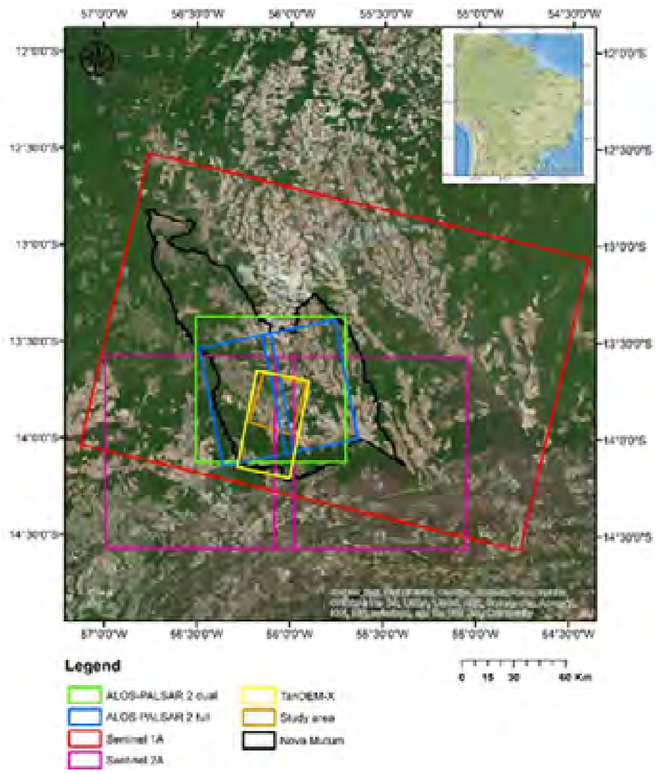


Figure 2. Location of the study area within the South America context. The scene footprints of different satellites are shown on top of a Google Earth image

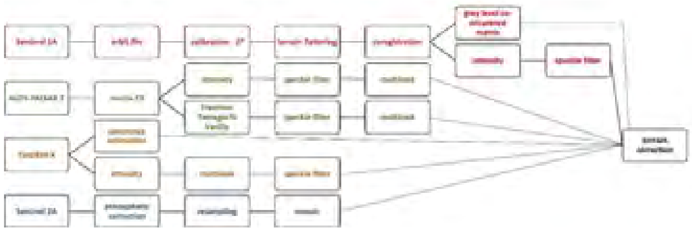


Figure 3. Flowchart of the proposal methodology.

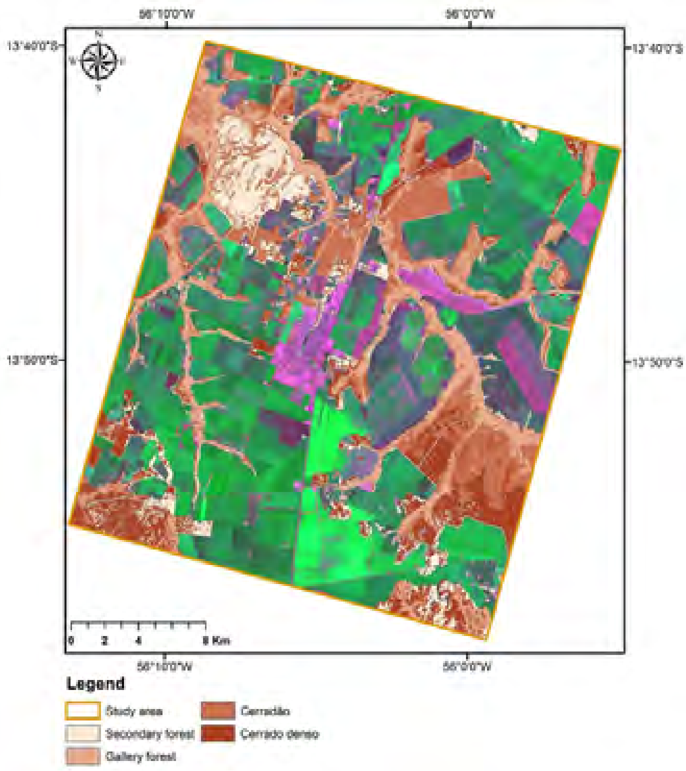


Figure 4. Classification of Cerrado forest type using all images from the dry and rainy season on top of a false color composition from Sentinel 2A, Bands 3, 4, and 8 (07 July 2017).

When applying a supervised random forest classification, two of the three classifications that obtained the highest overall accuracy and kappa values used radar and optical images (Figure 4). Bands 5, 11, and 12 of Sentinel 2A, texture images from Sentinel 1A cross-polarization, and coherence of TanDEM-X were the most important images in order to separate each class, as calculated by the random forest variable importance.

The results of User's accuracy show how the combination of SAR and optical images can contribute to the discrimination of different classes in the rainy season, when we have a high cloud cover. In the 4 classes, the classifications that used SAR and optical images have the highest User's accuracy (between 80% and 98% accuracy).

If you are interested in working with ecotones around the world using remote sensing, you can contact us. We have a great research group on this subject and we will be happy to have you!

Dr Flávia de Souza Mendes
flaviamendesgeo@gmail.com

Dr. Polyanna da Conceição Bispo
polybispo@gmail.com

REFERENCES:

de Souza Mendes, F.; Baron, D.; Gerold, G.; Liesenberg, V.; Erasmi, S. Optical and SAR Remote Sensing Synergism for Mapping Vegetation Types in the Endangered Cerrado/Amazon Ecotone of Nova Mutum—Mato Grosso. Remote Sens. 2019, 11, 1161.

INPE (2011): Program for the Estimation of Amazon Deforestation (PRODES). INPE. São José dos Campos.

Marques, E.Q.; Marimon-Junior, B.H.; tMarimon, B.S.; Matricardi, E.A.T.; Mews, H.A.; Colli, G.R. Redefining the Cerrado–Amazonia transition: Implications for conservation. Biodivers. Conserv. 2019, 1–17.

ABOUT THE AUTHOR

Dr. Flávia de Souza Mendes
flaviamendesgeo@gmail.com
Remote Sensing and GIS Analyst,
Remote Sensing Solutions - Munich

Flávia holds a PhD in Physical Geography and specializes in remote sensing. She worked for 8 years in renowned remote sensing research institutes on optical and SAR sensors. Her expertise lies in forest, agriculture, and land use change in tropical forests.

QUICK RESPONSE TO NATURAL DISASTERS VIA REMOTE SENSING

by Sadra Karimzadeh

For rapid response after natural disasters such as earthquakes, tsunamis, and storms, rapid damage mapping techniques are necessary. We will be able to dispatch rescue teams to the exact location of collapsed buildings and accordingly reduce the number of casualties in the first hours after the event. Statistics show that in the current century (21st century), more than 800,000 deaths have been recorded so far due to earthquakes in different parts of the Alp-Himalayan belt *(https://www.statista.com/statistics/263108/global-death-toll-due-to-earthquakes-since-2000/)*.

Earthquakes are sudden movements of the Earth that can cause serious long-lasting damage to buildings and infrastructure within a few seconds. In 1999, a severe earthquake in Izmit, Turkey with M 7.6 left more than 17,000 casualties. Four years after the Izmit earthquake, the Bam earthquake (2003) in Iran took the lives of 26,000 people [1, 2]. These are tragic events that still continue all around the world. The main cause of casualties in the immediate aftermath of most of the previous earthquakes is physical contact of rubble and exposed people. Later on, the trapped people in the rubble of the collapsed buildings may die due to injuries, suffocation, gas network explosion, etc. [3]. Although the main reason of death is related with structural engineering issues and retrofitting of the building, additional deaths can be prevented if search and rescue teams respond in a timely manner. Here, we see the value of remote sensing.

Remote sensing earth observation systems are mainly optical and synthetic aperture radar (SAR) systems. Higher spatial resolution of optical data will facilitate detailed investigations, while all-weather all-conditions coverage can be provided by SAR. With SAR we can take images from the Earth at night time too. So, if an earthquake happened at midnight, the capabilities of long wave-length SAR data can provide us with useful information about the Earth's changes. As shown in Figure 1, at least three SAR images will satisfy the damage mapping procedure based on the coherence values.

Figure 1. Multi temporal concept of InSAR coherence between pair t1-t2 and t2-t3 [4].

After the M7 earthquake near Samos Island near Turkey and Greece, a change map of Izmir was produced from SAR interferometry technique using a set of Sentinel-1 images (24 days) over the built-up areas. The SAR images with single look complex (SLC) format were obtained from 2020.10.08, 2020.10.18 and 2020.10.30. Two coherence maps (pre-seismic) and (co-seismic) were created, in which the image obtained in 2020.10.18 was a master image for both pre-seismic pair (2020.10.18 and 2020.10.06) and co-seismic pair (2020.10.18 and 2020.10.30). In Figure 2, forward changes can be interpreted as possible earthquake damage if other anthropogenic activities (reverse changes) do not exist. In the disaster-stricken area some anthropogenic activities can be detected if reverse and forward changes are too close to each other. In Izmir port (blue square) loading and unloading of cargo containers can be observed as forward and reverse changes. SAR data description: Incidence angle: 39 (deg.); Orbit: ascending 131; Look direction: west-to-east.

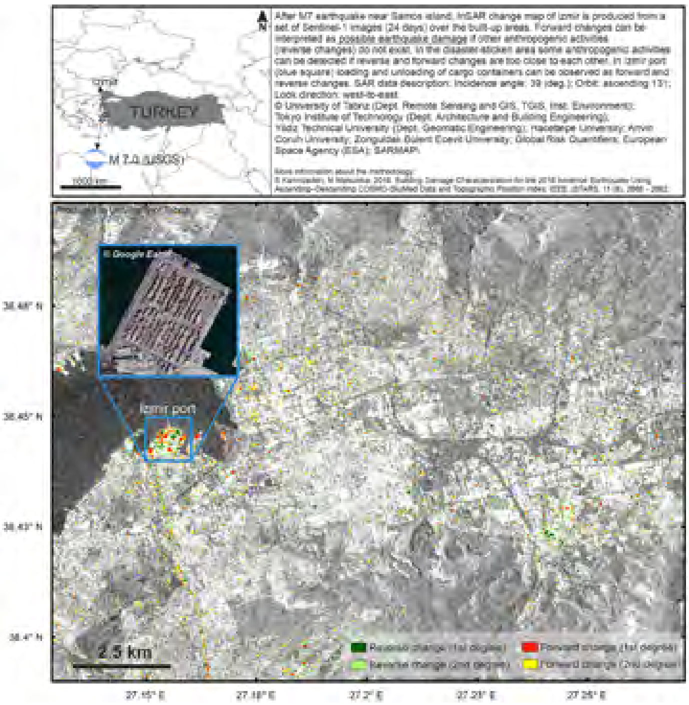


Figure 2. Change map of Izmir after M7 earthquake on 2020.10.30.

References:

[1] https://en.wikipedia.org/wiki/1999_%C4%B0zmit_earthquake

[2] https://en.wikipedia.org/wiki/2003_Bam_earthquake

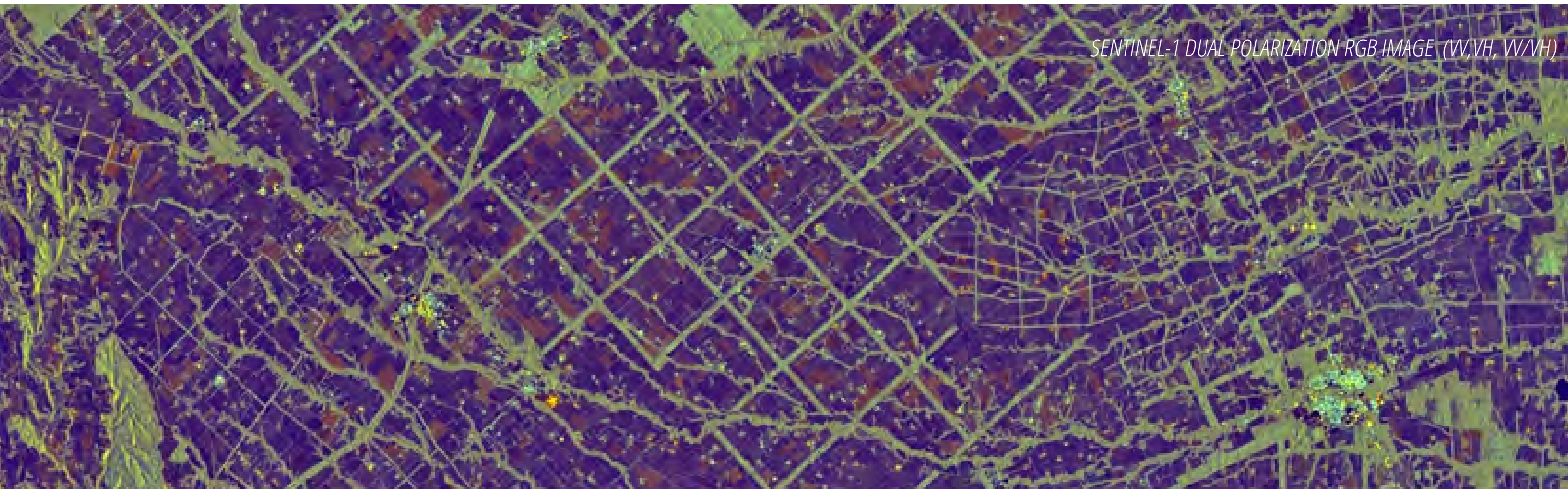
[3] Karimzadeh, S.; Feizizadeh, B.; Matsuoka, M. (2017a) From a GIS-based hybrid site condition map to an earthquake damage assessment in Iran: Methods and trends. Int. J. Disaster Risk Reduct., 22, 23–36.

[4] Karimzadeh, S.; Matsuoka, M. Building damage characterization for the 2016 Amatrice earthquake using ascending–descending COSMO-SkyMed data and topographic position index. IEEE J. Sel. Top. Appl. Earth Obs. Remote Sens. 2018, 11, 2668–2682.

About the Author

Sadra Karimzadeh
sa.karimzadeh@tabrizu.ac.ir
Assistant Professor
Department of Remote Sensing and GIS, University of Tabriz, Iran

Dr. Sadra Karimzadeh received the Ph.D. degree in engineering with a certificate of commendation from Kanazawa University, Kanazawa, Japan, in 2015. He was a postdoctoral researcher (supported by national elite's foundation of Iran) with the Department of Remote Sensing and GIS, University of Tabriz, Tabriz, Iran, in 2016. From 2017 to 2019, he worked as a JSPS researcher at the Department of Architecture and Building Engineering, Tokyo Institute of Technology, Yokohama, Japan. He also worked for the Geoinformatics Unit at RIKEN Institute (largest research institute of Japan) from January 2019 to June 2019. He is now an assistant professor of remote sensing with the Department of Remote Sensing and GIS, University of Tabriz, Tabriz, Iran. His research interests include SAR interferometry, radar imagery for earthquake damage assessment, GIS applications for disaster management, and site characterizations based on new technologies.



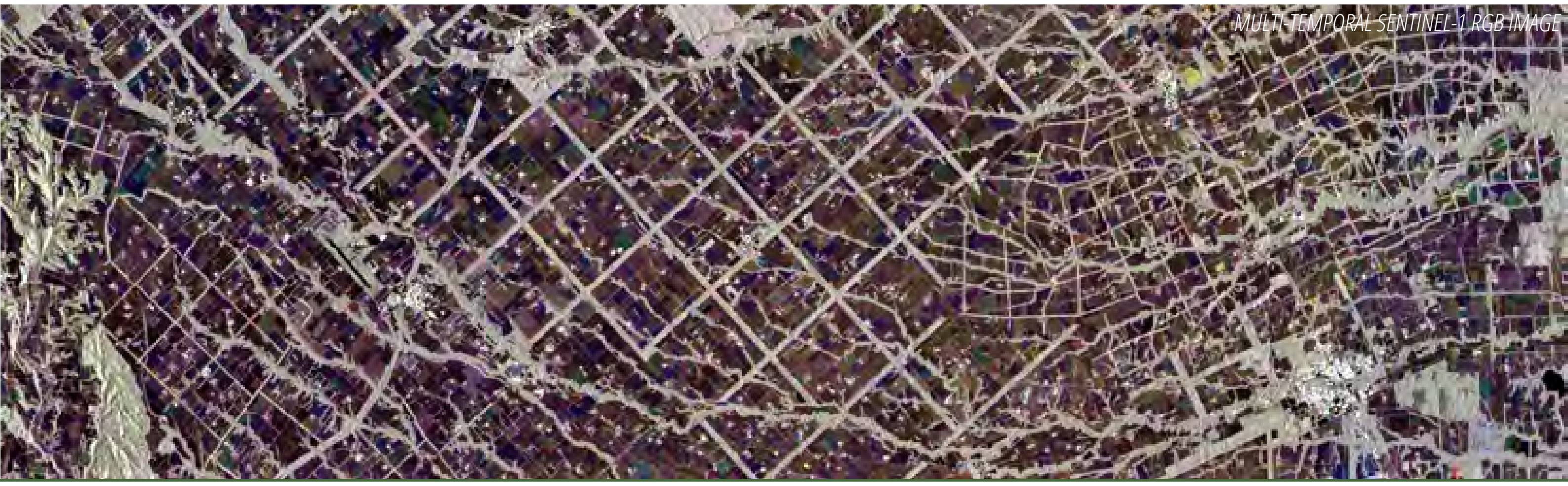
SENTINEL-1 DUAL POLARIZATION RGB IMAGE (VV,VH, VV/VH)

HOKKAIDO, JAPAN

This is in the Notsuke Region of Hokkaido island (Japan). Forests are managed to grow in strips across the landscape to form square grids that act as windbreaks, sheltering crops, grasslands and animals from harsh weather events. One multi-temporal Sentinel-1 image (the one grey with colours), and one RGB using polarizations (VV,VH,VV/VH).

BY DR. PEDRO RODRÍGUEZ-VEIGA

NOTES:
ESA Sentinel-1 C-band SAR dual pol. scenes with 10m spatial resolution.
By multi-temporal RGB, I mean that each channel of the RGB is from a different date.
In the case of Sentinel-1 each channel is an annual mean composite.
I use the crosspolarized band (VH).
The data is acquired by and processed in Google Earth Engine.



MULTI-TEMPORAL SENTINEL-1 RGB IMAGE

I MPORTANT
F OCUSED
O UTSTANDING
V ALUABLE

Masanobu Shimada

Full Name: Masanobu Shimada
Current Position: Professor
Affiliation: Tokyo Denki University
Research Interests and Expertise: SAR interferometry and SAR application on forestry and subsidence

Masanobu Shimada (M'97–SM'04–F'11) received his BS and MS degrees in aeronautical engineering from Kyoto University in 1977 and 1979, respectively, and the Ph.D. degree in electrical engineering from the University of Tokyo in 1999. He joined the National Space Development Agency of Japan (NASDA, which was one of the three agencies that formed today's Japan Aerospace Exploration Agency, commonly known as JAXA), in 1979 and conducted research projects for 34 years. During that time, he made three major achievements: 1) Sensor developments including the Ku-band Scatterometer, Polarimetric Interferometric Airborne L-band SAR 1 and 2, 2) Operational algorithm developments, such as SAR imaging, interferometry, polarimetry, calibration, mosaicking and other similar applications, 3) Lead several science projects, namely, the JERS-1 SAR calibration and validation (1992-1998), the JERS-1 Science Project (global rainforest and boreal forest mapping project and SAR interferometry for detecting the deformation distribution), the ALOS Science Project and PALSAR CALVAL, and the Kyoto and Carbon Initiative using the time-series PALSAR/PALSAR2 mosaics. His most impactful achievements were the deformation detection of the Hanshin-Awaji-Earthquake using the JERS-1 SAR interferometry, generation of the world's first global SAR mosaics that depict annual deforestation change, and experimental, near real-time deforestation monitoring using the ALOS/PALSAR ScanSAR.

His current research interests are high-resolution imaging for spaceborne and airborne SARs (PALSAR-2 and Pi-SAR-L2), calibration and validation, SAR applications including polarimetric SAR interferometry, and MTI using the UAVSAR interferometry.

Since April 1, 2015, he has been a professor at Tokyo Denki University and a guest professor at Yamaguchi University. At Tokyo Denki University, he has supervised around 40 undergraduate and Master's degree students and is currently supervising two Master's degree students and 11 undergraduate students.

He has more than 110 reviewed published papers (as of 2020) and more than 400 conference papers. He has published a book titled "Imaging from spaceborne and airborne SARs, calibration, and applications" (CRC press 391 pages) in November 2018.

Can you tell us how you started working on radar remote sensing? Who or what inspired you to become a scientist in this field of study?

Forty-one years ago, I started my career as an engineer at the Tsukuba Space Center of Japan Aerospace and Exploration Agency (JAXA). My section manager gave me a research theme to focus on, which was to investigate a spaceborne microwave scatterometer for a future satellite. A microwave scatterometer is an instrument to estimate the wind vector distribution over the ocean by measuring the radar backscatter. As it was different from my major at my university, which was fluid dynamics, the radar system and the digital signal processing on the time-frequency domain were quite new to me and there were difficulties, ..but some of the ease with the use of linear theory as well as data handling on the computer were new to me and inspired me so much. The measuring principle is simple and the radar system measures the doppler frequency between the satellite and the ground and radar signal propagation delay. Still, measurement accuracy is related to the satellite motion, instrument stability, and environmental effect, i.e., atmosphere and ionosphere. It is related to nature and the instrument. My bosses, who specialized in microwave measurements, inspired me as remote sensing in space was quite new to all the scientists at that time. Five years later, the microwave scatterometer project was terminated and replaced by the synthetic aperture radar project. I joined the data processing of the first Japanese spaceborne SAR, the JERS-1 SAR project. In this regard, I had an opportunity to stay in NASA/JPL to research about SAR calibration and principles as well as antenna pattern calibration. During this time, I met many great SAR researchers, and I was inspired significantly by them. I decided to be a SAR researcher at this time, and after, I continued my research activities related to using microwave radar signals.

> "..I met many great SAR researchers, and **I was inspired significantly by them.**"

Can you tell us about your current research? In your own opinion, why is your research important?

I have two research themes: subsidence and forest observation using the time series L-band SAR data.

First is the detection of the local subsiding or moving areas or spots quantitatively using the time-series SAR interferometry. Interferometry was first confirmed by the Young's interference experiment in 1803 using a source of illumination to observe a low-frequency pattern on the screen. Radar interferometry is similar to this concept and interferometry using the L-band SAR works for land cover types with vegetation because of better signal penetration.

Land gradually changes due to development, natural disasters, long-term terrestrial movement, etc. These changes have occurred or may occur at every corner of the land, even our land or houses are potentially moving targets. Error sources are at the phase estimation in the ionosphere and troposphere and their corrections are highly desired. My research is the time-series analysis of the InSAR and their decomposition while minimizing potential errors.

The second is deforestation, which is an ongoing Earth issue and it contributes to global warming. Estimating the forest and non-forest areas supports monitoring changes in these these areas and helps evaluate the carbon stock, particularly,above ground biomass. For this purpose, high-resolution 4D (time series-mosaiced in space) imagery are generated. My research includes the generation of the accurate high-resolution time series SAR mosaics, which cover global forest areas. It may step forward to the carbon or carbon change estimation with the global scale SAR data.

What is the most interesting project (or research) that you've undertaken as part of your job as a scientist? Can you share with us some of your most memorable experiences or some of what you consider as the highlights of your career?

I belonged to the deforestation monitoring project for Brazil around 2010. In early 2007, three visitors from Brazil visited us and asked about the ALOS/PALSAR acquisition over the Brazilian forest. Brazil was largely deforested at that time, and while its dry season can be visible by the optical sensor, it cannot be observed in the wet season. Thus, activating PALSAR in this area to acquire the necessary imagery was requested. Though most of the SAR mode (strip mode) were already filled to observe the Earth systematically, the ScanSAR mode, with lower spatial resolution but quicker revisit time, was only available upon request. We agreed to develop the quick processing of the ScanSAR and distribution system between the ALOS/PALSAR, Earth Observation Research Center (EORC), and the Brazilian Data Center in delivering the processed ScanSAR images within 24 hours after the data acquisition of ALOS/PALSAR. After several tests, the operations were efficiently implemented, deforestation monitoring were tested and routinely performed. These advancements in the operation chain were of great interest to both Japan and Brazil. Personally, my interest in this project was to code and develop the SAR processor for optimized and high-quality ScanSAR processing and it was completed. The Brazilian Broadcasting Company visited EORC and interviewed me about the processing status and recorded the video of the operation scenes. They often asked if we found any information related to illegal logging (but, I do not know). The project lasted three years, and I had a chance to collect ground truth data in the Amazon rainforest, near Tapajos National Forest, and encountered the illegal logging scene. It was dangerous to meet the loggers because legal/illegal loggers were not clearly identified. But the forest was totally clear-cut and the burnt areas continued to smell like burning gasoline and you can smell it at any place in the survey area. I really confirmed the deforestation with my own eyes. It was several days of excursion and I observed a lot of the forest conditions. I stayed at the local hotel. During the night, I was bitten by a lot of large mosquitoes and I feared infection. But luckily, I was OK. One more memory was the dinner at the local restaurant near the Amazon river. There was a variety of baked fish such as piranha, pirarucu, etc. It tasted good but the meat was very tough to bite. I also remembered the sightseeing from the 60m tower in the forest, it was marvelous and unforgettable, and one white eagle was flying over the forest. It was so beautiful! I always remember all memories in Brazil like it was yesterday when I hear the news on the TV.

What are some of the areas of research you'd like to see tackled over the next ten years? How do you envision the progress in radar remote sensing and its potential applications and impacts on society in general?

First, I plan to apply the image processing techniques (time-series interferometric SAR processing and the time-series large scale SAR mosaic) to local and global land monitoring: locally, my city and surrounded areas in the Kanto plain of Japan are experiencing land-use changes and subsidence.The local government and companies are interested to measure them accurately and widelyand I would like to collaborate them with the spaceborne InSAR techniques to further validate their ground truthing methods for improving the accuracy and applicability. Second is to conduct global forest monitoring, especially tracking changes in forest/non-forest areas, using the frequently available ScanSAR data and the high-resolution but annually acquired strip data. This is a collaborative project with the Japan Internationa Cooperation Agency (JICA) and JAXA. Recent spaceborne SAR has superb performance and there is a large volume of data. Implementation of the 4D data preparation is the key to global forest observation.

> *Implementation of the 4D data preparation is the key to global forest observation.*

What are some of the biggest challenges you face as a scientist in your field? Are tthere any common misconceptions about this area of research?

This is not a misconception, but data analysis is moving towards time-series analysis since the early 2010s, where the data is precisely analyzed for a scene, two or three combined with the model, and the large data are mainly used for the statistical validation. Then, the time-series data are effectively used for parameter estimation. Thus, it is necessary that the co-registration of all the data separated in time is as accurate as possible. Orbital geometry, time accuracy, and DEM accuracy as well as satellite maintenance will need to advance in order to implement these processes. Thus, I think interferometry and change detection using time-series data must all be handled in a time-space plane.

In that regard, I am still challenged in creating a global scale mosaic data, which is the radiometrically and geometrically calibrated orthorectified slope corrected (radiometrically terrain corrected) time-series SAR data. This type of SAR data may lead to further utilization of the ALOS/PALSAR-PALSAR-2 data for monitoring land-use change, i.e., forest/non-forest areas, land-use dynamics and land cover classification. This challenge is further aggravated with the need for bigger data storage and computer memory size as well as higher processing speeds. JAXA is now able to prepare and host large datasets, and I am cooperating with JAXA EORC.

What lessons or words of wisdom would you like to pass along to students and young researchers who are just starting their careers in Radar Remote Sensing?

My preferable statement is "continuation is power." These words encourage us and finally lead us to success or guide us to the goal, but we still need a lot of patience and failures are necessary. Radar remote sensing entirely relies on digital signal processing with the sampling theory. Recent remote sensing moves towards the high-resolution and wide imaging swath, in which time-frequency domains are effectively utilized, and thus the method becomes very complex. When I was in JPL, my boss taught me that computer simulation always allows people to understand the principle. Therefore, I copy these words at this point.

> "*continuation is power*"

Gopika Suresh

IMPORTANT
FOCUSED
OUTSTANDING
VALUABLE

Full Name:
Dr. Gopika Suresh

Current Position:
Research Fellow

Affiliation: Asian School of the Environment

Research Interests and Expertise:
SAR remote sensing for coastal hazard monitoring and marine pollution detection, Land Use and Land cover change analysis, InSAR for deformation analysis, science communication, Copernicus for the SDGs, and algorithm development in Python

I am a postdoctoral researcher at the Asian School of Environment (NTU Singapore). I am part of the Geodesy team where I develop algorithms and methods in Python to estimate and monitor coastline changes and map coastal hazards in Southeast Asia using Synthetic Aperture Radar (SAR) remote sensing data. I have a Ph.D. in Geosciences from the University of Bremen, a M.Sc. in Satellite applications engineering from the Technical University of Munich and a B.Tech in Electronics and Communications Engineering from the University of Kerala.

Prior to Singapore, I worked as a systems engineer for the METEOSAT Third Generation satellite (MTG) mission, as a postgraduate lecturer at the Frankfurt University of Applied Sciences, as a research scientist at the German Federal Agency for Cartography and Geodesy, and as a research assistant at the German Aerospace Center (DLR). My Ph.D. research focused on developing methods to detect natural oil slicks and estimate offshore oil seeps from SAR images. While working for the German Federal Agency, I developed algorithms to map land cover changes from Copernicus data and developed methods using Earth Observation data and products from the Copernicus programme for supporting the Sustainable Development Goals (SDG).

I am the co-organiser of the Twitter initiative SistersofSAR, where we aim to promote women in SAR remote sensing; the founder and executive coordinator of the 500Womenscientists-Singapore Pod, where we aim to promote women in STEM; and a member of the editorial board of "Discoveries in Remote Sensing", a section of the remote sensing journal that aims to increase representation in remote sensing.

Can you tell us how you started working on radar remote sensing? Who or what inspired you to become a scientist in this field of study?

As the daughter of a naval officer, I grew up around ships and was exposed, at a very young age, to terminology like sonar, radar, antenna, near range, far range etc. and had many opportunities to view the ship's bridge and see all the communication devices on board. We also spent many nights under the clear south Indian night sky stargazing and meteor hunting, my dad showing me the Northern Star and my mom, a passionate stargazer, teaching us about big constellations like Cassiopeia and the Big Dipper. I believe that such experiences perked my interest in science as well as in engineering. An avid reader, I became the biggest fan of science fiction and mystery novels and once American TV shows began being streamed on Indian TV, became the biggest fan of Spock and Data from Star Trek because of their scientific thinking and inquisitive attitudes. I am still a big Star Trek fan! Yet, since they were fictional, all the characters in these books and TV shows felt beyond my reach. My first real-life inspiration came in the form of astronaut Kalpana Chawla - she made my dream of studying about space and even going to space more "real". I like to think of my own childhood experiences as a constant reminder that young children in their formative years search for role models in people who look like them or come from the same cultural background. This is why I believe representation and inclusivity in every field of life is so important.

Having a knack for the sciences and mathematics, I decided to pursue an engineering degree in Electronics and Communications Engineering, where I was introduced to lectures in subjects like satellite communications and antenna wave propagation. I figured that this was my pathway to space and chose to pursue a M.Sc. in Satellite Application Engineering for which I left India and moved to Germany. While pursuing my M.Sc. at the Technical University of Munich, I had the opportunity to intern at the German Aerospace Center (DLR) where I met my first love in the form of a high resolution TerraSAR-X image. It was love at first sight and I have been in love with SAR since that day. I enjoy the mysteries of SAR data and the endless possibilities they offer.

"I enjoy the mysteries of SAR data and the endless possibilities they offer."

Can you tell us about your current research? In your own opinion, why is your research important?

Rapid economic and population growth has spurred development of new infrastructure in Southeast Asia, but this region also faces the constant threat of rising sea levels, which increase the vulnerability of coastal cities. This is the motivation behind my research which focuses on improving methods and developing algorithms to monitor coastline changes and inundation in Southeast Asia using SAR and multispectral remote sensing data. As part of my research, I have developed an algorithm that automatically detects the coastline and identifies coastal inundation from SAR images. By creating periodic maps of the coastline and comparing these to tidal gauge and mean sea level data, my research aims to identify vulnerable regions that are prone to constant coastal inundation. This will help reduce disaster risk and damage in the region and help policy makers devise strategies to make these coastal regions and coastal communities more resilient, all in line with the United Nations Sustainable Development Goals.

After spending the better part of the year focusing my research efforts on conceptualising, developing, and implementing the algorithm in Python, my coastline monitoring code is now ready and is currently being tested on Sentinel-1 datasets of the Bay of Bangkok, Singapore and Indonesia. Manuscripts are also in the pipeline. Unfortunately, due to CoViD-19 and the geographical setting of Singapore, it has been challenging to participate in conferences that occur in North American or European time zones and I have been unable to present my results at any conferences this year.

What is the most interesting project (or research) that you've undertaken as part of your job as a scientist? Can you share with us some of your most memorable experiences or some of what you consider as the highlights of your career?

Working with #SARisbeautiful data daily is the most fascinating part of my job as it allows me to travel to the depths, the heights, and so many corners of the world from home. The most interesting and, by far most challenging, task that I have undertaken as a scientist was to develop the first automatic algorithm to estimate offshore hydrocarbon seep locations by detecting natural oil slicks in SAR images, which was part of my PhD. research. It was daunting to attempt something that had not been done before, and I was a novice programmer when I started my PhD., yet the sense of accomplishment of creating something new and novel powered me until the finish line and I received the MARUM award for research in geosciences for this work. My Ph.D. was a collaboration between two institutes of the University of Bremen - the Institute of Environmental Physics and the Department of Marine Geology - and working with scientists from both fields gave me the opportunity to learn and think in a transdisciplinary sense that I believe is extremely important in our field of remote sensing. The finished product, called the Automatic Seep Location Estimator, was used to estimate the location of natural hydrocarbon seeps in the Black Sea and the Gulf of Mexico, from marine oil slicks that were detected in ENVISAT and RADARSAT images. The estimated hydrocarbon seep locations that were provided as shapefiles were then validated by research cruises conducted by scientists from MARUM (Center for Marine Environmental Sciences) using in-situ techniques.

I consider working on the Copernicus for the Sustainable Development Goals project while at the German Federal Agency for Cartography and Geodesy as another highlight of my career as it gave me the opportunity to work with national and international partners around the world such as the National Statistical Office, UN, GEO, UNOOSA etc. and helped me understand their needs from the remote sensing community.

> ***By opening our research and results to one another and to the public,*** *we will be more successful in helping build resilience and sustainability at local, regional, and global scales.*

What are some of the areas of research you'd like to see tackled over the next ten years? How do you envision the progress in radar remote sensing and its potential applications and impacts on society in general?

I think an area that still needs a lot of work and commitment is science communication and increasing national and international collaboration - especially between the developed and developing world. I believe that all our efforts in the field of SAR remote sensing must be communicated to local communities and institutions in a transparent manner that allows them to make important decisions and policies based on our cutting-edge research, applications, and results. By opening our research and results to one another and to the public, we will be more successful in helping build resilience and sustainability at local, regional, and global scales.

I am extremely passionate about the ocean and coastal region and I believe that we have heaps of potential for research in this realm, especially in Asia. Unlike 10 years ago, we have access to a range of SAR data, both archived and current, and will have access to even more data when upcoming missions like NISAR, TanDEM-L, HRWS and ROSE-L are launched. I envision more transdisciplinary approaches and would like to see more research combining different satellites and sensors, not just SAR or SAR and Sentinel-2 but Sentinel-3, Sentinel-6, GEDI, Aeolus etc. along with GPS and drone acquired data for monitoring, quantifying and understanding the vulnerabilities in the coastal ecosystem

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

Being a scientist in a new and rapidly evolving field like SAR remote sensing is a challenge in itself and involves, on one hand, handling and processing of large amounts of complex data and, on the other hand, keeping up with new missions, new data, new software, etc. As remote sensing scientists, we are required to constantly question, revisit and revise previously learned concepts, learn new programming languages, write code and spend a good amount of time dealing with bugs in codes, write manuscripts, abstracts, and grants, deal with rejections, edit/revise/review submitted manuscripts/grant proposals etc. Finding a tenure track in this field is also hard.

This field becomes tougher when you are from an underrepresented community, as many scientists in our field are coming to realise, recognise, and help rectify, thanks to all the diversity and inclusivity initiatives. As an engineer, scientist, programmer, woman of colour, and immigrant, I have faced explicit and implicit bias and discrimination in my career which have made every "normal" challenge in this field even harder. These unpleasant experiences motivated me to get involved in inclusivity and diversity initiatives in our field and I hope that we succeed in making our field more welcoming and inclusive for the next generation of remote sensing stars.

What lessons or words of wisdom would you like to pass along to students and young researchers who are just starting their careers in Radar Remote Sensing?

I do not consider myself wise enough to give out words of wisdom, so I will just share some thoughts for all of you to ponder. To all the young researchers in this field, SAR data is beautiful and mesmerizing and while it makes for pretty images and Twitter posts, it is hard to understand. But when do you comprehend it, SAR remote sensing is powerful and will give you the freedom to study any part of the Earth sciences in any region of our planet. However, responsibility and freedom are two sides of the same coin. If you continue in this field, you will be bestowed a great power, that of big data, beautiful weather and daylight independent data in different wavelengths, resolutions, and polarisations. With that power comes great responsibility: to make sure that your methods are reproducible, and that your results are correct. When they are, you have a responsibility to communicate your results/code/methods to every person on this planet, to scientists in our field and in other disciplines, to the public, to students or to local communities, so that they know the possibilities of SAR data and know who to come to when they need accurate results backed by solid scientific methodology. As India's most prominent aerospace scientist and 11th president, Dr. A.P.J. Abdul Kalam once said, "Be active! Take on responsibility! Work for the things you believe in. If you do not, you are surrendering your fate to others".

> *As India's most prominent aerospace scientist and 11th president, Dr. A.P.J. Abdul Kalam once said,*
>
> ***"Be active! Take on responsibility! Work for the things you believe in. If you do not, you are surrendering your fate to others"***

IMPORTANT FOCUSED OUTSTANDING VALUABLE

Full Name: Michael Schmitt

Current Position: Professor for Applied Geodesy and Remote Sensing

Affiliation: Munich University of Applied Sciences

Research Interests and Expertise: Remote Sensing, Earth Observation, Data Fusion, Applied Machine Learning

Michael Schmitt is a full professor for applied geodesy and remote sensing at the Department of Geoinformatics of the Munich University of Applied Sciences (MUAS). He also works as a consulting senior scientist at the Remote Sensing Technology Institute of the German Aerospace Center (DLR). Due to his habilitation, he has also been an Adjunct Teaching Professor at the Department of Aerospace and Geodesy of the Technical University of Munich (TUM) since March 2019. Before joining MUAS, Michael worked as a senior researcher at Signal Processing in Earth Observation (SiPEO), a joint venture of TUM and DLR. In summer 2016, he was a guest scientist at the Microwave Remote Sensing Laboratory of the University of Massachusetts Amherst.

His technical passion is in the fields of Earth observation and geospatial data science, i.e. he works on the extraction of geospatial information from different kinds of remote sensing data. For this purpose, he uses techniques from fields such as signal/image processing, machine learning or data fusion. For his dataset SEN12MS, which can be used to train deep learning models for the analysis of multi-sensor satellite imagery, he has won the Open Data Impact Award in 2020.

Can you tell us how you started working on radar remote sensing? Who or what inspired you to become a scientist in this field of study?

I started to work on radar remote sensing in 2008, when my studies of geodesy and geoinformation were in their final stages. I was very fascinated by the possibility of creating high-resolution images of the Earth with radar technology, and by the fact that those images could be acquired day and night, no matter if conditions are cloudy or not. Since I majored in photogrammetry, I was even more thrilled to learn that there is a related technique, called radargrammetry, which allows to reconstruct 3D information by forward intersection of range-Doppler observations. Thus, it was clear that I wanted to have my final thesis in this field. I was lucky to be accepted by Prof. Uwe Stilla for this purpose, who also offered me a job as research assistant and PhD candidate directly after my graduation. He has been a career mentor for me ever since.

Can you tell us about your current research? In your own opinion, why is your research important?

After finishing my PhD thesis in radar remote sensing, I adjusted my topic a little bit to the area of data fusion in remote sensing. I am convinced that this is an extremely important topic, as remote sensing consists of many different sensor technologies with different attributes, weaknesses and strengths. This holds in particular for the combination of optical and radar data.

With my research, I am trying to get as much information as possible out of those different data sources, using techniques from methodical fields such as signal/image processing, estimation theory or machine learning. Obviously, this area is very interdisciplinary, and one can cooperate with people from many different fields. [An important paper in this context is https://ieeexplore.ieee.org/document/7740215]

In recent years, artificial intelligence – or better, deep learning – has had an enormous impact on our community, improving classic tasks and enabling innovative new tasks. In this context, I am working on the development of models that allow analyzing remote sensing data independently from the observed scenes – something that is not yet an established standard in remote sensing.

".. artificial intelligence – or better, deep learning – has had an enormous impact on our community, improving classic tasks and enabling innovative new tasks."

What is the most interesting project (or research) that you've undertaken as part of your job as a scientist? Can you share with us some of your most memorable experiences or some of what you consider as the highlights of your career?

One highlight certainly was during my PhD studies, when we organized a flight campaign together with the University of Zurich and the Fraunhofer Institute for High Frequency Physics and Radar Technology. The SAR sensor was built into a military aircraft, and due to system constraints (it was an experimental millimeterwave SAR), it had to be flown at an altitude of about 700 m above ground level. Our study scene was the downtown area of Munich. On that day, quite some people called the local police, the press, and (eventually) me because they wanted to know why a big military plane was circling low over the city.

From a more technical point of view, I am thrilled by the possibilities of deep learning-based image-to-image translation – from SAR imagery into (artificial) optical imagery, from cloudy optical data to cloud-free optical data, from single images into digital elevation models etc. These are techniques that at least I could not have imagined 10 years ago.

What are some of the areas of research you'd like to see tackled over the next ten years? How do you envision the progress in radar remote sensing and its potential applications and impacts on society in general?

I'd like to cite Prof. Franz Meyer (University of Alaska Fairbanks) on that one: Like him, I am convinced that we are currently living in the golden age of SAR, with ever more satellites in orbit, private companies building their own systems and offering data and products. Being a bit biased by my research agenda, I think one of the strongest potentials still lies in data fusion, but with a growing focus on time series instead of single-date multi-sensor imagery. With an intelligent combination of SAR and optical satellite image time series, we will more and more be able to provide a quasi-continuous monitoring of our Earth, no matter if it is aiming at our environment or critical tinfrastructure.

I think one of the strongest potentials still lies in data fusion

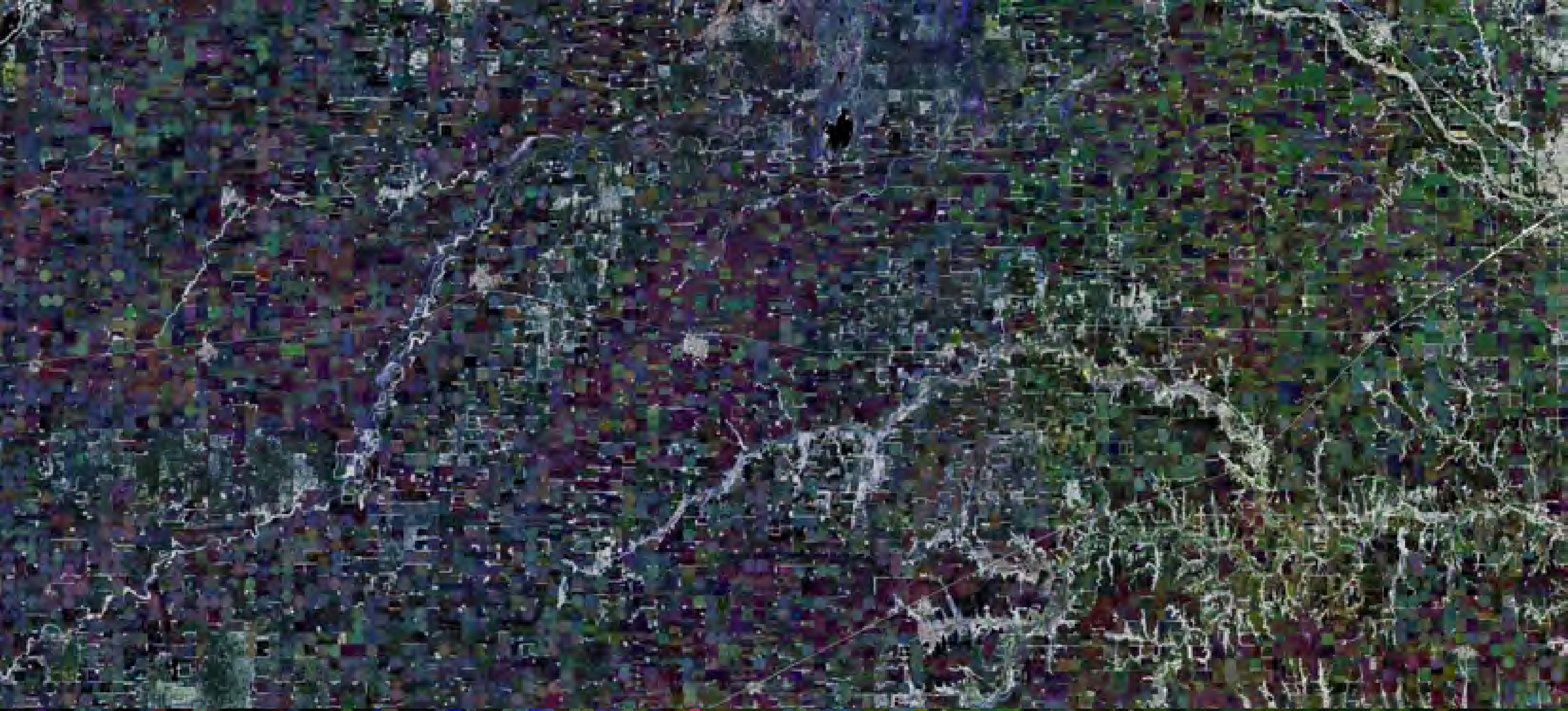
What are some of the biggest challenges you face as a scientist in your field? Are there any common misconceptions about this area of research?

Frankly speaking, I think right now the biggest challenge is that with more and more open remote sensing data being available, and with deep learning techniques at everyone's disposal, the competition in the scientific community has become much harder than it used to be in remote sensing, when having exclusive access to data already made half the next publication. Now, you have a good idea, and before you turn around, somebody has published something similar. But of course, this makes it also exciting!

What lessons or words of wisdom would you like to pass along to students and young researchers who are just starting their careers in Radar Remote Sensing?

In the beginning, try to focus! Even a relatively small field such as radar remote sensing covers a wide range of topics, from the hardware and system design via the signal processing algorithms for image focusing and techniques such as InSAR, TomoSAR etc. to modern machine learning approaches for information extraction. If you are just starting, you cannot cover everything, so I think it's best to first become an expert in one topic, and then broaden your skill set later.

*"..I think it's best to first become an expert in one topic, and then **broaden your skill set later.**"*



KANSAS, US

Centre pivot irrigation fields in Kansas

MULTI-TEMPORAL S1 AND PALSAR/PALSAR-2 RGB SCENES

BY DR. PEDRO RODRÍGUEZ-VEIGA

NOTES:

ESA Sentinel-1 C-band SAR dual pol. scenes with 10m spatial resolution.

JAXA PALSAR/PALSAR-2 (ALOS PALSAR / ALOS-2 PALSAR-2) refers to the freely available L-band SAR dual pol. annual mosaics generated by JAXA at 25m spatial resolution.

By multi-temporal RGB, I mean that each channel of the RGB is from a different date. In the case of Sentinel-1 each channel is an annual mean composite, for PALSAR/PALSAR-2 is an annual mosaic. I use the cross-polarized band (VH for Sentinel-1, and HV for PALSAR/PALSAR-2) in all cases.

The data is acquired by and processed in Google Earth Engine.

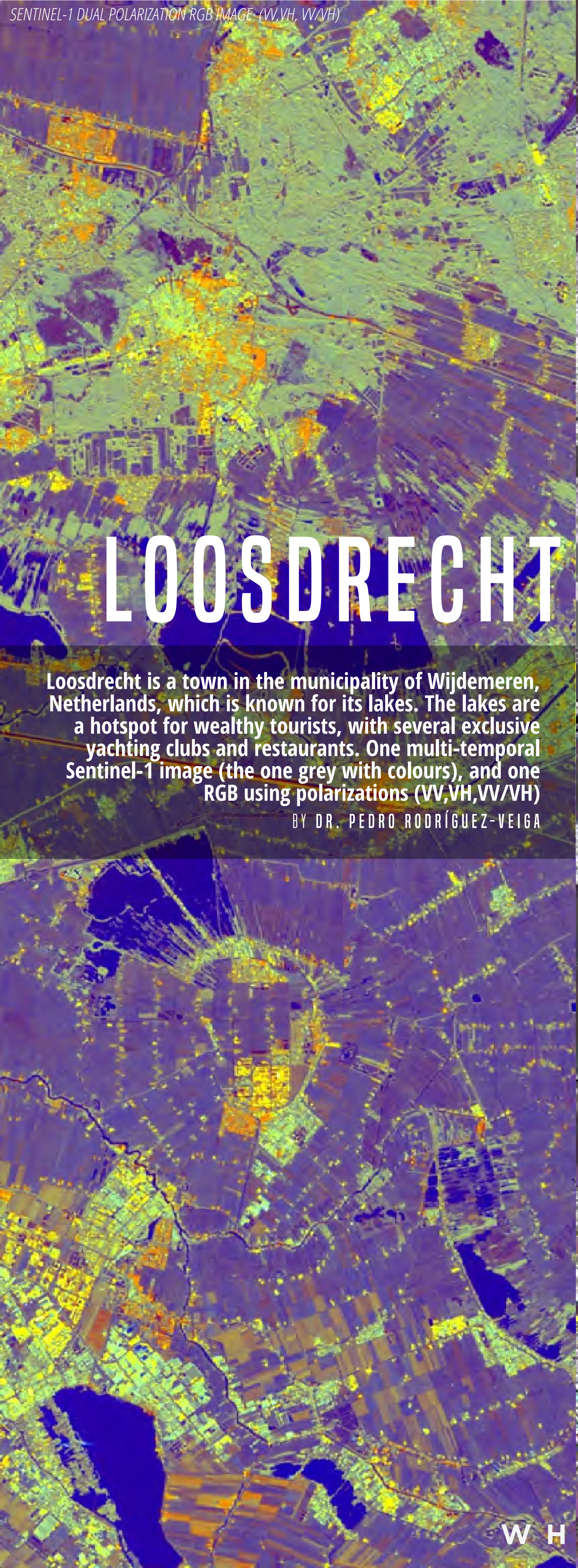

CALL FOR APPLICATIONS
THE ISPRS STUDENT CONSORTIUM
LEADERSHIP AND SERVICE MENTORSHIP PROGRAMME
DEADLINE OF APPLICATION IS
EXTENDED
UNTIL
01.08.2021
FOR MORE INFORMATION:
ISPRS STUDENT CONSORTIUM


JAN 2021
06
GEO MIXER
9AM NEW YORK | 3PM BERLIN | 2PM UTC | 10PM SINGAPORE | 1AM 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 ➲ bit.ly/2021GeoMixer
ORGANIZERS
ISPRS
GRSS
MS IEEE GRSS Student Chapter
asprs THE IMAGING & GEOSPATIAL INFORMATION SOCIETY
STUDENT ADVISORY COUNCIL
This cover has been designed using resources from Flaticon.com and Freepik.com

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 *early bird* 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 *regular* registrations
3 JULY 2021	Deadline for *late* registration

SENTINEL-1 DUAL POLARIZATION RGB IMAGE (VV,VH, VV/VH)



MULTI-TEMPORAL SENTINEL-1 RGB IMAGE

LOOSDRECHT NETHERLANDS

Loosdrecht is a town in the municipality of Wijdemeren, Netherlands, which is known for its lakes. The lakes are a hotspot for wealthy tourists, with several exclusive yachting clubs and restaurants. One multi-temporal Sentinel-1 image (the one grey with colours), and one RGB using polarizations (VV,VH,VV/VH)

BY DR. PEDRO RODRÍGUEZ-VEIGA

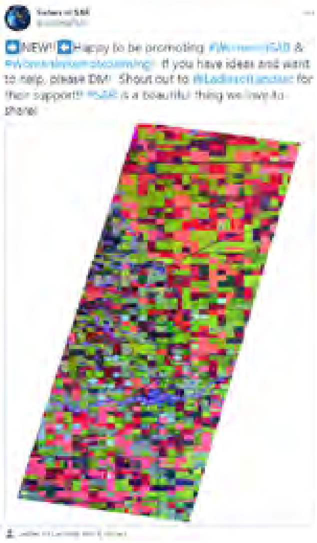
NOTES:
ESA Sentinel-1 C-band SAR dual pol. scenes with 10m spatial resolution.
By multi-temporal RGB, I mean that each channel of the RGB is from a different date.
In the case of Sentinel-1 each channel is an annual mean composite.
I use the crosspolarized band (VH).
The data is acquired by and processed in Google Earth Engine.

Our main goal is to share the exceptional advancements in SAR research and engineering around the world while showcasing amazing **#WomeninSAR** and promoting the accomplishments of **#WomeninSTEM**

BEGINNINGS

Our concept evolved out of discussions with Morgan Crowley of **@LadiesofLandsat** (LOL) during a #SAR training session in Ottawa, (Canada) in 2019. We were also encouraged by the IEEE Geoscience & Remote Sensing Society (GRSS) Inspire Develop Empower and Advance (IDEA) #IDEA committee. We wanted a Twitter handle that spoke to the link with the LOL and conveyed our support of women in SAR. This challenge was taken up by Laura Dingle Robertson and Heather McNairn - both from Agriculture and Agri-food Canada - and Sarah Banks of Environment and Climate Change Canada. With Morgan's input the team settled on a plan, and **@SistersofSAR** (SOS) was born. Sarah originally obtained the Twitter feed name in August of 2019 and we officially launched on April 27, 2020! We realized very quickly that we would need help, and the very next day Gopika Suresh of the Asian School of Environment/Earth Observatory of Singapore stepped up! We were also fortunate to receive support from Virginia Brancato of JPL NASA (California). Currently, we have more than 2,400 followers and a weekly tweeting format to showcase SAR research and women in remote sensing with participation from all around the globe.

@SistersofSAR content



#SARFact Mondays

Starting the week on a quirky and informative note, we post SAR facts about sensors, missions, SAR frequencies, SAR concepts, and other fun tidbits of information. There are so many different and unusual aspects to SAR and we want to help uncover the mysteries and dispel myths surrounding SAR with the help of experts, everywhere.

#TrainingTuesdays

We know that SAR is perceived as being complex! Our goal with Training Tuesdays is to highlight the myriad of available SAR training material around the world, available on-line and for free. We also provide links to training guides, along with upcoming SAR and Remote Sensing conferences and meetings.

#WomenWednesday

@SistersofSAR is all about celebrating amazing women in STEM in general and SAR research in particular. Every Wednesday we highlight a Twitter feed from around the world that supports women, champions gender equity, boosts marginalized communities, promotes geoscience and STEM for the next generation, and brings attention to and promotes opportunities for Women in STEM.

#PictureDay

is on Thursday and on this day we demonstrate that SAR images are not just fuzzy greyscale pictures but can also be incredibly beautiful. We focus on retweeting work and images from our followers along with providing some content ourselves from our friends and colleagues. But #PictureDay is not just about nifty SAR pictures. We also provide informative explanations about these interesting images including details on sensors, frequencies, and polarizations.

#SAR_STAR Fridays

are our pride and joy! The SAR_STAR is a woman at any point in her career. We give a few details of her choice which often includes education, employment, SAR favourites, SAR applications, and quirky details. Our STAR provides pictures from conferences, field work or personal life along with journal articles or conference presentations. These tweets are generally threaded and we try and tag the institutions and colleagues that the STAR has been associated with. As of November 20th we have featured 30 fantastic and amazing SAR women. We are aware of the lack of women mentors in the field of SAR remote sensing and we hope to change this by promoting as many SAR_STARs as possible

NEXT UP

We continue to tweet and retweet daily, promoting women and SAR! We are also currently working with @LadiesofLandsat and our #SAR_STARs Flávia De Souza Mendes & Sheryl Rose Reyes, President of ISPRS SC, on a GeoMixer Virtual Networking Event that will be coming soon.

Give us a follow and stay tuned!

PHD Scholarships & Fellowships

PhD student opportunities on ecosystem modeling and remote sensing at UW-Madison
University of Wisconsin-Madison
Madison, Wisconsin
Deadline: 13 December 2020
Link: https://is.gd/TJ4rRj

PhD Position (f/m/x) – Remote Sensing of Biodiversity
Helmholtz Centre for Environmental Research
Leipzig, Germany
Deadline: 20 December 2020
Link: https://is.gd/yLLKzS

PhD position– Remote Sensing of soil moisture dynamics (f/m/x)
Helmholtz Centre for Environmental Research
Leipzig, Germany
Deadline: 02 October 2020
Link: https://is.gd/04HtSs

PhD fellowship in UAV based remote sensing
University of Melbourne
Melbourne, Australia
Deadline: 20 December 2020
Link: https://is.gd/4RuVnC

PhD Student (f/m/d) Denoising and unmixing using remote sensing data
The Institute Freiberg for Resource Technology
Freiberg, Germany
Deadline: 31 December 2020
Link: https://is.gd/QGlooU

PhD Student (f/m/d) Real-time detection and characterization
The Institute Freiberg for Resource Technology
Freiberg, Germany
Deadline: 31 December 2020
Link: https://is.gd/U0YRry

PhD Student (f/m/d) / Master's degree in remote sensing, machine learning or related fields / Development of denoising approaches based on advances in signal processing and deep learning
The Institute Freiberg for Resource Technology
Freiberg, Germany
Deadline: 31 December 2020
Link: https://is.gd/6FTR0C

Multistatic SAR Remote Sensing
Cranfield University
United Kingdom
Deadline: Ongoing
Link: https://is.gd/IQ71AY

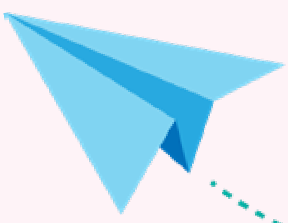
PhD position (f/m/x) – Remote Sensing of land-atmosphere coupling and hydro-climatic extremes
Helmholtz-Zentrum für Umweltforschung
Leipzig, Germany
Deadline: 01 January 2021
Link: https://is.gd/x0aL16

PhD position (f/m/x) – Climate extremes in tropical ecosystems - an assessment through data and models
Helmholtz-Zentrum für Umweltforschung
Leipzig, Germany
Deadline: 01 February 2021
Link: https://is.gd/jl85Ki

POSTDOCTORAL Positions & Jobs

Postdoc in AI for population mapping in Africa
The Ecole polytechnique fédérale de Lausanne (EPFL)
Lausanne, Switzerland
For additional information, please contact Prof. Devis Tuia (devis.tuia@epfl.ch)
Link: https://is.gd/8ajepZ

Postdoc in radar remote sensing of ground motion
Chalmers University of Technology
Göteborg, Sweden
Deadline: 11 December 2020
Link: https://is.gd/XEVq0O



Postdoc (m/f/d) Real-time detection and characterization
The Institute Freiberg for Resource Technology
Freiberg, Germany
Deadline: 31 December 2020
Link: https://is.gd/176a0b

Postdoc (m/f/d) Change detection and time-series data analysis using remote sensing data
The Institute Freiberg for Resource Technology
Freiberg, Germany
Deadline: 31 December 2020
Link: https://is.gd/l2pxtd

PostDoc (m/f/d) MOSAiC Airborne and Satellite Remote Sensing of Melt Ponds on Sea Ice
Alfred Wegener Institute - Helmholtz Centre for Polar and Marine Research
Bremerhaven, Germany
Deadline: 02 January 2021
Link: https://is.gd/mZ4LNg

Professorship (f/m/d) in the field Remote Sensing of the Atmosphere
University of Bremen
Bremen, Germany
Deadline: 15 January 2021
Link: https://is.gd/BzdGzt

Professorship (W3) Remote Sensing of the Atmosphere
University of Bremen
Bremen, Germany
Deadline: 25 January 2021
Link: https://is.gd/6F4BZU

UPCOMING EVENTS

JAN
FEB
MAR
APR
MAY
JUN
JUL
2021

28 JAN *to* 04 FEB

COSPAR 2021
SYDNEY, AUSTRALIA
COSPAR 2021 is going hybrid/virtual!
Website: *http://www.cospar2020.org/*

22-25 MAR

UASG-2020
7TH INTERNATIONAL CONFERENCE ON GEOMATICS & GEOSPATIAL TECHNOLOGY (GGT) 2021
KUALA LUMPUR, MALAYSIA
Website: *http://ggt2021.uitm.edu.my/*

19-20 MAY

GEO BUSINESS 2021
LONDON, UK
Website: *https://www.geobusinessshow.com/*

07-10 JUN

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

04-10 JUL

XXIVTH ISPRS CONGRESS
NICE, FRANCE
Website: *http://www.isprs2020-nice.com/*

You are awesome!

2020 has been a challenging year for all of us.
Your support, encouragement, little acts of kindness and compassion truly made this world a better place.
Thank you 🤗

It may have been a year full of setbacks, delays, melancholy, isolation and grief. But it is also a year of appreciation, gratitude, generosity and love.

It will be a different kind of celebration and an odd way of taking a break in almost a year of staying at home.

The ISPRS SC Board of Directors celebrates life and good health with you.

May the warmth, peace and sincerity of this holiday season fill your hearts as we all look forward to better days.

♡

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.

ACKNOWLEDGEMENT

The ISPRS SC Board of Directors and Newsletter team would like to thank all the contributors of the featured articles in this issue who shared their knowledge and research experiences with us.

Also, we would like to acknowledge **Dr. Pedro Rodriguez-Veiga** and **@SistersofSAR** for their exceptional contributions.

Finally, our great appreciation to the Consortium members and everyone who contributed to the activities of the organization this year.

We wish you a wonderful break and a great start to the New Year!

SPECTRUM

This is a multi-temporal Sentinel-1 RGB scene that shows the Paraná river, natural border between Argentina and Paraguay.

BY DR. PEDRO RODRÍGUEZ-VEIGA

NOTES:
ESA Sentinel-1 C-band SAR dual pol. scenes with 10m spatial resolution.
By multi-temporal RGB, I mean that each channel of the RGB is from a different date.
In the case of Sentinel-1 each channel is an annual mean composite.
I use the crosspolarized band (VH).
The data is acquired by and processed in Google Earth Engine.