AGSE 2019

Applied Geoinformatics for Society and Environment

10th International Summer School and Conference, 11 – 14 September 2019

Digital Landscapes: Chances for Development

Dietrich Schröder, Franz-Josef Behr (Eds.)

Programme and Abstracts

Stuttgart Active Alumni Group

Conference Web Site: http://applied-geoinformatics.org/

Publications of AGSE, Karlsruhe, Germany, http://publishing.applied-geoinformatics.org/

ISBN: 978-3-943321-18-0

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Preface

Applied Geoinformatics for Society and Environment (AGSE) series of conferences and summer workshops started in 2008 in Trivandrum, initiated by the initiatives of Dr. Pradeepkumar (University of Kerala) and of the Alumni Representative of Stuttgart University of Applied Sciences, Dr. Franz-Josef Behr. After the successful follow-up conferences in Stuttgart (Germany, 2009), Arequipa (Peru, 2010), Nairobi (Kenya, 2011), Johor Bahru (Malaysia 2012), Ahmedabad (India, 2013), again Stuttgart (2014), on Kish Island (Iran, 2017), Windhoek (Namibia 2018) this year's conference is located again at HFT Stuttgart campus, Germany. As the conference is closely related to the Master's Programme in Photogrammetry and Geoinformatics, we are very pleased to combine the conference with the celebration of the 20th anniversary of this study programme.

This Master of Science program started with the first batch 20 years ago, meanwhile there is a global network of about 500 alumni graduated from the program. Since its beginning, the course is supported by the German Academic Exchange Service (DAAD) in its program for Development-Related Postgraduate Courses (EPOS).

Also AGSE 2019 is incorporated into the DAAD supported alumni work of the University of Applied Sciences Stuttgart. Therefore, participants from many countries worldwide contribute with experiences from their home countries.

With the wide topic "Digital Landscapes: Chances for Development" the summer school aims at contributions of Earth Observation and Volunteered Geographic Information (VGI) for data collection and information provision. The support of findable, accessible, interoperable and reusable (FAIR) data by Spatial Data Infrastructures (SDIs) and collaborative data custodianship is another focus.

The concept includes invited talks by international experts in combination with presentations by participants in the mornings and workshops in the afternoons on topics related to technological developments and recent data provision by Earth Observation Systems.

The objective of the conference is to 'take the benefits of geographic information technologies to a wide canvas of applicable areas'. Since 2008 we – scientists, practitioners, students and alumni – continue this path to empower one another in a participative way.

We wish this event a successful exchange of knowledge crossing borders and disciplines.

Prof. Dr. Dietrich Schröder

Prof. Dr. Franz-Josef Behr

20 Years Master Programme Photogrammetry and Geoinformatics

Dietrich Schröder

Stuttgart University of Applied Sciences, Germany

The Master of Science program in Photogrammetry and Geoinformatics of HFT Stuttgart started 1999 with the first batch. The starting point was the ending of the funding of the IPO, the International Training Center for Photogrammetry at HFT Stuttgart, and the beginning of the Bologna process to create a common European higher education area. With the demand of an academic qualification raised by former participants of IPO and the new opportunities for Universities of Applied Sciences to start 2nd cycle academic programs, the professors of the Surveying and Geoinformatics field of study of HFT Stuttgart designed the curriculum for the new Master program in Photogrammetry and Geoinformatics.

The M.Sc. course aims at educating future decision makers and senior engineers of information and land management projects, national authorities for mapping, photogrammetry, land consolidation, cadastre, forestry, agriculture, rural and urban planning or environmental monitoring. The postgraduate course offers scientific and practice-oriented education and training in the fields of photogrammetry, remote sensing and geoinformatics. An important objective is the transfer of up-to-date techniques to practice, under various technological conditions.

Photogrammetric technology is trained on modern digital workstations. Focus is on processing aerial photographs, from scanning, automated aero triangulation and acquisition of digital elevation models, to ortho-image generation and topographic and thematic mapping. Gaining experience in working with alternative data sources of increasing importance, like high resolution remote sensing satellites and radar and airborne laser scanning, round off the modern photogrammetric education.

The main topics in the field of geoinformatics are the acquisition, storage, analysis, retrieval and display of spatial related data, concerning both earth's physical features and the man-made environment. Studying the methods for data modelling in geoinformation systems, designing and handling of diverse databases, GIS-data formats, GIS customisation including programming, all accompanied by intensive training are important parts of the postgraduate course. Most recent developments like Web technologies, 3D-visualisation and integration of GIS and photogrammetry prepare course participants for the future.

The course is designed for all kinds of professional producers or users of geodata (e.g. in photogrammetry, geodesy, civil engineering, land surveying, agriculture, cartography, forestry, geography, geology), in particular from developing countries, who are involved as decision makers or project engineers in the acquisition, administration and use of geodata in the context of geoinformation systems, photogrammetry and remote sensing.

From the very beginning, the study program is supported by the German Academic Exchange Service, the DAAD, in the EPOS program; a program to support professionals from developing countries who qualify for a 2nd cycle education. Each year up to 8 applicants are selected in an elaborate process for a full scholarship.

Meanwhile, in the past 20 years nearly 500 students have graduated from the study program, coming from about 90 different countries; more than 125 of them have been funded by DAAD. The international series of conferences Applied Geoinformatics for Society and Environment AGSE gives the alumni of the study program the opportunity to meet alumni from other batches and to build an active network with benefit for their professional career.

Keywords: *Education, AGSE, DAAD-EPOS, Master program*

Programme

Monday, September 09: Pre-Conference Workshop	
08:45–16:00	**SimStadt** *Volker Coors, HFT Stuttgart (Germany)* Building 2, Lab 103

Tuesday, September 10: Pre-Conference Workshop, continued	
08:45–13:00	**SimStadt** *Volker Coors, HFT Stuttgart (Germany)* Building 2, Lab 103
15:00	**Arrival & Early Registration** Building 2, Room 111 (Office Mr. Roth)

Wednesday, September 11

08:30 – 09:30	*Registration* *Building 1, Ground Floor*
09:30-10:15	**Opening Ceremony** Building 1, Aula | Chair: Prof. Dr. F.-J. Behr **Welcome Addresses** *F.-J. Behr, Head of AGSE, Stuttgart University of Applied Sciences, Germany* *L. Gaspers, Vice-President, Stuttgart University of Applied Sciences, Germany* *D. Schröder, Programme Director Master Course, Stuttgart University of Applied Sciences, Germany* *H. Mohl, Prof. em,. Stuttgart University of Applied Sciences, Germany* *B. Göhner, Friends of HFT Stuttgart*
10:15-10:45	*Coffee Break* Atrium Building 1
10:45-12:15	**20 Years Master Programme Photogrammetry and Geoinformatics** Building 1, Aula | Chair: Prof. Dr. D. Schröder *D. Schröder, Stuttgart University of Applied Sciences, Germany* *L. Niblaze, Alumna, International Expert, Senior Adviser, Georgia* *S. Singh, Alumnus, Technology Evangelist, Stuttgart, Germany* **Keynote** **OGC's Contribution towards Sustainable Geospatial Information Collection and Sharing** *Athina Trakas, OGC Director Regional Services - Europe, Central Asia & Africa*
12:15 – 13:45	*Lunch*

Wednesday, September 11

13:45 – 15:30	**Session: Earth Observation** Building 1, Aula | Chair: Prof. Dr. E. Gülch **3D Change Detection in Urban Areas by Estimating DSM from Single Remote Sensing Images Using Convolutional Neural Network Concepts** *H. Arefi, University of Tehran, Iran* **Monitoring Urban Growth Patterns Using Spatial Metrics: A Case Study of Nyeri Town, Kenya** *M. Ngigi, Dedan Kimathi University of Technology, Kenya* **Monitoring of the Mining Operation Using Satellite Images in Colombia** *R. R. Bastidas Mendez, National Mining Agency, Columbia* **Comparison of Hyperspectral Foliar Reflection of Invasive and Non-Invasive Angiosperms** *S. N. Parambath et al., C V Raman Laboratory of Ecological Informatics, Indian Institute of Information Technology and Management-Kerala (IIITM-K), Trivandrum, Kerala, India*
15:30-16:00	*Coffee break* Atrium Building 1
16:00-18:00	**Session: SDGs and Geoinformatics** Building 1, Aula | *Chair:* Prof. Dr. D. Schröder **Environmental effects of climate change and adaptive capacity of mountain community of the Karakoram Region** *S. Baig, COMSATS University Islamabad, Pakistan* **Mapping of Small-scale Mining Concessions using UAV and GNSS Technologies: The case of Ghana** *N. Tagoe, University of Mines and Technology, Accra, Ghana* **Potential water harvesting sites for recharging groundwater Using Remote Sensing and GIS** *M. Adam, Ministry of Water Resources, Irrigation and Electricity, Sudan* **Evaluation of the Climate Hazard of Rainfall Reduction using R and ArcGIS** *J.L. Gutierrez Ossio, Climate Change and Environmental Consultant, Bolivia* **Implementation of a geoportal using Open Source software** *K. Guardado, Universidad de El Salvador, San Salvador, El Salvador*
18:30-20:30	**Come Together and Icebreaker Party** Venue: Building 2, Ground Floor (2/086)

Thursday, September 12

08:45 – 09:30	**Keynote** **Continuous Remote Sensing Imagery from Micro to Macro Scale** Matthias Möller, University of Bamberg, Germany, and Beuth University, Berlin, Germany Building 1 Basement Lecture Room U37 | *Chair: Dr. Moses Ngigi*
09:30 – 11:00	**Session: Technological Developments** Building 1, Basement Lecture Room U37 | *Chair: Dr. Moses Ngigi* **Database Transformation, Cadastre Automatic Data Processing in QGIS and Implementation in Web GIS** *H. Ostadabbas, Dr. Koch GmbH, Germany* **Integration of Barangay Management Index System to GIS using QGIS software** *D. C. Milloza, Visayas State University, Baybay City, Philippines* **Inventory and Evaluation of Bridges in Georgia** *L. Nibladze, I. Khitaridze InCor LLC., Tbilisi, Georgia* **GIS and Smart Cities** *S. Singh, InSell GmbH, Stuttgart, Germany*
11:00 – 11:30	*Coffee break* Atrium Building 1
11:30 – 13:00	**Session: VGI and Participatory GIS** Building 1, Basement Lecture Room U37 | *Chair: Prof. Dr. M. Möller* **Towards a User-oriented Facilitation of Participatory Mapping in Indonesia** *H. Ferdiansyah, Geospatial Information Agency of Indonesia, Cibinong, Indonesia* **Participatory Spatial Tool to Support Village Land Use Planning in Tanzania** *F. Mbuduka, A. Ferdinands, Private Forestry Programme, Tanzania* **From Volunteered Geographic Information to Volunteered Geographic Services: Design of a Multi-Channel, Multi-Purpose Participatory Mapping Platform** *G. Dilk, Munich, Germany* **A Volunteered Geographic Information (VGI) approach to train and validate remote sensing-based solutions for gully erosion monitoring in Namibia** *M. Orti, Namibia University of Science and Technology, Windhoek, Namibia*
13:00 – 14:00	*Lunch*

Thursday, September 12

14:00 – 15:30	**Workshop** **Using QGIS and Implementation in Web GIS** *H. Ostadabbas, Dr. Koch GmbH, Germany* Building 2, Lab 140	**Webinar** **Presentation schedule is listed below**
15:30 – 16:00	*Coffee break* Atrium Building 1	
16:00 – 17:30	**Workshop: Using QGIS and Implementation in Web GIS (cont'd)** Building 2, Lab 140	**Webinar** **Presentation schedule is listed below**

14:00 – 15:30	Workshop see above	**Webinar** Building 2, Lab 103 | *Prof. Dr. Dietrich Schröder* **Introduction** *D. Schröder, Stuttgart University of Applied Sciences, Germany* **Production of Digital Educational Resources for Distance Education of the University of El Salvador** *K. Guardado, Universidad de El Salvador, San Salvador* **Mapping Crop Water Use at all Scales – Global to Local** *S. Kagone, ASRC Federal Data Solutions, Sioux Falls, SD, USA* **Improving Research Data Discovery at PANGAEA** *A. Devaraju, MARUM - University of Bremen, Bremen, Germany*
16:00 – 17:30		*Coffee break* **Urban growth prediction of the coastal city of Lagos, Nigeria towards achieving sustainable development** *W. R. Malot, Regional Centre for Mapping of Resources for Development (RCMRD), Nairobi, Kenya* **The Dynamics of Crop Evapotranspiration of Irrigated Land in the Karshi Steppe in Modern Trends of Global and Regional Climate Change** *Z. Gafurov, IWMI International Water Management Institute, Tashkent, Uzbekistan* **Toponymic Spatial Database as a Primordial Toponymic Activity - Design and Representation** *M. Faquiri, Morocco* **Analysis of Patterns of Use and Geographic Access to Health Facilities in Urban Lagos, Nigeria** *A. I. Onyeahialam, Aberystwyth University, Aberystwyth, UK*

Webinar cont'd

17:45 – 19:15

20 Years of Digital Terrain Models in Baden-Württemberg

N. Morariu, Landesamt für Geoinformation und Landentwicklung, Karlsruhe, Germany

Requirement Management – Experiences at SSB

K. Huning, SSB Stuttgarter Straßenbahnen AG, Stuttgart, Germany

Accuracy and Use Cases of Precise Point Positioning

P. M. Kabiro, R. Kettemann, M.Ngigi, Stuttgart University of Applied Sciences, Germany

Chair: Prof. Dr. Franz-Josef Behr

19:30 – 21:00

Invited Talk: Bridging the Geospatial Digital Divide

Suchith Anand, Global Open Data for Agriculture and Nutrition, Nottingham, UK

Fuel and Fire Risk: Assessing Riverside and Mount Spokane Parks for Potential Wildfire in Washington

D. M. Chapman, University of Washington, Seattle, USA

Study of the Three-Dimensional As-Built Survey using Terrestrial Laser Scanner In the Making of BIM Based 3 Dimension Construction Model (Case Study, Light Rail Train (LRT) Palembang)

A. Y. Saptari, Bandung Institute of Technology, Bandung, Indonesia

Geospatial Mapping using R software

K. Sudalaimuthu, SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu, India

21:15 – 23:15

Early Stage Bark Beetle Infestation Detection using UAV images

R. Paudyal, Technische Hochschule Deggendorf, Deggendorf, Germany

Geoinformation Role regarding SDG's indicators/monitoring

M. Zimmermann, Federal Institute for Geosciences and Natural Resources (GBR), Hannover, Germany

Assessment of a Health Vegetation Index in Hong Kong and Colombian Amazon using Sentinel 2, Landsat 8 and GoogleEarth Engine

A.F. Ramirez, FSC Global Development, Bonn, Germany

Water Consumption Map of City of Windhoek using Open GIS Platform

K. Negussie, Namibia University of Science and Technology, Windhoek, Namibia

Enhancing Food Security and Livelihood through Submergible Flood Embankment Mapping in Haor Areas in Bangladesh

Md. Z. H. Siddiquee, Institute Of Water Modelling, Dhaka, Bangladesh

Counting sorghum panicles in the field using deep learning

L. Malambo, Texas A&M University, College Station, USA

The webinar will be continued on Friday morning, 9:45.

Friday, September 13

08:45 – 09:30

Keynote

Bubbles, Busts and Crashes – Why Rising Inequality is Economically Unsustainable

Christian Kreiß, Aalen University, Aalen, Germany

Building 1, Basement Lecture Room U37 | *Chair: Dr.-Ing. Hossein Arefi, Assist. Professor*

09:30 – 11:00

Session: Earth Observation & Technology

Building 1, Basement Lecture Room U37 | *Chair: Prof. Dr. Hossein Arefi,*

Relationship between the woody-surface area of urban trees and their fractal dimension derived from terrestrial laser scanning

G. Arseniou, Michigan State University, East Lansing, USA

Accuracy Assessment of UAV Mapping

D. Tserensangi, Spatialmodelling LLC, Mongolia

Updating Topographical Maps of Nepal by Using ZY-3 Satellite Image

S. Shrestha, Survey Department, Government of Nepal, Nepal

Mapping Evapotranspiration of Agricultural areas in Ghana

K. Aidoo, Ghana Space Science and Technology Institute, Ghana

Webinar
Presentation schedule is listed below

11:00 – 11:30

Coffee Break

Atrium Building 1

11:30 – 13:00

Session Earth Observation & Technology (cont'd)

Building 1, Basement Lecture Room U37 |
Chair: Naa Dedei Tagoe, PhD, Senior Lecturer

Semantic Web based Approaches to publish spatial data on the Web

A. Balamurugan, MARUM - University of Bremen, Bremen, Germany

Methodology for obtaining high density point clouds using low cost sensors

W. Barragan, Universidad Distrital Francisco José de Caldas, Colombia

Air pollution maps of Greater Dhaka districts (Bangladesh) using Sentinel 5P Satellite imagery

M. R. Alam, Deep Blue Globe UG, Darmstadt, Germany

Webinar
Presentation schedule is listed below

Friday, September 13

9:45 – 11:00	Session Presentation schedule is listed above	**Webinar (cont'd)** Building 2, Lab 103 | *Chair: Dr. William Barragán* **Comparison of African Satellite Rainfall Estimates (RFE) with Rain Gauge Data in the Nyando Basin, Kenya** *C. O. Gaya, Jomo Kenyatta University of Agriculture and Technology, Kenya* **Modeling Sediment Dynamics under Climate and Land Use Change** *N. G. Alghorani, University of British Columbia, Canada* **Digitalisation for Sustainability: GIS, VGI and Open Data** *S. Gupta, Bonn Alliance for Sustainability Research / Innovation Campus Bonn (ICB) University of Bonn, Germany* **Smart Pollen Monitoring: The Web-based Application for Monitoring Tree-Pollen** *T. Santhanavanich, P. Würstle, Stuttgart University of Applied Sciences, Germany*
11:30 – 13:00		*Coffee Break* Building 2, Lab 103 | *Chair: Laura Nibladze, Senior Adviser* **Development of a Photogrammetric Monitoring System for a Resource-Saving and Automated Irrigation of Crops in Open Field and Protected Environment (PLANTSENS)** *L. Rojek, Beuth Hochschule, Berlin, Germany* **Geo-Business: A way from planning to delivery - Geo Strategic Planning & Agile Mindsets** *T. U. Khan, Evosoft GmbH, Nuremberg, Germany* **Earth observation for agricultural water management: A review on recent advances and opportunities** *S. Pareeth, UNESCO-IHE, Rotterdam, The Netherlands* **t.b.a.** *D. Rawal, CEPT University, Ahmedabad, India, rawalnet@yahoo.com*
13:00-14:00	*Lunch*	

Friday, September 13		
	WORKSHOPS	
14:00 – 15:30	**Satellite Data Analytics with Google Earth Engine** *Md. Z. H. Siddiquee* Building 2, Lab 140	**Agricultural monitoring with Sentinel-1 and Sentinel-2 data** *M.C. Goméz, CERCO, RUS – Research and User Support for Sentinel Core Products-Service Operation* Building 2, Lab 103
15:30 – 16:00	*Coffee Break* Atrium Building 1	
16:00-17:30	**Data analysis using R language** *J. L. Gutierrez Ossio* Building 2, Lab 140	**Agricultural monitoring with Sentinel-1 and Sentinel-2 data (cont'd)** *M.C. Goméz, CERCO, RUS – Research and User Support for Sentinel Core Products-Service Operation* Building 2, Lab 103

Saturday, September 14	
07:00 – 08:15	**Orienteering** *Prof. Dr. Franz-Josef Behr* An orienteering walk/run of approx.. 5 km will start at 07:15 in front of Building 1. You will get a map to find your way towards the goal and back. To take a shower: Please return to your accommodation.
09:45 – 12:00	**Excursion** **Stuttgart 21** Stuttgart, Central Station | *Dr. Anja Ernst* Costs: 8 Euros, 6 Euros for students, seniors, …
12:40-13:30	*Lunch break*
13:30 – 16:00	**Television Tower** **Informal Gathering in Biergarten** *Lunch on your own*

Abstracts

Potential Water Harvesting Sites for Recharging Groundwater Using Remote Sensing and GIS

Mohammed Adam

Ministry of Water Resources, Irrigation and Electricity, Sudan

ABSTRACT

Water management will be one of the most important issues for sustainable development in the near future for many countries in the world. Due to the lack of surface water, groundwater plays an important role for modern irrigation purposes in many countries. Very often, the use of groundwater for irrigation is linked with different problems especially when groundwater is over extracted. Third world countries are suffering lack of clean water compared to developed ones. Many conflicts around the world already happen because of water resources. Moreover, due to climate change, the problem will extend in the future. The high climatic variation prone to unreliable rainy seasons leads to droughts and desertification. Besides climate change, the poor policies in many countries increases deterioration problems of water resources. Therefore, more efforts are needed from international organizations for a sustainable water management.

Shortage of drinking water for human activity, livestock and irrigation is a severe problem in different regions of Sudan. So collection of rainfall water is one important water resource management. This is achieved by designing and construction of small dams, Hafirs and groundwater wells to solve the problems. During the last decades, space borne and airborne remote sensing technologies with geographic information system (GIS) are widely used in water resources management. Nowadays satellite remote sensing has the possibility to provide wide coverage of variables such as precipitation, land cover, digital elevation, soil moisture and vegetation change that are important inputs to modern hydrological models.

In this presentation, the concepts and application of remote sensed data with GIS for rainfall harvesting in Sudan is explained in detail, including the combination of surface and subsurface data in a decision support matrix to achieve the best sites selection. In a weighted overlay analysis rank values are used for each class of all thematic data layers according to their influence on ground water recharge and factor weighted values are assigned. Finally, an accuracy check of sites being determined in GIS Software is performed by field verification. As a result, it has been proven that GIS is a powerful, cheap and simple tool for quick decision making.

Keywords: *GPS, GIS, Remote Sensing, Water Resources*

Mapping Evapotranspiration of Agricultural Areas in Ghana

Kenneth Aidoo

Ghana Space Science and Technology Institute, Ghana

ABSTRACT

Climate change has an adverse effect on the environment especially in Sub-Sahara Africa, where capacity for food production and natural resource management like water is very low. The effect of climate change on regional food security and water resource management would have to be estimated to inform proper remedy. Any variations in the availability and distribution of water would have unfavorable effect on the rural population, there-by resulting in adjustment in their socio-economic activities. Gradual improvement in regional agricultural activities under climate change means there is a demand for water for irrigation. A combined estimation of transpiration and evaporation from plants and soil in the region is critical to determine annual water requirement for food production purposes. Evapotranspiration (ET) is a major component in the world hydrologic cycle and accounts for a significant amount of water (precipitation) that returns to the atmosphere. Understanding the spatial dimensions of ET is critical in evaluating the climate effects on regional food security and water resources management. A measure of this component is challenging due to variation in precipitation and environmental changes. Of the challenges encountered in ET estimation, various methods had been developed over the years to accurately estimate ET, such as Mapping Evapotranspiration with High Resolution and Internalized Calibration (METRIC). This paper therefore, creates Evapotranspiration map for agricultural areas, using remotely sensed data by satellite, process and analyze in ArcGIS. When normalized difference vegetation index (NDVI) were related to the availability of water for irrigation purposes, the results indicate a high evapotranspiration for agricultural fields with high NDVI than fields with low NDVI.

Keywords: *Evapotranspiration, Remote Sensing, GIS, NDVI*

Air Pollution Maps of Greater Dhaka Districts (Bangladesh) Using Sentinel 5P Satellite Imagery

Md Riad Alam

Deep Blue Globe UG, Germany

ABSTRACT

Dhaka, the capital of Bangladesh, is currently being considered as a densely populated megacity in the world. Based on the air quality, it is recognized as a highly polluted city in South Asia. Air pollution poses a great threat to public health conditions, therefore it is necessary to monitor air quality status at high spatial-temporal resolutions and take necessary actions to fight against an increasing amount of air pollution. By using satellite remote sensing, it is possible to estimate air pollutants concentration indirectly over a large area. Satellite imageries record electromagnetic radiation and convert these into total column density. The total column density measurements data from satellite imagery and near-surface pollutants concentration data from national air quality monitoring stations were used to map different pollutants level in greater Dhaka districts of Bangladesh in this research. Due to data unavailability and time limitation, it was not possible to map all air pollutants but here atmospheric Nitrogen-dioxide (NO_2) and particulate matter (PM_{10}) concentrations in greater Dhaka districts were explored. Average atmospheric concentrations of NO_2 were found below national standard in greater Dhaka districts during October 2018. On the other hand, PM_{10} concentrations were found higher than the national standard in three districts including Dhaka, Manikganj, and Narayanganj. Mostly, urban areas showed a significant level of air pollution due to the increased number of the brick kiln and motor vehicles found in greater Dhaka districts.

Keywords: *Air Pollution, Satellite Image, Sentinel 5P*

Modelling Sediment Dynamics under Climate and Land Use Shifts in the Upper Mississippi Basin

Nisreen Alghorani

Department of Geography, University of British Columbia, n.ghorani@hotmail.com

ABSTRACT

The processes related to sediment dynamics (erosion, transport, and deposition) result from multiple driving factors (i.e., climate, relief, land use, soil texture, etc.) that interact at different spatial and time scales. Changes in these dynamics may have significant consequences on water quality, soil fertility, and aquatic habitat. Because of these potential implications, there was a need to integrate sediment transport models with hydrological and climate models. Modelling sediment yields throughout large basins is a challenging problem; erosion processes are typically episodic and highly localized making them difficult to observe, and most of suspended sediment is non-linearly related to supply controls that vary due to the spatial heterogeneity of landscape and climate.

Few existing spatially distributed physically-based models simulate the processes of sediment dynamics and are suited for projecting climate-related changes to sediment. These models, however, assume stationary conditions of land use, hence, the change in flow regime due to climate shift is assumed to be the dominant control of sediment supply. In basins such as the Upper Mississippi that have been heavily influenced by long-term and large scale anthropogenic activities, this assumption might not be adequate. Given the role of land use and land cover in altering the mechanisms of erosion in two ways: On-site by modifying surface roughness and the energy of runoff available to detach sediment; and off-site by creating an erosive flow regime at different places, the framework of modelling sediment dynamics should account for the impact of land use change. This task, however, requires a deep understanding of the mechanisms of sediment production (i.e., hillslope erosion, gullying, landslides, bank collapse, etc.); the spatial and temporal scales of changes in supply controls; and the degree of sediment connectivity.

Keywords: *Climate, Landuse Shifts, Sediment Dynamics*

Bridging the Geospatial Digital Divide

Suchith Anand

Geo4All and Global Open Data for Agriculture and Nutrition, Nottingham, UK,
Suchith.Anand@nottingham.ac.uk

ABSTRACT

The advent of free and open digital technologies and open data is making science and innovation more open and collaborative. “Geo for All” [1] aims to create openness in Geo Education for developing creative and open minds in students which is critical for building open innovation and contributes to building up Open Knowledge for the benefit of the whole society and for our future generations. In order to achieve UN Sustainable Development Goals it is essential to provide free and open source geospatial tools to universities, government organisations in developing countries. The availability of Free and Open Source GIS technologies offers a great opportunity for governments and municipal authorities in developing countries also to implement GIS tools for their decision making and help improving the lives of some of the most poorest people. By combining the potential of free and open geospatial software, open data, open standards and open access to research publications will enable the creation of a sustainable innovation ecosystem for helping solve global cross disciplinary societal challenges from climate change mitigation to sustainable cities. Free and Open Source Software for Geospatial has now made it possible for a large number of government organisations, private companies and academics in both developed and developing countries to make use of geospatial software in many application domains. This will ensure that geo digital economy opportunities are also available to economically poor countries and economically poor people worldwide.

References

[1] https://www.osgeo.org/initiatives/geo-for-all/

[2] https://blog.scielo.org/en/2018/07/13/geo-for-all-open-principles-in-geoeducation-and-science/

Keywords: *Open Source, OSGeo, Geo4All, Digital Divide*

3D Change Detection in Urban Areas by Estimating DSM from Single Remote Sensing Images Using Convolutional Neural Network Concepts

Hossein Arefi

School of Surveying and Geospatial Engineering, College of Engineering, University of Tehran, Iran, hossein.arefi@ut.ac.ir

ABSTRACT

Volumetric and 3D Change detection is among major research topics in photogrammetry and remote sensing institutions which is useful in various applications such as urban and rural planning, mapping, and disaster management. Generating digital surface models (DSM) plays an important role in 3D change detection, which is still challenging especially, in the complex urban areas. The high time consuming and costly processing of DSM generation from images the researches are still improving. Height estimation from a single remote sensing image is a groundbreaking and challenging issue which makes feasible computing of 3D changes with lower time and processing cost. In order to address this issue, a deep convolutional neural network with an encoder-decoder structure is proposed. In the encoding part, a residual network is used to extract the local low-level and global high-level features of the different scales from the input image. A feature fusion strategy is utilized in the decoding part in order to reconstruct the geometry structure of the region and estimate the height values by utilizing the extracted features. The proposed convolutional neural network (CNN) framework is trained using single remote sensing images and their corresponding DSMs and the trained network is employed to estimate DSMs of the other single images which are captured at different time periods. Finally, 3D change maps are obtained by analyzing and comparing the estimated DSMs of different time periods. As the estimated DSMs belong to the different time periods, the structure of urban changes can be realized by computing the difference of the estimated DSMs.

Keywords: *Deep Learning, Convolutional Neural Network, Change detection, Sentinel*

Relationships between the Woody-Surface Area of Urban Trees and their Fractal Dimension Derived from Terrestrial Laser Scanning

Georgios Arseniou[a], David W. MacFarlane[b], Matthew Baker[c] and Dominik Seidel[d]

[a,b]Department of Forestry, Michigan State University, East Lansing, Michigan, USA
[c]Department of Geography and Environmental Systems, University of Maryland- Baltimore County, Baltimore, Maryland, USA
[d]Department of Silviculture and Forest Ecology of the Temperate Zones, Georg-August-Universität Göttingen, Germany

ABSTRACT

Urban trees are important contributors to the environment, providing a wide range of amenities that benefit humans (e.g., shade and water purification) and wildlife. There is a need to better understand the form and function of urban trees and the impacts of the urban environment. Biological theory suggests that trees have a fractal-like geometry and Terrestrial Laser Scanning (TLS) provides an unprecedented opportunity to characterize urban tree canopies and to quantify their fractal dimension, more simply described as their space-filling character. Two metrics, the box dimension and path fraction, can be derived from 3D point clouds of trees generated with TLS. We conducted an analysis of 29 trees of broad-leaved deciduous species scanned on the Michigan State University campus during the leaf-off period. We expected a relationship between the fractal dimension and the total surface area of tree stems and branches, which scales with tree respiration (i.e. tree construction and maintenance cost) and is thus of biological interest. We examined the relationship of the total-woody surface area of the urban trees (derived from point clouds) as a power function of the box dimension and the path fraction (also derived from point clouds). The results showed a strong positive correlation between the total woody-surface area and the box dimension, though not with the path fraction. This study demonstrates the potential for TLS technology to study important biological characteristics of urban trees.

Keywords: Terrestrial Laser Scanning, *Fractional Dimension, Woody Surface Area, Urban Trees*

Environmental Effects of Climate Change and Adaptive Capacity of Mountain Community of the Karakoram Region

Siddique Baig

COMSATS University Islamabad, Pakistan

ABSTRACT

About 500 Km long Karakoram mountain range covering ~ 207000 Km² land area encompasses parts of China, Pakistan, India, Tajikistan and Afghanistan. Response of mountain communities of Karakoram (majority in Gilgit-Baltistan) and their means of adapting to climate change (e.g. variations in rainfall/precipitation, anomalous glacier behaviors and temperature patterns) are unique. They employ a wide range of indigenous climate change handling and countering strategies like food storage for winters, inland migration to low-altitude areas, change in crop cultivation strategies, many of which are practical in the short term, but may enhance susceptibility in the long term. However, there is a lack of ground data obtained from communities pertaining to state of the climatic and environmental changes especially vulnerability and capacities accompanying receptive behaviors of mountain communities. Furthermore, data pertaining to access of mountain communities to mountain specific features like social services (e.g. electricity, clean drinking water, etc.) is lacking. To deal with this gap, we conducted a representative house-hold survey to explore environmental changes (e.g. climatic conditions, weather events, hazards, fluctuations in glacier size, water availability, disappearance of plants or animals, diseases on crops, livestock, health problems, food diversity) partially verified through GIS maps and adaptive capacity of communities living in 16 settlements within four sub-regions of Gilgit sub-basin in the Upper Indus mountain environments. Definitions provided by the Intergovernmental Panel on Climate Change (IPCC) are adopted for magnitude and hostile effects of climate change on mountain system and communities. The results show ~ 61% villages took crop adaptation as a strategy to minimize the negative effects of climate change. Mostly, dry season and change in the timing (duration) of cropping season are reported to be main weather events during the last 10/20 years resulting in less-food, less-harvest output. Floods followed by landslides remained the major hazard over the past 10/20 years resulting in financial losses and migration. Temperatures increased over the past 10/20 years while glacier sizes decreased. Less-snowfall followed by less-rainfall is reported over the same time period. Certain plants and mammals disappeared while new diseases appeared affecting livestock and crops. Majority of villagers reported that new varieties of seeds, food and fruits from low-land markets came into the mountains. Therefore, crops and food is stored for 0-3 months. In contrasts with earlier finds, services (jobs) followed by agriculture and business have become the main source of income. Mountain communities of Karakoram live in pockets or valleys therefore the conducted survey is not a representative of the entire Karakoram Range.

Keywords: *Karakoram; Vulnerability' Environment; IPCC*

Semantic Web based Approaches to publish Spatial Data on the Web

Aarthi Balamurugan

MARUM - University of Bremen, Bremen, Germany

ABSTRACT

Semantic web is an extension of the current web which allows the machines to share and to process the data on the web effectively and automatically. The web of data is stored and represented as a basic data model using the Resource Description Framework (RDF) where the data are stored as triples. The Web Ontology Language (OWL) provides the additional meaning to the RDF which provides information about the classes, properties and instance of the class. The data are supposed to become more accessible and analysable, an aspect which is particularly important for the rich amount of geospatial data which are often not directly searchable and accessible.

An application will be developed using the existing ontologies like schema.org vocabularies. The RDF data are created using the existing ontologies and merged with the application to make the machines understand. The application will be developed using the rich snippets so that the application is easily crawlable and understandable by the search engines. The spatial data are linked to other resources like GeoNames, Wikidata and DBpedia to create the web of data. The spatial data is displayed spatially using semantic web technologies like RDF and ontologies. This makes the data more accessible, crawlable and linkable. The application provides the information about the spatial data through persistent URIs.

Keywords: *Semantic Web, RDF, OWL, Ontology, URI, Vocabulary*

Methodology for obtaining high density point clouds using low cost sensors

William Barragán

Universidad Distrital Francisco José de Caldas, Colombia, wbarraganz@googlemail.com

ABSTRACT

This paper presents a methodology for obtaining high density point clouds using two different sensors, firstly, with Earth Lidar technology, on the other hand with a RGB-D sensor. Its application was fixed in the documentation and modeling of a monument considered Colombian heritage, the final result was the representation and visualization in a three-dimensional model, together with the different precision comparisons. The project was carried out through three phases: The first was the capture of the point clouds with the two different sensors, the second was the processing of the clouds preparing the information for the modeling and visualization in third dimension and the last phase, comparison of precisions and validation of results

Keywords: *Virtual 3D Model, Kinect, Terrestrial Laser Scanner, point cloud*

Monitoring of the Mining Operation Using Satellite Images in Colombia

Rafael Ricardo Bastidas Mendez

National Mining Agency, Columbia, rafaelr.bastidasm@gmail.com

ABSTRACT

The National Mining Agency (ANM) was created in Colombia in 2011, as an entity attached to the Ministry of Mines and Energy, to manage the State's mineral resources and promote the optimal and sustainable use of mining resources by the environmental authorities. Monitoring mining projects and controlling its conditions is highly relevant to verify the fulfillment of the contractual obligations of the mining titles in fiscal, environmental, legal and security terms. For this reason, monitoring of the mining operation has been implemented through the use of satellite remote sensing images to support site visits to mining projects where the obligations as mentioned above will be inspected. Furthermore, the harm to the environment generated by illegal extraction of minerals can be identified and monitored by using remote sensing images to alert the authority to take action. In this presentation the overall workflow of the implementation of the satellite imagery system for monitoring mining operations will be described, it will point out the challenges in the implementation of the system and how the ANM is using it to manage the mining titles.

Keywords: *Mining, Satellite Images, Remote Sensing, Change detection, Object-based, Planet, DigitalGlobe*

Fuel and Fire Risk: Assessing Riverside and Mount Spokane Parks for Potential Wildfire in Washington

D.M. Chapman

University of Washington, Seattle, US, dchapman1995@yahoo.com

ABSTRACT

We present an analyses of fire risk and FCCS fire potentials for two major Eastern Washington state parks: Riverside and Mt. Spokane. These two state parks are highly used and in close proximation to Spokane, the 2nd largest city in the state. Surface fire potentials for Mt. Spokane were predominantly "medium." Crown fire potentials were similar, with 53% and 30% of the park falling into the "medium" and "high" categories, respectively. Available fuels were high across the park, with 36% and 38% falling in the "high" and "very high" categories, respectively. Most of Riverside's surface fire potentials were "low" to "medium," with 31% and 36% of the park falling into these two categories, respectively. Both crown fire and available fuel potentials are predominantly low for Riverside. We conclude that there are areas in need of immediate fire risk reduction treatments in both parks, but that these areas are more prevalent in Mt. Spokane State Park than Riverside. Our results show that Mt. Spokane has greater available fuel and higher crown fire potentials than Riverside. However, Riverside experiences hotter, drier conditions for a longer time period than Mt. Spokane due to its lower elevations and lower snow retention. When taking these additional weather and fuel moisture into consideration, as well as its urban location, Riverside's potential fire risk may be higher than Mt. Spokane. These fire risk and fuel modeling results from FCCS will be used in tandem with the high-priority cultural, recreational, and social considerations for each park, such as: proximity to roads and development, presence of rare and important natural, cultural, or historic resources, and risk compounding factors like insect and disease outbreaks. Using these analyses and most recently collected vegetation data, WSPRC will decide on future management option.

Keywords: *Wildfire, Land Management, Fire Effects, Satellite Imagery*

Improving Research Data Discovery at PANGAEA

A. Devaraju

MARUM - University of Bremen, Bremen, Germany

ABSTRACT

PANGAEA is a digital repository for Earth and Environmental Science datasets. It is jointly managed by the Center for Marine Environmental Sciences (MARUM) and the Alfred Wegener Institute, Helmholtz Center for Polar and Marine Research (AWI). To date, PANGAEA has published more than 380,000 scientific datasets from projects, cruises, institutions, and individual scientists. This talk summarizes the repository's solutions to improve the findability and discovery of PANGAEA datasets. This includes linking datasets to related research objects (e.g., people, specimen, instruments, projects), improving data discovery through a recommender system and publishing structured metadata of datasets using schema.org.

Keywords: *Earth Observation, PANGAEA, Data discovery*

From Volunteered Geographic Information to Volunteered Geographic Services: Design of a Multi-Channel, Multi-Purpose Participatory Mapping Platform

Georg Dilk[a], Franz-Josef Behr[b]

[a]Iteratec GmbH, Munich, Germany, geo.d@posteo.de
[b]Stuttgart University of Applied Sciences, franz-josef.behr@hft-stuttgart.de

ABSTRACT

Populations across the world are facing different kind of disasters and crises every year. Even in our modern information era, disasters cause not only constantly rising economical damage, but also human harm.

Nevertheless, nowadays emergency response forces can get an overview of the crisis significantly faster than a decade ago. This is mainly due to the spread of smartphones, that allow everyone to create geographical information, the so-called Volunteered Geographic Information (VGI). The main benefit of VGI is the enormous speed at which geographical data can be collected. Nowadays different projects and platforms use VGI in multiple manners and for a wide variety of purposes, ranging from daily use to scientific applications and especially disaster management. In the field of disaster management, VGI is often collected from different social media platforms and mainly used to create a live map on the crisis.

As helpful as VGI may be, in such emergencies, one of its crucial impediments becomes evident: the requirement of an Internet connection. Lack of Internet is a reality in most developing countries, becoming more frequent if not permanent during crises. Another problem of many VGI-Projects is that they focus mainly on collecting information, but miss the opportunity to provide users with functions for mutual help.

The present work proves the technical feasibility for a new participatory mapping platform that overcomes the necessity of Internet by using SMS. Moreover, it enables a user-friendly collaboration between participants by incorporating the new concept of Volunteered Geographic Services (VGS).

The final product of this work is an evaluated sample participatory mapping platform, with a versatile Android-App as the main component, which not only allows users to provide spatial participatory information via Internet and, more important, via SMS, but provides users with a tool for multiple help and exchange of items.

Keywords: *VGI; VGS; Disaster Management*

Toponymic Spatial Database as a Primordial Toponymic Activity - Design and Representation

Meryem Faquiri

Rabat, Morocco

ABSTRACT

Toponymy (geographical names) is an essential component of topographic maps, this information has to be updated as well as the topographic information. The toponymic activity consists in the implementation of a set of technical tasks: collection of geographical names, validation and cartographic representation.

The extensive and increasing availability of collected toponymic data makes it increasingly difficult to manage this information even using traditional relational database. As more users are interested in retrieving information related to the locations and geometric properties of spatial objects, relational database technology is inadequate for managing spatial data. That means it is quite tedious to build a spatial database. The fundamental outlook and perspective required to achieve the objectives leads into the design of spatial toponymic database.

Developing a spatial database normally starts with developing a data model (which relates to the conceptual, logical and physical data modelling). The main steps for the task are:

- Analyze user environment and existing data and systems: products and datasets
- Determine the purpose of toponymic database and new future system
- Database conception: structure and organization of the data
- Choose a DBMS and implementation
- Choose of adequate tools for developing GUI to access to the spatial toponymic database
- Representation and visualization of the toponymic database in a GIS

Keywords: *Toponymic database, toponymy*

Towards a User-Oriented Facilitation of Participatory Mapping in Indonesia

Harry Ferdiansyah

Informasi Geospasial, Cibinong, Indonesia

ABSTRACT

Following the enactment of Geospatial Information Act in Indonesia, Participatory Mapping faces some challenges as the regulation applies practically on every aspect of the spatial-related activity that conducted in Indonesia region. This study explores the technical aspect of spatial data production regarding participatory mapping in Indonesia under the new situation. An interview and document research was taken to investigate in what way the participatory mapping actors have to accord in performing spatial data production that affected by the Act. It also includes the assessment of the initial steps that have been taken by National Mapping Agency to facilitate participatory mapping activities. The result shows there are several gaps need to be filled to find the decent solution to enable spatial data collaboration between the actors.

Keywords: *Participatory Mapping, National Mapping Agency, Spatial Data Collaboration*

The Dynamics of Crop Evapotranspiration of Irrigated Land in the Karshi Steppe in Modern Trends of Global and Regional Climate Change

Zafar Gafurov

IWMI International Water Management Institute, Tashkent, Uzbekistan

ABSTRACT

The current research aims to improve research analyses in the context of climate change and analyzes data on climate from the Global Circular Models (GCM), meteostations and remote sensing (RS) information using advanced tools and methods for improved water resource management. Water availability is crucial for development in Central Asia, and proper distribution and management of water in the agricultural sector is a major challenge under climate change. The technical method and approaches used in this work represent an advanced methodology to examine climatic variables and their dynamic changes to make future projections. It also employs RS-based approaches for future equitable water distribution and its balance in small or large scale areas. Therefore, this research will give an overview of how to analyze climate change and evapotranspiration (ET) rates using GCM and RS information for water management purposes. As ET is a part of water balance calculations and is a key element for water management and irrigation scheduling, the outputs and findings of this study can be used as an evidence base for more efficient water management in the region.

Keywords: *Water management, irrigation, Central Asia, Climate Change*

Comparison of African Satellite Rainfall Estimates (RFE) with Rain Gauge Data in The Nyando Basin, Kenya

Charles Onyango Gaya[a], Moses Kaloki Gachari[b], John Mwangi Gathenya[c]

[a,c] Jomo Kenyatta University of Agriculture and Technology, Kenya
[b] Dedan Kimathi University of Technology, Kenya

ABSTRACT

Information on spatially distributed precipitation is an important input in agricultural production and for monitoring droughts, floods and other extreme weather events. Ground based rain gauges are widely considered to provide the most accurate measure of precipitation at any location. Conventional rain gauge estimation of rainfall requires a dense network of gauges to accurately characterize precipitation over an area. However, the spatial coverage of ground-based gauges is very poor in most parts of Sub-Saharan Africa. Satellite-derived rainfall estimates have therefore been identified as readily and economically available data that can be used to estimate the precipitation. However, rigorous validation is necessary to have some level of confidence in using the satellite products for different applications.

The African Rainfall Estimation Algorithm (RFE) is one of the initiatives of satellite rainfall estimation that was developed primarily to estimate rainfall over tropical regions of the globe where more conventional surface observations are unavailable. This paper reports on the analysis of the potential for using RFE through a comparison with available gauge data for Nyando basin in the Lake Victoria region in East Africa. Historical rainfall data for the Nyando basin are used to evaluate the satellite-derived rainfall estimates (RFE) for the period 1995 to 2012. The RFE raster dataset and the point feature class of gauging stations were integrated in a GIS environment to extract the cell values of rainfall estimates at the positions corresponding to the locations of 35 gauging stations in the basin. The values were compared with the observed gauge data for the same period.

The results show that the satellite-estimated data performed reasonably well to detect occurrence of rainfall, but they cannot be used directly to represent daily rainfall values. The product shows good results for 10-day accumulation periods where regression analysis yielded an average correlation coefficient of 0.78 for the basin in the period under review.

Keywords: *Satellite rainfall estimates, RFE, GIS*

Agricultural Monitoring with Sentinel-1 and Sentinel-2 Data

Chloé Gilles, Miguel Castro Gómez, Tereza Smejkalova

RUS – Research and User Support for Sentinel Core Products-Service Operation, Serco UK&E Local Regional Government, Italy

ABSTRACT

A wide range of different and complementary data (RADAR, optical, IR) from Sentinel-1,2,3 and now also from Sentinel-5P are nowadays available with an open and free policy. For some applications, such as agriculture, the synergy between these data has been already shown. For several applications, there has been an increasing interest in jointly using both RADAR and optical data to compensate for the limitations of using single data products alone. The combination of the weather and illumination independence and the sensitivity to the size, density, orientation and dielectric properties of SAR sensors together with the multi-spectral information related to the leaf structure, pigmentation and moisture captured by optical sensors can provide greater insight and context in many areas of application.

This half-day tutorial will demonstrate the usage of Open Tools (ESA SNAP; QGIS; R) available within the RUS environment to run a supervised classification over an agricultural area using Sentinel1 GRD and Sentinel-2 products. Participants will be able to choose between two of the most relevant machine learning algorithms used for this purpose: Random Forest and Support Vector Machine (SVM).

A multi-temporal and multi-sensor pixel-based data fusion approach will be used in various scenarios to analyse the influence of different input data in the final classification accuracy. The data fusion will be implemented at feature level (fusion of images is done before applying the core processing task, e.g. classification)

Participants will get familiar with SAR and optical data pre-processing using batch processing in SNAP and its command-line implementation (GPT) as well as using existing R scripts implemented in a Graphical User Interface (GUI) within QGIS.

Keywords: *SNAP, QGIS, R, Agriculture Monitoring, Sentinel-1, Sentinel-2*

Production of Digital Educational Resources for Distance Education at the University of El Salvador

Karina Guardado

Universidad de El Salvador, San Salvador, El Salvador

ABSTRACT

This doctoral research has the goal to develop a theoretical-methodological conception for the production of digital educational resources for the distance education modality at the University of El Salvador. Therefore, the purpose of this presentation is to describe the progress developed so far in this research, including a synthetic background and progress related with the implementation of the Online University-Distance Education Project of the University of El Salvador, together with an approach of a georeferencing study for the selection of the location of the university study centers throughout the country.

Keywords: *distance education, digital educational resources, didactic content, information and communication technologies, Geographic Information Systems*

Implementation of a geoportal using Opensource software

Karina Guardado

Universidad de El Salvador, San Salvador, El Salvador

ABSTRACT

With the advancement of information and communication technologies, the expansion of internet connection and the development of open source software in the field of Geographic Information Systems(GIS), the implementation of web-based applications like geoportals has been facilitated. Geoportals make it possible to integrate, organize and combine geospatial data from different thematic areas and make it more accessible and easier to understand by non-expert users, through the use of tools that facilitate the visualization, search and feature identify capabilities of the data in a friendly and remotely way. Therefore the objective of this presentation is to provide a methodology for the implementation of a geoportal by using opensource software applications (GeoMoose, Openlayers, Mapserver, Linux, Postgresql and Postgis), starting with the list and description of the software, services (WMS, WFS) to be used and then the steps to follow for the configuration of the web server and applications, including the creation and connection to a database. Finally, some examples of geoportals implemented with these technologies are provided.

Keywords: *geoportal, Open Source, Geographic Information Systems, technology, geospatial data*

Digitalisation for Sustainability: GIS, VGI and Open Data

Shivam Gupta

Bonn Alliance for Sustainability Research / Innovation Campus Bonn (ICB) University of Bonn, Germany

ABSTRACT

The We are at the forefront of the number of adversities which are impacting our day to day life, such as climate change, environmental health hazards, food insecurity and increasing inequalities. To tackle these adversities, we as a global community agreed to take action in the form of 17 Sustainability Development Goals (SDGs) in 2015 for agenda 2030. However, the progress made to achieve SDGs is limited and at a slower pace. We are living in an era where the significance of digital technologies is highly prevalent in human lives. Hence, it is essential to uncover how we can effectively use digital technologies, also referred to as digitalisation, for taking concrete actions for SDGs. It would be of great use to harness the recent advancements in GIS, VGI and open data for producing evidence for action planning. The presentation will discuss the opportunists offered by new interdisciplinary research methods and techniques from GIS, VGI and open innovation for sustainable development. The presentation will also highlight the need for semantically connected open data, crowdsourcing and reproducible research for Sustainability. Additionally, the presentation will showcase the recent research conducted concerning the concept of Open City Toolkit (OCT) to exercise city level digitalisation for sustainable development. These new forms of distant digital solutions are not only a luxury but also the need of the hour for inclusiveness, equality and efficient decision making. Altogether, the presentation advocates the need for participatory geospatial approaches, reproducible research and open data for converging recent digital advancements for efficient sustainability development.

Keywords: *sustainability, digitalisation, open data, reproducible research, GIS, VGI*

Evaluation of the Climate Hazard of Rainfall Reduction using R and ArcGIS

Jose Luis Gutierrez Ossio

Climate Change and Environmental Consultant, Bolivia, jl.gutierrez@gmx.net

ABSTRACT

The impacts of climate change are present around the world and governments are forced to generate adaptation processes in a more efficient way, since climate change problems usually are greater than the available resources for countermeasures. As a contribution to adaptation to climate change, this paper presents a methodology using R language and ArcGIS to rank human communities based on the criterion of hazard exposure to the climate risk of droughts. The precipitation data used for the hazard evaluation comes from a public website of the National Meteorological and Hydrological Service of Bolivia (SENAMHI). That data was pre-processed using R language by completing the missing data, and calculating the difference in the amount of rainfall between the present (from 1991 to 2016) to the past (from 1961 to 1990) period. The calculated difference, for each of the seven-station, was the input data for ArcGIS to create a raster map using IDW (inverse distance weighted) technique to interpolate a surface from point data. Based on the created raster map, it was possible to extract the cell values for every community represented as a point feature. The result of the methodology was a rank of the communities that are more exposed to the climate risk of droughts at the present and possible in the future time. That rank will help the decision-makers to select the communities that require most governmental intervention to reduce the negative effects that the precipitation reduction is causing.

Keywords: *Adaptation, Climate Change, Geographic Information Systems, Climate Hazard, Drought, R.*

Requirement Management – Experiences at SSB

Katja Huning

SSB Stuttgarter Straßenbahnen AG, Stuttgart, Germany

ABSTRACT

Why does a public transport company like Stuttgarter Straßenbahnen with a history of 150 years and rich in tradition in many a way invest in something like Requirements Management or Requirements Engineering? According to Wikipedia Requirement Management as part of Requirements Engineering is the process of documenting, analyzing, tracing, prioritizing and agreeing on requirements and then controlling change and communicating to relevant stakeholders, especially in the context of project management.

At SSB we expanded this perspective to all IT-related Requirements in the company to manage their increasing number in the context of digitizing in-house processes and passenger information.

In this presentation we will look into the motives as well as chances and risks of Requirements Management and talk about first experiences in the middle sized company SSB.

Keywords: *Requirements EngineeringPublic Transport*

Accuracy and Use Cases of Precise Point Positioning

Pithon Macharia Kabiro[a], Rainer Kettemann[b], Moses Ngigi[c]

[a,b]HFT Stuttgart, Germany
[c]Dedan Kimathi University of Technology, Kenya

ABSTRACT

High accuracy (centimeter [cm]-level) positioning using Global Navigation Satellite Systems (GNSS) is usually dependent on infrastructure to support relative positioning techniques. However, due to the high costs associated with establishing such infrastructure, most developing regions of the world such as Africa are unable to use this technology. This study aims to determine if Precise Point Positioning (PPP) using a combination of dual-frequency GNSS receivers and a free online post-processing service may provide an alternative for high accuracy static positioning applications. The performance of PPP (in terms of accuracy and convergence) was evaluated for different geographic locations, transformation models, observation durations and receiver-antenna configurations. The results indicate that the achievable accuracy is dependent on the observation length and accuracies at the 3 cm level are achievable with observation lengths of about six hours. This relatively long observation period and the lack of real-time clock and orbit products are the current limitations of PPP for high accuracy positioning.

Keywords: *PPP; Accuracy; GNSS*

Mapping Crop Water Use at all Scales – from Global to Local

S. Kagone

ASRC Federal Data Solutions, Sioux Falls, SD, USA

ABSTRACT

Evapotranspiration (ET) is a vital component of the water cycle and remote sensing provides an effective method to mapping water use and availability. We use the Operational Simplified Surface Energy Balance (SSEBop) model to estimate actual ET using remote sensing-based data sets at different spatial and temporal scales, from global at 1km (MODIS) to field-scale at 30 m (Landsat) resolution for the United States. Global ET is useful for a broad view of hydroclimatic conditions for drought monitoring, while field and basin scale ET mapping is essential for tracking local water use dynamics through time. Cloud computing platforms such as Google Earth Engine (GEE) provide unprecedented efficiency in the creation of quantitative ET estimates at field-scale resolution. Over 16,000 Landsat images for the United States for a single year provide the potential to create not only current water use but long-term historical patterns over the entire Landsat archive. This presentation will give an overview of the SSEBop model, as well as discussing research examples such as a study where SSEBop Landsat ET was applied to the most productive agricultural region of the United States, the Central Valley of California, to study trends in water use for several crop types classified by the United States Department of Agriculture - National Agricultural Statistics Service (USDA-NASS) Crop Data Layers. Results showed the relative importance of particular crop types, such as the rise of profitable nuts – almonds or walnuts – in comparison to the decline in alfalfa; and the investment of water resources in those crops over time. The integration of remote sensing-based ET using the SSEBop model and GEE efficiently provided the water use information at multiple spatial and temporal scales. The distributed ET could be useful for stakeholders and water managers for sustainable agricultural production while understanding water availability and consumption.

Keywords: Evapotranspiration, Google Earth Engine, SSEBop model

Geo-Business-A way from planning to delivery (Geo Strategic Planning & Agile Mindsets)

Tanzeel Ur Rehman Khan

Evosoft GMBH, Nuremberg, Germany, tanzeelrehman130@hotmail.com

ABSTRACT

The geospatial industry is predicted to have an enormous growth in the upcoming years and a protracted need for well-educated workforce. It is the need of time to increase geo business with smart concept (digitalization) by defining promising geo use cases and business models. This describes more towards geo strategic planning (SWOT -Geo Product) for geo products within agile mindsets. The Agile Method is an approach to project management that is applied in software development. This method supports teams in responding to the impulsiveness of constructing the product (software or web-based products). It practices incremental, iterative work sequences that are said as sprints.

This geo business concept will motivate to start the geospatial business and services using above techniques. This is combination of academic and industrial processes. These processes will lead to show you some exemplary concepts of geospatial business under Spatial Junctions. Open source solutions are provided within this geo product as well as one can strengthens the academic concepts with already developed opens ource geospatial certification.

Keywords: *Open Source, Use Case, Digitalization, Agile, Geostrategy, Opensource Geospatial Certification, Spatial Junctions, Sprint.*

Counting Sorghum Panicles in the Field using Deep Learning

Lonesome Malambo[a], Sorin Popescu[b]

[a]Texas A M University, USA, mmalambo@gmail.com
[b]Ecosystem Science Management, Texas A M University, USA

ABSTRACT

Small unmanned aerial systems (UAS) continue to improve the collection of high-resolution imagery over large crop fields to support precision agriculture and plant breeding research. However, this efficiency in data collection is also creating massive datasets which are difficult to analyze efficiently. For effective utilization of UAS images, robust methods for characterizing various plant attributes are required. Deep convolutional neural network (deep learning) models currently show unparalleled performance in detecting and segmenting various objects in images from large image datasets. This study applied deep learning models to count sorghum panicles (heads), which are critical in sorghum crop improvement, from UAS images over selected sorghum experimental plots. A deep learning model was trained to semantically segment UAS images into sorghum panicles, leaves and the exposed ground. The segmentation output was then used to derive sorghum panicle counts in selected experimental plots. Results showed an overall accuracy of the semantic segmentation of 95%. There was also a good agreement, R^2 = 0.8, mean bias = -1, between the detected panicle counts and reference panicle counts based of a sample of 20 plots. Overall, deep learning models show good promise for robust and effective characterization of sorghum panicles.

Keywords: *Deep learning; sorghum; panicle; unmanned aerial system; plant breeding*

Urban growth prediction of the coastal city of Lagos, Nigeria towards achieving sustainable development

Waswa Rose Malot

Regional Centre for Mapping of Resources for Development (RCMRD), Nairobi, Kenya, rwaswa@rcmrd.org

ABSTRACT

The most extensive urban growths in the next 30 years are expected to occur in developing countries. Coastal city of Lagos, Nigeria – Africa's most populous megacity – is a prime example. The study aims to contribute to scientific advances towards achieving sustainable and more resilient cities by modelling the urban growth of Lagos using the Multi-Layer Perceptron (MLP) neural network for the Land cover transition modelling and the Markov Chain analysis for the change prediction on the Land Change Modeler (LCM). A visual validation of the model results using the ArcGIS was combined with kappa correlation statistics. The results show that by 2031, built-up areas would likely be the most spatially extensive LULC class in the study area with a percentage coverage of 34%. Recommendations were made on the current version of the IDRISI Selva which will help improve the reliability of prediction results and invariably contribute to the achievement of SDGs goals and Africa's Agenda 2063.

Keywords: *Land use, Land Cover, Land Change, Neural networks , SDGs*

Participatory Spatial Tool to Support Villayge Land Use Planning in Tanzania

Faraja Anjolye Mbuduka[a], Andrew Ferdinands[b]

[a,b]Private Forestry Programme, GIS and Land Use Planning Section, Tanzania, fmbuduka@yahoo.com

ABSTRACT

Land use plan is a way of ensuring that when decisions are made about land use allocation; environmental protection, biodiversity conservation and land rights to vulnerable social groups are taken into considerations. In Tanzania village land use plans are established to direct land use and village development for the e next ten years in a village. Planning practice is by conventional method which mostly involves GPS tracking in the field and sketching maps on flipcharts. Despite its crucial importance, land use planning through conventional method has led to few numbers villages being covered with land use plans and poor quality products being derived as the approach itself is expensive, time consuming and it is also characterized by poor involvement of the community during the process. Due to these limitations there have been a need for developing and adopting a participatory spatial tool that could help in locating these resources without first going into the field thus saving time, money, escaping all the difficulties and risks associated with remote field's localities while ensuring fully community participation and hence producing good quality land use plans.

Today, free spatial technologies are widely used to support participatory information and data collection and analysis in a multitude of societal applications. Private forestry programme, a bilateral programme between Ministry of Tourism and Natural Resource Management, Tanzania and Ministry of foreign Affairs, Finland Tanzania in collaboration with National Land use commission have developed a spatial tool for participatory land use planning to overcome the aforementioned challenges.

Spatial tool for participatory land use planning involves the use of freely available high resolution satellite imagery and other available spatial data for participatory mapping and thus enabling villagers to collect, analyze, and discuss location-based information even from areas that are inaccessible to field tracking with the global positioning system (GPS). It is opted as it creates more detailed, accurate and standardized VLUP maps without increasing the costs of the Village Land Use process. Spatial data produced using satellite images are reliably be matched with other spatial data such as data on vegetation and soils.

The most common satellite images which allow for the mapping of the land's surface are Landsat OLI and Sentinel-2 and aerial images. These are free-of charge environmental satellite data sets with medium-scale spatial resolution (10 –30 m). These high-resolution satellite images are accessed from the Internet without cost and be used to prepare a satellite image which is to be used during mapping.

The developed tool was adopted in 11 district authorities of the Southern Highlands of Tanzania where Private Forestry Programme operates between 2016 /2018. In a period of 3

years total of about 52 village land use plans equivalent to 30% of the total village land use plans being conducted in the country (since the introduction of Land Use Planning Act No. 6 of 2007 and the Village Land Act of 1999) were completed and final report being submitted and approved by the national land use plans which is a mega achievement.

The tool has already been incorporated into the National Village Land Use Planning guideline "The Guidelines for Participatory Village Land Use Planning, Administration and Management of 2018" to guide all stakeholders in conducting village land use planning. This conference presentation is intending to give detailed explanation on the new developed approach for conducting land use planning mapping, the rationale of using spatial tools in the process and comparisons on the quality of results from the two approaches i.e. convectional method and upon the application of spatial technology.

***Keywords**: Spatial Technology; Spatial Resolution; Satellite Images; Land Use Planning*

Integration of Barangay Management Index System to GIS using QGIS software

Diana Christa Milloza

Department of Geodetic Engineering, Visayas State University, Baybay City, Philippines, dianachrista.milloza@vsu.edu.ph

ABSTRACT

Land Use Planning and Management is one of the focuses of the Research, Development and Extension agenda of the Department of Geodetic Engineering, Visayas State University. With this, the department aims to help the local government units by means of capacitating t hem in their planning and decision - making activities. Thus, the department offered trainings and workshops to LGUs and one of them is the Integration of their implemented Barangay Management Information System (BMIS) to GIS using QGIS software.

The Barangay Management Information System (BMIS) aims to enhance the planning capacities of the LGU's by providing quality information in the barangay pertinent to the delivery of appropriate programs and relevant services to targeted constituents. The introduction of GIS in BMIS will upgrade the barangay (village) spot-map. A spot-map is the pictorial representation of the vital information about the barangay generated from BMIS software. GIS integrates hardware, software and data for capturing, managing, analyzing and displaying all forms of geographically referenced information (http://www.gis.com/content/what-gis). The advantage of integrating GIS and the BMIS data is that it would allow the local planning functionaries to view, understand, question, interpret and visualize data. Another advantage of GIS is the ease of storing and handling data, editing and updating of information compared to ordinary maps and reports.

Keywords: *Remote Sensing; Copernicus; Sentinel*

Continuous Remote Sensing Imagery from Micro to Macro Scale

Matthias Moeller

University of Bamberg, Germany and Beuth University Berlin, Germany, matthias.moeller@uni-bamberg.de

ABSTRACT

Over the past decade remote sensing has become an arbitrary technique for anybody. This development is mainly driven by the availability of drones at every time and at almost every location. Drone remote sensing imagery enables a micro scale monitoring of small objects with reliable results. With a spatial resolution of a few centimeters, the scale range of drones typically varies between 1:100 through 1:5.000. Drone imagery can be acquired from different angle and from several distances towards an object. This multi-angle imagery may later be used for an automated analysis, regarding the 3D reconstruction of features. Designated software packages are available as open source (e.g. Visual SFM, where SFM stands for structure from motion) as well as commercial 3D software packages, even online processing of the imagery is an option. The price of drone imagery is in a moderate range. Semi-professional drones for a daily operation start at 3500 Euro.

On the other hand, a number of satellites have been launched by EU ESA and U.S. NASA. Their sensors operate in the medium scale range, starting at 1:25.000 through 1:100.000. Landsat 8 Operational Land Imager (OLI) and Sentinel 2a/b are both optical sensors orbiting the Earth in a height of roughly 800 km. Those sensors record imagery with a spatial resolution of 10 m (Sentinel 2) up to 30 m (OLI). The spectral range of satellite sensors covers the visible to the thermal infrared electromagnetic spectrum.

The ESA – EU Copernicus program will consist of a series of sensors once it is in operational mode. The series starts with radar sensor Sentinel 1 that provides valuable insights in areas, usually hidden to the human eye. Tropical rainforest for examples are almost 100% covered by clouds. The active SAR radar (SAR-synthetic aperture radar) may penetrate the cloud cover and it brings up new views to the ground. First maps of the Amazon rainforest show the huge scarves caused by deforestation. The Sentinel satellite series will also consist of several sensors for meteorological purposes. A permanent monitoring of clouds, sea-ice and sea surface temperature is necessary to model and to predict future climate scenario. A Sentinel toolbox (SNAP) is freely available from ESA. This powerful software package enables users to conduct a fast processing and analysis of different Sentinel imagery.

The proposed presentation will give an over view of the state of the art of remote sensing sensors, imagery and analysis techniques. In a second of the talk some practical application be presented to the audience.

Keywords: *Remote Sensing; Copernicus; Sentinel*

20 Years of Digital Terrain Models in Baden-Württemberg

Nicoleta Morariu

Landesamt für Geoinformation und Landentwicklung, Karlsruhe, Germany

ABSTRACT

Almost 37000 km² of digital terrain models are continuously updated and improved by the State Office for Spatial Information and Land Development Baden Württemberg (LGL BW).
A lot of projects were developed in the last 20 years, starting with a complete first DTM computation, based on ALS data- as 1m grid, then with updates from point clouds generated from aerial flights and manual measurements on the stereo pairs of images, from terrestrial laser scan data and also from point clouds generated from UAV flights.
Every project improved our models, being able now to offer our clients a very detailed DTM, up to 0.25m grid with higher height accuracy: ±0.15m.

Keywords: *Digital Terrain Model, ALS*

Water Consumption Map of the City of Windhoek using Open WebGIS Platform

Tjakarapo U. Riruako[a], Kaleb G. Negussie[b]

[a,b]Namibia University of Science and Technology, Namibia

ABSTRACT

Major duties of a municipality are to provide efficient services (i.e. water supply, road infrastructures, sewage removal, electrical grids, etc.) to its residents within the vicinity of the city boundaries. At Windhoek municipality in the Department of Infrastructure, Water and Technical services, they ensure provision of clean water to the city's residents and to this end a complex urban water supply network is in place to tackle this essential task.

Besides the massive issue of pipe burst in Windhoek, there is a major problem of misuse of water. According to technical notes prepared for the World Health Organization by Reed and Reed, (2013) , the recommended water use is 80 litres per capita per day while in Windhoek this number exceeds to 120 litres per capita per day. Due to this water scarcity in the city, there has been a serious challenge to the administration of the city as drought recurrences have become a norm within the past decade (Orti and Negussie, 2019) . Being the capital city of Namibia and inhabiting nearly a quarter of the country's population of 2,3 million, the city relies on Namibian Water Corporation for 70% of its water supply, while the other 30% comes from surface water and boreholes. Due to recent shortages of water supply as a result of extreme drought occurrences (i.e. annual rainfall falling from a high of 1220mm in 2011 to as low as 48mm in 2019) in and around the city, there have been various discussions to abstract water using 700km pipeline from the Okavango river to address water shortages in the central parts of Namibia including its capital Windhoek.

In this study, we will use Open GIS concepts and tools (i.e. Open GeoSuite, QGIS, PostGIS, etc.) to develop an online map showing water consumption for each parcel in the city and will be used as a water demand management tool for the City administration. This will allow to spatially categorize outliers (i.e. consumers who are using significantly larger volumes of water compared to their neighbours) and assists in identifying leaks. The Water Map's WebGIS page provides a bird's eye view of the City of Windhoek municipality, as it appears on Google Maps. Zooming in to individual properties reveal the street address and the plot number as well as the water usage level. The plots of users who are within the water restriction limit of 80 litres per capita per day are marked with a green dot (City of Cape Town, 2018) . Windhoek municipality will be encouraged to use the water map as a public awareness tool. Residents with high-water usage categories will be encouraged to change their water usage behaviour.

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Keywords: *Windhoek, Open GIS, Water, Municipality, PostGIS, QGIS, Open GeoSuite*

Inventory and Evaluation of Bridges in Georgia

Laura Nibladze, Ivane Khitaridze

InCor LLC., Tbilisi, Georgia, laura.nibladze@gmail.com

ABSTRACT

According to inventory of Roads Department of Georgia, in 2015 there were 1172 existing highway bridges in Georgia on the international and interstate highways. However, their inventory and information on their current condition was updated sporadically based on outdated information from the 80th years since Soviet times and ongoing rehabilitation, reconstruction and construction of new roads with the existing or new bridges on them. For the regular maintenance of bridges, the whole territory of country was divided on 4 bridge zones with respectfully 4 companies being responsible for the minor repairing and fixing works and a couple of tens of bridges were selected annually for the in-depth inspection processes, which were often the source towards the decision for the rehabilitation or renovation.

In 2015, Roads Department of Georgia decided to do a comprehensive inventory of the highway bridges, as well as systematic evaluation of their current condition with the analysis and mapping the results. For this reason, together with representatives of our company were studied the existing bridge inspection best practices and corresponding standards in other countries, like Germany, Sweden, US, UK, France, Russia, European Union, based on which the most appropriate examples were adapted for Georgia and the framework for bridges inventory and inspections was developed.

This paper discusses the "Bridges Inventory and Evaluation Project" details that was conducted by our company.

As result of this project, which started in May 2016 as a pilot project covering only long highway bridges, then enroll into full-scale project for all bridges in 2017 and is now on its completion stage, were inspected in the field 1320 bridges on 210 highway roads; for each bridge was produced the separate passport with detailed description of bridge structural components, their parameters, their current functional condition, description of existing damages and proposed corrective measures with financial costs in case of maintenance. Also, each passport was equipped with the map of precise location of bridge with GPS coordinates and surrounding geographic objects and the detailed CAD drawings of front view and cross sections of bridge. Additionally, the current condition of bridge was evaluated and was estimated their technical condition in scale range between 0%-100% scores, where the lowest score was considered for the bridges with no need for any repair and the highest for the bridges that need the demolition. The scale was further divided on 7 categories and each bridge received the corresponding category based on the score. And each passport contained the cumulative page of evaluation information with score, category and estimated budget on the minor and medium scale repair and maintenance works.

At the final stage of project, the results of bridges evaluation were further spatially and statistically analyzed from various criterion point of view, such as geographical location, influence of ongoing or planned projects, climate, hydrology, existing and potential disasters, tourist and cultural activities, etc. The medium scale map depicting the findings and results of analysis is in the process as of current writing.

As the project outcome, the Government of Georgia received a comprehensive data and analytical information that will allow making the well-informed and more target-specified decisions on the planning the future works of maintenance, rehabilitation, reconstruction, and construction of new objects when and where the intervention is more appropriate and needed.

Keywords: *Bridges Inventory, Systematic Evaluation, Roads, CAD Drawings, Bridge Evaluation*

Monitoring Urban Growth Patterns Using Spatial Metrics: A Case Study of Nyeri Town, Kenya

Moses Ngigi

Dedan Kimathi University of Technology, Kenya, murimi99@gmail.com

ABSTRACT

Nyeri town is experiencing rapid urbanisation as is the case with many developing cities around the globe, predominantly in Africa and Asia. According to the 2009 census, the town had a population density of about 700 persons per square kilometer with this figure expected to rise to 950 by 2022. This has been coupled with an increase in the town's overall revenue. However, the urbanization process has brought about negative repercussions such as overstretching of the available infrastructure and also the encroachment of semi-agricultural rural areas to provide space for development. This has resulted in the depletion of the available resources and a shortage of various key amenities. Sustainable urbanisation is thereby very crucial in ensuring that even though the town progresses economically it does so with the betterment of the livelihood of its inhabitants. The main objective of this research is to monitor the urban growth pattern of Nyeri Town during different epochs i.e. 1987, 2000, 2010, 2014 & 2017. GIS and remote sensing techniques provide the toolkit required for carrying out the study due to the fact that they have spatial and temporal dimensions for monitoring, controlling, analysing, evaluating, and measuring urban growth patterns and land use changes.

Satellite images were used to highlight urban areas. The urban land cover maps pertaining to Nyeri Town for the different epochs were derived from Landsat Imagery. These maps coupled with the spatial metrics were used to monitor and analyse the urban growth pattern. It can be noted that urban land cover has increased from 389.61km2 in 1987 to 2367.47km2 in 1987.The Largest Patch Index also increased from 0.0455 to 1.8543 between 1987 and 2017. This can be attributed to increase in the population of the area, migration of persons into the area and other social-economic factors. This spatiotemporal information if availed to and looked into by the relevant stakeholders, will aid in the advanced visualization of urban growth for an appropriate and strategic future planning of the town.

Keywords: *Urbanisation, Sustainable Urbanisation, Spatio-temporal, Spatial Metrics, GIS*

Analysis of Patterns of Use and Geographic Access to Health Facilities in Urban Lagos, Nigeria

Anthonia Ijeoma Onyeahialam

Aberystwyth University, Aberystwyth, UK

ABSTRACT

This study presents what geographic access to and patterns of use of health facilities is for 505 sampled households living in central Lagos, Nigeria by analysing the 3Ws - where, when and what and how of health care facilities in relation to the sampled population. The available data sets are a georeferenced database from a household survey on socio demographics, type, when, where health care is accessed and how; spatial database of all health care facilities in Lagos, road network and public transport route. These were analysed to reveal patterns and differences in proximity of households to health facilities and health facilities of actual use and how they relate to prescribed times and distances to deliver health services and achieve better coverage towards meeting SDG 3.

Keywords: *Urban Health, Geographic Access, Lagos, Nigeria, Health Facility Use*

A Volunteered Geographic Information (VGI) Approach to Train and Validate Remote Sensing-Based Solutions for Gully Erosion Monitoring in Namibia

Miguel Vallejo Orti

Namibia University of Science and Technology, Namibia, morti@nust.na

ABSTRACT

Land degradation and specifically gully erosion are increasing phenomena causing great impact in Namibian rangelands. Economic and ecological consequences are remarkable, i.e. soil dissection and desertification, bush encroachment, loss of cultivable soil, higher flood risk and decrement of water quality. Many initiatives are dealing with this problem in Namibia, however current applied methods to identify gullies and monitor their evolution over time are not applicable at regional/national scale and cheap and efficient solutions are still lacking. Gullies are both land degradation and geomorphological phenomena, and due to its changing nature sometimes its measurement becomes a complex task, therefore standardization of gully measurement and monitoring techniques is still a research need worldwide. Previous researches conducted by the authors have attempted to identify gullies using Tandem-X DEM and monitor their evolution using Sentinel products. Nevertheless, validation campaigns for remote sensing solutions are costly, especially in a country like Namibia with limited human and technology resources and many isolated areas with difficult accessibility. Therefore, a solution based on Volunteered Geographic Information (VGI) is proposed, where farmers, local communities, students and any individual using smartphones provided with a GPS receiver, can identify affected areas in form of gully/non gully grid cells (12 x 12 m). Classified cells are used to i) generate a complementary database independent to those generated by RM means, ii) validate those outcomes generated by remote sensing and iii) generate training data to be used as observations into a continuous learning approach which improves current remote sensing classification algorithms.

Keywords: *Gully erosion, VGI, Remote Sensing, Namibia, Land Degradation, Classification, Measuring methods.*

Database Transformation, Cadastre Automatic Data Processing in QGIS and Implementation in Web GIS

Hamidreza Ostadabbas

Dr. Koch GmbH, Germany, hamidostad1990@gmail.com

ABSTRACT

This paper describes the development of automatizing the process of implementing, selecting, aggregating and layouting the relevant objects of the ALKIS data in an Open Source GIS (QGIS) via Python Language.

The standard land values will be visualized and presented in Web GIS. Therefore three different Web Clients will be compared according to performance and editing capabilities. Additionally the two different Web GIS server solutions, QGIS Server and ArcGIS online, will be described and evaluated.

Keywords: *Databases Transformation, WebGIS, QGIS Server, Python, Open Source*

Comparison of Hyperspectral Foliar Reflection of Invasive and Non-Invasive Angiosperms

Sooraj Nediya Parambath[a], Athira Kakkara[b], Jaishanker Raghunathan Nair[c], Sajeev C Rajan[d], Saroj Kumar Vasundharan[e], Vishnu Muraleedharan[f], Lijimol Dominic[g], Subin John Mathew[h], Ammini Joseph[i]

[a,b,c,d,e,f,g,h,i] C V Raman Laboratory of Ecological Informatics, Indian Institute of Information Technology and Management-Kerala IIITM-K, Trivandrum, Kerala, India

[a]School of Environmental Studies, Cochin University of Science and Technology, Cochin, Kerala, India

ABSTRACT

The overarching compulsions of sensor optimization compromises the spectral resolution in the space based earth observation platforms. This limits fine grained remote sensing studies of surface elements at individual level. Ground based hyperspectral remote sensing is a promising means to characterize individual elements. Here the authors report the use of hyperspectral remote sensing to understand foliar reflectance behaviour of angiosperms. (flowering plants). We report significant difference in foliar spectral reflection of invasive angiosperms in the photo synthetically significant 'red' portion of the electromagnetic spectrum. In situ spectral measurements of the 5 invasive and 15 non-invasive angiosperms were carried out in November 2018 using a field spectroradiometer (Ocean Optics, USB 4000). It records spectral reflectance from 344 nm-1041 nm with less than 1 nm resolution. All measurements were taken between 10.00 and 11.30 AM on matured healthy leaves (second from a growing bud). The analysis focused on the UV-visible/NIR portion of the spectrum. The pairwise spectral similarity of the invasive-noninvasive pairs was examined by Spectral Similarity Value (SSV). The highest spectral dissimilarity was observed in the 'red' and followed by the 'blue' region. This assumes significance due to the strong absorption spectra of photosynthesising cells in these regions.

Keywords: *Remote Sensing; Hyperspectral; Field Spectroradiometry; Invasive Plants, reflectance; photosynthesis*

Earth Observation for Agricultural Water Management: A Review on Recent Advances and Opportunities

Sajid Pareeth

IHE Delft Institute for Water Education, Delft, Netherlands, spareeth@gmail.com

ABSTRACT

Global climate change will impact local water resources is a foregone conclusion. These impacts will have major repercussions on water availability, especially for agriculture and for drinking, eventually impacting food, livelihood and health security of many rural people in developing countries. Often lack of updated data on critical indicators is a major hindrance to estimate and monitor the global challenge of increasing demand on food. For achieving food security it is very important to monitor the existing patterns of cropping systems (both land and water use) around the world periodically. Earth observing satellites has become a crucial source of data for monitoring the limited resources and there are continuous efforts been made to establish systems which are reliable and accurate. Here we review the role of data from these satellites along with different aspects of remote sensing techniques in monitoring agricultural land use types and water use in estimating the productivity. Such overview will also give us an idea on how well these information can be transformed into policies in ensuring sustainable use of resources meeting food and market demands.

New earth observing satellite missions and advances in remote sensing techniques has revolutionized the way we can monitor our limited land and water resources especially in the backdrop of climate change. In the last decades, a large number of research activities have been carried out in establishing the linkages between satellite observations and ground realties. In many cases, these research approaches have been transformed into operational systems to monitor our resources at global, national and regional scale. The role of information retrieved from earth observation has become part of policies and country specific resource management documents especially related to water resource management, crop health, crop water use, land degradation, precision agriculture, disaster management, biodiversity conservation etc.

In this study we review the recent advances and opportunities in using remote sensing techniques for agricultural water management, in particular related to crop type mapping and water use. The major indicators which gives us crucial data on crop water productivity with respect to water applied is crop type, Evapotranspiration (ET), water productivity, biomass, yield etc. Multiple aspects of remote sensing based approaches like scales, spatial and temporal resolution, multi spectral vs SAR data, latest satellite missions like Sentinel 2A/B and Sentinel 3, future missions, new techniques especially related to machine learning, open data and open source tools etc., will be analysed and presented. Further, different approaches in deriving dynamic land use types related to agricultural crops – crop type, seasonal crops, and crop growth pattern will be reviewed and demonstrated. For estimating ET, we will review remote sensing based surface energy balance models and methods based on regression models with vegetation indices.

Multiple case studies demonstrating the usability of remote sensing based approaches in monitoring land and water use related to agriculture will be explained from various parts of the globe. The study will give an overview on state of the art techniques in establishing a monitoring system for land and water use.

Keywords: *Remote sensing, Agriculture, Water management, Crop water use, productivity, earth observation*

Early Stage Bark Beetle Infestation Detection using UAV Images

Rajan Paudyal

Technische Hochschule Deggendorf, Germany, rajan.paudyal@th-deg.de

ABSTRACT

Disturbances caused by bark beetles infestation is a massive problem in Europe, especially in the Bavarian (Germany) and Šumava (Czech Republic) national parks. With traditional site inspection method, the infested tree detection is very time-consuming and error-prone. As no discoloration of the tree occurs during the early attack state of the beetles, the possibility to detect the infested trees is limited using the current remote sensing method (limited spectral resolution using RGB+NIR images). An effective method allowing an early stage detection of bark beetle infestation of larger areas is needed for conducting prompt forest management practices. The joint project "BarkBeeDet" aims at investigating this method using UAV based hyperspectral and thermal IR sensor in combination with an airborne laser scanner. The high temporal and spatial resolution data of these different sensors are used for tree segmentation and analysis using a combination of different vegetation indices. The study outlines the first result of image analysis and concludes the potential of this method for an effective early stage detection of bark beetle infestation.

Keywords: *Bark Beetle Infestation, early stage detection, UAV, Hyperspectral, Thermal IR*

Assessment of a Health Vegetation Index in Hong Kong and Colombian Amazon using Sentinel 2, Landsat 8 and GoogleEarth Engine

Andres Felipe Ramirez

FSC Global Development, Bonn, Germany, af.ramirez.mejia@gmail.com

ABSTRACT

The project investigates the use of Google Earth Engine in computing vegetation condition index (VCI) and vegetation health index (VHI) with open remote sensing data for Hong Kong and Colombian Amazon in the year 2017.

VCI is computed using Sentinel 2 data, while VHI, which includes a correction of temperature condition index (TCI), is delivered from VCI and thermal data obtained from Landsat 8.

JavaScript is used to develop scripts for processing the data and displaying the results as thematic maps in a web-based platform.

Keywords: Google Earth Engine, Sentinel 2, Landsat 8, Vegetation Health Index

Development of a Photogrammetric Monitoring System for a Resource-Saving and Automated Irrigation of Crops in Open Field and Protected Environment (PLANTSENS)

Lukasz Rojek

Beuth Hochschule, Berlin, Germany, lukasz.rojek@beuth-hochschule.de

ABSTRACT

The human eye perceives the world in visible light. This narrow wavelength range from approx. 400 nm (blue light) to 750 nm (red light) is only a part of the present electromagnetic spectrum. With additional optical instruments, it is possible to detect the radiation of other spectral ranges in order to collect further information about the object of observation. For plants, this information can be used for the estimation of the water status and consequently preventing insufficient water supply.

Water is one of the vital resources for agricultural plants. Quality, growth, and health of the crops are directly related to the water supply. Most plants react already very sensitively to minimal changes in water availability. To achieve a precise and individually targeted irrigation matching the actual demand for water, the water status of the crop needs to be constantly monitored. Moreover, the timely detection of water stress prevents negative effects on the physiological processes of the plant. It is particularly important for the production of fruits and vegetables in a protected environment (e.g. greenhouses) but also in the open field crops, especially in organic plant production in arid areas, depends on additional water supply.

The PLANTSENS project aims to develop a multisensory control system for automated water status measurement using a combination of near-infrared, thermal imaging, and short-wave infrared cameras. The first measurement method is carried out by a low-cost RGB-camera. Because of the removed infrared filter, the camera detects wavelengths outside the visible light in the near-infrared (up to 900 nm) spectrum and can be used to determine the Normalized Difference Vegetation Index (NDVI). The NDVI is a parameter that defines the photosynthetic activity (vitality) of the plant based on the reflection differences. This allows the identification of vegetation objects in the image and their differentiation from non-plant objects such as soil. The thermal camera determines water stress based on leaf temperature, that depends on the transpiration and conductivity of the stomata. The last measurement method is based on the absorption of electromagnetic radiation by water in the short-wave infrared spectrum. This has maxima especially in the ranges 970 nm, 1,200 nm, 1,450 nm, and 1,950 nm.

The proposed presentation will give an overview of the functionality of a photogrammetric monitoring system for automatic irrigation based on real-time processing and precise georeferencing.

Keywords: *NDVI, spectroscopy*

Smart Pollen Monitoring: The Web-based Application for Monitoring Tree-Pollen

Thunyathep Santhanavanich[a], Patrick Würstle[b], Giuliano Baumann[c]

[a,b,c]Faculty of Geomatics, Computer Science and Mathematics, University of Applied Sciences Stuttgart

ABSTRACT

Millions of people in the world suffer allergies from many types of tree pollens. Accordingly, the effective tool for monitoring tree-pollen is the need of the hour. To address this, we develop the web-based application "Smart Pollen Monitoring" in the case study area of New York City, USA. The application has following features: 1) to visualize the tree-pollen dispersal, and 2) to suggest the route to avoid the area with high density of tree-pollen. It computes tree-pollen dispersals based on tree positions, tree types with their historic-blooming statistic, and wind data on the cloud-based system. This web-client interface is built on 3D NASA WorldWind web globe. Lastly, the "Smart Pollen Monitoring" application was evaluated in an international workshop with experts on various topics.

Keywords: *Web-based GIS, Pollen Monitoring, Geovisualization, OGC SensorThings API, pgRouting, NASA WorldWind*

Study of the Three-Dimensional As-Built Survey Using Terrestrial Laser Scanner in the Making of BIM Based 3 Dimension Construction Model (Case Study, Light Rail Train (LRT) Palembang)

Asep Yusup Saptari, S Hendriatiningsih

Department of Geodesy and Geomatic, Institut Teknologi Bandung, Indonesia, aysaptari@gmail.com

ABSTRACT

The Light Rail Train (LRT) is a mode of railroad transportation that operates in the city center with tracks made on highways. LRT is a development innovation that is made as a solution to overcome congestion in big cities. The construction of LRT in Indonesia has been carried out in two cities, namely Jakarta and Palembang. To monitor LRT buildings, an as built survey method is needed, one method that can be used is a 3-dimensional survey using a Terrestrial Laser Scanner (TLS) tool. TLS is a tool that can record the scanning points using laser light. This three-dimensional survey is used to model objects through retrieving data point clouds objects which are then used to create 3 dimensional models.

Three-dimensional surveys have several stages starting from planning, point cloud acquisition, data processing, presentation. In this study the point cloud data observed was point cloud data at the Palembang LRT Cinde Station. Data retrieval is done using a Terrestrial Laser Scanner (TLS) tool. The problem is how to do scanning to get data that meets accuracy that is expected and can be implemented in a short time, for that at the stage of data collection carried out by a combination of controlled scanning (Refer to existing control points) techniques and free scans. The results of this scan are in the form of point cloud, point cloud data will then be processed through georeferencing, filtering and point cloud registration from the two scanning techniques. Furthermore, the registration results will be processed to form a 3-dimensional model of LRT buildings. In 3-dimensional modeling methods are also needed to shorten the modeling process, therefore it will be studied using the parametric object modeling method in modeling several LRT buildings.

In general, based on the data processing above, the results of point cloud data from the two scanning techniques and the parametric processing of modeling objects will be combined. It is expected that the accuracy of point cloud registration quality from the 3-dimensional model can be analyzed for its quality related to the use of control points and the parametric object modeling method.

Keywords: *Scanning; LRT; As-Built; points cloud; BIM*

Updating Topographical Maps of Nepal by Using ZY-3 Satellite Image

Sudip Shrestha

Survey Department, Government of Nepal, Nepal, geosurveyor@hotmail.com

ABSTRACT

It is intended to present the methodology and interim results of topographic map updating process. Survey Department, National Mapping Agency of Nepal prepared topographical maps from 1989 to 2001 with the map scale of 1: 25000 and 1: 50000 covering the entire country with total of 706 map sheets using aerial imagery. The digital database of each map sheet was also prepared. These maps have not been updated and revised, but considerable amount of infrastructure development and measurable changes in land-cover has been witnessed. Updating of existing topographical maps is conducted by using ZiYuan-3 survey and mapping (ZY-3) satellite images of resolution 2.1 m panchromatic and 5.8 m multispectral bands. Geocoding of satellite image was done by collecting ground control points from GPS. Orthorectification of images was created using ALOS PALSAR DEM of 12.5 m resolution. The interpretation process has been carried out manually and new features were digitized in existing database. A thematic layer of land-cover, road network, stream and river network, building and a built-up area, and administrative boundary is updated by overlaying the image with existing topographic database. The attribute data of place names, name of special buildings (hospital, school, etc.) and other features were also updated in the map. The result of updated topographical maps was verified by field inspection of the individual map sheet.

Keywords: *Remote sensing; satellite image*

Enhancing Food Security and Livelihood through Submergible Flood Embankment Mapping in Haor Areas in Bangladesh

Md Zahid Hasan Siddiquee

Institute of Water Modelling, Bangladesh, zhs027@gmail.com

ABSTRACT

Haor in the Northeast Region of Bangladesh is a very unique type of wetland and is characterized by the presence of numerous large, deeply flooded depressions, between the rivers. There are as many as 423 small or large haors in Bangladesh. The total cultivated area in those haor is about 1.26 million hectares. In terms of ecosystem, crop production practices, economic activities and over all livelihood of the farmers of haor areas are quite different from those of the other parts of the country. Pre-monsoon flash flood from the neighboring hilly region of India is a common phenomenon, which damages the only possible *Boro* crop of the region. Submersible embankment allows overtopping of monsoon floodwater into Haor after the harvesting time and gradually the area is inundated. This research paper attempts to identify the way and method that enhanced the food securing through Geo-spatial Technologies. The study area is the in north-eastern part of Bangladesh. Satellite images along with topographical survey data are used to identify the flood inundation area by spatial analysis. GIS mapping is used to visualization and support the decisions in connection with proposed submersible embankment. Since the cropped land area is being continuously shrinking over time leading to serious challenge towards increasing productivity and thus to the mission of attaining self-sufficiency in food production for the land scarce economy of Bangladesh, it has indeed become imperative to exploit the crop production potentiality of the large Haor areas to support livelihood with enhancing food security and a way forward in achieving sustainable development goals (SDG).

Keywords: *Crop production, Submersible Embankment, GIS, Livelihood, Food security, SDG*

GIS and Smart Cities

Satyendra Singh

InSell GmbH, Stuttgart, Germany

ABSTRACT

Keywords:

Geospatial Mapping using R software

K. Sudalaimuthu

SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu, India, karuppasamys@yahoo.com

ABSTRACT

R is an open source language, licensed under the General Public Licence (GNU) used for the purpose of statistical computing. It is a known from the various literatures that R-Software is a robust programming language offers tools for data analysis, data visualization and geospatial analysis and it is capable of handling the huge volume of statistical data. Because of the long history of R, the applications of R are very vast and versatile. There are many spatial objects library have been developed in R for the purposes of the spatial operations. Using those spatial operations from R-Software performed extensively for Geospatial analysis. The intention of this workshop is to deliver an introduction to R-Software as a tool to handle the spatial data in the form of visualize and analyze also discuss the Spatial mapping.

Keywords: *Spatial data analysis Mapping, R SoftwareOpen Source*

Mapping of Small-Scale Mining Concessions using UAV and GNSS Technologies: The case of Ghana

Naa Tagoe[a], Alexander Ayettey[b]

[a]University of Mines and Technology, Accra, Ghana, naadedei.tagoe@gmail.com
[b]National Survey and Mapping Division of Lands Commission, Ghana

ABSTRACT

Ghana is endowed with enormous natural resources such as cocoa, gold, timber, oil, gas, bauxite and manganese. The country is Africa's 2nd largest producer of Gold, after South Africa.

The benefits of mining gold at the macro level can be attributed to both the large-scale and small-scale sectors with small-scale sector being responsible for about 34 per cent of the total earnings. On the other hand, Small-scale Gold Mining (SGM) sector has had greater socioeconomic impact at a micro level. It provides both informal employment to local miners seeking basic livelihood and formal employment to local miners with legal title. Since its regularisation in Ghana, the sector has produced and sold over 1.5 million troy ounces of gold. Although no census data exist, it is estimated that, the sector directly employs over one million people with about 4,400,000 indirect dependents. This has reduced rural-urban migration, promoted economic development at a micro level and contributed towards poverty alleviation.

Notwithstanding its benefits, the SGM sector is highly characterised by negative social and environmental consequences such as child labour and associated human rights abuses, health implications, water pollution and environmental degradation from mercury. Several attempts have been made by previous governments to formalise the SGM sector. However, most miners operate informally mainly because of bureaucracies associated with the issuance of mining licenses and the absence of geological data and as a result, it is difficult for them to receive support from financial institutions. As a result, the operations of most miners in the sector are characterised by illegality, social conflicts and negative health and safety impacts.

To mitigate these challenges, the current Government of Ghana placed a ban on all small-scale mining activities and instituted the Inter-Ministerial Committee on Illegal Mining (IMCIM) to vet documents of all alleged SGM companies, to ascertain extent and boundaries of their mining concessions and to additionally regularise the unlicensed miners where possible.

The IMCIM collaborated with the National Mapping Agency by employing Unmanned Aerial Vehicle (UAV), Global Navigation Satellite System (GNSS) and other geospatial tools to achieve its mandate. It was observed that most miners were either mining beyond their boundaries or mining outside the licensed area.

Keywords: *Mapping, Small Scale Mining, UAV, GNSS*

Accuracy Assessment of UAV Mapping

Dashzevge Tserensangi

Spatialmodelling LLC, Mongolia, ts.dashzevge@gmail.com

ABSTRACT

Nowadays, unmanned aerial vehicle (UAV) platforms are becoming a valuable tool for mapping and 3D modeling of terrain surfaces and ground objects.

Mongolian surveyors have adopted the UAV technology for mapping since 2011. Currently, more than 30 mapping companies are using fixed wing UAVs and drones in large scale topographic mapping. Depending on the type and capability of the UAV, there is no unique guidelines for UAV mapping. Companies are following their UAV manufacturer's guideline for doing of aerial survey. Accuracy of the UAV mapping of individual companies in Mongolia are varying due to their experiences on flight operator, availability of photogrammetric specialists, proper distribution of Ground Control Point (GCP)s, and quality of imaging systems.

Mongolian Association of Geodesy, Photogrammetry and Cartography (MAGPC) together with mapping companies performed accuracy estimation of Digital Terrain Model (DTM)s and orthophotos generated using an imagery captured by three different UAVs.

Methodology used for accuracy assessment of UAV mapping and comparison between the UAV mapping results and terrestrial measurements, and estimated values of accuracy are presented in the paper.

Keywords: *UAV, Drone, GCP, GNSS, DSM, DTM, GSD, Accuracy, RMS, Mapping, Orthophoto.*

Organisational information

Venue / Location

The conference will take place in Stuttgart, Germany. Stuttgart is a vibrant, fascinating city and the state capital of Baden-Württemberg. It is the economic, cultural, sporting and social hub of a region in the heart of Europe with more than 2.5 million inhabitants.

The city is surrounded by beautiful countryside; the Black Forest and Lake Constance are highlights in southern Germany and are not far away.

The University of Applied Sciences (SUAS, German: Hochschule für Technik Stuttgart, HFT Stuttgart) is located in the heart of Stuttgart. The tradition of teaching building, construction and design at the Stuttgart University of Applied Sciences (HFT) reaches back to the year 1832. As you can imagine, the University has a great deal of experience and today we are an internationally renowned place of education.

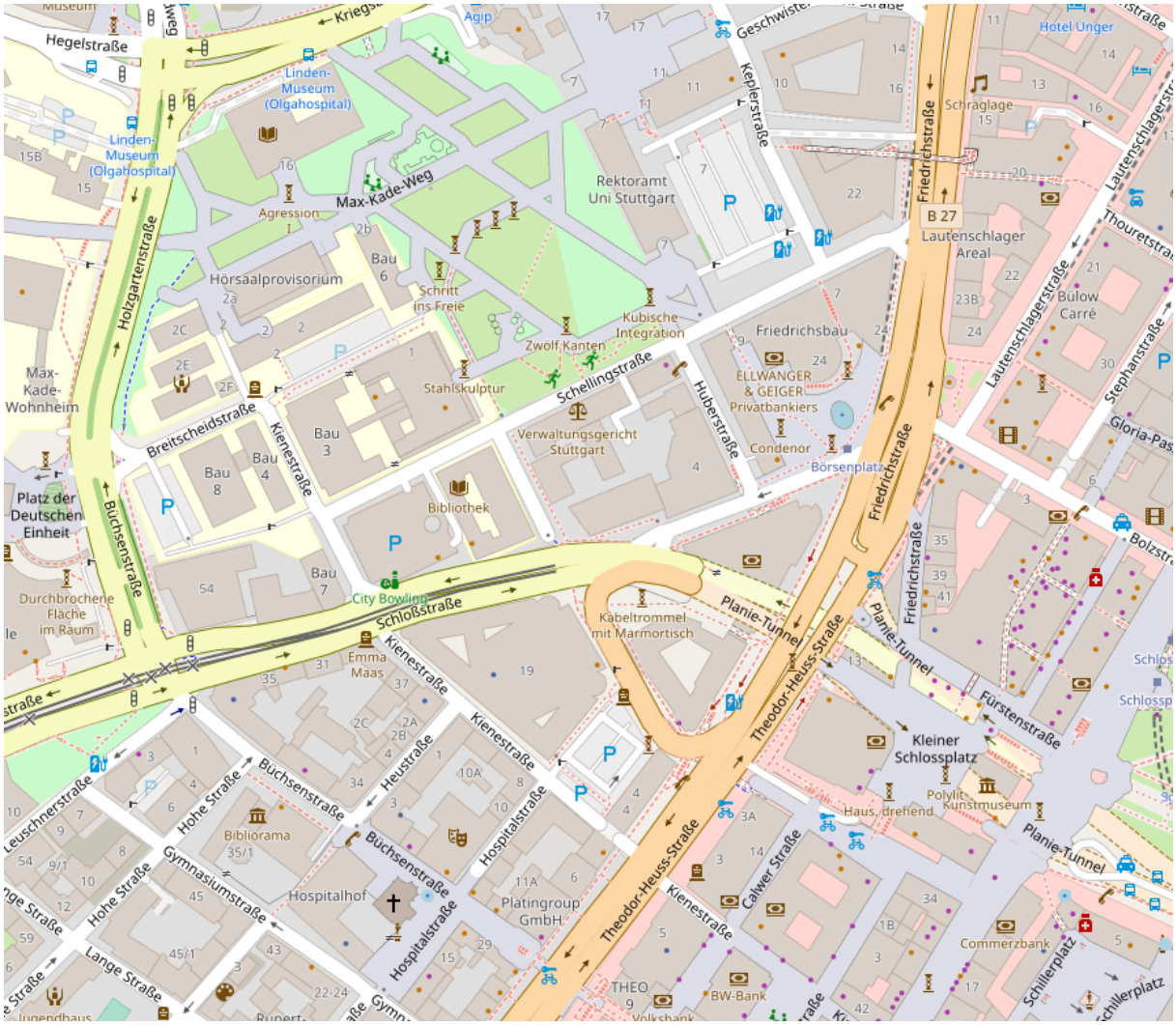

Figure 1: The location of AGSE 2019 (Source: OpenStreetMap and Contributers)

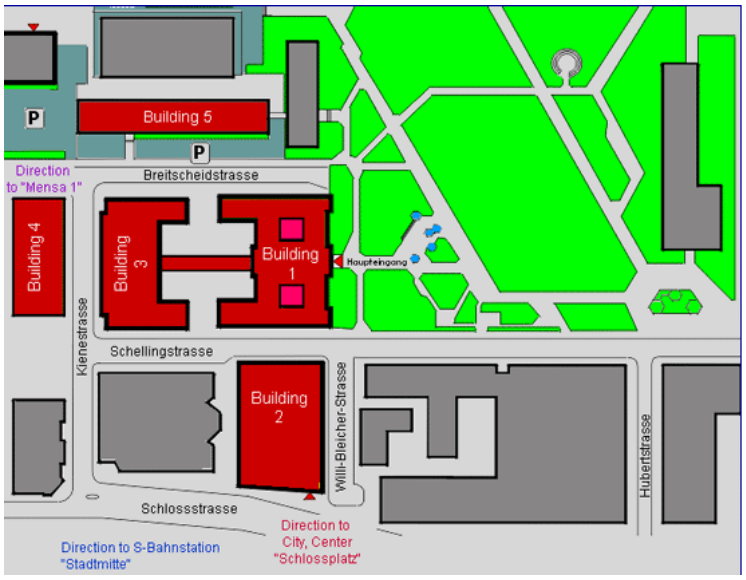

Figure 2: Campus Map of Stuttgart University of Applied Sciences (Source: http://www.hft-stuttgart.de/International/Incoming/firstdays/ouruni/).

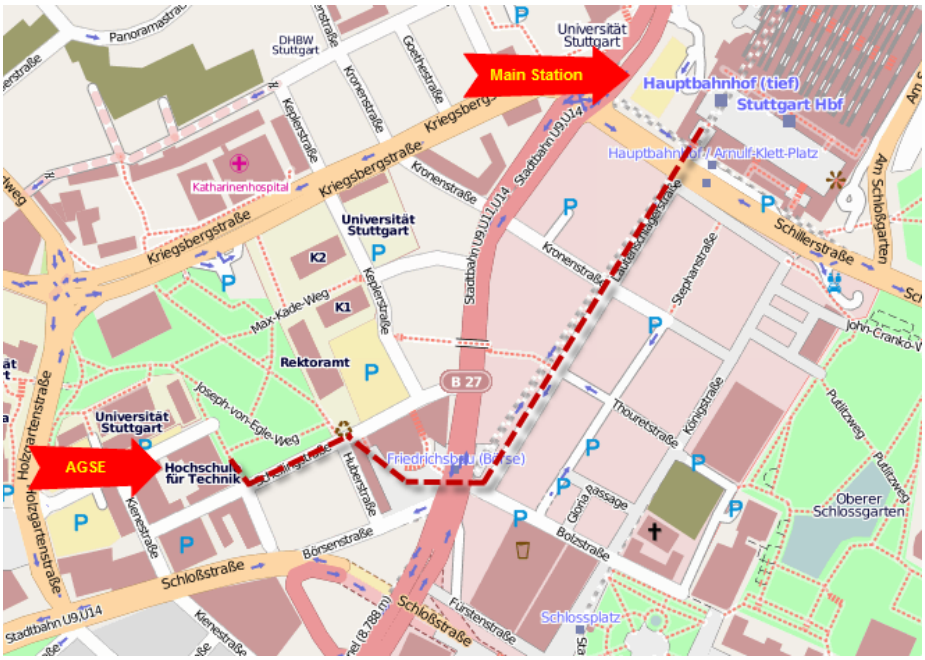

Figure 3: Foot walk from Main Station to Stuttgart University of Applied Sciences Source: OpenStreetMap and Contributers)

Accomodation

Stuttgart offers a wide range of hotels and hostels. You can use http://applied-geoinformatics.org/goto/hotels2019 to look for your accommodation. Special arrangements for this conference were made until 08 August 2019.

Having Lunch

The Hochschule has a cafeteria in its building 1 which serves snacks and small hot meals until 4 pm on weekdays with the exception of Friday when it closes at 2:45
The Mensa 1 (university dining hall) is within walking distance from AGSE, in Holzgartenstrasse next to the Kultur- und Kongresszentrum Liederhalle. It serves lunch from 11:30 am until 2 pm on Mondays to Fridays.
The city center is within 5 minutes walking distance from the University, e.g. in the Food Lounge in "Königsbau Passage" you'll find a lot of small fast-food shops/ bistros.

Public transport and Parkings

- From Stuttgart main station: Approximately 10 minutes walking distance from main station to the university (see map above) or by tram with U29/U14 until station „Börsenplatz".
- From the Stuttgart airport: Take the S-Bahn (suburban railway) S2 or S3 towards main station (Hauptbahnhof). Exit at station „Stadtmitte", frm there approximatly 5 minutes walking distance to the university.
- Parking: Right opposite the HFT Stuttgart there is a parking garage called „Hofdienergarage". Entrance on „Schellingstrasse".

Acknowledgements

The conference would not have been possible without the collaboration and support of different people and organizations. The members of the organizing committee would like to express their gratitude to "German Academic Exchange Service (DAAD)" for the support of the alumni conference provided by the German Federal Ministry for Economic Cooperation and Development (BMZ) and Ministery of Foreign Affairs (AA).

The support of Stuttgart University of Applied Sciences and the team members of Surveying and Geoinformatics Department as well as the grant provided by Knoedler-Decker-Foundation (through Prof. Franke, President of HFT), are gratefully acknowledged.

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The logo design by our alumna, Sajani Joshi M.Sc., is gratefully acknowledged.is

DAAD Deutscher Akademischer Austauschdienst
German Academic Exchange Service

Hochschule für Technik Stuttgart
University of Applied Sciences

VEREIN FREUNDE
Hochschule für Technik Stuttgart
http://freunde.hft-stuttgart.de

Baden-Württemberg International – Agency for International Economic and Scientific Cooperation

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