GISTAM 2023

9th International Conference on Geographical Information Systems Theory, Applications and Management

Final Program and Book of Abstracts

25 - 27 April, 2023

https://gistam.scitevents.org

GISTAM 2023

Final Program and
Book of Abstracts

9th International Conference on Geographical Information Systems
Theory, Applications and Management

Prague - Czech Republic
April 25 - 27, 2023

Table of Contents

Foreword

This book contains the abstracts and final program of the 8th International Conference on Geographical Information Systems Theory, Applications and Management (GISTAM 2022). This conference is sponsored by the Institute for Systems and Technologies of Information, Control and Communication (INSTICC), held in co-operation with the Società Italiana Di Fotogrammetria e Topografia (SIFET). This year GISTAM was held as a web-based event, due to the COVID-19 pandemic, from 27 - 29 April.

The purpose of the International Conference on Geographical Information Systems Theory, Applications and Management is to create a meeting point of researchers and practitioners that address new challenges in geo-spatial data sensing, observation, representation, processing, visualization, sharing and managing, in all aspects concerning both information communication and technologies (ICT) as well as management information systems and knowledge-based systems.

GISTAM 2022 received 27 paper submissions from 20 countries, 19% were accepted as full papers which shows the intention of preserving a high-quality forum for the next editions of this conference.

A short list of presented papers will be selected to be revised and expanded into a forthcoming book of GISTAM 2022 Selected Papers to be published by Springer in the CCIS Series. Additionally, a few papers will also be selected for a special issue in the Springer Nature Computer Science Journal.

The conference program includes three keynote speeches delivered by internationally distinguished speakers, namely: Niki Evelpidou (National and Kapodistrian University of Athens, Greece), Ahmet C. Yalciner (Middle East Technical University, Turkey) and Dimitri Konstantas (University of Geneva, Switzerland).

To recognize the best submissions and the best student contributions, several awards based on the combined marks of paper reviewing, as assessed by the Program Committee, and the quality of the presentation at the conference venue, are conferred at the closing session of the conference.

We would like to express our thanks to all participants. First of all, to the authors, whose quality work is the essence of this conference. Next, we thank all the members of the program committee and the auxiliary reviewers for their diligence and expert reviewing. We must deeply thank the invited speakers for their excellent contribution in sharing their knowledge and vision.

Finally, we acknowledge the professional support of the INSTICC team for all organizational processes in order to make it possible for GISTAM 2022 authors to present their work and share ideas with colleagues in spite of the logistic difficulties caused by the current pandemic situation.

We wish you all an inspiring conference we look forward to having additional research results presented at the next edition of GISTAM, details of which are available at https://gistam.scitevents.org/.

Cédric Grueau, Instituto Politecnico de Setubal, Portugal
Armanda Rodrigues, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Portugal
Lemonia Ragia, ATHENA Research & Innovation Information Technologies, Greece

Social Event and Banquet

Venue: Dinner and Show at the U Pavouka Medieval Tavern
Thursday, 27th of April, 19:00 – 23:00

In order to provide you with a full Czech experience, the Social Event will take place at the U Pavouka Medieval Tavern, a unique restaurant where you will be able to enjoy a special show taking you back hundreds of years. Its friendly and pleasant staff will take care of ensuring everything is perfect and ready to receive their guests.

Unlike the restaurants you are probably used to, you won't find any 21st century gadgets or décor in the Tavern, since the environment conveys a purely middle-age, candlelit scene. The building provides a cozy atmosphere that invites you straight in, being decorated with large wooden tables, torches, iron chandeliers, spider webs, ancient utensils, wine barrels, ropes and more within the rustic stone walls.

As for the show, it will consist of a 2.5h performance involving belly dancing, sword fighting, a live historical concert with real medieval instruments, and a fire show, so not only will you find yourself surrounded by a completely medieval interior but you will be a part of this fantasy and lose track of the present. You will also find pirates, jugglers, tarot-reading fortunetellers and snake charmers, all of whom are ready to enchant and entertain you.

These performers will accompany you throughout the night with music and dancing, making sure you are having the best time. Snakes and other animals also welcome you to the tavern, and you might be able to touch or even hold them! Let the warm atmosphere and energy take over, sit back and enjoy this time travelling experience during our journey to one of the most beautiful cities in the world.

Important Information

Internet Access
Please check at the welcome desk the information to connect to the wireless network.

Event App
Download the Event App from the Play Store and App Store now, to have mobile access to the technical program and also to get notifications and reminders concerning your favorite sessions.

Create Your Own Schedule *
The option "My Program" gives you the possibility of creating a selection of the sessions that you plan to attend. This service also allows you to print-to-pdf all papers featured in your selection thus creating a pdf file per conference day.

Online Access to the Proceedings *
In the option "Proceedings and Final Program" you cannot only download the proceedings but also access the digital version of the book of abstracts with the final program.

Digital Access to the Receipt *
By clicking on the option "Delegate Home" and then "Registration Documents" it will enable you to access the final receipt which confirms the registration payment.

Photos Availability
The photos taken at the venue will be shared with you shortly after the event is finished. There will be an option entitled "Photo Gallery" in PRIMORIS. There, besides having access to the photos, you can also create your own personal albums by selecting "My Albums "Create New Album" and also be able to tag yourself in those photos, using the option "Tag Me".

Keynotes Videos
The keynote lectures will also be available on video on the website after the event, as long as the appropriate authorization from the keynote is received, so you will be able to see them again or watch them should you have missed one.

Survey
Every year we conduct a survey to access the participants' satisfaction with the conference and gather the suggestions. You will receive an e-mail after the event with the detailed information. Your contribution will be carefully analysed and a serious effort to react appropriately will be made.

* Please login to PRIMORIS (www.insticc.org/Primoris), select the role "Delegate" and the correct event.

If you have any doubt, we will be happy to help you at the Welcome Desk.

General Information

Welcome Desk/On-site Registration
Monday, April 24 – Open from 16:00 to 18:00
Tuesday, April 25 – Open from 13:15 to 18:15
Wednesday, April 26 – Open from 09:00 to 18:15
Thursday, April 27 – Open from 09:30 to 16:00

Opening Session
Tuesday, April 25, at 14:15 in the Prague B+C room.

Welcome Drink
Tuesday, April 25, at 18:00.

Closing Session & Awards Ceremony
Thursday, April 27, at 15:45 in the Belvedere I room.

Farewell Drink
Thursday, April 27, at 16:00.

Meals
Coffee-breaks will be served in the Foyer to all registered participants.
Lunches will be served in the Restaurant to all registered participants. Please check the hours in the Program
Layout.

Communications
Wireless access will be provided free of charge to all registered participants.

Secretariat Contacts
GISTAM Secretariat
Address: Avenida de S. Francisco Xavier, Lote 7 Cv. C
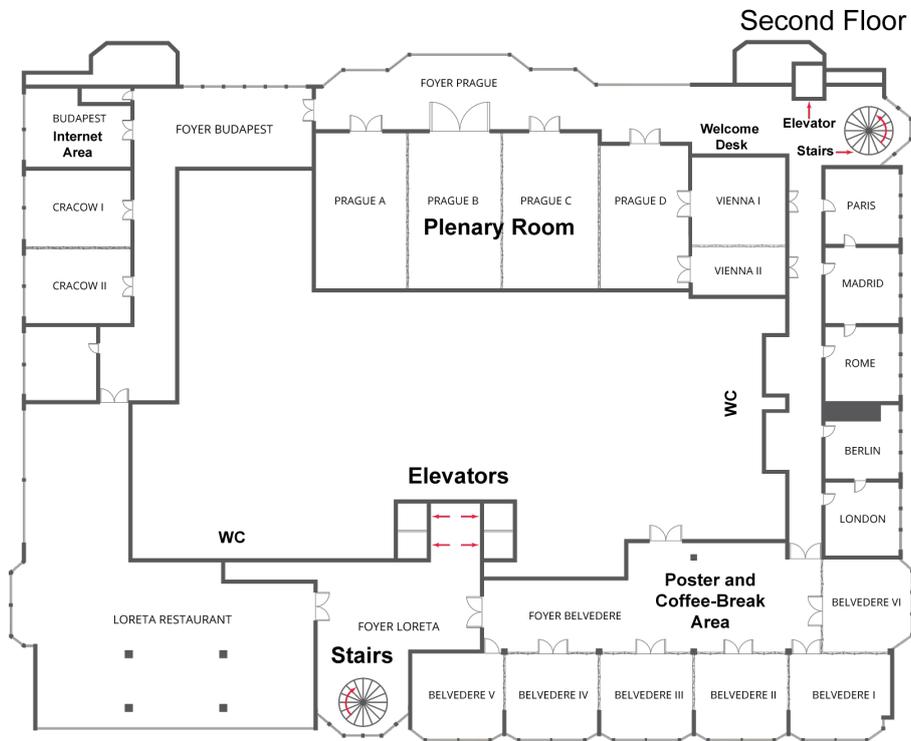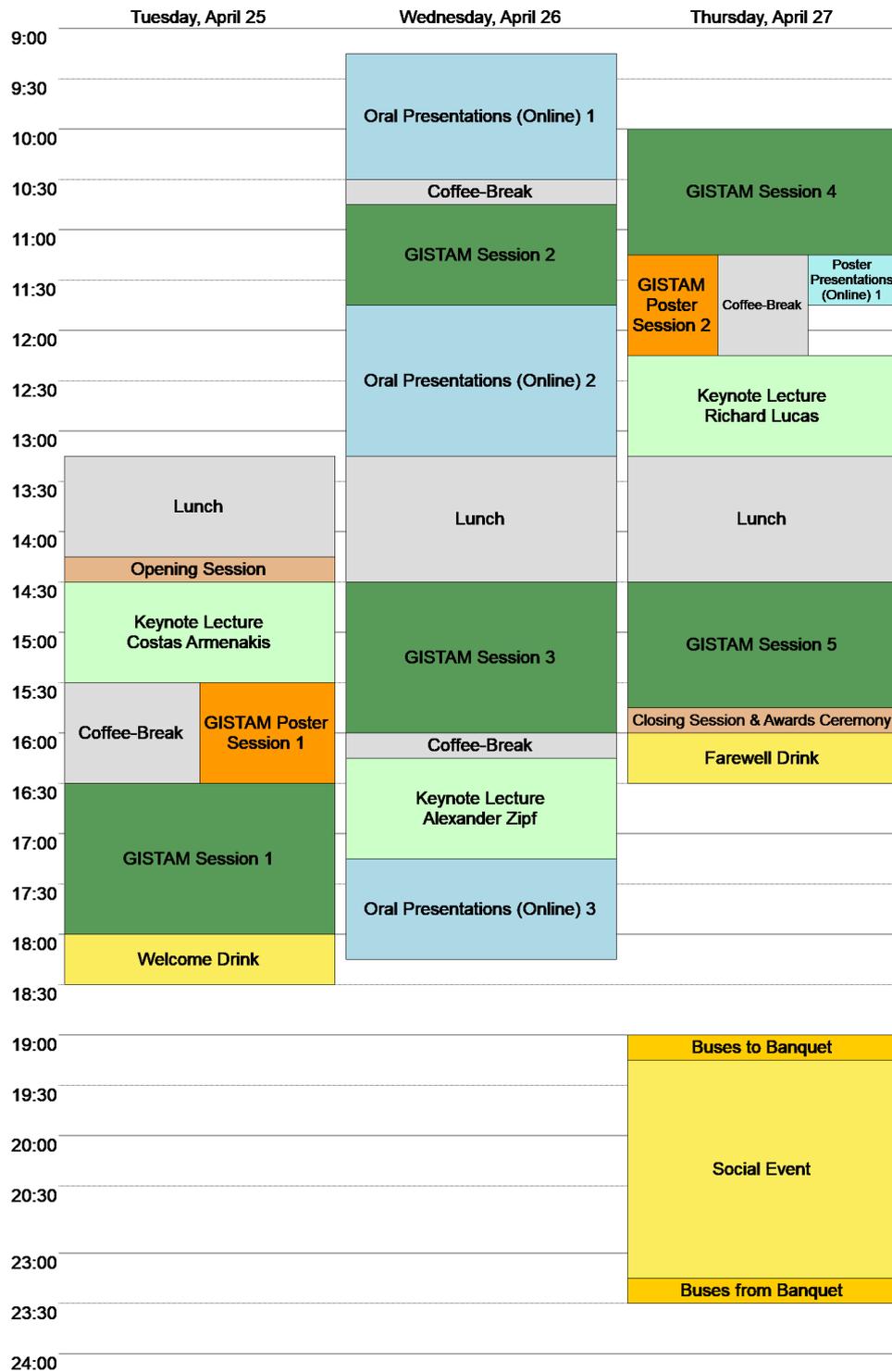2900-616 Setubal, Portugal
Tel.: +351 265 520 184
Fax: +351 265 520 186
e-mail: gistam.secretariat@insticc.org
website: https://gistam.scitevents.org

Rooms Layout

Second Floor

FOYER PRAGUE

BUDAPEST
Internet Area

FOYER BUDAPEST

Welcome Desk

Elevator

Stairs

CRACOW I

PRAGUE A | PRAGUE B | PRAGUE C | PRAGUE D

VIENNA I

PARIS

Plenary Room

VIENNA II

MADRID

CRACOW II

ROME

WC

BERLIN

Elevators

LONDON

WC

Poster and Coffee-Break Area

BELVEDERE VI

LORETA RESTAURANT

FOYER LORETA

FOYER BELVEDERE

Stairs

BELVEDERE V | BELVEDERE IV | BELVEDERE III | BELVEDERE II | BELVEDERE I

Program Layout

	Tuesday, April 25	Wednesday, April 26	Thursday, April 27
9:00			
9:30		Oral Presentations (Online) 1	
10:00			GISTAM Session 4
10:30		Coffee-Break	
11:00		GISTAM Session 2	
11:30			GISTAM Poster Session 2 / Coffee-Break / Poster Presentations (Online) 1
12:00		Oral Presentations (Online) 2	
12:30			Keynote Lecture Richard Lucas
13:00			
13:30	Lunch	Lunch	Lunch
14:00			
	Opening Session		
14:30	Keynote Lecture Costas Armenakis	GISTAM Session 3	GISTAM Session 5
15:00			
15:30	Coffee-Break / GISTAM Poster Session 1		Closing Session & Awards Ceremony
16:00		Coffee-Break	Farewell Drink
16:30	GISTAM Session 1	Keynote Lecture Alexander Zipf	
17:00			
17:30		Oral Presentations (Online) 3	
18:00	Welcome Drink		
18:30			
19:00			Buses to Banquet
19:30			
20:00			Social Event
20:30			
23:00			
23:30			Buses from Banquet
24:00			

Final Program
and Book of Abstracts

Contents

Thursday Sessions: April 27

Contents

Tuesday Sessions: April 25

Tuesday Sessions: April 25 Program Layout

Time	Belvedere I	Coffee-Break	Foyer Belvedere	Loreta	Prague B+C
13:00					
13:30				Lunch	
14:00					
14:30					Opening Session
15:00					Keynote Lecture Costas Armenakis
15:30		Coffee-Break	GISTAM Poster Session 1		
16:00					
16:30	GISTAM Session 1				
17:00	#7, #13, #17, #18				
17:30					
18:00					

Opening Session	**GISTAM**
14:15 - 14:30	**Room Prague B+C**

Keynote Lecture	**GISTAM**
14:30 - 15:30	**Room Prague B+C**

Mobile Sensing and Mapping: Where We Stand

Costas Armenakis

York University, Canada

Abstract: The availability of small to medium size ground and aerial mobile platforms equipped with integrated navigation and mapping sensors has led to wide use of these systems for geospatial data collection for generating 3D maps such as high-definition maps and digital twin infrastructures. In this presentation we will discuss the advances on various sensor localization and scene mapping approaches, collaborative systems and multi-modal sensor integration, computing architectures, and sensor data processing for complete, rapid, and accurate 3D scene reconstruction for reality capture towards the generation of various types of maps from point clouds to segmented virtual image types.

Poster Session 1	**GISTAM**
15:30 - 16:30	**Room Foyer Belvedere**

Complete Paper #9

Bushfire Susceptibility Mapping Using Gene Expression Programming and Machine Learning Methods: A Case Study of Kangaroo Island, South Australia

Maryamsadat Hosseini and Samsung Lim

School of Civil and Environmental Engineering, University of New South Wales, High Street, Sydney, Australia

Keywords: Bushfire, Susceptibility Map, Gene Expression Programming, Machine Learning, Kangaroo Island.

Abstract: Kangaroo Island, South Australia is one of the bushfire-prone areas. A catastrophic bushfire known as the black summer hit Kangaroo Island in 2019/2020. We chose Kangaroo Island as a case study to generate bushfire susceptibility maps using five different methods, namely gene expression programming (GEP), random forest (RF), support vector machine (SVM), frequency ratio (FR) and logistic regression (LR). To generate bushfire susceptibility maps, we used eight contributing factors including: digital elevation model, slope, aspect, normalized difference vegetation index, distance to roads, distance to streams, precipitation, and land cover. The proposed methods were evaluated by area under the curves (AUCs) of receiver operating characteristic. RF performed best with an AUC of 0.93, followed by SVM and GEP with AUCs equal to 0.89 and 0.88, respectively, but LR and FR performed least among the five methods with AUCs 0.85 and 0.84, respectively. The generated bushfire susceptibility maps show that western and central areas of Kangaroo Island are highly vulnerable to bushfire.

Complete Paper #12

LiDAR and SfM-MVS Integrated Approach to Build a Highly Detailed 3D Virtual Model of Urban Areas

Nives Grasso, Claudio Spadavecchia, Vincenzo Di Pietra and Elena Belcore

DIATI, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy

Keywords: 3D Models, Multisensor, Multiscale, LiDAR, UAS, Data Integration, Data Fusion, Geomatics.

Abstract: The three-dimensional reconstruction of buildings, road infrastructures, service networks, and cultural heritage in urban environments is relevant for many market segments and numerous functions in the management and coordination of public authorities. These stakeholders are showing increasing interest in modern acquisition and reconstruction technologies for digital models typical of the geomatic and computer vision disciplines. In this context, it is essential to methodically exploit the potential of active and passive instruments and apply multi-sensor integration techniques, to obtain metrically accurate and high-resolution products. This study proposes a multi-sensor and multi-scale approach for high-resolution 3D model reconstruction focused on a city portion of Turin (Italy). We performed an integrated survey based on LiDAR and photogrammetric techniques, both aerial and terrestrial. Then we produced a set of 3D digital products for (i) promoting the historical and artistic heritage through Virtual Reality (VR) applications, (ii) supporting the restoration of Baroque buildings, and (iii) providing advanced analysis concerning the alteration of the urban road system. The final output describes in detail the architectural elements investigated (e.g., 9,480,000 tringles to define the mesh of a statue). It emphasizes the need for deepening sensor integration and data fusion.

Complete Paper #19

GNSS Monitoring of Geodynamics in the Region Around Sofia and South-Western Bulgaria

Nikolay Dimitrov and Anton Ivanov

National Institute of Geophysics Geodesy and Geography, Bulgarian Academy of Sciences, Sofia, Bulgaria

Keywords: GNSS, Crustal Movements, Horizontal Velocity, Crustal Strain.

Abstract: For more than 25 years, the monitoring of geodynamic processes with modern GNSS technology in the region of Sofia and Southwestern Bulgaria continues. To investigate modern crustal motions in the area, Global Positioning System (GPS) data obtained between 1996 and 2022 are analyzed to obtain the velocity field for southwestern Bulgaria. For this period, monitoring covered 28 stations. The active strain in the region is also estimated from analysis of the results for velocity solutions. Some correlation between modern earth crust movements, seismic events and tectonic structures is established. The obtained results in a general way confirm previously data, but with much better accuracy and details at local level. The results can be used for a detailed geodynamic and geological study of the active fault structures in the area.

Tuesday, 25

Complete Paper #24

Accuracy Assessment of Direct Georeferencing Using UAV Matrice 210 RTK V2 on Gully Santiš, Island of Pag (Croatia)

Katarina Glavačević[1], Ivan Marić[2] and Ante Šiljeg[2]

[1] *Independent Researcher, Ludwigshafen am Rhein, Germany*

[2] *Department of Geography, University of Zadar, Zadar, Croatia*

Keywords: Direct Georeferencing, Matrice 210 RTK V2, Absolute Accuracy, D-RTK 2, UAV Photogrammetry.

Abstract: Rapid development and increased availability of unmanned aerial vehicles (UAVs) resulted in the exponential use of these systems in many scientific fields and activities. However, the application of photogrammetric models derived using the Structure from Motion (SfM) technique largely depends on the use of ground control points (GCPs). Since the acquisition of the GCPs requires the use of high-quality total stations or GNSS-RTK receivers, these procedures generally take up a lot of time. Execution of a photogrammetric process without using the GCPs is called direct georeferencing, and it is becoming an increasingly popular method. In this research, we tested three methods of RTK positioning using the system of the *Matrice 210 RTK V2* and *D-RTK 2* mobile station. The following methods were tested: (a) D-RTK 2 as a base station; (b) D-RTK 2 correction with the third-party base station; (c) network NTRIP corrections CROPOS. An absolute accuracy assessment of each RTK positioning mode was done using 10 check points (CPs). By calculating the total RMSE, it was determined that (b) and (c) RTK positioning modes have a centimeter level of accuracy (<10 cm). In this research, it is determined that the tested UAV system for direct georeferencing can be used in a wide range of geographical applications and other disciplines where absolute accuracy of centimeter-level is required.

Complete Paper #38

GIS Multicriteria Decision Analysis in Selecting the Optimal Location for Urban Green Space: A Case Study of Zadar City

Rina Milošević[1], Silvija Šiljeg[2] and Fran Domazetović[2]

[1] *Croatian Geographical Society Zadar, Zadar, Croatia*

[2] *Department of Geography, University of Zadar, Zadar, Croatia*

Keywords: Urban Green Areas, GIS-MCDA, Optimal Location, City of Zadar.

Abstract: The urbanization process has proceeded rapidly in recent decades, resulting in the rapid transformation of natural surfaces into impervious ones which has numerous impacts on the environment and human health. Urban green spaces are recognized as a critical spatial component for maintaining ecological balance and improving human mental and physical health. Therefore, the rational and even distribution of green spaces in the city is particularly important, as they represent the most accessible natural environment for city dwellers. The main objective of this study is to propose criteria and create a UGS suitability model (UGSSM) for the urban area of Zadar. The model is generated by applying the GIS multicriteria decision analysis (MCDA) and analytical hierarchical process (AHP). The model resulted in 580 ha of very high suitable (VHS) zones, mostly located in the northwestern part of the city. However, only 0.05% (N=38) of VHS zones are consolidated areas larger than 2 ha. Among VHS consolidated areas (>2 ha), the optimal one is depicted based on ownership verification. This framework can be applied to other small cities with some minor modifications.

For future research, we suggest including residents with physical disabilities in the selection and landscaping of the location.

Session 1A	**GISTAM**
16:30 - 18:00	Room Belvedere I
Spatial Analysis and Integration	

Complete Paper #7

Revisiting Food Deserts in North Carolina, USA, Using a Cloud-Based Real-Time Quality Assurance/Quality Control (QA/QC) Tool

Timothy Mulrooney and Isabel Gutierrez

Department of Environmental, Earth and Geospatial Sciences, North Carolina Central University, Durham, North Carolina, U.S.A.

Keywords: Food Environment, Geographic Information Systems, Quality Assurance, Quality Control, Spatial Data Quality.

Abstract: In the study of the food environment, little research has explored the spatial data quality of store locations which impacts the spatial representation of the food environment. In this paper, we created a cloud-based tool that can inspect, edit and create new supermarkets in real-time which changes the complexion of the food environment. Comparisons were made between data supplied between a CAB (Commercially Available Business) Database and those corrected after field verification. Results showed differences between the food environment using the data provided and the actual food environment after QA/QC, with a general underestimation of those who are truly food needy due to errors of temporal accuracy, misattribution and geocoding in the original data provided.

Complete Paper #13

Modelling Spatial Connectivity of Forest Harvest Areas: Exact and Heuristic Approaches

Pete Bettinger

Warnell School of Forestry and Natural Resources, University of Georgia, 180 E. Green Street, Athens, Georgia, U.S.A.

Keywords: Connectivity, Spatial Analysis, Land Management, Forestry, Natural Resource Management.

Abstract: A forest management planning process can involve the development of a tactical plan that illustrates for a land manager where to go and what to do within a specific period of time, acknowledging and satisfying all recognized management constraints. More often these days, forest management constraints address the size, timing, and placement of management activities. The optimization methods used to mathematically develop a forest plan, and to integrate spatial constraints into planning efforts are often referred to as exact and heuristic approaches. This paper describes how one might model spatial connectivity of forest harvest areas as constraints under both approaches, using two different representations of connectivity, the unit restriction model and the area restriction model. The heuristic approach to the latter has until now only been described using scientific notation. Here, we provide guidance for the programming logic.

Abstract #17

Spatial Analysis of Health Outcomes and Population Exposure to Aviation Noise in the Contiguous United States

Yelena Ogneva-Himmelberger

Clark University, U.S.A.

Keywords: N/A

Abstract: **Objective.** In this paper, we use GIS to identify areas affected by high aviation noise in the Contiguous United States and to analyze the prevalence of chronic disease in these areas. Specifically, we address two questions: Is there a statistical difference in the prevalence of high blood pressure, coronary heart disease and stroke between areas with different aviation noise levels? Where are the areas of health disparities that are simultaneously experiencing the highest noise exposure? High noise exposure a risk factor for these chronic diseases, so it is important to know where these two conditions are co-occurring. Our findings could inform the development of effective programs and policies related to noise abatement, and help prioritize investment in areas with the biggest health inequities.
Data. Aviation noise raster (30-meter) was obtained from the Bureau of Transportation Statistics. It represents the average daily noise level, modeled using flights and meteorological data. Health outcomes data was obtained from PLACES database (Population Level Analysis and Community Estimates) at census tract level. PLACES provides local-level model-based estimates for 29 health measures. We selected 3 measures known to be associated with chronic aviation noise exposure – the prevalence of high blood pressure, coronary heart disease and stroke.
Methods. We reclassified noise data into "low noise" (45-65 db) and "high noise" (65db+) categories. 65db is the threshold used by the Federal Aviation Administration to define "significant" aircraft noise exposure. To compare noise-affected areas with non-affected areas, we created circular buffers around each airport, so that the noise-affected area fits inside the buffer. Health outcomes data were clipped to airport buffers, and divided into three groups: those affected by "high-noise", "low-noise", and those not affected by noise (30,924 census tracts). Median values were calculated for each exposure group for each health outcome and compared using Kruskal-Wallis Test. To identify areas of the highest health disparities we selected census tracts in the 90-100th percentile for each health outcome and overlaid them with the "high noise". This resulted in a selection of census tracts where a high proportion of people are estimated to suffer from chronic diseases, and are exposed to a very high noise.
Results. The median values for health outcomes were higher in noise-exposed areas compared to non-exposed areas. Statistical test confirmed that these values were statistically different between three exposure groups (<0.05). We identified 126 census tracts (25,623 people) that have the highest prevalence of chronic disease and are also in very high noise areas. The highest number of people exposed to high noise is in Florida, Louisiana, Alabama, Texas, and Georgia.
Conclusion. We analyzed two novel, high resolution, nationwide data sets and found a statistically significant association between increasing prevalence of three chronic diseases and elevated noise levels. We also identified areas where extremely high values of health outcomes and noise overlap - areas where a high proportion of the population is estimated to have poor health, and is experiencing chronic exposure to very high airport noise levels. Our findings can support practitioners and policy makers in their efforts to improve the conditions of vulnerable populations in these areas.

Abstract #18

Investigation of Volunteered Geographic Information Data for Near-Real-Time Spatial Analysis of Fire Hazards

Janine Florath[1,2], Jocelyn Chanussot[3] and Sina Keller[1]

[1] *Karlsruhe Institute of Technology, Kaiserstraße 12, 76131 Karlsruhe, Germany, Germany*

[2] *Gipsa-lab, Université Grenoble Alpes, CNRS, Grenoble INP, 11 Rue des Mathématiques, 38400 Saint-Martin-d'Hères, France*

[3] *Gipsa-lab, Université Grenoble Alpes, CNRS, Grenoble INP, 11 Rue des Mathématiques, 38400 Saint-Martin-d'Hères, France, France*

Keywords: Natural Hazards, Volunteered Geographic Information Data, Spatial Analysis, Twitter, Wildfire, Geoinformation Systems.

Abstract: In recent years forceful natural hazards and disasters have posed a severe threat to humans [1, 2]. First responders, like rescue services, play a crucial role in reducing any threats and need real-time information about the location and possible extent of the hazard to mitigate and cope with potentially hazardous effects [3]. The mapping of approximate extents of wildfires can be achieved with remote sensing (RS) data with sufficient accuracies [4], but rarely in (near) real-time for non-commercial satellites due to the satellites' overpass time. As alternative data, volunteered geographic information (VGI) data, such as Twitter data, can be used to identify potential hazard areas or affected areas in almost near-real time [5, 6]. In our study, we aim to investigate and evaluate the possibilities and limitations of tweets for the spatial analysis of fire hazards in the absence of RS data. As a case study, we focus on the Bobcat fire in the Los Angeles National Forest in California, Unites States (U.S.), in 2020. We extract tweets with relevant keywords and their geographic location for the time of the fire from 06/09/2020 to 10/09/2020. Besides, as reference data, we rely on the given fire area generated with Sentinel-2 RS data (acc. to [4]) on 10th September 2020. When focusing on the methodological part, we consider different approaches. For the geographic cluster point of all the tweets, we first calculate the weighted median location of the tweet points, taking into account influencing factors like population density. Next, we estimate approximate hazard locations or affected areas with several approaches according to the availability of the respective data in the tweet texts: viewing angle to fire (from location point to mentioned target point), distance to fire, and road segment blocking information. Finally, the approaches' results are combined, and the possibly affected minimal and maximal hazard areas of the fire are estimated with a confidence interval. The findings from the Bobcat fire study indicate that the calculation of the weighted median center from tweets aligns well with the fire area, as determined from RS imagery. Our approach also demonstrates that the estimated minimal and maximal affected area corresponds closely to the area detected from RS. However, it should be noted that the estimation of the affected area from VGI may yield slightly different results, with the center of the estimated area located in an area where the population is more affected by the wildfire. Using geospatial analysis approaches on VGI obtained from sources such as Twitter can assist in identifying the region impacted by natural disasters, such as wildfires. This usage is particularly beneficial when RS data are unavailable or inadequate for determining the extent of potential impacts on populations. Despite limitations in precision when compared to other forms of data, VGI can provide approximate and timely estimates of affected areas, enabling emergency responders to plan their operations, allocate resources, and prioritize areas of concern.

[1] Karnjana Songwathana. 2018
[2] Ben Wisner et al. 2014
[3] Haiyan Hao et al. 2020
[4] Janine Florath et al. 2022
[5] André Dittrich et al. 2014

Tuesday, 25

[6] Yandong Wang et al. 2015.

Tuesday, 25

Wednesday Sessions: April 26

Wednesday Sessions: April 26 Program Layout
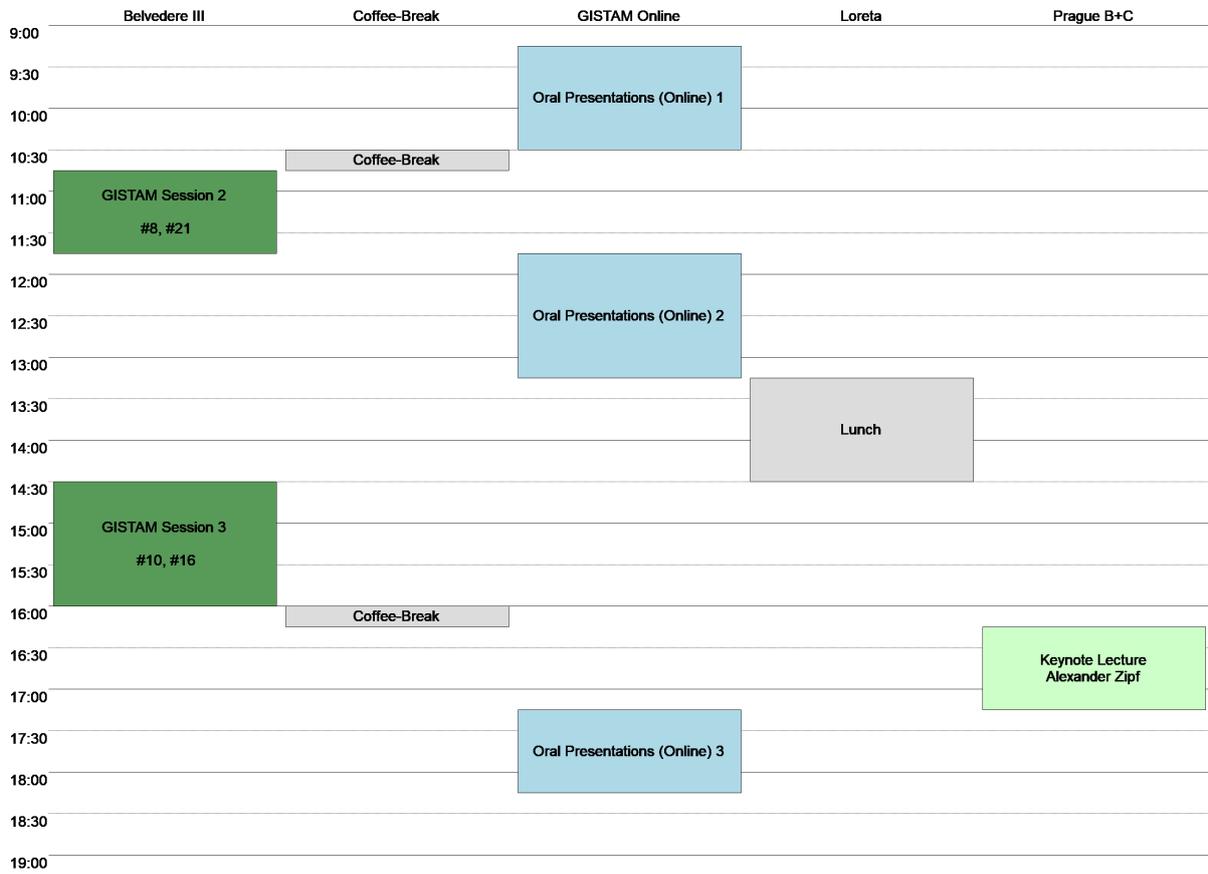
	Belvedere III	Coffee-Break	GISTAM Online	Loreta	Prague B+C

9:00

9:30 — Oral Presentations (Online) 1

10:00

10:30 — Coffee-Break

11:00 — GISTAM Session 2

11:30 — #8, #21

12:00

12:30 — Oral Presentations (Online) 2

13:00

13:30 — Lunch

14:00

14:30

15:00 — GISTAM Session 3

15:30 — #10, #16

16:00 — Coffee-Break

16:30 — Keynote Lecture Alexander Zipf

17:00

17:30 — Oral Presentations (Online) 3

18:00

18:30

19:00

Complete Paper #36

Exploring Spectral Data, Change Detection Information and Trajectories for Land Cover Monitoring over a Fire-Prone Area of Portugal

André Alves[1], Daniel Moraes[2,3], Bruno Barbosa[1], Hugo Costa[2,3], Francisco Moreira[3], Pedro Benevides[3], Mário Caetano[2,3] and Manuel Campagnolo[1]

[1] *Forest Research Centre, Associate Laboratory TERRA, School of Agriculture, University of Lisbon, Tapada da Ajuda, 1349-017 Lisboa, Portugal*

[2] *NOVA Information Management School (NOVA IMS), Universidade NOVA de Lisboa, Campus de Campolide, 1070-312 Lisboa, Portugal*

[3] *Direção-Geral do Território, Rua Artilharia Um, 107, 1099-052 Lisboa, Portugal*

Keywords: Land Cover Change Classification, Thematic Map, Spectral Composites, NDVI, CCDC, COSc, Earth Observation.

Abstract: Land use/land cover (LULC) change detection and classification in maps based on automated data processing are becoming increasingly sophisticated in Earth Observation (EO). There is a growing number of annual maps available, with diverse but related production structures consisting primarily of classification and post-classification phases, the latter of which deals with inaccuracies of the first. The methodology production of the "Carta de Ocupação do Solo conjuntural" (COSc), a thematic land cover map of continental Portugal produced by the Directorate-General for Territory (DGT) mostly based on Sentinel-2 images classification, includes a semi-automatic phase of correction that combines expert knowledge and ancillary data in if-then-else rules validated by photointerpretation. Although this approach reduces misclassifications from an initial Random Forest (RF) prediction map, improving consistency between years and compliance with ecological succession, requires a lot of time-consuming semi-automatic procedures. This work evaluates the relevance of exploring an additional set of variables for automatic classification over disturbance-prone areas. A multitemporal dataset with 124 variables was analysed using data dimensionality reduction techniques, resulting in the identification of 35 major explanatory indicators, which were then used as inputs for RF classification with cross-validation. The estimated importance of the explanatory variables shows that composites of spectral bands, which are already included in the current COSc workflow, in conjunction with the inclusion of additional data namely, historical land cover information and change detection coefficients, from the Continuous Change Detection and Classification (CCDC) algorithm, are relevant for predicting land cover classes after disturbance. Since map updating is a more challenging task for disturbed pixels, we focused our analysis on locations where COSc indicated potential land cover change. Nonetheless, the overall classification accuracy for our experiments was 72.34 % which is similar to the accuracy of COSc for this region of Portugal. The findings suggest new variables that could improve future COSc maps.

Complete Paper #27

New Challenges in the Implementation and Exploitation of a Low-Cost Web Map of the Active Deformation Areas Across Europe

José Navarro, Danielly García and Michele Crosetto
Centre Tecnològic de Telecomunicacions de Catalunya (CTTC/CERCA), Av. Carl Friedrich Gauss 7, 08860 Castelldefels, Spain

Keywords: Active Deformation Areas, EGMS, Geoprocessing, Land Subsidence, Open-Source, WebGIS.

Abstract: The European Ground Motion Service (EGMS) is already offering data on Persistent Scatterers (PS) throughout Europe, which will aid in analyzing ground deformation on a continental scale. However, to more fully comprehend ground motion processes, it is preferable to use Active Deformation Areas (ADA) instead of PS. The CTTC has been using its ADAfinder tool to generate ADAs since 2018. With the new availability of EGMS PS data for the entire continent, the CTTC is now working on producing ADAs for all of Europe and making them accessible to the public through a self-developed, in-house hosted, web-based map application. A former paper describes the initial steps taken to develop it. This work focuses on how the challenge of processing a huge amount of data has affected the design and implementation of the tools used in the data production workflow. Additionally, the manner in which the EGMS data is structured, providing data sets that spatially overlap, has resulted in a new problem: overlapping ADAs. The approach to resolving this issue is also discussed in this paper. The result is an evolution of the initial concept where not only economic reasons but also considerations on automation and handling of large volumes of data have guided the design and implementation of the system.

Complete Paper #35

Modeling & Simulating the Evacuation of a Building Based on Building Floor Plan and Evacuation Strategies

Shreya and K. Rajan
Lab for Spatial Informatics, IIIT Hyderabad, Hyderabad, Telangana-500032, India

Keywords: Building Evacuation, Evacuation Strategies, Floor Plan, Path Planning.

Abstract: Accidental fires in public and large buildings not only cause property loss but also can lead to loss of lives. During such emergencies, building evacuation depends on a range of factors including floor plans, exits available, obstructions if any, the occupancy levels of the building, and so on. The study here brings together the spatial, temporal, and path planning possibilities to evaluate fire evacuation strategies for 2D building plans. It provides a geospatial framework to assess the impacts of dynamic changes in the building environment and its impact on evacuation outcomes. In this study, occupancy-based path planning using Pgrouting over an IndoorGML formatted data is combined with modeling their interactions over the path toward the exit to assess the outcomes. This computational approach over the time-dependent path provides interesting insights into determining the number of paths and the need for one or more exits during an emergency. The study shows that integrating the floor plan into path generation and people flow can be a powerful tool for assessing the building environment.

Session 2A   **GISTAM**
10:45 - 11:45   **Room Belvedere III**
Spatial Modeling and Reasoning

Complete Paper #8

Spatio-Temporal Modelling of Relationship Between Organic Carbon Content and Land Use Using Deep Learning Approach and Several Co-Variables: Application to the Soils of the Beni Mellal in Morocco

Sébastien Gadal[1,2], Mounir Oukhattar[1], Catherine Keller[3] and Ismaguil Houmma[1,4]

[1] *Aix-Marseille University, CNRS, ESPACE UMR 7300, Univ. Nice Sophia Antipolis, Avignon University, France*

[2] *Department of Ecology and Geography, Institute of Environment, North-Eastern Federal University, Republic of Sakha Yakutia, Russia*

[3] *Aix-Marseille Univ., CNRS, IRD, Coll de France, INRAE, CEREGE, Technopole de l'Environnement Arbois-Méditerranée, BP80, 13 545 Aix-en-Provence, Cedex 4, France*

[4] *Hassan II Institute of Agronomy and Veterinary, Department of Geodesy and Topography, Geomatics Science and Engineering, Morocco*

Keywords: SOCS, LULC Change, Remote Sensing, Soil Analysis, Spatial Distribution, Machine Learning Classification, Deep Learning Modelling.

Abstract: In recent decades, population growth has led to rapid urbanisation associated with a land degradation process that threatens soil organic carbon stocks (SOCS). This paper aims to model the interrelationships between SOCS and land use/land cover (LULC). The approach was based on the use of environmental covariates derived from Landsat-5 TM/8 OLI images, forty soil samples, Kriging spatial interpolation method and a Multi-layer Perceptron (MLP) model for the geo-spatialisation of SOCS. The analysis shows a high positive autocorrelations (R^2 >0.75) between vegetation indices and SOCS, particularly higher for SOCS derived from spatial modelling with MLP. On the other hand, the relationship between LULC and SOCS from the three approaches is very variable depending on the dynamics of LULC. The autocorrelations between SOCS and LULC units are very weak in 1985 and 2000 but significant for the year 2018. This suggests that the land use dynamics in the area are favourable to SOCS. In general, the results show that SOCS increased in the tree crop, unused land and forest areas but decreased in the cropland. The SOCS varied in the following order: forest cover>unused land>cropland>urban area>tree crops. This indicates that LULC, topography and vegetation types had an impact on SOCS distribution characteristics.

Complete Paper #21

Evaluating the Fulfilment Rate of Charging Demand for Electric Vehicles Using Open-Source Data

Hana Elattar, Ferdinand von Tüllenburg, Sebastian Wöllmann and Javier Valdes

Institute for Applied Computer Science, Deggendorf Institute of Technology, Technologie Campus Freyung, Freyung, Germany

Keywords: Electric Vehicles (EVs), Energy Demand, Charging Infrastructure.

Abstract: With the shift towards electric vehicles accelerating; we are working with open-source data to estimate to which degree existing charging infrastructure is fulfilling the demand created by electric vehicles. This paper is explaining how to create such a calculation by extracting data from large public areas in the city of Lindau (Bodensee), Germany as a showcase. With this data we aim to evaluate whether charging stations located in the premises of public and commercial buildings cover the demand of electric vehicles reaching the said buildings. This research is conducted as a first step of methodologies development that aims on the long term to create a tool that supports in the optimal placement of new charging stations. The methodology chosen is inspired by two main concepts: the first is the attractiveness factor concept used for the creation of travel models, while the second is the classification of charging stations based on location to determine their rate of occupancy. They are both used to cluster buildings and charging stations respectively to be able to determine the number of users in the area of study (AOS) compared to the overall number of electric vehicles reaching the destination in a given day. This paper takes the island in the centre of the city of Lindau (Bodensee) as its area under investigation and uses open-source data along with the appropriate assumptions as a base for its calculations.

Oral Presentations (Online) 2   **GISTAM**
11:45 - 13:15   **Room GISTAM Online**
Modeling, Representation and Visualization

Complete Paper #18

Borehole Inner Surface Visualization System with Vibration Cancellation and Trajectory Smoothing Based on Optical Monocular Video Camera

Nan Zong[1], Waleed Al-Nuaimy[1], Heba Lakany[1] and Paul Worthington[2]

[1] *School of Electrical Engineering, Electronics and Computer Science, University of Liverpool, Brownlow Hill, Liverpool, U.K.*

[2] *Department of Engineering & Development, Robertson Geologging Ltd., York Road, Deganwy, U.K.*

Keywords: Geological Data Logging, Monocular Video, Image Processing, Data Visualization.

Abstract: The rapid digitization and modelling of the planet brings with it increased demand for the tools necessary to process and visualize disparate streams of multivariate and often highly complex geophysical data streams. The rationalization of detection hardware and the integration of sensors offers the potential to economically visually explore and map geophysical environments such as the interior of subterranean boreholes. This paper addresses the challenge of visual reconstruction of the geometry of the inner surface of a borehole from video data collected via a monocular optical camera. We introduce a novel system of algorithms to unwrap the cylindrical borehole inner surface data and to compensate for the offsets and errors arising during data acquisition. Three modules are designed for this task: Unwrapping module consisting o algorithms to generate visualization results of borehole inner surfaces; Vibration cancellation module that compensates for rotation and drift errors caused by the movement of detectors, balancing computational cost and performance; Trajectory smoothing based on image convolution signal processing methods to filter out anomalies and interruptions that arise as a result of the other processing stages. The proposed system integrates these modules to generate planar side-view images with a high level of spatial accuracy. This system also contributes to establish a novel and easy-to-access visualization tool of boreholes with simplified detectors that only consists of a monocular camera and a fixed circular LED band. Results has demonstrated the system is capable of resisting high frequency drift and the effects of rotation and vibrations in harsh

Wednesday, 26

subterranean environments. This novel combination of video and image processing marks a significant improvement over currently available or published borehole video exploration techniques, and can be further extended and enhanced to deliver more accurate multi-sensor 3D modeling and reconstruction of the complex inner structure of geophysical boreholes.

Complete Paper #33

Spatial Patterns in Neurodegenerative Disease's Hospitalizations in Portugal (2000-2016)

Mariana Oliveira[1,2], Alberto Freitas[1,2], Ana Teodoro[3,4] and Hernâni Gonçalves[1,2]

[1] Center for Health Technology and Services Research (CINTESIS@RISE), Faculty of Medicine, University of Porto, Rua Doutor Plácido da Costa, s/n 4200-450 Porto, Portugal

[2] Department of Community Medicine, Information and Health Decision Sciences (MEDCIDS), Faculty of Medicine, University of Porto, Rua Doutor Plácido da Costa s/n, 4200-450 Porto, Portugal

[3] Department of Geosciences, Environment and Land Planning, Faculty of Sciences, University of Porto, Rua do Campo Alegre 687, 4169-007 Porto, Portugal

[4] Earth Sciences Institute (ICT), Pole of the FCUP, University of Porto, 4169-007 Porto, Portugal

Keywords: Neurodegenerative Diseases, Spatial Epidemiology, Hospitalization Rates.

Abstract: Neurodegenerative diseases, usually arisen from the death of nervous system cells, is a rising concern on the worlds' population increasing life expectancy. More precisely, Portuguese population, along with that of other developed countries, is ageing at a fast rate. The understanding of such diseases' patterns is of utmost relevance to help manage the burden it represents in the health system. In this retrospective study, we analysed over 170 thousand hospitalizations with discharges between 2000 and 2016. We computed age-standardized hospitalization rates for each neurodegenerative disease. The most prevalent disease in our sample was Alzheimer with 60% of cases, and the least prevalent was Parkinson with only 0.05% of cases. The spatial analysis shows that Santarém and Portalegre (neighbour) districts in central Portugal, have the highest rates. The increase in hospitalization rates over the study period is also clear when looking at the spatio-temporal analysis. Although limited by the usage of secondary health data, this study represents a background for other studies on the field of neurodegenerative diseases, presenting with relevant insight on the spatio-temporal patterns of each and every neurodegenerative disease in Portugal at the moment.

Complete Paper #23

On-the-Fly Acquisition and Rendering with Low Cost LiDAR and RGB Cameras for Marine Navigation

Somnath Dutta, Fabio Ganovelli and Paolo Cignoni

Institute of Information Science and Technologies "Alessandro Faedo" (ISTI), Italian National Research Council (CNR), Via Giuseppe Moruzzi 1, 56124 Pisa, Italy

Keywords: LiDAR-RGB Images Calibration, Computer Graphics.

Abstract: This paper describes a hardware/software system, dubbed NausicaaVR, for acquiring and rendering 3D environments in the context of marine navigation. Like other similar work, it focuses on system calibration and rendering but the specific context poses new and more difficult challenges for the development

when compared to the classic automotive scenario. We provide a comprehensive description of all the components of the system, explicitly reporting on encountered problems and subtle choices to overcome those, in an attempt to render an insightful picture of how this and similar systems are built.

Complete Paper #41

Vector Tile Geospatial Data Protection Using Quantization-Based Watermarking

Danila Glazkov[1,2], Nikolay Chupshev[1,2] and Victor Fedoseev[1,2]

[1] Samara National Research University, Samara, Russia

[2] Samara-Informsputnik JSC, Samara, Russia

Keywords: Mapbox Vector Tiles, MVT, Geospatial Data, GIS, Geospatial Data Protection, Watermarking, QIM.

Abstract: The paper proposes a watermarking method for protecting geodata presented in the Mapbox Vector Tile (MVT) format against theft. MVT is an open format that is gaining popularity in web mapping services due to efficient storage and fast rendering. However, the vector nature of the format makes it an easy target for attackers who want to steal data and use in their services. The method proposed in this paper protects MVT data with a digital watermark based on re-quantization of point coordinates of object geometry. The method can be adjusted using a number of parameters that allow finding a balance between the robustness of the digital watermark to map distortions and the error introduced when embedding. A series of experiments performed showed the robustness of this method to several distortions: removal of some objects and layers, reduction in the number of points of existing objects, addition of new objects, controlled shift of points in the tile geometry. With a proper choice of the watermark parameters, even with a moderate level of each of the listed distortions, which does not lead to a loss of significance of the protected geodata, the method can reach 100% watermark extraction accuracy of all bits of the built-in watermark.

Session 3A	GISTAM
14:30 - 16:00	Room Belvedere III
Disaster Management	

Complete Paper #10

Sentinel 2 High-Resolution Land Cover Mapping in Sub-Saharan Africa with Google Earth Engine

Elena Belcore and Marco Piras

DIATI, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy

Keywords: Land Cover, Machine Learning, Sentinel-2, Google Earth Engine, Sub-Saharan, Natural Hazard, Climate Change.

Abstract: This work aims to develop an efficient methodology for high-resolution spatial and thematic land cover maps of sub-Saharan areas based on Sentinel-2 data. LC mapping in these areas is complicated due to their land morphology, climatic conditions and homogeneity of surface spectral responses. Two pixel-based supervised classification approaches are compared in Google Earth Engine. The aggregated method classifies each image and then aggregates the results on frequency bases at pixel level. The stacked method classifies all the images together in a single stacked database. Additionally, the influence of linear atmospheric correction models on the overall accuracy (OA) is assessed, and the best-performing approach is compared

to existing Land Cover (LC) maps of the area. 16 Sentinel-2 images (level 1C) from 2017 and 2019 were atmospheric and topographically corrected and classified into nine classes. The results show similar performances for the analysed approaches, with a slightly high OA for the aggregated classification (0.97). The atmospheric correction has little impact on the results.

Complete Paper #16

3D Geospatial Data Management Architecture for Common Operational Picture Functionalities in Emergency Response

Iñaki Cejudo, Eider Irigoyen, Harbil Arregui and Estíbaliz Loyo

Intelligent Systems for Mobility and Logistics, Vicomtech Foundation, Basque Research and Technology Alliance (BRTA), Mikeletegi 57, Donostia, Spain

Keywords: Emergency Management, Disaster Response, Command, Control, Location Based Services.

Abstract: In disaster management, the emergency response commanded from the Command and Control center can make the difference for a faster and safer outcome. Novel sensing tools provide new capabilities to monitor and evaluate what happens in real time with location information of first responders and casualties being a key resource. Therefore, Geographical Information Systems (GIS) are essential when representing the Common Operational Picture to have a complete understanding of the situation in the field, obtained through big amounts of real-time data coming from multiple sources, and therefore support decision making. Moreover, the 3-dimensional representation of the terrain and buildings enhance the classical 2D map representation. In this work, a detailed overview of the architecture components and functionalities developed for a data-driven emergency response 3D web GIS application is described. In addition, a quantitative evaluation of how the number of location records collected from various numbers of first responders impacts the performance of some geospatial tasks needed for an efficient visual representation is provided, depending on the data measurement frequency.

Keynote Lecture	GISTAM
16:15 - 17:15	Room Prague B+C

Using VGI for Social Good: Potentials and Pitfalls for Using OSM for Humanitarian Aid and Climate Mitigation

Alexander Zipf

Heidelberg University, Heidelberg, Germany

Abstract: Volunteered Geographic Information (VGI) has gained popularity in recent years as a data source for social good, particularly in the fields of humanitarian aid but also towards climate mitigation. This talk explores the potentials and pitfalls of using OSM for humanitarian aid and climate mitigation. The potentials of OSM include its ability to provide timely and accurate information to aid workers and climate researchers, while the pitfalls include concerns around data quality and bias. While there are significant challenges to overcome in using OSM for social good, its potential to contribute to these efforts is substantial, and I will highlight some recent examples developed by HeigiT.org how it can be used in real world applications.

Oral Presentations (Online) 3	GISTAM
17:15 - 18:15	Room GISTAM Online
Hydrological Remote Sensing	

Complete Paper #39

Data-Driven Modelling of Freshwater Ecosystems: A Multiscale Framework Based on Global Geospatial Data

Bruna Almeida and Pedro Cabral

Information Management School (NOVA IMS), Universidade Nova de Lisboa, Campus de Campolide, 1070-312 Lisbon, Portugal

Keywords: Remote Sensing, Ecosystem Services, Water Modelling, Machine Learning, Geographical Information Systems.

Abstract: Freshwater ecosystems are primarily impacted by climate, land use and land cover changes, and over-abstraction. Satellite Earth observation (SEO) data and technologies are key in environmental modelling and support decisions. These technologies combined with machine learning (ML) are a powerful approach for modelling freshwater ecosystems at a multiscale level. The goal of this study is to present a set of reference data and guidelines that can be used to estimate the water and wetness probability index (WWPI) in different spatial and temporal scales. To find the best model's predictors, sensitivity analyses were carried out in a predictive ML model implemented in a transnational river basin district (Portugal – Spain), the Tagus Basin. Satellite imagery, satellite-derived data, biophysical variables, and landscape characteristics were the explanatory variables evaluated in the sensitivity analyses, and some of them were included in the framework as a reference source of spatial data.

Complete Paper #31

Using Deep Learning and Radar Backscatter for Mapping River Water Surface

Diana Orlandi[1], Federico Galatolo[1], Mario Cimino[1], Carolina Pagli[2], Nicola Perilli[3], Joao Pompeu[4] and Itxaso Ruiz[4]

[1] *Dept. of Information Engineering, University of Pisa, Italy*
[2] *Dept. of Earth Science, University of Pisa, Italy*
[3] *Dept. of Civil and Industrial Engineering, University of Pisa, Italy*
[4] *BC3, Basque Centre for Climate Change, Leioa, Spain*

Keywords: Hydrological Remote Sensing, River Water Surface Mapping, Radar Backscatter, Convolutional Neural Network, Attention.

Abstract: In the last decades, the effects of global warming combined with growing anthropogenic activities have caused a mismatch in the water supply-demand, resulting in a negative impact on numerous Mediterranean rivers regime and on the functionality of related ecosystem services. Thus, for water management and mitigation of the potential hazards, it is fundamental to efficiently map areal extents of river water surface. Synthetic Aperture Radar (SAR) is one of the satellite technologies applied for hydrological studies, but it has a spatial resolution which is limited for the study of rivers. On the other side, deep learning technology exhibits a high modelling potential with low spatial resolution data. In this paper, a method based on convolutional neural networks is applied to the SAR backscatter coefficient for detecting river water surface. Our experimental study focuses on the lower reach of Mijares river (Eastern Spain), covering a period from Apr 2019 to Sept 2022. Results suggest that radar

backscattering has high potential in modelling water river trends, contributing to the monitoring of the effects of climate change and impacts on related ecosystem services. To assess the effectiveness of the method, the output has been validated with the Normalized Difference Water Index (NDWI).

Wednesday, 26

Thursday Sessions: April 27

Thursday Sessions: April 27 Program Layout
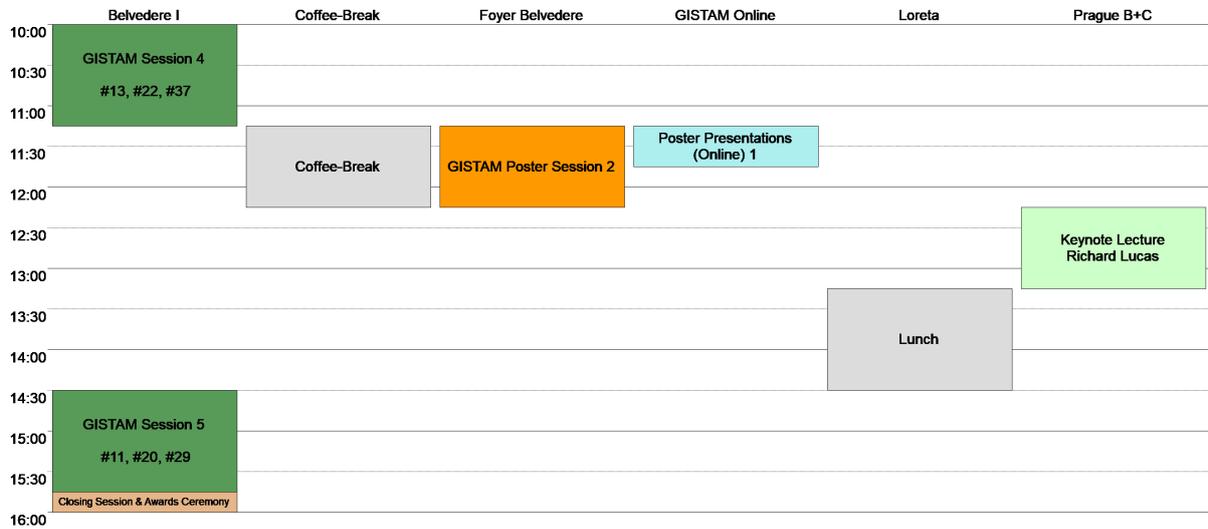
	Belvedere I	Coffee-Break	Foyer Belvedere	GISTAM Online	Loreta	Prague B+C
10:00						
10:30	GISTAM Session 4					
	#13, #22, #37					
11:00						
11:30		Coffee-Break	GISTAM Poster Session 2	Poster Presentations (Online) 1		
12:00						
12:30						Keynote Lecture Richard Lucas
13:00						
13:30					Lunch	
14:00						
14:30	GISTAM Session 5					
15:00	#11, #20, #29					
15:30						
	Closing Session & Awards Ceremony					
16:00						

Complete Paper #37

Identification of Emergent and Floating Aquatic Vegetation Using an Unsupervised Thresholding Approach: A Case Study of the Dniester Delta in Ukraine

Ioannis Manakos[1], Eleftherios Katsikis[1], Sergiy Medinets[2], Yevgen Gazyetov[2], Leonidas Alagialoglou[1] and Volodymyr Medinets[2]

[1] *Information Technologies Institute, Centre for Research and Technology Hellas, Thessaloniki, Greece*

[2] *Odesa National I.I. Mechnikov University, Odesa, Ukraine*

Keywords: Wetland, Sentinel-2, Floating Vegetation, Emergent Vegetation, Thresholding, Multi-Class Segmentation.

Abstract: Monitoring of emergent and floating vegetation in freshwater ecosystems is of high importance for water management in an area. This study proposes a methodology for the automatic monitoring of aquatic vegetation using indicators estimated via remote sensing image analysis. The study area is located in the Lower Dniester Basin in Southern Ukraine. The approach is developed using Sentinel-2 images and validated with field measurements. The goal is to discriminate and map three classes of aquatic surface condition; namely, areas covered with floating vegetation, or dominated by emergent vegetation, and open water. The approach is transferable across different dates over a period of three years. Results are useful for governmental authorities and natural/ national park administrations for near real-time monitoring of aquatic vegetation to mitigate the impact of overgrowth on water quality, biodiversity, and ecosystem services.

Abstract #13

Characterising Spatiotemporal Variability of South Asia's Climate Extremes in Past Decades

Yun Chen[1] and Tingbao Xu[2]

[1] *CSIRO Environment, Acton, Canberra, Australia*

[2] *Australian National University, Australia*

Keywords: N/A

Abstract: We systematically examined past spatiotemporal changes in climate variability to gain some cross-regional insights into South Asia's vulnerability to extreme conditions. Gridded Asian Precipitation-Highly-Resolved Observational Data Integration Towards Evaluation (APHRODITE) precipitation and Princeton Global Meteorological Forcing Dataset (PRINCETON) temperature data from 1975-2004 were used to derive a suite of annual extreme indices. Long term mean and decadal variations of these indices were mapped. Long-term change tendencies were also detected from a suite of 'slope' maps composed by the 30 yr change trend at each grid cell in the region. Most precipitation indices indicated a tendency towards drier conditions, whereas all temperature indices marked a steady coherent warming trend. The extremely wet day precipitation index exhibited the largest change, indicating an increase in heavy precipitation in South Asia. The highest maximum temperature extreme showed increases, indicating more unbearable heatwaves in the region. These trends present a previously unrecognised regional picture of the patterns and trends in historical climate extremes, with each grid cell representing spatiotemporal characteristics of changes. The present study is superior to most studies that only summarise an averaged regional trend from tendencies over large areas, and therefore will improve trans-boundary understanding of extreme climates in South Asia. Our study also exemplifies the application of existing gridded regional/global data sets. It provides valuable means of cross-regional information for bridging gaps where gauging observations are unavailable, particularly in data-poor developing countries.

Complete Paper #22

Standards-Based Geospatial Services Integration for Smart Cities Platforms

Bruno Rienzi, Raquel Sosa, Gastón Abellá, Ana Machado, Daniel Susviela and Laura González

Instituto de Computación, Facultad de Ingeniería, Universidad de la República, Montevideo, Uruguay

Keywords: Geospatial Services, Smart Cities Platforms, Standards.

Abstract: Smart cities usually refer to the use of information and communication technologies to provide citizens with improved city services and quality of life, in an affordable and sustainable way. Geospatial technologies, especially those based on standards, are relevant to this purpose, as location is crucial for organising, processing, and analysing urban information and services. During the last years, many smart cities platforms have emerged to provide support for the design, implementation, deployment, and management of smart cities applications (e.g. FIWARE). Although these platforms frequently consider the spatial dimension, they do not usually provide native support for typical geospatial services (e.g. data access, portrayal, and processing services). Therefore, geospatial-related features provided by applications are usually developed from scratch and on a per-case basis, which leads to code duplication and hinders their implementation agility, maintainability, and reuse. This paper proposes a standards-based solution for geospatial services integration for smart cities platforms, which comprises an overall architecture as well as a reference implementation based on FIWARE and includes three smart cities applications.

Complete Paper #17

A Novel Method for InSAR Phase Unwrapping with Single Baseline

Tian Chenxi and Huang Guoman

Chinese Academy of Surveying and Mapping, Haidian District, Beijing, China

Keywords: Interferometric Synthetic Aperture Radar (InSAR), Single-Baseline (SB), Multi-Baseline (MB), Phase Unwrapping (PU).

Abstract: The precision of phase unwrapping (PU), one of the primary methods used in interferometric synthetic aperture radar (InSAR), has a direct impact on the accuracy of the digital elevation model (DEM) that InSAR produces. The phase continuity assumption restricts single-baseline (SB) PU, and it is frequently hard to achieve optimal PU results in complex terrain areas with significant gradient variations. Fortunately, by utilizing numerous InSAR interferograms, or the elevation changes corresponding to each interference fringe in the interferogram, multi-baseline (MB)

PU can totally overcome the restriction of the phase continuity assumption. Therefore, this paper proposes a virtual-baseline (VB) PU based on the two-stage programming (TSPA) MB PU approach to transform the SB PU problem into a MB PU problem. The novel method can be referred to as VB-TSPA. First, the effect of baseline length on MB PU is comprehensively considered to determine the virtual baseline length. Then a corresponding interferogram is simulated according to the length. Finally, the TSPA method is used for the MB PU. The experimental results from simulated and real data demonstrate that the novel PU method has a better effect than the traditional SB PU algorithm and can obtain higher precision DEM.

Complete Paper #40

Deep-Learning Based Super-Resolution of Aeolianite Images on the Purpose of Edge Detection and Pattern Extraction

Antigoni Panagiotopoulou[1], Lemonia Ragia[2] and Niki Evelpidou[3]

[1] *Department of Surveying and Geoinformatics Engineering, University of West Attica, Egaleo Campus, Egaleo 12244, Greece*

[2] *School of Applied Arts and Sustainable Design, Hellenic Open University, Patras 26335, Greece*

[3] *National and Kapodistrian University of Athens, Faculty of Geology and Geoenvironment, Athens 15772, Greece*

Keywords: Aeolianite Image, Naxos, Deep-Learning, Densely Residual Laplacian Super-Resolution, Sobel Edge Detection.

Abstract: In the current work processing of Aeolianite images, from a quarry in the island of Naxos in Greece, is presented. The deep-learning based technique called Densely Residual Laplacian Super-Resolution (DRLN) is applied on the original images of size 3000×4000 pixels to increase their spatial resolution per the factor of 4. Edge detection is applied on the initial images as well as on the super-resolved images of 12000×16000 pixels. Visual and numerical comparisons on several Aeolianite scenes prove that the super-resolved images are advantageous in relation to the initial images of lower spatial resolution, as far as edge detection and pattern delineation are concerned. The improvement in edge detected components reaches 83%. Classification or pattern extraction could significantly benefit from encompassing the proposed methodology for Aeolianite images as a preprocessing step.

Poster Session 2	GISTAM
11:15 - 12:15	Room Foyer Belvedere

Abstract #20

Investigation of Efficient Delivery Methods by Survey-based Simulation of Team Delivery

Toshihiro Osaragi and Yuya Taguchi

School of Environment and Society, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro, Tokyo, Japan

Keywords: Team Delivery System, Multiple Traveling Salesman Problem, Delivery Operation, Optimization.

Abstract: In recent years, with the increase in the use of delivery services, a method for efficient delivery is required. In this paper, we propose a method to shorten the delivery service time of multiple staff (team delivery) by using some techniques developed for the multiple Traveling Salesman Problem. Using the method, a simulation is executed based on the parameters taken from the survey of the actual delivery service. Furthermore, we compare

the actual and optimal delivery routes, and demonstrate some new findings.

Abstract #12

Small Infill Potentials: An Automated Approach to Identify Vacant Lots Based on Cadastral Data

Denise Ehrhardt[1], Martin Behnisch[2] and Mathias Jehling[2]

[1] *Spatial Information and Modelling, Leibniz Institute of Ecological Urban and Regional Development, Weberplatz 1, Dresden, Germany*

[2] *Leibniz Institute of Ecological Urban and Regional Development, Weberplatz 1, Dresden, Germany*

Keywords: Infill Development, Vacant Lots, Cadastral Data, Knowledge-Based Classification.

Abstract: Infill development policies have been widely adopted as strategies to reduce urban sprawl and to promote sustainable urban transformation. However, little empirical data is available to analyse infill processes and to facilitate future mobilisation of infill potentials. This is especially true for small-scale residential infill, which often takes place on vacant or underused lots as soft densification.

We address this issue by introducing a geospatial approach that enables automatic detection of vacant lots for large areas based on cadastral data. Based on the definition of vacant lots, we derive parcel and neighbourhood characteristics to delimit them from built-up parcels and other infill development potentials and employ a hierarchical decision tree to decide whether a parcel can be considered a vacant lot or not. The workflow consists of five successive processing steps. First, we delimit built-up areas and reduce the dataset to land use type residential and mixed use. Second, a preliminary dataset of non-built-up parcels is generated. As many of the identified parcels do not match the definition of vacant lots, in a third step the preliminary data is revised to eliminate too small, odd shaped or not accessible parcels. To distinguish persistent from temporary vacant lots, we combine the final dataset of vacant lots with information on new development areas. Finally, the accuracy of the results is evaluated by comparing it to a reference dataset. The approach proves to be robust regarding its precision, showing an accuracy of 95.5 %.

The method is applied in a study area in Germany, covering 11.000 km^2 and containing large cites as well as rural municipalities. Based on the derived vacant lots dataset, we analyse spatio-temporal development for the period of 2011-2021. Our results show that every fourth vacant lots was mobilised since 2011. Yet, at the same time, additional vacant lots emerge, as new residential development areas are not fully built-up, which, in rural areas, results in a net increase of vacant lots. Although the quantity of vacant lot area in 2021 suggests high potential for residential infill, parcel- and neighbourhood characteristics indicate that the main development on these infill potentials is expected to promote additional single-family housing, rather than more dense structures. We argue that more active and strategic planning of soft densification processes is needed to realise the full potential of infill on vacant lots.

In practice, automatic identification and monitoring of infill potentials and processes are important both, for policy-making and for local planning practitioners. For small municipalities with little financial capacities, the approach can provide an overview regarding their vacant lots and can serve as a basis for strategic planning decisions. For the regional or national level, a yearly monitoring can be established at little cost. Although the approach proves to be robust regarding its precision and is promising for a nation-wide application, the soon expected data availability for whole Germany has to be awaited and some optimisation in the method have to be made to implement the workflow in practice.

Thursday, 27

Complete Paper #30

Biodiversity, Urban Quality Life and Air Quality Indices for Hotspot Detection of Transformation Opportunities in Cities: A Case Study in Barcelona

Danielly García[1], Mariona Ferrandiz-Rovira[2,3,4], Oriol Serra[2] and M. Parés[1]

[1] Centre Tecnològic de Telecomunicacions de Catalunya (CTTC/CERCA), Av. Carl Friedrich Gauss 7, Castelldefels, Spain

[2] Replantegem. Carrer Creueta 119, B-E, Sabadell, Catalonia, Spain

[3] CREAF, Cerdanyola del Vallès, Catalonia, Spain

[4] BABVE, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Catalonia, Spain

Keywords: Biodiversity, Urban Life, Air Quality, Indicators.

Abstract: Half of the world's population lives in cities, where usually there are few little green space and there are also high levels of air pollution. Moreover, the traditional urbanization of cities contributes to climate change, promotes the loss of global biodiversity and induces serious health problems for citizens. Both climate change and the loss of biodiversity affect negatively to the ecosystems and therefore human health, as they are responsible for providing clean air, food, fresh water, medicines, renewable resources... This deterioration increases significantly the risk of human-borne infectious diseases such as coronavirus or HIV. The ability we have to re-naturalize anthropogenic spaces and learn to generate spaces for coexistence will be key for the future of our society. The research presented in this paper aims to do a step forward to achieve that ability by working in three schools of the city of Barcelona and their surroundings. Among other actions, in this project, a diagnosis of neighborhood has been carried out. The diagnosis includes the identification and quantification of relevant indicators regarding neighborhood's biodiversity and also the quality of daily life and the analysis of pollutants (NO2 and PM10) near the schools during the 2021-2022 school year. All these information has been merged in a single geographic data base and relevant hotspots where to act have been identified. The information has been shared with city council and citizens.

Complete Paper #32

Imperviousness Density Mapping Based on GIS-MCDA and High-Resolution Worldview-2 Imagery

Lovre Panda

University of Zadar, Department of Geography, Trg kneza Višeslava 9, Zadar, Croatia

Keywords: WorldView-2, Imperviousness Density, GIS MCDA, LULC, NDVI, Slope, TWI, Urban Area, Zadar, Croatia.

Abstract: Accurate monitoring and extraction of impervious surfaces are essential for urban planning and sustainable environmental management. Increasing urbanization has led to a significant increase in the extent of impervious surfaces, which, along with climate change, are the leading cause of increasingly frequent flooding in urban areas. To prevent flooding disasters in urban areas, flood hazard and risk analyses must be carried out. An imperviousness density model is one of the most important criteria in such analyses. In this study, an imperviousness density model of the city of Zadar was created using GIS-MCDA and four criteria (LULC, NDVI, slope and TWI). The criteria were extracted from WorldView-2 (WV-2) imagery and linearly standardized using the Fuzzy logic approach. The Analytic Hierarchy Process

(AHP) was used to determine the final model for imperviousness density. The model with a spatial resolution of 0.5 m, based on the WV-2 imagery turned out to be much more detailed than existing publicly available models, such as the Copernicus imperviousness density model, which is based on Sentinel-2 imagery with a spatial resolution of 10 m.

Keynote Lecture	GISTAM
12:15 - 13:15	Room Prague B+C

Planetary Restoration: Informing Pathways Through Earth Observations

Richard Lucas

Aberystwyth University, U.K.

Abstract: Over past decades, Earth observations have provided unique insights into how our planet has changed through human activities as well as natural events and processes. In this keynote, Prof. Richard Lucas will provide a perspective on how these same data can be used to inform the restoration of ecosystems and environments, the conservation and protection of biodiversity and more sustainable use of resources with the ultimate goal of improving the well-being of both humans and nature. Using diverse examples from around the world, the capacity to consistently retrieve or classify descriptors of the environment historically and over multiple spatial and temporal scales from optical, radar and/or lidar data and then combine these to generate spatial insights into the past and current states and dynamics of landscapes will be conveyed. Options and opportunities for using this information to imagine, value, co-design and agree on future landscapes under a range of change scenarios and monitor progress towards ambitions and evaluate risk will then be conveyed. Particular focus will be on using information from Earth observations but other sources as evidence for change impacts and pressures, whether these be driven by factors such as economy and climate.

Session 5A	GISTAM
14:30 - 15:45	Room Belvedere I
Machine Learning for Spatial Data	

Complete Paper #11

The Evolution of the South-Eastern Baltic Sea Coastline Between 1988 and 2018 by Remote Sensing

Sébastien Gadal[1,2] and Thomas Gloaguen[1,3]

[1] Aix-Marseille Université, Université Côte-d'Azur, Avignon Université, CNRS, ESPACE UMR 7300, 84000 Avignon, France

[2] Department of Ecology and Geography, Institute of Natural Sciences, North-Eastern Federal University, 670007 Yakutsk, Republic of Sakha Yakutia

[3] Cultural and Spatial Environment Research Group, Faculty of Civil Engineering and Architecture, Kaunas University of Technology, 44249 Kaunas, Lithuania

Keywords: Coastal Evolution, Coastline Recognition, Minimum Noise Fraction, Convolution Operators, Remote Sensing, Spatial Accuracy, South-Eastern Baltic.

Abstract: This article aims to define and explain the evolution of the coastline in Latvia, Lithuania, and Russia since the late 1980s. Coastal erosion is a critical issue for public authorities and is considered as one of the main environmental problems in the south-eastern Baltic region. The political, economic, and social changes associated with the collapse of the Soviet Union have created new pressures in recent decades in previously

Thursday, 27

relatively undeveloped coastal regions. The geomorphology of the latter is the result of various natural morpho-dynamic processes: swells, tides, tectonic movements, etc. Landsat 4-5 TM, Landsat 8 OLI satellite images series between 1988 and 2018 are used to estimate the position of the coastline. The spatial accuracy of the shoreline automatic recognition based on the combination of minimum noise fraction and Laplacian convolution operators is compared with the manual methods of photo interpretation. The results showed a global change of −0.21 m/year with local and temporal disparities. It can be explained by a variety of natural and anthropogenic factors that disrupt the sedimentary stock and the hydrodynamic forces controlling coastal evolution.

information could be close to full image analysis for the prediction of perceptual qualities. A lightweight solution is presented, which quickly predicts the sense of urban space from the implied highly compressed segmentation feature vectors of the street-view images via deep/machine learning models. Our solution achieves an average accuracy of about 62%, which is acceptable compared to the baseline result accuracy of 68%, and significantly reduces the complexity of the data and the computational effort.

Closing Session & Awards Ceremony	GISTAM
15:45 - 16:00	Room Belvedere I

Complete Paper #20

When Should We Report the Traffic Jams of Today? A Case Study on a Swiss Highway Using Graph Neural Networks and Expert Knowledge

Jhonny Pincay[1,2], Ana Oña[3,4] and Damian Nomura[1]

[1] *Viasuisse AG, Zentralstrasse 115, Biel, Switzerland*

[2] *Pontificia Universidad Cat ólica del Ecuador, Avenida 12 de Octubre 1076 y Roca, Quito, Ecuador*

[3] *Swiss Paraplegic Research, Guido A. Zäch, Nottwil, Switzerland*

[4] *Department of Health Sciences and Medicine, University of Lucerne, Lucerne, Switzerland*

Keywords: Speed Prediction, Graph Neural Networks, Transportation, Smart Logistics, PyTorch Geometric.

Abstract: This case study manuscript details the conception and implementation of an artifact that uses floating car data to forecast average speeds on a segment of a Swiss national road. To consider the spatial and temporal dependencies when performing the predictions, the studied segment was modeled as a graph and as a time series problem. Subsequently, to obtain a prediction model, the data collected over a month and augmented to simulate the behavior during summer were used as the input to train a Graph Neural Network. After the evaluation of the results it was concluded that despite the considerable differences between the forecasted values and the reality, it was possible to perform such an implementation with limited data and resources. Moreover, a handful of traffic reporters still considered the results appropriate, and suitable.

Complete Paper #29

Evaluation of Urban Perception Using Only Image Segmentation Features

Xinyi Li, Benjamin Beaucamp, Vincent Tourre, Thomas Leduc and Myriam Servières

Nantes Université, ENSA Nantes, École Centrale Nantes, CNRS, AAU-CRENAU, UMR 1563, F-44000 Nantes, France

Keywords: Urban Perception, Voluntary Geographic Information, Place Pulse 2.0, Computer Vision, Panoptic Segmentation, Deep Learning, Machine Learning.

Abstract: Deep learning has been used with the street-view imagery Place Pulse 2.0 to evaluate the perception of urban space along six perceptual dimensions: safe, lively, beautiful, wealthy, boring, and depressing. Traditional methods automatically extract feature representations from images through a convolutional neural network to yield prediction. However, the formers are computationally intensive and do not take a priori into account the semantic information from panoptic segmentation scene. In light of this, we propose that learning with semantic

Thursday, 27

Author Index

Author Index

Final Program and Book of Abstracts of GISTAM 2023

9th International Conference on Geographical Information Systems Theory, Applications and Management

https://gistam.scitevents.org

LOGISTICS:

EVENT MANAGEMENT SYSTEM:

IN COOPERATION WITH:

PROCEEDINGS WILL BE SUBMITTED FOR INDEXATION BY: