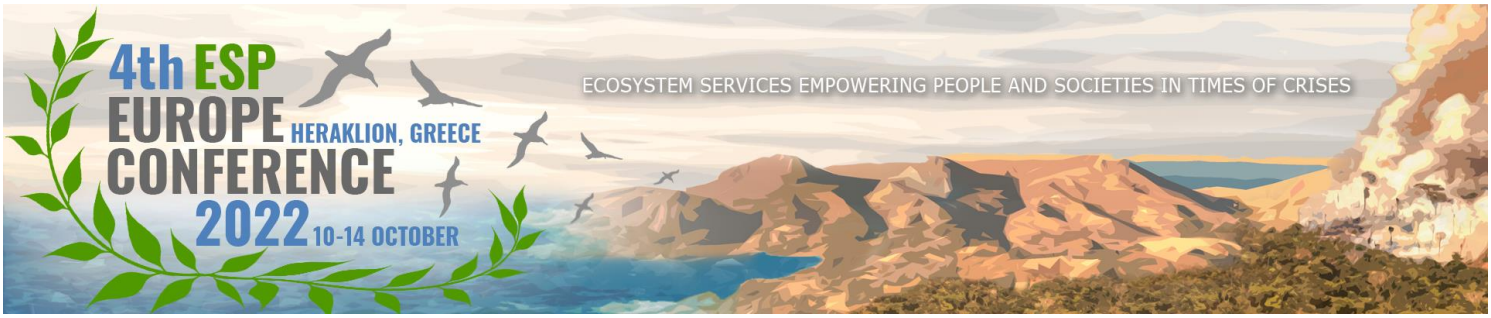


BOOK OF ABSTRACTS

I. SESSION DESCRIPTION

ID: T14a

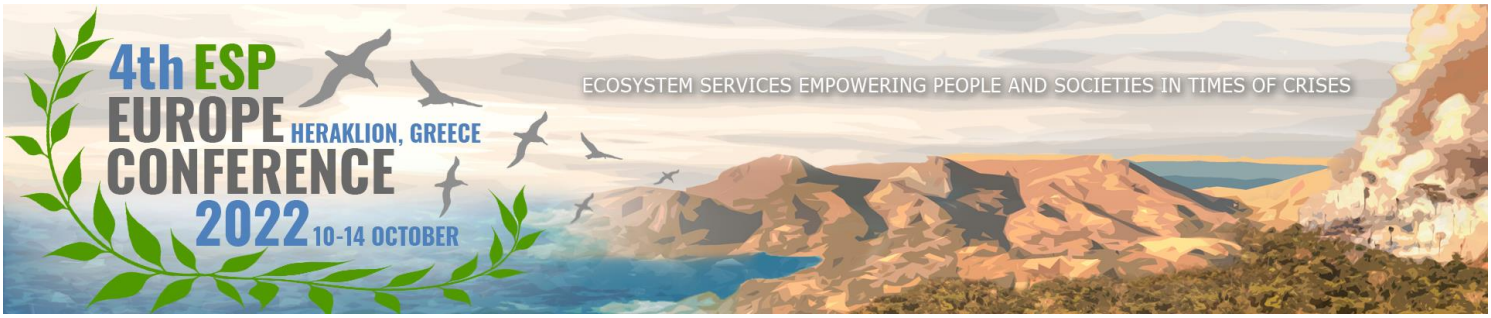
Integrative digital systems for planning and managing ecosystem services: State of the art and future prospects

Hosts:

	Title	Name	Organisation	E-mail
Host:		Stefan Schmidt	Institute of Geography, Ruhr University Bochum, Germany	stefan.schmidt-y9u@ruhr-uni-bochum.de
Co-host(s):		Blal Adem Esmail	Institute of Geography, Ruhr University Bochum, Germany	blal.ademesmail@rub.de
		Jingxia Wang	Department of Urban Studies and Planning, The University of Sheffield, UK	jingxia.wang@sheffield.ac.uk
		Ulla Mörtberg	Department of Sustainable Development, Environmental Science and Engineering, KTH Royal Institute of Technology, Sweden	mortberg@kth.se
		Jochen Hack	Institute of Environmental Planning, Leibniz Universität Hanover, Germany	hack@umwelt.uni-hannover.de
		Christian Albert	Institute of Geography, Ruhr University Bochum, Germany	christian.albert@rub.de

Abstract:

With the advent of the digital transformation efforts to interconnect the physical and digital worlds are in full swing. Ecological and socio-economic investigations of the environment are moving to the “cyber-physical” world, promising to provide more integrative, faster and smarter ecosystem management. The digitalisation of ecosystems service research became practical due to access to low-cost, low-power sensor technologies, advanced digital connectivity, cloud computing platforms, machine learning analytics and conversational artificial intelligence etc.



Utilizing sensors, software and other technologies for the purpose of generating, connecting and exchanging data with other agents (devices, systems or users) on a communication network can improve knowledge processes on ecosystem services (locating, acquiring, using, sharing and disseminating as well as archiving) and support effective decision-making. However, the adoption and application of digital tools and services provided by the cyber-physical world in daily work routines of observations, measurements and responses to environmental change is still limited to specific domains and ecosystem services, such as precision agriculture and food production.
The aim of this session is to explore integrative digital systems for assessing, planning, and managing with ecosystem services and discuss the requirements for establishing fit-for-purpose systems in practice.

We seek contributions that reflect on insights gained in applying digital tools for assessing, planning, and managing with ecosystem services in participatory spatial planning, landscape planning, and design processes. These include, for instance, dashboards, digital twins, point cloud, the Internet of Things, big data, urban analytics, Public Participation Geographic Information System (PPGIS), sensors/automated monitoring, real-time streaming, application programming interface (API), or other communication techniques. Contributions that focus on novel technologies for collecting empirical data on biodiversity and ecosystem services, as well as for engaging large and small citizen groups in the planning process are especially welcome. In addition, we are particularly interested in contributions that reflect on the potential and limitations of digital tools based on empirical evidence from real-life participatory spatial planning processes.

Goals and objectives of the session:

The aim of this session is to explore integrative digital systems for assessing, planning, and managing with ecosystem services and discuss the requirements for establishing fit-for-purpose systems in practice.

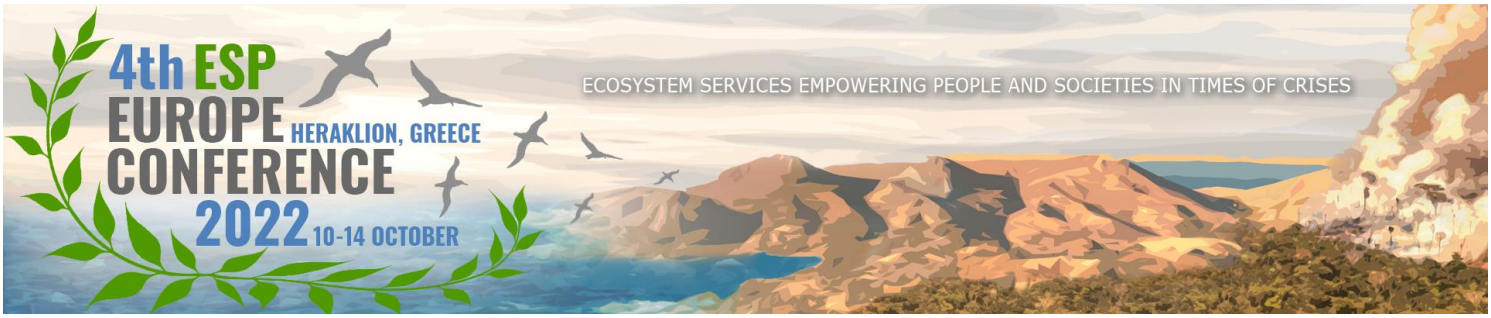
The session will foster collaboration in the ESP Thematic Working Group 14 on the “Application of ES in Planning & Management”. It is organized in cooperation with the IALE working group on Landscape Planning.

Planned output / Deliverables:

Paper in scientific journal

Session format:

Standard session (presentations)



Voluntary contributions accepted:

Yes, I allow any abstract to be submitted to my session for review

Related to ESP Working Group/National Network:

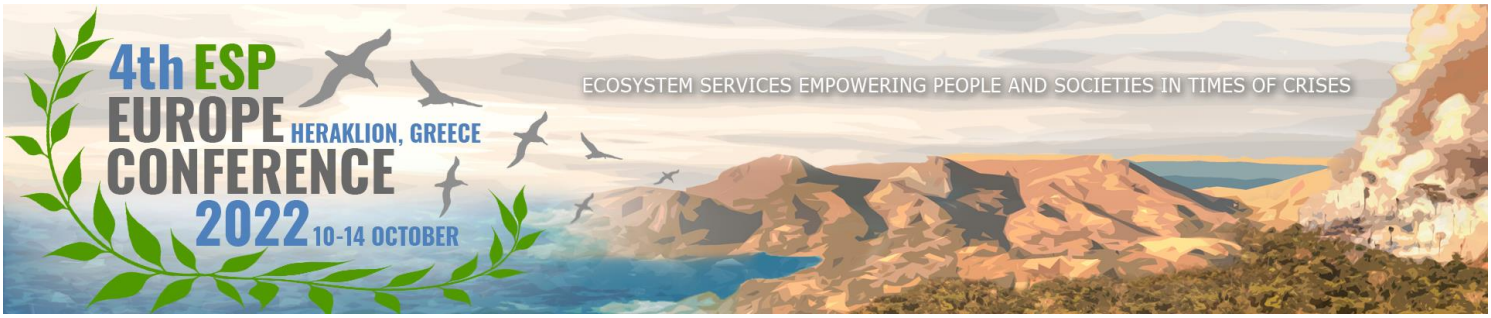
Thematic Working Groups: TWG 14 – Application of ES in Planning & Management

II. SESSION PROGRAM

Date of session: 11.10.2022
Time of session: 11:00 to 12:30

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
11:00 to 11:12	Stefan	Schmidt	Ruhr University Bochum	Introduction of session
11:13 to 11:25	Spyridon	Christofilakos	German Aerospace Center	Spatially-explicit Uncertainty of Remote Sensing Coastal Biodiversity Products using a scalable cloud-based framework in the Google Earth Engine.
11:26 to 11:38	Inhye	Kong	University of Zurich	Unstructured text analysis to understand landscape: current practice and future prospects
11:39 to 11:51	Jingxia	Wang	University of Sheffield	A heuristic typology of digital geoparticipation to mainstream ecosystem services management in spatial planning
11:52 to 12:04	Cheng	Chen	Leibniz Centre for Agricultural Landscape Research (ZALF)	Digital decision support systems for planning and managing with ecosystem services in agricultural landscape: use cases of nature conservation measures
12:05 to 12:17	Maria	Riffat	Ruhr University Bochum	Urban biodiversity and ecosystem dashboards to inform planning and governance: a review of best practices
12:18 to 12:30	Ederson Augusto	Zanetti	Green Farm CO2FREE	PNBSAE: Integrating Ecosystem Services into Products and Services Supply Chains



III. ABSTRACTS

Abstracts are ordered based on the session program. The first author is the presenting author unless indicated otherwise.

1. Type of submission: Abstract

T. Thematic Working Group sessions: T14a - Integrative digital systems for planning and managing ecosystem services: State of the art and future prospects

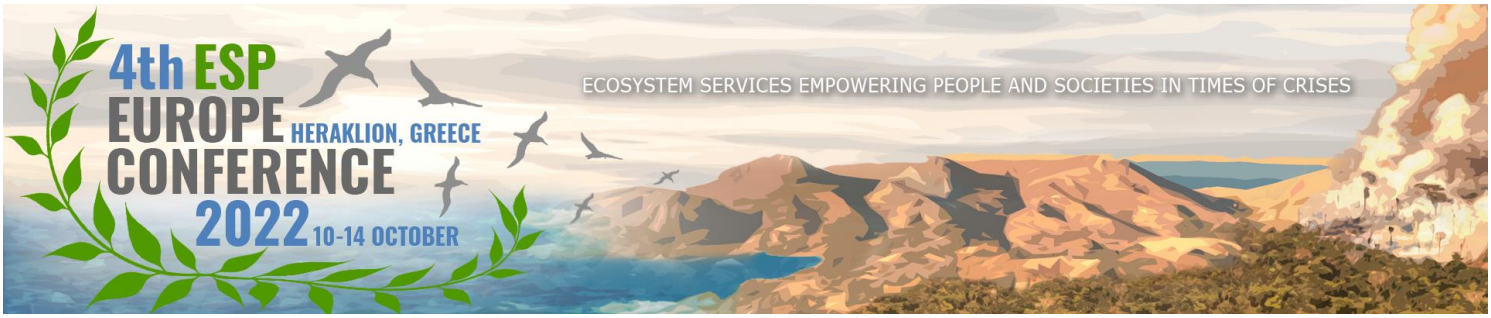
Urban biodiversity and ecosystem dashboards to inform planning and governance: a review of best practices

Presenting author: Maria Riffat

Affiliation: Chair of Environmental Analysis and Planning at the Institute of Geography, Ruhr University Bochum, Germany, Germany

Contact: maria.riffat@rub.de

Information on the status and trends of biodiversity, ecosystems, and their services (BES) is key to governing the transformation of cities and regions towards more sustainable pathways. Digital dashboards, understood here as visual displays of consolidated qualitative, quantitative or spatial information, are could be effective tools to provide relevant BES information to participatory planning processes, in turn allowing for better-informed decisions. Despite an increasing application of dashboards in many fields of spatial data, such as in the case of COVID-19 infection rates, case studies applying BES information in dashboards are rare and scientific understanding is missing regarding their characteristics and functionalities. This study aims to identify and analyze contemporary case studies of dashboard applications to inform urban planning and governance with information on BES. Our research design involves developing of a theoretical framework of key attributes of BES dashboards, for example including dashboard purposes, design, process and output features. We identify and systematically review 12 state-of-the-art BES dashboard applications from Europe, Asia, and North-America. Our preliminary results illustrate a growing number of dashboard applications for representing and illustrating BES information. The reviewed best-practices dashboards, among others from New Jersey City, US, Surrey Sustainability Dashboard, Canada, and Hongkong, China exhibit a range of purposes, with diverging content as well as functional, visual and output features. Similarly, 66 recognized BES indicators vary widely, i.e. from the representations of the health-status of trees in Jersey City, US, to evaluating the status and functionality of ecosystems with trees,



connectedness of green spaces, and water-bodies in Surrey Sustainability Dashboard, Canada and biodiversity index, habitat risks, connectedness of ecosystems in Singapore Biodiversity Dashboard and many more. Taken together, our results shed light on the contemporary frontier of BES-dashboard applications and provide suggestions for key research needs for advancing dashboards to inform planning for nature and people.

Keywords: Biodiversity and ecosystems dashboards, Decision making, Landscape planning process, Planning-governance interface, Digital Landscape Planning

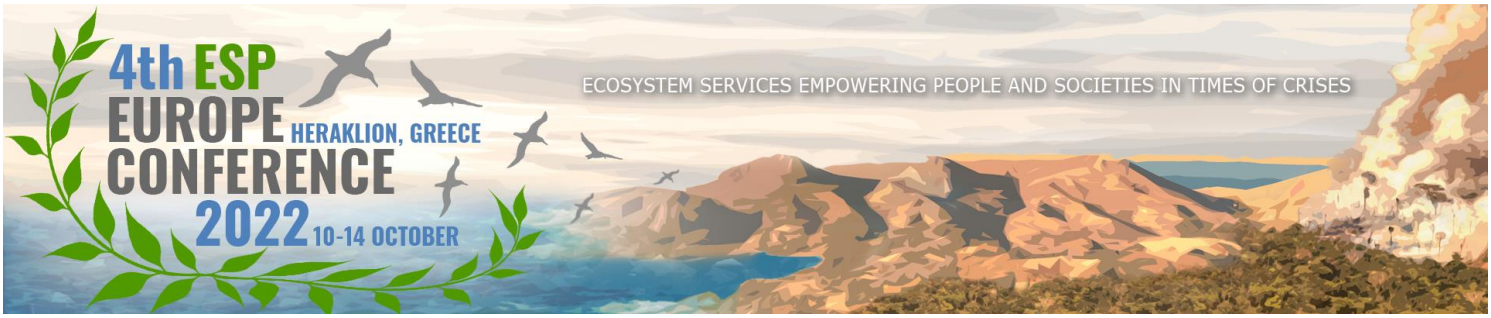
2. Type of submission: Abstract

T. Thematic Working Group sessions: T14a - Integrative digital systems for planning and managing ecosystem services: State of the art and future prospects

Digital decision support systems for planning and managing with ecosystem services in agricultural landscape: use cases of nature conservation measures

Presenting author: Cheng Chen
Other author(s): Ariani Wartenberg, Nahleen Lemke
Affiliation: Leibniz Centre for Agricultural Landscape Research (ZALF), Germany
Contact: cheng.chen@zalf.de

Agriculture has already gone digital in many respects, with numerous digital technologies fast emerging in scientific communities and playing a key role in farming practices. However, the primary application of digital technologies in the agricultural sector aims to increase or optimise productivity, giving less attention to provision of ecosystem services and other principles of sustainable development. Promoting the integrative systems of agriculture, ecosystem services, and digital technologies could promote synergies and foster new learning. In particular, Decision Support Systems (DSSs), aiming at data collection and processing to inform farm management decisions, are becoming increasingly comprehensive in response to the needs of different stakeholders. In order to demonstrate an approach that employs digital technologies to support highly complex decision-making towards sustainable agricultural systems, we present the Digital Agricultural Knowledge and Information System (DAKIS). The DAKIS is a digital knowledge-based DSS that integrates remote and in situ sensors, real-time databases, AI algorithms, agro-ecological models, agro-economic models, sustainability impact assessment, and user inputs. To exemplify the DAKIS conceptual and technical architecture, we develop use cases to illustrate technical and



logical aspects underpinning user interactions. Different use cases provide site-specific optimization recommendations, thus allowing end-users to align agricultural decisions (e.g., on crop type and management practice selection) in a way that minimizes trade-offs and conflicts. The use cases are developed based on a rule-based system to support the spatially-explicit identification of land-use and management combinations in the delivery of a diverse set of ecosystem services. For example, the use case of grassland buffer demonstrates the potential to provide biomass, erosion control, biodiversity and stakeholder collaboration on a 46 hectares site in Germany. Other use cases include flower strip, hedgerow, agroforestry and crop rotations. Our results show the opportunities and limitations of using digital technologies to embed the consideration of ecosystem services into farmers' decision-making.

Keywords: digital technologies, digital agriculture, biodiversity, land use, sustainability

3. Type of submission: Abstract

T. Thematic Working Group sessions: T14a - Integrative digital systems for planning and managing ecosystem services: State of the art and future prospects

Spatially-explicit Uncertainty of Remote Sensing Coastal Biodiversity Products using a scalable cloud-based framework in the Google Earth Engine.

Presenting author: Spyridon Christofilakos
Other author(s): Alina Blume, Avi Putri Pertiwi
Affiliation: German Aerospace Center (DLR), Remote Sensing Institute, Department of Photogrammetry and Image Analysis ,12489 Berlin, Germany,
Contact: spyridon.christofilakos@dlr.de

Recent advances in remote sensing have enabled the global monitoring of Earth's biodiversity. These developments are providing global information on the extent, structure, function and services of different ecosystem types, and their benefits to the environment and humans. In contradiction with the advances, relevant uncertainty methods and information are missing the understanding of the product biases. In our study, we present a uncertainty quantification framework, developed entirely within the Google Earth Engine, which assesses both thematic (e.g., ecosystem presence/absence) and continuous products (e.g., satellite-derived bathymetry) related to coastal biodiversity using multi-temporal and cloud-free 10-m Sentinel-2, field data collections, and human-annotated data points. By

exploiting the cloud-native machine learning classifier and its outputs, we estimate the uncertainty of the procedure per pixel. With that information, our model is able to re-train itself in a data driven way and produce better results. There are three areas of interest in this study. The first is the Archipelago of Bahamas, where we assess a four-class benthic habitat classification product. Our second and third study area is the national scale of Belize and the Quirimbas Archipelago (Mozambique), respectively, in which we generate a satellite-derived bathymetry map. In the case of classification, our model achieved a better overall accuracy in comparison with the initial classification while the producer and user accuracy of the habitat class that we are interested in, seagrass, rose by 13% and 7% respectively. On the regression results, our framework highlights the areas with most uncertainty given the byproducts of the maximum likelihood regression that took place. While still in its alpha version, we think that further developments of the framework could allow better quantification of the data and model uncertainty. By reducing the uncertainties in the coastal biodiversity monitoring, more effective policy making efforts can be achieved and thus, better conservation.

Keywords: uncertainty, GEE, classification, biodiversity, monitoring

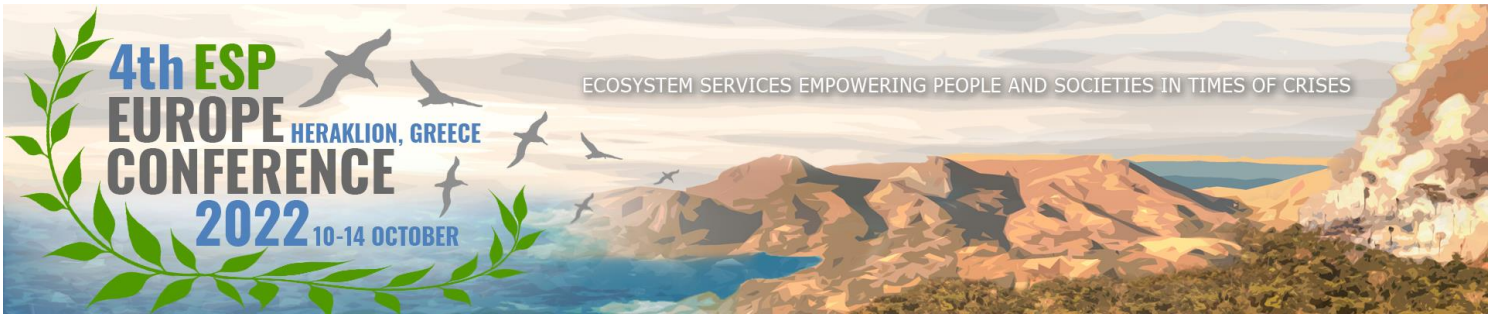
4. Type of submission: Abstract

T. Thematic Working Group sessions: T14a - Integrative digital systems for planning and managing ecosystem services: State of the art and future prospects

PNBSAE: Integrating Ecosystem Services into Products and Services Supply Chains

Presenting author: Ederson Augusto Zanetti
Other author(s): Isadora, Pineda,
Affiliation: Green Farm CO2FREE, Brazil
Contact: eder.zanetti@fulbrightmail.org

The Platform for Business with Ecosystem and Environmental Services and Goods (PNBSAE), was conceived to serve products and services by mainstreaming ecosystem services into their chains. It is a registry system operating since 2010, allowing for rural landholders in Mato Grosso state, Brazil and broadly, to develop projects destined to generate credits for biodiversity, water, pollinators and any other ecosystem service. The PNBSAE has already registered the first biodiversity credit ever in Brazil, from Crow Eagle (Harpya Harpyja) valuated at US$ 125,000 each individual, and the two first ones are already at Fazenda Porto



Bonito, serving as a basis for future reintegration of the animal to its natural habitat. The PNBSAE i also operating with carbon and water credits, which makes it a reference for individuals, companies and other organizations, looking into best biodiversity and ecosystem services practices in the country. PNBSAE is currently advocating for brazilian rural landholders capacity of preserving biodiversity while generating carbon and water credits, showcasing best practices and proving room for suporters to add. Lately PNBSAE participated at UNFCCC COP26 and climate conference in 2022, and gis etting ready for COP27. Our team participated at IPBES9 and one of our assistant researcher is going to be at Youth IPBES 2022, to further disseminate the platform, its goals and procedures, in order to make it available for any interested person or corporate around the globe. There is room within the platform for individuals and corporate looking into offsets, or investments, to find the best available Projects in the country, and in the near future also into partnering countries. Mitigation and biodiversity credits are new in Brazil, which focus on public sector as the main actor behind biodiversity conservation, and PNBSAE is a business driven system, creating new perspectives for preservation within the private sector.

Keywords: PNBSAE, Biodiversity, Crown Eagle, Private sector

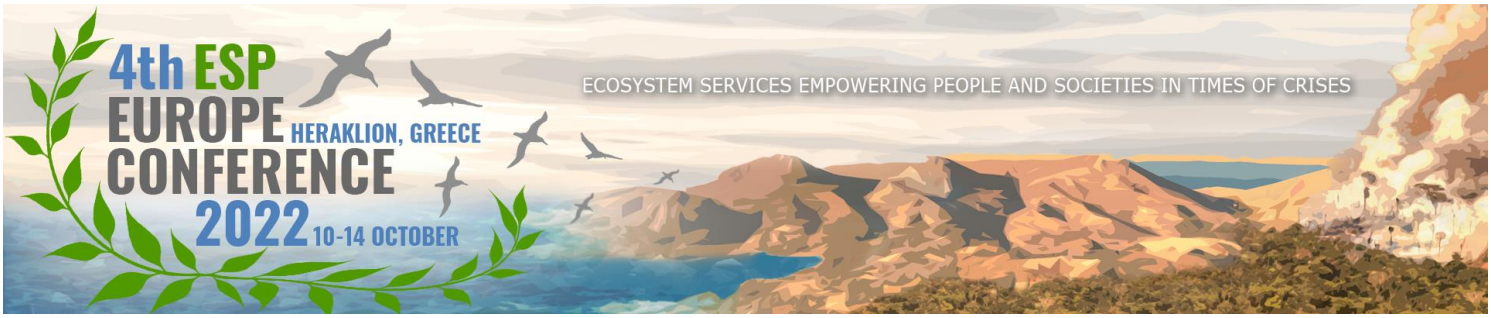
5. Type of submission: Abstract

T. Thematic Working Group sessions: T14a - Integrative digital systems for planning and managing ecosystem services: State of the art and future prospects

A heuristic typology of digital geoparticipation to mainstream ecosystem services management in spatial planning

Presenting author: Jingxia Wang
Other author(s): Dr. Ian Babelon,
Affiliation: The University of Sheffield, UK,
Contact: jingxia.wang@sheffield.ac.uk

Community mapping of ecosystem services (ES) is both an ancient and innovative practice. As the world awakens to the climate emergency and recovers from the COVID-19 pandemic, digital geoparticipation provides a powerful range of methods to bridge expert and resident environmental knowledge while facilitating data-driven and evidence-based decision-making to embed the ES management in spatial planning. Notwithstanding an impressive corpus of knowledge about geoparticipation in environmental planning, recent socio-



technical innovations signal the need to reclassify the range of existing and emerging digital tools and approaches to make best use of them in practice.

This contribution to session T14a assesses the integrative potential of geoparticipation in the form of Public Participation GIS and community-based mapping to review, manage and enhance ecosystem services in spatial planning. Our paper provides an original, heuristic typology of digital geoparticipation that takes stock of the flurry of objectives for community participation, use-cases, the spatial scale of engagement, product functionalities, licensing mode, and stakeholder collaboration. The ecosystem services mainly comprise cultural ES, biodiversity conservation, as well as wider provisioning and regulatory ES depending on the respective context. We ground our typology in a selective overview of international empirical data spanning regional planning, urban development, regeneration, land-use planning, environmental resources management, citizen science, sociotope mapping and neighbourhood planning. While focusing on the 'global North', our typology includes methods relevant to the 'global South'. Moving forward, stakeholders would benefit from more creative, iterative appropriations of hybrid or 'phygital' approaches that fuse or combine digital and in-person participation as part of local governance innovation. Stakeholder collaboration also needs to address internal contradictions that underpin both proprietary and open-source products and data to effectively embed participatory management of ecosystem services in spatial planning.

Keywords: Public Participation GIS; community mapping; citizen science; phygital engagement; land-use planning

6. Type of submission: Abstract

T. Thematic Working Group sessions: T14a - Integrative digital systems for planning and managing ecosystem services: State of the art and future prospects

Unstructured text analysis to understand landscape: current practice and future prospects

Presenting author: Inhye Kong
Other author(s): Franziska Komossa, Ross Purves
Affiliation: University of Zurich, Switzerland
Contact: inhye.kong@geo.uzh.ch

Understanding how people perceive the landscape and its values is critical for landscape policy and management. In recent decades, the advent of Web 2.0, digital transformation,

and big data analytics has broadened opportunities to explore the semantics of landscapes. Social media (e.g., Twitter, Flickr and online tourism reviews such as TripAdvisor) has dominated efforts to extract information relevant to landscape values from “big data”. However, the shortcomings of social media remain critical in terms of data quality, integrity, reliability and perhaps most importantly, availability, with large private corporations acting as gatekeepers to data.

Here, we demonstrate the potential of lengthy unstructured text corpora, including historic archives and news media articles, which have become available online as a result of digital archiving efforts and Application Programming Interfaces (APIs). We elaborate how natural language processing (NLP) and computational text analysis on such unstructured text corpora can bring added momentum to landscape research. Text frequency or keyword extraction methods, such as TF-IDF and collocation, provide a glimpse of the most salient elements in texts and provide first clues as to what is valued. Topic modeling techniques including structured topic modeling (STM) enable us to reveal latent topics which can be labelled by experts with local knowledge. Sentiment analysis is useful for detecting potential emotions attached to the texts. Historical articles can be used to perform longitudinal comparisons showing how public perception of keyword/topic/sentiment changed over time. Geographic information retrieval (GIR) can retrieve geographic information from the corpus, such as toponyms, which allows to plot the spatial distributions of the findings.

Unstructured text analysis is thus suitable to unravel intangible values embedded in the landscape and deliver them in a measurable and quantifiable manner. Furthermore, it can support data-driven landscape management and policy development allowing in-depth discourses related to landscape value.

Keywords: big data; text analysis; natural language processing; cultural ecosystem services; conservation