# BOOK OF ABSTRACTS



## I. SESSION DESCRIPTION

### ID: T19

Novel approaches and co-creation of standard protocols for assessing cultural ecosystem services based on social media content

### Hosts:



| | Title | Name | Organisation | E-mail |
|---|---|---|---|---|
| Host: | | Fulvia Calcagni | Humboldt University of Berlin, Germany; University of Haifa, Israel | fulvia.calcagni@gmail.com |
| Co-host(s): | | Andrea Ghermandi | University of Haifa, Israel | aghermand@univ.haifa.ac.il |
| | | Johannes Langemeyer | ICTA / UAB (Spain); Humboldt University of Berlin, Germany | johannes.langemeyer@uab.cat |



### Abstract:

In an urbanizing world with ecosystems increasingly being degraded and people lacking direct nature experiences and perceptions of dependencies, cultural ecosystem services (CES) are increasingly gaining importance in maintaining and fostering people's relational values and environmental stewardship. However, assessments of CES – and associated relational values – still face methodological hurdles due to their subjective, context-specific and intangible nature. Recently, approaches based on crowdsourced data, such as photographs and texts from social media platforms (e.g., Flickr, Twitter, Instagram), have been gaining momentum. Yet, the development of such approaches is still at the experimental phase and lacks a shared and grounded framework for application. This relates both to the technical aspects of characterizing the individual CES reflected in the data as well as the ethical issues related to the management of the data. This hinders cross-study comparisons and validations, as well as the uptake of this promising technique by decision-makers and a wider societal acceptance of this research approach. The participants to this session will be expected to share novel research advances and, grounded on their respective fields of expertise, will be asked to contribute to the collective design and testing of a prototype protocol for the assessment of CES and relational values through the analysis of visual information and text from social media data.

### Goals and objectives of the session:

The overall goal of the session is to collectively design a protocol for CES and relational values assessments through social media data. This will be achieved by engaging the participants along the following specific objectives:

1. Present and discuss innovative approaches and applications of social media data analysis to the assessment of CES and relational values;
2. Test and contribute to the further development of a prototype protocol showcased in preview at the session, which is aimed at advancing the standardization of all the aspects related to social media-based CES analyses.

The protocol is currently being developed as part of an ongoing German-Israeli Foundation (GIF) research project. When finalized it is expected to establish best-practice procedures for the key steps in social media data coding and analysis, including statistical validation, as well as ethical principles for data retrieval, data handling, and sharing of results (e.g., CES maps) and underlying data, consistently with the need to safeguard the privacy of social media users.

The session will build on the session "T4b: Mapping cultural ecosystem service: use of social media to assess cultural ecosystem services", which was held in the 2019 ESP World Conference in Hannover. A continued engagement of the participants in the development of the protocol will be encouraged after the session through the activities of the ESP Thematic Working Group on Big Data & Digital Communication.

## Planned output / Deliverables:

The session in meant to expand the methodological and procedural ground for CES values assessment through social media, with the final aim of reaching an agreed-upon protocol for improving cross-studies comparisons and integration in decision-making. It further aims at strengthening and aligning the scientific community working with social media data for CES assessment and the ESP Thematic Working Group on Big Data & Digital Communication.

## Session format:

Discussion forum and 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 19 - Big data & Digital communication

## II. SESSION PROGRAM

**Date of session:** 13/10/2022
**Time of session:** 11-12:30

### Timetable speakers

| Time | First name | Surname | Organization | Title of presentation |
|---|---|---|---|---|
| 11:00 - 11:05 | Fulvia | Calcagni | Humboldt University of Berlin, Germany - University of Haifa, Israel | Session intro |
| 11:05 - 11:15 | Edgars | Jūrmalis | Latvian State Forest Research Institute "Silava" | Geocaching as a data source for assessing recreational use of forests in Latvia. |
| 11:15 - 11:25 | Andrzej | Affek | Institute of Geography and Spatial Organisation Polish Academy of Sciences, Warsaw | What can Google Maps tell us about the cultural ES in urban green spaces? A Warsaw case study. |
| 11:25 - 11:35 | Thomas | Schmitt | University of Bayreuth, Germany | Recreation and its synergies and trade-offs with other ecosystem services of (pre-)Alpine grasslands: The role of management, agri-environmental schemes, infrastructural, and environmental factors |
| 11:35 - 11:45 | Claudia | Carvalho-Santos | CBMA & IB-S, University of Minho, Braga, Portugal | Cultural ecosystem services related to rivers: modelling and mapping supported by social media in NW Portugal |
| 11:45 - 11:55 | Abdesslam | Chai-Allah | Université Clermont Auvergne, INRAE, France | A trail-based approach using crowdsourced data to assess cultural ecosystem services |
| 11:55 - 12:05 | Nathan | Fox | University of Michigan, USA | Visual magnitude and social media: an innovative viewshed approach to assessing landscape preferences |
| 12:05 - 12:15 | Ilan | Havinga | Environmental Systems Analysis Group, Wageningen University | Deep learning and social media reveal specific cultural contributions of biodiversity |
| 12:15 - 12:25 | Nina N. | Kaiser | Environmental Campus Birkenfeld, University of | Facilitating an objective identification of human-nature interactions from computer vision-based labels of |

| Time | First name | Surname | Organization | Title of presentation |
|---|---|---|---|---|
| | | | Applied Sciences Trier, Germany | Instagram posts by a proposed new standardised clustering approach. |
| 12:25 – 12:30 | Fulvia | Calcagni | Humboldt University of Berlin, Germany – University of Haifa, Israel | Session wrap-up |

## 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: T19 – Novel approaches and co-creation of standard protocols for assessing cultural ecosystem services based on social media content

Deep learning and social media reveal specific cultural contributions of biodiversity

*Presenting author: Ilan Havinga*
*Other author(s):* Diego Marcos, Patrick Bogaart
*Affiliation*: Environmental Systems Analysis Group, Wageningen University,
*Contact*: ilan.havinga@wur.nl

Biodiversity generates large contributions to human well-being. However, rarely are the cultural contributions of biodiversity to human well-being quantified at large scales in the form of Cultural Ecosystem Services (CES) to achieve sustainable policy goals. Now social media and deep learning enable a novel approach through which to develop CES indicators based on peoples' interactions with individual species. Using a deep learning model to capture peoples' interactions with selected flora and fauna on social media, we mapped the distribution of these interactions in Great Britain and compared user activity with citizen science data. After applying a second, pre-trained deep learning model, we were also able to identify different preferences for individual species on social media versus citizen science. Finally, we compared peoples' cultural interactions with species richness and abundance for a group of 36 bird species, sometimes finding large differences between peoples' interactions and these ecological measures. Still, we found that peoples' interactions with a set of threatened migratory birds matched their presence in the country over time. Our findings show that deep learning and social media reveal very specific CES measures. However, by using social media, a greater variety of human-nature interactions can be

captured and measured on a spatial basis. These therefore constitute powerful new techniques in capturing CES related to biodiversity and in understanding its cultural importance.

*Keywords*: biodiversity, cultural ecosystem services, social media, machine learning, conservation

*2. Type of submission: Abstract*

T. Thematic Working Group sessions: T19 - Novel approaches and co-creation of standard protocols for assessing cultural ecosystem services based on social media content

# Recreation and its synergies and trade-offs with other ecosystem services of (pre-)Alpine grasslands: The role of management, agri-environmental schemes, infrastructural, and environmental factors

*Presenting author: Thomas Schmitt*
*Other author(s):* Maria Hänsel, Andrea Kaim
*Affiliation*: University of Bayreuth, Professorship of Ecological Services, Bayreuth Center of Ecology and Environmental Research (BayCEER), Universitätsstraße 30, 95447 Bayreuth, Germany,
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(Pre-)Alpine grasslands provide multiple ecosystem services. Besides provisioning services such as fodder production, grasslands provide important and often overlooked cultural services such as recreation or aesthetics. In this study, we investigate the relationship of photo-user days from geo-tagged photographs, indicating recreation, with other ecosystem services to identify synergies and trade-offs, and explore additional factors explaining the spatial pattern of recreation. Firstly, we assessed the synergies and trade-offs between recreation, fodder production indicated by yield, and non-provisioning services indicated by agri-environmental payments, and their relationship to management-related variables with a Redundancy Analysis. Secondly, to better explain the recreational values of grasslands, we analyzed how environmental and infrastructural features influence the occurrence of photo-user days with a hurdle regression. Lastly, we conducted a Point Pattern Analysis to unravel its spatial components. We found a weak, but significant negative relationship between photo-user days and yield, which implies that people slightly prefer extensive grassland to intensive grassland to visit. Our results also showed that agri-environmental schemes that are targeted towards extensive grassland management can positively influence recreational value. Other factors, such as proximity to touristic features (e.g., castles), presence of infrastructural features (e.g., cable cars), and environmental characteristics (e.g., low share of croplands, distance to forests) also influence the spatially clustered distribution of photographs. The importance of these factors indicates the value of grasslands for recreation being a component of the cultural landscape. These results also indicate that

cultural ecosystem services of grasslands can be considered to be co-produced by natural, social, and infrastructural components. The study further discusses limitations to the explanatory power of geo-tagged photo analysis to determine the wide range of cultural ecosystem services of grasslands. We conclude that grasslands play an important role for recreation in a (pre-)Alpine environment, which can also be effectively supported through targeted agri-environmental payments.

*Keywords*: cultural ecosystem services, geo-tagged photographs, grasslands, mountains

*3. Type of submission: Abstract*

T. Thematic Working Group sessions: T19 - Novel approaches and co-creation of standard protocols for assessing cultural ecosystem services based on social media content

Visual magnitude and social media: an innovative viewshed approach to assessing landscape preferences

*Presenting author: Nathan Fox*
*Other author(s):* Brent Chamberlain, Derek Van Berkel
*Affiliation*: University of Michigan, United States of America
*Contact*: foxnat@umich.edu

Studies are extensively using images, text and spatial location from social media posts to assess cultural ecosystem services. Even though it is acknowledged that the context of the surrounding landscape can provide information on scenic or areas of interest, studies often only focus on the metadata of the social media posts. Where studies utilise viewshed approaches to understanding landscape characteristics, they often only take a crude measurement of viewshed using a traditional binary, visible or non-visible. Results drawn from this approach are limited by the fact that it assumes equal visibility for near and far features without accounting for the variability in an observer's view. To better understand visual relevancy, we introduce the visual magnitude viewshed approach, which calculates the amount of space each visible area occupies within the view of the observer accounting for the effect of slope, aspect and distance relative to the observer. We apply the visual magnitude approach to georeferenced images uploaded to Flickr that were taken inside the Troodos Global Geopark, Cyprus, and compare the results to the traditional viewshed approach. Here, we find that the use of the visual magnitude provides rich information on which landscape characteristics have visual relevancy to the observer. In the context of the Troodos Geopark, aesthetically pleasing views do not just include natural landscapes but are often related to anthropogenically altered features such as mineral extraction sites and vineyards for which the geopark is known. By better providing a measure of visual relevancy, the visual magnitude approach to viewshed analysis enables a more robust understanding of which landscape characteristics provide aesthetic services.

*Keywords*: Social media, cultural ecosystem services, geoparks, aesthetics, viewshed

*4. Type of submission: Abstract*

T. Thematic Working Group sessions: T19 - Novel approaches and co-creation of standard protocols for assessing cultural ecosystem services based on social media content

# A trail-based approach using crowdsourced data to assess cultural ecosystem services

*Presenting author: ABDESSLAM CHAI-ALLAH*

*Other author(s):* Sandro Bimonte, Nathan Fox

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Social media have emerged as an established data source for the assessment of cultural ecosystem services (CES). However, studies often rely on the Photo-User-Day metric, a measure of the number of individuals uploading at least one photo on a unique day, in a specific location. This metric may introduce biases into the assessment of visitor preferences, as people often visit multiple places and can be attracted by a diversity of areas during their one-day trip. This type of diversity can only be assessed by simultaneously studying all the visited sites.

This study develops a novel approach based on the Trail-User-Day (TUD), a spatial object covering the area visited by people during their one-day trip. These TUDs represent for a 'functional unit' of the zone with which visitors interact during these trips. We assessed the profile of land covers in TUDs, as well as their diversity to evaluate the demand for specific habitats using three social media platforms (Flickr, Wikiloc and NaturaList) in Auvergne region (France). By comparing the pattern of CES potential supply (% of each land cover in Auvergne adjusted by criteria of accessibility) and use (% of land cover in areas visited by users within TUD), we show that, depending on platforms, the percentage of grasslands within visitors' TUDs is 3 to 15% higher than the potential supply, whereas the use for arable land is 3 to 16% lower. The Shannon index of land cover diversity in TUDs is 2 to 104 times higher than in random squares of similar areas of the platforms' TUDs.

Our findings illustrate that TUD approach offers a novel entry point to use social media data for a deeper understanding of people's preferences and can allow capturing the importance of landscape diversity for providing multiple CES (aesthetic, activity, and naturalist).

*Keywords*: Cultural ecosystem services, Social media, Trail-User-Day, Landscape diversity, Recreation

*5. Type of submission: Abstract*

T. Thematic Working Group sessions: T19 - Novel approaches and co-creation of standard protocols for assessing cultural ecosystem services based on social media content

# Geocaching as a data source for assessing recreational use of forests in Latvia.

*Presenting author: Edgars Jūrmalis*
*Other author(s):* Zane Lībiete,
*Affiliation*: Latvian State Forest Research Institute "Silava", Latvia
*Contact*: edgars.jurmalis@silava.lv

Cultural ecosystem services provided by forests, including recreational activity benefits, are crucial for society yet often difficult to assess. In terms of planning and developing recreational areas or managing more sensitive sites to redirect visitor flows, data on visit rates, revelead preferences and other inputs are important. Geocaching is a powerful, yet underused volunteered geographic information source – recreational activities employing geocaching elements can be both monitored and set up as guided 'anchor points' for recreational activities. This can prove beneficial especially in nature protection areas and other relevant sites of interest (heritage, historical sites). Geocaching can also be defined as a 'hybrid' of both a social media network (users post logs, reviews, interact with friends and the wider community) and a gamified route/point navigation service. The multifaceted nature of geocaching and its potential benefits are currently underused due to the involvement of only a relatively small number of active geocachers and the stakeholders involved in providing geocaches and the necessary maintenance; therefore, more research should be conducted to study and share the benefits of geocaching. In our research, we explored some of the qualititative and quantitative features of geocaches and discuss both existing and potential uses of geocaches in terms of recreational activities in and potential visitor flow management in forest landscapes in Latvia. We observed that most geocache placements occur near or in urban centers, with rural landscape geocaches placed with less spread or in special 'trail series'. User log reviews and geocache descriptions are of diverse quality, yet offer potential for increased gamification of forest recreational visits.

*Keywords*: recreational activity, forests, geocaching, volunteer geographic information

*6. Type of submission: Abstract*

T. Thematic Working Group sessions: T19 - Novel approaches and co-creation of standard protocols for assessing cultural ecosystem services based on social media content

# Cultural ecosystem services related to rivers: modelling and mapping supported by social media in NW Portugal

*Presenting author: Carvalho-Santos Carvalho-Santos*
*Other author(s):* Catarina da Silva, Claudia Pascoal
*Affiliation*: CBMA & IB-S, University of Minho, Braga, Portugal, Portugal
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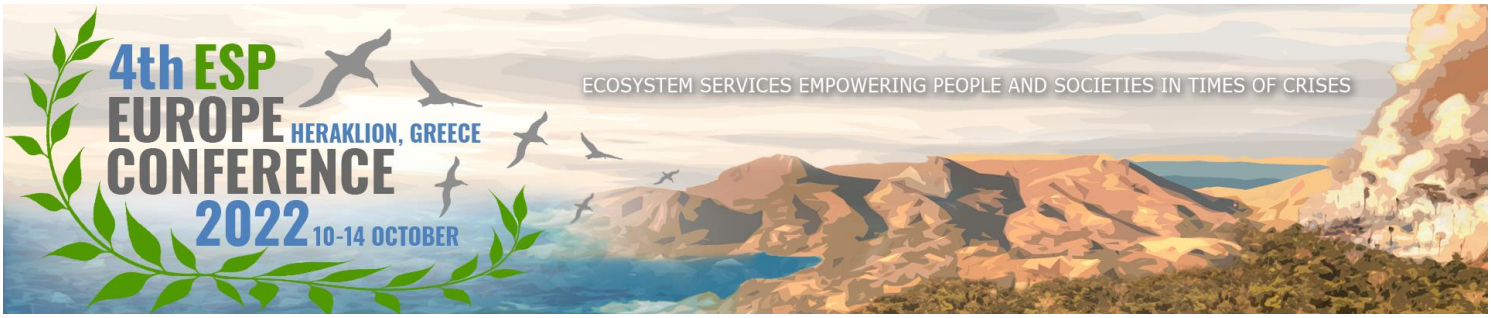
Rivers offer several cultural ecosystem services (CES) that directly benefit human well-being and the quality of life. Traditional evaluations of these services are based on the use of public questionnaires that are expensive and difficult to implement, in addition of having limited spatial and temporal coverage. To overcome traditional assessments and considering the rapid improvement in computational power and data storage capacity over the last years, new methodologies have emerged, such as the use of social media to identify, model and map the potential supply and demand for CES associated with environmental variables. The objective of this study is to provide a useful methodology that can be applied to any river with similar characteristics that efficiently map CES associated with rivers, using photographic data and environmental variables. First, we downloaded the images from Flickr and iNaturalist for the years 2018 and 2019 in three main rivers in NW Portugal (Minho, Lima and Cávado). Next, we manually grouped the images into categories that are associated with the river's CES (biodiversity, recreation, historical heritage and landscape). Eleven environmental variables related to CES were tested using Multimodel Inference to understand which group of variables best explain the distribution and categories of the images. The most represented category of images was: historical heritage in the Minho River (39%), biodiversity in the Lima River (70%), and recreation in the Cávado River (62%). The Multimodel Inference suggests that the variables that best explain the distribution of images are the presence of protected areas, distance from urban areas, number of trails, leisure/tourism points, and average annual temperature, which can be used to potentially map CES provision. In conclusion, the understanding of how CES related to rivers are provided support land managers and decision-makers on options to protect biodiversity ensuring the provision of ecosystem services.

*Keywords*: Cultural ecosystem services (CES), rivers, mapping CES, social media, NW Portugal




*7. Type of submission: Abstract*

T. Thematic Working Group sessions: T19 - Novel approaches and co-creation of standard protocols for assessing cultural ecosystem services based on social media content

# Facilitating an objective identification of human-nature interactions from computer vision-based labels of Instagram posts by a proposed new standardised clustering approach.

*Presenting author: Nina N. Kaiser*

*Other author(s):* Martin Palt, Stefan Stoll

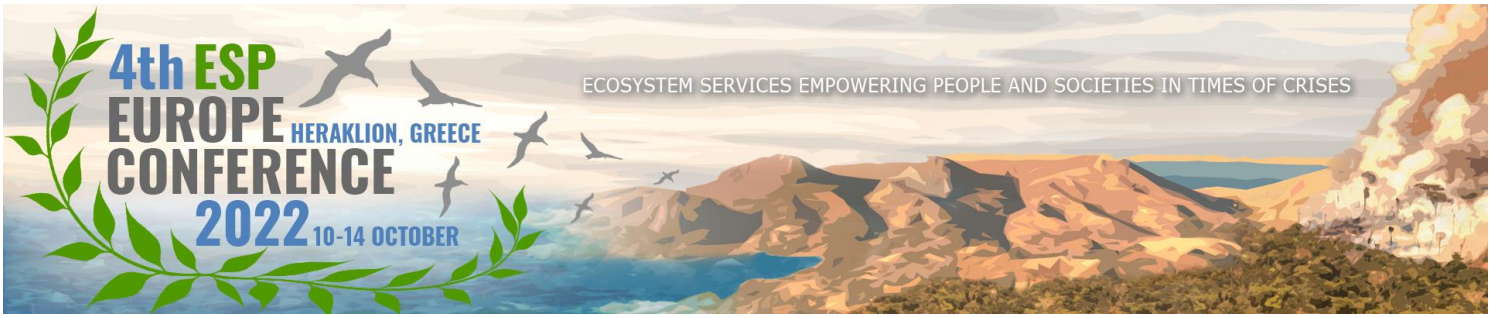
*Affiliation*: Environmental Campus Birkenfeld, University of Applied Sciences Trier, 55761 Birkenfeld, Germany, Germany

*Contact*: n.kaiser@umwelt-campus.de

Assessments of cultural ecosystem services (CES) or human-nature interactions have recently been supplemented to great effect by the analysis of voluntarily shared social media posts, especially georeferenced images. Images posted to social media can be objectively labelled using AI-based methods to describe their content, which then can successfully be related to e.g. environmental explanatory variables through cluster analyses. However, the ever-increasing amount of social media posts also poses challenges towards processing and interpretability, calling for standardised approaches. Therefore, reproducible standard protocols which yield usable cluster descriptions have to be established.

Here, we assembled a large dataset of images posted to Instagram referencing sites within the Hunsrück-Hochwald national park in Germany (n=17291) pertaining to depictions of the natural environment and people respectively, which are both difficult to automatically discriminate further with respect to CES. These images were labelled using Google Cloud Vision and subsequently subjected to hierarchical clustering based on Bray-Curtis dissimilarity. The resulting clusters were then described either by their ten most frequently assigned labels or alternatively by the ten labels, which account for the greatest separation of a given cluster from the remaining dataset based on SIMPER analysis. Subsequently, the two label sets were then compared regarding their suitability to facilitate the deriving of distinct experiences and activities of the posting users.

We conclude that relying on characteristic labels based on SIMPER analysis is advantageous due to not relying on ubiquitous labels which occur across all clusters without contributing to their differentiation. This is particularly important, e.g. to identify specific human-nature




interactions that presuppose people's demand for certain natural structures. While the ultimate transfer of user experience and activity derived from social media posts to CES still relies on expert opinion or literature, the approach we propose greatly objectifies the description of image clusters.

*Keywords*: Automated image labelling, image content clustering, social-ecological systems, natural resource management, research protocol

*8. Type of submission: Abstract*

T. Thematic Working Group sessions: T19 - Novel approaches and co-creation of standard protocols for assessing cultural ecosystem services based on social media content

# Automating the assessment of urban relational values ascribed to cultural ecosystem services for environmental sustainability

*Presenting author: Fulvia Calcagni*
*Other author(s):* Johannes, Langemeyer, Andrea, Ghermandi
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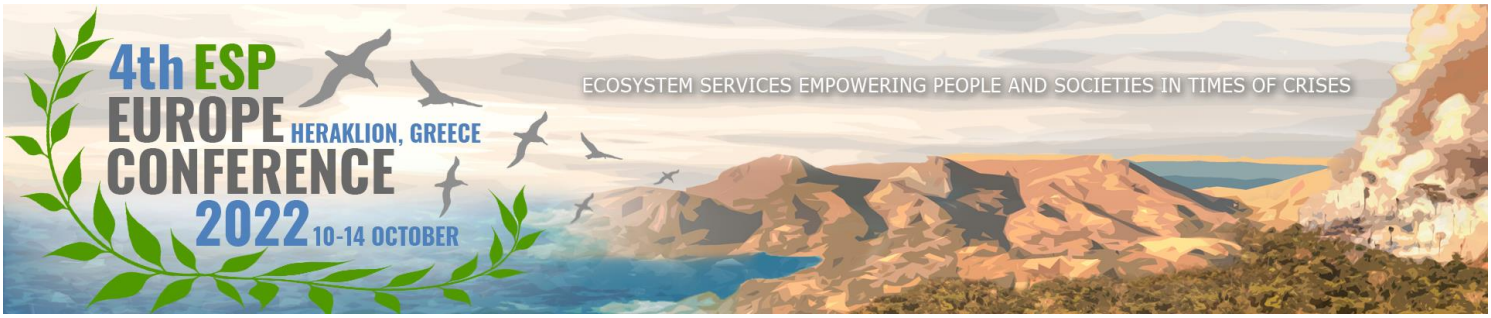
*Contact*: fulvia.calcagni@gmail.com

Assessing Cultural Ecosystem Services (CES) recently gained increasing importance in informing landscape and urban planning and management. As aligned to core values of justice, care and reciprocity, values ascribed to CES have been defined as inherently relational and their assessment is believed to improve the social legitimacy of the corresponding decisions taken. The use of Social Media (SM) data and metadata proved promising in undertaking this task, overcoming hurdles due to more time- and energy-intensive traditional data collection methods, as well as capturing the nuances of multiple context-based and plural relational values ascribed to CES. Yet, in addition to issues of data interpretation and representativeness, the large volumes of unstructured SM data available, can challenge their use and operationalization. Despite rapid advances in automatic data analysis, studies relying on a pre-trained software, whether for image classification or text-mining, appear to have limitations in dealing with data variety and non-standardized formats. Human brain, in turn, is apt to embrace the complexity and context-dependency of the data, although for relatively small samples. Therefore, this study pursues the collaboration between human and machine intelligences by training Google Cloud AutoML




Vision and Natural Language based on a set of manually coded visual and textual data, respectively. The so-supervised model was then employed to analyse a larger database of outdoor photographs taken within the whole Metropolitan Area of Barcelona and, after re-confirming the agreement with manual coding over a sample, it showed the utility of human-machine collaboration to improve further large-scale SM data-based relational CES values assessments.

*Keywords*: Cultural Ecosystem Services; Social Media Data; Supervised Machine Learning approach

*9. Type of submission: Abstract*

T. Thematic Working Group sessions: T19 - Novel approaches and co-creation of standard protocols for assessing cultural ecosystem services based on social media content

*Presenting author:* Andrzej Affek
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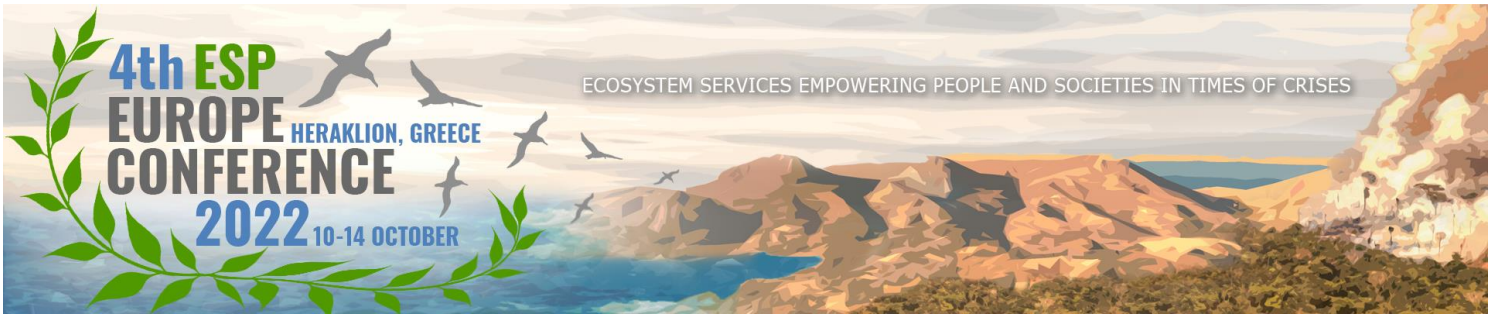
Interacting with nature is crucial for human well-being. For city residents, urban green space (UGS) is the most accessible part of nature, therefore it is necessary to recognize their needs, preferences and patterns of UGS use in order to properly plan and manage it. We propose to use Google Maps reviews to estimate both potential (average review score) and use (number of reviews) of UGS elements for recreation.

In Google Maps, each user can rate and express an opinion about any object in space. Assessment is made by assigning points (stars) on a scale of 1-5.

In order to calculate the values for Warsaw, a detailed analysis of objects belonging to Outdoor & Recreation category in Google Maps was carried out within the city's administrative borders. Only publically accessible sites with at least 50 reviews (representativeness) were taken into account, and these opinions had to be related predominantly to recreational value resulting from the presence of blue or green infrastructure (relevance) (e.g. cemeteries were excluded).

In total, 207 UGS objects in Warsaw met the above criteria. The Royal Baths Park was the most often reviewed (65,000 reviews), while University Library Garden and the Royal Castle Gardens reached the highest score (4.9). We therefore conclude that those green spaces




provide the most cultural ES and have the highest cultural ES potential, respectively. At the district level, cultural ES potential and delivery is the highest in the city downtown (average score 4.7; 142,000 reviews) and the lowest in industrial districts located in city periphery.

We believe that Google Maps reviews, by providing a very large and therefore highly representative and free sample of UGS users' opinions and preferences, can serve as a useful tool for a rapid assessment of both the potential and flow of cultural ES in cities.

Keywords: cultural ES; urban green space; Google Maps; review scores; Warsaw