BOOK OF ABSTRACTS

I. SESSION DESCRIPTION

ID: T3a
The operationalization of ecosystem services indicators: a matter of scale, data, purpose and end-users
Hosts:

	Title	Name	Organisation	E-mail
Host:		Roxanne Suzette Lorilla	BEYOND Centre of EO Research & Satellite Remote Sensing / IAASARS / National Observatory of Athens	rslorilla@noa.gr
Co-host(s):		Alexander P.E. van Oudenhoven	Leiden University	a.p.e.van.oudenhoven@cml.leidenuniv.nl
		Lyndre Nel	Hungarian University of Agricultural & Life Sciences	lyndre.agri@gmail.com
		Ute Schwaibold	University of the Witwatersrand	Ute.Schwaibold@wits.ac.za

Abstract:

The operationalization of ecosystem services (ES) monitoring at a global scale requires the identification of essential metrics linked to readily accessible data. This includes capturing both the ecological and social dimensions of ES to assess socio-ecological systems (including potential, supply, demand, flow, and value/benefit). However, some ES are more easily conceptualized and measured at a specific scale, while it may be challenging to understand the ES at other scales. Due to the diversity in data collection scales and methods, science and policy domains, methodological frameworks, and potential users, it is difficult to support the formulation of recommended concrete indicators. So, how and why do we deem an ES indicator as most appropriate to the purposes of their assessment? Do advances in big data availability and analysis enable the monitoring of ES at larger scales, thus contributing to the creation of more fit-for-purpose and replicable ES indicators? If so, how can the up-scaling of ES indicators facilitate decision-making processes when management actions are often made locally? How can local data be used to complement or validate the evaluation of ES that is based on large-scale data? And what type and frequency of data ensure the usefulness of ES indicators to policymakers devising local decisions? Given the variety of mapping and modeling approaches for monitoring and assessing ES, are 'simple', straightforward, and replicable ES indicators more understandable to users than the ones that are more 'complicated', time-consuming, and resource-based, meaning risking feasibility? Finally, Several ES studies frequently refer to achieving or supporting different environmental objectives and goals (e.g. SDGs, post2020 Biodiversity Framework, and Common Agricultural Policy); still, few studies feed information back into planning processes

to influence land-use decisions. All this indicates the need for close collaboration between ES data providers/producers (domain experts), analysts/modelers (researchers), and receivers (end-users) to bridge the gap between ES science and policy implementation. This session of the Thematic Working Group (TWG) 3 on Ecosystem Services Indicators sets out to identify key variables of ecosystem services, contributing to the general attempt of developing a conceptual and methodological framework for identifying and monitoring ES at multiple scales. One of the TWG's main goals is to communicate ES indicators to be more easily conceptualized and used by the intended end-users. Therefore, we welcome both traditional (e.g. slides presentation) and alternative (e.g. video/multimedia) presentation formats with your creativity being the only restriction. We invite submissions, with data and ES indicators being central in your submission, that emphasize:
- the combination of multiple datasets (e.g. earth observation, products from ES initiatives, socioeconomic datasets, field measurements, and local data, etc.) to estimate ES indicators,
- the idea behind the selection of a specific method and ES indicator (including, data availability, analyses' complexity), for a particular ecosystem (e.g. forest, agricultural, coastal, urban), and
- the usability and usefulness from the perspective of both researchers and end-users (practitioners and decision-makers).

Goals and objectives of the session:

To discuss the development and use of ES indicators while answering some of the questions raised above. To showcase how different data sources can be used to assess all components of ES. We envision identifying how practitioners and ES experts can collaborate to produce a more concrete and reproducible list of ES indicators. Finally, we want to advance and reflect on the work of ESP TWG 3 on ES Indicators.

Planned output / Deliverables:

In the latter part of the session, we will discuss interest in and commitment to an open access Special Issue composed of the session contributions for an Open Access journal. We consider it crucial that practical experience and reflection should be published and shared.

Session format:

Other (Standard-like session where presenters may choose between a traditional (slides) and an alternative presentation format (video/multimedia))

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 3 - ES Indicators

II. SESSION PROGRAM

Date of session: Wednesday 12th October 2022
Time of session: 11:00–12:00; 16:00–18:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
11:00 11:10	Roxanne Suzette	Lorilla	National Observatory of Athens	Welcome to Session T3a, and ESP working group T3 on ecosystem service indicators
11:10 11:25	Bhumika	Uniyal	Bayreuth University	Development and analysis of ecosystem services indicators for large scale studies
11:25 11:40	Ralf-Uwe	Syrbe	Leibniz Institute of Ecological Urban and Regional Development	Local climate regulation in cities as ecosystem service: Proposal of an indicator for Germany as part of the national ecosystem monitoring
11:40 11:55	Helena	Duchková	Charles University	The role of population data in urban ecosystem service assessments: A case study of microclimate cooling in Prague, Czechia

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
16:00 16:15	Alexander	van Oudenhoven	Leiden University	Bridging Society and Ecosystems with fit-for-purpose indicators on Social-Ecological Systems
16:15 16:30	Catherine	Galy	ANDRA International	Long term environmental observatory coupled with ecosystem services evaluation: a case study in France around Cigéo industrial project
16:30 16:45	Amy	Thomas	UK Centre for Ecology & Hydrology	Land Degradation Neutrality Indicator: care needed with interpretation due to false positives from ES trade-offs
16:45 17:00	Mostafa	Keshtkar	Shahid Beheshti University	Develop an integrated index with a nexus approach for applying ecosystem services to decision support systems
17:00 17:15	Ralf-Uwe	Syrbe	Leibniz Institute of Ecological Urban and	Ecosystem extent account and biotope valuation at federal level in Germany

		Regional Development (IOER)	
17:15	TWG3 Ecosystem Service Indicators		Plenary discussion

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: T3a - The operationalization of ecosystem services indicators: a matter of scale, data, purpose and end-users

Local climate regulation in cities as ecosystem service: Proposal of an indicator for Germany as part of the national ecosystem monitoring

Presenting author: Ralf-Uwe Syrbe
Other author(s): Sophie Meier, Michelle Moyzes
Affiliation: Leibniz Institute of Ecological Urban and Regional Development (IOER), Germany
Contact: r.syrbe@ioer.de

In densely built-up city quarters, urban green spaces contribute to maintaining urban quality of life and human health. Phenomena such as heat stress can be reduced as means of local climatic balancing. In order to make the according ecosystem service climate regulation of urban green infrastructure measurable and thus specifically controllable, a country-wide applicable indicator has been developed.

For the indicator "urban climate regulation", both the supply of climate-regulating services by urban green spaces and the demand for them by the residents are recorded. Based on regularly available nationwide geodata, a specific cooling capacity value is determined for the most important urban surface types, using tree canopy and land cover, and taking into account area sizes and location characteristics.

Overall, 76% of the population in the 165 German cities studied can benefit from high or very high cooling capacities in their close living environment. In 37 cities, even more than 85% are provided with good or very good cooling capacity by green infrastructure. The proposed indicator enables a comparison between the cooling capacity of individual land types, city districts as well as entire urban areas and can consequently be a professional planning and decision-making basis for resilient urban development.

Besides climate regulation services, further ecosystem services indicators are developed and monitored as part of the research data center of the Leibniz Institute of Ecological Urban and Regional Development (IOER) which is a partner of the national research data infrastructure (NFDI for Biodiversity). The IOER research center provides spatial data, tools, and assessment information on land use, land cover, landscape quality, and biodiversity. For this purpose, ecosystems with their extent, characteristics, and services are assessed quantitatively and cartographically. The contributions are presented here using the example of urban climate regulation service.

Keywords: Climate adaptation, Cooling, Shadow, Evapotranspiration, Health protection

2. Type of submission: Abstract

T. Thematic Working Group sessions: T3a - The operationalization of ecosystem services indicators: a matter of scale, data, purpose and end-users

Long term environmental observatory coupled with ecosystem services evaluation: a case study in France around Cigéo industrial project

Presenting author: Catherine GALY
Other author(s): Paul Olivier, Redon, Romain, Perrier
Affiliation: ANDRA, France
Contact: catherine.galy@andra.fr

Our societies are campaigning for tight regulation on environmental impacts, pushing the industries to invest in environmental monitoring programs though out the life cycle of projects. From 2007, the French National Agency for radioactive waste management (Andra) in charge of implementing the Cigéo project, a deep geological disposal for High and Intermediate Level Long lived Nuclear waste, set up a long-term environmental research observatory (Observatoire pérenne de l'environnement, OPE), before any construction started. OPE monitoring programs on water, air, soil, biodiversity and human activities were set across a 350km2 area to record any evolution to this socio-ecosystem and, in turn, to identify the origins of these changes: those of the Cigéo project from those due to other origins (climate, socio-economic drivers, land use..).

If Cigéo project is accepted, OPE will then be an exceptional environmental research and monitoring tool recording, over the Cigeo secular operating period, the evolution of its rural host territory currently dominated by agriculture and forestry. Taking advantage of the numerous different data collected by the monitoring program, the OPE has started to adapt the framework proposed by the French Evaluation of Ecosystems and Ecosystem Services (EFESE - 2012) to its territory characteristics (geology, hydrogeology, landscape, land use…). The Ecosystem services selected here are not assessed for economic valuation but as indicators to monitor and forecast evolution trends. In order to choose the appropriate

approach, a first wave of research projects (PhDs and post-docs) are currently testing different model-based approaches to evaluate bundle of ecosystem services including carbon storage, water quality regulation, water storage, nutrients regulation, pollination and biomass production. The aim is to identify a set of assessment approaches robust enough to be used by Andra for impact assessment and landscape management and by local communities for managing ecological or energetic transitions and implement education programs.

Keywords: Impact assessment, Environmental monitoring

3. Type of submission: Abstract

T. Thematic Working Group sessions: T3a - The operationalization of ecosystem services indicators: a matter of scale, data, purpose and end-users

Ecosystem extent account of biodiversity at federal level in Germany

Presenting author: Ralf-Uwe Syrbe
Other author(s): Burkhard Schweppe-Kraft, Sophie Meier
Affiliation: Leibniz Institute of Ecological Urban and Regional Development (IOER), Germany
Contact: r.syrbe@ioer.de

The performance of ecosystems for the conservation of biodiversity should become a part of the national accounting according to SEEA-EA. A monitoring of spatially explicit ecosystem balances allows to indicate quality losses and to justify conclusions to ensure sustainable land use.

As monitoring variable representing the state and performance of ecosystems, a biodiversity area indicator is presented here. The indicator uses a hierarchical ecosystem classification according to CORINE. The spatial extension and change of ecosystems are regularly monitored nationwide for Germany. For this purpose, a combination of repeatedly available high-resolution land cover data with non-area but thematic specific data was defined. This combination allows a comparative assessment of the ecosystem inventory regarding both area and quality. The proposed indicator uses cardinal biotope value points from the federal compensation guideline. Ecosystem types derived from the land cover model are specified by EU reporting such as NATURA 2000, Water-Framework Directive and High Nature Value Farmland as well as by the German Federal Forest Inventory.

In addition to the assessment with biotope value points, a monetary evaluation is carried out. It consists of comparable average costs for the development of a single biotope value point. This economic calculation step uses the data of a detailed habitat-related cost estimates of LANA for the implementation of NATURA 2000.

Keywords: habitat types, biotope values, land cover, economic assessment, natural capital

4. Type of submission: Abstract

T. Thematic Working Group sessions: T3a - The operationalization of ecosystem services indicators: a matter of scale, data, purpose and end-users

Development and analysis of ecosystem services indicators for large scale studies

Presenting author: Bhumika Uniyal

Other author(s): Thomas, Koellner,

Affiliation: University of Bayreuth, Professorship of Ecological Services, Bayreuth Center of Ecology and Environmental Research (BayCEER), Universitaetsstr. 30, 95447 Bayreuth, Germany, Germany

Contact: bhumika.uniyal@uni-bayreuth.de

Quantification of ecosystem services plays a crucial role in environmental decision making. There is a lack of universally accepted methods/equations for the quantification ecosystem services on a watershed level. The availability of global datasets and large scale modelling outputs provided us with immense data that must be utilized for the quantification of ecosystem services on both space and time. Therefore, we propose different mathematical equations based on output of the Soil and Water Assessment Tool (SWAT) to quantify four provisional and regulatory ecosystem services in terms of indices. The considered ecosystem services include water quantity and water quality regulation, erosion regulation as well as food and feed provisioning services using indices that vary between 0 to 1. Furthermore, we will demonstrate the effectiveness of the proposed equations by applying them to one small catchment (Schwesnitz catchment - 100 km2) and on a larger catchment (Main catchment - 21668 km2) located in Bavaria, Germany. SWAT model was developed for the two catchments and were calibrated and validated for annual crop yield, daily streamflow, daily/monthly sediment and bi- monthly nitrate loads during 1995-2020. Thereafter the model outputs were used for the quantification of ecosystem services. The proposed equations are versatile and can be easily implemented in the quantification of ecosystem services from the outputs of any hydrological and agro-hydrological model around the globe. Furthermore, this is a first step in the direction of exploring the spatially and temporally available data for the quantification of ecosystem services but it needs further validation.

Keywords: Ecosystem services, quantification, ecosystem service indices, SWAT

5. Type of submission: Abstract

T. Thematic Working Group sessions: T3a - The operationalization of ecosystem services indicators: a matter of scale, data, purpose and end-users

Bridging Society and Ecosystems with fit-for-purpose indicators on Social-Ecological Systems

Presenting author: Alexander van Oudenhoven
Other author(s): Jorn van der Veer,
Affiliation: Institute of Environmental Sciences, Leiden University, Netherlands
Contact: a.p.e.van.oudenhoven@cml.leidenuniv.nl

Sustainability challenges have increasingly been studied through the lens of integrated social-ecological systems (SESs), in which complex interactions occur place between social and ecological processes. SES research aims to provide usable knowledge regarding these complex systems to support sustainability practice and policy. A major challenge involves bridging social and ecological data for holistic measurement. Social-ecological indicators that capture interactions between society and ecosystems can credibly inform decision- and policy-making for sustainability.

This study systematically evaluated indicators that were used across different social-ecological research projects affiliated with the Programme on Ecosystem Change and Society (PECS). Through an extensive review of recent scientific publications, we extracted 882 indicators used for SES measurement from different case studies. We introduced a social-ecological spectrum to specify the extent to which these indicators integrate aspects of both society and ecosystems. To explore this further, we collected expert judgement for 135 indicators from researchers (previously) involved in the different case studies. Besides the perceived degree of integration, expert judgment covered the perceived effectiveness to bridge society and ecosystems by accounting for interactions, and the extent to which indicators were known to inform decision-making.

Individual indicators that integrate both dimensions are less common. Mapping integrated social-ecological indicators on a five-point spectrum is often dependent on context and the specific purpose of measurement, and leaves room for differing perceptions. Overall, integrated indicators are most of the time not considered very effective to bridge society and ecosystems. The 42 effective bridging indicators that are identified tend to relate to land use or land cover, nature conservation, flood protection, and natural resource access levels. Expert judgment revealed that social-ecological integration is not always required for effective bridging. Individual indicators are found to effectively bridge society and ecosystems in four different ways, which will be discussed further in the presentation and discussion.

Keywords: indicators, social-ecological systems, science-policy interface, fit for purpose, expert judgment

6. Type of submission: Abstract

T. Thematic Working Group sessions: T3a - The operationalization of ecosystem services indicators: a matter of scale, data, purpose and end-users

The role of population data in urban ecosystem service assessments: A case study of microclimate cooling in Prague, Czechia

Presenting author: Helena Duchková
Other author(s): Davide Geneletti, Davina Vačkářová
Affiliation: Global Change Research Institute of CAS; Charles University in Prague, Czech Republic
Contact: duchkova.h@czechglobe.cz

Green areas, providing benefits of cooling the surrounding environment, are not distributed equally in urban space, leading to some people benefiting more from ecosystems' cooling abilities and some people left exposed to higher levels of heat stress. Population data have been widely used as an indicator to estimate benefits and needs for ecosystem services (ES), including microclimate cooling. However, the spatial and temporal resolution and various socio-economic population data selected for a study can largely determine the results. Few studies have used people's movement as an indicator for heat exposure, revealing different levels of heat stress depending on a person's daily route. This has not been employed in ES assessment of urban cooling and could have important implications for equitable spatial planning in the context of climate change increasing the magnitude and frequency of extreme temperature events. We address these issues by exploring the differences in microclimate cooling realised benefits and unsatisfied needs, while employing residential data (static) and diurnal intra-urban population movement data (dynamic) on a census unit and a building scale on a case study of Prague, Czechia. We use InVEST Urban cooling model to estimate the provision and couple it with the need for cooling, represented by the levels of heat stress based on the Wet Bulb Globe Temperature, also accounting for vulnerabilities of various socio-economic groups and places. The results show areas where people benefit from ecosystem cooling and where they are exposed to extreme temperatures in static and dynamic model, census unit and building resolution, daytime and night-time. Besides identifying the areas for microclimate improvement for a specific case study, the research enhances the understanding and use of population data in urban ES assessments and stresses the significance of how data and indicator selection alter the results that could be later picked up by decisionmakers for spatial planning.

Keywords: heat exposure, heat stress, population movement, spatial planning, urban heat island

7. Type of submission: Abstract

T. Thematic Working Group sessions: T3a - The operationalization of ecosystem services indicators: a matter of scale, data, purpose and end-users

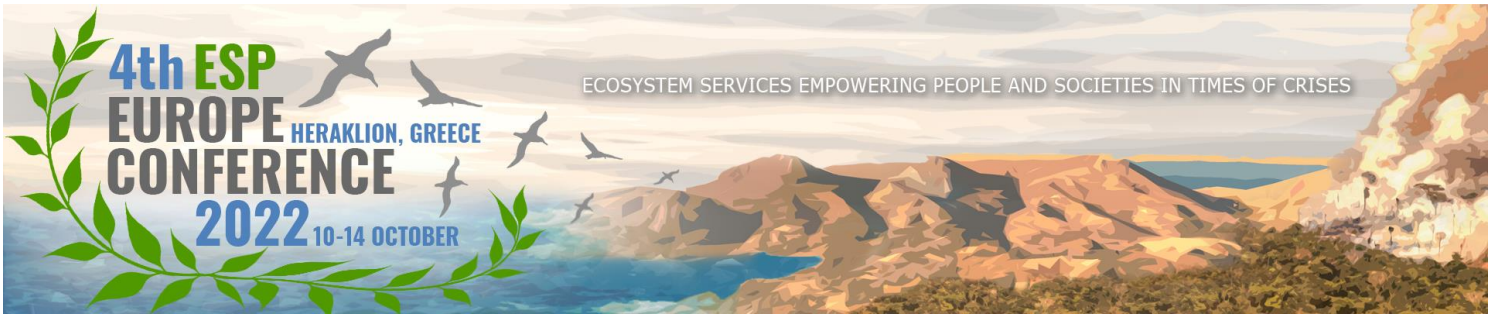
Land Degradation Neutrality Indicator: care needed with interpretation due to false positives from ES trade-offs

Presenting author: amy thomas
Other author(s): Chris Feeney, Stephen Lofts
Affiliation: UKCEH, United Kingdom
Contact: athomas@ceh.ac.uk

Land degradation affects around 25% of land globally. Preventing land degradation underpins most of the UN Sustainable Development Goals (SDG), particularly target 15.3. Over 100 countries have set Land Degradation Neutrality (LDN) targets. SDG indicator 15.3.1 provides a simple means of assessment, combining sub-indicators of productivity, soil carbon and land cover to identify area improving and degrading. Each sub-indicator represents multiple Ecosystem Services (ES), alongside biodiversity, therefore trade-offs between these can complicate assessment and create false positives. Due to response rates and data availability for the sub-indicators, LDN is best able to detect land cover change and declining yields; other aspects of land condition may be omitted. Land cover change dominate ES and biodiversity trends in countries with ongoing agricultural and urban expansion. However, management affects many of the same ES and Biodiversity issues, and can create opposing trends for productivity and other ES. Many countries with LDN targets have well-established agricultural landscapes, therefore other drivers including management driven trends affect much larger areas.

Here we explore these issues for the UK - a data-rich country with a well-established agricultural landscape. The results: 1) integrate land degradation data omitted by the core indicator; 2) highlight key trade-offs; 3) explore benefits of new high-resolution data. Critically, we demonstrate false positives from the trade-off between increased cropland productivity and soil carbon loss (11% from 1978). Additionally, including degradation data for critical load exceedance and erosion produced a switch from net area improving (18%) to net area degrading or degraded (up to 55%). We also note impacts on assessment results from spatial resolution of data and trade-off preferences for producing or regulating services in the land cover change matrix. With appropriate consideration of trade-offs and inclusion of additional data, the LDN indicator can help to assess and communicate progress on SDG 15.3.

Keywords: Sustainable Development Goals, trade-offs, Earth Observation data



8. Type of submission: Abstract

T. Thematic Working Group sessions: T3a - The operationalization of ecosystem services indicators: a matter of scale, data, purpose and end-users

Develop an integrated index with a nexus approach for applying ecosystem services to decision support systems

Presenting author: Mostafa Keshtkar

Other author(s): Naghmeh Mobarghei, Romina Sayahnia

Affiliation: Department of Planning and Designing the Environment, Environmental Science Research Institute, Shahid Beheshti University, Tehran, Iran, Iran, Islamic Republic Of

Contact: m_keshtkar@sbu.ac.ir

The concept of ecosystem services and their fundamental importance to human well-being, health, livelihood, and security are receiving growing attention. Still, there is currently a lack of knowledge in incorporating this concept into spatial planning, especially in the Middle East. Based on this, our research was conducted with the aim of providing an integrated index of multiple ecosystem services on a national scale as the main component of the decision support system in Iran. According to availability and importance of data, list of common indicators were divided to modelable and non-modelable ecosystem services. The existing challenges is the lack of threshold limits in the modeling of ecosystem services. For this purpose, the nexus approach was used and security indicators were integrated with ecosystem services modeling. With using the multi-criteria method, selected security indicators for water, food, soil, energy groups were composite and the final index was extracted. Analysis of ecosystem services modeling, against the ES combined index based on the nexus approach, showed that there are significant differences in the use of ecosystem services between the primary data and the indexed groups. The results shows that determining the thresholds for the ecosystem services supply-demand and creating a nexus-based index with the aim of providing security, can eliminate ecosystem services usage gaps in decision-making.

Keywords: Ecological assessment, biodiversity, policymaking, sustainable development, composite index