

BOOK OF ABSTRACTS

This Book of Abstracts provides a comprehensive overview of the session content and is structured into three main sections:

- I. **Session Description** – an introduction to each session, including its objectives and expected outputs
- II. **Session Program** – a detailed schedule for each session, including speakers and timing
- III. **List of Abstracts** – a complete compilation of all accepted abstracts

I. SESSION DESCRIPTION

ID: T4a

FAIRy tales: Opening up ES spatial tools, code, data and maps

Hosts:

	Name	Organisation	E-mail
Host (s):	Louise Willemen	University of Twente	l.l.willemen@utwente.nl
Co-host(s):	Miguel Villoslada	University of Eastern Finland	miguel.villoslada@uef.fi
	Benjamin Burkhard	Uni Hannover	burkhard@phygeo.uni-hannover.de
	Solen le Clec'h	Wageningen University	solen.leclech@wur.nl

Abstract:

Mapping ecosystem services has gone well beyond producing yet another figure for a report. In line with the momentum for open data practices, this session will showcase ways of sharing and re-using spatial information on ecosystem services, with Open Science as a starting point. We will address FAIR practices in sharing spatial tools and codes, alongside challenges such as ensuring usability of open data, overcoming hurdles faced by stakeholders, and determining how to keep data updated and usable in the long-term (hence replacing outdated ones)

In parallel with the push toward open science, the growing availability of open datasets could raise important issues of consistency, transparency, and interpretation. Inconsistencies in data exchange and coding approaches, coupled with the risk of misinterpretation, can easily undermine trust and lead to poorly informed decisions. By bringing these issues together, the session aims to highlight not only the opportunities of open practices rooted in FAIR principles, but also to discuss the responsibilities needed to ensure that ecosystem service mapping supports well-grounded outcomes.

We welcome presentations and shared experiences that illuminate our path towards FAIR practices in ecosystem services mapping. Not only success stories, but also lessons learned from challenges, setbacks, or work in progress are encouraged. We especially welcome contributions engaging with the rapidly expanding landscape of open datasets (e.g. Copernicus, GBIF) and their application in FAIR ecosystem services research and practice.

Goals and objectives of the session:

1. FAIRy tales, share opportunities and challenges of opening up ecosystem services spatial tools, code, data, and maps, with a focus on usability, transparency, and long-term accessibility.
2. Explore how FAIR we are. Assess to what extent the ecosystem services community has adopted FAIR principles in their daily mapping practices.

3. Build a FAIR roadmap. Distil lessons learned and promising practices into practical steps to guide the ecosystem services mapping community.

Planned output / Deliverables:

TBD, possibly a joint article

Session format:

Standard and short presentations and scientific debate.

Related to ESP Working Group:

TWG 4 – Mapping ES

II. SESSION PROGRAM

Room: Lounge

Date of session: Thursday 21, May 2026

Time of session: 09:00 – 10:30

Timetable speakers:

Time	First name	Surname	Organization	Title of presentation
9:00 - 9:05				Introduction to the session
9:05 - 9:15	Ken	Bagstad	Data Foundation	The ecosystem services community needs a shared and ambitious approach to FAIR.
9:15 - 9:25	Louise	Willemen	University of Twente	Exploring nature data sharing potential by private companies.
9:25 - 9:35	Anna	Pacholak	Space Research Centre of Polish Academy of Sciences	Where is snow?.
9:35 - 9:45	Julien	Barrere	INRAE	Unlocking the Potential of National Forest Inventories: A FAIR Framework for Open Ecosystem Services Mapping.
9:45 - 9:55	Nyi Nyi Nyan	Lin	University of Salzburg, Department of Geoinformatics	FAIR-by-Design Web-Native EO Toolbox for Urban Ecosystem Diagnostics in the Danube Region.
9:55 - 10:05	Alberto	Viola	University of Trento	Integrating Ecosystem Condition and Services in Alpine Forests: A Trentino Case Study (Italy).
10:05 – 10:25				Debate/discussion with audience and presenters
10:25 – 10:30				Wrap-up

III. LIST OF ABSTRACTS

The first author is the presenting author unless indicated otherwise

1. The ecosystem services community needs a shared and ambitious approach to FAIR

First author: Kenneth Bagstad

Other author(s): Greta Adamo, Flavio Affinito, Donat Agosti, Stefano Balbi, Marcel Buchhorn, Bálint Czúcz, Nfamara Dampha, Zuzana Harmáčková

Affiliation: Data Foundation

Contact: ken.bagstad@protonmail.com

More widespread implementation of the Findable, Accessible, Interoperable, Reusable (FAIR) Principles is vital to advancing ecosystem services (ES) research and practice, but these Principles are unevenly understood and applied in today's ES community. Drawing on shared research across international ES initiatives (i.e., IPBES, SEEA, GEO BON, TNFD), this presentation will highlight four key considerations for FAIR for ES, identifying challenges, lessons learned to date, and potential solutions.

First FAIR applies not just to ES-relevant data but to code and computational workflows, and must be considered throughout the entire scientific life cycle. Second, interoperability can aim for different levels of ambition (e.g., syntactic vs. semantic interoperability), and a shared understanding of interoperability definitions and aspirations is critical. Third, while interoperability and reusability are the most challenging aspects of FAIR, further progress toward findability and accessibility is both possible and necessary. Fourth, the lack of a shared language for ES-relevant concepts represented by data and models, and capable of enabling machine-to-machine communication, is the principal barrier to interoperability and reusability. While commonly agreed and used semantics are a challenging goal, they are extremely important as frameworks and tools proliferate, and finding ways to collaboratively build and apply shared semantics is crucial. Overall, we believe that an ambitious approach to the FAIR Principles – which aims for semantic interoperability – is needed to achieve equally ambitious ES monitoring goals, effectively reuse existing knowledge, and manage the flood of new scientific information.

Achieving FAIR for ES will require significant coordination among the research community. Careful consideration of human dimensions of interoperability, including cultural and institutional dynamics and incentives, are at least as important as technical challenges. We believe ESP and other institutions can play a vital role in the convening needed to achieve widespread adherence to the FAIR Principles for ES.

Keywords: Artificial intelligence, community building, FAIR, machine-to-machine communication, semantics

2. Exploring nature data sharing potential by private companies

First author: Louise Willemen

Other author(s): Frank Ostermann, Ivan Paspaldzhiev, Denitza Pavlova, Martin Georgiev

Affiliation: University of Twente

Contact: l.l.willemen@utwente.nl

Private companies are increasingly collecting biodiversity data in response to regulatory and voluntary frameworks. Despite this, much of their data remains underutilised and is rarely shared on public platforms. On request of Biodiversa+, we explored how to stimulate private companies in adopting FAIR data practices. Here we share our experiences and findings in working with this target group. Our objective was twofold: to identify common, relevant, and crucial combinations of business and biodiversity data standards and practices, and to describe how this combination can be implemented in practice. We used four guiding questions: Q1. What are the main typical profiles of businesses that create, provide, and use biodiversity data? Q2. What are the main biodiversity data sharing practices and infrastructures? Q3. What are efficient combinations between the profiles and practices? Q4. What are recommended best practices to share biodiversity data to realize these combinations for mutual benefit? Based on a desk review of relevant business requirements and data standards, we conducted company

interviews and participated in a workshop for private sector and data sharing experts. We identified four profiles of companies and their motivations, challenges, and opportunities for data sharing.

Case studies of biodiversity data sharing frontrunners like TotalEnergies, Holcim, Barilla, Biotopie, and Lake Constance Foundation reveal that while data sharing is beneficial, common obstacles include data ownership issues and a lack of in-house expertise.

To support the uptake of FAIR practices by companies, we developed a practical seven-step guide, from defining goals and preparing data, to resolving legal issues, selecting platforms, and building internal capacity. It concludes by encouraging a culture of data stewardship to unlock the strategic and global value of corporate biodiversity data. The work is published under CC BY 4.0 at DOI: 10.5281/zenodo.16967457

Keywords: FAIR, data standards and platforms, corporate perspectives

3. Where is snow?

First author: Anna Pacholak

Other author(s): Andrzej Kotarba, Dr habil., Michał Krupiński, Kamil Drejer

Affiliation: Space Research Centre of Polish Academy of Sciences

Contact: apacholak@cbk.waw.pl

In the era of digital transformation, open science initiatives increasingly rely on innovative platforms that facilitate data sharing and collaborative research. However, opening research data still remains a significant challenge. How can such data be unlocked and shared as user-oriented open services? This contribution presents the journey of open research data and explores its role in fostering the reuse of spatial information on ecosystem services.

The transformative role of open data will be explored with particular focus on a climate-related case study involving a snow cover service - a unique and innovative solution at the European scale. The service leverages the Interactive Multisensor Snow and Ice Mapping System (IMS), which integrates data from multiple sources. It is automatically updated with real-time satellite and meteorological data from NOAA, EUMETSAT, Copernicus and other sources, providing a current snapshot of ongoing phenomena while also enabling the analysis of geo-spatial changes through archived historical data.

It serves diverse purposes, including climate research, education, winter tourism, but also as a warning system in case of heavy snowfall or fast melting causing floods. This explains why the snow cover service has gained popularity, standing as a flagship example of how advanced scientific research and IT solutions, combined with effective data analytics and visualization, can be transformed into valuable public service.

The role of European initiatives and projects (e.g. FPCUP) that support international collaboration, data exchange, and the development of FAIR practices and interoperable solutions, underscoring their importance in advancing open data practices, will also be highlighted.

Keywords: open science, open data, snow online service, climate

4. Unlocking the Potential of National Forest Inventories: A FAIR Framework for Open Ecosystem Services Mapping


First author: Julien Barrere

Other author(s): Philip Roche

Affiliation: INRAE, Aix Marseille Université, UMR RECOVER, Aix-en-Provence, France

Contact: julien.barrere@inrae.fr

Through their systematic and standardised protocol, maintained over extensive temporal and spatial scales, National Forest Inventories (NFIs) are a promising, yet underutilised, source of data for ecosystem services mapping. This is partly due to the historical focus of NFIs on timber assessment which limits the range of services that can be evaluated, and to the reluctance of national authorities to make these data public. However, these limitations have been changing in recent years: an increasing number of countries are now making NFI data publicly available, and protocols are shifting from simple dendrometric surveys towards comprehensive forest ecosystem assessments with an increasing focus on biodiversity



compartments. These changes pave the way for NFI to be used as an open science tool for mapping a wide variety of ecosystem services. In this presentation, I will demonstrate the potential of NFI data for mapping ecosystem services by presenting a biophysical framework that uses dendrometric, floristic, and dead wood surveys to quantify seven forest ecosystem services (i.e. carbon stock, timber volume, biodiversity potential, the provision of medicinal and edible plants, erosion mitigation, and climate regulation). I will explain how this framework, which is fully compatible with the FAIR principles and has publicly available code and data, can be used to analyse the spatial and temporal patterns of ecosystem services on a national scale, using France as a case study. Finally, I will discuss the barriers and perspectives to expanding this framework to a broader spectrum of services and, more importantly, to a continental scale, while remaining compatible with the FAIR principles.

Keywords: National forest inventory, ecosystem services, biophysical evaluation

5. FAIR-by-Design Web-Native EO Toolbox for Urban Ecosystem Diagnostics in the Danube Region

First author: Nyi Nyi Nyan Lin

Other author(s): Martin Sudmanns, Hermann Klug, Dirk Tiede

Affiliation: University of Salzburg, Department of Geoinformatics

Contact: nyinyinyan.lin@plus.ac.at

Urban regions across the Danube face growing pressures from heat, drought, and land degradation, yet many municipalities lack accessible tools for timely, spatially explicit diagnostics. As part of the Interreg SpongeCity project (2024 to 2026), we developed a FAIR-by-design, web-native Earth Observation (EO) toolbox to support ecosystem service assessment and nature-based planning in 12 pilot cities. The system operates entirely within a web browser, requiring no installation, cloud credentials, or specialized infrastructure. It enables real-time exploration of EO DataCubes using modern web technologies. Underlying datasets are automatically compiled and updated from public EO sources such as Sentinel-2, ECOSTRESS, and Copernicus services, using the cloud-optimized Zarr format to support scalable, chunked access across devices.

The architecture is modular, allowing input datasets and analysis functions to be adapted, extended, or localized. Current tools include urban heat island detection, vegetation trend analysis, and multi-temporal spatial statistics. The system maintains responsive performance on low-resource hardware and integrates OGC-compliant metadata and service interfaces to support interoperability and reproducibility. Beyond lowering technical and infrastructural barriers, the toolbox enables municipalities to embed EO-based diagnostics into participatory planning workflows. It enhances local capacity, preserves data sovereignty, and promotes accessible governance for climate resilience.

By aligning technical innovation with societal needs, the SpongeCity Toolbox (<https://spongecity.zgis.at>) demonstrates how lightweight, standards-based web infrastructure can support social ecological technological systems (SETS) approaches in urban sustainability transitions.

Keywords: Web-native Earth Observation, Urban ecosystem services, FAIR geospatial infrastructure, Climate-resilient urban planning, Social-ecological-technological systems (SETS)

6. Integrating Ecosystem Condition and Services in Alpine Forests: A Trentino Case Study (Italy)


First author: Alberto Viola

Other author(s): Laura Giuffrida, Maria De Salvo, Sandra Notaro

Affiliation: University of Trento

Contact: alberto.viola-3@unitn.it

Forest ecosystems provide essential ecosystem services that support human well-being, particularly in mountain regions where ecological processes are highly sensitive to climate variability and disturbance. Despite growing interest in forest ecosystem services, spatially explicit assessments that document forest condition and ecosystem services over time remain limited, especially in Alpine contexts. This study presents a spatially explicit assessment of forest condition and key regulating ecosystem services in the Autonomous Province of Trento (Northern Italy). We used the ARIES platform to assess forest condition and three ecosystem services: vegetation carbon storage, annual water yield, and sediment retention. Forest condition was evaluated for 2000 and 2018 using a composite Forest Condition Index integrating



abiotic, biotic, and landscape indicators derived from remote sensing data processed through openEO. Ecosystem services were estimated for 2000, 2010, and 2021 using biophysical models parameterized with climate, land cover, soil, topographic, and ecological data. All outputs were produced at 100 m spatial resolution and aggregated by forest type and administrative units. Spatial statistical analyses were applied to identify hotspots and coldspots of forest condition. Results show a consistent improvement in forest condition between 2000 and 2018 across all forest types and administrative units, reflecting gains in canopy structure, connectivity, and landscape naturalness. Hotspots of high forest condition are primarily located in higher-elevation and less fragmented areas, while coldspots are concentrated in valley systems subject to stronger anthropogenic pressure. Ecosystem services exhibit marked temporal variability over the 2000–2021 period: annual water yield and sediment retention increased between 2000 and 2010 but declined sharply by 2021, while vegetation carbon storage shows substantial losses in coniferous forests following major disturbance events.

Keywords: Forest Ecosystem Services, Forest Condition Index, Hotspot Analysis, Aries, Remote sensing