

VALORADA Capacity Building Programme

Overview of urban data space for EU Green Deal: the USAGE project

Natalia Oprea

The Lisbon Council SDA Bocconi School of Management



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The USAGE project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under the Grant Agreement no 101059950 - call HORIZON-CL6-2021-GOVERNANCE-01-17 (IA)

Setting up the policy scene

European Data Strategy

European 'digital transition' set in 2020 to achieve the full potential of datadriven innovation in EU.

Common European Data Spaces European Green Deal

European 'green transition' set in 2019 to turn environmental and climate challenges into economic opportunities

9 Policy areas for climate resilience 74%

of population in Europe lives in urban areas

EU cities marshalling 'twin' transition

Cities are called on to lead the Green and Digital Transition by:

- Activating the participation of all stakeholder groups.
- Exploiting the potential of data to effectively support Green Deal actions at local level





How can data spaces enable cities to realise EU Green Deal ambitions?



USAGE project

Home News & Media Events Challenges People&Partners Synergies Resources



www.usage-project.eu

USAGE at a glance



Italia

Consortium

SPECTRAL · VALUE

Data space defined

"Holistic approach that addresses both data governance and technical considerations aiming to facilitate more structured and flexible data sharing and use."

What it is

- an ecosystem of actors
- share data
- governance, legal and technical tools required

Data Space is a decentralised infrastructure which follows governance principles, standards, practices and enabling services that support trusted data transactions between participants. (DSSC, 2025)

USAGE Flow





USAGE workflow model



Status-quo assessment results

Urban Heat'Sectorised' approach: several policy instruments spanningLegal: ac and pro- exchang Organisa	 Move beyond data collection for monitoring purposes:
Floodingsclimate mitigation/ adaptation sectors (mobility, energy)harmoni collection manage staff ski alignment acrossAccess to green'Integrated' approach: alignment acrossstaff ski or staff ski analysis Strategi involven	 ational: sation of data improve data accuracy for agenda setting Cross-linking shareable & exploitable datasets for policy formulation



USAGE approach & solutions



Take home messages

Data Spaces have the potential to:

- support data-driven actions to tackle climate challenges > ensuring accurate & updated information throughout the entire policymaking process, agenda setting and policy implementation
- spur the collaboration between various city stakeholders
- Datasets can be easily replicated across urban areas

It is important:

- Need for homogenisation
- Clear agreements among actors
- Ensure 'No DS's an island'

100 + 200 OpenStreetMap

re °C

Thank you!

natalia.oprea@lisboncouncil.net www.usage-project.eu





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Case study of urban data space: the USAGE project

Giacomo Martirano (EPSIT)



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USAGE facts and figures



- 4 prototype urban data spaces being implemented in 4 pilot cities (Ferrara-IT, Zaragoza-ES, Graz-AT, Leuven-BE)
- 11 use cases addressing 3 European Green Deal policy areas covered by Local Green Deal/City Contracts
- A policy-driven use case conceptual model
- BPMN (Business Process Model and Notation v2.0) representation of the use cases
- A GeoNetwork-based catalogue (<u>https://usage.geocat.live/</u>) currently publishing 426 datasets metadata and 62 tools & algorithms metadata:
 - harvesting existing CKAN open data catalogues
 - allowing editing of new metadata using ISO 19115 based templates
 - adopting a procedure to document (in the lineage field) semantic and syntactic requirements for new datasets

USAGE facts and figures

- A GeoServer instance (<u>https://usage.geocat.live/</u>) currently providing access to 85 workspaces with 224 layers:
 - through view and download OGC Web Services (for expert users)
 - using GeoCat Bridge QGIS Plug-in (to facilitate dataset publication from QGIS)
 - enabling a data storage through a Web Accessible Folder (for internal data sharing of unpublished raw data)
- Semantic harmonisation of Decision Ready Information (use case output datasets) according to documented data models
- DRI effectively shared to decision makers and citizens (through html pages, user stories, etc.)
- An urban data space validation approach focused on use-cases
- A data space validation dashboard
- On-going mapping of 4 prototype data spaces toward technical and business & organisational Building Blocks of DSSC Blueprint (now v2.0)

Policy-driven use case conceptual model



Use case workflow in BPMN



Combine the various datasets, and using the building foorprints as the base, and containing attributes of building attributes, roof slopes, roof materials, area and prioroty level <u>Lool metadata</u>

Suitability and priority map Vector Roof footprints (building footprints) Coded according to how suitable they are – measure is suitability (Most Suitable, Suitable, Moderately Suitable, unsuitable) based on combination of parameters: Roof slopes: < 20°; Roof material : Desirable: Concrete, asphalt | Undesirable: Tile; Roof area: > 5sqm; Priority areas: Low vegetation(<0.3), high temperature(UHI zone) Roof suitability is then categorized into Suitable, Moderately Suitable, or unsuitable. To be superimposed on a backround of orthoptot for visualisation

Potential extensive green roof locations

link to dataset metadata

An urban data space validation approach focused on use cases



A data space validation dashboard



Thank you!

g.martirano@epsilon-italia.it

www.usage-project.eu



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Overview and roadmp of the Copernicus Data Space Ecosystem - data and tools

Monika Krzyzanowska - Business Development Director monikak@cloudferro.com

Earth Observation data – status and challenges

- "Abundance of the data" free and commercial,
- Aapplications and services are developing dynamically ,
- Use of the LLM and AI related services, thus need for processing,
- Traceability services for the data

Earth Observation data – status and challenges

- Instant access to a very large repositories of the data,
- Access to flexible and scallable processing resources,
- Trusted, secure, fit to be used for planning and disaster related operations,
- Expectations to get information



Data Space Ecosystem

dataspace.copernicus.eu

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Conclusio

The Copernicus Programme

Copernicus is the Earth observation component of the European Union's Space programme, observing our planet's environment and systems. It offers raw data and derived products that draw from satellite Earth Observation and in-situ (non-space) data.

- Data open and free to all.
- Biggest EO programme in world.
- 16TB of data collected everyday.
- Huge benefits to business and academia in Europe
- Key tool in tackling major societal challenges e.g. climate change









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Online code labs and interfaces

Cloud computing

Conclusion

Largest data space for the largest EO programme

- The authoritative source for full and up-to-date archives of Sentinel user data, digitally traced for a permanent record of authenticity
- Immediately available, free and open data
 - Currently over 80 PB and more than 100 PB by 2028
- Governed by a Service Level Agreement, ensuring continuity and trust (up to December 2028 with optional extension until December 2032)
- **Open ecosystem** of advanced services (e.g. API Access, Cloud processing, Code Repository, thirdparty data and services)







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Optical Satellites

• Sentinel-2

- 10 m spatial resolution, 13 optical bands, ~5 day revisit
- Sentinel-3 OLCI / SLSTR
 - 300 m spatial resolution, 21 bands, daily revisit
 - 1000 m spatial resolution, thermal imaging, revisit twice daily
- Sentinel-5P
 - 7.5 km resolution, spectral bands focusing on air pollution, daily revisit
 - Most optical bands are obstructed by clouds
 - Except for thermal imaging, optical satellites depend on sunlight









Level 3 ARD Data products: Sentinel-1 and Sentinel-2 mosaics

- Sentinel-1
 - Monthly mosaics with terrain flattening applied
 - No swath edges, dramatically reduced speckle
 - High applicability for land cover and agriculture mapping
 - Current time range: 2020-2024



- Sentinel-2
 - Quarterly Cloudless mosaics
 - No swath edges, no clouds
 - RGB+NIR Bands suitable for land cover classification and as a benchmark for disaster monitoring
 - Current time range: 2020-2024







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Level 2 ARD Data products: Sentinel-3 CDSE is not just for "raw data"

- Marine
 - Integrated Water Vapour (for atmospheric correction)
 - Algal Pigment Concentration
 - Total Suspended matter
 - Photosyntetically Active Radiation
 - CDM absorption coefficien



- Land
 - GIFAPAR (photosynthesis)
 - Integrated Water vapour column
 - OTCI terrestrial Chlorophyll index
 - Calibrated reflectance at 681 and 865 nm









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Copernicus Contributing Missions (CCM-s)



- CCMs supply additional data beyond the Sentinels to Copernicus to ensure that a whole range of observational requirements is satisfied.
 - VHR Optical Data
 - SAR Data
 - DEM Data
- The main users of CCM data are the Copernicus services, which address several key thematic areas for the benefit of European citizens.
- Other Copernicus users are also able to access certain CCM collections, depending on their eligibility. [Discover/View/Download]
- Example vi Odata/STAC:
 - VHR Europe 2015-2021
 - VHR Urban Atlas (2006, 2009)









dataspace.copernicus.eu



PROGRAMME OF THE EUROPEAN UNION


Additional EO data

Name	Туре	Accessibility	Time range/Extent
Sentinel-2 Mosaics	Optical	OpenSearch, Sentinel Hub, Browser	2020-2021/Global
Copernicus DEM	Elevation model	OpenSearch, Sentinel Hub, Browser	2018/Global
SMOS L1/L2	Soil Moisture	OpenSearch, OData	2009 - ongoing
ENVISAT MERIS	Optical	OpenSearch, OData	2002-2012
Landsat 5 / 7 / 8	Optical	OpenSearch, OData	1984-2013 / 1999-ongoing / 2013 - ongoing
Copernicus Land Monitoring Service	Processed products	S3	Europe
Copernicus Marine Environment Monitoring Service	Processed products	\$3	Global/European/individual water bodies
Copernicus Atmosphere Monitoring Service	Processed products	\$3	Global
Sentinel-1 RTC	SAR	OpenSearch	2018-Present/Global
Sentinel-1 CARD-BS	SAR	OpenSearch	2014-Present/Europe
Sentinel-2 Land cover	Processed products	OpenSearch	2017/Europe







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The data access revolution: A P I

We now have the cloud - downloading and local processing is **dead**

- The data is stored in uncompressed, streaming-ready formats (like Spotify)
- You request the custom end product you want
- The data pre-processing, subsetting, analysis and visualization is done in the cloud – you get the result



API access

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Download vs API access

The legacy way – download-based data access

- Data is available in pre-defined tiles
- Rolling archive: current data is immediately accessible, but archive data has to be queried and made available
- Raw data storage on the client side needed
- Data has to be moved to servers or virtual machin es
- Requires heavy investment
- Difficult to scale up

The new way – API based direct server-side processing

- Data available for your Area of Interest
- All datasets immediately available, no delay for requesting current or archive data
- No need to store raw data on the client side
- Virtual machines can be used that already have the data on board
- Much less investment needed
- Can be scaled dynamically





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Data access and processing APIs

- Streamlined access (Sentinel Hub, OpenEO)
 - STAC Catalogue
 - Visualisation (OGC)
 - Sentinel Hub Processing (instant, batch)
 - Provides images based on satellite data collections
 - Allows filtering by quality, date, AOI
 - Supports direct calculation of pixel operations in evalscripts
 - Batch process API enables asynchronous processing for large areas with high performance
 - Statistical (instant, batch)
 - Bring your own data (COG, zarr)
 - openEO



Sentinel-2, kNDVI, near Lublin, Poland











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Use case: Visualizing the effect of a volcanic eruption



With Copernicus Browser, it is possible to quickly

- Open an image of the island, create a mosaic
- Browse to the volcano
- Apply an algorithm to visualize volcanic activity
- Prepare a GIF for change detection
- Apply an algorithm for change detection

Advanced visualization and analysis without prior knowledge or GIS software







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Copernicus Browser

- Search, query and download all User Level Products
- Interactive visualisation and analysis of most important data collections
- Export subset of the data (also in print quality)
- Comparison, time-lapses, area analysis and more
- 3D exploration and visualisation











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Conclusion

EO Coding is difficult to start

- You need to understand of lot of things:
 - Data formats and management
 - Map projections
 - Satellite image generation and spectral analysis
 - Raster-vector integration
 - Data visualization
- CDSE turns this into a series of incremental steps
 - Data management is done by the backend
 - Visualization is done by the Browser and Jupyter
 - You can focus on the core part









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Cloud computing capacity



CREODIAS 2.0 – first commercial element of the Copernicus Data Access Ecosystem

- Immediate access to EODATA
- User friendly tools
- Cloud services for data processing
- Serverless processing
- Competitive pricing
- Premium support





PROGRAMME OF THE EUROPEAN UNION



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CREODIAS provides commercial services from CloudFerro and Open Telekom Cloud

- Computing Services
- Data Storage
- Cloud Container Engines
- GPU Servers

hoose a service provider	
REODIAS provides commercial services for Copernicus Data Space Ecosystem, of , and RHEA. Choose a provider from whom you want to order services.	erred by a Consortium consisting of: T-Systems, CloudFerro, Sinergise, VITO, DLR, ACRI
CloudFerro	O T-Systems
Click here to purchase CloudFerro's services. Services are immediately accessible post-payment. Users who do not have an account on the CREODIAS platform will be redirected to the registration page.	Click here to purchase Open Telekom Cloud Services from T-Systems on CREODIAS. The services will be made available to you with a few mouse clicks. Just provide us with some administrative information to set up your Open Telekom Cloud account. Our support team @ copernicus@t-systems.com is happy to assist in case of any questions.
More	T-Systems product





Cesa









ROADMAP | UPDATE April 2025

https://documentation.dataspace.copernicus.eu/Roadmap.html

Upcoming improvements

Q1 2025 Achievements

- New STAC Catalogue prototype (incl. STAC v1.1)
- Optimisation of checksum publication
- Ecosystem services registry
- Sentinel-1C new mission data
- Sentinel-1 SLC Bursts added to Copernicus Browser including API interfac
- Sentinel-2C new mission data
- openEO: support for export to STAC API
- openEO: support for export of data to object storage
- openEO: improved tooling for large area processing
- Workspace and processing improvement
- Historical traces for Sentinel-5P

Q2 2025 Release

- CLMS data available in the Copernicus Browser and Streamlined Services
- New STAC Catalogue for remaining Sentinel missions and products
- Sentinel-1 Global Mosaics remaining historical data
- Sentinel-2 Global Mosaics remaining historical data
- Sentinel-2 reprocessing for years 2022 and 2023
- Sentinel-3 OLCI L1 reprocessed data in CDSE
- New space sample datasets discovery and visualisation
- Copernicus Marine Environment Monitoring Service access via CDSE STAC
- First Sentinel Sample Zarr products accessible via CDSE (EOPF integration)
- Landsat Collection 2 L1 2021-2025 available in CDSE
- CCM: visualization of VHR's in Copernicus Browser
- CCM: implementation of VHR 2024 ingestion and start of delivery
- Copernicus Browser update for easier on-demand ordering
- openEO: Copernicus Vegetated Land Cover Characteristics (HRL-VLCC)
- openEO: support for docker based processes via CWL/OGC Application Package



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What is CDSE

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Future vision

Conclusion

Future vision of Copernicus Data Space

Ecosystem

Copernicus Data Space Ecosystem will serve data from future Copernicus satellites

We attract upstream commercial data providers to join and serve their data in the API system.



Future vision of Copernicus Data Space Ecosystem

- We foster downstream algorithm developers to join and serve their solutions
- Public operational services
- Commercial EO solutions



Future vision

Copernicus Brows

Online code labs Cloud

^{nputing} Future vision

Future vision of Copernicus Data Space Ecosystem

We expect to federate and interact with other providers

- DestinE
- EU Open
 Science Cloud
- Commercial Data Space Providers



Cloud computing

Conclusions

A free, public platform for EO-based solution development

- Building and selling/opening EO solutions is possible without major investment
- Bandwidth, processing capacity or data storage is not a limit any more
- Learning EO technology is a series of incremental steps instead of a steep learning curve
- A transformative solution for Earth Observation

Contact of presenter





Company overview

- CloudFerro a European/Polish midcap technological company in EO downstream sector
- Cloud computing services, data and platforms for Space and other advanced markets
- Compliance with EU regulations and standards, fully European company with European competencies, IPRs, resources
- Proactive R&D and product development



CloudFerro – key features





CloudFerro Clouds



Y BIELIK

Bielik is an advanced language model developed by a Polish team, designed for efficiency in Polish. It excels in comprehension and natural language generation, offering high quality responses and interactions with optimal use of resources.

PLLuM

PLLuM-8x7-chat, created by a consortium of Polish scientific institutions with the support of the Ministry of Digitial Affairs, was specially trained on extensive collections of Polish texts. Thanks to this, it perfectly understands and processes the Polish language with its unique properties, ensuring exceptional quality when working with Polish content.

∞ Meta

LLaMA 3.1 and LLaMA 3.3, developed by Meta, are advanced large language models designed for high efficiency and scalability. They excel in natural language understanding and generation tasks, offering improved performance while being resourceefficient.

Wdeepseek

DeepSeek-RI-Distill-Llama-70B is a language model that combines efficiency with powerful reasoning capabilities. This model contains 70 billion parameters and was created through a distillation process, which allowed it to preserve key reasoning patterns from the larger DeepSeek-RI model with 67I billion parameters.

MISTRAL AI_

Pixtral is a multimodal model by Mistral AI - Europe's premier LLM company, that processes text and images in their natural resolution, providing flexible token usage and analysis of complex documents and visualizations without partitioning.

Public and private clouds



Computing Services – public cloud environments providing Virtual Machines (VM), Virtual Machines with local storage (VM.local), Dedicated server virtual machines (DS), GPU, Kubernetes, private clouds, multitenant private clouds, remote locations

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Network Storage – object, block and file storage with different performance and availability tiers dependent on storage media (NVMe, SSD, HDD), replication and location



Local Storage – local SSD and HDD disks and NVMe storage for Virtual (VM, VM.local) and dedicated computing instances (DS, BM)



Backup and long term Storage – cost efficient storage in secure remote locations targeted for backup, archive and dark storage



Internet Access – Public Network access with geographical and carrier redundancy; direct access to GEANT academic network



Data Science and AI – moldel's hosting, GPUs, Jupiter Hub, Major TOM embeddings, EO data repositry



CloudFerro's competitive advantages



Focus, concentration and simplicity

Our mission is to provide cloud and storage services with necessary tools. **Our offer is very simple**



Infrastructure as a Service complemented with Platform as a Service

Own **IaaS extended with PaaS** aimed at the Space, in particular the EO and scientific community



Open Source and in-house development

Own technology stack, no vendor lock-in, no third party IPRs



Cost-efficiency Transparent, flexible and effective cost models



Understanding the needs of EO data users

Data science team committed to develop optimal tools addressing **specific needs of EO data users**



Fully European company Compliance with EU laws and standards, local competencies and data in EU data centres



Security

Tier3 data centres in Europe; ISO 9001, ISO 27001, BSI 200-1, BSI-C5 certificates



Redundancy across Europe Secure, green Data Centers in distant locations



Full scope technical support Acting as a **one-stop-shop** to get help, 3 lines of local support



Largest online public EO data repository in Europe/world

Over 90PB of EO data stored

Thank you for your attention

For more information, please visit: www.cloudferro.com or link up with us on: www.cloudferro.com

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in https://www.linkedin.com/company/clfr/ f https://www.facebook.com/cloudferro/