**OPEN EARTH
MONITOR**

D2.1 Stakeholder Committee and "Open-Earth-Monitor design" workshop

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List of Acronyms

OEMC	Open Earth Monitor Cyberinfrastructure
EU	European Union
EC	European Commission
ESA	European Space Agency
NSO	Netherlands Space Office
Belspo	Belgian Space Agency
UNCCD	United Nations Convention to Combat Desertification
UN-FAO	United Nations Food and Agricultural Organization
UNCCD	United Nations Convention to Combat Desertification
IPCC	International Panel on Climate Change
UNFCC	United Nations Framework Convention on Climate Change
UNCDC	United Neighbourhood Community Development Co-operation
UMD	University Maryland
INPE	National Institute for Space Research, Brazil
GEO	Group on Earth Observation
ML	Machine Learning
FAIR	Findable, Accessible, Interoperable, Reusable
TRUST	Transparency, Responsibility, User focus, Sustainability, and Technology
CARE	Collective benefit, Authority to control, Responsibility, and Ethics
NDVI	Normalized Difference Vegetation Index
Belspo	Belgian Space Agency
EFI	The European Forest Institute
JRC	The Joint Research Centre
GEO-BON	Group on Earth Observation – Biodiversity Observation Network
GEO-GLAM	Group on Earth Observation – Global Agricultural Monitoring
GEO-GFOI	Group on Earth Observaton – Global Forest Observation Information
GEO-LDN	Group on Earth Observation – Land Degradation Neutrality
UniA	University of Athens

Executive summary

Stakeholders play an important part in the project as they will influence and provide feedback on the project's use cases and the project in general. Therefore, all stakeholders will be invited to join (in person, or virtually) the Open-Earth-Monitor Cyberinfrastructure (OEMC) annual conference, 4—8. September 2023, in Bolzano, and this practice will be continued to all the remaining OEMC annual conferences.

The first part of the document describes the approach taken to compile a list of stakeholders and then analyses the composition and three different groups of stakeholders: the broad list of stakeholders, use-case-related stakeholders, and the Stakeholder Committee (the key stakeholders).

The second part of the document presents the design recommendations and the needs collected from the key stakeholders during the initial survey at the OEMC design workshop that took place during the OEMC kick-off meeting in Wageningen. The project will have another workshop in the future, and thus, this report will be updated accordingly.

The report is produced from the activities carried out within tasks T.2.1—5 and T8.1—2. The outputs are relevant for all the tasks in WP3—6 as the stakeholder needs, and feedback will have an impact on the design of particular functionalities of the OEMC computing engine (WP3), preparation and dissemination of the in-situ data (WP4), and EU and world monitors (WP5 and WP6, respectively).

Stakeholder Groups, Mapping, and Structure

Design and establishment of a stakeholder community are one of central elements of the OEMC project, as **stakeholder needs and feedback** will be systematically considered during the development of the OEMC product and services (WP3—6). Stakeholder feedback and needs will be acquired in two ways (a) from direct interactions at OEMC workshops and specific stakeholder interviews and (b) from online surveys. The first online survey collects feedback on FAIR geospatial and environmental data reaching **a broad list of stakeholders**. The remaining surveys will then focus on the OEMC use cases introduced by the OEMC monitors (WP5 and WP6), where **use-case-related stakeholders** will be directly approached through targeted online interviews. The interviews will be designed with the OEMC use case representatives, and the feedback will be used to design the use cases better. The survey design will be discussed in the OEMC D2.3 deliverable in detail. Figure 1 gives a schematic representation of different stakeholder groups and interaction approaches.
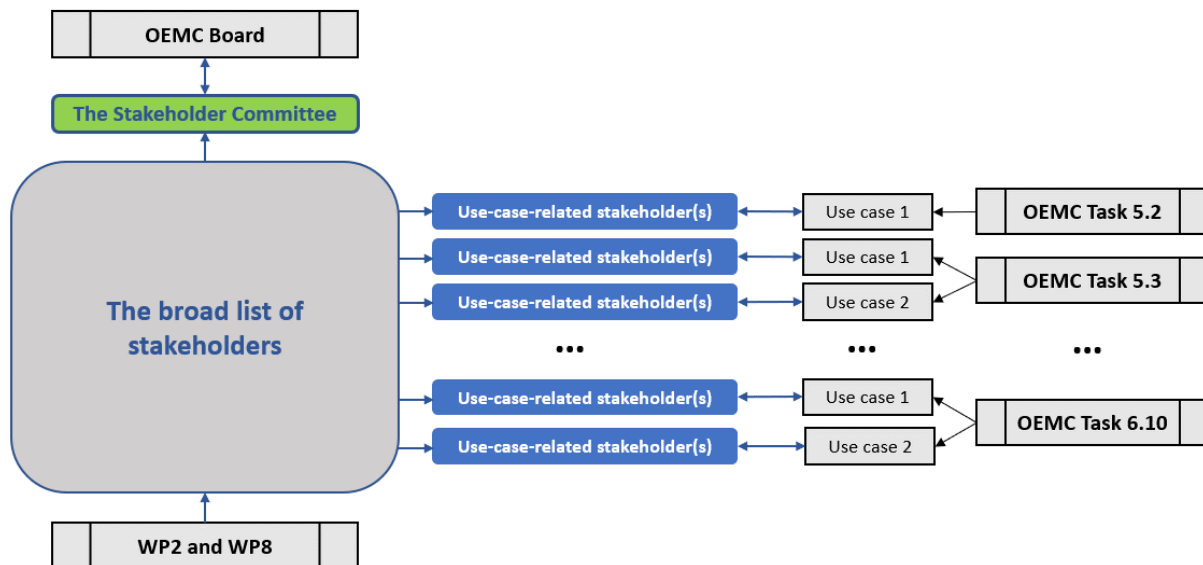

Figure 1: Stakeholder groups and the interaction with different OEMC activities and groups

A broad list of stakeholders has been compiled by selecting potentially interested colleagues from major international organizations whose expertise overlaps with the OEMC project goals. We considered at least one representative from the GEO Flagship Programmes, such as GEO-BON, GEO-GLAM, GEO-GFOI, and GEO-LDN, the European programmes, national space agencies, and research organizations such as EuroGEO, Copernicus, EC, ESA, NSO, Belspo, JRC, EFI and from the UN organizations such as UN-FAO, UNCCD, IPCC, UNFCC, and UNCDC. In addition to that, we considered stakeholders representing the private sector, NGOs, and local governments. According to the geographical scope and type of organization they work in, the stakeholders are categorized into the following types:

- international government
- national/regional government
- EU agencies and programmes
- EU research organizations
- corporations
- commercial SME

- NGO
- non-for-profit
- academia, and
- Hybrid.

The stakeholders are further distinguished according to their job roles into the following three categories:

- policy
- technical, or
- both.

The broad stakeholder list was compiled from contacts delivered to WP2 through the OEMC partners from the organizations mentioned above and from contacts of experts collected through extensive internet research and consulting experts' official organization's websites. Finally, each OEMC use cases leader was asked to provide at least one stakeholder relevant to their use case. The broad stakeholder list currently includes more than 40 contacts. The OEMC consortium plans to extend that list further in the future, particularly when preliminary OEMC products and services are disseminated publicly, e.g., through workshops and direct engagement with users.

The OEMC project includes 24 products and services and three special OEMC activities (front-end visualization, FAIR data, and OEMC engine) (Table 1). Based on the stakeholder feedback collected at the OEMC design workshop that took place at the kick-off meeting, for each of the 24 products and services, i.e., **24 OEMC tasks**, at least one **use case** will be introduced to demonstrate the usability of the particular OEMC product or service (Figure 1). Each use case will be co-designed and evaluated with at least one stakeholder referred to as **use-case-related stakeholder(s).** Each OEMC use-case leader will directly suggest at least one stakeholder to compile the use-case-related stakeholder list. If some use cases stay without their stakeholder, we from WP2 will map a stakeholder from the broad list of stakeholders. The mapping will be done according to the stakeholders' expertise and envisaged interest. Eight stakeholders are already assigned to the current use cases, whereas most of the remaining use-case-related stakeholders have already been contacted by the use-case leaders, who are now waiting for their final confirmation. It is noted that the process of forming use cases is ongoing, and the number of use-case-related stakeholders is expected to rise with new use cases being introduced.

Table 1: A list of OEMC products and services and the corresponding OEMC working tasks

	OEMC products and services		
	Name	**Lead**	**Task Num.**
1	EU-in-situ-data tool	OGH	5.2
2	EU-reforestation planner tool	OGH	5.3
3	EU-forest management tool	TS	5.4
4	EU-coastal monitor	LWE	5.5
5	EU-biodiversity monitor	ETH	5.6
6	EU-crop monitor	SIN	5.7
7	EU-climate monitor	GILAB	5.8
8	EU-flood monitor	CNR	5.9

9	EU-soil monitor	OGH	5.10
10	EU-snow monitor	EURAC	5.11
11	EU-extreme-weather-risk monitor	CNR	5.12
12	EU-rapid forest disturbance monitor	WUR	5.13
13	EU-air quality monitor	IFGI	5.14
14	EU-land-based mitigation potential impact tool	MPG	5.15
15	World-reforestation monitor	ETH	6.1
16	Tropical-deforestation monitor	WU	6.2
17	Tropical-crop monitor	OGH	6.3
18	World-land degradation neutrality monitor	OGH	6.4
19	Global ML-based gridded meteo dataset	GILAB	6.5
20	World-flood risk monitor	OGH	6.6
21	World-Drought and Fires Monitor	CNR	6.7
22	World-forest carbon emissions monitor	GFZ	6.8
23	Planet Health Index	MPG	6.9
24	World-carbon flux monitor	MPG	6.10
Special OEMC Activities			
	Name	**Lead**	**Task Num.**
25	Generic front-end visualization framework	VIZ	5.1
26	Open-Earth-Monitor computing engine	OGH	WP3
27	FAIR environmental data	GFZ/IIASA	WP2

From the broad stakeholder list, we proposed 11 key stakeholders to participate in **the Stakeholder Committee (**key stakeholders, Table 2). The role of the committee is to provide general needs and feedback to the OEMC board (Figure 1). The key stakeholders will be engaged directly, i.e., by inviting them to annual OEMC meetings as keynote speakers and for panel discussions. First, feedback and needs from the key stakeholders were surveyed already at the OEMC kick-off meeting in Wageningen, which is discussed in the following section in detail. It should be noted that the 11 key stakeholders from Table 2 have been officially invited by the OEMC project coordinator (Tomislav Hengl, OGH) to join the Stakeholder Committee, and we are waiting now to receive their confirmations. Based on the replies from the proposed key stakeholders, we will decide how the Stakeholder Committee will be further extended.

Table 2: A list of key stakeholders that are forming the Stakeholder Committee

	Name	**Organization**	**Type**	**Role**	**Overlap with OEMC**
1	Erwin Goor	EC	European agencies and programmes	Policy	all
2	Patrick Griffiths	ESA	European agencies and programmes	Both	WP3, WP5−6
3	Barron Joseph Orr	UNCCD	International government	Policy	WP4, WP6
4	Gert-Jan Nabuurs	IPCC, WUR	International government	Both	WP4−6
5	Yana Gevorgyan	GEO	International government	Policy	WP2, WP4−6
6	Gilberto Camara	INPE	National/regional government	Both	WP3−6

7	Peter Ströbl	JRC	European research organizations	Both	WP3, WP5−6
8	Raymond Sluiter	NSO	European agencies and programmes	Both	WP5−6
9	Julia Wagemann	-	Commercial SME	Technical	WP2, WP5−6
10	Rochelle Schneider	ESA	European agencies and programmes	Technical	WP5−6
11	Hannes Reuter	EC	European agencies and programmes	Technical	WP5−6

Open-Earth-Monitor Design Workshop

The OEMC design workshop occurred during the project kick-off meeting on 18.−20. July 2022, at Wageningen University. Key stakeholders from organizations such as EC, ESA, NSO, UNCCD, UMD, INPE, and GEO were invited to participate as keynote speakers in the public part of the kick-off meeting. We approached the stakeholders with more targeted questions from the OEMC consortium members and general questions from a broad audience (60 persons in total, including OEMC staff). The keynote speeches and the discussions afterward (Figure 1) were summarized to identify stakeholder needs and recommendations for the OEMC project. To complete the feedback and understand better user needs, a broad audience was also involved through polls and Q&A questions on the Slido platform. The feedback summary is then disseminated (a) publicly as a blog post hosted by the Nerd For Tech community (Hengl et al. 2022) and (b) internally as an OEMC internal report (Ross 2022). For the reader's convenience, we repeated and summarized the major feedback and discussion here once again. Our focus was mainly on regrouping, relating, and interpreting how the feedback can potentially affect the OEMC design, particular WPs, and particular OEMC tasks. Therefore, it is noted that the text and the conclusions below overlap with the above-mentioned blog (Hengl et al. 2022).

Figure 2: Discussion forum with the key stakeholders participating in-person and online at the kick-off meeting.

Feedback on OEMC Engine

Several stakeholder takeaway messages (Hengl et al. 2022) were directly related to the development of the OEMC engine (WP3). Patrick Griffiths (ESA) noted that the overlap in pre-processing of the EO data and in the functionalities of European EO processing platforms is high. This is highly inefficient and should be considered within WP3. Gilberto Camara (INPE) pointed out the sits (Satellite Image Time Series Analysis on Earth Observation Data Cubes) package (Simoes et al. 2021) that could be potentially explored in the development of the openEO ML extension (T.3.3). In the review on user perspective on future EO cloud-based services, Wagemann et al. (2021) identified that one of the key challenges are non-standardized data formats and workflows as well as too many EO portals. Online participants at the OEMC design workshop also confirmed this conclusion and stakeholder messages by preferring a highly integrated and federated ecosystem of EO platforms rather than having monolithic or diverse and non-integrated platforms (Figure 2).
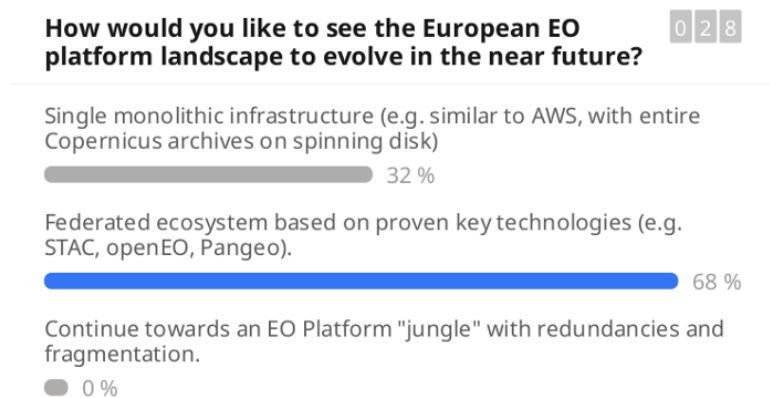

Figure 3: Preference of the online participants on future European EO data processing solutions

Feedback on EO Data & Products

Stakeholders raised several important requirements for EO data and derived information. Barron Orr (UNCCD) suggested data co-design at every stage in the decision process, starting from the planning rather than using the data only in the monitoring and evaluation phases. This will help bridge the current data and governance gaps and is directly related to OEMC use case activities in WP5 and WP6. Yana Gevorgyan (GEO) put forward FAIR-TRUST-CARE data principles to help obtain more autoreactive information and bridge the digital divide between developing and developed nations. Yana Gevorgyan, Barron Orr, and online participants (Figure 3) see open data and technology solutions as direct and primary contributors to those goals. The OEMC engine (WP3) and OEMC-derived data (WP5 and WP6) are in-line with those demands.

Which of these aspects do you think will be most essential to ensure a meaningful contribution of EO to the Green Deal implementation?   0 3 5

IoT, in-situ and feedback from citizens via mobile devices.
31 %

Modelling & Digital Twins.
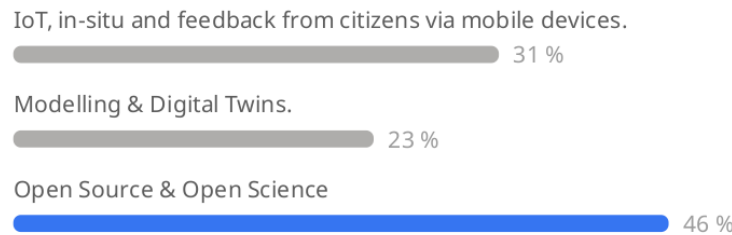23 %

Open Source & Open Science
46 %

Figure 4: Preference of the online participants on different aspects contributing to the Green Deal implementation

Gilberto Camara pointed out the importance of having self-consistent maps and class definitions (e.g., natural savanna, cattle pasture, and deforestation classes) to provide trustworthy global products that can also be useful to policymakers at the local level. Patrick Griffiths and Tomislav Hengl (OGH) noted that there is an expansion of global maps with continuous variables (NDVI, FPAR, tree cover, canopy height, etc.) that may represent land cover in greater detail, but Gilberto Camara thinks that a simplified representation such as land cover land use maps will be still preferable by many policymakers. Wagemann et al. (2021) suggested targeting intermediate users instead of policymakers and introducing a cloud certification mechanism to increase trust in cloud-based services. For online users, the decision-ready information derived from EO data should come with the application's documentation and traceability and should be based on analysis-ready and accessible data (Figure 3).

List terms and tests that help prove that we are dealing with Decision-Ready-Information   0 2 5
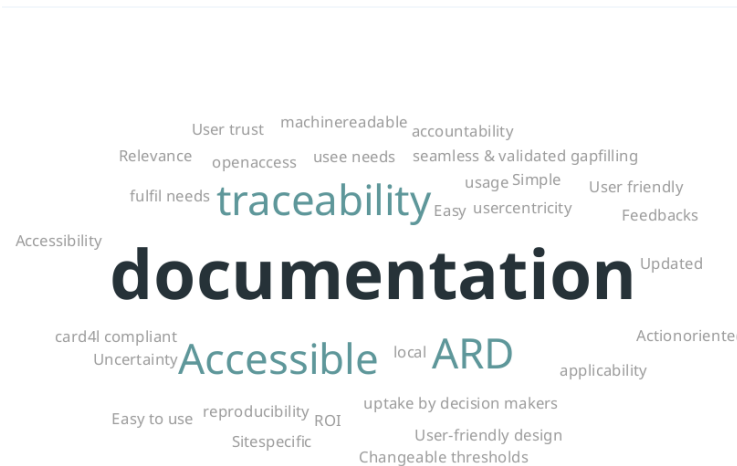
User trust   machinereadable   accountability
Relevance   openaccess   usee needs   seamless & validated gapfilling
usage Simple   User friendly
fulfil needs   traceability Easy usercentricity   Feedbacks
Accessibility
documentation   Updated
card4l compliant
Uncertainty Accessible   local ARD   Actionoriented
applicability
Easy to use   reproducibility ROI   uptake by decision makers
Sitespecific   User-friendly design
Changeable thresholds

Figure 5: Most important terms and tests for the online participants related to the decision-ready information

Feedback on In-Situ Data

The relevance and availability of in-situ data were also discussed. Gert-Jan Nabuurs (Wageningen University) stressed that using EO data only in forest planning is too risky without combining them with in-situ data. The expansion of EO data and products should be followed with an increase of reference in-situ

data. Matt Hansen (UMD) emphasized that high-quality in-situ data ensures unbiased estimates derived from the EO-based global maps. Nevertheless, Gert-Jan Nabuurs also observed that many high-quality in-situ data, such as the national forest inventories, are not open, i.e., unsavable for use with EO data. To change that, it is essential to build trust and proper attribution to the work colleagues and institutes done on collecting and preparing in-situ data and put more pressure on governments to open the in-situ data. Within WP4, OEMC will also consider alternative ways of collecting reference data, i.e., through citizen science (T4.8). Another way forward is to ensure a better connection between in-situ and EO data, which will be tackled in OEMC by preparing different in-situ data (WP4) and their integration with EO data within the OEMC engine (WP3).

Feedback on Business Development

Ensuring the sustainability of EO businesses and tracking the impact of the environmental investment was seen as not trivial by stakeholders. Joanna Ruiter (NSO) suggested that financial services must accompany new tools and EO information to have an impact in low- and middle-income countries. In his blog, Joe Morrison stressed that users do not mind paying subscriptions for applications they use every day. For OEMC activities, that would mean introducing applications and use cases that will be served, which should be ensured through intensive stakeholder engagement within WP2 in OEMC. Furthermore, those recommendations are also relevant for business development and project sustainability activities with WP7.

Feedback on the OEMC Design

Erwin Goor (EC) went through examples of similar and successful projects, such as e-Shape, that relied on an extensive list of use cases. This was addressed by introducing and placing use cases in the center of the OEMC project design (Figure 5). Each OEMC monitor in WP5 and WP6 will introduce several use cases in which use-case-related stakeholders will assess implementation and service.
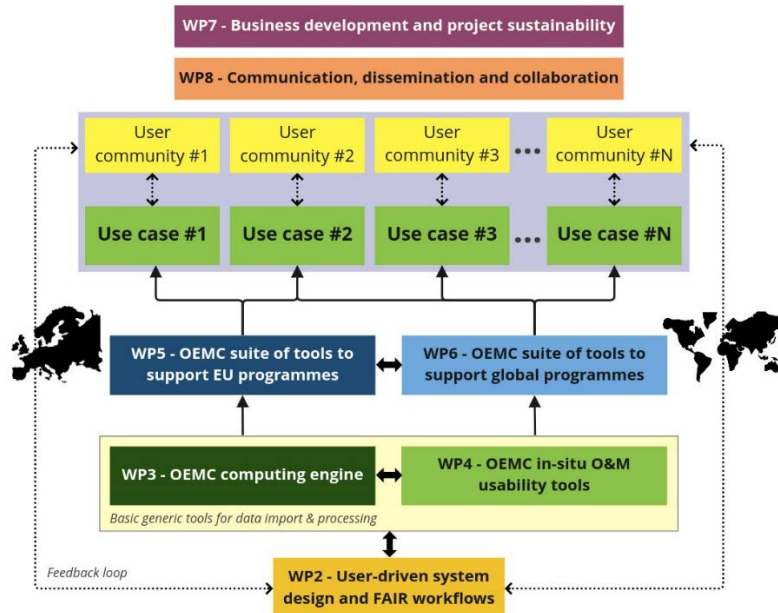

Figure 6: New OEMC project design with use cases taking the central role

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