ANERIS

Operational Sensing Life Technologies for Marine Ecosystems

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Milestone M4 – Co-design exercise with technology providers in Europe

Lead Beneficiary: Science for Change

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29/06/2023

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Preface

This document comprises the main means of verification of the co-design activities with technology providers in Europe. There are 2 main reports on this period that come from the co-design exercise carried out in the Kick-off meeting of the project and a series of 3 workshops with technical experts in Work Package 2.

Report on the co-design activities of the KoM

25/03/2023

Lead Beneficiary: Science for Change

Author/s: Miguel Hernández, Mar Escarrabill, Blanca Guasch, Alina Luna and Jaume Piera

Summary

This report comprises the main outcomes of the ANERIS Kick-Off Meeting co.design workshops, held in Barcelona the 8th and 9th of March of 2023. The objective of the first session was to get to know each other among partners, and generate a first network of the connections in the project. On the other hand, the second day was focused on brainstorming about the characteristics of the Operational Marine Biology (OMB) data product. Those OMBs data products that are expected to be developed in the framework of the project in the different Case Studies, merging different technologies. More than 40 participants were involved in those sessions, contributing to the first ideation process for a co-designed OMB system.

Table 1: *Main links to supplementary documents of the session*

Title	Links
Digitized maps (Miro board)	https://miro.com/app/board/uXjVMd0cfdY=/
PDF version	ANERIS 230314 – Digitalization Maps Ko…
Introduction to co-design (Presentation)	20230306_ANERIS_KoM_Introduction to …
Pitch of the technologies (Presentation)	Technologies
Folder with the Network activity	Technologies.JPG

List of Abbreviations

KOM – Kick-Off Meeting

OMB – Operational Marine Biology

WP – Work Packages

CS - Citizen Science

1. Session of the 8th of March

During the afternoon of the first day of Kick-Off Meeting, a networking session was organized to promote a first contact among the people who will be working hand-by-hand in the project. After an icebreaker, the main activity was presented, which consisted of finding the connections among the different key categories and actors of the project, i.e., partners, technologies, case studies and Work Packages (WP). There were 6 different maps that aimed to connect:

- Partners with each other
- Technologies with each other
- Case Studies with technologies
- Case Studies with partners
- Technologies with partners
- Work Packages with technologies

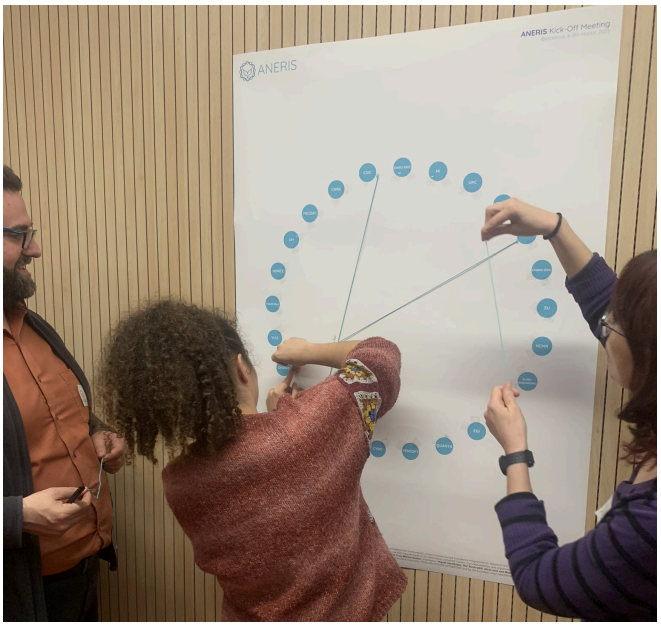

Figure 1: *Partners starting with the connexions (Source: Tweet by @CatiaM_Monteiro)*

Several networks were created which visually showed how the different partners, technologies, case studies and WPs will interact with each other. One facilitator per map helped to connect the threads. The main characteristics of the session are described in Table 1, while the captures of the final maps are available in this folder.

Table 1: *Details of the co-design session in the 8th of March*

Title	Networking session

Objective(s)	Get to know each of the partners involved and find the connections among them.
Duration	45’
Number of participants	50
Number of groups	6

2. Session of the 9th of March

The second day of the KoM focused on building on and reflecting about the concept of Operational Marine Biology, starting from the 4 different case studies proposed in the project. The participants of each case study worked on 3 different work-maps that guided the activity with the aim of developing the concept of OMB data products.

At the beginning of the session, an introduction to co-design was done by Blanca Guasch from Science for Change, to present the possibilities of this methodology in the project. The presentation is available in this link.

After that, technology leaders presented each of the 11 different technologies so all participants got introduced to them. Presentation available in this link.

The digitized version of these dynamics is available in the Miro platform in this link and as a PDF in this link.

2.1 First dynamic: General brainstorming on OMBS

The first map comes from the OMB products analysis established in the project (Figure 2) and addressed 5 different questions:

1. **Identify requirements.** What international conventions/regulations exist related to the topic?
2. **Spatial and temporal extent of biological variables.** What observing/monitoring programs already exist related to the topic?
3. **Usability, needs, social acceptance, relevance.** How relevant, feasible and impactful is the topic? Should this be a priority?
4. **Initiate solutions; deliver to requirements.** What solutions/OMB products can we propose for this topic?
5. **Sustainability, threats, competitors, accessibility, costs, acceptance, etc.** Are there any other ideas, issues or considerations related to the topic we should take into account?

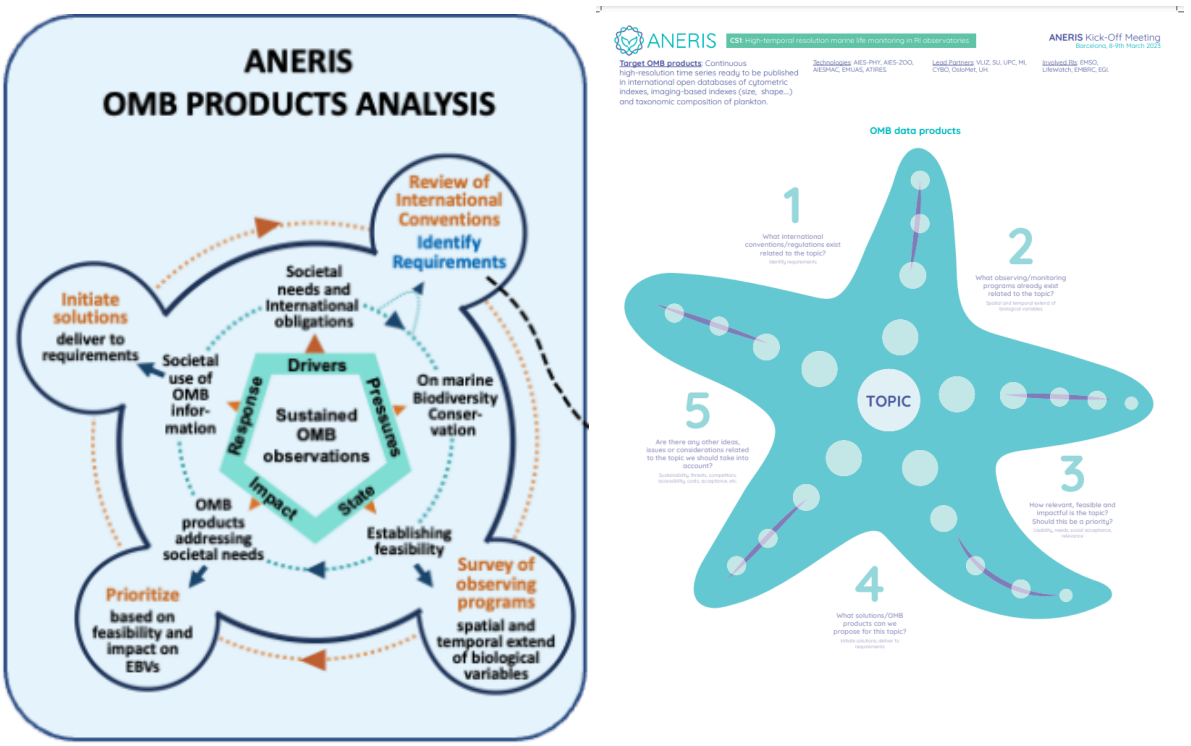

Figure 2: *ANERIS OMB products analysis and the work map*

The topics that were addressed in each of the groups were the following:

- Case study 1: Invasive species and Imaging for phytoplankton, zooplankton and macrofauna
- Case study 2: Species diversity, non-indigenous species, technology and Intraspecific genetic variation
- Case study 3: Seasonal presence/absence of species
- Case study 4: Invasive species, Zooplankton monitoring for climate change, ecosystem productivity, Imaging + Genomics in school and Harmful Algal Blooms monitoring.

Some general answers from this section were the following:

1. **Identify requirements.** OSPAR, MSFD, EU List of Invasive species, Convention on Biological Diversity (CBD)
2. **Spatial and temporal extent of biological variables.** OSPAR national and EU monitoring programs, NISKIN, ARMS, GBIF, EMOBON, Citizen Science initiatives
3. **Usability, needs, social acceptance, relevance.** Discovering new species, monitoring invasive species, biodiversity tourism, coastal restoration programs, maximizing monitoring capacity and combine strengths
4. **Initiate solutions; deliver to requirements.** Time series of biologic data, maps of invasive species, complement Lab data with in-situ data, Alert and early warning systems for invasive species, validation of imaging data with genomics as a service.

5. **Sustainability, threats, competitors, accessibility, costs, acceptance, etc.** Time resolution has to be adapted for different stakeholder, large amount of data involves storage strategies, keep citizens and community involved, consider the long-term continuity after the project ends,

<u>The full list of outputs from this part is available in Annex 2.</u>

Figure 3: *Case studies*

After this first part, the different groups worked on getting more specific about one OMB product they selected. Following the structure of a mermaid, this part asked about the following questions:

- **What are the needs and goals we want to address? What impact(s) do we seek to achieve?**
- **Who is our target audience?**
- **What technologies should we include in the OMB?**
- **Requirements of Minimum Viable OMB (MVOMB)**

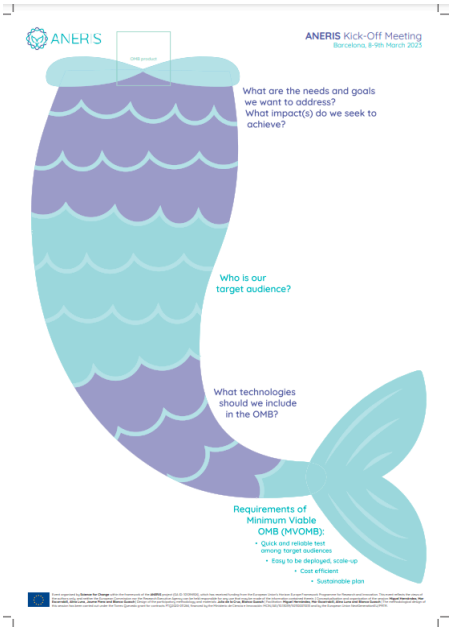

Figure 3: *Second map of the session, focusing on the OMB products identified previously*

The targeted OMB product for each of the case studies was:

- Case study 1: **Time Series of species / taxa occurrence traits: size, shape, etc.**
- Case study 2: **A set of map(s) related to Non-Invasive Species, Biodiversity loss and biodiversity**
- Case study 3: **Inventory maps**
- Case study 4: **Identification of species that are indicators of good or bad conditions in the environment.**

For each case study the main outputs of this part are included in the ANNEX 3.

2.2 Second dynamic: Developing different OMB Data products

This last dynamic focused on the information flow that each case study will have in order to implement the OMB data products, through the sequential phases of Acquisition, Validation, Curation and Interpretation and Dissemination, and also including the transversal phase of training. The work-map is shown in Figure 4.

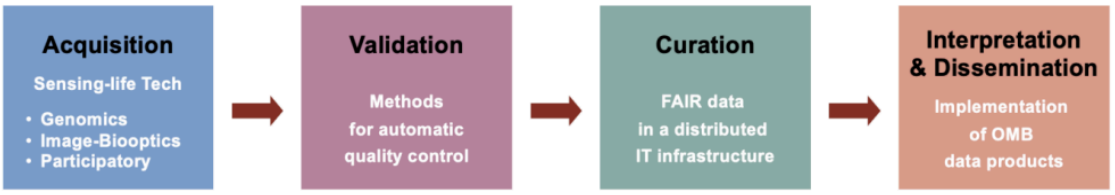

Figure 1 *The Operational Marine Biology (OMB) information flow will be based on an* ***automatic pipeline of information production****, from acquisition to interpretation and dissemination*

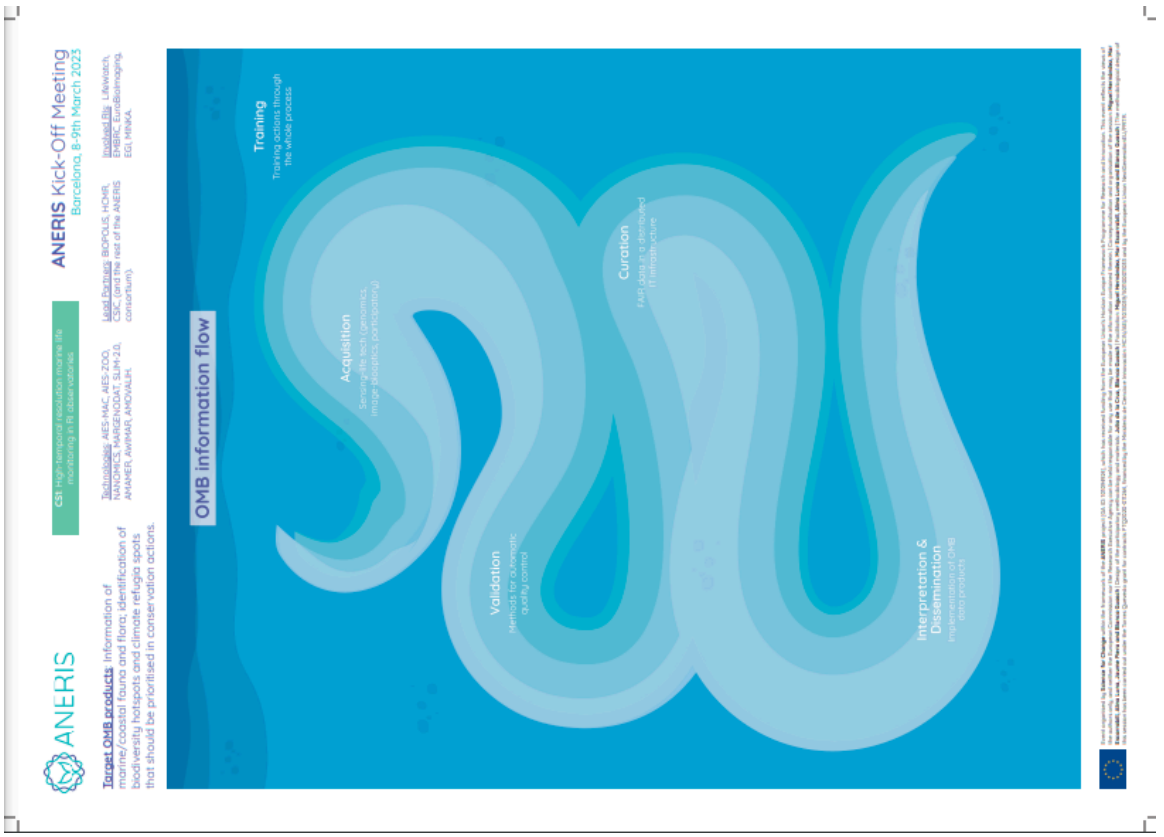

Figure 4: *Third map of the session, based on the OMB information flow scheme*

In this part some selected contributions are the following:

- **Acquisition:**
  - Address the problem of fouling in imaging technologies through quality control,
  - create protocols for collecting data,
  - use of water cameras or water cases for smartphones,
  - technology of data sensors
- **Validation:**
  - use of calibration objects,
  - provide confidence intervals,
  - assess the data pipelines already existing by the consortium,
  - usage of Hybrid IA and collaborative validation and,
  - automated assessment of quality.

- **Curation:**
  - Associate the metadata and the processing info in the OMBs, making it FAIR and publicly available,
  - upload data to global repositories and
  - promote standards and common ontologies and vocabularies.
- **Interpretation and dissemination:**
  - awareness of the technologies among researchers,
  - make maps open and supply data to other spaces (GBIF, MINKA),
  - adapt the tool to different communities and create relations with other projects (ProBleu).
  - Politicians want bioindicators to be like traffic lights
- **Training:**
  - Service of RIs for mentoring how to implement the technologies
  - Manual of curation by partners
  - Workshop about technology development within ANERIS inviting experts to discuss about it
  - Minimize training by automating and simplifying.

Table 2: *Details of the co-design session the 9th of March*

Title	General brainstorming on OMBs
Objective(s)	1) Identify the OMB products that can appear from the CS and define them taking into account the stakeholders involved and the current framework 2) How to implement the OMBs and brainstorm the information flow that should follow
Duration	3h
Number of participants	50
Number of groups	4
Link to the Miro Board	https://miro.com/app/board/uXjVMd0cfdY=/
Link to the PDF	ANERIS 230314 – Digitalization Maps Ko…

Acknowledgements

Conceptualisation and organisation of the session: **Miguel Hernández, Mar Escarrabill, Alina Luna, Jaume Piera and Blanca Guasch (PhD)** | Design of the participatory methodology and materials: **Julia de la Cruz, Blanca Guasch (PhD)** | Facilitation: M**iguel Hernández, Mar Escarrabill, Alina Luna, Jaume Piera, Karen Soacha, Sonia Liñán, Ana Álvarez, Xavi Salvador and Blanca Guasch (PhD)** | Logistics: **CSIC, SfC and FECDAS team**

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ANNEX 1: Outputs from the session: Starfish map on brainstorming OMB products

Table 1: *Details of the co-design session in the 8th of March*

Question	Inputs
What international conventions/regulations exist related to the topic?	• OSPAR • MSFD • HAB'S 2 Food safety monitoring • BALLAST WATER MANAGEMENT CONVENTION • HELCOM • EU LIST OF INVASIVE SPECIES • Biodiversity strategy 2030

	● WATER FRAMEWORK DIRECTIVE (WFD) ● MARINE STRATEGY FRAMEWORK DIRECTIVE (MSFD) ● MARITIME SPATIAL PLANNING (USP) ● CONVENTION ON BIOLOGICAL DIVERSITY (CBD) ● CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF WILD FAUNA & FLORA (CITIES) ● INSPIRE DIRECTIVE. ● EUROPEAN GREEN DEAL ● EU BIODIVERSITY STRATEGY
What observing/monitoring programs already exist related to the topic?	CS1 ● OSPAR NATIONAL AND EU MONITORING PROGRAMS Eg, Atla Sea in France ● SonLIT ● ECOLOGICAL IMPACT STUDIES CS2 ● Atlantic intertidal monitoring ● NISKIN ● ARMS ● SEDIMENT SAMPLES OPEN OCEAN (NORCE) CS3 ● Europe OBIS ● GBIF ● Worms CS4 ● CITIZEN SCIENCE INITIATIVES ● EURO BioImaging ● EMOBON ● EMBRE ● MARS
How relevant, feasible and impactful is the topic? Should this be a priority?	CS1 ● DISCOVERING NEW SPECIES ● COASTAL RESTORATION PROGRAMS ● TURISM ● ECOLOGICAL IMPACT STUDIES (RENEWABLE ENERGIES) ● INDUSTRY - AQUACULTURE CS2 ● SOCIAL ACCEPTANCE DEPENDING OF THE SPECIES AND THE IMPACT OF THE INVASION ● SOCIAL ACCEPTANCE DEPENDING OF THE ECONOMIC SECTOR IMPACTED ● ENDANGERED SP ● INVASIVE SP

	● CLIMATE CHANGE CS3 ● EDUCATE PEOPLE AND CREATE COMMUNITY ● Biodiversity tourism - Sense of belonging ● create Community ● Need of restoration CS4 ● EXPLORE COMPLEMENTARITIES ARISING FROM THE COMBINED USE OF THE TECHNIQUES ● DEVELOP THE TECHNICAL COLLABORATIVE INTERFACE ● MAXIMIZING MONITORING CAPACITY ● SUPPORTING MULTIPLE POLICIES ● COMBINE STRENGTHS FROM BOTH METHODS FOR BETTER BIODIVERSITY ASSESSMENT.
What solutions/OMB products can we propose for this topic?	CS1 ● DETECTION OF SPECIES FOR FURTHER (GENOMIC) ANALYSIS . ● CAMERA WITH TIMELAPSE CAPABILITIES AND AI. ● TIME SERIES FOR PHY ZOO MACRO ● FEATURE OF THE PRODUCT : COMPLEMENT LAB DATA WITH ON SITU DATA CS2 ● NEW NETWORK OF DECENTRALIZED MONITORING FOR THE EXISTING MONITORING PROGRAMS ● FUSION MATERIAL FOR GENERAL AUDIENCE ● INTEGRATE IN THE APPROACH OF CITIZEN SCIENCE ● MAPS OF INVASIVE SPECIES ● 'MAPS OF GENETIC VARIATION FOR SOME SPECIES =>FISHERIES' ● HOTSPOTS FOR BIODIVERSITY LOSS CS3 ● Dashboards oriented to special species ● Alert system ● Guides per zone and species ● WATER QUALITY INDICATORS ● ALERT & EARLY WARNING SYSTEM (INVASIVE) CS4 ● VALIDATION OF IMAGING DATA WITH GENOMICS AS A SERVICE ● TIME SERIES OF BIODIVERSITY DATA ● Combine high temporal / spatial Resolution with accurate identification
Are there any other ideas, issues or considerations related	CS1 ● TIME RESOLUTION HAS TO BE ADAPTED FOR

to the topic we should take into account?	DIFFERENT STAKEHOLDER. ● Different end- users, different strategies to make the product useful ● LARGE AMOUNT OF DATA →Storage strategies ● Spatial coverage CS2 ● FOR ALL TOPICS: NAGOYA ABS CS3 ● CLUBS / NGO , COMMUNITIES Visibility (RATHER THAN INDIVIDUALS) ● Training to use MINKA ● IF you promote the community it works by itself ● KEEP IN MIND THE USERS AND CITIZENS ● Continuity after the project CS4 ● RIs, LEGAL ENTITIES WITH LONG-TERM FUNDING TO GUARANTEE SUSTAINABILITY BY OPERATING THE PRODUCTION/PROMOTION OF OMB PRODUCTS ● FOR Ai TO EXISTING TECHNOLOGIES RECOGNISE SPECIES YOU NEED A LOT OF DATA ● ENV DNA IN WATER REMAINS APPROX 2 DAYS ● PROBABLY THE WAY FORWARD WOULD BE TO START FROM THE TWO ENDS OF THE PROCESS: 1) LOOK AT THE REQUIREMENTS OF THE POLICIES LEGISLATION 2) LOOK WHICH OF THE ATTRIBUTES OF THE CURRENT PRODUCTS CAN CONTRIBUTE TO ADDRESSING OF THE ABOVE POLICIES / LEGISLATION 3) PUT SCIENTIFIC , AND TECHNICAL TEAMS TO DESIGN: MAPPING OF SCIENTIFIC STEPS TO CREATE THE OMB PRODUCTS AGAINST EXISTING TECHNOLOGIES

ANNEX 3: Outputs from the session: Mermaid map on addressing OMB products

Case study 1: High-temporal resolution marine life monitoring in RI observatories
Technologies: AIES-PHY, AIES-ZOO, AIESMAC, EMUAS, ATIRES. Lead Partners: VLIZ, SU, UPC, MI, CYBO, OsloMet, UH.

Involved RIs: EMSO, LifeWatch, EMBRC, EGI. Target OMB products: Continuous high-resolution time series ready to be published in international open databases of cytometric indexes, imaging-based indexes (size, shape....) and taxonomic composition of plankton.	
OMB product	• Time Series of species / taxa occurrence traits: size , shape , etc.
Needs and goals	• BETTER UNDERSTANDING OF THE ECOSYSTEM • FIND SOLUTIONS FOR THE LONG TERM • CREATE A MODEL TO LINK THE THREE MONITORING METHODS
Target audience	• EMUAS → Citizens • Industry, aquaculture
Technologies	• AI technologies • Diff. tech at different stages TRL 0 to 9
Minimum viable requirements	• INCLUDE CONFIDENCE LEVELS TO THE DATA COLLECTED • RELIABLE DATA • CALIBRATION - Standards for Traits data • ECONOMICAL ASPECTS → Low-cost MAINTENANCE

Case study 2: Improved spatial and temporal resolution of marine life monitoring based on genomics	
Technologies: NANOMICS, MARGENODAT, SLIM-2.0. Lead Partners: HCMR, VLIZ, NORCE. Involved RIs: LifeWatch, EMBRC, EGI. Target OMB products: A set of indicator maps for species diversity, intraspecific genetic variation and non-indigenous species occurrence.	
OMB product	• A SET OF MAP(S) RELATED to NIS DISTRIBUTION, BIODIVERSITY LOSS and BIODIVERSITY MAPS
Needs and goals	• MORE BIODIVERSITY DATA AGGREGATED AND UNDERSTANDABLE • IMPROVED SPATIAL AND TEMPORAL RESOLUTION • IMPROVED KNOWLEDGE AND DECISION-MAKING

	ABOUT BIODIVERSITY
Target audience	• SCIENTISTS • CITIZENS • DECISION MAKERS* • IN CONTEXT OF NATURAL PARKS, ETC. • NATURAL PARKS ETC • *FISHERIES . • *POLITICAL SECTOR ? •
Technologies	• - NANOMICS → COLLECT • - MARGENODAT → BUDGE • - SLIM 2.0 • PROTOTYPE OF EACH TECHNOLOGY TRL 5 TO TRL 7 • IT IS VERY EXPENSIVE TO THINK IN OTHER SEQUENCING DATA •
Minimum viable requirements	• ->COLLECTION AND HANDLING OF THE SAMPLE • -> STORE • -> MAKING IT ACCESSIBLE • PLATFORM FOR VISUALIZING THE MAP INTERACTIVE • SUM 20. • --> SIMILAR TO NANOMICS • A MIX OF 1) BIODIVERSITY MATRIX 2) RELATIVE ABUNDANCE • RAW DATA -->TRAINING • NANOMICS - BIOIMAGING ->CBIS ->* GBIF • -RAW DATA -> gen bank ->PROCKOP • COLLECTION OF THE SAMPLE: GUIDES FOR PEOPLE

Case study 3: **Large scale marine participatory actions (bio blitzes)**
Technologies: ATIRES, AIES-BEN, AMAMER, AWIMAR, AMOVALIH. Lead Partners: CSIC, Quanta, Marsbased, Dribba, HCMR, BIOPOLIS, MedCities, FECDAS. Involved RIs: LifeWatch, EOSC, EGI, MINKA.

Targeted OMB products: Seasonal maps of species occurrences with special focus on threatened and alien/invasive species.	
OMB product	• Inventory maps
Needs and goals	• EARLY WARNING SYSTEM • Bioindicator species • REGULAR MAPS OF PRESENCE /ABSENCE
Target audience	• POLICY MAKERS • SCIENTISTS • ENVIRONMENTAL NGOs • GENERAL PUBLIC • MEDIA, INFLUENCERS
Technologies	• Water cameras • Sound recording • AWIMAR • Smartphones in underwater cases • Artificial Intelligence
Minimum viable requirements	• Minimum participation

Case study 4: **Merging imaging and genomic information in different monitoring scenarios**	
Technologies: AIES-MAC, AIES-ZOO, NANOMICS, MARGENODAT, SLIM-2.0, AMAMER, AWIMAR, AMOVALIH. Lead Partners: BIOPOLIS, HCMR, CSIC, (and the rest of the ANERS consortium). Involved RIs: LifeWatch, EMBRC, EuroBioImaging, EGI, MINKA. Target OMB products: Information of marine/coastal fauna and flora; identification of biodiversity hotspots and climate refugia spots that should be prioritised in conservation actions.	
OMB product	• IDENTIFY SPECIES THAT ARE INDICATORS FOR GOOD OR BAD CONDITIONS IN THE ENVIRONMENT EXAMPLE : ABUNDANCE OF SPECIE X is A SIGN OF BAD WATER QUALITY • PENDING: DECIDE iN WHICH SPECIES TO FOCUS OR which TAXA ZOOPLANCTON ?

	PHYTOPLANCTON ? - ....?
Needs and goals	• Provide information to politicians and decision-makers • Empower citizens • FACILITATE THE WORK OF PEOPLE IMPLEMENTING POLICIES • GIVE METRICS TO DECISION- MAKERS , WATER FRAMEWORK DIRECTORS ASSESS QUALITY OF WATER • Increase spatial or Temporal resolution
Target audience	1. Policy MAKERS / Policy IMPLEMENTORS → Create and implement policies 2. ENVIRONMENTAL AGENCIES STUDENTS, RESEARCHERS CITIZEN SCIENTISTS → Obtain the data 3. CITIZENS → Be aware
Technologies	• AT THIS LEVEL ALL TECH. COULD BE ELEGIBLE. NEED TO SEE AT WHAT LEVEL AND HOW • NANOMICS SLIM 2. 0 MARGENODAT • AMOVALIH • CHECK THIS PAPER (useful for all OMBs) The 10-tenets for integrated, successful and sustainable marine management
Minimum viable requirements	• SERVICES MAY HAVE DIFFERENTS INTERFACES FOR DIFFERENT USERS • OUTPUT INFO SHOULD BE EASY TO UNDERSTAND DIGEST FOR NON - TECH PEOPLE • EASY TO LEARN • ADDITIONAL VALUE AGAINST THE PRODUCTS THAT ALREADY EXISTS'

ANNEX 3: OMB Information Flow workshop

Case study 1: High-temporal resolution marine life monitoring in RI observatories	
Acquisition Sensing-life tech (genomics, image-biooptics, participatory)	• Video and photo better for CS • Photos can be done at night • Imaging problem: Fouling • QUALITY CONTROL AT ACQUISITION LEVEL FOR

	FOULING ● FLOW REPOSITORY " database of flow cytometry"
Validation. Methods for automatic quality control	● QUAREP - LiMi - microscopy image data + GENERIC QUALITY METRICS FOR IMAGES. ● CALIBRATION OBJECT (COLOR CHECKER) ● Size checker = KNOWN PATTERN DISPLAYED in front OF THE CAMERA UNDERWATER ● PROVIDE CONFIDENCE INTERVALS OF THE OMB
Curation FAIR data in a distributed IT infrastructure	● Bioimage Archive REPOSITORY FOR BIOLOGICAL IMAGES ● MAKE IMAGES PUBLICLY AVAILABLE ● ASSOCIATE THE METADATA AND THE PROCESSING INFO WITH THE OnBS
Interpretation & dissemination Implementation of OMB data products	● Awareness of the technology among the researchers ● CREATE THE BASIS OF A BIOLOGICAL MODEL FOR A SPECIFIC ECOSYSTEM ● THE DATA (open) could be used as a training set for their trainings in deep learning or machine learning ● RAW DATA (dissemination addressed to scientists)
Training actions through the whole process	● ZOOPLANKTON AND PHYTOPLANKTON NEED SPECIFIC TRAINING (MANUFACTURER) ● PROVIDE REFERENCE DATASETS OF CLASSIFICATIONS FOR THE GENERAL PUBLIC ● STANDARDS FOR TRAITS (LOOK FOR OTHER FIELDS (Plants/animals) STANDARDS AS WELL ● SERVICE OF RIs FOR MENTORING HOW TO IMPLEMENT THE TECHNOLOGIES

Case study 2: Improved spatial and temporal resolution of marine life monitoring based on genomics	
Acquisition Sensing-life tech (genomics, image-biooptics, participatory)	● NEW DATA ● PROTOCOL FOR COLLECTING DNA ● WORKSHOPS PROTOCOL/ calls / ANALYSIS FOR COLLECTING DATA ● 1) PROCOL INVOLVING OTHERs DEPENDING OF THE SAMPLE ● 2)PEOPLE ENGAGEMENT CREATE AND COMMUNICATE

	• 3) COLLECTING DATA
Validation. Methods for automatic quality control	• EXPLOITING EXISTING DATA --> GENBank • SLIM 2.0 PIPELINE EXIST TO ASSES • **PIPELINE EXIST.** NANOMICS NEED TO BE ASSESSED BY THE CONSORTIUM
Curation FAIR data in a distributed IT infrastructure	• MAKING FAIR EXCEL SHEET -METADATA SEQUENCE -METADATA PIPELINE MARGENODAT
Interpretation & dissemination Implementation of OMB data products	• MAKE THE MAP OPEN & CONNECTED TO MINKA? • SUPPLY ANERIS DATA IN AN OPEN PLATFORM - GBIF • NEW SPACE FOR THE MAPS
Training actions through the whole process	• TRAINING PROGRAM BASED ON THE PROTOCOL " SELECTED " • Manual of Curation by partners

Case study 3: **Large scale marine participatory actions (bio blitzes)**	
Acquisition Sensing-life tech (genomics, image-biooptics, participatory)	• Water cases • Water cameras • Citizen own camaras • Recorders
Validation. Methods for automatic quality control	• Hybrid artificial intelligence • Collaborative validation
Curation FAIR data in a distributed IT infrastructure	• personal local backup • global repositories
Interpretation & dissemination Implementation of OMB data products	• videos = map = graphic infographics • reach general public (AWARENESS RAISING EVENTs) • facilitate the Information to: NGOs schools "communities" • Public presentations • Adapt the tool to different communities: in different languages • guide physical maps • Social media ex. tik tok

	• webinars events • Create relations with other projects like ProBleu
Training actions through the whole process	• Training workshop Basic concepts of AI for image Analysis • Workshop about Technology develop within ANERIS Inviting Experts to discuss it

Case study 4: **Merging imaging and genomic information in different monitoring scenarios**	
Acquisition Sensing-life tech (genomics, image-biooptics, participatory)	• TECHNOLOGY DATA SENSORS • SAMPLING RAW DATA • HARDWARE • SOFTWARE
Validation. Methods for automatic quality control	• AUTOMATED ASSESSMENT OF QUALITY • QA/QC TO BE DEFINED • CROSS / COMBINE/ BUILD ON VALIDATION METHODS OF THE 2 TECHS ?
Curation FAIR data in a distributed IT infrastructure	• STANDARDS AND COMMON ONTOLOGIES / VOCABULARIES • FAIR DATA -->FAIR SERVICES RAW DATA PRESERVED BUT NOT READILY AVAILABLE FOR SERVICES
Interpretation & dissemination Implementation of OMB data products	• CONVERSION OF RESULTS INTO KNOWLEDGE (AUTOMATED SERVICES) • MAPS , CONTOURS STATISTICS (E.G . WATER QUALITY) • EX : POLITICIANS WANTS BIOINDICATORS TO BE LIKE GREEN / RED LIGHT • FIND EASY WAYS TO INTERPRET DATA
Training actions through the whole process	• - HANDS- ON WORKSHOPS • WEBINARS • GUIDELINES (USER GUIDE / MANUAL) • 'RESEARCHERS • POLICY-MAKERS ON INTERPRETATION' • SUITE OF EDUCATION SERVICES • MINIMIZE TRAINING BY AUTOMATING / SIMPLIFYING

Identification of necessities for co-design activities in genomic technologies

Author: Miguel Hernández (SfC)

30/06/2023

Introduction and context

During M6 of the project, three internal co-design activities were carried out internally in the framework of Task 2.1 ,with the title *Identification of necessities for co-design activities in genomic technologies*. Each of the three was focused on one technology, with the objective of brainstorming and shaping the future co-design activities in Genomic Technologies on WP2. Being more specific, the goals were to firstly, identify which key aspects want to be further explored through co-design, find stakeholders that can help achieve those goals and select in which stages of the design process we will want to involve the stakeholders.

Given that, three main questions guided the exercise:

1. **What issues do you face regarding your technology?**
2. **Which stakeholders would you like to involve to try to find a solution for the issues previously identified?**
3. **Given the prioritized issues, In which stage(s) of the development would you like to involve the stakeholders you have prioritized before? What do you need from them and which information you'd like to get?**

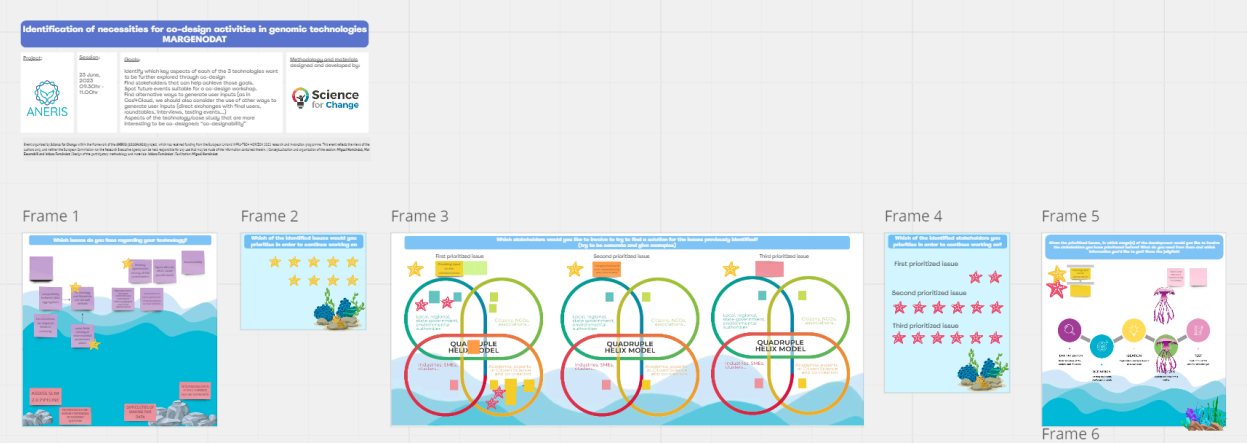

Figure 1: *Screenshot of the Miroboard used.*

Table 1. *Available links of the different sessions*

Technology	Date	Miro link	Recording
NANOMICS	09/06/2023	https://miro.com/app/board/uXjVMDzkHQ4=/?share_link_id=928770267056	https://drive.google.com/file/d/1sCmXUEmalNoiV05wB_NPDRILyeWcX3kt/view?usp=drive_link
SLIM 2.0	14/06/2023	https://miro.com/app/board/uXjVME3-reY=/?share_link_id=109562269498	https://drive.google.com/file/d/1mmAlO5TA93jJC1BjtHerHXefAL665uaT/view?usp=drive_link

MARGENODAT	23/06/2023	https://miro.com/app/board/uXjVM-hYNSM=/?share_link_id=714520953582	https://drive.google.com/file/d/1XD-UbfdVao6tsoA-RKs2Vd910UkPx0ad/view?usp=drive_link

Outcomes of the sessions

NANOMICS

Which issues do you face regarding your technology and the data you generate? (Prioritized options are underlined)

PROTOCOLS for sampling:

- Protocols need to be adjusted to the study system (intertidal, water samples, sediments). How do we make sure they are comparable? (***)
    - Protocols to be tested for different genomic methods and different communities
    - Contamination while handling samples (*)
- little research so far with the technology - more difficult to choose the right protocol/data analysis
- access to sampling equipment, boats. depending on the type of data you want
- Collection and handling of the sample
- NO PROTOCOLS ARE VARIABLE DEPENDING OF SCIENTIFIC

DNA LIBRARIES

- DNA libraries still lacking many taxa - decreases power of detection (***)

DATA MANAGEMENT

- Data harmonization and centralization (**)
- Big data management and FAIRness
- DIFICULTIES OF MAKING FAIR DATA
- FIND WAYS TO DIGEST AND DISPLAY THE DATA

OTHERS:

- Lack of communication between the stakeholders

Which stakeholders would you like to involve to try to find a solution for the issues previously identified? (Prioritized options are underlined)

1st prioritized issue (PROTOCOLS):

- **Governmental authorities:** Water Framework directive, Ocean Best practices from UNESCO
- **Citizens, NGOs, associations:** Natuurpunt, engaged citizens, look for available protocols from projects already using nanopore & citizen sciencee.g. wilderlab.co.nz UNESCO eDNA
- **Academia:** Rbins, OBON: Ocean Biomolecular Observation Network (UN Ocean Decade action), EMBRC stations are interested in protocol development (e.g., VLIZ and HCMR in ANERIS)
- **Industries:** Ilumina, Oxford nanopore

2nd prioritized issue (DNA LIBRARIES):

- **Governmental authorities:** N/A
- **Citizens, NGOs, associations:** N/A
- **Academia:** Rbin, other EU projects focused on barcoding: BGE, Horizon EU project: DNAqua-lib (starting in Oct 23), ENA EMBL-EBI, PR2 database
- **Industries:** N/A

3rd prioritized issue (Data harmonization):

- **Governmental authorities:** EMODNET, GBIF, OBIS, Ocean Best practices (UNESCO)
- **Citizens, NGOs, associations:** N/A
- **Academia:** EU project MARCOPOLO, EMOBON, OBON: Ocean Biomolecular Observation Network (UN Ocean Decade action), VLIZ Open Science Team
- **Industries:** N/A

Given the prioritized issues, In which stage(s) of the development would you like to involve the stakeholders you have prioritized before? What do you need from them and which information you'd like to get?

1st prioritized issue (PROTOCOLS):

- Citizens→ Emphatization and Testing
- Academia → Definition and prototyping

2nd prioritized issue (DNA LIBRARIES):

- Academia → Definition

3rd prioritized issue (Data harmonization):

The academia in this case was differentiated in two fields: genomics and data scientists.

- Genomic scientists → Emphatization and definition

- Data scientists → Testing

SLIM 2.0

Which issues do you face regarding your technology and the data you generate? (Prioritized options are underlined)

- Integration with GBIF and similar infrastructures
- Testing of the new developments with final users

Which stakeholders would you like to involve to try to find a solution for the issues previously identified? (Prioritized options are underlined)

1st prioritized issue (Integration with GBIF/Integrate sequenced data with species data):

- **Governmental authorities:** EMOBON
- **Citizens, NGOs, associations:** N/A
- **Academia:** Link with GBIF (Pascal from VLIZ), Research centers that do metabarcoding+omics
- **Industries:** startups

2nd prioritized issue (Testing of functionalities of SLIM 2.0):

- **Governmental authorities:** N/A
- **Citizens, NGOs, associations:** Associations
- **Academia:** Research centers + universities that do omics
- **Industries:** Startups interested on the technology

Given the prioritized issues, In which stage(s) of the development would you like to involve the stakeholders you have prioritized before? What do you need from them and which information you'd like to get?

1st prioritized issue (Integration GBIF or similar):

- All stakeholders → TESTING
  - Test the internal pipeline for producing maps in the project
  - There is already something and that we are already in the testing phases

MARGENODAT

Which issues do you face regarding your technology and the data you generate? (Prioritized options are underlined)

- Terminology and standards are not well defined
  - Compatibility among data aggregators
  - No consensus on required fields in archiving
  - Some fields missing to store essential provenance values
- Finding agreements among all stakeholders
  - Who do what, avoid parallel work
  - Many stakeholders working at sometimes slow speed and at different geographic scales (local, regional, global)
  - Dependent on third parties for implementation outside ANERIS
- Sustainability

Which stakeholders would you like to involve to try to find a solution for the issues previously identified? (Prioritized options are underlined)

1st prioritized issue (Providing input on the standardization):

- **Governmental authorities:** OBIS-UNESCO
- **Citizens, NGOs, associations:** Taxonomic backbone (e.g. WoRMS)
- **Academia:** EU projects (eDNA-Aquaplan) for the overview of the standards, other experts consutations
- **Industries:** N/A

*In this case ANERIS is located in the center, designing the tool and promoting its implementation

Given the prioritized issues, In which stage(s) of the development would you like to involve the stakeholders you have prioritized before? What do you need from them and which information you'd like to get?

1st prioritized issue (Providing input on the standardization):

- All stakeholders → PROTOTYPING & TESTING
  - There is not that much freedom at the initial phases of design

Future steps

➔ **Start with the ideation and organization of specific co-design workshops focused on the challenges and stakeholders identified.**

Once we have identified the main challenges and stakeholders, the next steps are to start ideating and organizing the activities that will help us obtain the key information that we need in that respect. In the next few months, our energies should be centered into that task.

For NANOMICS, a workshop dedicated to the definition and/or prototyping of sampling protocols with experts can be an interesting option. Also, understanding the point of view of citizens could be another important task where co-design activities can help. Another option that can be considered is the definition of DNA libraries with academic experts. Meanwhile, for the other two technologies (SLIM 2.0 and MARGENODAT), a good approach could be to prepare a testing event with key stakeholders, such as GBIF representatives, EMOBON and also EU projects related to the topic. The objective of this event should be to align the different points of view and avoid duplication of efforts.

➔ **Find alternative ways to generate inputs from stakeholders and register them!**

Direct exchanges with final users, roundtables, questionnaires, interviews or other informal events can be very useful to obtain valuable information for our research. In previous projects those other methods also served for developing technologies more aligned with the final user needs.

➔ **Explore the possibilities of collaborating with other Work Packages which can have similar necessities.**

The exercise of understanding the issues and necessities of each technology just have started, and there will probably be some common issues in other technologies in the project. Furthermore, the ANERIS project has 25 partners, most of them with several international connections. Probably, we can join efforts in ways that we have not even thought about.