Underlying models for the European Digital Twin Ocean

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EDITO
ModelLab

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Introduction

The EDITO-MODEL Lab Advisory Board (AB) aims at providing the consortium with independent review of project goals and achievements and the provisioning of advice on the best paths for impact and society uptake of project deliverables. This Board includes several external independent thematic experts with specific skills on ocean and coastal modelling, on IT infrastructure and with connection with Copernicus, EMODnet, EOSC, Joint Research Centre or Destination Earth.

Experts part of the Project AB cover a large spectra of activities:
- B. Chapron (Observations, IFREMER, FR),
- J. Piera (Citizen science, CSIC, ES),
- F. Jourdin (AI, SHOM, FR),
- A. Oliveira (Coastal, LNEC, PT),
- A. Rocha (ILIAD, model interoperability, INESC TEC, PT),
- S. Garavelli (EOSC, FAIR data, CSC, FI),
- D. Macias Moy (JRC, EU (Modelling)),
- F. Courteille (AI, NVIDIA, UK).

F. Courteille from NVIDIA became a member of the AB following the exit of Partner 14. NVIDIA, to maintain its specific skills and expertise in the Project.

In 2023, within the first year of the Project, the members of the AB have been closely associated to key Project meetings where they shared their views on the Project developments and provided their recommendations to guide the Project upcoming activities:

- **Kick-Off Meeting, 21-22 February 2023, Toulouse (FR) (hybrid)**

The Kick-Off Meeting of the EDITO-Model Lab Project was organised in Toulouse, France, on 21-22 February 2023. The AB participated in-person and remotely and provided first feedback and watch-points following the presentation of the planned activities for each Work Package.

Figure 1: Kick-Off-Meeting, 21-22 February 2023

- **Meeting with Advisory Board, 18 July 2023 (remotely)**

A dedicated online meeting was organised on 18th July 2023 in order to present to the AB members the first six months´ developments of the Project and collect their feedback.

- **Co-design Review Meeting, 22-23 November 2023, Delft (NL) (hybrid)**

EDITO-Model Lab Co-Design Review was organized on 22-23 November 2023 at Deltares in Delft, The Netherlands, and remotely, gathering over 70 participants from the Project, its Advisory Board and external parties (23 representatives from EU and International initiatives: EDITO-Infra, ILIAD, ACCIBERG, ActNOW, CocliCo, DT-BIOFLOW, ECOSCOPE, ESiWACE3, NECCTON, Mission Atlantic, RESTCOAST, Destination Earth, Copernicus Marine Champion User Advisory Group, Early Career Ocean Professionals, and UN OceanPrediction DCC). The AB played an active role in this key meeting aiming at validating components crucial for the EDITO-Model Lab Technical Architecture, providing recommendations within each thematic Review sessions and chairing the final open discussion.
Minutes of the meeting and a dedicated News Article on EDITO-Model Lab website are available: https://edito-modellab.eu/news/edito-model-lab-wraps-up-co-design-phase-with-empowering-testers-rsquo-workshop

Figure 2: Co-Design Review, 22-23 November 2023

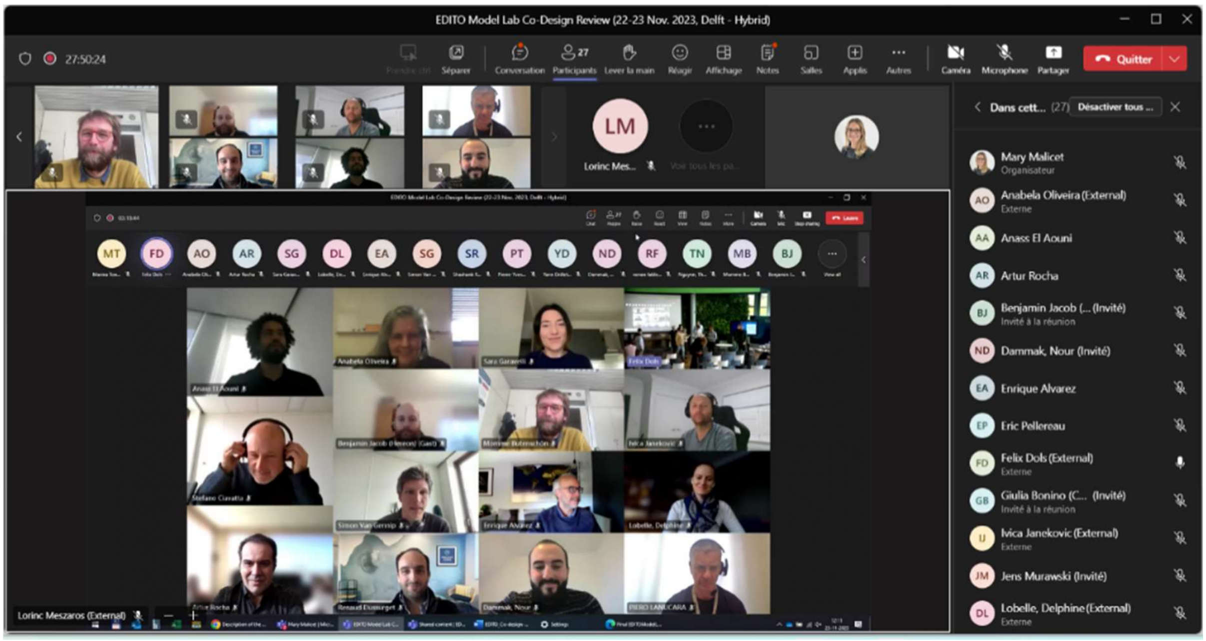

Figure 3: Co-Design Review, 22-23 November 2023

- **Annual General Assembly, 16-18 January 2024, Lecce (IT) (hybrid)**

The Annual General Assembly of the EDITO-Model Lab project was organized on 16-18 January 2024 in Lecce, Italy, and online. The AB reacted to the presentation of the Project's achievements in 2023 and upcoming plans for 2024, and took an active part in the User Sessions also involving external users (39 representatives of other EU projects and international initiatives) providing feedback on the Project first demonstrations.
Minutes of the meeting and a dedicated News Article on EDITO-Model Lab website are available: https://edito-modellab.eu/news/edito-model-lab-highlights-major-achievements-at-2024-general-assembly

Figure 4: General Assembly Meeting, 16-18 January 2024

During those meetings listed above, the members of the Advisory Board were able to react to EDITO-Model Lab Partners' presentations, by asking questions, providing comments, confirming relevance, suggesting possible improvements, identifying possible barriers and progress axes, etc. with regard to their own project/initiative and expertise, in the perspective of the co-development of the Digital Twin Ocean, and allowing EDITO-Model Lab to validate/refine/adapt upcoming activities of the Project.

The present deliverable D1.5 - First Annual Advisory Report for the first reporting period includes the compilation of the minutes of the meetings attended by the Advisory Board. This report enables the Advisory Board's recommendations and comments to be followed up at project level and the development plan to be adapted.

Deliverable D1.6 - Second annual Advisory Board Report due Month 24 (December 2024) will integrate the actions taken by the Project following the remarks collected in the present report.

1.KoM, February 2023 I AB first feedback

1.1 General comments

- Very ambitious, very valuable project
- Very competent consortium with all required expertise

- Wide scope of application and a tight timeline: need for a very stringent, time control strategy; need for a continuous adoption of success path (making sure that the flow of results is met, using existing/simplest approaches)
- Avoid modeling silos - need for a continuous communication between AI and several process-based model communities, and between model communities (sharing expertise, experiences, difficulties, tools)
- Reach out for the scientific/technical community - provide tools (code/interface/training) to allow for other models/other forcings/other application sites and problems to join
- CMEMS is nowadays the best example of community service that everyone uses and values - aim at reaching CMEMs acceptance level for EDITO model lab results

1.2 Concerns for model connections

- Atmospheric Inputs? ECMWF? How will users access those predictions? Will the possibility to use/upload higher resolution (regional/local) atmospheric predictions be available?
- Processes at the coast and inside estuaries/ Spatial resolution for coastal processes (a few meters necessary) - how will ww3 and circulation models interaction occur (automatic exchange procedure)? freshwater interaction and river prediction? Use AI models for river prediction (WP2)? Wave and current interaction at complex geometries (e.g. tidal inlets)? Should the context for EDITO model lab be focused at regional/coastal but away from wave breaking/intertidal flats areas?
- How will river flows forecasts be produced and how will generic plugs be developed to allow for relocatability (e.g. allow for an external river forecast input through Web service?)

1.3 Concerns on modeling tasks (WP3/WP4)

- Unclear how the several modeling teams will collaborate and take advantage of common bottlenecks – need for modeling forum meetings? Need for target goal definition and use these as experience exchange times?
- Risk of WP3: different models reach different levels of execution/maturity – impact on WP5/WP6/WP7
- WP4 – github and gitlab will not be enough – promote collaboration mechanisms between modelers (CD/CI mechanisms are mentioned in WP5)
- How will timelines between WP3 and WP4 occur? Will standard/existing model configurations be used for the common model environment (and guarantee that success is achieved at the end, even at less ambitious scale)?

- How will uncertainty (forcings, models parametrization,…) be taken into account in the several models/model framework?
- Can the five stage validation be done in a continuous way (for forecast purposes)?
- Will the final code available at gitlab/github be open? Very important for community uptake and following licenses from underlying model software?
- What standards and good practices will be adopted? For example, will CWL descriptions be produced?
- Which hybrid model integrations will be tested in task 4.2.1? Will intermediate results be available for community testing? If so how?
- Main tasks presented in WP3 consist in increasing spatial resolutions and nesting coastal models in physical models. These tasks are classic model developments: they may not be consistent with the general goal of the project which is to configure models and DDE (in terms of computerized adaptation) for a DTO representation of the ocean.

1.4 Concerns on WP5-6-7

- How to ensure interoperability? How will models be described so that they can be found? How to maximize model portability to a different computing environment?
- Relocatability of products/outcomes and how fast to deploy them elsewhere? How to build new coastal applications based on EDITO model core (users outside the team)? Will detailed IT/coastal modeling guides be build?
- Why do we have the HPC platforms outside the EDITO Infra in WP5 scheme? Would the connection to EuroHPC be also available at EDITO Infra or are we creating here a possibility for other computational resources providers (e.g. private ones like amazon and others?) This would create the possibility to handle sensitive applications.
- Will the results of WP6/7 demos be publicly available at the viewer interface? It is an important step towards the scientific community to recognize this work as reliable/accurate.
- Will the what-if scenario building generic and its building tool available for other applications in the future? Jupyter notebooks are fine for researchers and (some) consultants, not for coastal managers.

1.5 Opportunities for collaboration

- Possible starting points for ILIAD collaboration:
- On “processes interoperability”: WP5 to WP5 workshop (?) → How to deploy, under which conditions, using which standards?
- On Focus Applications (EML WP6) and What-if Scenarios (EML WP7): connection with marketplace (ILIAD WP6) and Pilots (ILIAD WP7)
- Task 6.4 (EML WP6) and Task 7.5 (EML WP7): capacity building (WP10)
- What about ANR MEDIATION “Developments for a robust and efficient DTO”?

2. Design of Model integration (AI and models) (WP2-WP3)

2.1 Summary of recommendations

2.1.1. AI-based Emulators for Ocean Modelling and Forecasting

Container-based architecture:
The AB recommends distributing DDEs as self-contained containers.

Differentiable programming on GPU:
To ease the development of differentiable accelerated kernels the Warp framework could be a tool to consider for generating differentiable GPU kernels.

DDE update policy and procedures:
As new data will be produced, acquired DDEs must be continuously updated to improve speed and accuracy: procedures and update policies have to be defined in accordance with WP4.

Considering Neural Operator in the neural network architectures:
Traditional Machine Leaning approaches such as U-Nets learn a map at a fixed resolution, where input and output are functions in infinite functional space. Neural operators generalize neural networks to overcome this problem. Rather than learning maps between finite-dimensional spaces, they learn an operator that can directly map one function to another, providing a discretization-invariant model.

Integration in EDITO software/Inference:
We recommend to discuss/plan asap with WP4 how the DDEs will/could be integrated in EDITO software (models,…).

Will the Neural Network models been directly integrated into the models for inferencing (with the TorchFort interface library for instance) or rely on an inference server architecture (with a specific interface API to be defined) to be designed and implemented (an example is the NVIDIA Nemo microservices) ?

2.1.2. Models for EDITO

KPI GPU port:
The AB recommends publishing periodically performance (GPU speed-up) and accuracy indices on reference cases used for the port.

Hackathon as an optimization booster:
Participation to a hackathon could be a good way to speed-up the GPU port.

WP3 T3.1 staffing

Because of the amount of work of T3.1-Improvement of next generation ocean models for EDITO (NEMO development with a mixed-precision version, the GPU port, Unstructured-grid models optimizations), the question of adequate staffing must be asked. To clarify this point, could it be possible to publish a dashboard with a finer detailed roadmap/tasks schedule for the second year, periodically updated?

2.2 Detailed feedback I AB Meeting #1 (July 2023)

Concerns for model connections

AB remark	EDITO Model Lab answer
Atmospheric Inputs? ECMWF? How will users access those predictions? Will the possibility to use/upload higher resolution (regional/local) atmospheric predictions be available?	*Important issue not fully solved, still issues with ECMWF operational forecast availability. First suggestion is to provide on EDITO global surface fluxes computed with the global system. (1/12° or 1/36° hourly fields) for downscaling.* *Atmospheric forecast will be internal product during development phase* *Action to check with ECMWF how real time atmospheric forecast could be disseminate in DestinE. Need for other DT?* *Access to other atmospheric forecasts to be defined during the design phase.* *Describe in the Data Management Plan.*
Processes at the coast and inside estuaries/ Spatial resolution for coastal processes (a few meters necessary) - how will ww3 and circulation models interaction occur (automatic exchange procedure)? freshwater interaction and river prediction? Use AI models for river prediction (WP2)? Wave and current interaction at complex geometries (e.g. tidal inlets)? Should the context for EDITO model lab be focused at regional/coastal but away from wave breaking/intertidal flats areas?	*Important comment, but perhaps not our first priority.* *We will describe in the design phase the different approaches adopted by each group/each model.* *Nothing is defined in EDITO to use emulator for river runoff, but we have to define what database will be available on EDITO and what are the projects that will work on this topic, link also with Copernicus Land. EMODnet will have a river product including the estuarine processes in the next year. If we identify the rivers needed we can influence the priority given to the implementation for these particular rivers.* *Currently is on a beta version. EMODnet data will be available on EDITO data lake*
How will river flows forecasts be produced and how will generic plugs be developed to allow for relocatability (e.g. allow for an external river forecast input through Web service?)	*River flow can be retrieved from existing datasets (e.g. ECFAS, GLOFAS? in EMODNET?). Then, coupling model with Estuary box model is planned for specific implementations.* *To force the EBM, the river-runoff input still needed. [EBM should be intended a 2-layer box model to compute the net release at river mouths and the salt wedge intrusion, but the upstream volume flux is necessary; EBM is not an hydrological model].*

Concerns on modelling tasks

AB remark	EDITO Model Lab answer
Unclear how the several modeling teams will collaborate and take advantage of common bottlenecks – need for modeling forum meetings? Need for target goal definition and use these as experience exchange times?	*Regular meetings in WP3 to exchange common bottlenecks and possible solutions. Co-design workshops between model developers (WP3) and model users (WP6-WP7) in the FAs-WiS.*
Risk of WP3: different models reach different levels of execution/maturity – impact on WP5/WP6/WP7	*Natural selection of models and several re-evaluation moments. The TRL for each model component will be consolidated during the design phase and only modeling component with TRL>7 will be used for the DEMO (FA and WiS). That will be defined in the Strategic Plan deliverable*
WP4 – github and gitlab will not be enough – promote collaboration mechanisms between modelers (CD/CI mechanisms are mentioned in WP5)	*We will promote the existence of the Virtual Lab from the beginning of the project.see discussion during KO meeting. GitHub or GitLab already include lots of functionnalities.*
How will timelines between WP3 and WP4 occur? Will standard/existing model configurations be used for the common model environment (and guarantee that success is achieved at the end, even at less ambitious scale)?	*The first tasks of the two work packages are taking place in parallel.*
How will uncertainty (forcings, models parameterization,…) be taken into account in the several models/model framework?	*Will be part of the integration path (T4.1). Uncertainty quantification will be applied in at least 1 FA/WiS. Quantification of uncertainty is one of the priorities for documentation and validation. Specific tasks are well identified in the project T3.4 Validation/calibration of models with satellite and in situ observations. T4.4 validation toolbox in VOML.*
Can the five stage validation be done in a continuous way (for forecast purposes)?	*Potentially nice and perhaps it can be adapted or recommended in one application but continous validation is not really essential.*
Will the final code available at gitlab/github be open? Very important for community uptake and following licenses from underlying model software?	*Yes, at the end of the project. Intermediate version of the code will be also available for the training and hackathon*

What standards and good practices will be adopted? For example, will CWL descriptions be produced?	*VOML will foster the best practices for software and model development including Common Workflow Language*
Which hybrid model integrations will be tested in task 4.2.1? Will intermediate results be available for community testing? If so how?	*Not yet confirmed. To be confirmed during the co-design workshop of the models. 3 Emulators identified as potential component for the demonstrator (Focus application and what if scenario) 1) Lagrangian trajectories 2) surface velocities 3) turbidity*
Main tasks presented in WP3 consist in increasing spatial resolutions and nesting coastal models in physical models. These tasks are classic model developments: they may not be consistent with the general goal of the project which is to configure models and DDE (in terms of computerized adaptation) for a DTO representation of the ocean.	*Priority is to optimize current models using the new platform and the new EuroHPC center. WP3 will answer to how we will use the current existing ocean models in a new environment including cloud computing, access to marine data lake, interoperability of model configuration in different EuroHPC centers and sequence of different models using an orchestrator*

During the meeting of 18th July, the AB also pointed out that the Project should make sure that atmospheric forcing (cf. ECMWF forecasting) is a dimension that is considered within the project's developments.

2.3 Detailed feedback l Co-Design Review (November 2023)

REVIEW Session 1 – Model Integration (WP2, WP3)

Discussion

Anabela Oliveira (AB) about Emulators: *"Which dimensions do you consider?"*
A: In EDITO we mostly focus on 2D but also some 3D and 4D field.

"Are you considering to allow the users to fine tune ML model parameters?"
A: There will be possibility to reproduce the exact same simulation (exact model) but also fine tuning will be allowed via configuration files.

"Is the turbidity emulator physics informed?"
A: We chose turbidity for several reasons (e.g. data availability and relevance). The emulator methodology is not physics informed at the moment (agnostic) but for 3D fields we will consider some physics information.

"Will WP2 developments allow users to find ML parameters ? "
A (Ronan Fablet, IMT): For time series yes. You can call the exact code. For turbidity: mostly agnostic (3D + time representation)
A (Yann Drillet, MOi): DTO can provide more flexibility in new products, on demand information ! (not done in Copernicus , so complementary to it)

Models and downscaling
Diego Macias (AB) about Modelling and downscaling:
"How do you deal with the connection between global and regional configurations? Is there any kind of ***two-ways nesting****?"*
A: Most of our applications are classical one-way nesting (downscaling). We have a two-way nesting example from DMI calibrated for a larger region (basin scale) using open data for an extended period and then users can set up coastal models (40-200m).

"How do you treat ***rivers in the regional configurations****? that is highly relevant for example in the context of What If scenarios."*
A: Some of the coastal configurations (e.g. SHYFEM and SCHISM) include estuaries to have a river-sea continuum along river branches.
Jun She: users can choose any subdomain (including rivers) and will be able to set up any combination of subdomains. Stress test done at high resolution, it takes 2 days .

"I appreciate the implementation of ***unstructured grids*** *in the configurations but do have an idea on how much* ***computationally demanding*** *this is w.r.t. more traditional grids? How do you plan to evaluate the added value of this type of grids?*
A: We don't have exact metrics yet, but we are planning to quantify the performance of the different configurations and grids. Remark of Miguel: We are confident that the infrastructure we have can handle the new high-resolution configurations.

"Do we include wave spectra? "
A: For global models we plan to save the wave spectra for a specific range in the coastal area to facilitate the downscaling (sub sampling). In CMEMS it is a key question to save the full spectra as additional variable.

"Can we include other models?
A: We are implementing capabilities for relocate-ability and trying to add other "downstream" models like oil spill models/ecological impact models, etc.

Francois Courteille (AB) about Emulators: *"Nvidia has an open framework called Modulus (https://developer.nvidia.com/modulus). We should have a look at it.*

" Emulators are used to speed up computation. They should scale on the various architecture. How do you make it possible? "

Relevant link provided by Lorinc Meszaros (Deltares)11:31
https://developer.nvidia.com/modulus: NVIDIA Modulus Neural Network Framework. NVIDIA Modulus is an open-source framework for building, training, and fine-tuning Physics-Machine Learning models with a simple Python interface.

Performance and resolution:
Ronan Fablet (IMT): The goal is not only to accelerate but also to have better representation of the processes (e.g. lagrangian dynamics). We already have a number of solutions that we know can scale to the required resolution for turbidity (e.g. daily, sub-kilometre for 2D). We have simplistic speed related KPI (80% reduction in speed).
Remark of Julien: The recent evolutions in the atmospheric science may not be replicated in the ocean sciences. Neural operators are the future (An application of neural operators for mapping satellite altimetry: https://arxiv.org/abs/2211.10444).
Remark of Nadia: we also gain performance in model building of traditional models, not only emulators.

Stefano Ciavatta (NECCTON project) about Emulators: *"NECCTON is using similar data assimilation methods for Arctic ocean colour. Would be nice to share methods."*
Yann Drillet (MOi): The tools we develop will be interoperable so that other projects can make use of it.

Goneri Le Cozannet (BRGM, CoCliCo project): Suggestion to collaborate on flood and water level modelling: *'It will be nice to be able to access data (water levels, currents,..)"*
Ivan Federico (CMCC): EML will provide data in this direction. For flooding, extreme events, water land, important for EML . Remark Miguel Castrillo: We continue working towards GPU (cf. Nemo,..)

Feedback on SLIDO Review Session 1:

***EMULATORS** : What are your suggestions regarding the emulators that will be developed during the project? Variables, resolution, domain?*

Jun She (DMI)

My impression is that Emulators are not mature yet comparing to the numerical models, thus user applications (with Ocean Bench) will be largely limited. A robust set of forecast and multi-source data-simulation AI-based models should be developed, and showing similar quality as state-of-the-art numerical models.

Francisco Hernandez (VLIZ)

Make sure variables are standardized (name, definition, units) between different models and resolutions and data in the Copernicus and EMODnet data products.

Artur Rocha (AB)

I would like to reinforce the utmost importance of Trans-model factors such as interoperability and reproducibility. So, all design options that enable easy swapping of different models and simulations, and that ensure that all the results of each simulation are reproducible are very important.

Anabela Oliveira (AB)

- possibility to tune emulators changing model parameters - possibility to select data sources (including model outputs) and data periods for training/validation - include automatic ways to compare with data/PDE-models forecasts

MODELS & DOWNSCALING *: What are your suggestions regarding the downscaling strategy from the global to the coastal and the different models that will be used?*

Jun She (AB)

Here both CMEMS global/regional and EDITO ML global should be used as a start point for downscaling. It is essential to establish standards (KPIs, eg auto-relocatibility, downscalability, Tech Quality, Sci. Quality, stability) for on-demand models. Suggest to do stress tests for each on-demand coastal model, including assessment of these KPIs, both for general downscaling and extrem event downscaling.

Francisco Campuzano (ATL)

Regarding the river data, it can be used the outputs from EMODnet river node that provides near-real-time data for many European rivers. It should be incorporated through EMODnet Infra

Francisco Hernandez (VLIZ)

Make sure variables are standardized (name, definition, units) between different models and resolutions and data in the Copernicus and EMODnet data products.

Artur Rocha (AB)

Enable mechanisms for the easier/seamless integration of higher resolution models. Likewise facilitate the use of AI resources to improve localized prediction.

Diego Macias (AB)

- How do you deal with the connection between global and regional configurations? Is there any kind of two-ways nesting? - How do you treat rivers in the regional configurations? that is highly relevant for example in the context of What If scenarios. - I appreciate the implementation of unstructured grids in the configurations but do have an idea on how much computationally demanding this is w.r.t. more traditional grids? How do you plan to evaluate the added value of this type of grids?

Anabela Oliveira (AB)

- handle global models outputs in a flexible way (e.g. wave spectra) and optimize forecast boundary conditions provisioning - allow for the use of other coastal models and updated model versions of the presently included models (notion of model modularity and common model components)

HPC OPTIMISATION *: How optimization of models on current and next-generation computing platform (HPC) is addressed in the project? Priorities, what is missing ?*

Jun She (DMI)

Standard baseline HPC tests should be carried out, including performance in subroutine level, scalability, portability, load balance for many-core supercomputers. Then limited/targeted optimization can be made within EDITO ML.

Francisco Hernandez (VLIZ)

Will the software be enough hardware agnostic. Specially the GPU use, the container images etc..

Artur Rocha (AB)

Priorities once again to interoperability, but also scalability according to the availability of resources. Furthermore, factors such as the efficient use of computational resources to obtain better results with minimum energy use.

ACCESS TO SIMULATIONS *: Do you need access to reference simulation that will be performed?* What kind of simulations? Resolution, area, period?

Francisco Hernandez (VLIZ)

Anything that improves resolution and timeliness of the coastal data will be interesting for marine spatial planning and economic activities, aquaculture etc. Specially the parameters that drive the ecosystem and biodiversity.

Artur Rocha (AB)

Facilitate parametrization, making available templates and applications adapted to the areas, outputs and topics of interest.

Diego Macias (AB)

I will be interested in having access to some of the regional configurations results. Adriatic and North Sea are the most attractive to me

Anabela Oliveira (AB)

Yes, reference simulations are very important for the construction of added value services either at ocean (oil platforms, wave and wind energy platforms,...) or at coastal/estuarine scales (ports, recreation, protected areas,...). Wave and circulation simulations are very important, as well as coupled simulations with biogeochemistry. Resolution: a few kilometers for global products; 100m for regional products Area: whole globe, as added value services may be needed anywhere Period: depends on uses. Reanalyses available cover several decades

3. Design of the Core Model Suite and Virtual Ocean Model Lab (WP4-WP5)

3.1 Summary of recommendations

Several recommendations were identified by the AB for the Core model suite and Virtual model lab:

- Interoperability is fundamental for the maintenance of the products as new models and services are proposed;
- Relocatability must be include by design as the EDITO products should be ready for application anywhere;
- Computational resources should be linked to the Lab and be part of the services offered.

3.2 Detailed feedback I AB Meeting #1 (July 2023)

Concerns on WP5/6/7

AB remark	EDITO Model Lab answer
How to ensure interoperability? How will models be described so that they can be found? How to maximize model portability to a different computing environment?	*The interoperability of EDITO core models will be ensured. These will be ensured by WP5 activities. Interoperability in EDITO framework will be define more precisely : portability with model compatible with several infrastructure. + connection and technical interfaces between model component and software (pre and post processing) + common vocabulary and definition*
Relocatability of products/outcomes and how fast to deploy them elsewhere? How to build new coastal applications based on EDITO model core (users outside the team)? Will detailed IT/coastal modeling guides be build?	*Subtask 5.3.2 deals with this. D6.1 and D7.1 include interactive handbooks (e.g. Confluence, Wiki, Github) to support the training of intermediate users and the upscaling/ replication of the DTO methodology.*
why do we have the HPC platforms outside the EDITO Infra in WP5 scheme? Would the connection to EuroHPC be also available at EDITO Infra or are we creating here a possibility for other computational resources providers (e.g. private ones like amazon and others?) This would create the possibility to handle sensitive applications.	*EuroHPC is a Joint Undertaking from member countries and EC. It's the first Supercomputing initiative governed by member countries and EC (PRACE was bottom-up). This is the way for Europe to be competitive in Supercomputing resources and it's paid by public funding. Not sure about the benefit of using private providers in the US like Amazon*

Will the results of WP6/7 demos be publicly available at the viewer interface? It is an important step towards the scientific community to recognize this work as reliable/accurate.	*WP6/7 will deliver demos to be posted on the project website as success stories.*
will the what-if scenario building generic and its building tool available for other applications in the future? Jupyter notebooks are fine for researchers and (some) consultants, not for coastal managers.	*Jupyter notebook will be used to develop the what if scenario and to share this new service with internal and external user during the last year of the project and during the training workshop. Other improved interfaces should be defined but that's not the priority of EDITO Model Lab project.*

3.3 Detailed feedback l Co-Design Review (November 2023)

REVIEW Session 2 – Design of the Virtual Ocean Model Lab (WP5, link with WP4):

Discussion

Marco Amaro Oliveira (ILIAD) Questions on containerization and respecting OGC standards
A: All components/services and APIs respect OGC standards and discoverable (FAIR). We are using Helm charts: https://helm.sh/docs/topics/charts/ , STAC: https://stacspec.org/en/ . We use asset materialization (capacity to retrieve/regenerate the data that is referenced but not necessarily stored yet). EDITO Infra & internal EDITO Model Lab still look to understand each other's needs better. Modelers want to have the resources specified. Developers want to have the applications specified. This will feed into the discussion after Review 4. There is a need for a close collaboration between the modelling institutes and the Edito Infra developers next year. This can be started at the General Assembly in Lecce, Italy. Any instance has its own computing resources and data storage.

"Is the infrastructure scalable and allows access to multiple users in parallel? "
A: yes, but if a job is dispatched to an external HPC then it depends on those resources. The infrastructure scales up and down automatically. The importance of data pipelines between HPC and cloud is recognized and will be implemented within EDITO-infra.

Arthur Rocha (AB) has Remarks on SLIDO, see hereafter
A: We do not invent any technology in our project but follow the cloud community and OGC and applications are portable.

A, Nadia Pinardi (UNIBO): Remarks on the business model: we develop open and free applications but additional private access should be paid to Wekeo is a good example where cloud computing is paid. Thomas Geenen from Destination Earth also confirms that there should be open and paid components. Remark of Alain Arnaud (MOi) is that the main target of EDITO is to support scientific research around ocean and therefore a public infrastructure, as opposed to ILIAD, for instance, that is much closer to private end users. Arthur (ILIAD) highlights that although the models of the two initiatives could be different it is important that there are no technological barriers between the different architectures/solutions.

[14:25] Bruno Kinoshita (BSC)
Helm charts: https://helm.sh/docs/topics/charts/

And STAC: https://stacspec.org/en/

[14:31] Renaud Dussurget (MOi)
this is called asset materialization, capacity to retrieve/regenerate the data that is referenced but not necessarily stored yet

SLIDO Feedback Review Session 2:

RESOURCES: Which applications can run on EDITO Infra cloud ? Which ones do need HPC capabilities?

Jun She (DMI)

Smaller model runs, post-processing and data analysis can run on EDITO-Infra; large model runs e.g., global model run and regional-coastal sea model run should use HPC, which can be further decided by model providers.

Anabela Oliveira (AB)

Core applications, either from the consortium or integrated after a quality control check All unstructured grid simulations will likely need HPC

Artur Rocha (AB)

Hopefully any, developed internally or externally to EDITO, that has gone through a screening process and was deemed: 1) of interest to the associated communities; 2) of good quality under pre-determined conditions; 3) and complying to standards and good practices.

TECHNOLOGIES: We made certain technical choices - are these limiting with regards to other initiatives?

Jun She (DMI)

First, the technical choices should serve the purposes of end user applications and expert use applications; second, it has to be interoperable with existing infrastructure EDITO-Infra and DestinE infra.

Anabela Oliveira (AB)

There are many technologies available for these themes, so it is impossible to link with all. Making FAIR guaranteed and proper documentation is the way to go.

Artur Rocha (AB)

They seem to be from the design documentation. More technical and hands-on workshops and bilateral meetings will ensure that it effectively happens.

DATA: How can we make the model data accessible to users? How users will discover the data that is available?

Jun She (DMI)

CMEMS is a successful example of data provision, incl. data format, standards, way of data search and delivery. EDITO should deliver data in a cloud database, with similar standards of CMEMS DIAS.

Anabela Oliveira (AB)

Through GUI, tailored for different users needs and backgrounds (e.g. a researcher and a coastal manager needs different capabilities and friendliness services)

Artur Rocha (AB)

Possibly by means of a pluggable/extensible tool shed (something like Galaxy comes to mind).

SECURITY: How would we handle security: EDITO Infra authentication, GUI / APIs security, HPC accounts.

Anabela Oliveira (AB)

EGI Check-in service is a good option for authenticated login

Artur Rocha (AB)

Use and contribute to the further development of ECs authentication and authorization infrastructures.

INTERACTIVITY: Will we setup a mechanism to perform scalable on-demand simulations?

Jun She (DMI)

Yes, this will be quite important for future EDITO ML on-demand service. One aspect is HPC efficiency of the simulations. Good scalability will ensure fast execution of the on-demand jobs.

Anabela Oliveira (AB)

Yes, that is a fundamental step for a DTO and should be possible for both what-if scenarios and forecasting

Artur Rocha (AB)

Use state of the art solutions (e.g. Min.IO) thought for scalability according to processing needs.

PORTABILITY: Will the EDITO Model Lab components be portable (out of EDITO Infra)?

Jun She (DMI)

Yes, interoperability and portability with esp. CMEMS, DestinE and EuroHPC is important

Anabela Oliveira (AB)

Yes, this is also a very important property. Many applications can have confidentiality issues that EDITO cannot fully guarantee. Therefore all code should be open source, fully documented at contents, formats and installation level in multiple environments, so it can be ported to another environment.

Artur Rocha (AB)

That would be really nice, by enforcing standards and software containerization.

4. Design of the applications (models and tools) (WP6-WP7)

4.1 Summary of recommendations

Several recommendations were identified by the AB for the demonstrators:

- EDITO should be used as a collaborative platform;
- Demonstrators are more educational tools than actual decision support tools.
- Interoperability is fundamental for the maintenance of the products as new models and services are proposed;
- Clear and realistic WiS and FS properties requirements (from an IT needs viewpoint) is necessary so the user knows what are the limits for his/hers wishes;
- Other tools for on-demand forecasting using the selected models could be also included (outside of NEMO+shyfem on-demand forecasting).
- Plastic pollution, decarbonization and water scarcity are high on the political agenda and could be included in coastal configurations.

4.2 Detailed feedback l Co-Design Review (November 2023)

REVIEW Session 3 – Design of Applications (models and tools) (WP6, WP7):

Discussion

Diego Macias (AB) : *"JRC offers collaboration for some what-if scenarios (marine litter and also in assessing seaweed cultivation potential) as they run the same what-ifs. "*

Anabella Oliveira (AB): *"Is it possible to share the model configurations and let users to modify these (e.g. change friction coefficients)? "*
A: Yes.

"Are they relocatable and can be run on-demand?"
A: Yes, but with the note that some applications will be easier to run in-demand than others

Delphine Lobelle (ECOP, Fugro) is Interested in coastal hazard and co-design in general, also related to CoastPredict. *"Are the WiS precomputed or can they be run live ?"*
A: That is per scenario and per application under discussion. It can be better to re-run a simulation of a demonstrations. Some other demonstrations only need post processing and others are, more interactive/on-demand, like the scenario where dispersion trajectories can be provided,

The interactivity of what-if scenarios and are they pre-run? This differs per what-if scenario. All will be interactive, but on-demand capability is not for all of them. At the moment there is no clear strategy for this, and it will follow user requirements.

Francisco Hernandez (VLIZ*): "The demonstrators are especially interesting if they use data accessible in more geographical areas (not only one site). If such necessary data is not yet in CMEMS and EMODNET, we can initiate discussions to include them. "*

Patrick Lehodey (MOi): thinks that our demonstrators are more educational tools than actual decision support tools. The biggest value is in the tools developed and training. Answer: indeed, the applications are demonstrators of our new capabilities, the exact applications are less important. Reaction from CMCC: where we compete with commercial providers (e.g. ship routing) it is more difficult. Therefore, we have to distinguish commercial and non-commercial applications.
In the NECCTON project, they deal with fishing issues (fishing related what-if scenarios) including climate change scenarios co-developed with FAO.

Christophe Briere (EGIS, REST-COAST Project): Representing the REST-COAST project, they investigate large scale nature-based solutions and have what-if scenarios. How do we approach the sharing of what-if scenarios? It is not only about sharing the what-if scenarios but also on the dedicated training. Remark of Nadia: we should go beyond and allow external parties to develop and share their what-if scenarios. Reaction of Giovanni: we should use EDITO as a collaborative platform. E.g. to compare with scenarios developed within the RESTCOAST project.

Nadia Pinardi (UNIBO): We should embrace the opportunity of sharing the data from other projects.

Patrick Lehodey (MOi) : working with users is key and taking into account context of BBNJ.

A Gianandrea Mannarini : users of regional applications are difficult to involve , happy to learn how to better interact. Felix Dols: think on how to combine tools to achieve results

C Briere (EGIS, REST-COAST Project): *"restauration of coastal ecosystems, have ecomorphodynamic models WiS, what process to ensure that WiS and Applications are shared ? Technical issue so guidance can be provided ? Or issue of ownership ? Or governance ? '*

Ghada El Serafy (Deltares): it is also about capacity building / knowledge transfer / training on the use of the models
Yann Drillet (MOi) : model lab : will not develop WiS, but provide guidance and best practices to implement scenarios, what tools tested and share them , … Objective is to provide facilities for scientists/researchers/decision makers/ , and new type of services and tools and new output / key to use FA and WiS to explain users what is the model suite ,

Giovanni Coppini (CMCC): indeed, in REST-COAST there will be observations, EDITO is a collaborative platform where REST-COAST WiS can be tested , but we need to find way to provide data / scenarios , to be an example to the entire community

Felix Dols (Deltares) : from FA1, an application on seagrasses and molluscs in the Wadden sea, we now aim to translate the methodology to mangroves in Indonesia and publish that on the DTO.

Nadia Pinardi (UNIBO) : ask other projects to provide their data into DTO

Yann Drillet (MOi) : of course, in particular beyond the Edito Model Lab project

SLIDO Feedback from Review Session 3:

How these applications would benefit you and your work most? (e.g., using the tools, interacting with the model configurations, reference for setting up your own applications; study material for students; etc.)

Francisco Hernandez (VLIZ)

For the applications to benefit other users, the availability of data needs to be carefully monitored. Using as much as possible data from CMEMS and EMODNET that will form the data lake. And if additional parameters are needed, try to add them to these. EMODNET is open to new data streams.

Diego Macias (AB)

As stated, JRC is working on What if Scenarios for marine litter and also in assessing seaweed cultivation potential on EU marine regions. We will be more than happy to share our experiences and approaches and learn about yours.

Jun She (DMI)

The FAs may serve for model inter-comparison studies, and help us to establish similar applications.

Anabela Oliveira (AB)

All of the above

Is your organization/program/project interested in testing, co-designing the EDITO Model lab Demonstrations (FA and WiS)?

Francisco Hernandez (VLIZ)

Yes, there are several applications (MPA's , coastal bio-protection, suitability models, aquaculture /CO2) that match what we are building in Edito Infra, Bluecloud 2026 and in DT Bioflow.

Anabela Oliveira (AB)

Yes, in testing and co-designing with a focus on coastal societal uses

Diego Macias (AB)

Absolutely! We could provide a perspective from the policy making side that might add value to your work (e.g., how to link measures for pressure reduction to specific policies implementation).

Jun She (DMI)

Yes, interested.

What are the main obstacles of using co-developing the models and tools demonstrations from your perspectives?

Francisco Hernandez (VLIZ)

Data availability needs special attention if you want to translate the applications to other region or extend the applicability of the tools for other applications.

Anabela Oliveira (AB)

The scope of possibilities can be very large (e.g I want to test a new navigation channel and I need a way to interact with the platform to define it, the platform then needs a way to refine the SCHISM's grid to account for this new channel accurately). I think a very clear and realistic WiS and FS properties requirements (from an IT needs viewpoint) is necessary so the user knows what are the limits for his/hers wishes.

Jun She (DMI)

A proper user interface for on-demand FA and WiS is essential.

Do you think the presented models and tools for applications representative for the challenges policy makers face? / What do you miss?

Francisco Hernandez (VLIZ)

Very representative ! Maybe extend some applications for example for safety (predicting harmful algae), tourism (predicting jellyfish)

Anabela Oliveira (AB)

The suite of numerical models selected is very good and representative of the best modelling tools currently available. However, on-demand forecasting is only available for NEMO+shyfem and other tools for on-demand forecasting using the selected models could be included. LNEC is happy to help integrate our on-demand forecast service for SCHISM (OPENCoastS) in EDITO model lab.

Diego Macias (AB)

Plastic pollution and decarbonization are high on the political agenda. Also water scarcity is very relevant now, maybe we can discuss how to include this aspect in your coastal configurations? Happy to discuss!

Jun She (DMI)

Yes, the models used in EDITO are suitable for the purpose of FA and WiS.

5. Design of Demo Services (output and products)

5.1 Summary of recommendations

A main recommendation was identified by the AB for the demo services:

- EDITO-Infra to develop a catalog of available products, based on existing catalogs.

5.2 Detailed feedback l Co-Design Review (November 2023)

REVIEW Session 4 – Design of Demo Services (output and products)

Discussion

Anabela Oliveira (AB): Stressed that iterations are needed to arrive at applications that meet user requirements.

Ute Brönner (ILIAD): Offered to collaborate more closely between ILIAD and EDITO. ILIAD is invited to the GA in Lecce in January 2024.

Enrique Alvarez (MOi, OceanPrediction DCC): Pointed out that we have to be careful in what we expect from end-users. For example if you work with international ports, the degree of expertise differs widely. Yann mentioned that we will discuss this in Review Session 5.

Remark Gianandrea Mannarini (CMCC): Proposed to have a catalog for the services that will be on the EDITO platform. Proposed to invite selected stakeholders to the meeting in Lecce.

Remark Yann Drillet (MOi): EDITO Infra develops a catalog of all products that are / will be available on the catalog.

Francesco Hernandez (VLIZ): EDITO Infra will provide tools to stac data in a uniform way . Model that run should provide metadata so the data can be stored and approached from a catalog. There is a tutorial on how to make use of the data from the datalake and how to add data in the datalake so that it is findable and usable.

Marina Tonani (MOi, EDITO-Infra): Certain viewers will be integrated as services on the EDITO platform. Readily available for everyone. If a new application is built, a developer can contribute with a viewer, also to be published on the EDITO platform.

Sara Garavelli (AB) & Arne Berre (ILIAD) propose to **not develop a new catalogs, but to make use of existing ones**. As this will simplify the access for the users and therefore adds value.

6. Design of User Interaction/Exploitation (test and evaluation)

6.1 Summary of recommendations

A main recommendation was identified by the AB for user interaction and exploitation:

- "Champion users" should be designed through webinars, surveys, bilateral meetings and hackathons, allowing rich Users Narratives

6.2 Detailed feedback l AB Meeting #1 (July 2023)

Opportunities for collaboration

AB remark	EDITO Model Lab answer
• Possible starting points for ILIAD collaboration: ○ On "processes interoperability": WP5 to WP5 workshop (?) → How to deploy, under which conditions, using which standards? ○ On Focus Applications (EML WP6) and What-if Scenarios (EML WP7): connection with marketplace (ILIAD WP6) and Pilots (ILIAD WP7) ○ Task 6.4 (EML WP6) and Task 7.5 (EML WP7): capacity building (WP10) ○	*WP5-6-7 are happy to collaborate with ILIAD marketplace.* *The Digital Ocean Forum#2 organise by the European Commision was a good example to identify collaboration with external projects*
What about ANR MEDIATION "Developments for a robust and efficient DTO"?	MEDIATION and TRACCS are French projects with strong link with ocean model development especially CROCO and NEMO. https://www.ocean-climat.fr/Les-actions-et-projets/Les-projets-de-recherche/MEDIATION

During the meeting of 18th July, the AB also pointed out that the Project should look at the possibility to include technical exchange with ILIAD in the co-design phase as exchange with other projects is key.

6.3 Detailed feedback l Co-Design Review (November 2023)

REVIEW Session 5 – Design of User Interaction/Exploitation (test and evaluation)

Discussion

Anabela Oliveira (AB)
A suggestion: keep the user requirements inquiries going on during the whole project. sometimes small changes in the information processing can accommodate many requests.

Ute Brönner (Iliad)
Note, that we are developing a range of DTO pilots in Iliad with identified user base that you might want to leverage. We are also using a concept of alpha and beta users in other project that might fit here. I would like to add another aspect to Nadia's arguments on observations and ensembles and that is spatial grid resolution. Sometimes there is hardly scientific merit when you do not have enough resolution, e.g. you cannot transport things in the coastal ocean with complicated coastal features if you do not have sufficient resolution.

Anabela Oliveira (AB)
Maybe consider different configurations of access/users to accommodate different backgrounds of the users

Renaud Dussurget (MOi)
In EDITO-Infra, Users should be able to include and publish their own datasets to make it visible on catalogs

Sara Garavelli (AB)
Instead of building another new catalogue I would recommend to use an existing one. I am sure the services and the data can fit one of the existing catalogs.

Enrique Alvarez (MOi, Ocean Decade DCC)
Maybe consider different configurations of access/users to accommodate different backgrounds of the users this is an option that sometimes works quite well

Arne Berre (Iliad):
Iliad has for instance a federated catalogue - already created.

Renaud Dussurget (MOi)
you should be able to integrate your own viewing software stack in edito-infra, (or re-use existing components if they fit)

Marina Tonani (MOi, EDITO-Infra):
users can use key words to find what they need

Arne Berre (Iliad)
Very good - it is important to have well defined interfaces between the various components and services (i.e. APIs) - so that for instance various viewers can be used.

Renaud Dussurget (MOi)
quick reminder, there is a big difference between persistent services (eg. generic viewers, etc...) and on-demand applications that can be popped by a user from the datalab at any time. This may impact cataloguing/referencing.

Fabrice Messal (MOi)
Need to prepare a strong user support!

Anabela Oliveira (AB): points out that this is a key point of success. She shares experience from organizing user engagement. Sharing models and tools works for intermediate users, but not for end users, mostly being non-technical and not used to work with tools like the ones published on EDITO Infra. Regarding training, it is smart to combine this with big existing conferences (like EGU) to set up the demo sessions. Harnessing from the already existing gathering of intermediate users is efficient. Regarding end-users, mingle with the communities and make use of projects that focused on getting involved. Training must be interactive and facilitating.

Arthur Rocha (AB): For him intermediate users can be invited after internal sprints between developers of the platform and of modellers, developpers of applications and tools. Make the sprints thematic, so that users with specific interest will connect to the topic and not loose interest. Organizing sessions has been done by ILIAD and they want to help EDITO structuring this. Make sure that infrastructure is "alive", by continuous communication, updates and activities.

Angélique Melet (MOi, CocliCo Project): collected user requirements for platform that will be developed by the project. The beta will be verified with the end-users and then evaluated. There is a chance to connect what CocliCo develops can be published on the EDITO platform. This will require technical support; capacity building and communication.

Sara Garavelli (AB): be aware that the group of potential users is very broad.

1. Prioritize groups of users
2. Think about incentives for users (what do they gain when they volunteer as beta users, financial, recognition, etc.)
3. Attend the events where the users already are.
4. Time the connection to users with the maturity of the services that are offered.

Enrique Alvarez (MOi, OceanPrediction DCC): define clearly what are the benefits of EDITO Infra for intermediate users.

Delphine Lobelle (ECOP, Fugro) asks Angelique Melet how the user interaction was done. This was with assigning "champion users" and have dedicated sessions to identify their specific needs. From this process the understanding of user needs was very useful for efficient design of the solution. It went relatively smooth and resulted in valuable output.

Miguel Castrillo (BSC): we need a clear path for different users and their specific needs. This can be different per sub-group of intermediate users. First step is to show intermediate users what they can do with the platform.

Nadia Pinardi (UNIBO): For different Focus Application & what-if scenarios the target users can already be engaged to start the testing.

Lörinc Mezsaros (Deltares): We can help each other to radiate the transformative nature of EDITO, to become ambassadors and inspire others to use the platform.

For future exercises Enrique Alvarez (MOi, OceanPrediction DCC) recommends to split the discussion on the different targets we are mixing a bit here: Beta testers, intermediate users and final users are very different and so it is the approach to them.

Jun She (DMI): mentions that EDITO Model Lab focusses on the underlying models and their development.

Yann Drillet (MOi): mentions that by the end of 2024 the majority of internal developments will be ready, so the focus can shift to dissemination, training and capacity/community building.

SLIDO Feedback from Review Session 5:

How to involve beta testers/decision makers and other future users?

Enrique Alvarez (MOi, OceanPrediction DCC):

for future exercises I recommend to split the discussion on the different targets we are mixing a bit here: Beta testers, intermediate users and final users are very different and so it is the approach to them

Artur Rocha (AB):

I would suggest the organization of a series of thematic co-design workshops targeted at different user profiles.

Enrique Alvarez (MOi, OceanPrediction DCC):

It is important to be active in the search for these key people. Once identified, close dialogue is the only way forward. It is very important from the beginning they understand the benefits that the activity will have for their own objectives. To explain the concept could take time. Additionally, predefined surveys could help to launch the dialogue.

Angelique Melet (MOi, CoCliCo):

In CoCliCo, users are involved in the design and evaluation of the core web-platform. For interactions to collect user needs, we have 3 decision case studies, each one with champion users. 1. National and pan-EU flood risk mapping; link to the Flood Directive. Champion Users: FR and NL 2. Regional and city-scale spatial adaptation planning. Champion Users: ICLEI. 3. Coastal infrastructure investment (mostly harbours). Champion Users: Federlogistica. We collected user needs (as "must-have", "nice-to-have" and "could-have") through webinars, surveys, bilateral meetings. We then developed rich user narratives. These functional requirements and Rich User Narratives provide the foundation for continued co-design of the CoCliCo platform. When the platform will be ready, a co-evaluation phase will start by opening the web platform to targeted users. After iteration on the platform, the CoCliCo platform will be more open.

Hackathons / How to get beta testers involved?

Artur Rocha (AB):

Hackathons are definitely a way. Also, joint software sprints (applying methodologies such as LeSS, to give an example). Specific tasks could be targeted, such as: - how to deploy model A (good practices, how to describe inputs, outputs, etc) - how to deploy an application so that it becomes available for users to find - how to explore outputs from model X with viewer Y - ...

Enrique Alvarez (Moi, OceanPrediction DCC):

Hackathons can be crucial for dissemination of the product. It is very important to design those properly. Beta testers, a very different thing, must understand the importance of their work for the general benefit. There must be a mechanism to credit the work of Beta testers, stated from the beginning.

Angelique Melet (MOi, CoCliCo):

Co-evaluation of the co-designed developed CoCliCo platform. Check the platform and provided information, functionalities are fit for purpose.

How to answer user needs and to interact directly with users?

Artur Rocha (AB):

Maintain a backlog of user needs and wishes, along with the key users for each, then prioritize.

Enrique Alvarez (MOi, OceanPrediction DCC):

As for point one, dialogue is critical. It is important to prepare didactic material to explain the products to the users, making stress on the benefit derived from the use of the product. Surveys are also a very important asset for the dialogue.

Are the applications/products fit for purpose?

Angelique Melet (MOi, CoCliCo)

co-evaluation of the service

Artur Rocha (AB)

I think so, but my opinion is less important than the one of the key users. Conduct workshops with these users and collect their feedback in a structured way.

Enrique Alvarez (MOi, OceanPrediction DCC):

I have not enough detail on the design to evaluate. The products selected to be developed look fit for purpose,

Are data present on EDITO Platform fit for use?

Artur Rocha (AB)

Same as previous.

Enrique Alvarez (MOi, OceanPrediction DCC):

All data in EDITO platform is fit for Purpose... the question is if we have all what is needed.

What kind of support will they need from EDITO-ML?

Artur Rocha (AB)

Capacity building is definitely a key point. Work out synergies with other projects and initiatives for that.

Enrique Alvarez (MOi, OceanPrediction DCC):

I believe that a similar one that the one available at Copernicus Marine Service

Angelique Melet (MOi, CoCliCo)

For CoCliCo: CoCliCo will provide pre-cooked sets of geospatial data layers to support decision-making wrt adaptation to sea level rise. But advanced services will require data that is not available all across Europe. To inform such advanced services, we develop Exploratory Tools, a workbench for future upgrades of the full-track platform, as datasets, tools and computation capabilities get improved over time. For these Exploratory Tools, we benefit from the interoperability features of the web-platform (its API, OCG/INSPIRE compliance) and use IT solutions such as on-the-fly computations allowing to minimize computation time and data storage on the user side. A support would be needed wrt HPC, and for using core / pre-cooked datasets to force more refined, coastal modelling systems using at their boundaries. For instance, they can use water levels provided by CoCliCo to force a marine flooding model with more accurate digital elevation models available at local to national scale, or coastal defenses data layer (than used in pan-EU data layers in CoCliCo).

What is their experience with HPC modelling?

Artur Rocha (AB)

Maybe not very experienced, but there may be surprises too! Make it so that it becomes progressively more straightforward to use. Good examples help, easy parametrization, templates, etc.

Enrique Alvarez (MOi, OceanPrediction DCC):

If you refer to the users, I guess low or non-existing

Angelique Melet (MOi, CoCliCo)

Will clearly depend on users and applications for CoCliCo.

6.4 Detailed feedback l AGA (January 2024)

WP1/WP8 - Achievements and next steps - Project Management and Communication-Dissemination-Uptake

- **Discussion:** Several levels of communication and dissemination. Demonstrations, Hackathons, but also need for regular messages on social media also for small achievements but that demonstrate the added value of the project.
  In particular:
- Advisory Board member Sara Garavelli (CSC IT Center for Science, Finland) was interested to know how the Project is planning to demonstrate the added-value of EDITO.
- Nicolas Segebarth (EC, DG RTD) suggested to orient the communication regarding the Project developments on the new features that EDITO will be bringing (what is now feasible that was not before).

- Advisory Board member Anabela Oliveira (LNEC Laboratório Nacional de Engenharia Civil, Portugal) raised that EDITO needs simple workflow not to limit the use of this powerful tool and was wondering how this can be done.

7. Horizon View 2024-2025 - Consideration for Project upcoming activities

7.1 Summary of recommendations

A main recommendation was identified by the AB for Project upcoming years' activity:

- Outreach and communication are key. OceanPrediction DCC community can be used to increase reach.

7.2 Detailed feedback l Co-Design Review (November 2023)

Discussion

DEMO preparation for the Digital Ocean Forum #3: June 25-26 2024 (Brussels)

- We want to connect to UN Decade Collaborative Centres. Developing best-practices and facilitating services to them.
- There is a discussion going on about integration of EDITO in Destination Earth.
- The developments of infrastructure: Data, Copernicus data and computing EOSC, GEANT and EuroHPC.

Anabella Oliveira (AB) hosts the discussion on the levels of Services, being Explore, Create and Contribute.

Sara Garavelli (AB) finds the picture really helpful in communicating the objectives.

Francois Courteille (AB) asks for the readiness level of the components that are necessary for the project. We see that many components are stand-alone at relatively high TRL, but not connected and not accessible for everyone.

EDITO-Model Lab is budget wise only a small part of the playing field, but is playing a role in integrating the components that many other projects are delivering and developing. This depends on leadership of uniting contributors and stakeholders.

On strategic level many projects, programs and communities have the same vision. On operational level many discussions are needed to finetune the design of components and digital twin (eco)system. Think about formats and data structure. Miguel Castrillo (BSC) sees that this is happening. Differences between the climate and oceanographic community are discussed.

Arthur Rocha (AB) reinforces the importance of interoperability. From the concrete suggestions that were given in Review Session 5, the ambition to take leadership depends on small steps in uniting communities of users, developers, and decision makers. With the limited budget that every project has, these steps need to be taken.

The interoperability between EDITO and DestinE depends on formats, according to Jun She (DMI).

The standards from model output from different fields are clearer than the data standards for variables that are measured with in-situ sensors, like biological / chemical sensors.

Renaud Dussurget (MOi):
I would like to emphasize that although we're focusing on ambitions objectives and might not have capacities/funding of a NOAA+gafam players within EDITO (and next steps), starting thinking in a similar way and having technical teams leveraging new technologies within our workflows will also support modernizing our legacy stack. This is what we're doing in Copernicus marine, and capacities could be leveraged at a broader scale in the community as long as we concretely start exchanging/sharing on that.
Also, remind EDITO-Infra development teams are already orientating their technical roadmap to make the discover/contribute/create thing technical feasible. I guess this also applies to technical teams from other project such as Iliad.

SLIDO Feedback from Final Discussion – Horizon View 2024-2025:

1-Are you interested in contributing to the DTO? If yes, how can you contribute to any of the 3 levels of services? As a tester, as a developer, as a use case provider? Other role?

I would be glad to have a tester role

2-Are there any technical issues that can be endanger EDITO products adoption? How should we overcome them? What type of institutions/projects/teams will be potential adopters?

Francisco Hernandez (VLIZ)

Biggest danger is that the tools (models) that you build are not 'found' and someone else rebuilds them.

Anonymous:
This is quite broad, since some products are for the masses (e.g. visualization) and others for selected users (e.g. oil spill). Big main risk is not keeping products simple to use and robust. Co-design and beta-testing is important to avoid this. We need to do the products that the users want , not the ones we want.

3-Several initiatives are working on the ocean digital twin paradigm. How should EDITO interact with this international level community to joint efforts towards a unified vision and interoperable products? How should we address design and model component harmonization? How should we approach the community?

Francisco Hernandez (VLIZ)

Making sure the EDITO-Model Lab models use and produce standardized variables (CF for sure, but also biology, geology and human activities) . Even if the data formats defer ..as long as they can be translated to each other... that will only be a delay in the workflow.

Anonymous:
The right framework for this dialogue is the UN decade for the oceans. We have the OceanPrediction DCC defining standards for interoperability and a whole Programme devoted to Digital Twins (DITTO)
Again, The UN Decade can be instrumental. OceanPrediction DCC is about to publish an architecture for ocean forecasting that can be useful for this.

As suggested in the question, depends very much on the case. Some products will have a small number of users, and therefore an in-person approach is recommended. Others will be massive, and for those virtual learning tools are recommended.

Francisco Hernandez (VLIZ)

Communicate the results, refer to tutorials, build ready to use services .. EDITO infra is offering several tools to make that possible.

Anonymous:

Some ideas: 1) Teach teachers.... find key people that can carry the message to different communities. 2) Use existing tools for capacity development (OTGA for example). 3) Use the community gathered at OceanPrediction DCC to increase your reach. Link with the future capacity development activities at the OceanPrediction DCC 4) make sure you have the right ocean literacy tools, and they are distributed via the right channels, especially for generalist products. For example, contact good YouTube channels on science divulgation and try to do outreach there.