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Agenda Item 4: Progress report on the activities carried out to implement SPA/RAC activities under the UNEP/MAP Programme of Work for the biennium 2022-2023

An Overview of ILIAD project - Integrated Digital Framework for Maritime Data and Information Services

Note:

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Note by the Secretariat

1- This report includes a summary description and progress of the ILIAD project.

2- This report is hereby presented to the Sixteenth Meeting of SPA/BD Focal Points for information and the Focal Points are highly encouraged to take note of the upcoming outcomes from the ILIAD project as it aims to provide to stockholders in several seas, including the Mediterranean, innovative and effective management and conservation digital solution covering several sectors of the coastal and marine area including human activities.

Table des matières

Project Overview

The ILIAD Project, which is funded by the EU from 2022 to 2024, is a collaborative effort among 56 partners from 18 different countries in Europe, the Middle East, and North Africa. The consortium's main objective is to create virtual representations of the ocean that will incorporate and expand upon existing EU earth observing, modeling, digital infrastructures, and computing facilities. The result will be highly accurate predictions of future developments in the maritime domain.

ILIAD leverages the investments made in policies and infrastructures for the blue economy over the last two decades. It aims to develop an interoperable, data-intensive, and cost-effective Digital Twin of the Ocean (DTO), taking advantage of the explosion of new data from various earth data sources and advanced computing infrastructures, such as cloud computing, HPC, the Internet of Things, and Big Data. The DTO will be an inclusive, virtual/augmented, and engaging platform that addresses all Earth Data challenges and contributes to a sustainable ocean economy as defined by the Centre for the Fourth Industrial Revolution 4.0 and the Ocean.

ILIAD will fuse a large volume of diverse data using a semantically rich and data agnostic approach, enabling communication with real-world systems and models. Ontologies and a standard style-layered descriptor will facilitate semantic information and intuitive discovery of underlying information and knowledge to provide a seamless experience. Geovisualisation, immersive visualization, and virtual or augmented reality technologies will allow users to explore, synthesize, present, and analyze the underlying geospatial data interactively.

The ILIAD DTO's enabling technology will contribute to the implementation of the EU's Green Deal and Digital Strategy and to the achievement of the UN Ocean Decade's outcomes and the UN Sustainable Development Goals. The System of Systems approach will be used to integrate all existing EU Earth Observing and Modelling Digital Infrastructures and Facilities. To promote additional applications through ILIAD DTO, the partners will create the ILIAD Marketplace. This marketplace will function like an app store, where providers will distribute apps, plug-ins, interfaces, raw data, citizen science data, synthesized information, and value-adding services derived from the ILIAD DTO.

1. Introduction to the report

This document serves as an introduction to the ILIAD project and provides an overview of the several activities carried out by SPA/RAC to contribute to the project's continuous development. It also summarizes the different contributions and updates made to the project in various fields such as data sharing, low-cost sensor development, IoT sensory integration, data harmonization, geo-visualization, socio-economic data extraction and merging, data fusion, AI techniques, and citizen science.

The ILIAD project aims to develop a comprehensive maritime data and information services framework, integrating and extending existing EU earth observing, modelling, digital infrastructures, and computing facilities to provide highly accurate predictions of future developments. SPA/RAC has been actively involved in the project and has contributed to its development by focusing on engaging stakeholders, facilitating, and managing the organization of capacity-building trainings and discussions addressing the policy goals DTOs on topics such as data gaps, relevant added value of the data applications delivered by ILIAD—e.g., climate vulnerability and risks data products, waves spectral characteristics and direction of microplastics and/or floating litter distribution, possibilities for scaling up efforts with existing technologies.

Overall, this document provides a brief overview of the ILIAD project and SPA/RAC's contributions towards its success, highlighting the various fields where the project has made significant progress, and demonstrating the project's potential to revolutionize the maritime sector.

2. Concept

The ILIAD project has been structured into 11 work packages to ensure a streamlined and efficient workflow. Each work package has been further divided into tasks, creating a dynamic and well-organized framework that ensures that everything progresses smoothly. To guarantee continuous progress and support throughout the project, WP leaders from the 56 international partners have been appointed. This hierarchical structure ensures that every aspect of the project is overseen by leaders at both the work package and task levels, with active participation from all project participants.

This well-structured framework helps to ensure that the project progresses efficiently and effectively, with clear leadership and oversight at every level. By breaking down the project into work packages and tasks, the project team can focus on specific areas of development and ensure that everything is moving forward in a timely and efficient manner. The appointment of WP leaders from the partner organizations ensures that the project benefits from a broad range of expertise and perspectives, helping to ensure that the project meets its goals and objectives. Overall, this structured approach is key to the success of the ILIAD project.

- **WP1: Co-designing the Digital Twins of the Oceans :** WP1 is responsible for co-designing the base version of the ILIAD Digital Twin of the Oceans (DTO) using a system of system approach. This ensures compatibility with other systems and solutions, as well as adherence to worldwide standards.

- **WP2: Data Acquisition from Pilots/Collection of Existing Databases:** WP2 is proceeding with collecting real-time ocean data from sensors, evaluate their operability, integrate ocean data (historical, hindcasts, reanalysis, forecasts) from existing data platforms and networks; and (g) create and document best practices and standards.

- **WP3: Citizen Engagement & integration of data from citizen science:** WP3 aims to develop a citizen community for the ILIAD project by providing a software platform and integrated tools that enable the use and integration of data acquired through citizen science.

- **WP4: ILIAD DTO – Ocean Interoperability Data Space:** The ILIAD DTO will be an Ocean Interoperability Data Space that supports interoperability for the increasing amount of heterogeneous ocean data and services. Access to the DTO will use existing standardized OGC spatial APIs, enhanced by new Digital Earth and Digital Twin APIs. WP4 connects to data and services from WP2 and Citizen Science data from WP3 through web portals.

- **WP5: DTO Modeling and Analytics services:** Co-design in assembling, configuring, and deploying the Artificial Intelligence and analytics services combining numerical modelling and Machine Learning techniques required for the Pilot Context Twin.

- **WP6: User XP and UI Design, Dashboard, and Immersive Visualization:** WP6 will research, design, test and implement the DTO Interactive Environment (IE). This includes the design and development of the overall and specific types of user experiences (UXP); user interactions (UI) and (graphical) user-interfaces (GUI); geo-data-3D-visualisation; output system (reports) / dashboards, etc, …

- **WP7: Demonstration and impact assessment of ILIAD pilots:** Engage end-users in testing and validation of DTO products and services.

- **WP8: Policy Impact Facility:** WP8 will create tools for policy engagement and collaborate with stakeholders to advance the UN Decade for Ocean Science in Sustainable Development goals and UN SDG, with a focus on policy harmonization between EU member states and non-EU countries under marine agreements like the Barcelona Convention for the Mediterranean Sea, Bucharest Conventions, etc.

- **WP9: Technology Transfer and Business Development:** WP9 will design an exploitation package with effective business models to ensure sustainability of the ILIAD DTO and related services beyond the duration of the project.

- **WP10: Stakeholder Engagement and Capacity Building:** WP10 will coordinate internal and external engagement activities, provide capacity-building support, and develop best practices for capacity development across sectors.
- **WP11: Outreach, Communication and Dissemination:** WP11 main aim is to maximise the impact of the project's outcomes through dissemination and communication to relevant audiences (e.g., researchers, industry, policy makers).

3. ILIAD Objectives

Iliad has set both main and secondary objectives to implement the project's vision. The main objective of Iliad is to provide an interactive framework called the Digital Twin of the Ocean (DTO), which will be based on digital technologies that are compatible with Destination Earth. The DTO will consist of ocean simulators based on high-resolution numerical ocean models, available ocean observation data, and digital analysis toolboxes that will enable the configuration of ocean simulators for what-if

scenarios. Iliad aims to bring together EU infrastructures related to data management, cloud computing, and information and environmental monitoring services through marine observations. The project will demonstrate the value of the DTO approach by engaging pilots for various stakeholders and assemble a diverse user community to address their challenges. Iliad's secondary objectives align with the call objectives and respective Working Packages (WPs), as the project is divided into these packages. These objectives include integrating data from existing and new observatories and automated sensor platforms, increasing citizen engagement, ensuring implementation of data access to model results in state-of-art standards and formats, developing a digital twin of the ocean through co-creation, providing a serviced modeling and simulation environment, demonstrating the DTO impact through testing of pilots, ensuring multi-stakeholder engagement and involvement, supporting industry partners to develop new business models and opportunities, and actively transferring technology and developing businesses. More details on the ILIAD approach and methodology to fulfil theses objectives are available here : https://www.ocean-twin.eu/the-iliad-methodology

4. Overview of SPA/RAC specific tasks

SPA/RAC is an active contributor to ILIAD's development, playing a key role in WP8, WP10, and WP11. Their involvement includes various activities such as attending virtual meetings and webinars dedicated to tasks related to ballast water management (BWM) and Non-indigenous species (NIS) management. In addition, SPA/RAC facilitated and organized a technical online meeting to support the involvement of UNEP/MAP-IMO-REMPEC (REMPEC) as a regional Mediterranean entity in the ballast water pilot.

SPA/RAC identified key policies and regional stakeholders by mapping relevant policies and institutions and involving them in co-design phases or prospective trainings. SPA/RAC contributed to the elaboration of the deliverable D10.1 – Capacity Development Needs Assessment and Roadmap of ILIAD, assessing the capacity development needs for all ILIAD activities and outlining a roadmap for capacity development activities during the ILIAD project period. They attended meetings and organized discussions with OGC to support the data harmonization and validation process.

SPA/RAC also disseminated ILIAD project information, website, and events through their social media channels and email network, targeting the UNEP/MAP system, including the regional centers, the Barcelona Convention Contracting parties, and other relevant regional institutions. Their efforts helped to reach and involve external key stakeholders such as the FAO/GFCM and the UNEP/MAP-IMO-REMPEC in the project.

SPA/RAC made an asssessement of the capacity needs of the pilots teams and is setting a capacity building programme with the support of the ILIAD consortium.

5. ILIAD Progress

Objective		Summary progress
O1	Integrate data from existing and new observatories and automated sensor platforms	The progress towards Objective 1 is on track in the ILIAD project. WP2 has identified and recorded databases containing various data, including from external repositories such as CMEMS, EMODnet, NOAA, and more. The Pilot Digital Twins have been classified into two categories based on their capacity to perform the full loop in systems' automation. The appropriate datasets and parameters needed from external repositories have been identified for each Pilot DT. Seven different sensory systems have been developed, and some have already

		been deployed at testing sites. These sensory systems include the low-cost Hydromast sensor, the microplastic sensor, an unmanned aerial vehicle (UAV), the SeaExplorer glider system, the Docktech synchronized sensors, and the ILVO sensory system. All collected datasets will be transferred to appropriate public databases of EU Initiatives.
O2	Increase citizen engagement, considering cultural and emotional aspects	The progress towards achieving Objective 2 of the Iliad project, which is citizen science and citizen engagement, is also on track. During the first year of the project, the focus was on collecting needs related to the jellyfish monitoring pilot from University of Haifa (UOH) and the Varna port monitoring pilot from Technical University Varna (TUV). Different levels of maturity and engagement were observed among the teams, and the Varna pilot received feedback and experience from several WP3 partners. The first period was dedicated to setting up the different actions related to citizen science and citizen engagement, and actual actions towards the MO and KPI will take place in the next periods. In addition, DUTH developed an algorithm that can collect data from Twitter related to climate change and global warming. The algorithm was tested on a dataset of more than 15 million tweets from 2006 to 2019 in English, and it extracted information such as geolocation, temperature deviation, gender of the Twitter user, stance, sentiment, aggressiveness, and topic of the tweet. This algorithm will eventually be used for Extreme Events Detection for DT focusing on the Oil Spill and the Mucilage monitoring and modeling. The project also identified a sustainable context and framework for citizen involvement in jellyfish reporting and citizen science in Southern European Seas. Training material was collected in different languages and forms, and a catalogue of active citizen science projects was compiled, with a focus on European seas during the first period. During the first 12 months of the project, 15 engagement activities, including training sessions, workshop participation and organization, and conference participation, took place. Two hackathons were carried out, and one press release was published. A total of 212 participants participated in various training sessions. A citizen science framework was also developed, and it was released in January 2023. Tutorial sessions and workshops are planned in 2023 to engage both internal Iliad pilots' partners and external citizens in using the platform.
O3	Ensure implementation of data access to model results in state-of-art standards and formats	Regarding Objective 3, Year 1 has seen significant progress in the development of the Ocean Information Model (OIM), which serves as a framework for organizing and representing oceanographic data. An initial version of the OIM has been created in both OWL

		ontology and JSON-LD contexts, which allows for efficient exchange of OIM-compliant data based on JSON. To ensure the long-term accessibility of the data, persistent identifiers have been registered in the w3id domain. The Jellyfish pilot data has also been successfully integrated into an OIM-compliant format. In addition, a set of tools has been provided to aid in the preparation and integration of data, and OIM data has been made accessible through standard semantic queries and exposed via OGC standard APIs. A dedicated collaborative technical task force, consisting of both WP4 and WP5 partners, has been formed to accelerate progress towards providing access to the model results. Overall, significant progress has been made in Year 1 towards achieving Objective 3.
O4	Develop a digital twin of the ocean through co-creation including data fusion from ocean models and sensors	The work towards achieving Objective 4 is progressing as planned. During the first year of the project, the ILIAD DTO (Digital Twin Ocean) was co-designed by 22 different teams across 13 different ocean fields, with Cultural Heritage being added to the proposal in 12 fields. Multiple pilots utilize the same ontology, such as the MetOcean ontology and model used across the majority of pilots. The ILIAD teams have designed 15 ontologies ranging from wind speed, wave high, fish biomass, shipping fuel costs, to ocean floor sediment. They have also designed 20 models ranging from offshore wind farm maintenance operations risk, financial impacts and risk, water quality, algae bloom, chlorophyll concentration, jellyfish movement, oil spill movement, wave energy production, tidal energy production, fish capture areas, to ocean cultural heritage sites. Additionally, 15 thematic models have been designed, including offshore wind energy, wave energy, tidal energy, oil spill, shipping routing, aquaculture, microplastics, fisheries, ballast water, jellyfish, insurance, harbor safety, ship routing, cultural heritage, and coastal sediment.
O5	Provide a serviced modelling and simulation environment	The work planned towards achieving Objective 5 is on track. The objective involves defining and implementing a reference interoperability architecture that allows for the efficient deployment and running of processing requests with necessary parameters, and makes the results available to users. The architecture is designed to follow open standards and best practices and is being tested with selected pilots. To gather information from different stakeholder groups, two workshops were organized during the second UN Ocean Conference, and an additional workshop was organized during the 2nd ILIAD General Assembly. Pilot leaders had the opportunity to discuss the reference interoperability architecture and API for the service processing layer, standards behind it, and the needs and requirements of the pilots. The pilots currently

		supported in WP5 include Jellyfish, Oil Spill (Cretan and Thracian Sea), North Sea Fisheries, and Varna Port Pilots.
O6	Demonstrate the DTO impact through testing of pilots, or Pilot Context Twins (PCT), with to-date and what-if scenarios	Objective 6 is focused on demonstrating the pilot's relevant impact, but it is too early to report progress since it relates to the actual use of the software that is currently under development. However, pilot mock-ups have been developed and discussed with potential users/stakeholders to validate the team's attempt to work from the translation of requirements to actual hands-on design. The status of pilot developments is updated monthly, with some pilots being prioritized for close developments and alignment with more technical-oriented work packages. These prioritized pilots include Jellyfish, Oil spills, Environmental/water quality monitoring, Aquaculture, and Fisheries North Sea. WP7 was also started earlier in January 2023 to progress faster in this area and allow more time for deliberations.
O7	Multi-stakeholder engagement to ensure that the ILIAD DTO, as an instrument to monitor, assess, and improve policy, has the desired impact—esp. with respect to DestinE and the UN Decade on Ocean Science for Sustainable Development	The objective involves the design of the User Interface (UI) and User Experience (UX) of the Iliad DTO Interactive Environment (IE) and the Iliad Marketplace for discovering and accessing Digital Twins of the Ocean (DTOs). User groups and stakeholders have been consulted from the beginning of the project through dedicated workshops and bilateral meetings to ensure that the products meet the end-user requirements collected. The products will be prototyped in period 2 and stakeholders will be invited to validate them and provide feedback prior to further development phases to allow iteration cycles of development. In addition, the Iliad project has been engaging multiple stakeholders through the implementation of the communication, dissemination, and sustainability plan (CDEP). To date, the data indicates that communication and dissemination activities (excluding scientific publications) reached a total of 49,247 people, with the majority of the people reached being from the general public. The key channels of communication and dissemination reaching stakeholder groups were the project website, social media activities, conferences, workshops, and webinars. Iliad has also been represented at multiple meetings with key stakeholder groups and important collaboration partners, including Mercator Ocean, BlueCloud, VLIZ, Emodnet, and the EC. The text lists the key events where Iliad was represented during the first 12 months of the project. ILIAD events and webinaires are available here : https://www.ocean-twin.eu/events
O8	Support industry partners to create or/and expand their portfolio of DTO and develop new business models and opportunities based on ocean data related services.	The progress towards Objective 8 is being made through the efforts of the Work Package 9 team. They have been providing support and guidance to partners on potential business opportunities and have started developing initial business models based on requirements collected from related activities. The progress made towards the Key Performance Indicators for this objective are as follows:

	Technology Transfer and Business Development	- Number of use cases identified - At the time of the deliverable submission, 15 use cases were identified, but the number has since increased to over 20. - Number of developed and tested mock-ups - Initial mock-ups have been created but not yet tested, as per the plan. - Number of end-to-end solutions using real-world data - All solutions are likely to use real-world data, but as planned, these are not yet operational in this first reporting period. - Number of DTOs (Digital Twins) with added functionalities - All digital twins being created will have added functionalities and novelties beyond current state-of-the-art. - Number of collaborations with industry to ensure fast adoption - Most implementations will include industry partners from the Iliad consortium, and all will try to involve actual potential customers in prototype testing when it occurs, as per the plan. In summary, progress towards Objective 8 is being made with the identification of over 20 use cases, initial mock-ups created, and development of business models based on requirements collected. The digital twins being created will have added functionalities beyond the current state-of-the-art, and collaborations with industry partners from the Iliad consortium will ensure fast adoption.