Iliad

Iliad Newsletter

The Iliad consortium develops virtual representations of the sea that will integrate earth observing, modelling and digital infrastructures to provide predictions of future developments "at sea".

December 2023

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In this issue

Editorial

Iliad is progressing well on all fronts with the first pilot Digital Ocean Twins (DTOs) and the Iliad Marketplace set to launch in the new year.

The new Iliad website, that will be the home to the marketplace, has recently been launched at ocean-twin.eu.

A current focus is the upcoming Plenary Meeting, which will take place on the 19th to 20th December 2023 in Barcelona. The primary focus of this meeting will be the unveiling of 12 pilot DTOs and spotlighting the progress achieved so far in the project. Watch for updates on the project website and social media channels over the coming weeks.

As we approach the end of the second year of the project, we take this opportunity to reflect on some of the highlights of the project so far and the exciting products and services that are set to launch.

This newsletter will give a flavour of the Iliad project, its objectives and approach as well as its position in the European landscape. We highlight some of the innovative Iliad pilot DTOs, the Iliad Marketplace, the Iliad Academy and the Iliad Blue Technology and Business Innovation Facility (BTBIF). This edition will set the stage for the project products and services, contribution to European DTOs, training and capacity building facilities and contribution to EU Blue Growth.

We are excited for 2024 and we hope you enjoy reading this.

The Iliad Coordination and Management Team

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Project Summary

Charalampos Ipektsidis, Netcompany Intrasoft (Project Coordinator)

The ocean, this vast body of water, is highly complex. It consists of geophysical, biological, and chemical components that continuously interact along with our human activities. To reflect this complexity when developing Digital Twins of the Ocean (DTOs), numerous data sets, models, technologies and knowledge are necessary. The European community has over the years created and developed powerful resources that enable us to implement a variety of DTOs.

The Main objective of Iliad is to provide Digital Twins of the Ocean (DTOs) as an interactive framework based on digital technologies compatible with Destination Earth, including ocean simulators based on high-resolution numerical ocean models, available ocean observation data, as well as digital analysis toolboxes that allow configuration the ocean simulators for "what-if" management and policy scenarios.

Iliad DTOs will bring together EU infrastructures related to data management, cloud computing and information and environmental monitoring services via marine observations.

Iliad will create and implement a DTO framework, which will function as a domain specific precursor of the Destination Earth DTO.

Iliad will demonstrate the value of the DTO approach through engaging pilots for a variety of stakeholders. Iliad will assemble a broad and diverse user community of existing and new users who will use the project's innovative technological solutions to address their challenges. Exemplary showcases and pilot demonstrators will show impact and promote user uptake.

The Iliad Approach

The Iliad approach to developing DTOs reflects the diverse nature of the European ocean landscape. Rather than creating one single twin, the federated nature of Iliad DTOs reflects the wide array of needs, requirements, and stakeholders that we expect will drive forward the Digital Ocean of the future. The focus of Iliad is therefore to equip stakeholders with the tools they need to build DTOs tailored to their needs and, more importantly, ensure these Digital Twins (DTs) are interoperable with each other and the wider European and international Digital Twins community.

The Iliad project has an ambition to take advantage of the ongoing development of European Data Spaces in general and to interoperate with the European Green Deal Data Space in particular.

Project Summary

Continued...

Data spaces and other data resources

One of the nine proposed sectorial European data spaces is the Green Deal Data Space (GDDS). The vision of this data space is to ensure the effective and efficient reuse of heterogeneous data in support of all stages of environmental policies, to meet the objectives of the European Green Deal.

The requirements for the European Green Deal Data Space include, among others, harmonisation, documentation, and exposition of geospatial environmental data in accordance with legal provisions, to preserve privacy when reusing citizen-generated data on the environment, and to provide licensing information alongside the data to ensure their reusability.

With the ongoing development of European Data Spaces, the Iliad strategy is to align and harmonise with the ongoing development with a strong link to the European Green Deal Data space and also to further use and enhance the data sharing activities in the Ocean community.

What is Iliad?

What: Iliad provides Digital Twins of the Ocean (DTOs) to represent marine systems in virtual environments, accessible through a central marketplace and demonstrated through key innovative pilots.

How: The DTOs provide real-time, interactive access to integrated data, tools and information from marine monitoring platforms, services and models, allowing complex analysis, simulation and predictive management scenarios

Why: The DTOs support planning and decision-making on conservation, environmental and socio-economic objectives for a range of stakeholders and end-user groups

Spotlight on Iliad Pilot Digital Twins

The Iliad pilot DTs are being co-created directly with stakeholders across energy, fisheries, aquaculture, marine traffic, environmental/pollution monitoring, biodiversity, insurance, harbour safety, plastics, sediment transportation, oil spill, jellyfish, swarms, among many others.

The Iliad pilot DTs will be available via the Marketplace, which is set to launch at the beginning of 2024.

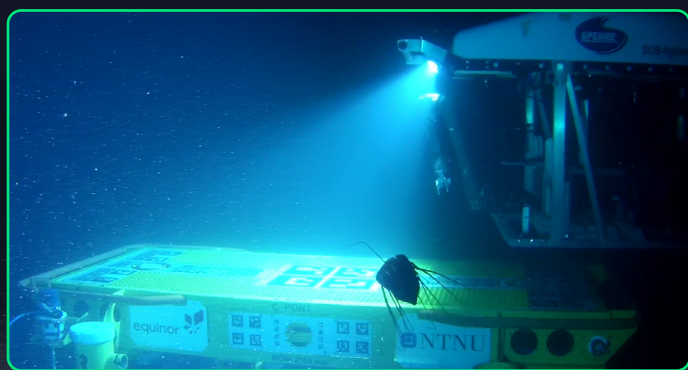## Iliad Pilot: A Digital Twin of the Trondheim fjord for water quality monitoring

Ute Brönner[1], Antonio Vasilijevic[2], Raymond Nepstad[1], Emlyn Davies[1], Halvar Gravråkmo[2]

[1] SINTEF Ocean, [2] NTNU

The Trondheim Fjord, alternatively referred to as Trondheimsfjorden (pronounced [ˈtrɔ̂n:(h)æɪmsˌfjuːɳ]), is a substantial inlet of the Norwegian Sea and ranks as the third-longest fjord in Norway with a length of 130 kilometres (81 miles). Situated in Trøndelag county in the west-central region of Norway, the fjord spans from the municipality of Ørland in the west, all the way to the municipality of Steinkjer in the north. Along its path, it passes significant locations such as the city of Trondheim, the Trondheim airport, and some of the country's prime agricultural lands. The Trondheim Fjord has an impressive maximum depth of 617 metres (2,024 feet), found between Orkland and Indre Fosen. It is known for its diverse marine life, housing both southern and northern species; a noteworthy fact is that at least 90 fish species have been recorded in its waters. Additionally, the Trondheim Fjord is recognised for having the highest biological production among Norwegian fjords. In recent times, discoveries have revealed the presence of deep water corals (Lophelia pertusa) within the fjord, in proximity to the city of Trondheim. The fjord is also an important waterway for the Coastal Express Route 'Hurtigruten' and cruise ships visiting Norway ("Trondheim Fjord". Retrieved June 28, 2023, from https://en.wikipedia.org/wiki/Trondheim_Fjord)

SINTEF and NTNU, with backing from the Norwegian Research Council and Equinor, have initiated the establishment of OceanLab. This facility in the Trondheim fjord aims to provide a full-scale testing and research platform in the ocean environment. Its ultimate goal is to meet upcoming demands in education, research, and innovation within marine and maritime sectors. Even though it's still under development, some aspects of the infrastructure are already partially available to academic and industrial partners as well as research organisations. Upon completion, the OceanLab infrastructure will be incorporated into the future Norwegian Ocean Technology Centre ('Norsk havteknologisenter') Fjordlab, thereby further enhancing its capabilities and offerings


OceanLab. Retrieved June 28, 2023, from https://www.ntnu.edu/oceanlab.

Iliad Pilot: A Digital Twin of the Trondheim fjord for water quality monitoring

Continued...

Given its rich biodiversity and importance for the region, SINTEF Ocean, with its department for Climate and Environment and NTNU AUR Lab are developing a Digital Twin based on sensors deployed within OceanLab and data from operational ocean models, e.g. Norkyst800 by the Norwegian Meteorological Institute, to monitor water quality and alert pollution or other irregular events. The twin will also be used to understand transport patterns for marine litter or other objects in the fjord area which will inform stakeholders for safe and secure operations in the fjord.
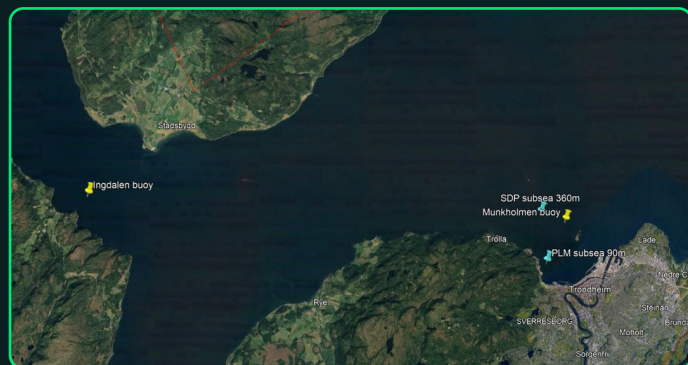

The twin employs temperature, salinity and current data from currently two locations in the fjord (the yellow ones in the map above) and uses the Munkholmen buoy site data for transport of observed matter in a time window of -6 to +6 hours from the current time.

In the case of an event, more frequent data retrieval and more instances of the transport models will inform potential response (pollution), search and rescue (lost objects) or planning of operations (marine litter). In the case of extreme weather events that might lead to sewage discharges, there will be modelling of matter at known locations for water quality assessments. For the general public, we report water temperatures and wind at known locations for leisure (bathing, diving).

Data will be combined with AIS data for ship traffic for contextualization.
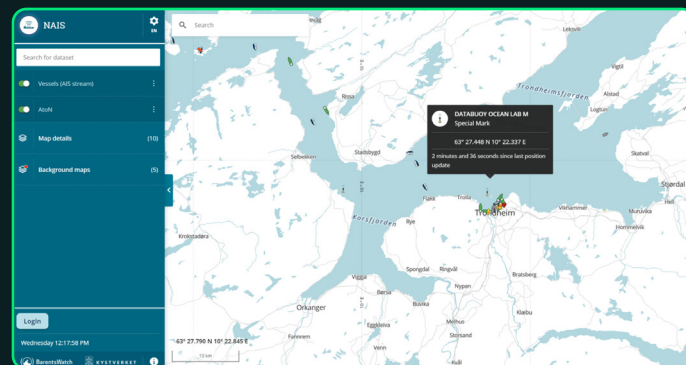
The water quality pilot is rather generic and will be enhanced with other data and other functionality for an aquaculture pilot in (middle) Norway that looks into water quality and transport for operation planning, algae warning and infection network and another one to provide risk metrics for aquaculture insurances. Outside Iliad we plan to enhance this work for governance of the Trondheim fjord, services to maritime transport and the autonomous shipping test area in OceanLab and SINTEF and NTNU research. Research projects include autonomous subsea intervention, CO2 and methane from waterborne and landborne transport, seagrass and other biodiversity monitoring, noise and light pollution and seaside support for Trondheim becoming smart and climate-neutral by 20230.

# Iliad Pilot: Hydrographic survey in Thracian Sea using a glider

Georgios Sylaios, DUTH

The scientific team from Democritus University of Thrace (DUTH) launched in summer 2023 the first mission of ALSEAMAR's SeaExplorer glider, to monitor water column hydrography, currents and marine life, as part of Iliad's Thracian Sea pilot Digital Twin. The glider is a state-of-the-art vehicle, carrying novel sensors, like the UVP6 camera, capable of taking photos of plankton abundance and diversity and the ADCP collecting currents and fluxes along its course. The system provides detailed, real-time information on the water column dynamics, from surface to the depth of 1,000 m, in the environmentally-vulnerable region of the North Aegean Trough.

Data will reveal the thermally-induced changes in water column stratification, under climate change conditions, the patterns and response of the deep chlorophyll maximum layer and the level of oxygenation of the deeper parts of the Trough. Parameters like water temperature, salinity, dissolved oxygen, turbidity, chlorophyll-a and CDOM concentration, together with the three-dimensional currents throughout the water column, and the images of plankton (phyto-, zoo- and ichthyo-plankton) at areas of its increased presence have been monitored.
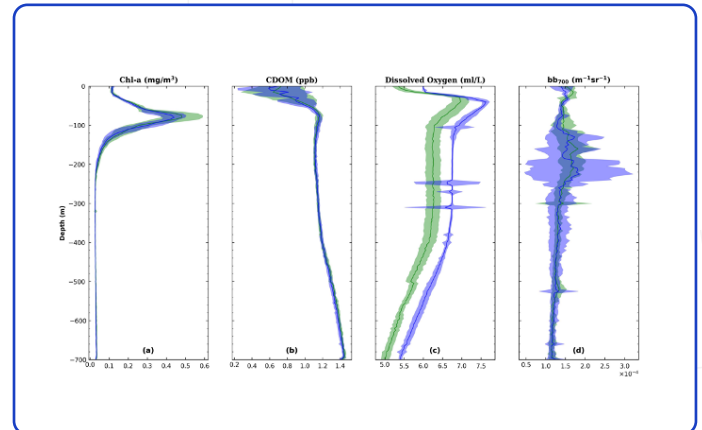
The mission aims to provide insights on stratification/mixing drivers and impacts, and improve the performance and forecasting capacity of oil spill simulations in the area. Oil weathering processes like evaporation, biodegradation, flocculation and sedimentation will be better described utilising the glider-collected data. Furthermore, the mission will provide data on the trophic level of the area, its interrelation with the Black Sea Water outflow from the Dardanelles and the local river plumes enriching the waters in nutrients and organic matter. The glider moved along a triangular track, repeated twice over this mission, starting from the Athos Basin in the central North Aegean Trough, the southern part of Thassos Island and towards the western Samothraki Island.

Iliad Pilot: ILVO North Sea Fisheries Digital Twin

Clyde Blanco, ILVO

The North Sea Fisheries pilot is developing a digital twin of the Belgian fisheries aimed to provide a suite of decision support tools for a more economical and selective fishing activity. This pilot serves as an expansion of a local project called VISTools which uses fishing vessels as data collection platforms.

This project is developing a system for fishers and vessel owners where they can gain high resolution and real-time insights in their operations. Five test fishing vessels are equipped with onboard sensors that collect data on weights and locations of catch and fuel consumption of each fishing tow. This information, coupled with fish and fuel prices, gives vital insights of the fishing operations to vessel owners on land. Data collection, streaming, processing, basic analytics, and visualisation are already operational for 4 fishing vessels. The online dashboard of VISTools is shown in Figure 1. Additional hitch-hiking environmental sensors are also attached to the fishing nets which collect depth profile of salinity, temperature, and turbidity during towing. However, these sensors prove to be difficult to work with. A new generation of NKE sensors will be launched later this year and these will replace the current sensors in the pilot.

The high resolution (spatial and temporal) catches and fuel consumption data collected in VISTools sensors can be essential input data to build predictive models that can be used as decision support tools.

This pilot is currently developing three models – catch prediction, fuel efficiency, and ecosystem models. The catch prediction model utilises the catch data gathered by VISTools which is enriched by data from other sources such as eLogbook, fisheries observer, and ICES bottom trawl surveys. This is coupled with environmental data from Marine Copernicus and EMODnet. Using machine learning, the presence and absence of catch is modelled using the environmental parameters as predictors. The model is still in its initial phase and further improvements are still needed. However, this initial version can already be used as a test bed for model containerization and operationalization. The outputs of the catch prediction model are expected to guide fishers in planning the best grounds for fishing sole (Solea solea) and European plaice (Pleuronectes platessa). The fuel efficiency model is based on the ship routing model built by the Foundation for Research and Technology – Hellas (FORTH).
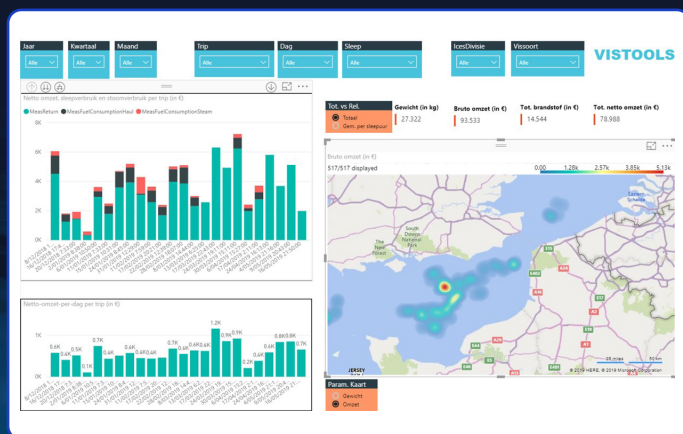

Figure 1. Interactive VISTools dashboard showing the locations of catch (right panel), fuel consumption during fishing and steaming (upper left panel), and net revenue (lower left panel) of each trip.

Iliad Pilot: ILVO North Sea Fisheries Digital Twin

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This is further customised for the Belgian fishing vessels and the model will be validated using the fuel consumption data gathered by VISTools. By indicating a start and end points, this model will suggest the best route that will optimally consume fuel, taking into consideration the forecasted weather conditions at sea. Presently, the model is still in the parameterization stage. The ecosystem model on the other hand is being implemented using the Ecopath with Ecosim software. This model is a representation of the southern North Sea food web with a focus on commercial species and including the different fishing fleets in the interactions. It uses the 1991 ecosystem snapshot (Ecopath) of the southern North Sea ecosystem as the base of the model. Ecosim is then used to simulate the evolution of biomasses of each functional group through time. This model is suited in testing different "what if" scenarios and how it will affect the whole ecosystem being studied. The Ecopath is already balanced and the Ecosim module is being developed.

A minimum viable product (MVP) of all aspects of the pilot is expected to be operational by the last quarter of 2024. At the present, the real-time data collection part of the pilot is already operational and is ready to be connected to the other pilots of the federated ecosystem of ILIAD. The modelling aspect is foreseen to be ready by the end of the year.

The mock-ups of the model output visualisation are shown in Figures 2 and 3.
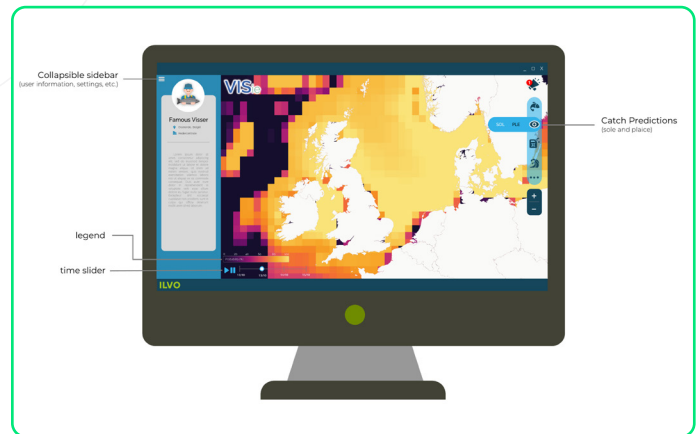
Figure 2

Figure 3

Iliad Marketplace

Si Keeble, Blue Lobster IT Limited
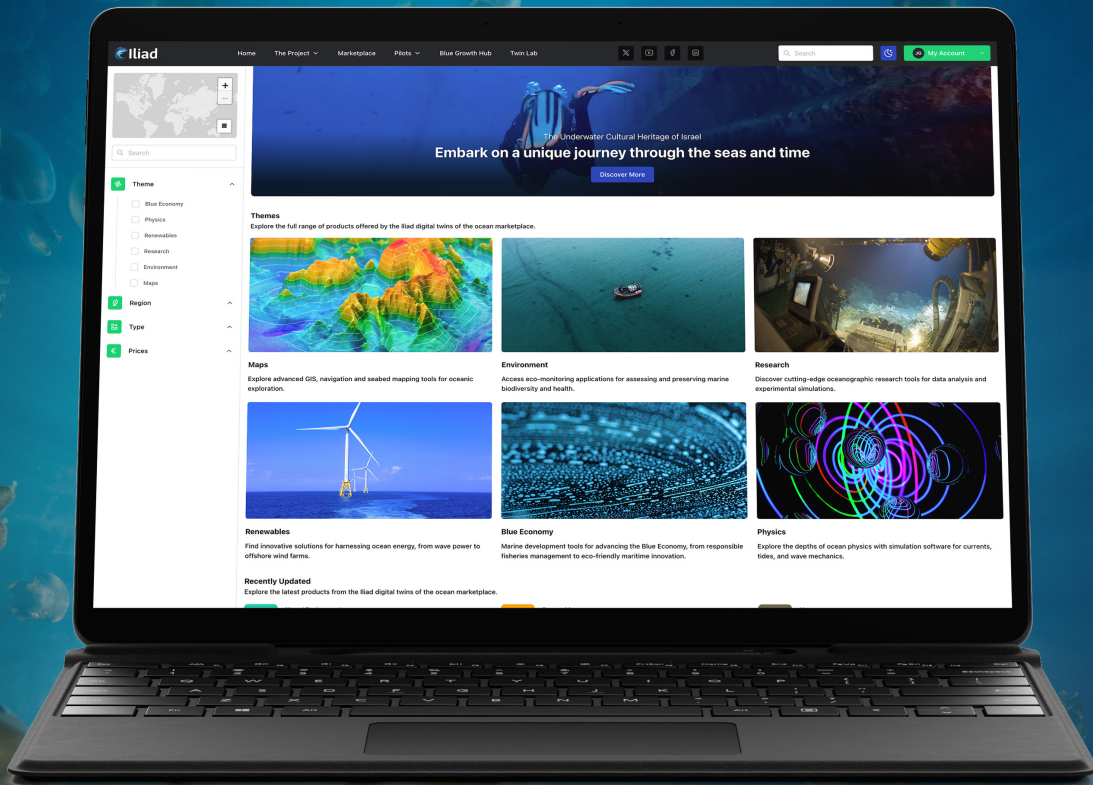
The Iliad marketplace, set for launch at the beginning of 2024, will act as a central hub, facilitating the discovery, access, and utilisation of pilot DTs (and their component parts) in alignment with the FAIR Data principles.

The marketplace will be open to all creators of DTOs to provide a central platform for DTO discovery and knowledge sharing. This initiative is complemented by the advent of TwinLab, an innovative space fostering the Collaborative Development and Co-design of DTOs. TwinLab serves as a crucible for sharing components of nascent DTOs, promoting a community-driven approach where pilot projects can evolve into mature services, subsequently integrated into the Marketplace.
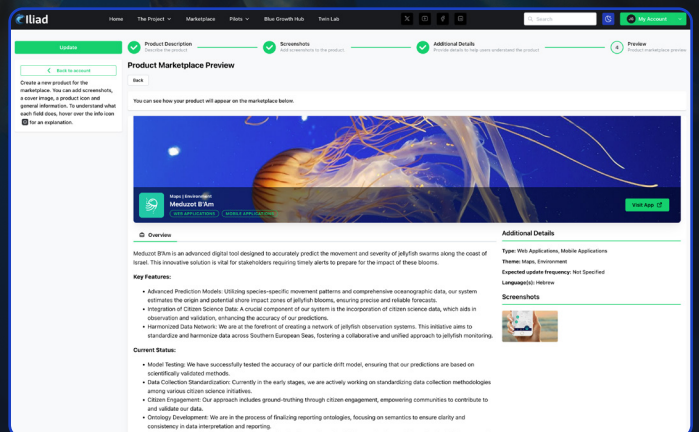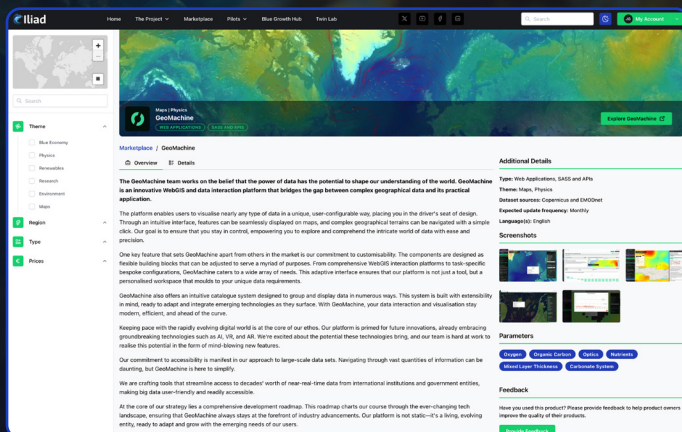
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Iliad Academy

Garabet Kazanjian, American University of Armenia (AUA)

The Iliad Academy, an important component of iliad's Innovation Booster support, will serve as the educational and capacity development hub for the project and beyond, hosting content related to ocean digitalisation, twinning, marine sustainability, and blue economies. In addition to its online hub, the academy will also organise physical activities offering training and workshops to address the following needs:

1. Fulfil the internal capacity building needs of the Iliad consortium and its associated partners

The Iliad academy will organise and/or host all the training sessions, workshops, and materials needed to share the knowledge and expertise with all consortium partners and other relevant European projects. When appropriate, these sessions will be recorded and made available on the platform, for further later use. Any developed toolkits, guidelines, tutorials, or training material could also be made available publicly at a later stage.

2. Cater to the training needs of end-users to benefit from offered DTO tools and developers to add services to the Iliad Marketplace

The Iliad academy will host all training material to help end-users understand the functionality of the Iliad DTO, facilitate the usage of the offered applications on its marketplace, and support companies that want to have their services offered on it. This can include application documentation, guidebooks, tutorials, webinars, training sessions, standards, and best practices. These offerings will be co-designed by receiving continuous feedback from end-users and developers alike to better understand their needs and challenges. The academy will host diverse, multi-disciplinary content from technical capacity development, to business management support, and policy development and compliance It will also host material it receives from the Iliad Blue Technology Business Innovation Facility (BTBIF) and the Iliad Policy Impact Hub (PIF).

3. Provide online and in-person educational and professional content related to Blue Growth and ocean sustainability

The Iliad academy will curate the aforementioned training and capacity-development material and receive additional content from partners to offer to educational institutions as online/offline courses, MOOCs, and to businesses as certificate training programs to their staff.

Currently, you can use the Iliad academy to access the Iliad webinar series, as well as to find relevant a body of knowledge on ocean best practices, data sharing and management principles, and insights on interoperability from project partners.

The Iliad academy also organised the first Digital Twins of the Ocean Summer School in September 2023 at the Marine Observatory of Al Hoceima, Morocco.

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A look ahead to the Iliad Blue Technology and Business Innovation Facility (BTBIF)

Michael Kouchakdjian, American University of Armenia (AUA)

One of the missions of the Iliad DTO is to create platforms for promoting, managing, supporting, and developing the technological and innovation outputs for Blue Growth. These deliverables include data, services, software, knowledge, solutions, tools, models, etc. which build capacity and provide availability of the fruits of Iliad DTO to a broad and diverse user community that consists of both existing and new users.

Within the cluster of outputs are included platforms consisting of the Iliad Academy, Iliad Marketplace, Iliad Digital Blue Growth Hub, and the Iliad Blue Technology and Business Innovation Facility (BTBIF). At the core of the BTBIF is the concept of commercialisation and business development – a platform to commercialise, create value, and monetise the multitude of technologies and innovations that come out of the DTO which can provide the foundation for long term sustainability and future growth.

There are multiple approaches to commercialisation of innovation and technology which will be supported by the BTBIF.

- Licensing and Technology Transfer to Commercial Partners
- Development of Products and Services with Direct Selling and Marketing
- Startups and Spin-off Ventures
- Partnerships, Strategic Alliances, and Joint Ventures with Established Firms
- Intellectual Property Monetisation

To this end, the BTBIF will serve as the platform that guides and connects to services, opportunities, and support mechanisms through Iliad partners to promote technology transfer, business development, business incubation and accelerations programs, partnering, advising, mentoring, coaching, funding identification, and investment. Support may also include assistance to identify solutions for implementation in terms of: a) start-up operations, such as identification of incubators, third party support for management – legal, administrative, b) investors (e.g. identification of venture capitalists in the market sector, identification of business angel networks), and c) identification of financial instruments for start-ups or new businesses from banks, local governments, national funding, identification of crowdfunding platforms and schemes.

Initial approaches for directing commercialization will be linkages with existing European entities, organisations, and resources such as Horizon Europe, European Innovation Council, European Investment Fund, Enterprise Europe Network, European Patent Office to name a few.

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European Digital Twin of the Ocean

A leap in ocean knowledge and sustainable action

Guest article: EDITO building the operational core of the European Digital Twin of the Ocean

By Lilian Diarra, Mercator Ocean

Launched at the end of 2022, the European-funded project EDITO-Infra, is developing a public operational infrastructure for the European Digital Twin of the Ocean. Implemented by Mercator Ocean International and VLIZ, the project combine and integrate key data publishing components of the existing EU ocean observing, monitoring, prediction data programmes and services, namely, the Copernicus Marine Service and the European Marine Observation & Data Network (EMODnet) into a single digital framework.

EDITO-Infra will support the development of a new generation of ocean numerical models and simulation environment being developed by a sister interdependent R&D project EDITO-Model Lab. EDITO-Model Lab will build a state-of-the-art core model suite, based on modelling and simulation software, artificial intelligence, algorithms, and specialised tools to form a new service capacity for accessing, manipulating, analysing, and understanding marine information, with enhanced ocean forecasting and ocean climate prediction capabilities.

Within this context, the EDITO projects will construct a thriving digital ecosystem for the further development of the European Digital Twin of the Ocean, hosting the deployment of multiple sectoral and local digital twins, from other related initiatives, including Horizon Europe Iliad (pilot applications) and the Mission Lighthouse (European seas) projects.

Iliad's contribution to EDITO will be twofold. The digital twins developed will be interoperable with EDITO-Infra and will feed the data lake, as well as be integrated in the core engine providing additional simulation and prediction capabilities for industrial applications related to Iliad key areas.

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Upcoming Events

Iliad Plenary Meeting 2023
19-20 December 2023, Casa de Convalecencia, Barcelona

The International Event on Marine Conservation Databases and Digital Transformation
4-6 March 2024, Al Hoceima, Morocco (and Hybrid)

11th Annual World Ocean Summit and Expo 2024
11-13 March 2024, Lisbon, Portugal

2024 Ocean Decade Conference
10-12 April 2024, Barcelona, Spain

IMDIS 2024
27-29 May 2024, Bergen, Noway

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