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Marine domain in OGC
Federated Marine SDI
Iliad

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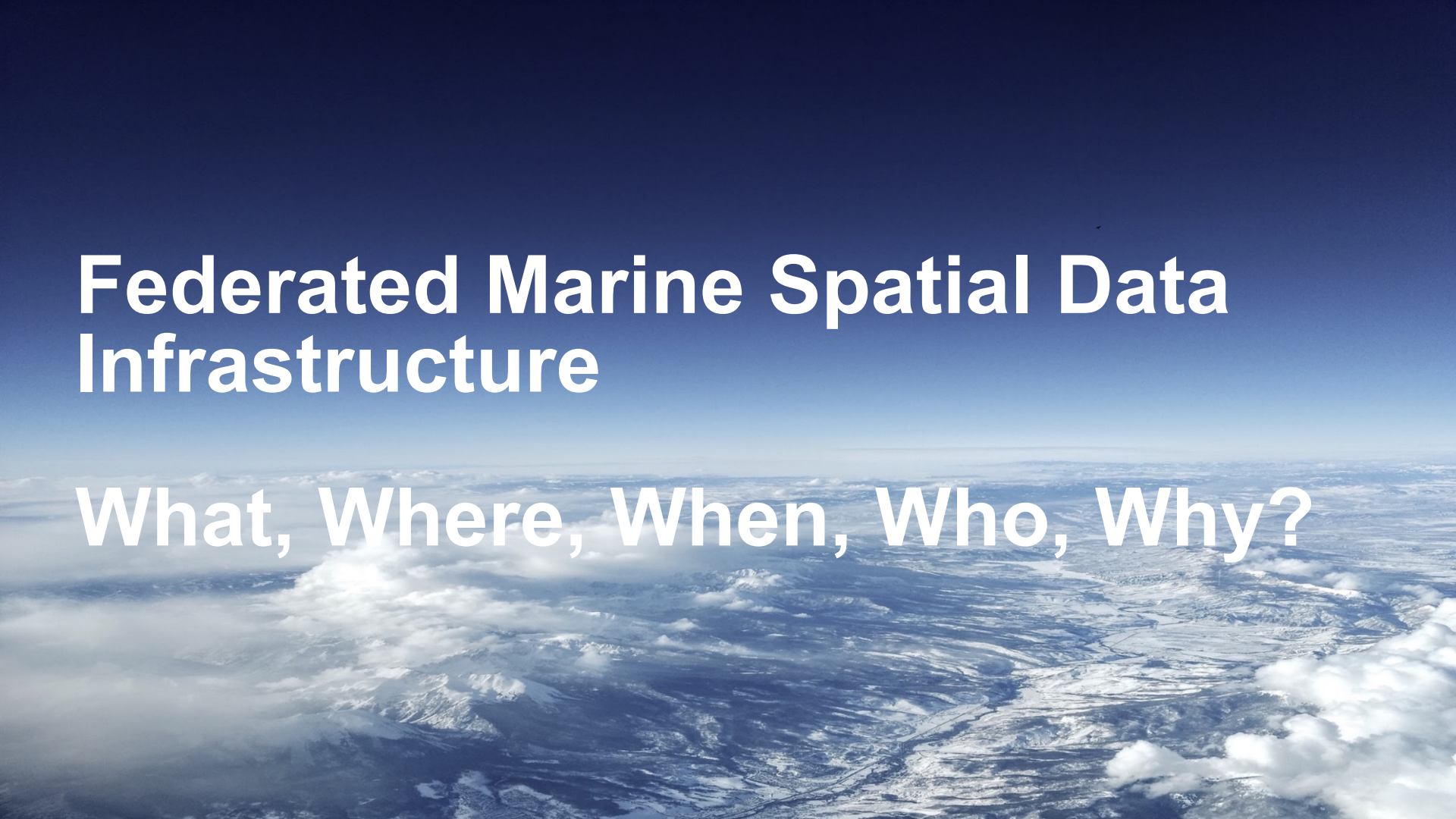
5 May 2023


Federated Marine Spatial Data Infrastructure
What, Where, When, Who, Why?

FMSDI Pilot Projects

Why?	• Climate **Change** impacts • Disasters impacts: storm surge, change in biodiversity, grounded ships • New use cases for example for navigation datasets
What?	• **Federated** effort • **Interoperability** between land and sea especially coastal areas • FAIR principals, efficient data usage and analysis
When?	• Started at August 2021 • went through **3 phases** • April to October 2023, Current phase of the project
Where?	• North Sea and Baltic Sea • Arctic • Singapore, Canadian Arctic, Caribbean
Who?	• Hydrographic offices, Transportation, Marine Biologists, coastal guards, academics, businesses. • Governments, Local Governments, Private organizations, etc. • All of us!

FMSDI Initiative inception

A project within OGC Collaborative Solutions & Innovation (COSI)

Demonstrate aspects of multi-country/region Federated Marine Spatial Data Infrastructures:

- **Stakeholders** - Inclusivity – future focus on less developed regions
- **Delivery** - Demonstrate how federated Marine SDI can provide simple, secure access using modern standards based approaches (OGC APIs, IHO S-1XX), ISO); FAIR
- **Areas of interest -** Baltic and North Sea, Arctic, South East Asia, Caribbean
- **Theme:** Unlock the value of data for Non-navigational applications

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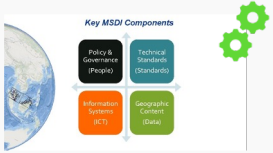
Incremental development

Timeline - Marine Domain

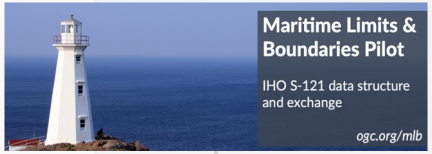
Understand status quo

Protected areas at OGC API endpoints

Complex scenarios, new areas



OGC Marine DWG Approved



2016

Now

Supporting Work

UN-GGIM

Standards Guide Edition 3 (Aligned with IGIF)

"Where do I start?"

ISO

IHO Open Geospatial Consortium

First joint IHO MSDIWG and OGC Marine DWG Meeting

IHO Open Geospatial Consortium UN-GGIM

First joint IHO MSDIWG, UN-GGIM WG and OGC Marine DWG Meeting

Now

Arctic. Canada

Digital Twins

Land/Sea, Singapore

Marine Data Interoperability in the Caribbean

FMSDI Phase 1-3 Initiative Sponsors

Danish Geodata Agency

UK Hydrographic Office

NGA NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY

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Phase 1:
RFI on Marine Data Resources
(Focus on Marine Protected Area)

Understand
status quo

RFI: What data is served at what API?

Dominant legacy OGC standards role
Significant IHO stake

Increasing modern exchange including APIs and Linked Data

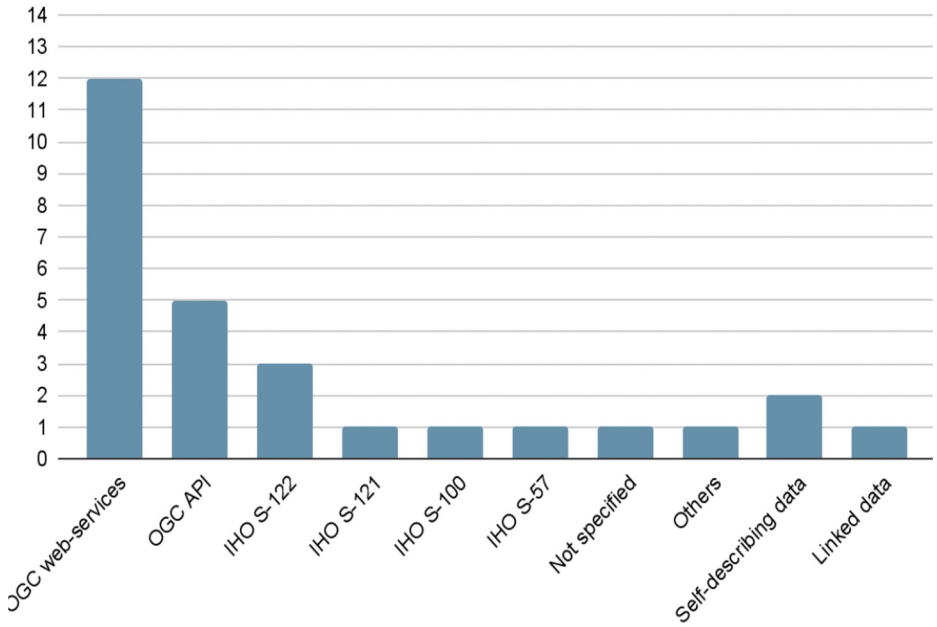
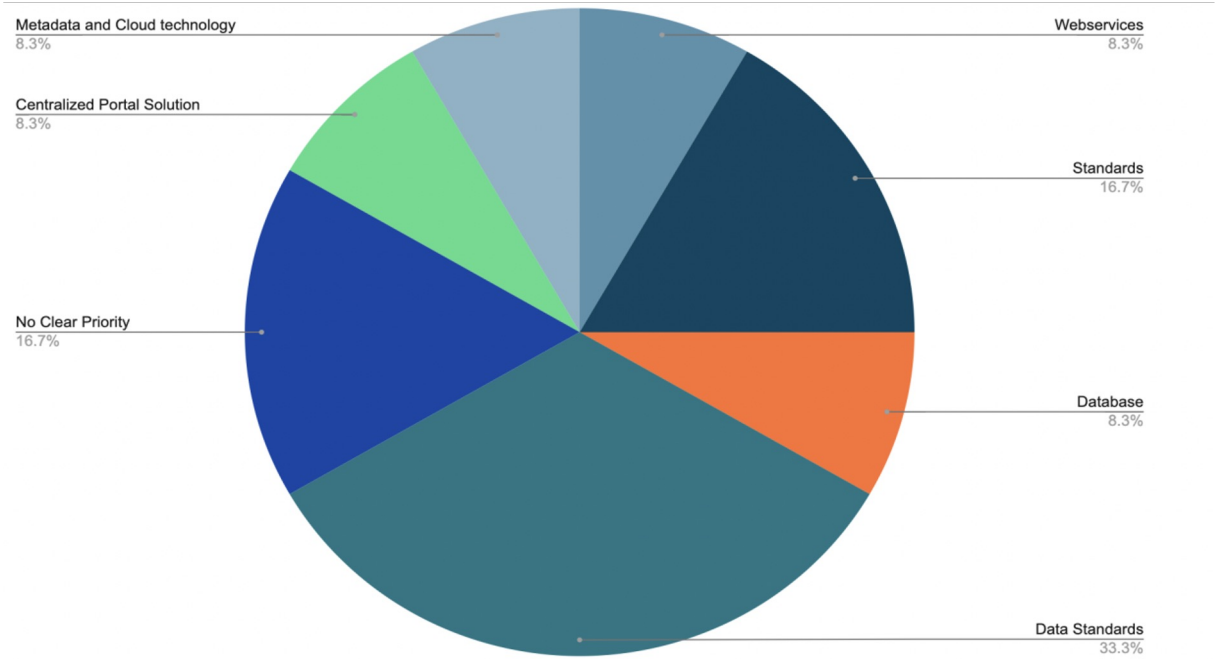


Figure A.8 – Summary of the answers from 14 respondents regarding what current and/or emerging open international standards they employ within the context of an MSDI.

Key SDI Technology and regional strategy



- The need for international collaboration in the FMSDI is prominent
- A regional approach for the FMSDI may be best
- Regional established MSDIs shall coordinate with neighboring regions for interoperability and share best practices

Phase 2:
IHO and OGC Standards Applied to Marine Protected Areas

Demonstrate marine protected areas at OGC API endpoints

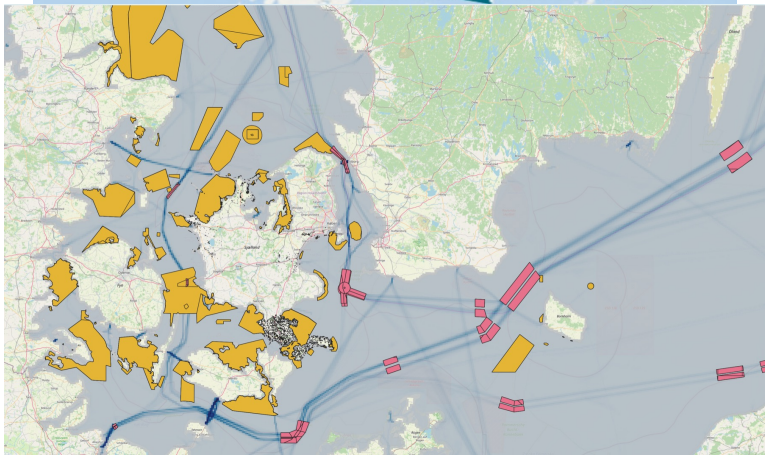
UNGGIM-IGIF derived maturity model for Marine SDIs

Phase 2: Summary & Participants

- Demonstrate access to **Baltic/North Sea Federated Marine Protected Area** (MPA) data for a wider variety of end users outside of the traditional MSDI domain.

- Demonstrate marine data infrastructure beyond IHO S-1xx data (greater fidelity, mobility, and variety of data and standards (e.g. terrestrial, meteorological, earth observation, online sensors, etc.))

- Test and improve marine data accessibility and analysis with **modern OGC APIs**



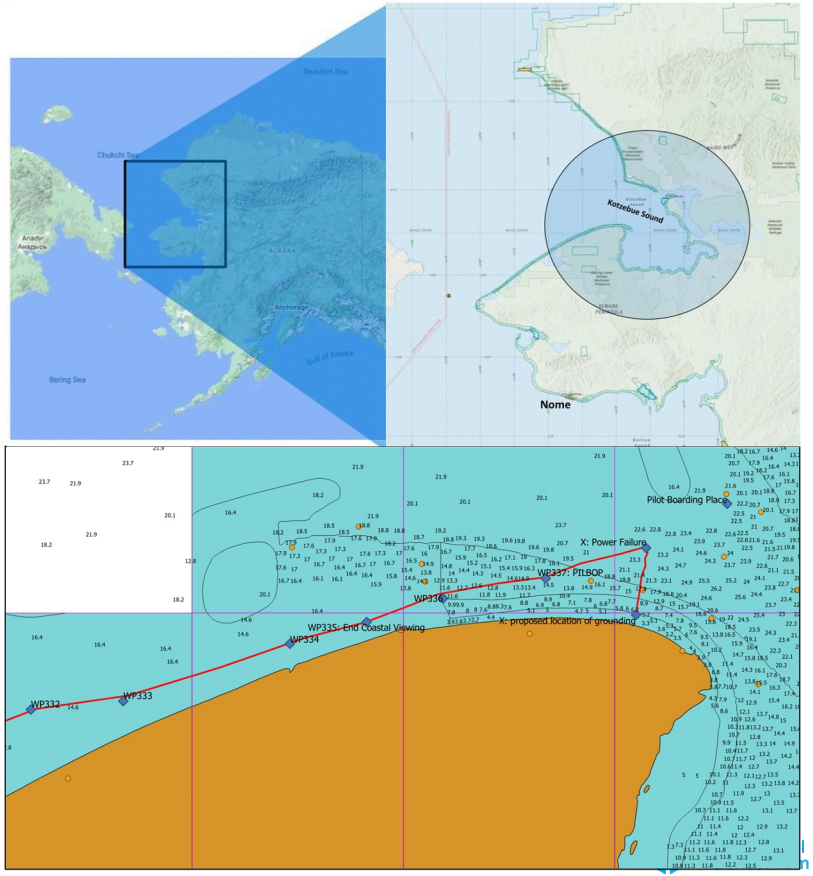
Phase 3:
Connecting Land and Sea to Protect the Arctic Environment

Extend to new location: Arctic

Add more data, more services to address more complex scenarios

Overarching Scenario

- Significant increase in shipping traffic in last decade; increased risk
- Discovery grounded in an ecologically sensitive area, namely the Bering Land Bridge National Preserve.
- A sea-based, transportation, health, and safety scenario incorporating the land/sea interface in Alaska
- National parks and Large Marine Ecosystems (LMEs) with challenging navigation conditions

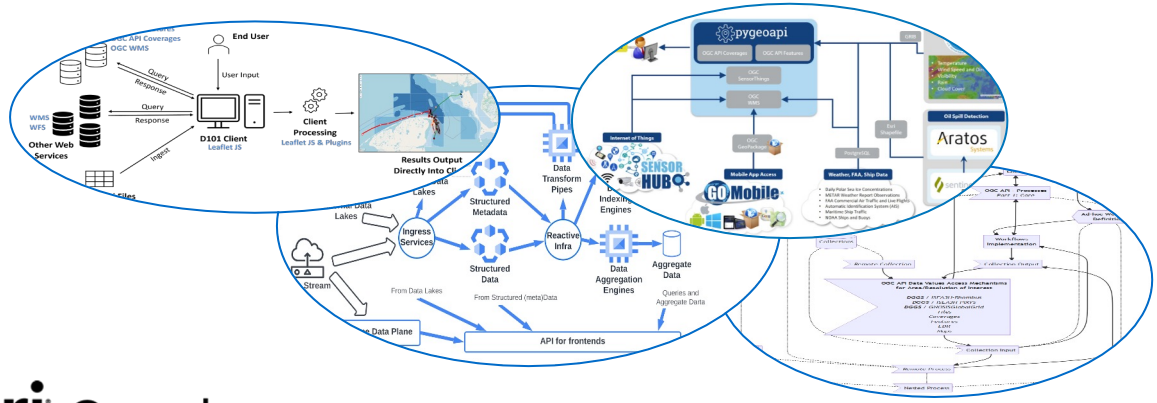


Phase 3: Participants Sub-scenarios

- **Search and rescue mission**
- Explore land/sea interface through standards currently relating to **Maritime Safety**,
- Vessel **vulnerability**
- Detecting and simulating **oil spills**

- Current **information to crew** based on the data layers included in the Arctic Voyage Planning Guide (AVPG) and others
- **climate change** and effects on persons living in the Arctic region,
- **Erosion, projected sea level rise/climate** change model-based RCP scenarios, lost permafrost, with known geological conditions that indicate shoreline erodibility.

Interoperability in action



COMPUSULT

Ecere corporation

esri Canada

IIC TECHNOLOGIES

- Proved flexibility in various architectures and scenarios
- Importance of implementations, esp. for complex problems
- Fit for purpose and good practices
- **Denied, Degraded, Intermittent, or Limited Bandwidth (DDIL)** environments: Proved to be a challenge.

HELYX™

SCHULICH School of Engineering Geomatics Department — UNIVERSITY OF CALGARY

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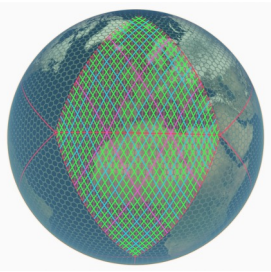
Further needs



Access to raw sensor and telemetered data is scarce, white stains

Data exchange standards may not align with data management standards

- especially problematic with time-dynamic data

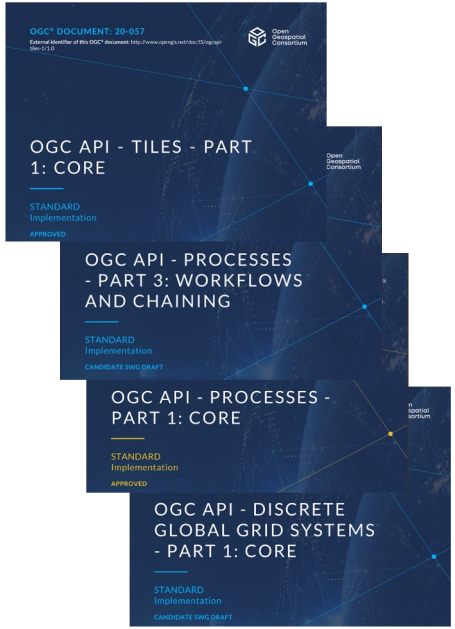
Architecture lock-in may result if data standards are too rigid

- Alternative platforms are valuable for identifying and overcoming

DGGS representation effective for arctic areas but:

- challenging for clients
- various complexity for various atom shapes

Implementations of the emerging standards



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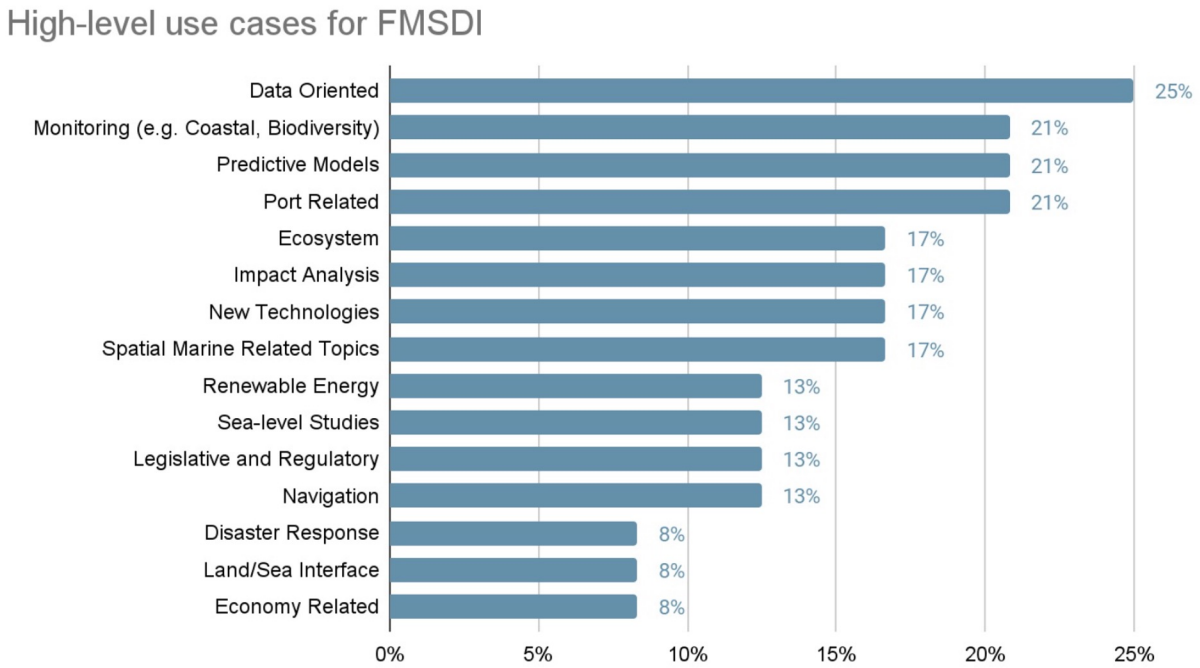
Engineering Report of Phase 1 & 2
Towards A Federated Marine SDI:
IHO and OGC Standards Applied to Marine Protected Areas

Phase 3: Survey on User Community Needs



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FMSDI Reports

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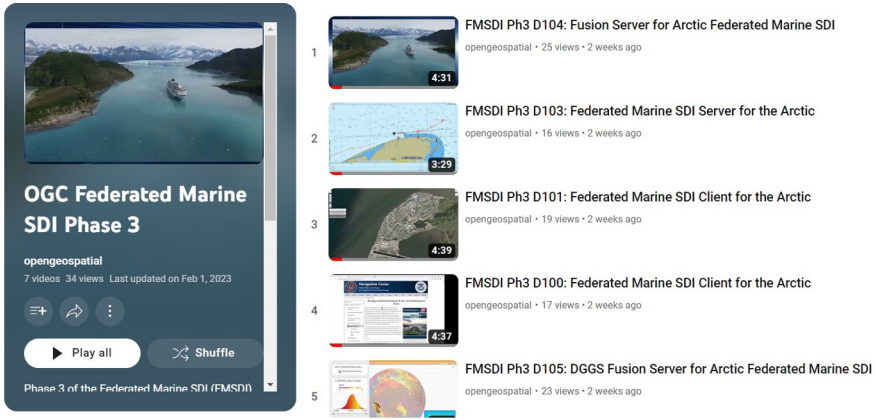
More FMSDI Content

FMSDI Pilot Phase 1, 2, 3 Playlists



Additional OGC Marine SDI videos are available here:

https://www.youtube.com/@opengeospatial

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The Present

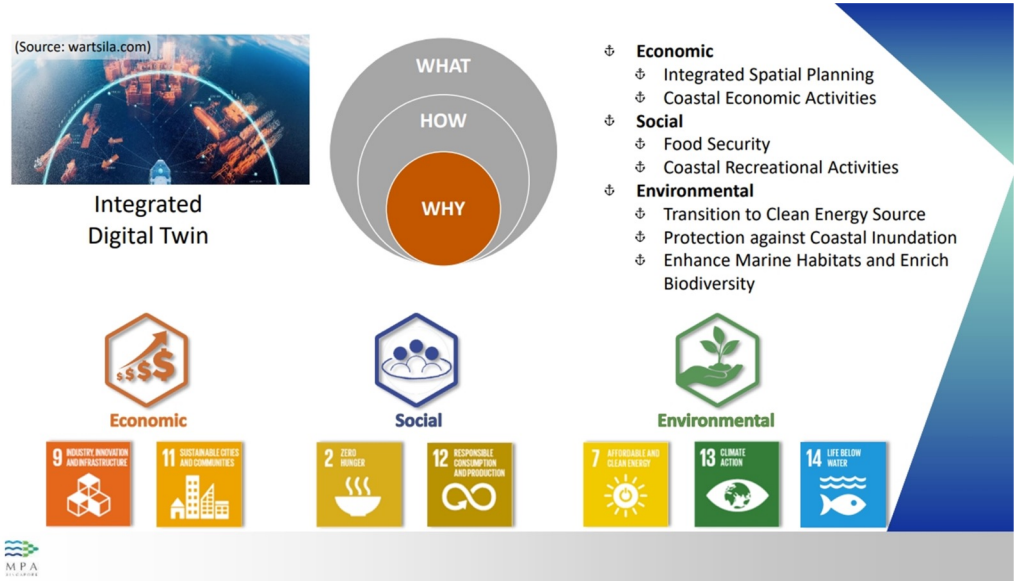
Phase 4:
Connecting Land and Sea for Global Awareness

Extend to three locations: Singapore, Canadian Arctic, Caribbean

Digital Twins of Land and Sea, Digital Arctics, Integrating Land & Sea for Various Use Cases

Digital Twin Challenge

Integration of Land and Marine data for Coastal Protection Planning, Critical Infrastructure Protection, and Resilience.



Maritime & Port Authority

MPA SINGAPORE

SLA SINGAPORE LAND AUTHORITY

Sources: Eric Foo, MPA - https://ggim.un.org/meetings/2022/4th-EG-LAM/documents/2.3_Eric_Foo.pdf , collected Sept 14, 2022
3D graphic courtesy of SLA : https://www.sla.gov.sg/articles/press-releases/2020/launch-of-onemap3d-beta-at-singapore-geospatial-week-2020

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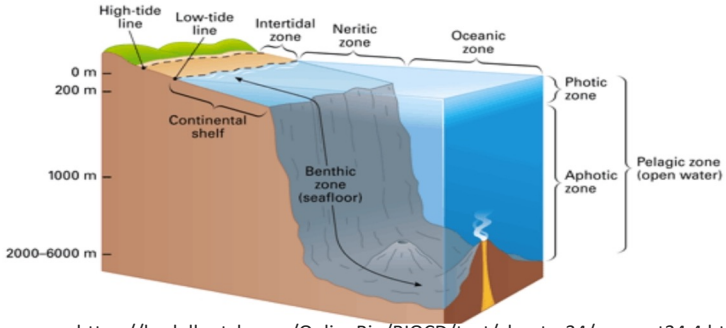
Digital Arctic

Government of Canada / Gouvernement du Canada

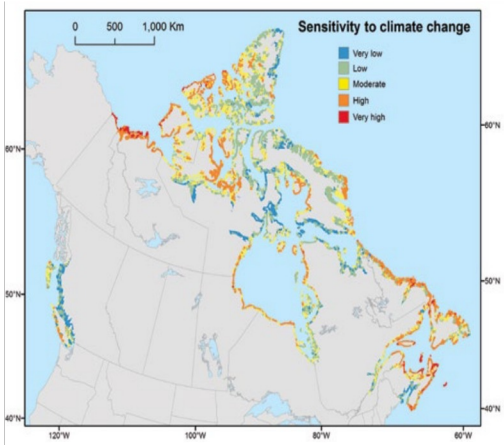
Canada

Coastal erosion at the land – sea interface:
Where the land meets the sea

- Support measurement of impacts of **coastal erosion** in the context of a changing Arctic. **migration corridors**
- Impacts on **local communities**
- **Integrating Sensor Feed** (e.g weather buoys), tabular and spatial data, improved data discovery, catalogues, web service to API transition, emerging Arctic requirements (e.g. vector tiles and style sheets across land - water interface (roads, coastline).



https://bodell.mtchs.org/OnlineBio/BIOCD/text/chapter34/concept34.4.html



From *Canada's Marine Coasts in a Changing Climate*[2]

Use Case: Marine Data Interoperability in the Caribbean

- navigation data in scenarios that go beyond actual navigation
- necessary extensions or modifications for complex scenarios
- standards-based data open in the development of new markets
- sustainable use of ocean resources for economic growth

UK Hydrographic Office

CARIGEO
Caribbean Geospatial Development Initiative
GEO-EMPOWERING THE CARIBBEAN

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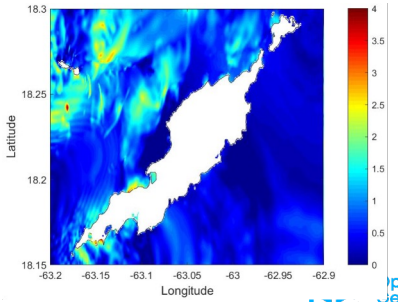
DIGITAL TWINS OF THE OCEAN



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Iliad – Digital Twin of the Ocean

Iliad areas of interest

Enabling an ecosystem of interoperable digital twins for the ocean trough:

- Connecting to *existing* ocean data infrastructures
- Enhance ocean data infrastructures with *additional* observation technologies and citizen science

Create an open marketplace accessible for all providers and users by:

- Development of *innovative methods* in open frameworks and platforms
- Enable model *evaluations & comparisons* for many Earth science applications from weather, energy, aquaculture to climate and more

Provide solutions to address future societal challenges by:

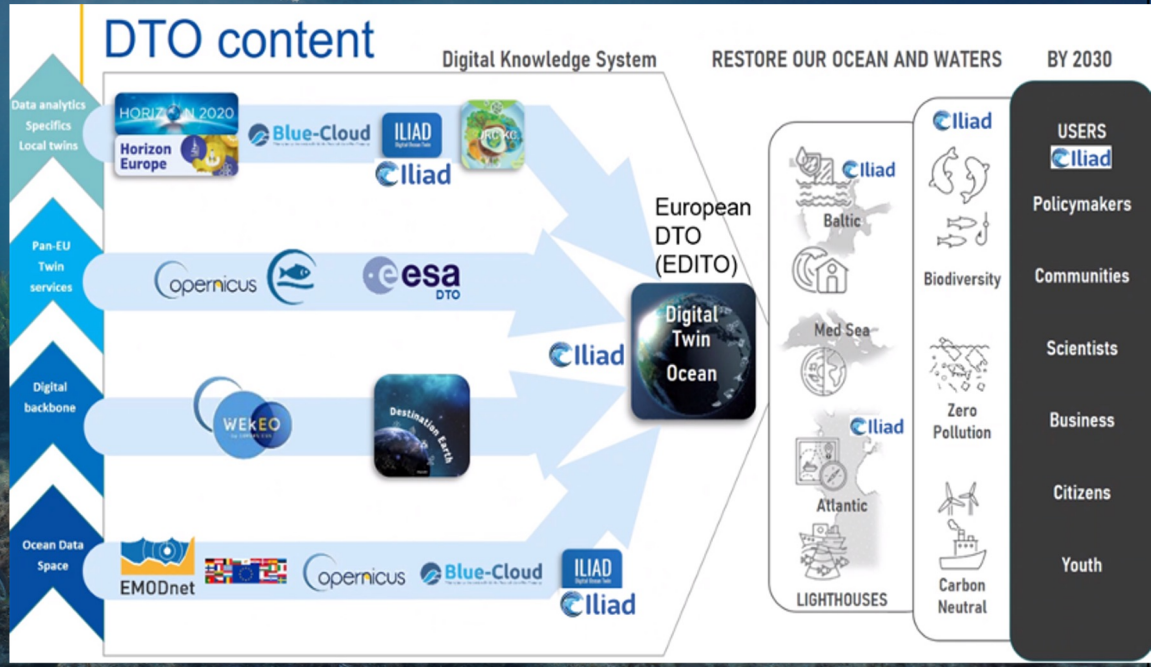
- Assembling a broad and diverse *user community* of existing and new users,
- Supporting the communities in testing and using the project's *innovative technological solutions*

D**igital twin** of the ocean through co-creation including data fusion from ocean models, sensors, citizen science

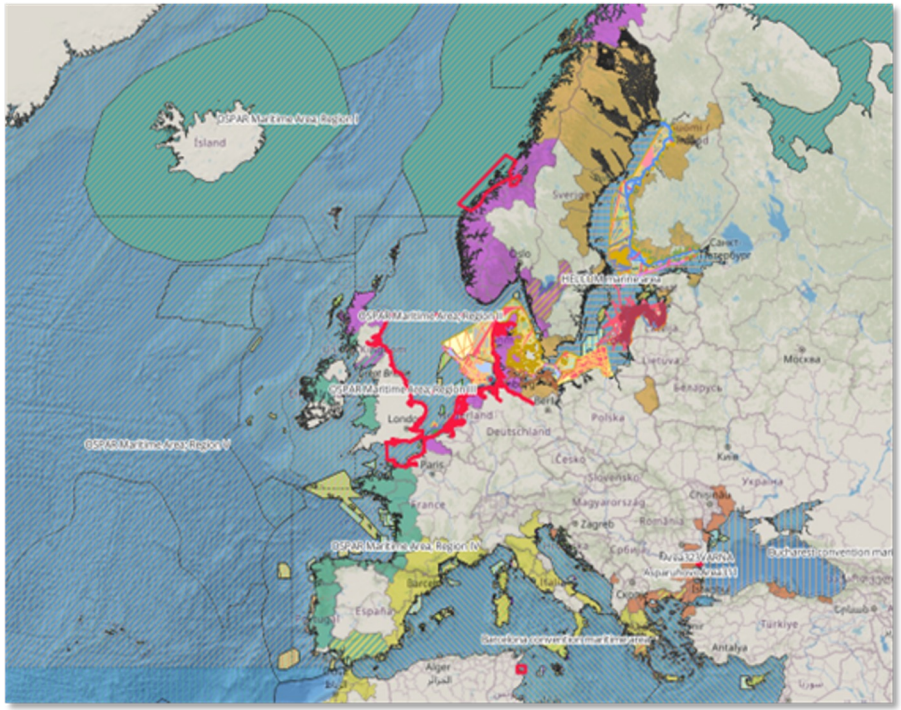
- Provide a serviced **modelling and operational simulation environment**

- **Integrate** on business and technical level with **public Twins'** components and industry **data spaces**

- scale up through the **industrial data spaces**



Iliad areas of interest



Fisheries Productivity & Sustainable Aquaculture

Aquaculture & Harmful Algae, Water Quality & Ship Traffic

Ballast Water Monitoing

Met Ocean Hind, Now & Forecast

Jellyfish Swarm Forecast

Oils Spill Simulation

Insurance For Marine & Maritime Activities

Coastal Sediment Transport

Existing Wind Farm Capacity

Ocean Energy Potential

Harbour Safety

Plastic Pollution Monitoring

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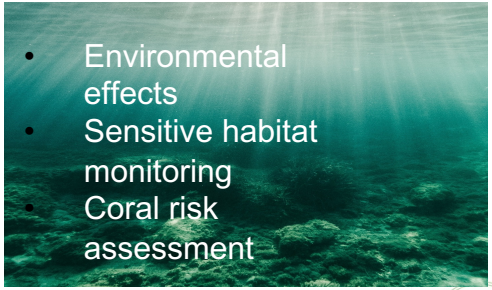
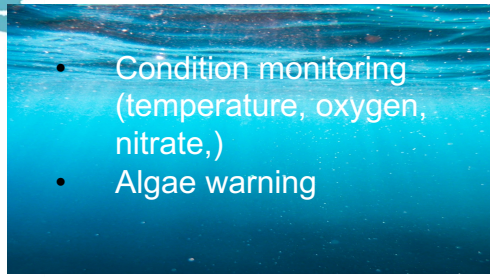
Multi factor twinning

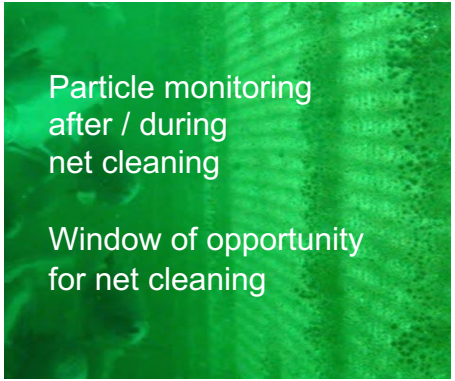
Based on the Plastic Pollution, Aquaculture



- Environmental effects
- Sensitive habitat monitoring
- Coral risk assessment

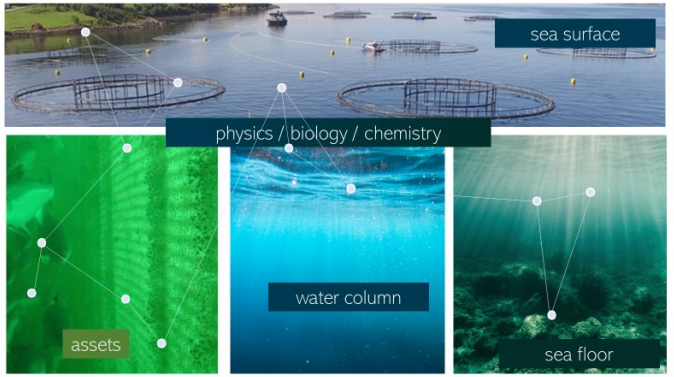


- Condition monitoring (temperature, oxygen, nitrate,)
- Algae warning



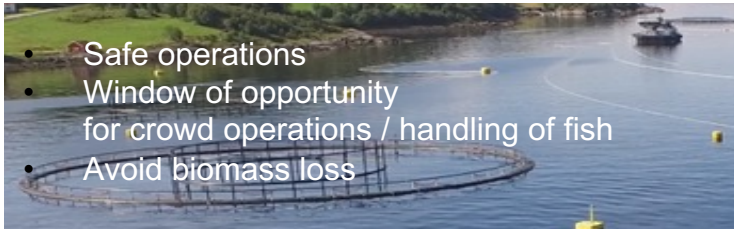
Particle monitoring after / during net cleaning

Window of opportunity for net cleaning



CSRD

- Automated reporting
- SDG digital twin
- Data management
- Synergies



- Safe operations
- Window of opportunity for crowd operations / handling of fish
- Avoid biomass loss

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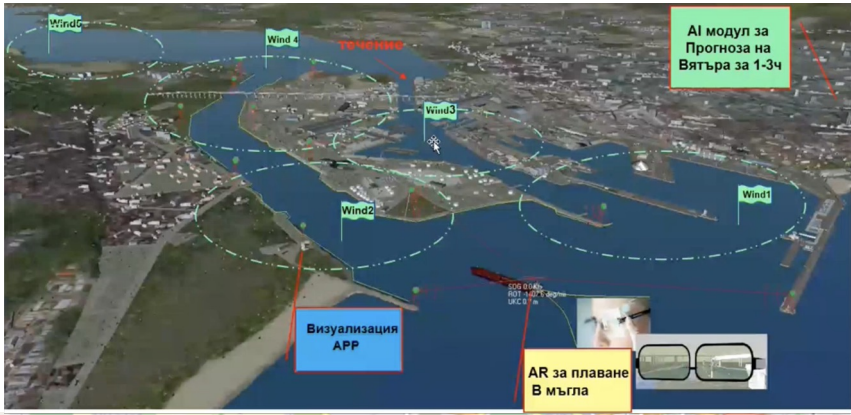
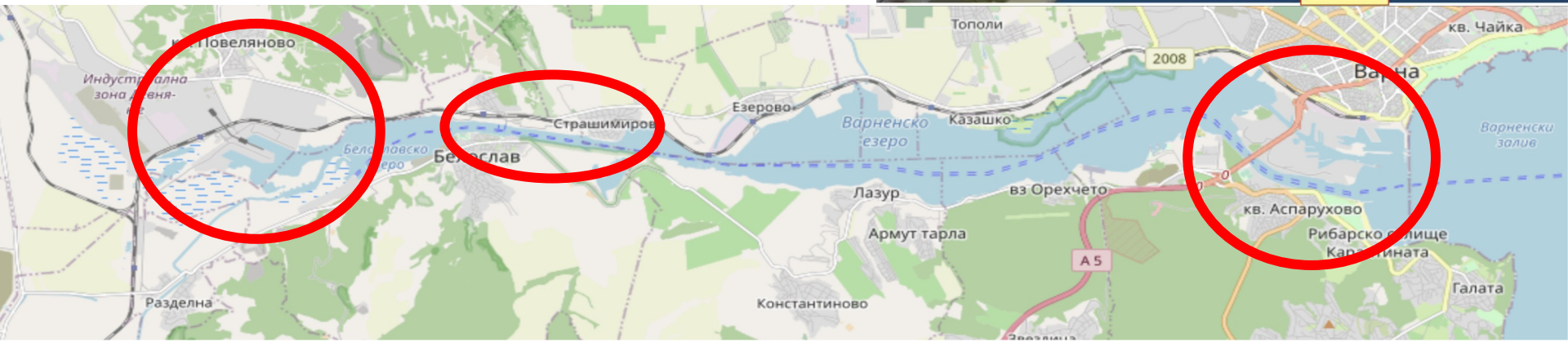
Harbor navigation in rough conditions

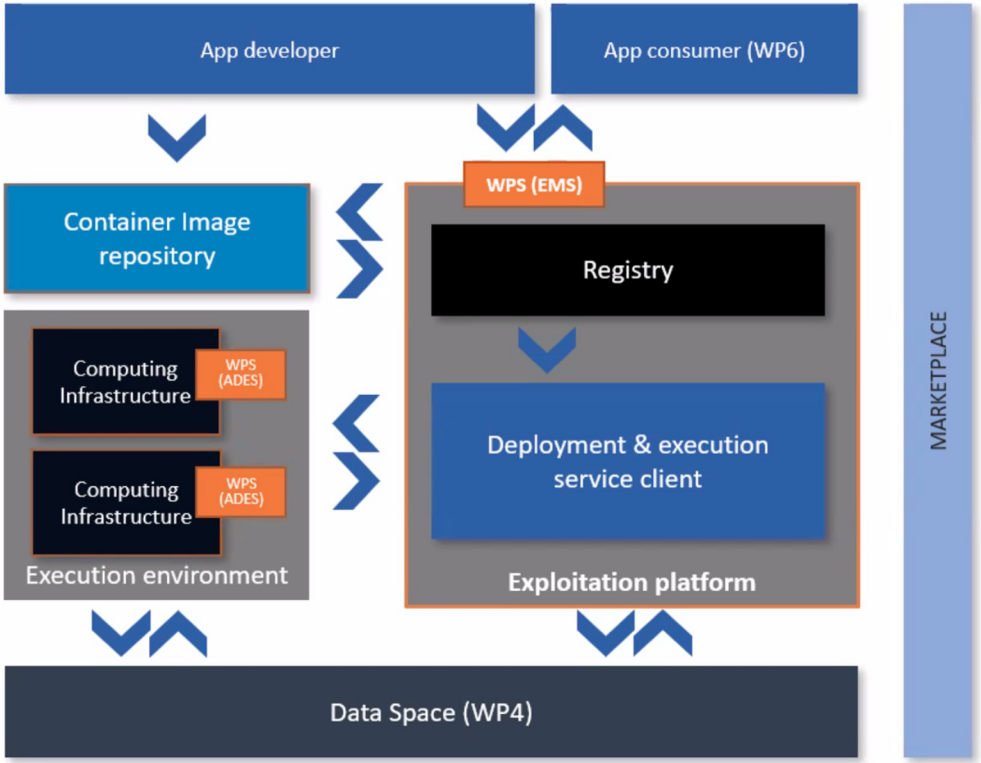
Observation data combined into VR technology to help navigation

‘**Varna port**’ is a >20km system of several ports in bay, river and lakes
- observations currently streamed in custom text format
- integration into ILIAD market harmonized services
- integration with Citizen Science pilot shall reuse data services built around Jellyfish pilot





Environment Digital Twin interoperability



EO best practices in near to data analytics

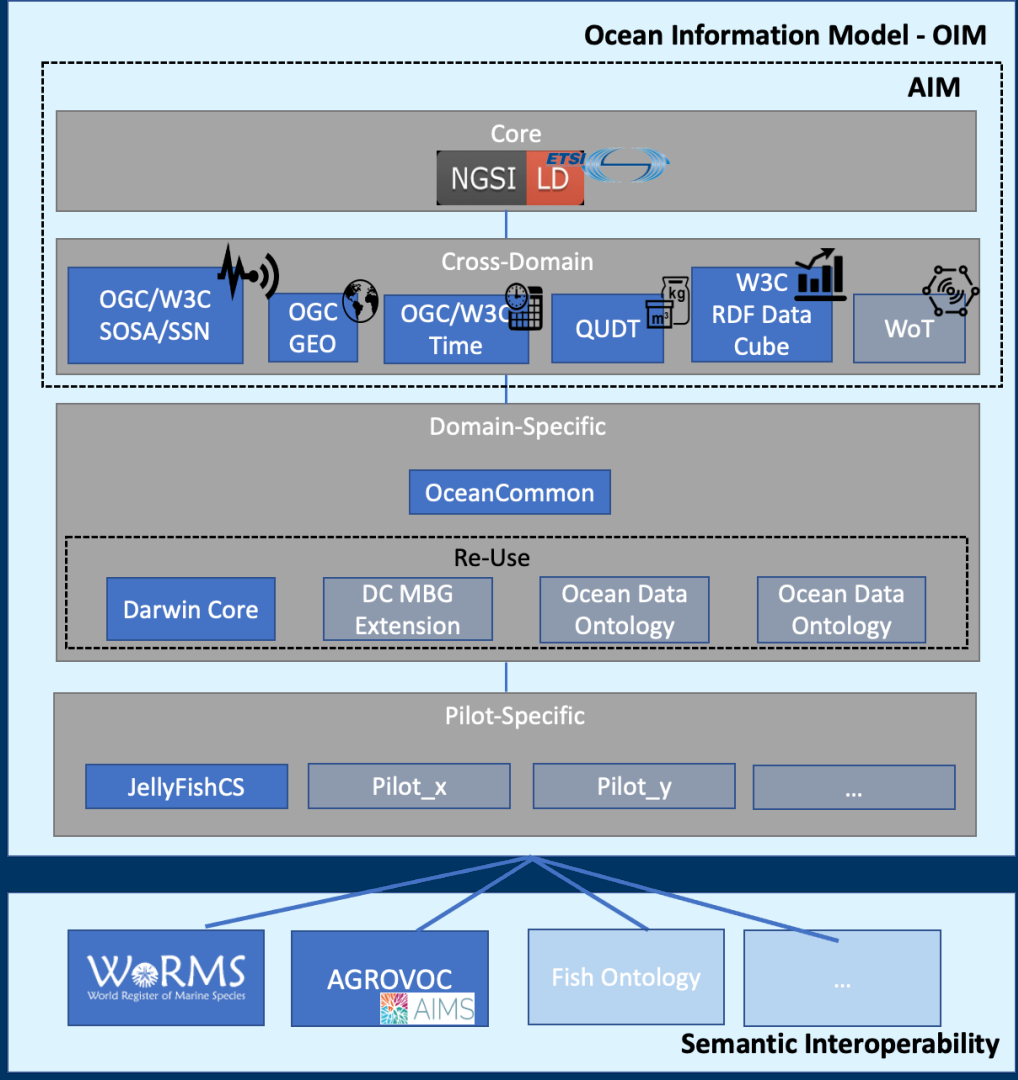
Federation of intermediate and central data hubs – marketplace, discovery & access toolkits

Portable processing services – execution toolkit

Linked Data for data with provenance/lineage, observables and factors – Ocean Information Model

Ocean Information Model (OIM) construct

- OGC APIs integrated – cross standards redundancy reduction
- realized as a *suite of* ***ontologies*** and ***contexts*** bringing both legacy and new applications into common space
- uplift and formal validation tools for continuous integration
- implemented in line with best practices, ***reusing*** existing ***standards*** and well-scoped ***models***
- establishes ***alignments*** between base models to enable their ***interoperability*** and the ***integration*** of existing data



Iliad Innovation hub

Iliad Summer School

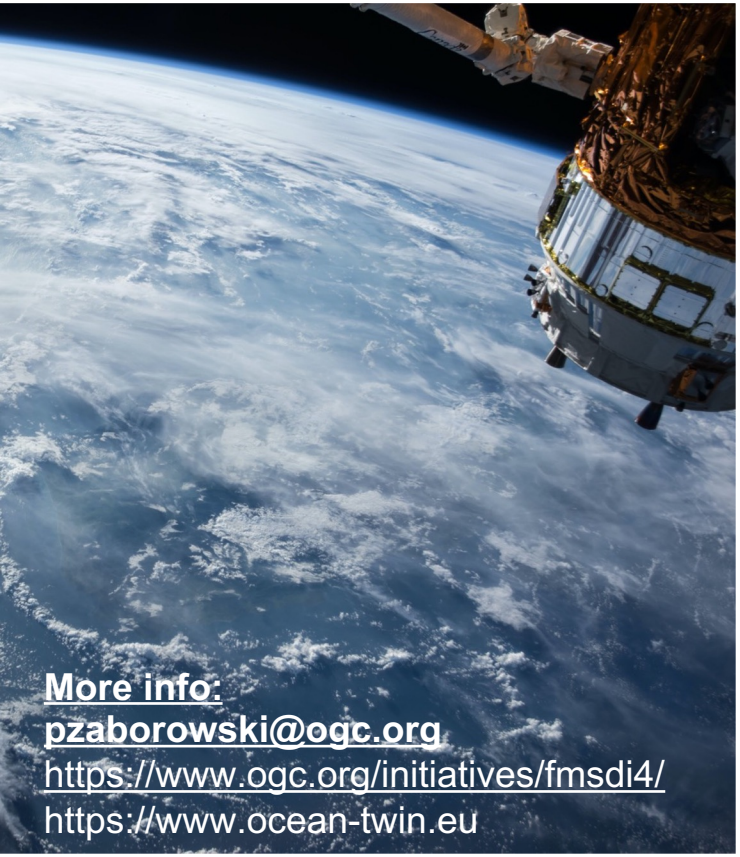

The Future

Ideas?

- Additional Small Island States – Sea Rise Scenarios?
- Mediterranean – Cross Jurisdiction Federated MSDI /environment ?
- Middle East - Coastal Dynamics, sea rise , environmental sensitivity?
- Africa – Extreme Weather events (land and sea) ?
- South America - all the above ?

Interested ? Let's discuss!

Contact Trevor Taylor (ttaylor@ogc.org) to schedule a call



Thank You

Community

500+ International Members
110+ Member Meetings
60+ Alliance and Liaison partners
50+ Standards Working Groups
45+ Domain Working Groups
25+ Years of Not for Profit Work
10+ Regional and Country Forums

Innovation

120+ Innovation Initiatives
380+ Technical reports
Quarterly Tech Trends monitoring

Standards

65+ Adopted Standards
300+ products with 1000+ certified implementations
1,700,000+ Operational Data Sets
Using OGC Standards