Marine domain in OGC
Federated Marine SDI
Iliad

Piotr Zaborowski, Sina Taghavikish, OGC
Rob Thomas, Sara Saeidi, Trevor Taylor, OGC
5 May 2023
Federated Marine Spatial Data Infrastructure

What, Where, When, Who, Why?
# FMSDI Pilot Projects

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate Change impacts</td>
<td>Federated effort</td>
<td>Started at August 2021</td>
<td>North Sea and Baltic Sea, Arctic, Singapore, Canadian Arctic, Caribbean</td>
<td>Hydrographic offices, Transportation, Marine Biologists, coastal guards, academics, businesses. Governments, Local Governments, Private organizations, etc. All of us!</td>
</tr>
<tr>
<td>Disasters impacts: storm surge, change in biodiversity, grounded ships</td>
<td>Interoperability between land and sea especially coastal areas</td>
<td>went through 3 phases</td>
<td>April to October 2023, Current phase of the project</td>
<td></td>
</tr>
</tbody>
</table>
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
Incremental development
Complex scenarios, new areas
Protected areas at OGC API endpoints
Understand status quo

Timeline - Marine Domain

2016

OGC Marine DWG
Approved

Phase I + 2
Phase 3

OGC - IHO
Federated Marine SDI
Demonstration Pilot
Connecting Land and Sea Across Nations

OGC - IHO
Federated Marine SDI
Demonstration Pilot
Connecting Land and Sea Across Nations

2016

IHO-OGC Marine SDI Concept Development Study

UN-GGIM
Standards Guide
Edition 3 (Aligned with ISO)
“Where do I start?”

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

Now

Iliad
Digital Twin of the Ocean
The Iliad consortium will develop virtual representations of the sea that will integrate earth observing, modelling and digital infrastructure to provide predictions of future development “at sea”

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

Supporting Work

Arctic Region
Digital Twin
Land/Sea, Singapore

Marine Data Interoperability in the Caribbean
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

- 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.
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
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

High-level use cases for FMSDI

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Oriented</td>
<td>25%</td>
</tr>
<tr>
<td>Monitoring (e.g. Coastal, Biodiversity)</td>
<td>21%</td>
</tr>
<tr>
<td>Predictive Models</td>
<td>21%</td>
</tr>
<tr>
<td>Port Related</td>
<td>21%</td>
</tr>
<tr>
<td>Ecosystem</td>
<td>17%</td>
</tr>
<tr>
<td>Impact Analysis</td>
<td>17%</td>
</tr>
<tr>
<td>New Technologies</td>
<td>17%</td>
</tr>
<tr>
<td>Spatial Marine Related Topics</td>
<td>17%</td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>13%</td>
</tr>
<tr>
<td>Sea-level Studies</td>
<td>13%</td>
</tr>
<tr>
<td>Legislative and Regulatory</td>
<td>13%</td>
</tr>
<tr>
<td>Navigation</td>
<td>13%</td>
</tr>
<tr>
<td>Disaster Response</td>
<td>8%</td>
</tr>
<tr>
<td>Land/Sea Interface</td>
<td>8%</td>
</tr>
<tr>
<td>Economy Related</td>
<td>8%</td>
</tr>
</tbody>
</table>
TOWARDS A FEDERATED MARINE SDI: IHO AND OGC STANDARDS APPLIED TO MARINE PROTECTED AREA DATA ENGINEERING REPORT

ENGINEERING REPORT

DRAFT
More FMSDI Content

FMSDI Pilot Phase 1, 2, 3 Playlists

Additional OGC Marine SDI videos are available here:

https://www.youtube.com/@opengeospatial
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
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)).
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
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
Digital 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
Multi factor twinning

Based on the Plastic Pollution, Aquaculture

- Environmental effects
- Sensitive habitat monitoring
- Coral risk assessment

Particle monitoring after / during net cleaning

Window of opportunity for net cleaning

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

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

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

CSRD

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

Particle monitoring after / during net cleaning

Window of opportunity for net cleaning
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
The Future
• 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

More info:
pzaborowski@ogc.org
https://www.ogc.org/initiatives/fmsdi4/
https://www.ocean-twin.eu

Copyright © 2023 Open Geospatial Consortium