Towards a Canadian Integrated Ocean Observing System

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The Ocean is Valuable

Ocean Economy:
Ocean-based industries
Natural assets and ecosystem services

- 2010 - Ocean based industries generated USD $1.5T & 31M FTE
- 2030 Ocean industry projected to generate $3T & 40M FTE

Ocean Health
(Observation and Monitoring)

Organisation of Economic Cooperation and Development

http://www.oecd.org/futures/oceaneconomy.htm
The ocean sciences community in Canada has diversified.
Canada’s ocean community collects large amounts of data, however:
  - there is no mechanism to integrate easily data from various sources
  - no coordination and collaboration mechanism for the Canadian ocean community

Canada’s lack of a national integrated ocean data system leads to fragmented and isolated data.

So…

Canada’s ocean science community, led and supported by Fisheries and Oceans Canada (DFO), is developing the Canadian Integrated Ocean Observing System (CIOOS) to bring existing Canadian and international ocean observation data into a federated system which will generate value for users.
CIOOS is envisioned as a network of people, resources, and technology, collaborating to build a comprehensive ocean observing community.
CIOOS will serve the needs of coastal communities, Canada, and the world.
Value Proposition

How will CIOOS solve client problems or improve their situation, deliver specific benefits, and promote the initiative as being beneficial from the status quo?

Current State

Wants

Needs

Concerns

User-friendly

Funding

Suitable Data

Data Sharing

Costs

Improve

Innovate

Integrate

• Timely access to a broad range of environmental information.
• Efficiency in ocean observation.
• Economic and scientific benefits to government, industry, scientists, and citizens.
• Sustainability of aquatic ecosystems and the safety and security of our waters.

CIOOS

Benefits

Efficiency

Open Data

Common Standards

Info Exchange

Economic

Features

Linked Regional Nodes

Multiple Users

Interoperability

Experience

Features

Common Standards

Linked Regional Nodes

Multiple Users

Interoperability

Experience
CIOOS Vision

A Canadian integrated ocean observing system that brings together and leverages existing Canadian and International ocean observing programs and the data they collect, generating value-added data products on a publicly accessible web platform that maximizes utility to end-users.

- Improve coordination and collaboration among diverse data producers
- Improve access to information for decision making
- Enable discovery and access to data
- Provide support for a wide variety of applied and theoretical research efforts to better understand, monitor, and manage activities in Canada’s Oceans

CIOOS will allow for Data to be discoverable, accessible and interoperable

PRIMARY ASSUMPTIONS
Leverage what you can….build what you must!
CIOOS starts with data, but doesn’t finish there - an Integrated system goes beyond data
Global Ocean Observing System (GOOS)

- Canada recognizes the value in forming stronger links to the existing GOOS structure – we are following the GOOS model, with the goal to become a regional alliance.
- Items of interest to Canada:
  - lessons learned during the development of other GRAs
  - data sharing
  - enhancing regional capacity development
  - linking with other observation systems with dedicated marine service goals, such as oil spill response capabilities
CIOOS
Canadian Integrated Ocean Observing System

Collaboration

Fisheries and Oceans Canada
Pêches et Océans Canada

Polar Knowledge Canada

Savoir polaire Canada

Natural Resources Canada
Ressources naturelles Canada

Environment and Climate Change Canada
Environnement et Changement climatique Canada

SLGO
St. Lawrence Global Observatory

ArcticNet

ORCA
Ocean Research & Conservation Association

DALHOUSSIE UNIVERSITY

University of Victoria

University of British Columbia

UBC

The University of British Columbia

OCEAN TRACING NETWORK

NSERC CRSGR

Canada Foundation for Innovation Fondation canadienne pour l'innovation

jcomm

The Global Ocean Observing System

GOOSS
GROUP ON EARTH OBSERVATIONS

Global Environmental Observation System of Systems
CIOOS Task Team

- Multi-partner team established to design and implement CIOOS.
- Key representatives from Government, Academia, Network Centres of Excellence.

Objectives:
- Develop a governance structure for CIOOS;
- Clarify the scope of the CIOOS;
- Develop roles and responsibilities for the various components; and,
- Develop initial estimates on financial resources to support the CIOOS.
What would a CIOOS look like?

CIOOS will function as a collective of ocean observing systems or “Regional Associations”

Regional associations will continuously provide quality controlled data and information on the current and future states of Canada’s oceans.
Governance

Federal initiatives (FGP, Open Data)

National CIOOS presence

Data Exchange Server/ Web service

GTS

Federated collection

Regional Association

Long term archival

National Oceanographic Data Centre

DFO

Thematic Node e.g. Argo, gliders

Regional Association

Data Nodes

Data Exchange Server

Regional Association

Data Exchange Server
The CIOOS Component Hierarchy

Data feeds into regional and thematic nodes and is aggregated by regional associations, where appropriate (e.g. Gliders). The national portal also aggregates data for the purposes of visualization.

Data that is compliant or nearly compliant can be accepted into CIOOS via a node.

Data that requires work to be made compliant with CIOOS can be integrated with assistance from a node (with reasonable limits).

Data can be taken from almost raw and integrated into CIOOS with a large amount of assistance from a node.
Regional Associations

- Accepting and/or accessing data from independent data sources (e.g., Universities, DFO and other associations)
- Verification of standards / format etc.
- Short – Medium term data storage
- Data manipulation / assimilation
- Regional portal
- Data visualization and tools
- Data transfer to NODC for long term archiving
- Data acquisition via Federal institutes and other efforts (e.g. cruises, Argo etc)
- QA/QC
- Make DFO data available to regional Associations
- Long term archival
- Transmission of real time data to GTS
- Standards oversight and evolution
- International data exchange
Web Presence

National Portal

Regional Portals

Interactive Map
Data Portal
Visualization Tools
Regional Links
Membership of the Regional Association
Proof of Concept

Where do we go now?

Pilot implementation (phase 1 in developing a CIOOS). This will:
• provide a **proof of concept** showing the benefit to a national network integrating data;
• **identify issues** that need work or improvement;
• offer an opportunity for **further outreach and stakeholder consultation**; and,
• **improve cost estimates** for further national development.

Establish prototype Regional Associations that will:
• integrate a minimum number of variables, data types, and visualization tools;
• demonstrate the value and feasibility of integrating key variables (e.g. T); and,
• demonstrate how they are building a regional network, which will act as the precursor to a more robust Association.
Proposed variables for inclusion in CIOOS, including an evaluation of their availability and readiness. Proportion of core variables that are, Mature (green), Pilot (yellow), and Concept or have No Coverage (red) in each region.
International Collaboration

Ongoing discussions with the U.S. and exchange of staff.
Participation in International Organizations/Initiatives - IOC, JCOMM (Global Ocean Observing System meetings), AtlantOS.
GOOS Regional Alliance – Ocean basin, North American???
Continue to foster collaboration between Canada and US Regional Associations.
Looking Forward

Next Steps

• Winter 2018 - Draft CIOOS Development Plan
  – Proof of Concept phase to test a scaled-down version of a CIOOS (RA’s, baseline EOV’s, test interoperability, visualization tools)

• June 2018 - CMOS conference
  – Present CIOOS to a wider audience, get community support and buy-in
  – Potential panel session with DFO, Academic Institutions and Network Centers of Excellence

• 2018 - Launch CIOOS website

• Continue to engage internationally
Questions

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### Proof of Concept

<table>
<thead>
<tr>
<th>Variable</th>
<th>Availability</th>
<th>Readiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Sound</td>
<td>Low</td>
<td>Pilot</td>
</tr>
<tr>
<td>Bathymetry</td>
<td>High</td>
<td>Mature</td>
</tr>
<tr>
<td>Bottom Type</td>
<td>Low</td>
<td>Concept</td>
</tr>
<tr>
<td>Currents (surface &amp; subsurface)</td>
<td>Moderate</td>
<td>Mature technology, limited coverage</td>
</tr>
<tr>
<td>Fish Abundance and Distribution</td>
<td>High</td>
<td>Mature</td>
</tr>
<tr>
<td>Ice</td>
<td>High</td>
<td>Mature</td>
</tr>
<tr>
<td>Inorganic Carbon</td>
<td>Moderate</td>
<td>Mature</td>
</tr>
<tr>
<td>Live Coral</td>
<td>Moderate</td>
<td>Mature technology, limited coverage</td>
</tr>
<tr>
<td>Marine Mammals</td>
<td>Moderate</td>
<td>Mature</td>
</tr>
<tr>
<td>Nutrients</td>
<td>Moderate</td>
<td>Mature, some gaps</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Moderate</td>
<td>Mature, some gaps</td>
</tr>
<tr>
<td>Phytoplankton</td>
<td>High</td>
<td>Mature</td>
</tr>
<tr>
<td>Salinity (surface &amp; subsurface)</td>
<td>High</td>
<td>Mature</td>
</tr>
<tr>
<td>Sea State</td>
<td>High</td>
<td>Mature</td>
</tr>
<tr>
<td>Sea Surface Height</td>
<td>High</td>
<td>Mature</td>
</tr>
<tr>
<td>Seagrass Cover</td>
<td>Moderate</td>
<td>Limited coverage</td>
</tr>
<tr>
<td>Surface Heat Flux</td>
<td>None</td>
<td>No coverage</td>
</tr>
<tr>
<td>Surface Stress</td>
<td>High</td>
<td>Mature</td>
</tr>
<tr>
<td>Temperature (surface &amp; subsurface)</td>
<td>High</td>
<td>Mature</td>
</tr>
<tr>
<td>Zooplankton</td>
<td>Moderate</td>
<td>Mature</td>
</tr>
</tbody>
</table>

**Proposed variables for inclusion in CIOOS, including an evaluation of their availability and readiness.**