International Coastal Atlas Network

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International Coastal Atlas Network (ICAN) Participation in the GEO Architecture Implementation Pilot – Phase 2 (AIP-2)

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International Coastal Atlas Network Response to the GEOSS AIP-2 CFP

1 Overview

We understand that GEOSS would welcome the participation of coastal and marine systems, as those aspects of the Earth have not yet made it the forefront of GEOSS discussions. The **International Coastal Atlas Network (ICAN)** would like to participate and assist by essentially providing a coastal data infrastructure model and functioning coastal system for GEOSS. Coastal data and information will be an important ingredient in reaching consensus on the architectural elements needed to support interoperable systems for understanding all aspects of the Earth system. In recent years significant momentum has occurred in the development of Internet resources for coastal environments, where 2.2 billion people live within a 100 km range. A key aspect of this trend has been the development of coastal atlases, based on web-enabled GIS. However, current inventories within coastal atlases are insufficient for the purposes of networking between them. Each atlas has different classifications of data and information (e.g., critical information on coastal erosion that may be needed across a broad geographic region as supplied by several different atlases). New semantic web tools and evolution of standard metadata descriptions and interfaces are opening a road to interoperate within atlases, and we therefore see the approaches and solutions of ICAN are promising with regard to assisting GEOSS. We therefore look forward to leveraging our approaches and solutions for the GEO Architecture Implementation Pilot – Phase 2 (AIP-2).

Referencing GEOSS Table 1 of Examples of AIP Coordination with GEO Tasks (GEOSS call, page 3), the tasks that our efforts would be most closely related to include: Registry DA-06-04 “Data, Metadata and Products Harmonization”; Biodiversity BI-06-02 “Biodiversity Requirements in Earth Observation”; and Disasters DI-07-01 “Risk management for flood” (although we will describe an additional scenario below for coastal erosion).

2 Proposed Contributions

ICAN offers the following proposed contributions to the Architecture Implementation Pilot:

- ICAN would like to contribute components and services to the Pilot based on the next phase in the development of our proof-of-concept prototype that inter-relates metadata and other information between two mature coastal web atlases (the Oregon Coastal Atlas, www.coastalatlas.net, and the Marine Irish Digital Atlas, mida.ucc.ie).
- Participation in the development of a set of user scenarios that support the GEO Societal Benefit Areas.

- ❖ ICAN will register its components and services in the GEOSS Registry to support access by GEOSS Clearinghouse and Portal. This will also support demonstration of the aforementioned set of coastal user scenarios.
- ❖ We fully ascribe to the GEOSS Process for Reaching Interoperability Arrangements (produced by GEO Task AR-06-01), and plan to participate in the refinement of the initial architecture in Annex B based upon the Pilot activities.
- ❖ Interaction with the Standards and Interoperability Forum in making "special arrangements" for use of non-GEOSS standards.
- ❖ Participation in GEOSS meetings, workshops, and telecons.

2.1 Societal Benefit Area Alignment and Support

The efforts of ICAN are best aligned with the Societal Benefit Areas (SBAs) of **Disaster Response** and **Biodiversity** (biodiversity where nearshore marine protected areas are concerned). We propose to enhance SBA descriptions and deployment, by developing a set of coastal zone management user scenarios that support the above-mentioned GEO SBAs.

By way of background on ICAN, in recent years significant momentum has occurred in the development of Internet resources for decision makers, scientists and the general public who are interested in the coast. A key aspect of this trend has been the development of coastal web atlases, based on web enabled geographic information systems (GIS).

A coastal web atlas is defined in O'Dea *et al.,* (2007), as: *a collection of digital maps and datasets with supplementary tables, illustrations and information that systematically illustrate the coast, oftentimes with cartographic and decision support tools, all of which are accessible via the Internet.*

O'Dea, L., Cummins, V., Wright, D., Dwyer, N. and Ameztoy, I., 2007. *Report on Coastal Mapping and Informatics Trans-Atlantic Workshop 1: Potentials and Limitations of Coastal Web Atlases.* University College Cork, Ireland, Coastal & Marine Resources Centre.

Driving factors for coastal web atlas development include the need for:

- Better planning to cater for increased **population pressures** in the coastal zone (e.g. the UN estimate that by 2020 75% of the world's population will be living within 60 km of the coastal zone; UN 1992; Shi and Singh, 2003).
- Decision support systems in relation to **climate change** scenarios in vulnerable coastal regions.
- Information to facilitate assessments of **risk to natural hazards** (including tsunamis and floods).
- Access to data and maps to support **marine spatial planning** (MSP) as a tool for better coastal and marine area management.

- Maps of jurisdictional boundaries for maritime territories in support of claims related to the **United Nations Convention on the Law of the Sea** (UNCLOS), which has a deadline for submissions of 2013.
- More efficient and effective coastal and marine area **governance** including access to relevant data and information.
- Information on **resource availability and exploitation** including habitat and species information, as well as ecological and community resilience.

Shi, H. and Singh, A., 2003. Status and interconnections of selected environmental issues in the global coastal zones, *Ambio*, 32 (2): 145-152.
United Nations, 1992. *Agenda 21: The United Nations Programme of Action from Rio*. United Nations, New York, USA, 147 pp.

These driving factors have already resulted in the proliferation of ad hoc coastal web atlas projects that have been designed to address thematic (e.g., fisheries management, recreational use) or spatial areas of interest (e.g., country to local level). While multiple benefits are derived from these tailor-made atlases (e.g. speedy access to multiple sources of coastal data and information; economic use of time by avoiding individual contact with different data holders), the potential exists to derive added value from the integration of disparate coastal web atlases, to optimize decision-making at a variety of levels and across themes. Opportunities exist to facilitate such a development by providing for data interoperability among existing coastal web atlases, and within the context of international programs such as GEOSS.

The immediate **benefits** of integration and interoperability are improved data search, discovery, documentation, and accessibility. For example, if there is a dataset missing in one atlas, it may be immediately located in another. If similar datasets are found in both atlases, they may wish to be combined to enhance study in either region. This is based on the notion that "no atlas is an island." Sometimes more than one atlas is needed in order to address complex regional problems such as hazard mitigation, climate change, intergovernmental marine spatial planning, etc.

Coastal atlas users require various kinds of information depending on societal roles and responsibilities. Use cases or scenarios can be developed around related topics to facilitate ontology development and ultimately interoperability across coastal web atlases. Important topics commonly addressed by the coastal web atlases user include: coastal erosion, flooding (including tsunami inundation and sea level rise), and hazard spills (oil, other chemical). ICAN is currently focusing on **coastal erosion** scenarios as part of an interoperability prototype that inter-relates metadata and other information between two mature coastal web atlases (the Oregon Coastal Atlas, www.coastalatlas.net, and the Marine Irish Digital Atlas, mida.ucc.ie). This prototype could be leveraged by or included in the GEO Architecture Implementation Pilot. There are many more topics along the lines of coastal disasters and biodiversity that interoperable coastal atlas databases could address.

With regard to any particular topic, the kinds of information needed by users commonly vary by the societal "roles". For example, coastal resource managers (as regional planners) commonly need access to different information about coastal erosion than would coastal property owners or emergency responders. We identify a collection of roles to help further describe the need for data interoperability. Roles, sometimes referred to as clients or end-users, provide an anchor for understanding data access and needs. The following roles are targeted in this example. Other roles do exist.

- ❖ Coastal Resource Manager/Planner
- ❖ Private Property Owner
- ❖ Emergency Responders
- ❖ Scientist
- ❖ Local system administrator

Information system development commonly takes advantage of "use cases" articulated on the basis of user roles. Use cases provide a general sense of the information requirements for applications. To provide general insight into the different kinds of information needed we can articulate questions commonly associated with various societal roles. Those questions represent the core aspects of a use case; although there are more details for use cases that are beyond the scope of this discussion.

Below, a series of questions are developed for various clients (roles) addressing the topic of "Coastal Erosion." The client may take on any one, or all of the roles identified above. However, it is best to articulate end user questions for a few to provide examples for development of the upper ontology, which remains the final objective.

Test Case Scenario: Coastal Erosion

- **Role/Client - Coastal Manager** (uses an inventory to take regulatory action; helps form policy guidelines as potential statutes or regulatory rules)
    1) What are the erosion rates along a geographically defined shoreline (coastal) reach?
        a. Where are erosion hot spots based on geology and wave action?
        b. Where are erosion hot spots conflicting with human uses of the coast? (as indicated by, permit history and presence of hardened structures as indicator of areas with high erosion rates?)
        c. For a defined planning window (e.g. 25 years) what is the anticipated extent and magnitude (e.g., high, medium, or low risk) of coastal erosion risk along a designated reach of shoreline?
        d. What is the potential for new development in the above designated risk zones? What actions can be taken to avoid, minimize or mitigate the placement of new development in predicted high-risk zones?

    2) Where/When/How has the shoreline been defended? (aka armored, aka hardened, aka protected)
        a. How has the shoreline been managed over time?
        b. What are the existing engineered structures?
        c. What is the historic permit record at a selected location?

3) Where is the socioeconomic infrastructure at greatest risk due to coastal erosion?
    a. Public infrastructure: public utilities (waste water treatment facilities, power plants, etc), shipping lanes / port entrances, Road / Rail transportation networks,
    b. Social: housing developments, cultural resources, public access, beaches

4) Where is the potential for habitat loss due to coastal erosion a significant risk
    a. Ecological: essential fish habitat, wetlands, beaches, environmentally sensitive habitat areas, wildlife refuges, conservation areas.

- **Role/Client - Private Property Owner** (seeks insight about adverse impacts to a property)
  1) What is the erosion rate along my stretch of shoreline?
      a. how close is my home to "the edge"?
      b. will my home survive to the end of my mortgage?

  2) What is the best method to protect my shoreline?
      a. What methods of protection are allowed in my state? What rules am I subject to or grandfathered from?
      b. Define shoreline protections strategies
      c. What methods of protection are my neighbors taking? How will their actions affect my property? Can we act together to achieve some economies of scale or other cost/effort savings?
      d. Determine action/no action alternatives

  3) Is the shoreline I am considering for purchase stable?
      a. What is the nature of the erosion problem?
      b. What structures are present?
      c. What is the risk of erosion due to future storms?
          i. Am I exposed to storm generated waves?
          ii. What is my elevation about sea level? Am I in the flood zone?
          iii. Has it flooded during previous storms or hurricanes?

- **Role/Client - Emergency Responders (**need information about past, present, or future hazardous events**)**
  1) How big is an incoming storm / erosion-causing event?
      a. how do I alert affected areas?

  2) What public infrastructure is threatened by chronic or severe erosion events [e.g. transportation networks, pubic utilities (waste water treatment facilities, power plants, etc)]?

3) Where are the heightened social risks associated with severe coastal erosion (e.g. housing developments, schools, cultural resources)?

4) Where are the best evacuation routes during major coastal storm events?

5) Where are sites that have historically experienced major coastal erosion during storm events?

6) Where are best locations for emergency staging equipment (debris removal, rescue boats, sand removal vehicles)?

- **Role/Client - Scientist** (investigates research questions for knowledge building relevant for policy implications and decision support action)
  1) What is the geomorphic evolution of the coast?
     a. what historic photography, geomorphology profiles, LIDAR surveys, shoreline surveys are available for study?

  2) How many major erosional events due to severe storms have occurred within a defined section of shoreline in the past 50 years?

  3) How have anthropogenic activities impacted natural coastal erosion process?

  4) Can a predictive model of hot spots be developed with the data available?

- **Role/Client - Local system administrator** (supports other users with getting access to data, perhaps from own system or other systems)
  1) What data and information can I make accessible regarding coastal erosion?
     a. What feature categories (historic photography, geomorphology profiles, LIDAR surveys, shorelines, plant/animal species, surveys etc.) exist in a designated area?
     b. Where do existing data reside? Can my system access the data?
     c. Can the data be shared (data ownership, permissions, licensing)?
     d. How well are existing data documented (reports, metadata), and does the documentation support the potential future uses of the data by my intended audience?

  2) What analysis or visualization tools can I provide that can make use of available data to answer common questions from my audience(s) regarding coastal erosion?

3) Can I extract information from the atlas network to bolster data available to support coastal issues within my own program? Are current inventories insufficient?

4) Does my Area of Interest extend beyond the geographic boundaries of the available Atlas system's area of responsibility?

    a. If so, are there neighboring or regional Atlases that might have supplemental information that might be of use?
    b. If so, are the contents of neighboring or regional Atlases accessible to users of my Atlas, and the analysis or visualization tools it contains?

As an example of how the interoperability prototype would work in practice, if a coastal planner needs to make a map of or obtain data about a specific coastal erosion zone he/she would (Figure 1):

1. Define geographic extent: area or name of place.

2. Categorize or state hazard of interest.

3. Draw all layers that have a hazard and create a legend.

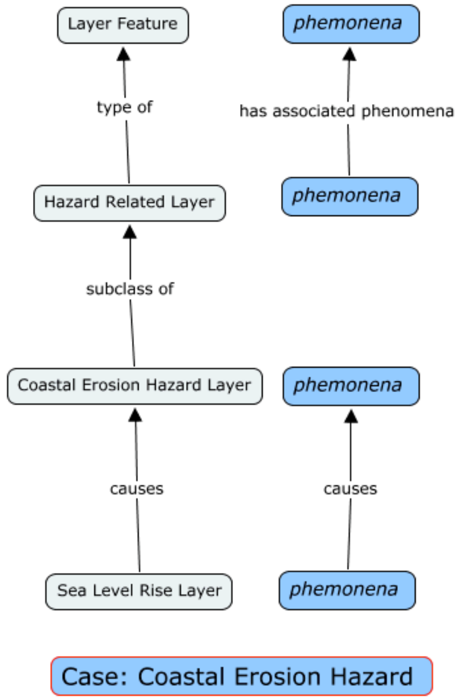

Fig. 1: *Specific example of how coastal erosion scenario/use case might be understood by the user and structured in an ontology.*

Behind the scenes, in more technical terms, the semantic mediation process includes the following steps:

1) Data providers publish an Open Geospatial Consortium's catalogue services for the web (CSW) which would describe a Web Mapping Service (WMS). For each WMS description there is a topic associated with it, and an associated XPATH (XML Path Language) of where to put the topic.
2) The portal presents English labels for the upper ontology (super terms).
3) Users selects one or more.
4) The portal finds narrower terms (subclass of the selected terms), via a SPARQL query to an ontology repository.
5) The portal previously invoked CSW services, extracted the application ontology terms and the relation to the endpoint services (e.g., WMS), and stored this in a service-ontology. It is desirable to identify the best XPATH for enabling the WMS and the topics for associated with each WMS.
6) For each narrower term from item 3, the portal finds the associated services in the service-ontology.
7) The portal invokes each service found and gathers information (end point and description). It is desirable to know how to construct the URL for GETRecords and XPATH.
8) The portal presents links to the map and a brief description.

The initial user focus of ICAN is currently on coastal planners/resource managers, property owners, emergency response teams, and local coastal web atlas system administrators (aka atlas administrators). Information related to disasters and biodiversity, as well as the boundaries of regulatory jurisdictions are routinely required for coastal and ocean planning, regulatory, and enforcement work. The outcomes associated with the scenarios described above will improve the ability of agency staff to quickly and efficiently analyze local geographic patterns of hazards, community development, and jurisdiction in a regulatory and/or planning context. It will be used internally to more accurately and effectively characterize and evaluate issues and impacts related to coastal erosion (initially), but could also be used to inform and educate the public and coastal zone management community.

For a description of participation and/or membership of ICAN in related SBA activities, as well as relevant experience, please see **Section 3, "Description of Responding Organization."**

2.2 Component and Service Contributions

ICAN would like to contribute components and services to the Pilot based on the next phase in the development of our proof-of-concept prototype that inter-relates metadata and other information between two mature coastal web atlases (the Oregon Coastal Atlas, www.coastalatlas.net, and the Marine Irish Digital Atlas, mida.ucc.ie) (Figure 2). The approach leverages ontologies and semantic mediation (i.e., translations of terms and queries) using the OGC's CSW, WMSs, and web feature services (WFSs), to our knowledge an unprecedented combination for coastal resource management.

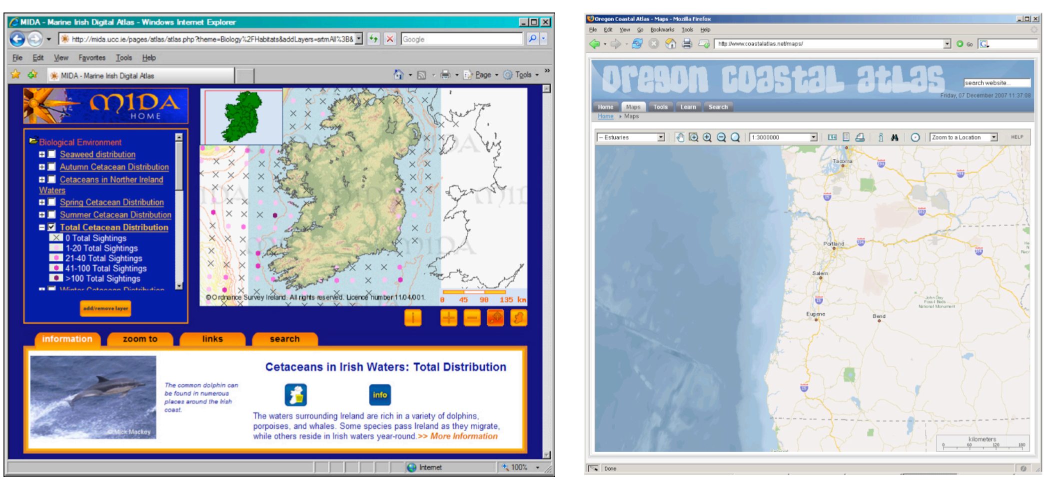

__Fig. 2.__ Established coastal web atlases such as the Marine Irish Digital Atlas, and the Oregon Coastal Atlas address coastal management topics for distinct spatial areas, but currently do not have the ability to network their inventories.

ICAN will register its components and services in the GEOSS Registry to support access by GEOSS Clearinghouse and Portal. This will also support demonstration of a set of coastal user scenarios as described above in the Section 2.1.

The expected **benefits** from the implementation of ontologies for coastal web atlas interoperability are improved data search, discovery, documentation, and accessibility. More specifically:

- better/more complete discovery and filtering of data;
- clearer, more precise, more computable characterization of data;
- contextualization of information, so that it is provided in the right format, place, and language;
- semantic value, where human users as well as computerized inference engines and harvesters can make better use of information, which leads to better display of search results, where terms can be substituted if they are equivalent; and
- integration of ontologies into existing decision-support tools of a CWA, which will then immediately be working with more appropriate data sets.

As an example, if there is a dataset missing in one atlas, it may be immediately located within another. If similar datasets are found in both atlases perhaps they may be combined to enhance study in either region. Given that no coastal web atlas functions alone as an island, and is often part of a larger universe of resources that is needed for effective marine spatial planning, resource management, and emergency planning, coastal web atlases must build a common approach toward managing and disseminating the coastal data, maps and information that they contain. Sometimes more than one coastal web atlas may be needed in order to address regional problems such as hazard mitigation, climate change, intergovernmental marine spatial planning, etc.

The approach used in this study for integrating information from atlases is *mediation* (Figure 3). A mediator translates queries between high-level applications to low level applications (the local atlases). To translate queries the prototype developed in this study uses ontologies and standard interfaces. High-level applications use a global ontology and low-level application uses local ontologies. Concepts from local and global ontologies are mapped (e.g., termA subclass of termB), thus the mediator knows how to interpret query semantics from the high level application to the lower level application.

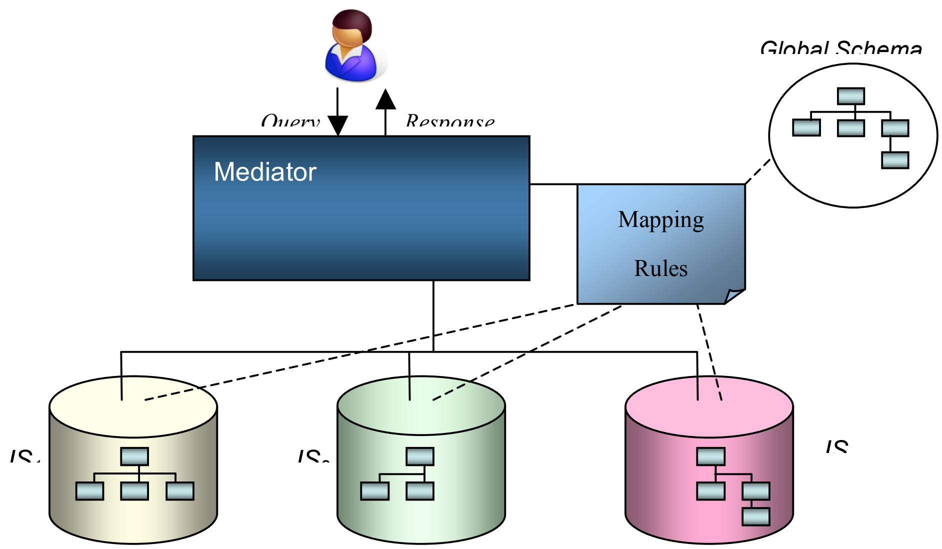

Fig. 3. *Diagram of a typical mediation architecture. Several distributed Information systems, IS_1, IS_2, …, IS_n, use local ontologies, models, or schemas. A mediator offers a single access point using a common global ontology. The mediator uses mapping rules between the global schema and the local schemas in order to rewrite the user's query into queries over the local information systems, reformulates the responses conforming to the global ontology and combines them to construct a complete response.*

The prototype relies on standard interfaces implemented in each local atlas. Again, OGC WMS are made available via OGC CSW. The prototype uses the CSW – ISO 19115 profile. Each map is represented as a standard ISO geospatial metadata record. Each record is tag appropriately with local concepts from local ontologies. The mediator knows how to communicate with a CSW interface and understands ISO 19115 metadata, and knows how to extract the concepts from each record.

2.3 Architecture and Interoperability Arrangement Development

By way of architecture development that could be leveraged for GEOSS, our targeted, integrated coastal web atlas, called *global atlas* or *super atlas* (Figure 4), is a *virtual* atlas that offers transparent access to a variety of distributed and heterogeneous *local* coastal atlases (please note that the term "global" does not refer to the globe in this context. Rather, it is the term used by the database community to refer to the integrated data schema in a mediated approach as opposed to local schemas.. The notion of "virtual", in this context, means that local atlas resources are not integrated and copied at the integrated level. Rather, they remain at their locations and are remotely accessed, harmonized and integrated on the fly depending on users' requests. This allows a high degree of independence and autonomy for the local atlases and facilitates extendibility in an architecture where atlases can be added and removed at any time without affecting the global atlas, provided that they implement the core services specified below (Figure 5).

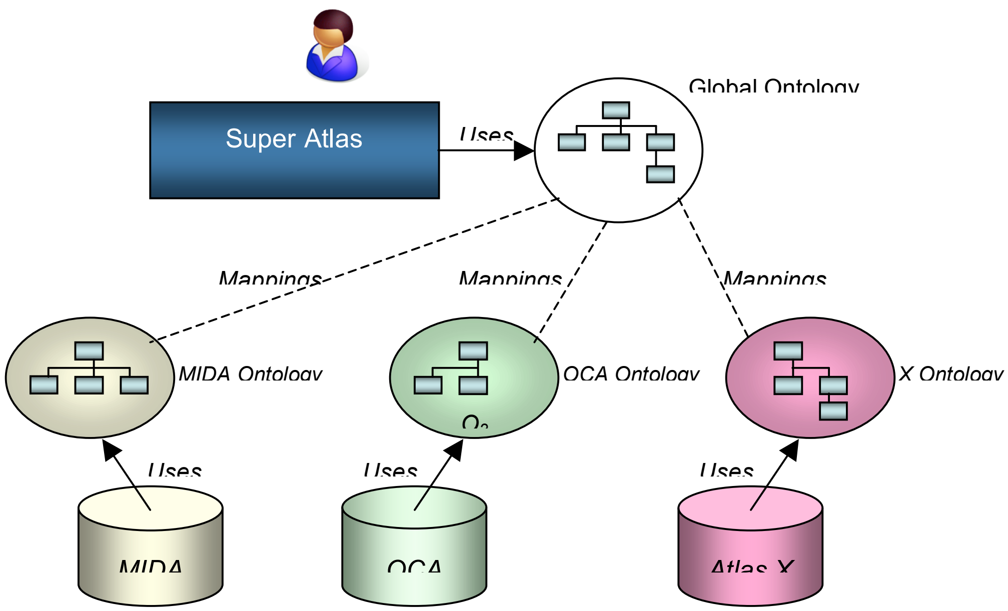

Fig. 4: *Flow chart of ontologies developed for use in the proof-of-concept prototype.*

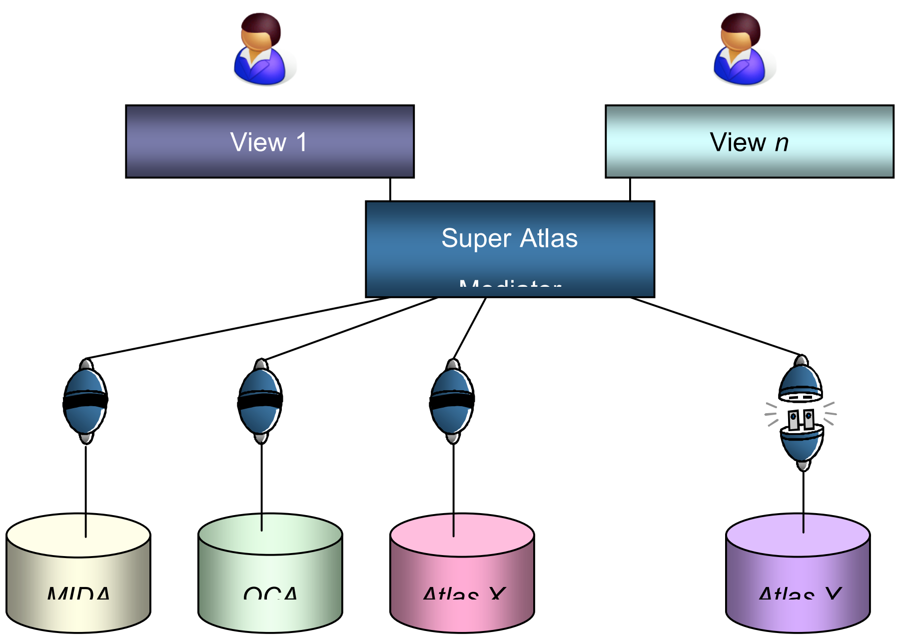

Fig. 5: *In a virtual integration architecture such as mediation, atlases can be added or removed quite easily without affecting the super atlas, provided that they have the right connectors. Different views and graphical interfaces can be provided to users using the same mediation engine to access and integrate local coastal web atlases.*

Atlases users could have different concepts in mind to formulate queries. A coastal planner or an emergency responder may expect different user interfaces to query information in a network of interoperable atlases. An ontology could be defined for different domains of applications, disciplines or communities. A user of a given interface can search and select thematic layers for a given region (typically identified by a bounding box or a common name). They formulate their queries conforming to the global ontology (associated with the interface in question). The super atlas mediator parses the user's request and rewrites it conforming to local coastal web atlas' ontologies. Each resulting query is sent to the appropriate coastal web atlas, which will process it. Information from coastal web atlases are then collected, rewritten according to the global ontology and combined, then sent back to the user.

Important topics commonly addressed by the coastal atlas user include: coastal erosion, flooding (including tsunami inundation and sea level rise), and hazard spills (oil, other chemical). As stated above, coastal erosion has been chosen as an application use case/scenario for testing the global atlas prototype. It is understood that there are many more topics (such as coral reef health and resilience) that interoperable coastal atlas databases would address. For this use case, users are provided with a global ontology of topics (themes) related to coastal erosion. The user refers to the global ontology and formulates a CSW search request using the keywords and the area of interest. The global atlas rewrites the user's request into CSW requests over local atlases' CSWs using their local ontology terms, executes the so-obtained requests, and collects metadata records (responses) from local coastal web atlases. Users can consult the metadata records and overlay and visualize the corresponding data in a map. Figure 6 illustrates the use cases as well as the proposed user interface.

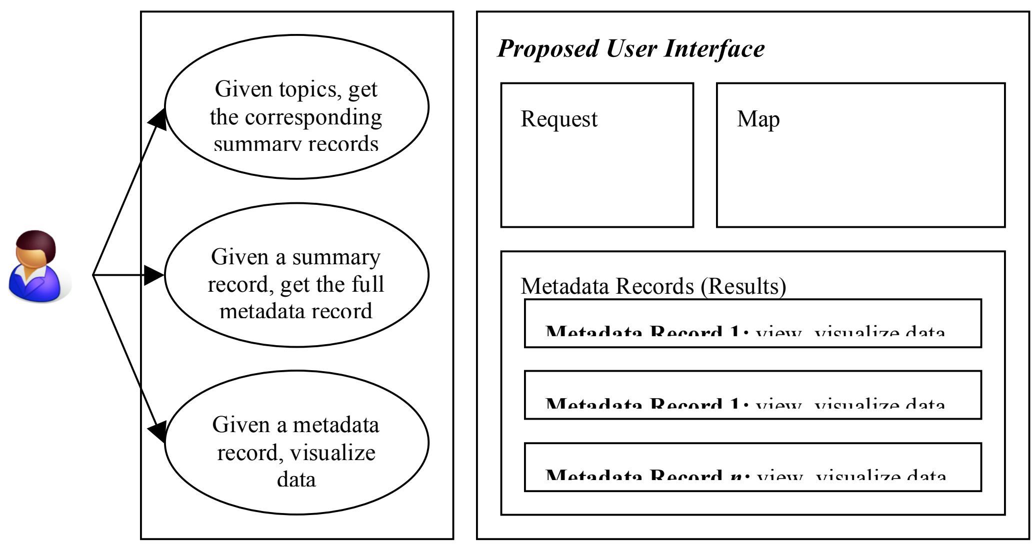

Fig. 6: *Super Atlas use case and proposed interface.*

The global ontology, also called super ontology, is a common ontology that defines metadata-related controlled vocabularies for the super atlas. A controlled vocabulary is defined by the Marine Metadata Interoperability initiative as "*a set of restricted words, used by an information community when describing resources or discovering data*", providing more specificity than just the metadata. Ontologies can both act as registration mechanisms for vocabularies, and as a means of mapping vocabularies to each other using defined relations. The controlled vocabularies reside in local atlas OWL ontologies mapped to terms in a super ontology.

In the current version of the super atlas, the global ontology defines keywords for disciplines, themes, places, times and strata conforming to the five ISO-19139 keyword types. Relationships between those keywords are defined as part of the global ontology, e.g. "Effects of Coastal Change" *is a* "Coastal Change Topic"; or also "Cork" *is within* "Republic of Ireland".

The super ontology is:

- based on **community-held constraints** on mapping and presentation conventions, developed to maximize the comparability and reliability of information about our coasts.
- allows **integrated searching** for data in multiple atlases.
- provides a **framework** for atlas development initiatives.
- **facilitates** cross-jurisdictional collaboration, planning and management.
- encourages **harmonization** among the global atlas community.

The super ontology structure thus provides a recommended framework for building regional coastal atlas communities. Once a super ontology was defined and agreed upon, a demonstration (proof-of-concept) was developed to test the interoperability between two coastal web atlases initially. In order to bring together two coastal web atlases with similar yet disparate content (thematically and semantically), it was decided to build two ontologies for them, an OCA.owl (Oregon Coastal Atlas), and a MIDA.owl (Marine Irish Digital Atlas) and then map those ontologies to the super ontology. It may not be immediately obvious how Oregon and Ireland may need to be interoperable, but these two mature atlas efforts can be used as a testbed for interoperability. Both provide interactive access to spatial data and metadata via web GIS, use similar technologies (open source Minnesota MapServer running on Apache web services), and contain metadata meeting national/international standards (i.e., FGDC and ISO). This proof-of-concept may then be used to make connections within regional partnerships (e.g., the OCA can use lessons learned in developing a regional network of coastal web atlases with Washington and California, while the MIDA can do the same for building and strengthening atlas networks with the UK, Belgium, and other parts of Europe). The prototype is therefore envisioned as a seed application, a template of sorts that can be used by many others and develop further from there.

Mapping ontologies connect multiple coastal web atlases via a **distributed network** by defining the mappings and relationships between local ontology terms and the global ontology terms. An example is given in Figure 7. The example shows terms of the global ontology (followed by prefix "super:") together with terms of the MIDA and OCA ontologies (respectively followed by prefixes "mida:" and "coa:"). Terms from the same ontology can be related, for example the MIDA term "Geology" is more specific /

narrower (*is a* relationship) than the MIDA term "Physical Environment". This is defined as part of the MIDA ontology. The OCA term "Hazards" is narrower than the global term "Effects of Coastal Change". This relationship is defined as part of the mapping ontology between OCA and the global atlas vocabularies. No relationships need to be defined across local ontologies as no communication is required between local atlases.

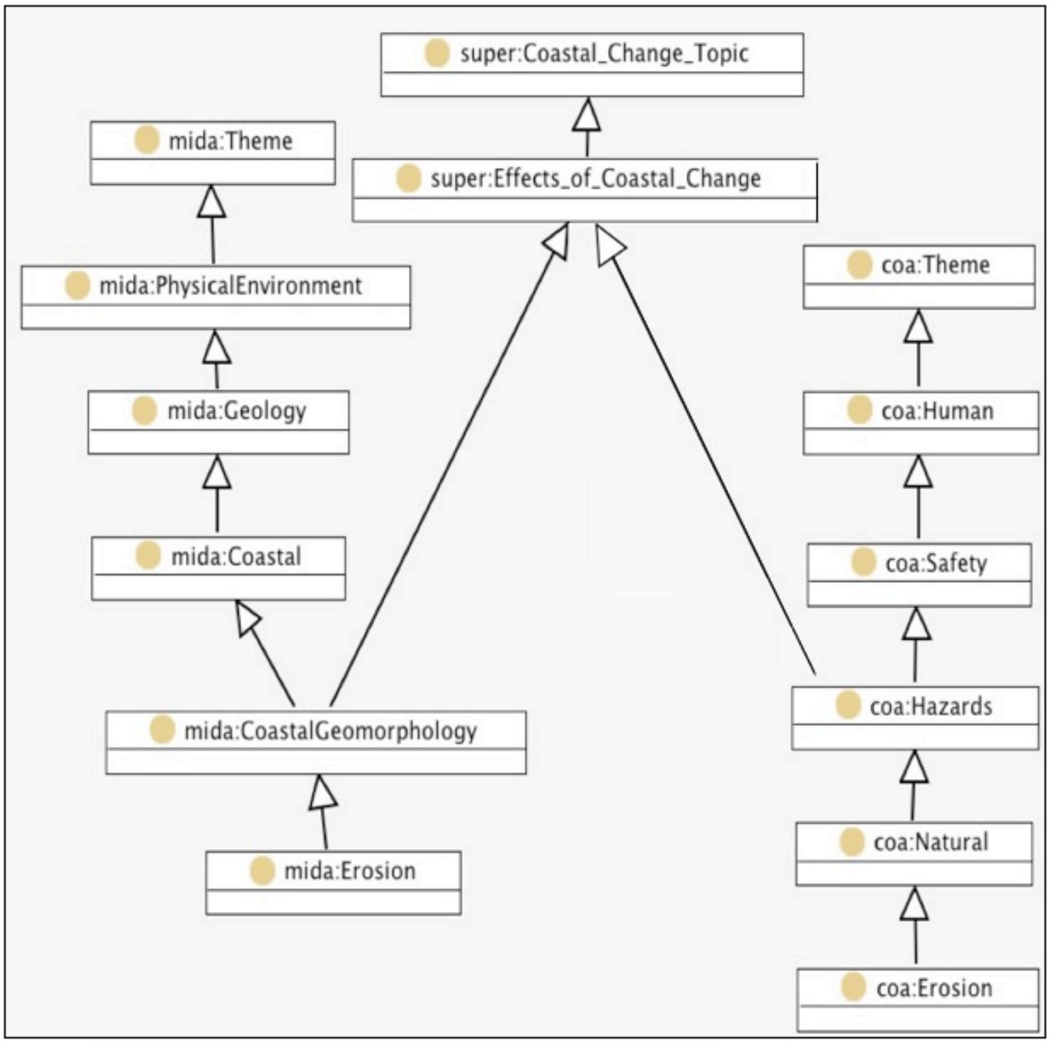

Fig. 7: *Diagram showing the use of controlled vocabularies (built from the metadata and ultimately revealing which data sets are interoperable and how.*

A first version of the global coastal atlas prototype is available at [http://ican.ucc.ie]. Figure 8 shows a screenshot of the prototype. The upper portion of the page allows a user to build a simple CSW request based on a keywords list (extracted form the global ontology) and a bounding box that can be drawn on the map. The lower portion contains the response as metadata records, with the possibility of viewing full metadata.

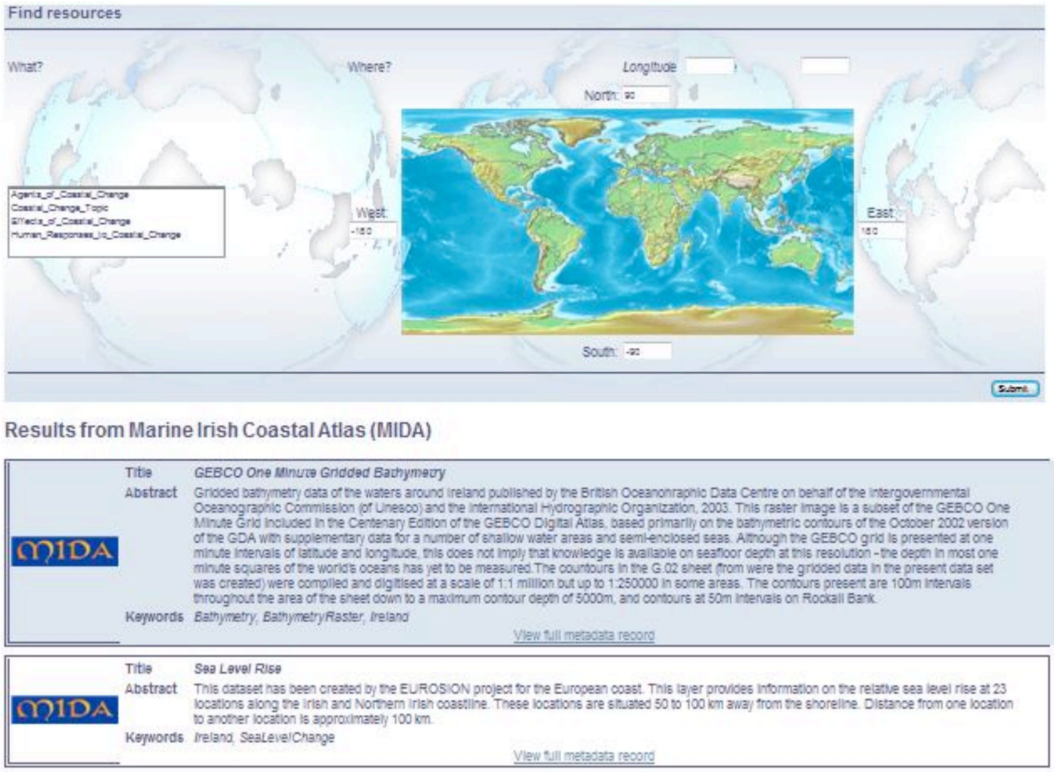

Fig. 8: *Screenshot of the global coastal atlas mediator prototype.*

The prototype allows the user to:

- Select keywords from the list of "global" keywords, defined as part of the global themes ontology; if you do not select any that means that you are interested in EVERYTHING;
- Select an area of interest by dragging a bounding box in the map area; if you do not select any that means that you are interested in the whole globe;
- Submit your query using the “Submit” button in the request division.

The atlas mediator will consult a registry of atlases and identify the atlases that may have data within the bounding box selected, as the bounding box is associated with each atlas representing its geographic extent. The registry also specifies the location of the CSW of each atlas, used to store and query metadata.

Next, the atlas mediator will translate the global keywords you selected into local (MIDA and OCA) keywords using ontology mappings. A local keyword is considered as a translation if it is narrower than the global keyword in the user's request.

Finally, the atlas mediator will send a request to each atlas' CSW using the atlas' keywords. This means that the mediator will talk to each atlas CSW in its own language.

Results from the atlases' CSW are collected and sent back to you as summary metadata. You can view the full metadata records by clicking the "View full metadata" link. This will generate and send a new request to the appropriate CSW and pops up a new window with the full metadata record. For the moment the result is in XML.

The long-term view is for global level operational interoperability that will evolve as the ICAN community strives to increase awareness of the opportunities that exist for increased data sharing among policy makers and resource managers as strategic users of a coastal web atlas. A major goal is to help build a functioning digital atlas of the global coast based on the principle of shared distributed information for improved coastal governance (hence our interest in GEOSS). We anticipate important linkages between coastal observing and international deep ocean observatories in the context of the Integrated Ocean Observatory System (IOOS), where coastal web atlases would naturally provide a resource management nexus. We will go about this by organizing a cooperative interoperability and network project to globally-integrate locally-maintained coastal atlases as the premier source of spatial reference information about the coastal zone of all coastlines throughout the world. By developing community-held constraints on mapping and presentation conventions, we will maximize the comparability and reliability of information about our coasts. This is done to provide a basis for rationally informed discussion, debate and negotiation of sustainable management policies for our societies, nations and people throughout the world. This has tremendous potential relevance not only on both sides of the Atlantic for the North American and European, partners involved, but also has implications for global spatial data infrastructures and Internet mapping projects.

Next steps will for ICAN prototype include:

- Develop prototype web interface to facilitate distributed querying and visualisation of data from both atlases.
- To make the ontologies easily accessible, we will implement general registration of the ontologies using CSW with ISO 19139 (an implementation of 19155), as well as WMS and WFS. This is an improvement over prior approaches where ontologies were developed but it was difficult to make them accessible via open, standardized approaches.
- Integrate WFS and CSW mediation techniques in order to define a more complete approach for integrating both data and metadata.
- Design and implement a semantic mediator tool to perform queries and return results.

- Continue prototype evaluation and improvement, with integration into theGEO Architecture Implementation Pilot.

In terms of participation and/or membership in standards developing organizations, the lead institutions of ICAN (Oregon State University and the Coastal & Marine Resources Centre) are both university members of the OGC (http://www.opengeospatial.org/ogc/members). The NOAA Coastal Services Center, a member of ICAN, is also a technical member of the OGC and coordinates the FGDC Subcommittee on Bathymetric and Nautical Charting Data to support coastal and ocean aspects of the NSDI. As such, ICAN plans to support refinement and elaboration of the currently defined architecture and interoperability arrangements by bringing these experiences to bear through GEOSS meetings, workshops, and telecons. We fully ascribe to the GEOSS Process for Reaching Interoperability Arrangements (produced by GEO Task AR-06-01), and plan to participate in the refinement of the initial architecture in Annex B based upon the pilot activities. We also plan to interact with the Standards and Interoperability Forum in making "special arrangements" for use of non-GEOSS standards. These would include standards currently identified by the Marine Metadata Interoperability (MMI) initiative (see http://marinemetadata.org/conventions/content-standards) or those in use to support ocean floor mapping (e.g., Generic Mapping Tools or GMT grid formats, http://gmt.soest.hawaii.edu).

3 Description of Responding Organization

ICAN is a newly founded informal group of organizations who have been meeting over the past two years to scope and implement data interoperability approaches to coastal web atlases. We are currently not a GEO Member but would like to be a participating organization, one that would essentially provide a coastal data infrastructure model and functioning coastal system for GEOSS. The **mission/strategic aim** of ICAN is to share experiences and to find common solutions to CWA development (e.g., user and developer guides, handbooks and articles on best practices, information on standards and web services, expertise and technical support directories, education, outreach, and funding opportunities, etc.), while ensuring maximum relevance and added value for the end users. The long-term view is for global-level operational interoperability, which will evolve as the ICAN community strives to increase awareness of the opportunities that exist for increased coastal and marine data sharing among policy makers and resource managers as strategic users of a CWA. We see ICAN participants as playing a leadership role in forging international collaborations of value to the participating nations and optimizing regional governance in coastal zone management. A major goal is to help build a functioning digital atlas of the worldwide coast based on the principle of shared distributed information. We will go about this by organizing a cooperative interoperability network for the integration of locally maintained coastal web atlases as the premier source of spatial information about coastal zones throughout the world. We will do this by developing community-held constraints on mapping and data distribution conventions to maximize the comparability and reliability of information about our coasts. This is done to provide a basis for rationally informed discussion, debate and negotiation of sustainable management policies for our societies, nations and people throughout the world. This has tremendous potential to be relevant not only on both sides of the Atlantic for the North American and European partners involved, but also has implications for **global spatial data infrastructures** and Internet mapping projects.

Current members of ICAN include:

Coastal and Marine Resources Centre, University College Cork, Ireland
Department of Geosciences, Oregon State University, USA
African Marine Atlas (South African Institute for Aquatic Biodiversity and University of Ghana)
British Oceanographic Data Centre, England, UK
California Coastal Commission, USA
Caribbean Marine Atlas (9 Caribbean nations including Barbados and Trinidad & Tobago)
Centre for Marine and Coastal Zone Management, University of Aberdeen, Scotland, UK
Co-ordination Centre for ICZM, Belgium
Department of Geography, University of Washington, USA
Department of Marine, Ireland
Environment & Heritage Service, Northern Ireland, UK
European Environment Agency, Denmark
Flanders Marine Institute, European Network for Coastal Research, Belgium
Geological Survey of Ireland
Institute for Natural Resources, Oregon State University, USA
Institute of Marine Science, Venice, Italy (Atlas of Lagoon of Venice)
Marine Institute, Ireland
Marine Metadata Interoperability (MMI)
Maritime & Coastguard Agency, UK
Memorial University Newfoundland, Canada
Monterey Bay Aquarium Research Institute, USA
NOAA Coastal Services Center, USA
NOAA’s Digital Coast Initiative
Oregon Coastal Management Program, USA
San Diego Supercomputer Center, USA
Scripps Institution of Oceanography, USA
SIGLA (GIS for the Coastal Zone Management of Andalucia), Spain
Strangford Lough Management Committee, Northern Ireland, UK
Ulster Museum, Northern Ireland, UK
UNESCO IOC's IODE (International Oceanographic Data and Information Exchange)
University of Ulster, Northern Ireland, UK
Université Paul Cézanne, France
Virginia Institute of Marine Science, USA
Washington (state) Department of Ecology, USA
Wisconsin Sea Grant’s Digital Great Lakes and Coastal Communities

ICAN’s approach to supporting the GEO Architecture Implementation Pilot includes leveraging the approaches and results of the ICAN interoperability prototype (e.g., exposing and sharing our controlled vocabularies, super ontologies, semantic catalogs, and our customized guides and profiles of OGC services (CSW, WMS, WFS, WCS). We are currently seeking additional funding from the NSF, NOAA, and from European agencies to support the human and system resources needed to maintain and extend the

ICAN prototype. This includes salary support for ICAN technical team members Yassine Lassoued, Declan Dunne and Tanya Haddad (see below).

Contact information: Dawn Wright will serve as both Programmatic Contact and as Technical Contact at the outset. She is a professor of geography and oceanography at Oregon State University and is lead coordinator of the entire ICAN initiative along with colleagues Ned Dwyer and Val Cummins of the Coastal and Marine Resources Centre (CMRC), University College Cork, Ireland. She is also a current co-coordinator of the ICAN technical work group which has been tasked with researching and developing solutions for coastal web atlas advancement. A major focus is developing the OGC-based prototype described above to globally-integrate locally maintained coastal atlases, as well as related coastal web atlas technical resources for the coastal zone management community (e.g., user and developer guides, information on standards and web services, expertise and technical support directories, and more). The ICAN technical work group is coordinated through an email listserv, the address for which is also provided as Technical Contact (ican_tech@lists.oregonstate.edu). The current membership of the ICAN technical work group is:

Selorm Ababio, University of Ghana, African Marine Atlas, sdababio@gmail.com
Juan Arévalo, European Topic Centre Land Use and Spatial Information, juan.arevalo@uab.cat
Luis Bermudez, Southeastern Universities Research Association (SURA), bermudez@sura.org
Simon Claus, Flanders Marine Institute, European Network for Coastal Research, simon.claus@vliz.be
Franz Daffner, European Environment Agency, Franz.Daffner@eea.europa.eu
Declan Dunne, CMRC, d.dunne@ucc.ie
Tanya Haddad, Oregon Coastal Management Program, tanya.haddad@state.or.us
David Hart, Wisconsin Sea Grant, dahart@wisc.edu
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Alessandro Sarretta, Italian National Research Council-Institute for Marine Sciences, Alessandro.sarretta@ve.ismar.cnr.it
Dawn Wright, Oregon State University, dawn@dusk.geo.orst.edu

ICAN also has a governance structure led by Ned Dwyer of the CMRC, Roy Lowry of the British Oceanographic Data Centre, John Helly of the San Diego Supercomputer Center, John Pepper of the UK Hydrographic Office, and Dawn Wright of Oregon State University.