Integrating and Visualizing Sea Ice Charts and Cruise Tracks using Linked Open Data and Open Source Tools

An NSF-Funded effort of the National Snow and Ice Data Center (NSIDC) and the Rensselaer Polytechnic Institute (RPI) Tetherless World Constellation

Evan W. Patton, Siri Jodha S. Khalsa, Deborah L. McGuinness, Ruth E. Duerr, Peter L. Pulsifer, Peter Fox, Rui Yan

http://nsidc.org/ssiii/

What is SSIII?

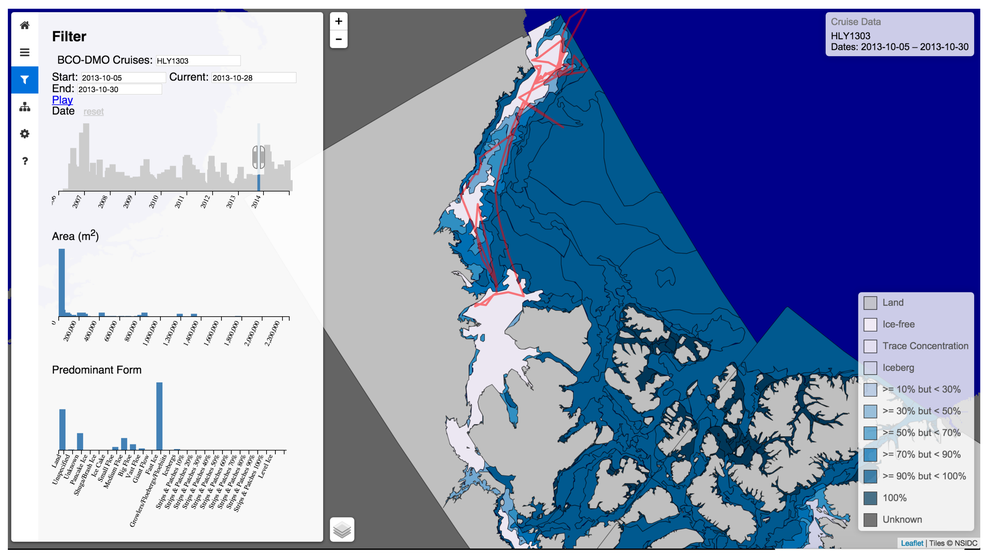
SSIII, the *Semantic Sea Ice Interoperability Initiative*, is collaborative project between NSIDC and Rensselaer Polytechnic Institute that is funded by the US National Science Foundation and is aimed at increasing the interdisciplinary understanding and usability of Arctic data through semantic technologies and community engagement.

Project Objectives

- Extend, strengthen, and enhance the interoperability of Polar data and information services by facilitating community development and review of ontologies.
- Develop detailed, yet broad, sea ice ontologies linked to relevant marine, polar, atmospheric, and global ontologies and semantic services.
- Investigate linkage to elements of local and traditional Arctic knowledge in the sea ice ontologies.
- **Make selected NSIDC sea ice data holdings available as linked open data using the sea ice ontologies**
- Encourage the use and evolution of the ontologies by other networks and interested parties.
- Integrate the sea ice ontologies into developing global and polar ontologies and the related semantic frameworks.

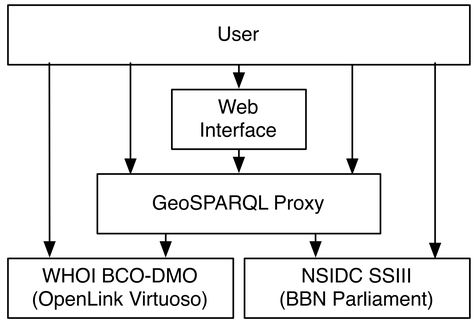
Web Application & Software Stack

SSIII is developing a web-based interactive map client that can query the SIGRID data, and integrate it with other data, such as vectors representing the routes of oceanographic cruises. These data are retrieved, via SPARQL, from the BCO-DMO archive. Using this tool one can search the BCO-DMO archive for a particular cruise and then the filters (shown at the left in the figure below) will be automatically updated to reflect the SIGRID data available during the dates of the cruise. This allows scientists to quickly observe the ice conditions such as predominant form of ice or ice concentration. Lastly, one can play back the SIGRID data to visualize changes in ice over time.



Our interactive client is built on free and open source software using web standard technologies. Leaflet.js is used to render the map content and data are served to the portal using OGC GeoSPARQL queries with the results reformatted to GeoJSON. Visualization of the ice characteristics is performed using D3.js and Crossfilter. SIGRID RDF data are stored and queried using BBN Parliament™, an open source triple store with spatial indexing and GeoSPARQL support built on Apache Jena.

Depending on the user's abilities, she may access data via the web interface, via our GeoSPARQL proxy (which converts GeoSPARQL geometries into GeoJSON), or by accessing SPARQL endpoints directly.



We Welcome Your Involvement and Comments

LIST OF ACRONYMS

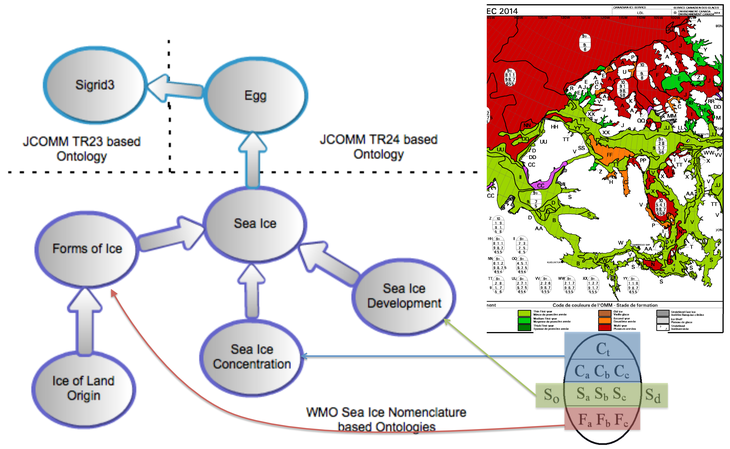
BCO-DMO – Biological and Chemical Oceanography Data Management Office

OGC – Open Geospatial Consortium

(Geo)SPARQL – (Geo) SPARQL Protocol and RDF Query Language

Ontology Development

The diagram below depicts the principle ontologies that have been developed, the source vocabularies on which they are based, and how they are mapped from the traditional Egg codes used to encode sea ice data. These ontologies were deliberately kept small, single purpose and modular in the hopes that this would facilitate reuse and maintenance for the long term. The ontologies range from ones that describe purely the physical characteristics of sea ice to ones that describe ice chart data encoded in SIGRID-3 format through the bridge of an ontology describing the contents of an egg code.



Each ontology is available in Web Ontology Language (.owl) and Manchester Ontology Notation (.omn) form, and can be downloaded from https://code.google.com/p/ssiii/.

Future Work

The Joint Technical Commission for Oceanography and Marine Meteorology of the World Meteorological Organization has established an Ice Chart Colour Code Standard and Ice Information Product Specification (S-411). As the mapping components of the application mature we will work towards compliance with these specifications. This includes standardized portrayals including colors and other cartographic elements, feature classification and metadata elements.

We are also looking for opportunities to integrate additional open linked data sources.

This project is funded by NSF Award ACI 0956010 INTEROP