# The Many Dimensions of Sea Ice - A Beginning Ontology

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

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## INTRODUCTION

SSIII, the *Semantic Sea Ice Interoperability Initiative*, is an NSF-funded effort to increase the interdisciplinary understanding and usability of sea ice data by establishing a network of practitioners working to enhance semantic interoperability of all Arctic data.

Presented here is an initial sea ice ontology that emerged from a workshop in which sea ice modelers, field researchers, remote sensing scientists and operational forecasters described the dimensions of sea ice from the perspective of their respective disciplines.

## OBJECTIVES

- Extend, strengthen, and enhance the interoperability of established and emerging network of Polar data and information services by facilitating community development and review of ontologies.
- Develop a detailed, yet broad, sea ice ontology linked to relevant marine, polar, atmospheric, and global ontologies and semantic services.
- Explicitly incorporate elements of local and traditional Arctic knowledge in the sea ice ontology.
- Make available NSIDC sea ice data holdings using the sea ice ontology and encourage the use and evolution of the ontology by other networks and interested parties.
- Integrate the sea ice ontology into developing global and polar ontologies and the related semantic frameworks.
- Improve the discovery, understanding, and use of sea ice data by enabling faceted searches of sea ice data in multiple existing and developing search interfaces.

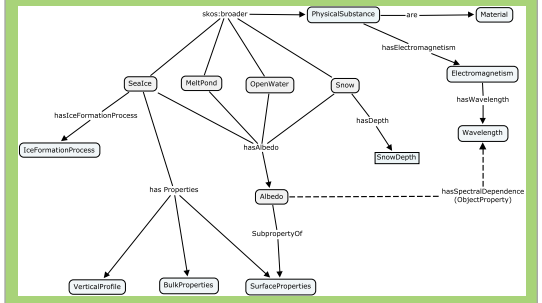
## PROCESS

Two use cases were developed by the team. The first focused on improving the parameterization of sea ice albedo in climate models. The second focused on forecasting navagable conditions in the Bering Sea. At the workshop one day was devoted to each use case in which we attempted to model the relevant concepts and terminology, and the relationships between them. This poster discusses the model that was developed for the albedo parameterization model.

## FEEDBAK SOUGHT

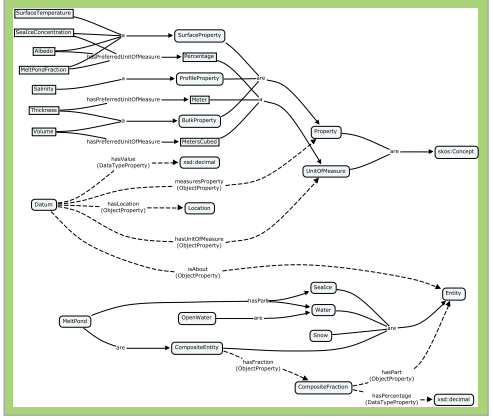
For our Sea Ice ontology to become practical and useful to the community we need the involvement of the community. This poster is our initial outreach effort beyond the first workshop's participants. In addition to comments on the models presented here, we solicit feedback on how they could be linked to relevant marine, polar, atmospheric, and global ontologies and semantic services.

## High-level overview of initial Sea Ice – Albedo Model



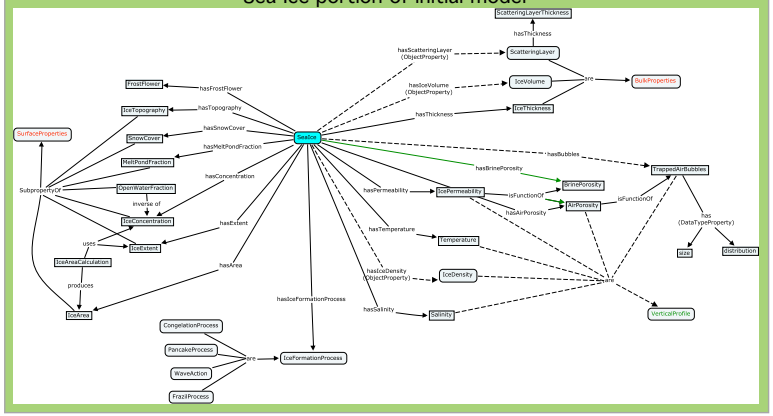

The Albedo parameterization use case produced an initial Sea Ice model that combined all the concepts captured in the workshop discussions, supplemented by the WMO Sea Ice vocabulary. A simplified version of this model is shown at the left. Some of the details are shown in the lower two panels. Not all of the content contained in the initial model is shown.

The model is created in CMAP Ontology Edition (COE) and used conventions given in the legend at the left.

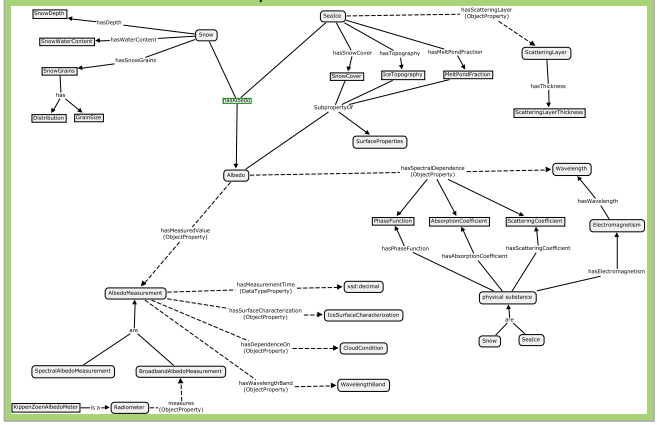



This approach separates classes representing phenomena from classes representing how those phenomena are measured. In this way we can model more information than simply asserting that "Sealce has Thickness". We assert that Sealce is type of Entity, and a Datum is used to describe an Entity. Furthermore, a Datum measures a Property and Thickness is a BulkProperty that is a subclass of Property. Thus, not only are we able to assert that "Thickness is a Property of Sealce" but also what units Thickenss has and where it was measured. Also shown is how the

## Sea Ice portion of initial model




## Albedo portion of initial model




## ISSUES WE ENCOUNTERED IN DEVELOPING THIS ONTOLOGY

1. Knowing when to represent a concept as a concrete instance vs. an abstract class. Many participants in the project are practitioners who deal with a particular phenomena in concrete terms such as a measurement that describes the phenomena rather than the abstract notion of that phenomenon. Modeling as a class can provide more extensibility and overall flexibility (i.e. ability to extend with new properties), but may be less meaningful to practitioners. See UR panel.
2. Sea ice is very process oriented. This requires concepts such as 'realization' and the use of specialized predicates that may or may not have been formalized by the participant communities.
3. Disciplinary perspectives have on an impact on the modeling. We debated whether certain characteristics should be modeled as geographic features or not.
4. Choosing appropriate top and mid-level ontologies, particularly establishing appropriate predicates.
5. Managing size and complexity of CMaps with respect to stakeholders. There was a need to 'chunk' the CMap into smaller, more 'digestable' bites to avoid overwhelming our domain experts.

## FUTURE ACTIVITIES

- Convert models to formal ontologies
- Publish Version 1 of simplified sea ice ontology
- Define connections to other mid- and upper-level ontologies
- Apply ontology to selected Sea Ice data sets
- Hold second Sea Ice Semantics workshop, with a focus on incorporating local and traditional Sea Ice knowledge.

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