Modular Ontology Modeling with Ontology Design Patterns
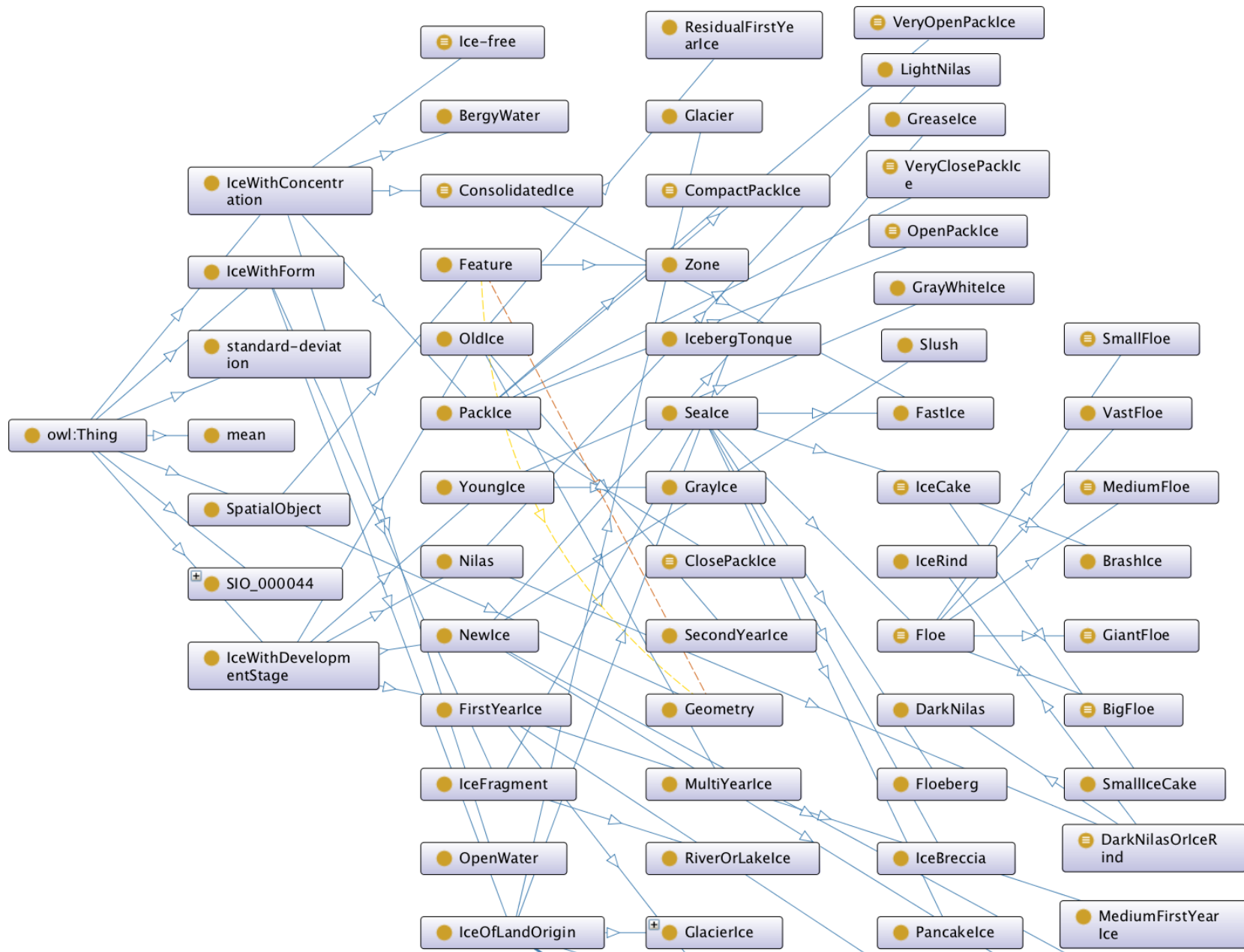
Nazifa Karima
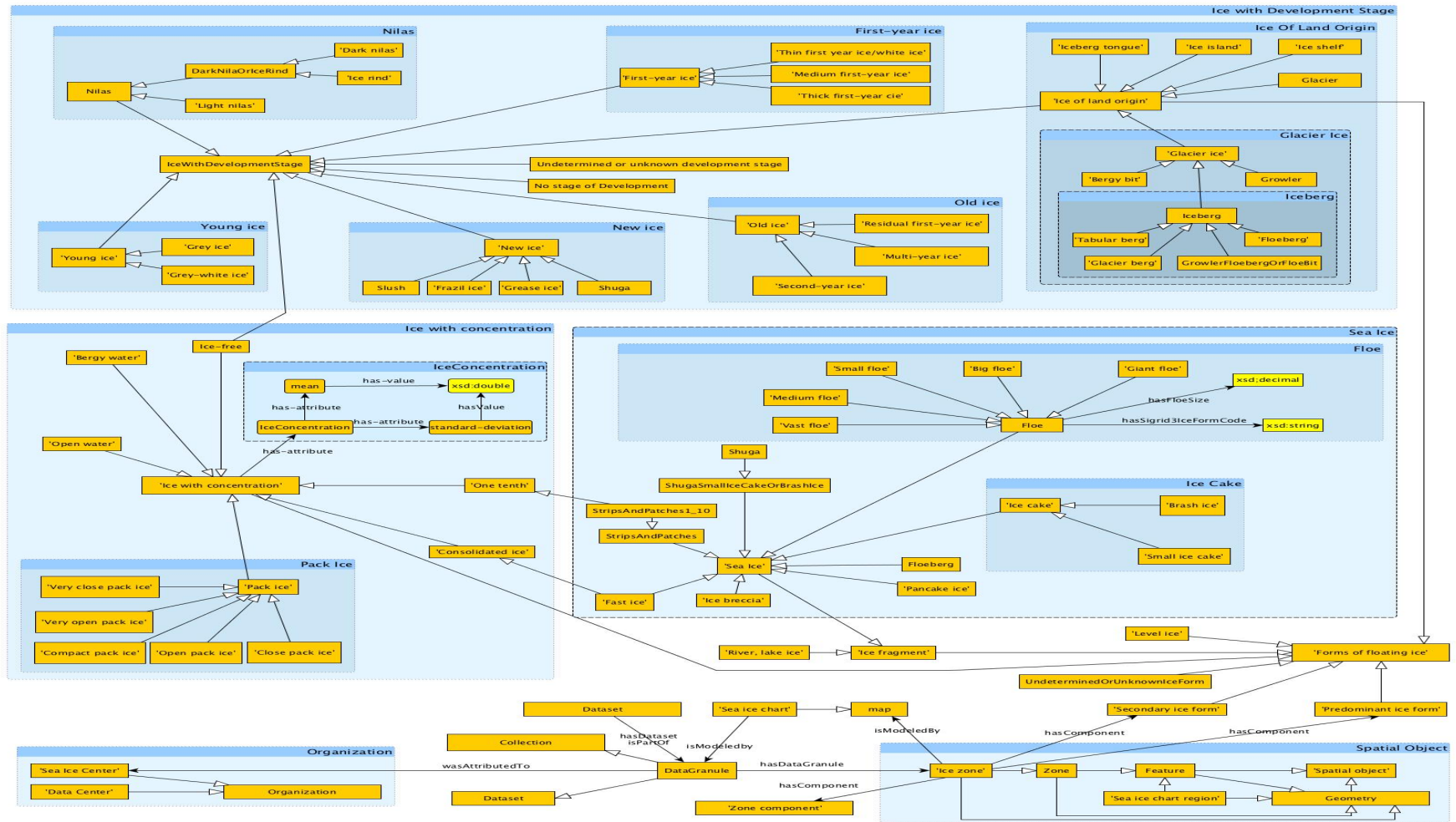
Adila A. Krisnadhi

How do we make sense of this ontology?

- Divide it into modules
- Find relations among these modules provided by the ontology

SeaIce ontology divided into 17 modules

Ontology Design Pattern

So how do we get the relations?

- Look into the Object Properties
- Look into Data Properties
- Look into axioms involving these properties
- Look into the annotations for all entities in the ontology
- Consult domain experts/original developers of the ontology

Ontology Design Pattern

Ontology design pattern (ODP): A ("reusable") solution of a frequently occurring modeling problem in the domain and can act as a building block of a more complex ontology.

Content pattern (CP): An ODP that models a particular generic notion in a particular domain.

Pattern-1: Pattern for "Ice with Development Stage"

Ontology Design Pattern can also be used to build a 'good' ontology from scratch.
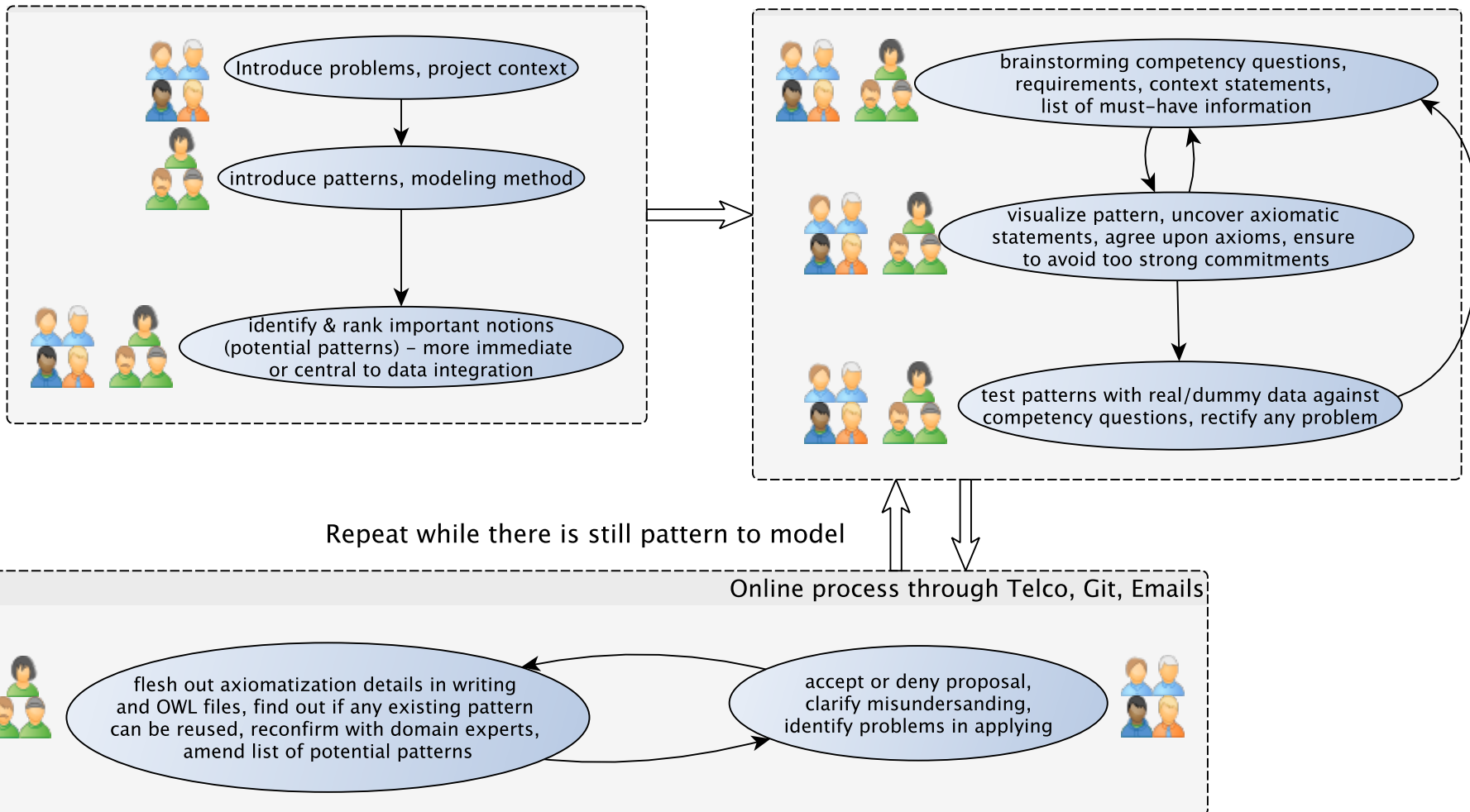
- Principle #1: Small >>> Large
  - Smallness usually implies simplicity
- Principle #2: Modular >>> monolithic
  - Easier to use as building blocks.
  - Highly extendible
  - Easily understandable
- Principle #3: Be aware of multiple perspectives.
  - Strike a balance between fostering interoperability vs. allowing semantic heterogeneity.
  - e.g., street is a connection between two places, but also a separation that cuts a habitat into pieces.
- Principle #4: Add human-readable annotations
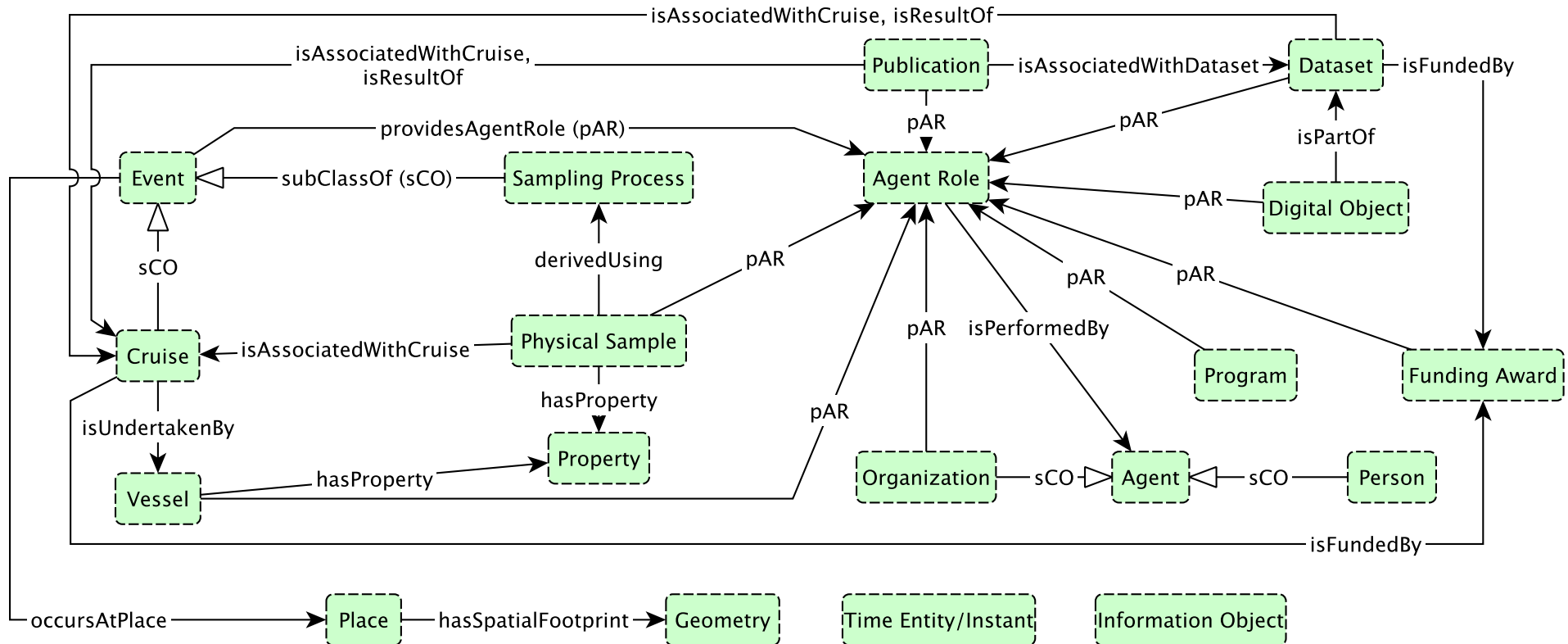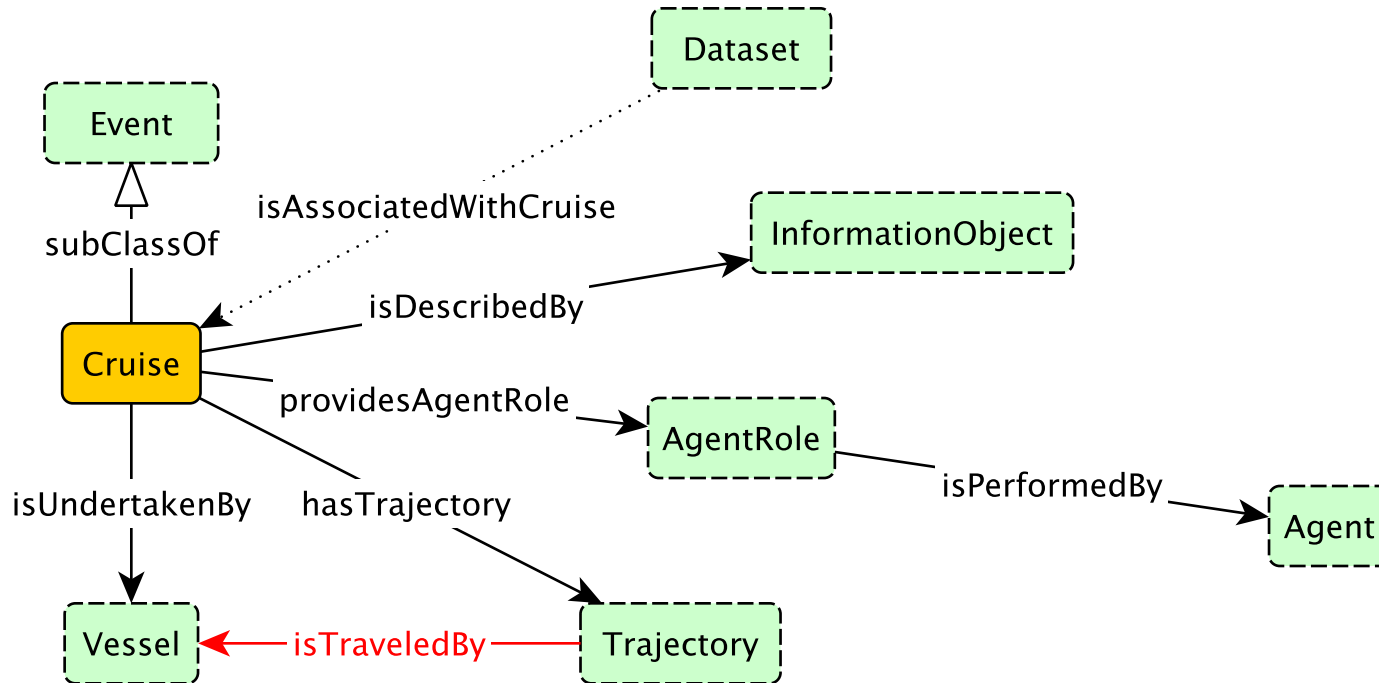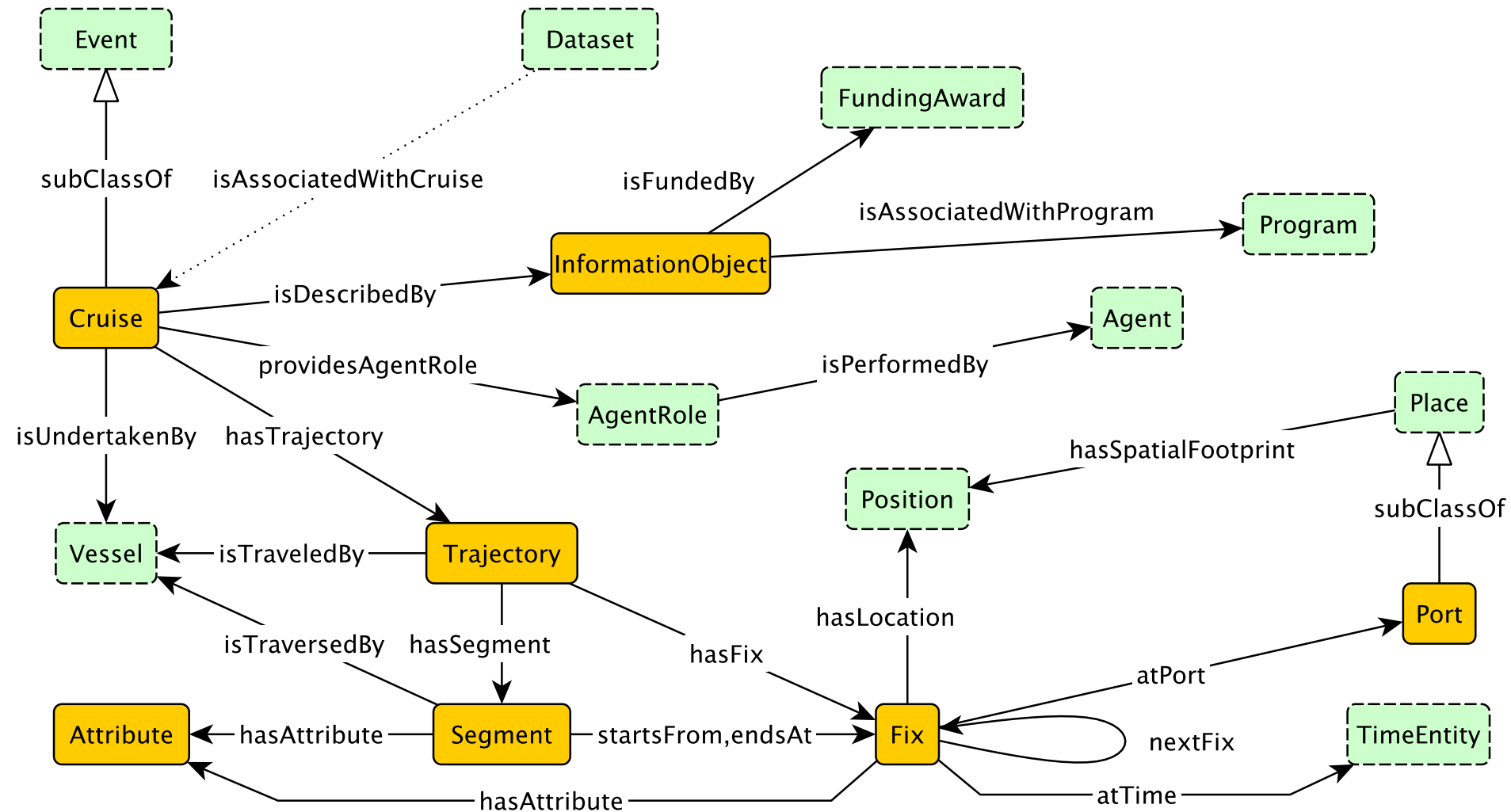 - Improve understandability.
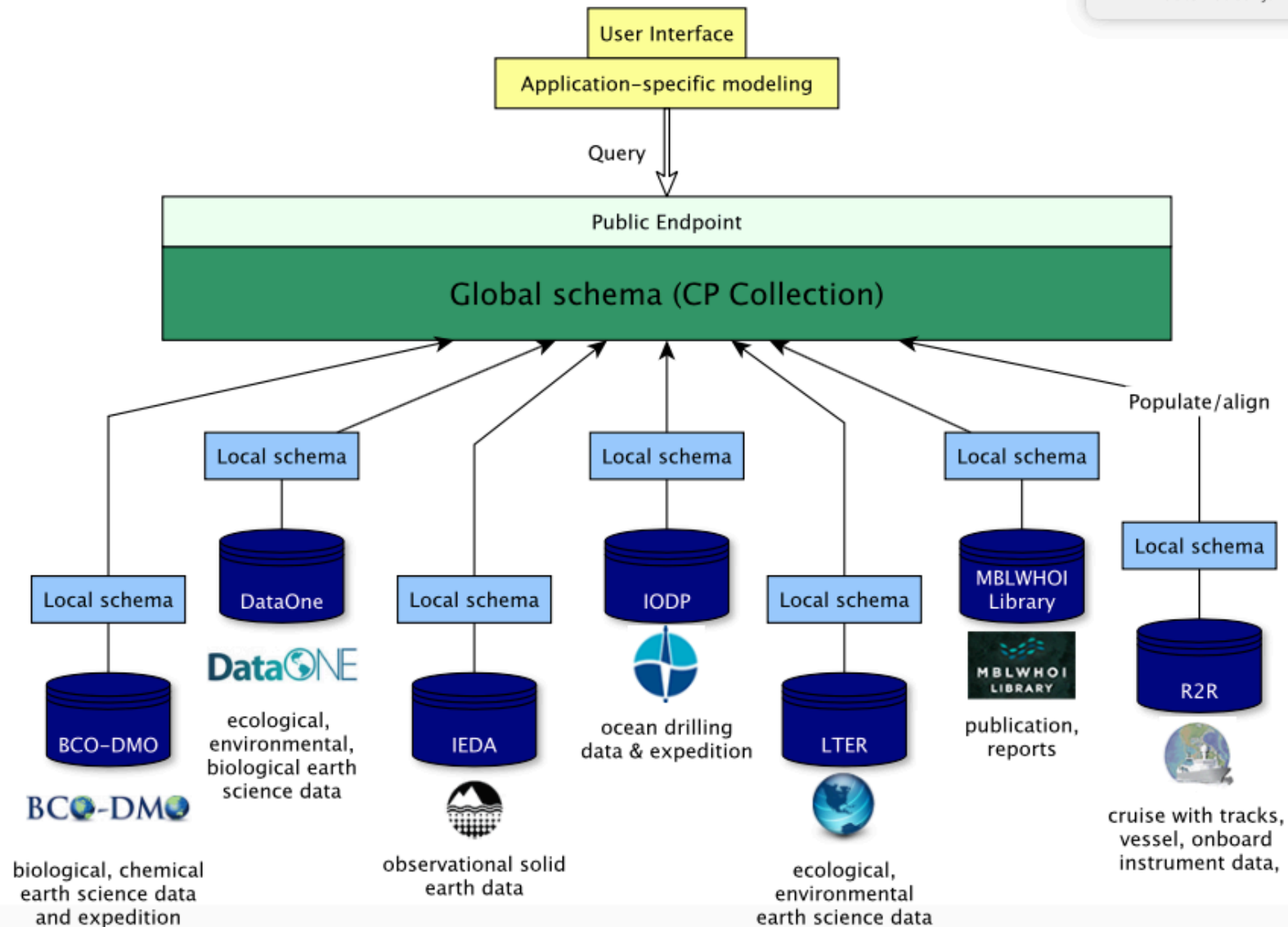
Modeling Workflow

Personnel needed:
more than one domain experts, data providers,
people understanding possible use cases,
ontology engineer familiar with modeling approach

Introduce problems, project context

introduce patterns, modeling method

identify & rank important notions
(potential patterns) – more immediate
or central to data integration

brainstorming competency questions,
requirements, context statements,
list of must-have information

visualize pattern, uncover axiomatic
statements, agree upon axioms, ensure
to avoid too strong commitments

test patterns with real/dummy data against
competency questions, rectify any problem

Repeat while there is still pattern to model

Online process through Telco, Git, Emails

flesh out axiomatization details in writing
and OWL files, find out if any existing pattern
can be reused, reconfirm with domain experts,
amend list of potential patterns

accept or deny proposal,
clarify misundersanding,
identify problems in applying

Cruise Trajectory

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  - *Consortium of Ocean Leadership*: Douglas Fils

$$\exists \text{hasIceConcentrationType.}\{\text{Bergy Water}\} \equiv \exists \text{hasIceForm.}\{\text{IceOfLandOrigin}\} \sqcap$$
$$\exists \text{hasIceConcentrationType.}(\exists \text{hasMean.}\{0.15\} \sqcap \exists \text{hasStandardDeviation.}\{0.05\}) \quad (1)$$

$$\{\text{"1 to 2 tenths"}\} \equiv \exists \text{hasMean.}\{0.15\} \sqcap \exists \text{hasStandardDeviation.}\{0.05\} \quad (2)$$

$$\text{PartOfIceArea} \sqcap \exists \text{hasIceConcentrationType.}\{\text{"1 to 2 tenths"}\} \sqcap \exists \text{hasFormOfIce.}\{\text{IceOfLandOrigin}\}$$
$$\equiv \exists \text{hasIceConcentrationType.}\{\text{Bergy Water}\} \quad (3)$$