An example of end-to-end model coupling for marine ecosystem services using ARtificial Intelligence for Ecosystem Services (ARIES).

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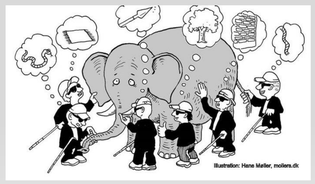
What if our data and models could talk to one another, and decision makers could draw on decades of scientific information to more quickly and reliably answer questions about today's most urgent problems?

1 Problem Identification



- **Different conceptualizations /** same reality
- Views that do not talk to each other
- Need to provide answers to **complex queries**
- Now attention paid to **integration**, **interoperability** and **complementarity** of models
- Interoperability needs to be planned from the beginning
- It needs a collaborative **integrated modelling** community

AIM: To provide answers to complex marine ecosystem services challenges

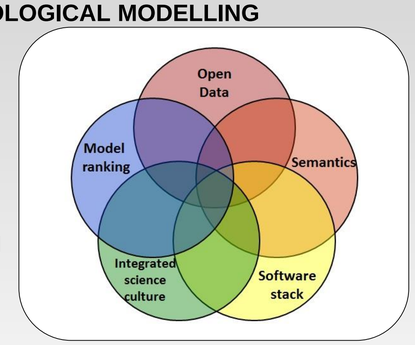
2 ARIES

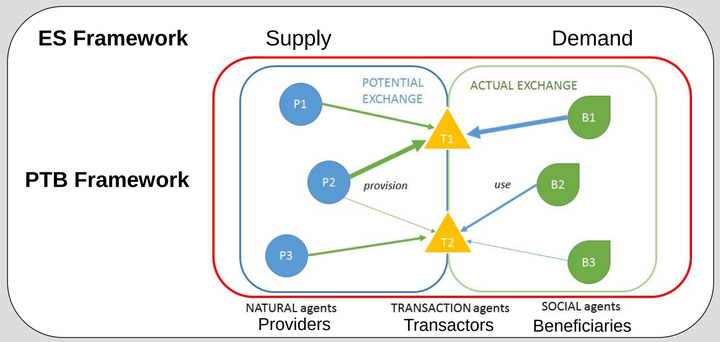
Using the ES & the PTB Framework

Links Natural Capital, Natural Processes, Human Beneficiaries and Service Flows to Society ----- **SOCIO-ECOLOGICAL MODELLING**

Integrated Modelling based on:

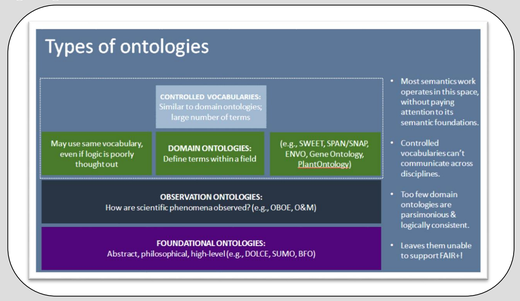
1) Open data
2) Semantics
3) Software stack
4) Integrated science culture / Collaboration
5) Artificial Intelligence and model ranking





1) Open data: Making data **FAIR** (Findable, Accessible, Interoperable, Reusable). By putting data on the Internet, making it findable and readable by computers, and able to be interpreted by computers (interoperable), data can become reusable.

2) Semantics: A multidisciplinary solution to the problem of finding common language to describe scientific phenomena in our world. We have developed a semantic framework that gives the precision, modularity, and logical consistency needed to support multidisciplinary science. It bridges to accepted scientific *authorities*, which for the first time provides a common scientific language that can support integrated modeling.
Modeling language for both technical and non-technical users named **K.IM**



3) Software stack: **K.LAB**. Is the technology that powers ARIES. Built using Eclipse with open-source code stored in BitBucket.

k.LAB
knowledge modelling environment
Version 0.9.10 "Sophia"
© 2008-2017 integratedmodelling.org
Primary Developers
Fernando Mat
Ioannis N. Athanasiadis
S. Luke Scott

4) Collaboration: New paradigm of collaborative modelling.

- Modelers can add their models (and data) to the network and become available to other users
- Cloud-based technology allowing collaborative model building
- Transparent and automatic documentation of the models used through the IM Community and the various collaboration platforms (Web-page; Confluence; Bitbucket; Geoserver; Jira…)

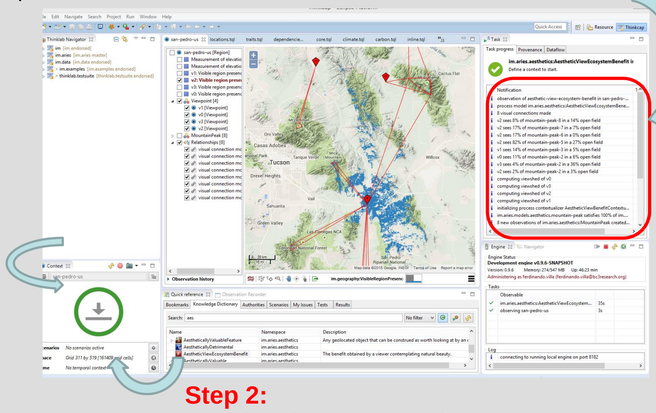
5) AI & model ranking:
Key challenge is the ability of a computer to select the "right" data and model to answer a given question in a particular time and place. This is a cornerstone of "Artificial Intelligence (AI)" – enabling a machine (i.e., a computer) to make choices based on information supplied by the people who use the system to address a given integrated modeling problem.

We use *ranking algorithms* that take into account the basic characteristics of particular data and models, combined with precise semantic annotation to prevent the reuse of data in inappropriate contexts.
Provenance information is provided in a diagram each time the system is used, making the choices made by the computer during the modeling process more transparent.

3 STEPS

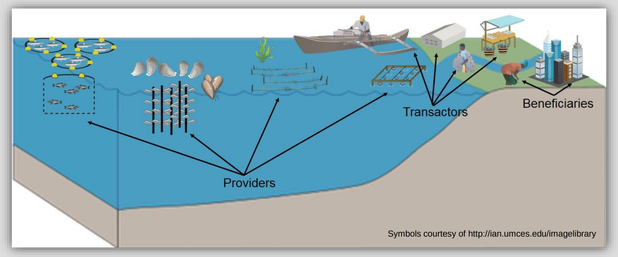
Step 3:
- Creates agents and processes from ontological specs
- Builds best-case model out of components and data on the semantic network
- Computes it…

Step 1: Set overall context to region **X**

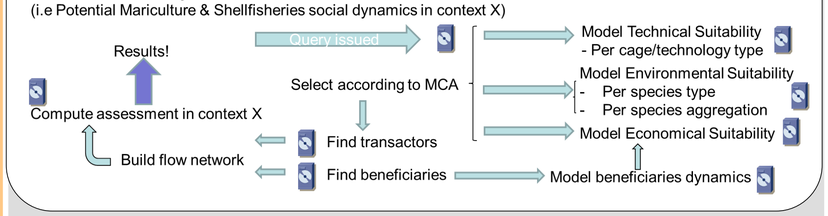


Step 2:
Drag/drop the concept to observe

4 MARICULTURE & SHELLFISHERIES EXAMPLE



Query:
1. Set context to region **X**
2. Observe something
(i.e Potential Mariculture & Shellfisheries social dynamics in context X)



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