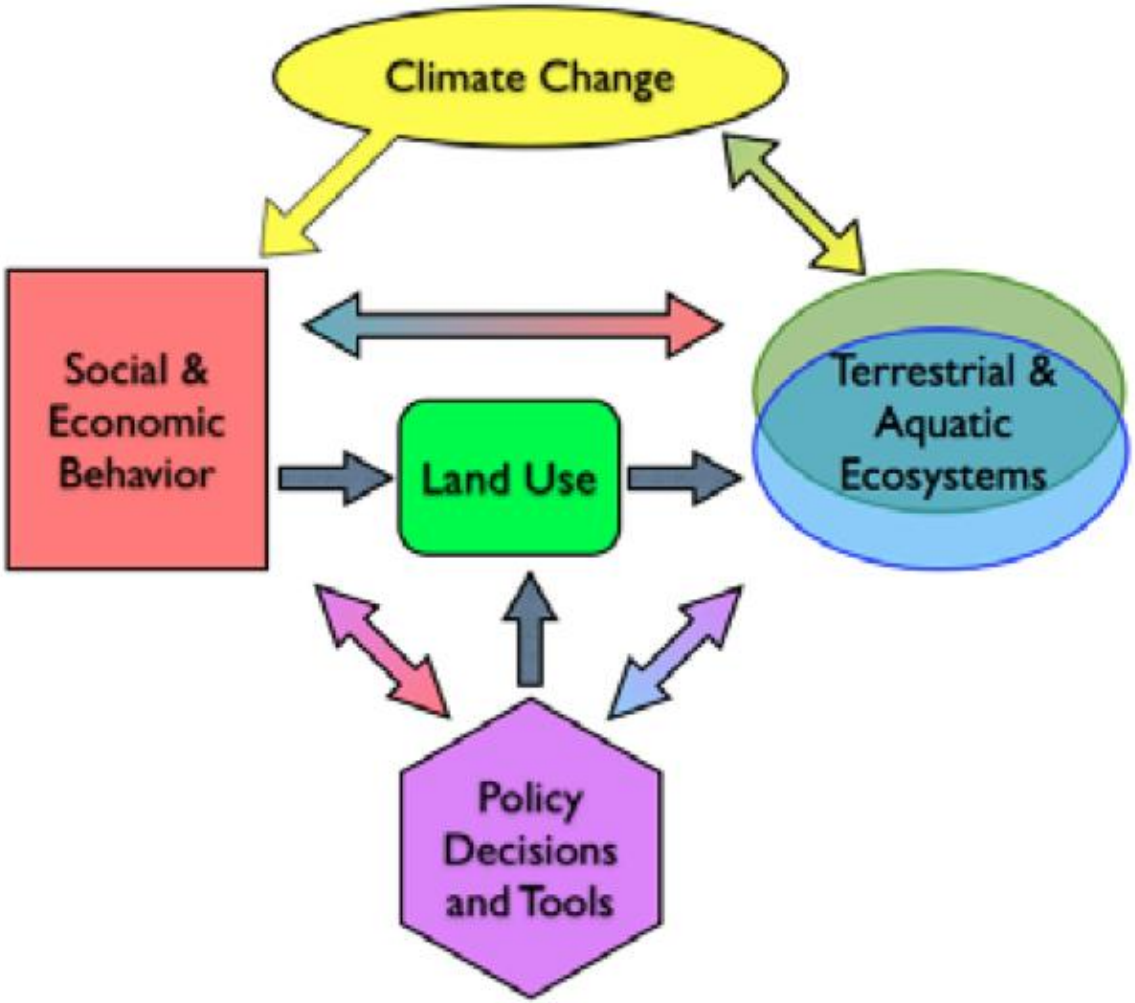
RACC
Research on Adaptation to Climate Change

Integrated Assessment Model of the Lake Champlain Basin

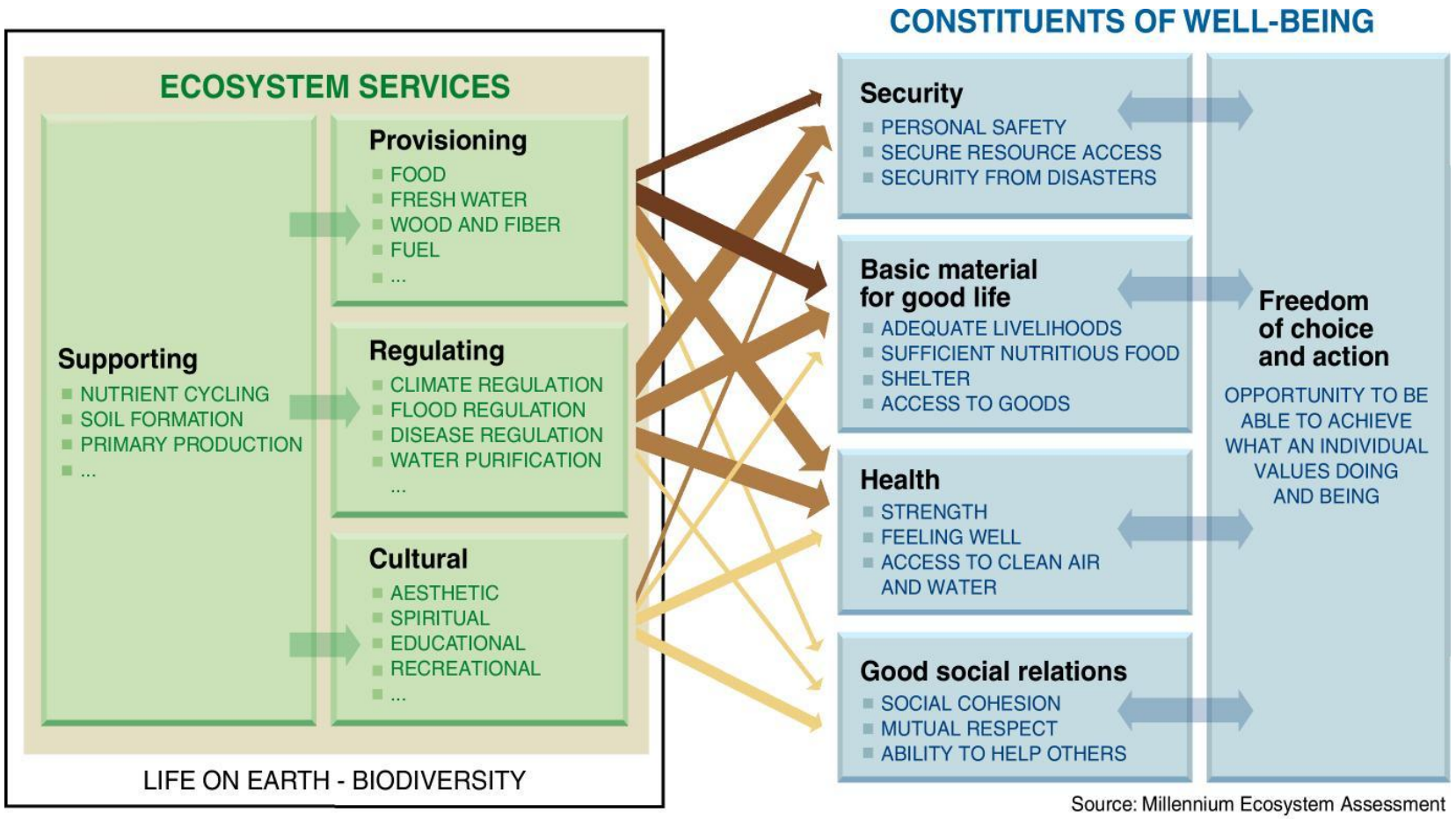
Overarching Question

How will the interaction of climate change and land use alter hydrological processes and nutrient transport from the landscape, internal processing and eutrophic state within the Lake, and what are the implications for adaptive management strategies?

To investigate the impacts of climate and land use change on the region's economy and ecological infrastructure, and evaluate potential adaptation strategies, an **Integrated Assessment Model of the Lake Champlain Basin** will be developed based on **spatially-explicit modeling of ecosystem services**.



Ecosystem Services



Source: Millennium Ecosystem Assessment

Role of Modeling

1. Scoping Models

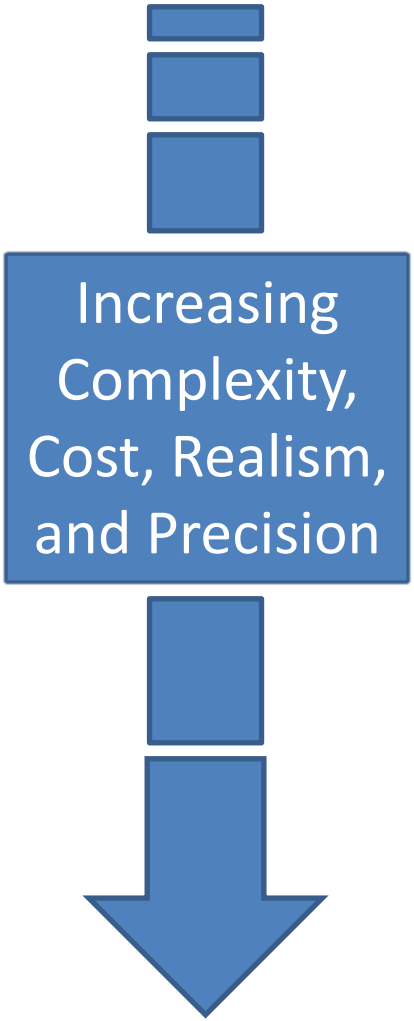
   High generality, low resolution, broad participation by all stakeholder groups.

2. Research Models

   More detailed and realistic attempts to replicate the dynamics of a particular system of interest, with emphasis on calibration and testing.

3. Management Models

   Medium to high resolution. Emphasis on producing future management scenarios. Can be exercising #1 or #2, or require further elaboration to apply management questions.



Source: Costanza, R. and M. Ruth, "Using Dynamic Modeling to Scope Environmental Problems and Build Consensus," *Environmental Management* 22: 183-195, 1998.

IA Model will:

1. Connect inputs and outputs of **independently defined models** developed from research on terrestrial, aquatic, and socioeconomic system response to regional climate and land use change scenarios.
2. Integrate via **semantic annotation** of the model types, the concepts they observe, and their corresponding spatial, temporal, and conceptual contexts.
3. Explicitly address **uncertainty and scale-mismatches** through an array of advanced techniques from neural networks, Bayesian statistics, agent-based models, and process-based models.
4. Result in **tangible impacts on watershed planning** to improve resilience and reduce the vulnerability that human communities and supporting ecosystems face as the result of destabilizing climate drivers.

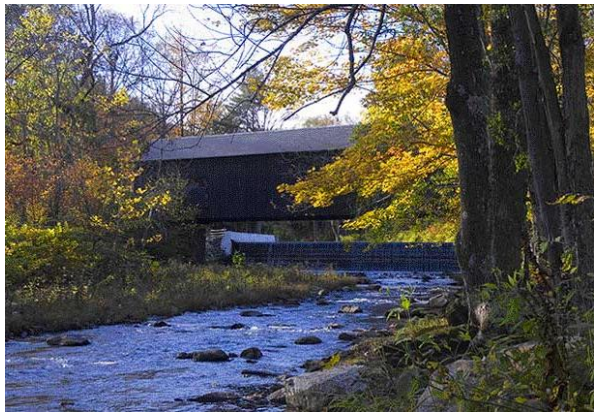
Integrated Modeling Platform

Areas of provision of ES and biodiversity

Flow paths between provision and use areas

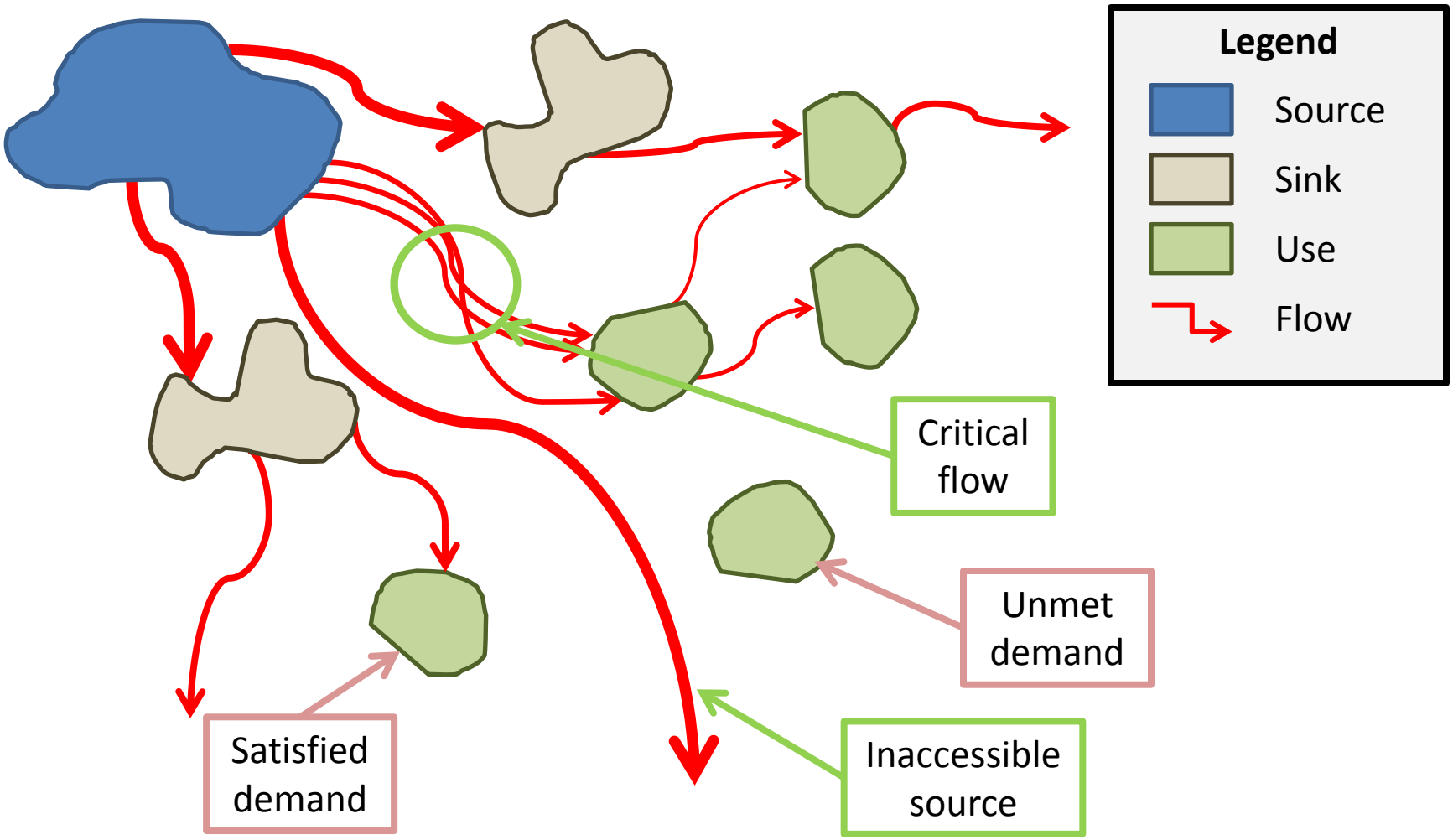
Areas of use of ES & biodiversity where beneficiaries are located

Provision Sheds



Benefit Sheds

Spatially Explicit Modeling of Ecosystem Services

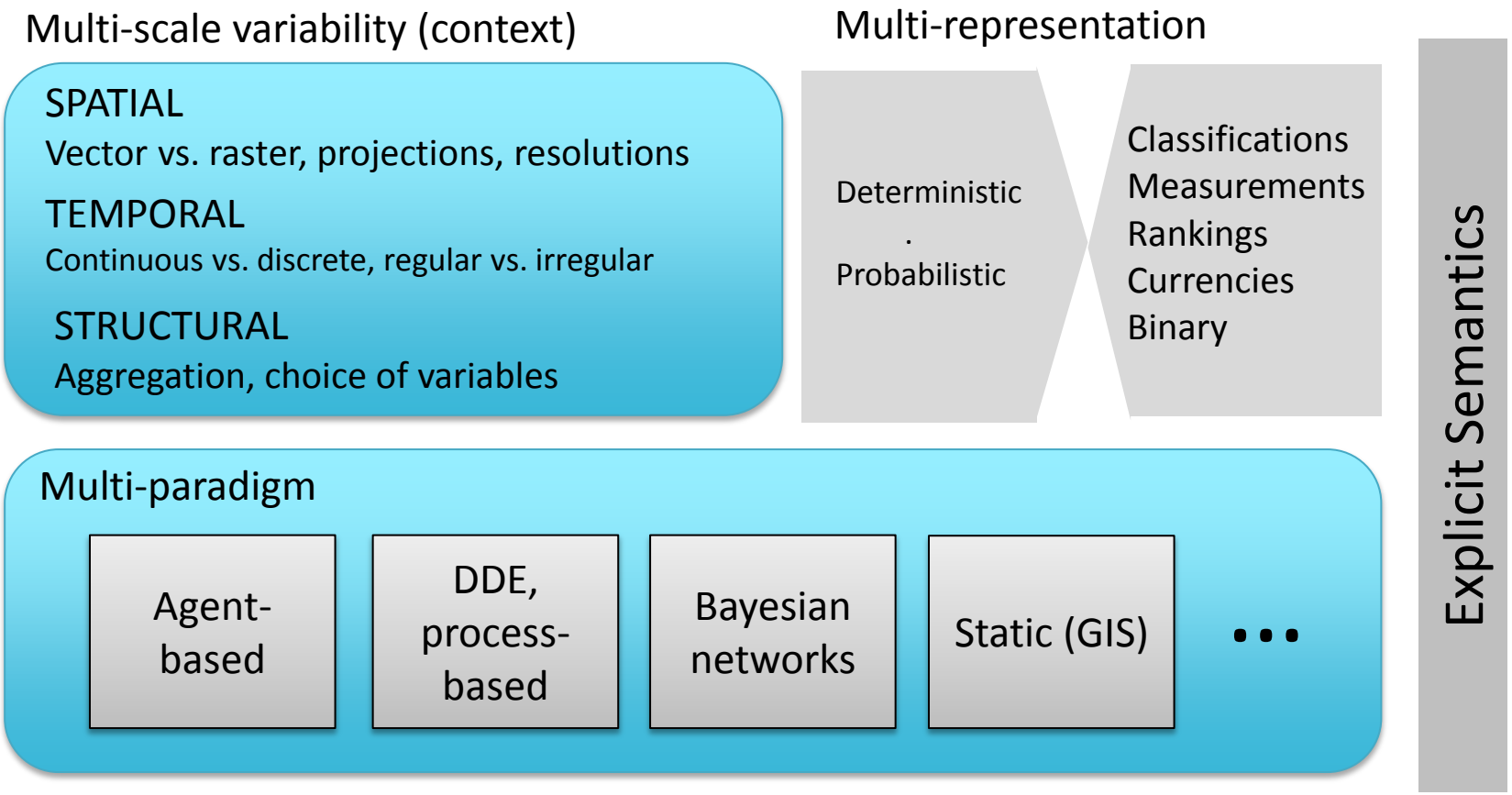


Integrated Modeling Platform

ARIES: ARtificial **I**ntelligence for **E**cosystem **S**ervices

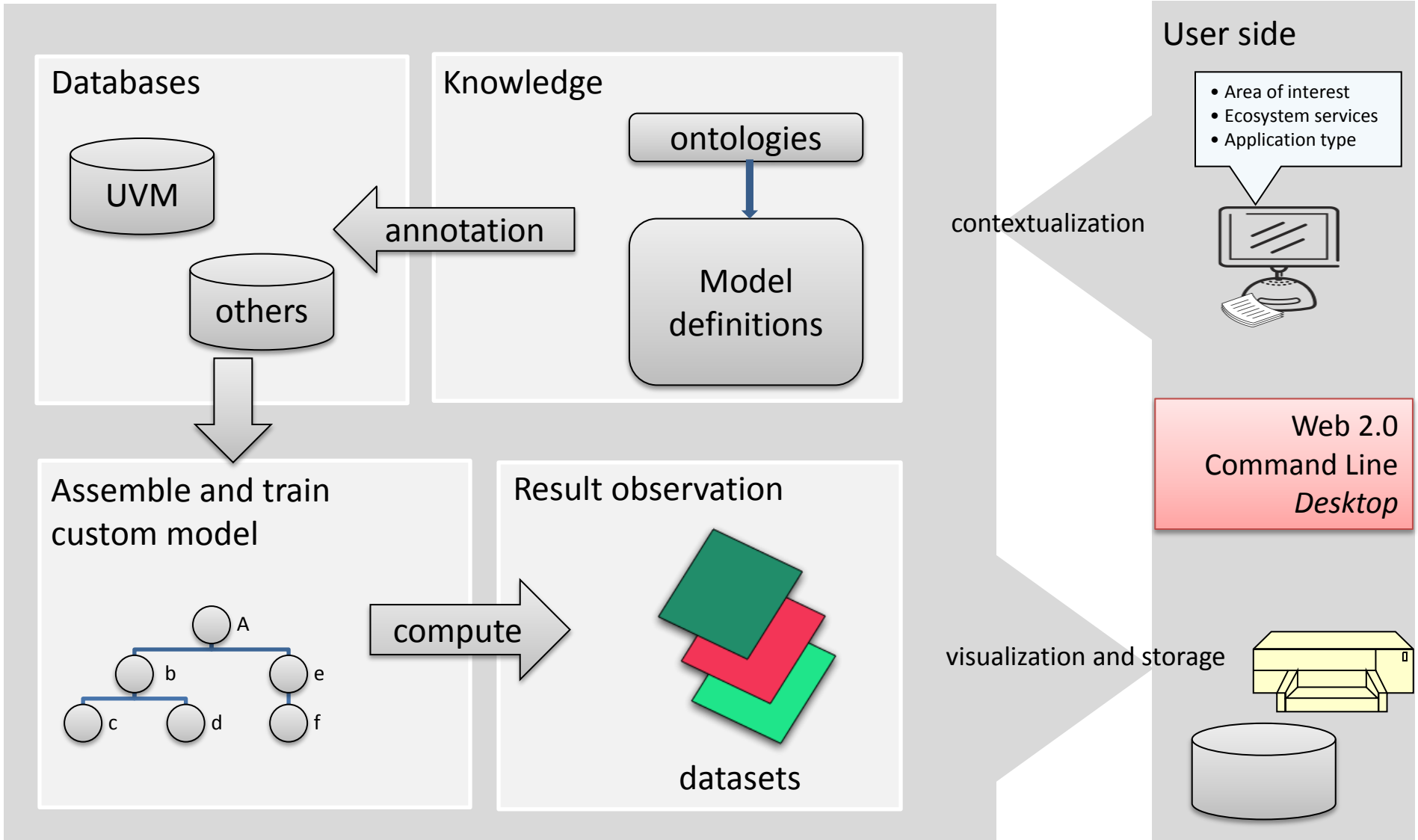
- **Assessment** toolkit for ecosystem services (ES) and their values.
- Not a single model, but an **intelligent system** that customizes models to user goals.
- A mapping process for ecosystem service **provision**, **use**, and **flow**.
- Includes both **deterministic** and **probabilistic** models to inform decision-makers of likelihood of possible outcomes.
- **Web-based**, customizable for specific user groups, geographic areas and policy goals.
- Target **audience** includes researchers, governmental decision makers and policy makers, business environment and various public-private sustainability initiatives.

Integrated Modeling Platform



Semantically annotated data & models -> True Modularity, Substitutability
Content mediation and propagation -> Automatic Scaling & Matching

Integrated Modeling Platform



Objectives	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5
Development of Integrated Modeling Platform	X	X	X	X	X
Scoping Model Development					
-- Climate-land-water-policy scenarios	X			X	
-- Spatial database and model library	X	X	X	X	X
-- Probabilistic models of provision, flow, and use		X			X
Research Model Integration					
-- Integration of hydrology process models	X	X			
-- Integration of governance & ABM models			X	X	
-- Integration of lake process models			X	X	
-- Application of climate scenarios			X	X	X
Management Model Application					
-- Scaling between sub-basin and basin-wide				X	X
-- Coupling of human-natural systems				X	X
-- Refinement of scenarios				X	X
-- Web-based scenario analysis				X	X
Integrated Modeling Research -- Semantics, uncertainty, scaling, emergence, feedbacks, visualization	X	X	X	X	X