Regulatory Models
and
Salish Sea Model Development

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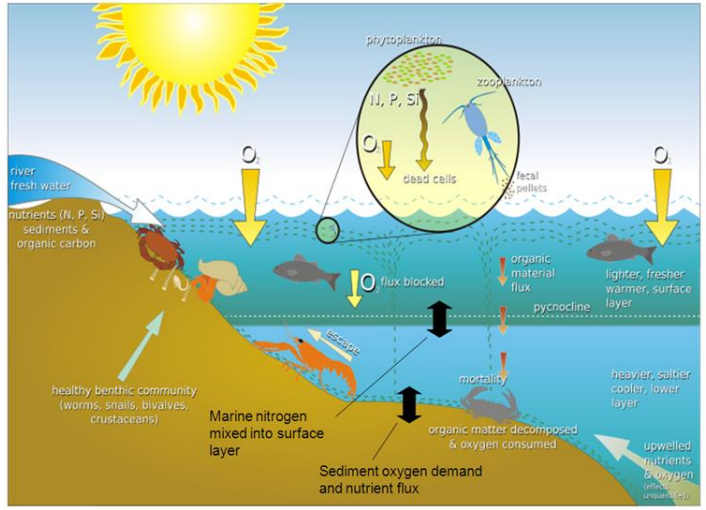
Topics

- Models in the regulatory process
- Salish Sea Model
  - Building and Testing
  - Documentation and Peer Review
  - Uncertainty
  - Acceptance
  - Application

Models and the Clean Water Act



- Models give us:
  - Scientific basis for regulatory decisions
  - Mathematical linkage between pollution and impacts
  - Identification of major and minor pollution sources
  - Estimated outcomes of different alternatives
  - Prediction of future changes (e.g., population growth)

Characteristics of a good regulatory model

- Model framework includes the important processes and capabilities
- Processes, equations, and assumptions are well documented
- Incorporates all available input data
- Thorough documentation of model development
- Transparency about limitations and uncertainty
- Peer review
- Public review

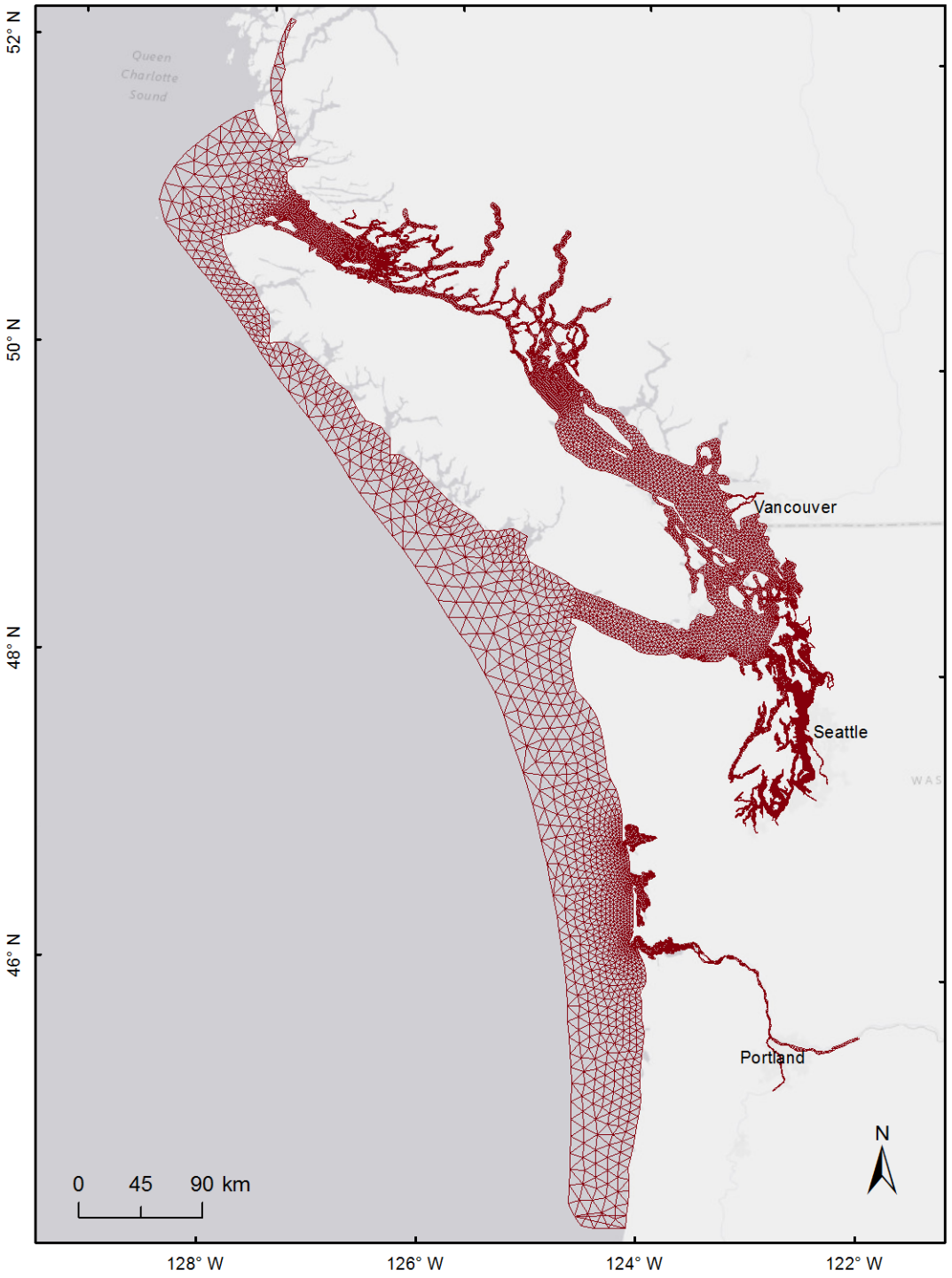
Salish Sea Model…Typical or Atypical?

- Answer: Both

- Typical
  - Mathematical equations linking nutrients and DO/pH
  - Normal steps in model-building process

- Atypical
  - Large scale and complexity of Salish Sea (akin to Chesapeake Bay model)
    - Longer development time and higher cost
    - Limitations in estimates at smaller scales
  - More peer review and documentation than typical TMDL models

Salish Sea Model



Scientific Tool

FVCOM + CE-QUAL-ICM

(Hydro) (WQ)

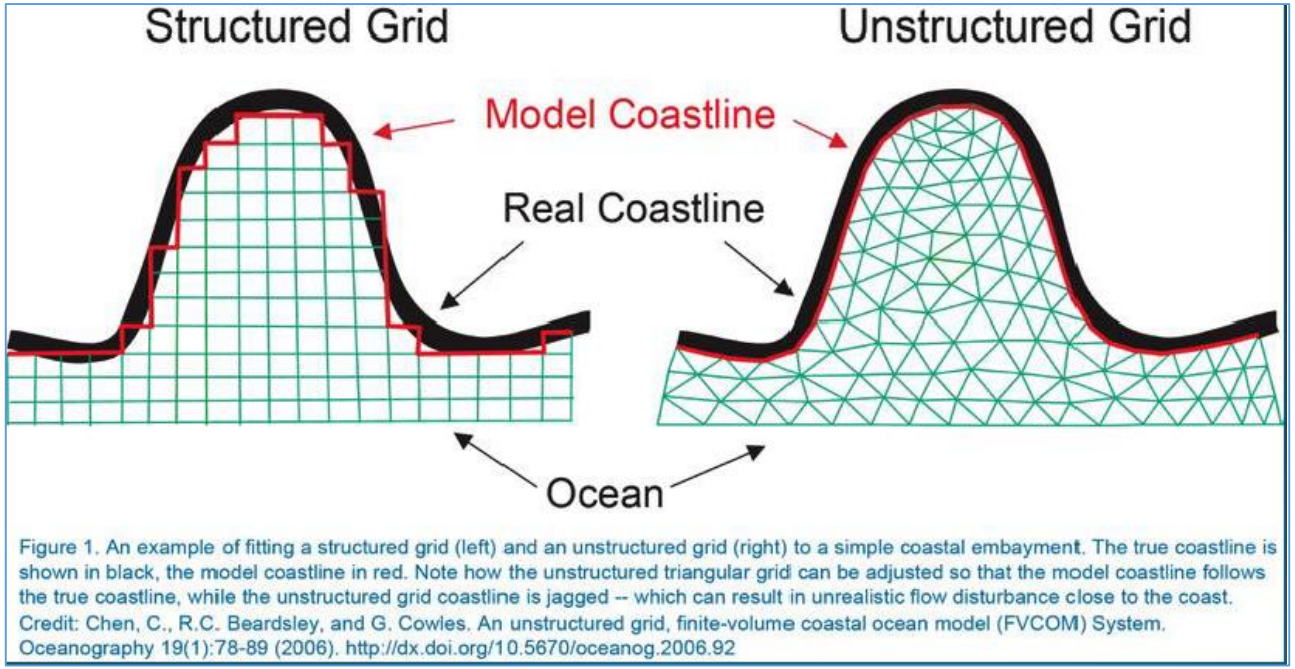
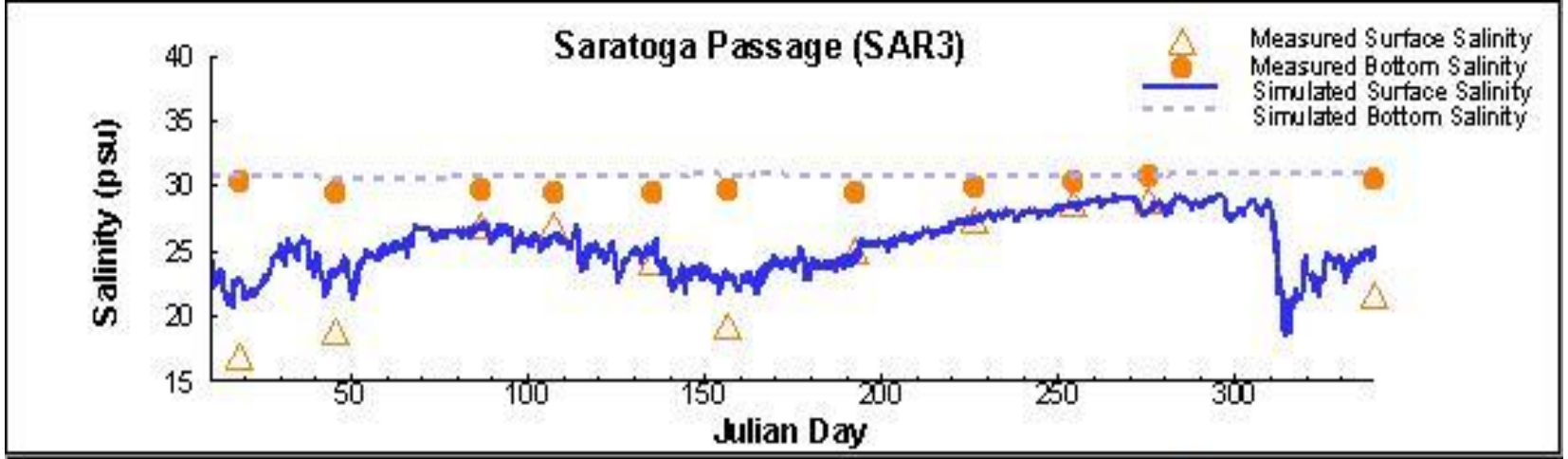


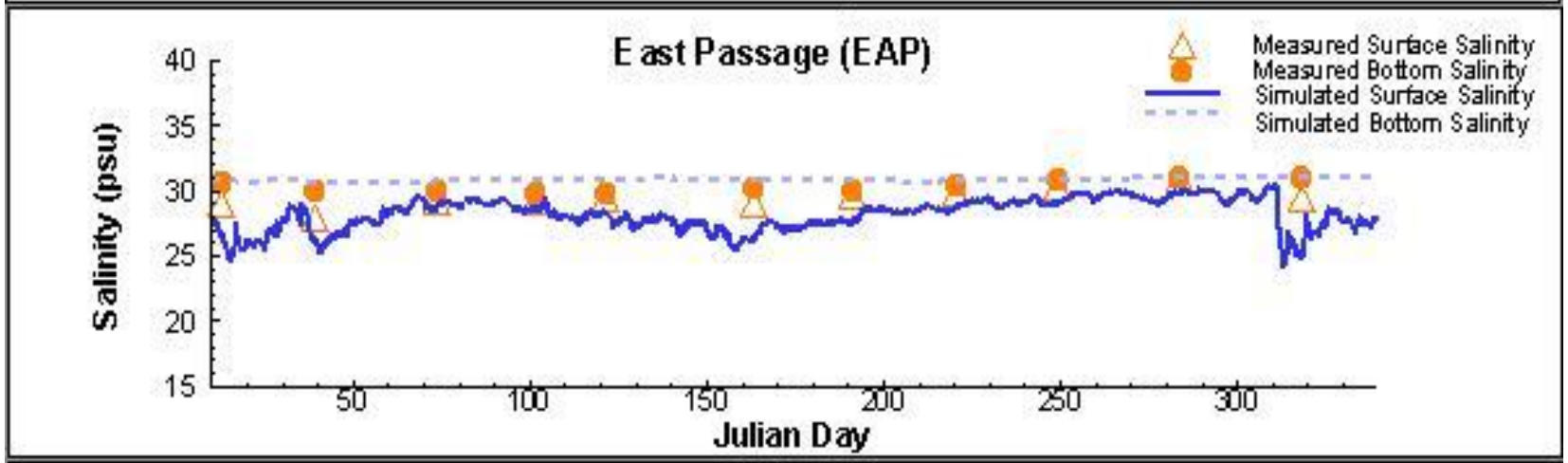
Figure 1. An example of fitting a structured grid (left) and an unstructured grid (right) to a simple coastal embayment. The true coastline is shown in black, the model coastline in red. Note how the unstructured triangular grid can be adjusted so that the model coastline follows the true coastline, while the unstructured grid coastline is jagged -- which can result in unrealistic flow disturbance close to the coast. Credit: Chen, C., R.C. Beardsley, and G. Cowles. An unstructured grid, finite-volume coastal ocean model (FVCOM) System. Oceanography 19(1):78-89 (2006). http://dx.doi.org/10.5670/oceanog.2006.92

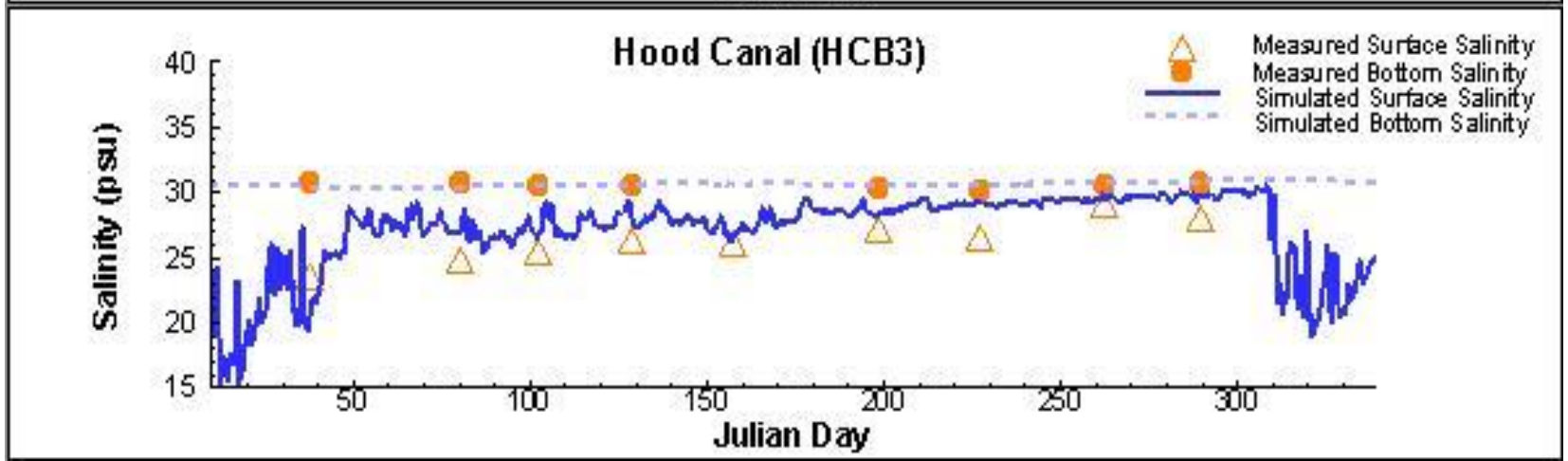
Source: PNNL

Matching patterns is a test of:

- Freshwater input volume
- Vertical mixing
- Interbasin mixing



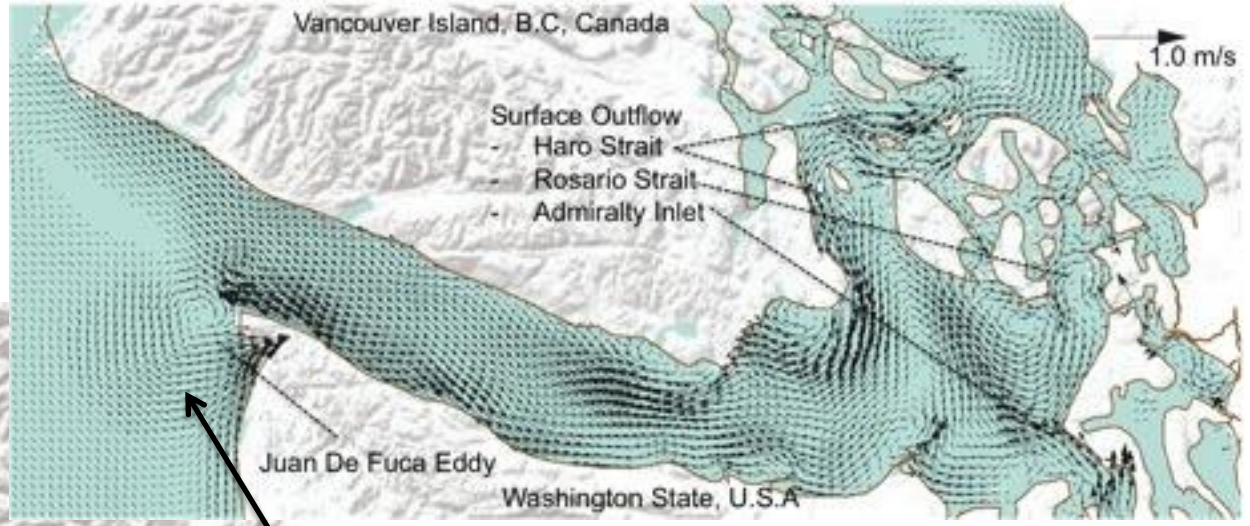




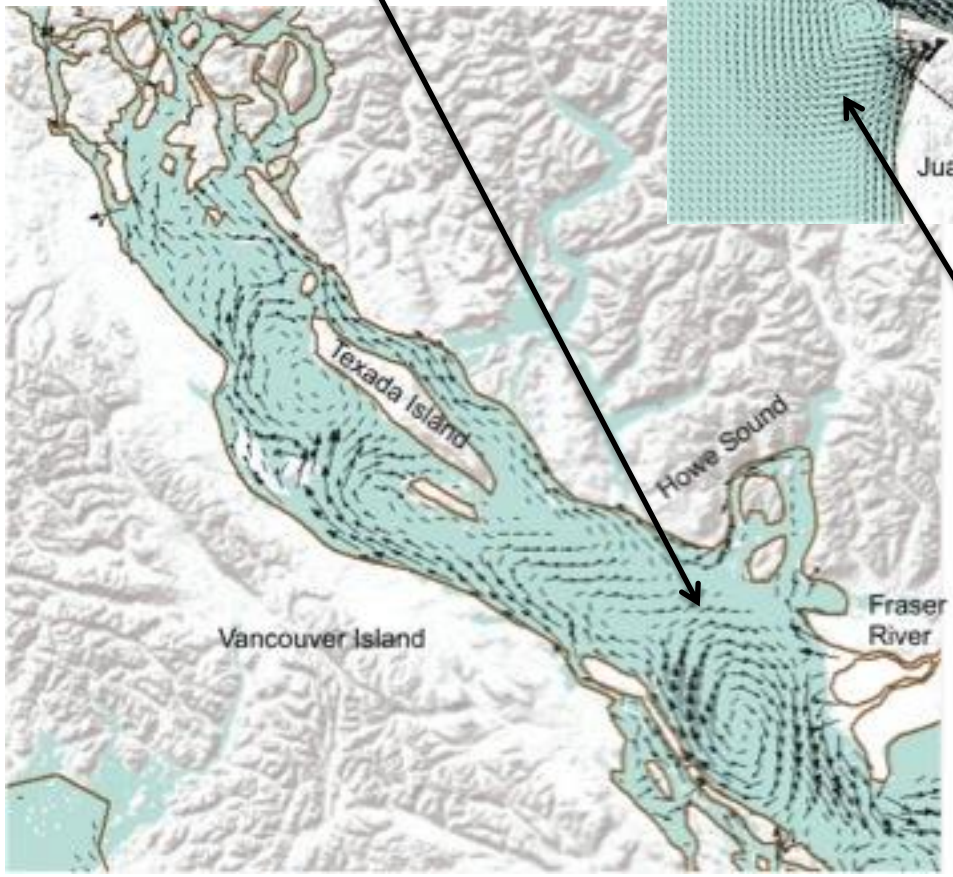
Source: PNNL

Surface Currents

Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965



Fraser River Eddy

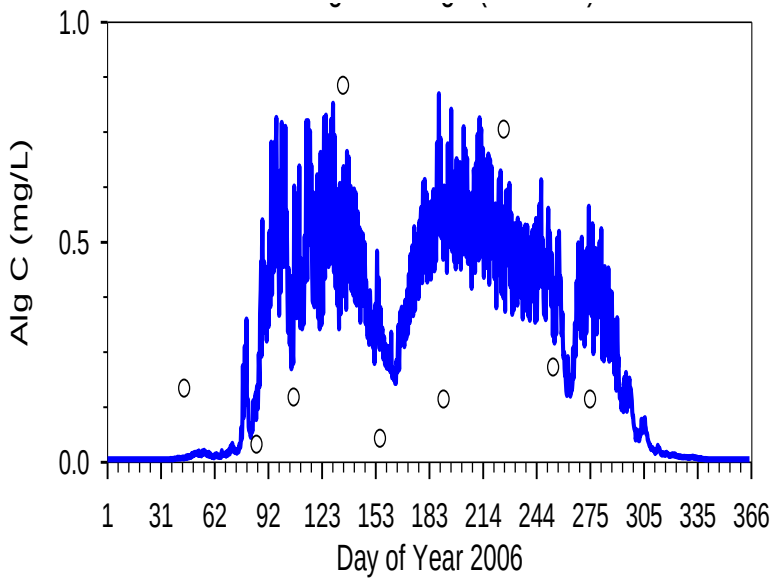


Juan De Fuca Eddy

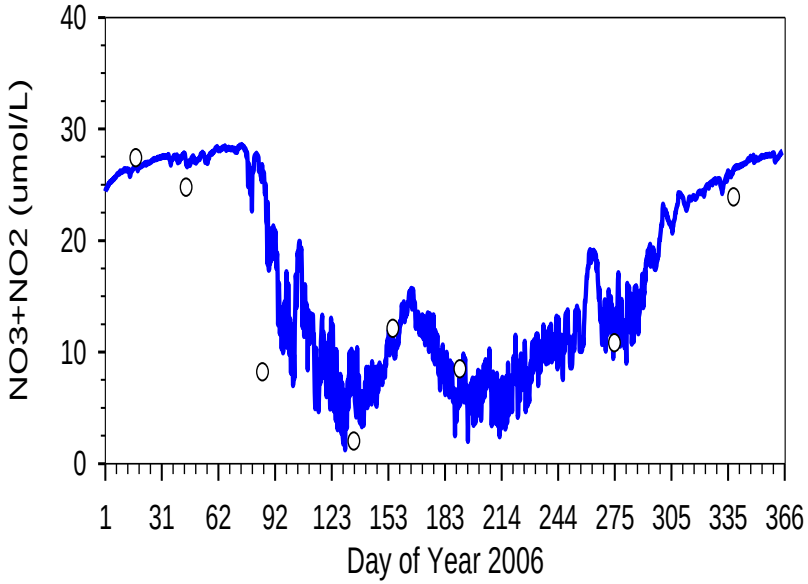
Source: PNNL

Saratoga Passage, Year 2006, Surface Layer

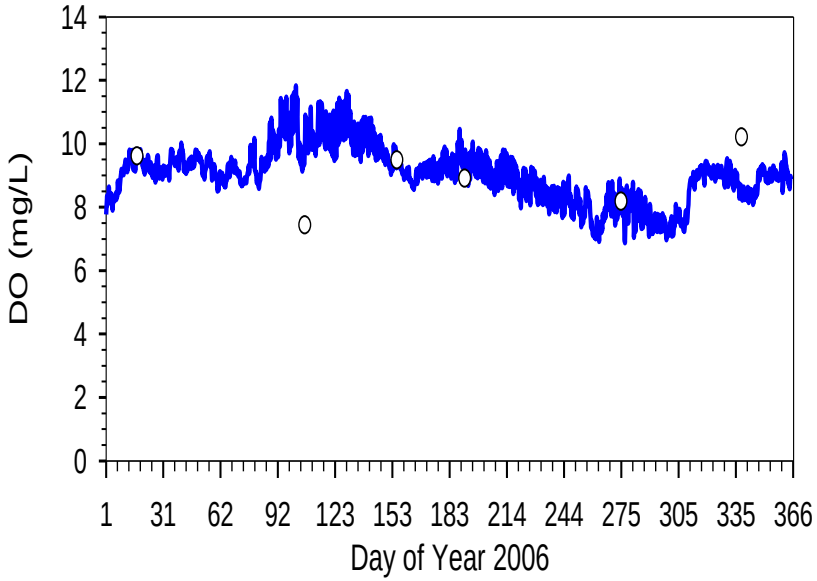
Algae



Nitrate/Nitrite



Dissolved Oxygen



- Patterns are test of:
  - Nutrient supply
  - Nutrient/Biomass/DO linkage
  - Seasonal variation

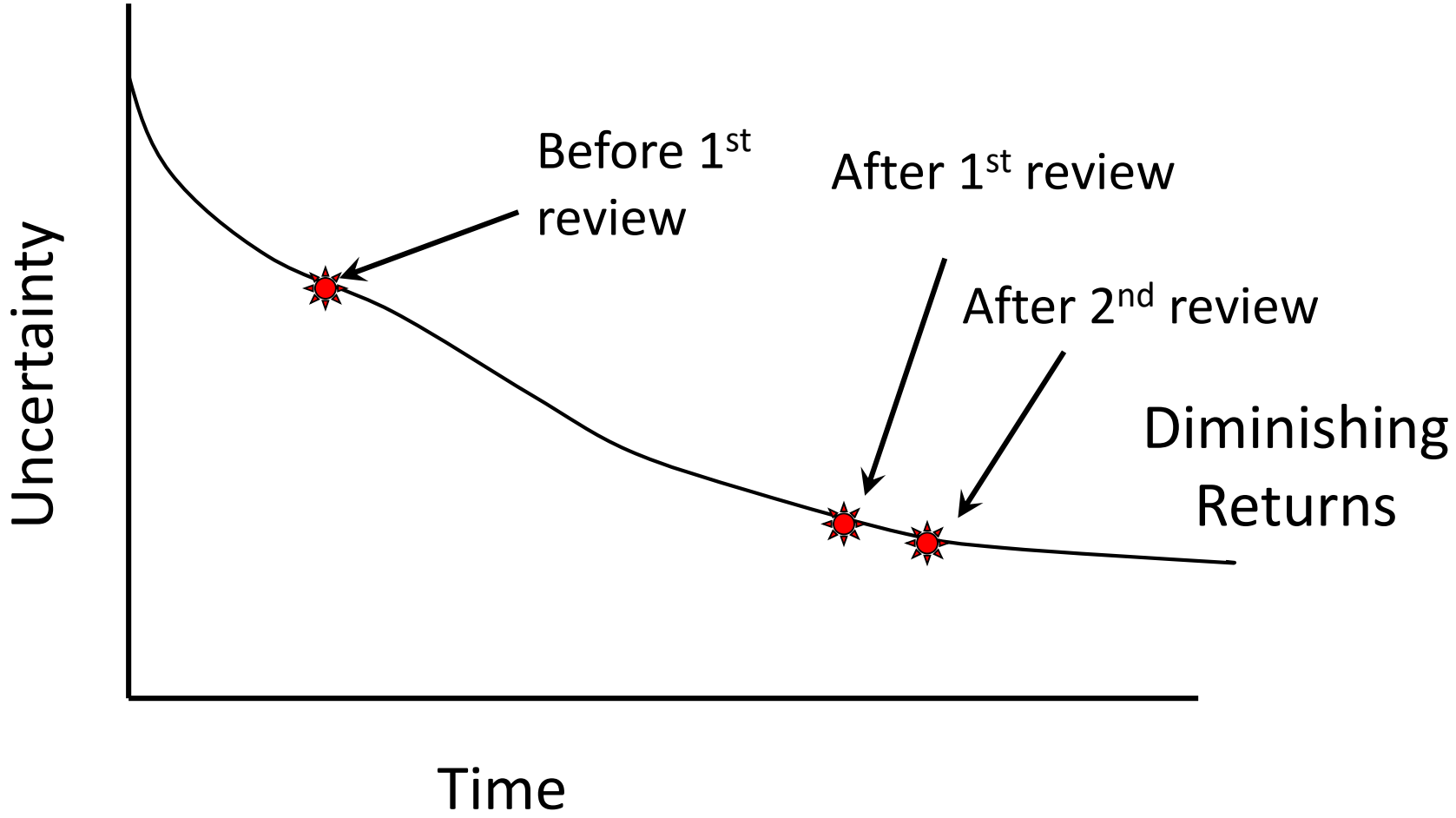
Source: PNNL

Model Uncertainty and Acceptance

- Uncertainty
  - Fact of life in water quality modeling
  - Ideal : perfect match with observations
  - Reality: irreducible model error

- Model Acceptance
  - No fixed numeric guidelines for “acceptable” model error
  - Judgment call…by the water quality agency

Getting to Acceptance

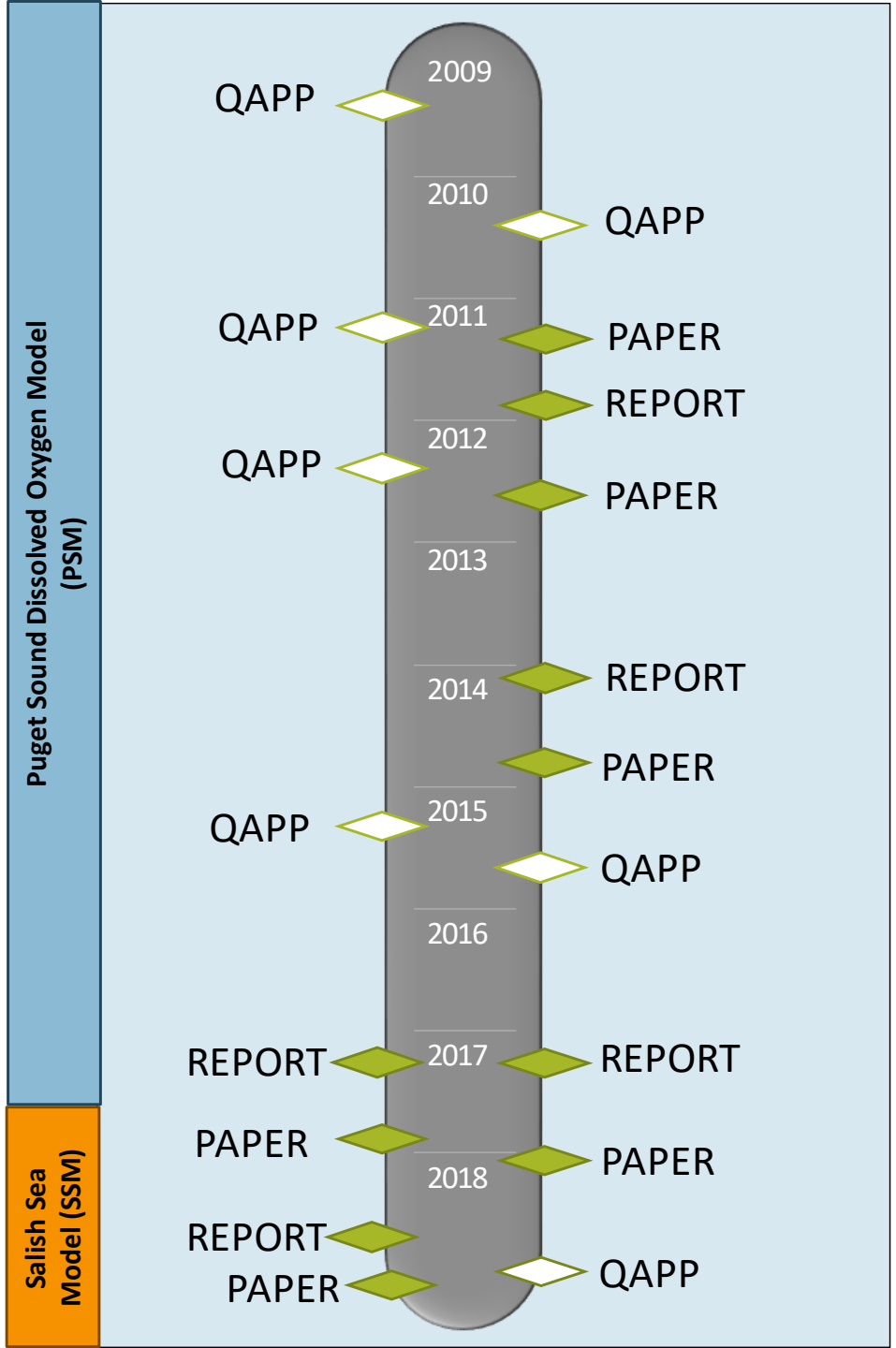


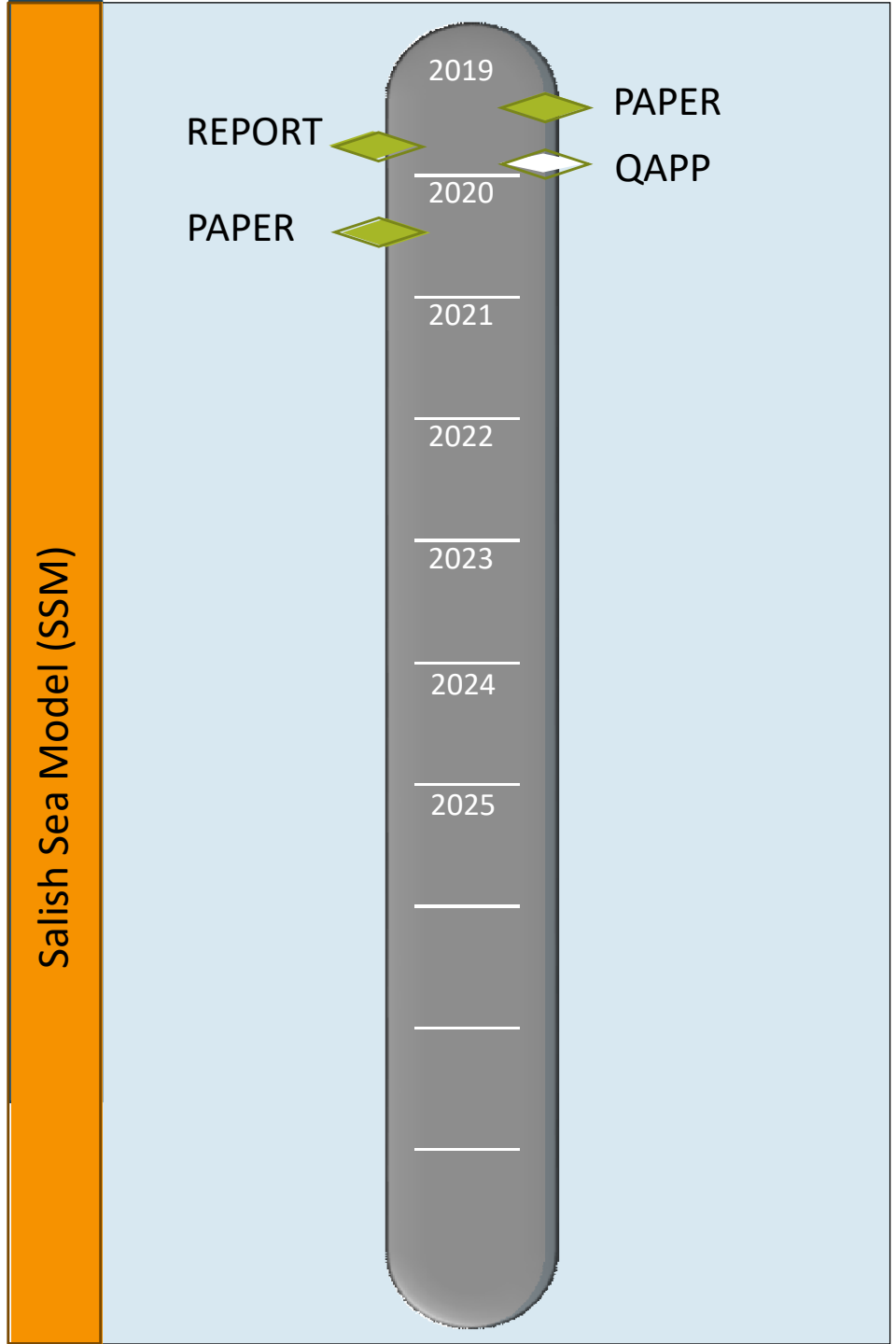
Salish Sea Model

Long term development and improvement

Documentation

Peer review





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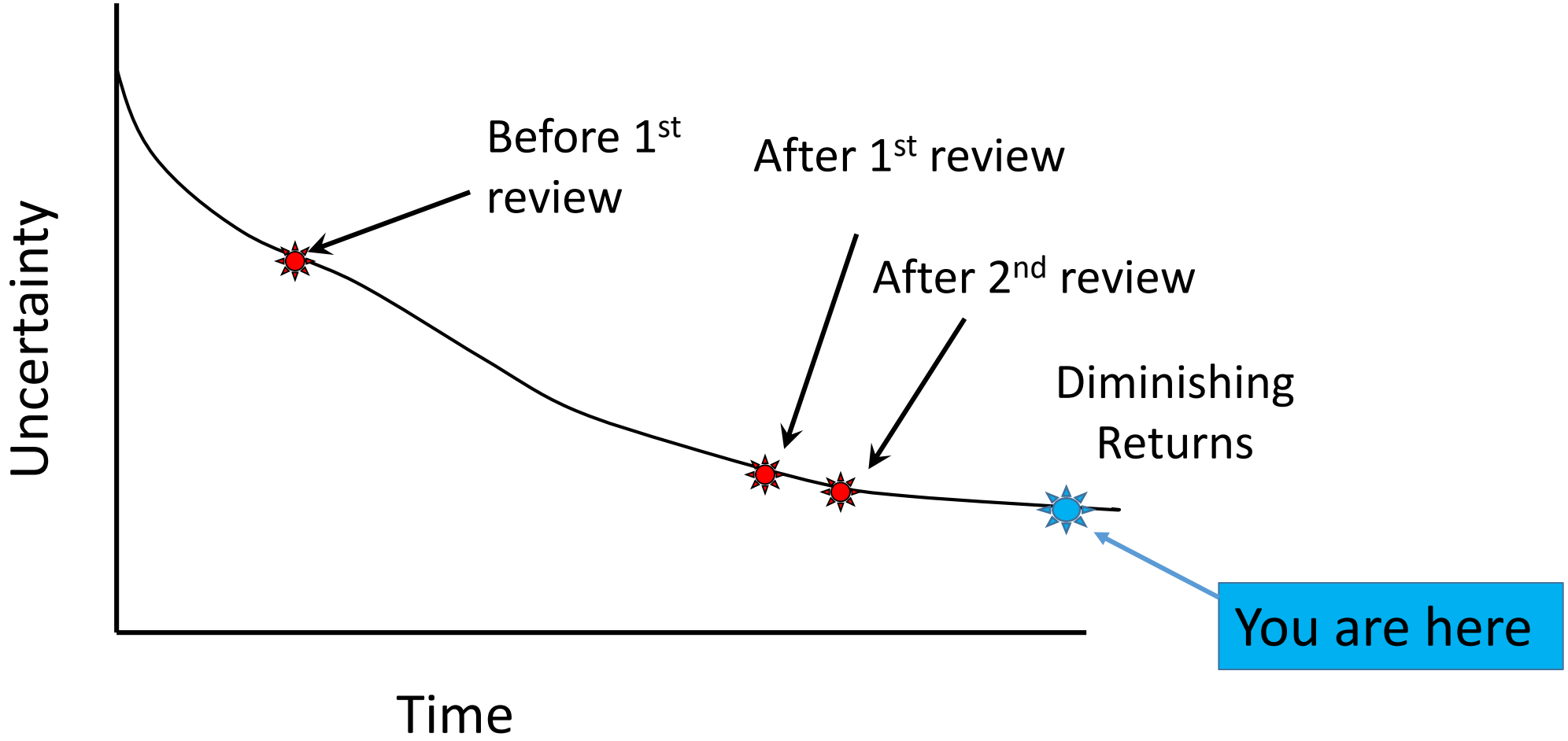


Where we are

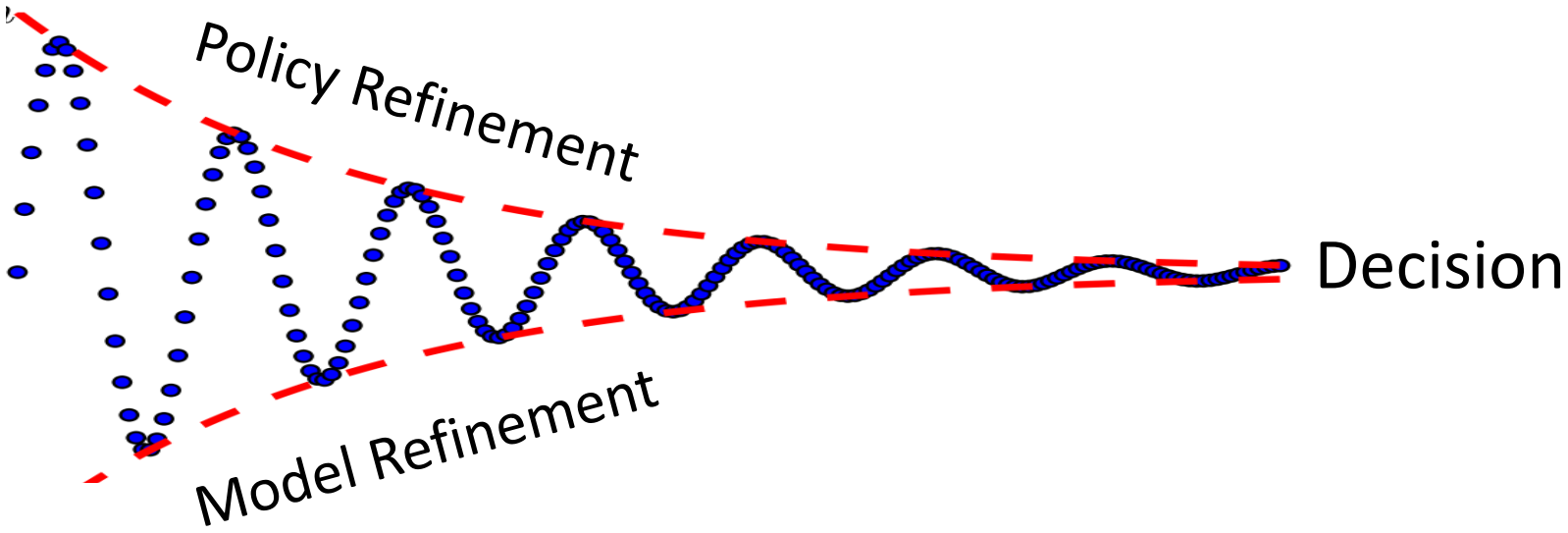
- Ecology has accepted the model for use in the nutrient project
  - Calibrated model or “core model”
  - Final reports on model development – input data, assumptions, calibration (plots and error stats), etc.

- Scenario Phase
  - “What if” scenarios
  - Isolating source impacts – “Best Estimates”
  - Many model runs with specified source input changes
  - Guided by policy goals and practical considerations

- New questions about the core model?
  - Re-opened and modified only for discovery of new information or substantial error

Models and Policy are refined together

- Build the best model you can
- Ask scientists and stakeholders for ideas/info to improve it
- Accept model and start applying scenarios
- Model Scenarios and Policy Approaches are refined until final decision



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Agency

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