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)

Source: PNNL
Matching patterns is a test of:

- Freshwater input volume
- Vertical mixing
- Interbasin mixing

Source: PNNL
Surface Currents

Fraser River Eddy

Juan De Fuca Eddy

Source: PNNL
Saratoga Passage, Year 2006, Surface Layer

- 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

![Diagram showing the relationship between time and uncertainty, with points labeled as Before 1st review, After 1st review, After 2nd review, and Diminishing Returns.](image-url)
Salish Sea Model

Long term development and improvement

Documentation

Peer review

Puget Sound Dissolved Oxygen Model (PSM)

Salish Sea Model (SSM)
Getting to Acceptance

Uncertainty

Time

Before 1st review
After 1st review
After 2nd review
Diminishing Returns

You are here
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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