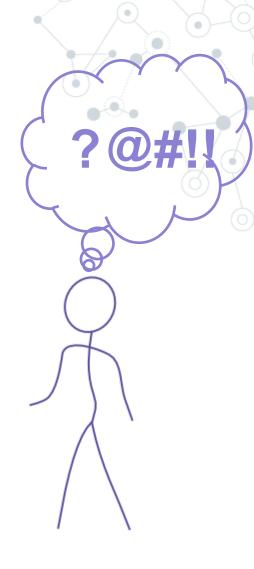
# Communicating Models

Explaining complex systems to diverse audience

This model is a Black Box

All models are wrong, but some are useful



#### **Communicating Models**

- Two levels required
  - Technical documentation
    - Each stage of model development should be thoroughly documented, including equations and assumptions

- Communicating to non-technical audiences
  - How do we communicate to nonmodelers, stakeholders, general public, etc...

Developing a good modeling practice is essential for communication

Biggest issues: readability and repeatability. Can the model be recreated?

What is missing is a modeling practice that details the trial-and-error process.

ODD protocol is a modeler's model description. It doesn't tell the story unless you're familiar with the protocol.

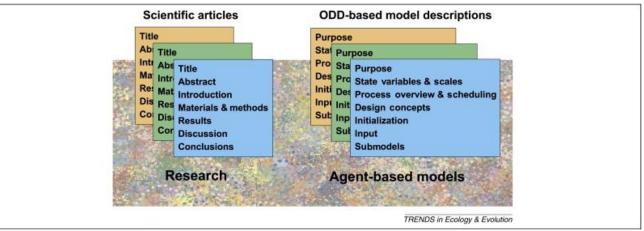
#### **Establishing a modeling practice**

- Poor track record of documented modeling practice created black box syndrome
  - ad hoc model design,
  - Poor evaluation and testing
  - Unknown sensitivities
  - Lack of clear documentation for parameters
  - Improper application (documentation should include how model should be applied)
- Peer reviewed manuscripts don't cut it when communicating models—they don't relay the process and aren't transparent to nonscientists.

#### **TRACE**

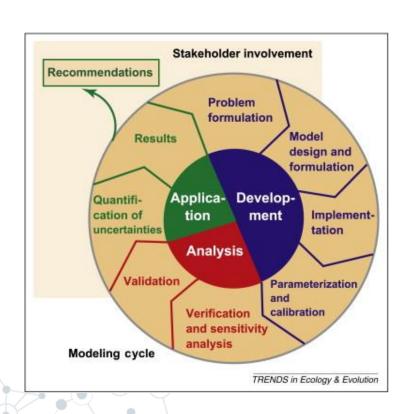
- Models don't fit into traditional structure because they are both a method and result
- Transparent and comprehensive ecological modeling (TRACE) documentation attempts to set a standard for model communication and

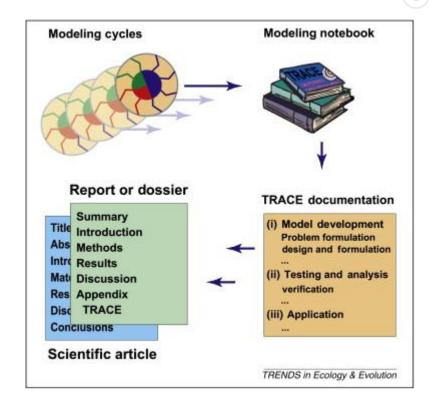
defensibility



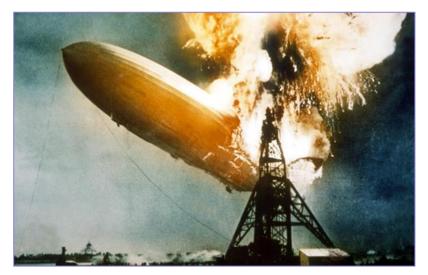
#### **Modeling notebooks**

### Document the process like lab studies



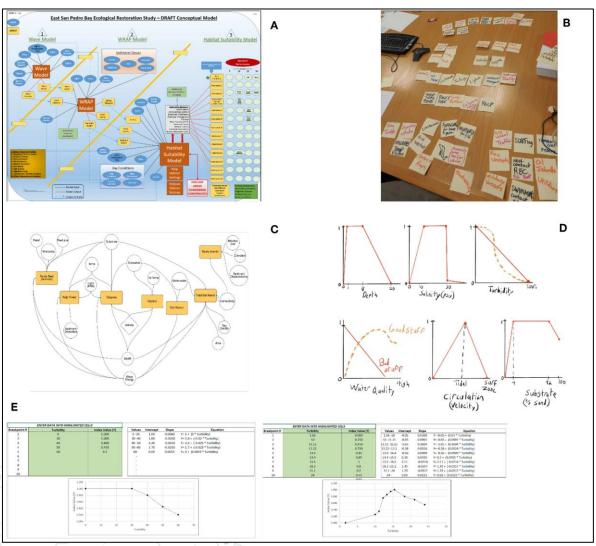


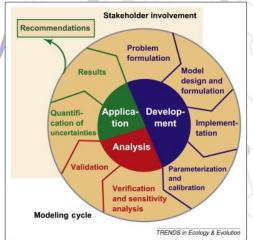
### Model Communication can be a disaster!



- Most ignored aspect of modeling
- Confusion over the meaning of "model"
- Preexisting notions prevent audience from understanding objective
  - Very rarely do we
    Analyze audience
    Anticipate potential obstacles

# Stakeholder engagement Case study: East San Pedro Bay





- Development shouldn't be limited to modelers only
- Stakeholders provide valuable input, and tend to have a lot of power within the community
- Engage early and often.
  - If possible have them assist with model development

Herman et al., 2019

# Three Common Obstacles in Communicating Models



- 1. Audience fails to understand meaning & use of a key concept or term
- 2. Audience struggles to represent mentally some phenomenon, structure, or process
- 3. Audience may have a preexisting understanding preventing them from believing (therefore understanding) the model

# 1. Audience fails to understand meaning of a key concept

### **Elucidating Explanation:**

- Lists a concept's critical features
- Provide an array of varied examples & nonexamples
- Provides opportunities to practice distinguishing examples from nonexamples by looking for critical features

# 2. Audience struggles to represent mentally some phenomenon, structure, or process

### A General Impression of the System

- Develop a summary image identifying critical components
- Structure-suggesting titles & organizing analogies
- Strong main points & connections
- Easily discernible points with clear connections between them that create a narrative form
- Clear conceptual models can really help with this

# 3. Audience's preexisting notions prevent understanding

#### **Transformative Explanation**

- States existing "lay" or "implicit" description of the system
- Acknowledge the apparent plausibility
- Using examples familiar to the audience, point out where existing description falls short
- Present an alternative explanation
- Demonstrate how alternative more effectively represents the system

## **Model Communication**

Agent-based case study: Oyster modeling in Chesapeake Bay

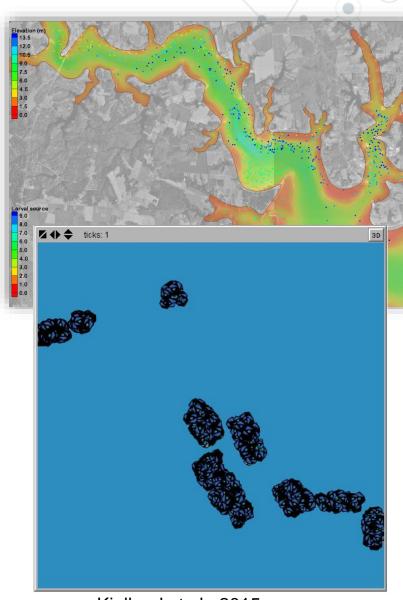
- Oyster abundance at all time low
- Federal and state agencies disagree on how to best manage species (fishery vs. environmental benefits)

- Developed an integrated hydrodynamic-ecological model to address management questions
  - Multi-disciplinary team developed hydrodynamic, particle tracking, and agent-based models

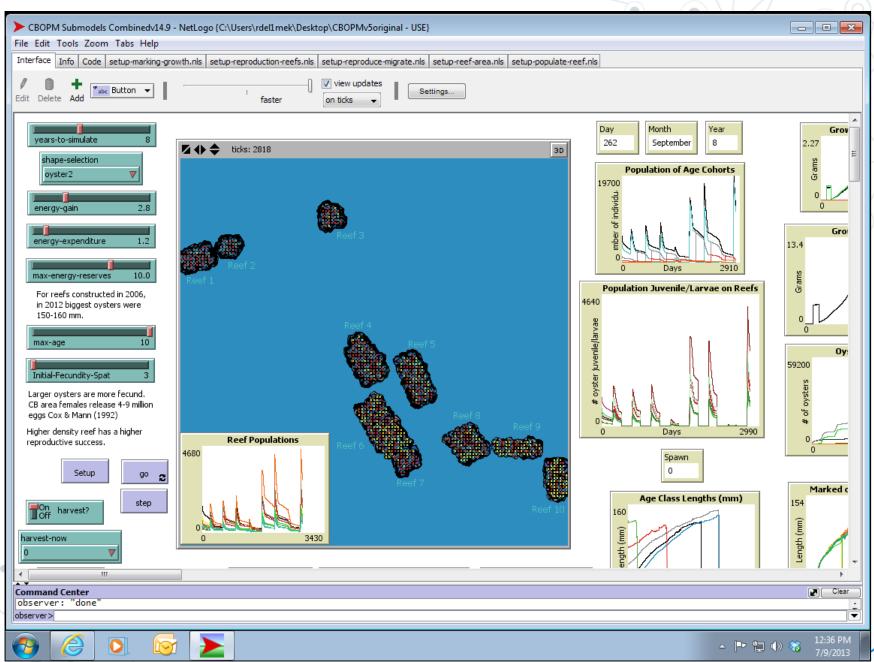
Communication challenge

How to make this understandable &

meaninaful? 14.0 Oyster reefs 12.0 Great Wicomico River Ingran Chesapeake

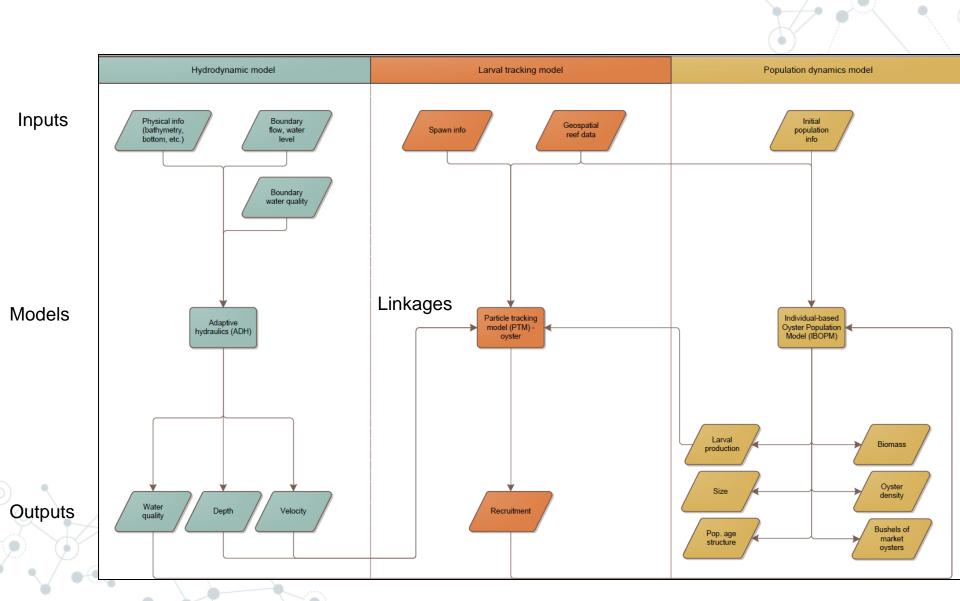


Kjelland et al., 2015



- We decided on a mediated-modeling approach (Herman et al., 2019)
- Federal & state stakeholders
  - Planners, project managers, fisheries managers, oyster biologists
  - No engineers or modelers in stakeholder group, but they had general understanding of models
- <u>Audience Analysis</u>: Series of meetings prior to, during, and after model development
  - Preliminary meeting: discussion of modeling approach
    - Identified background knowledge and experience of stakeholders
  - Second meeting: we convened with stakeholders to evaluate model and develop scenarios

### Obstacle 2: Understanding big picture



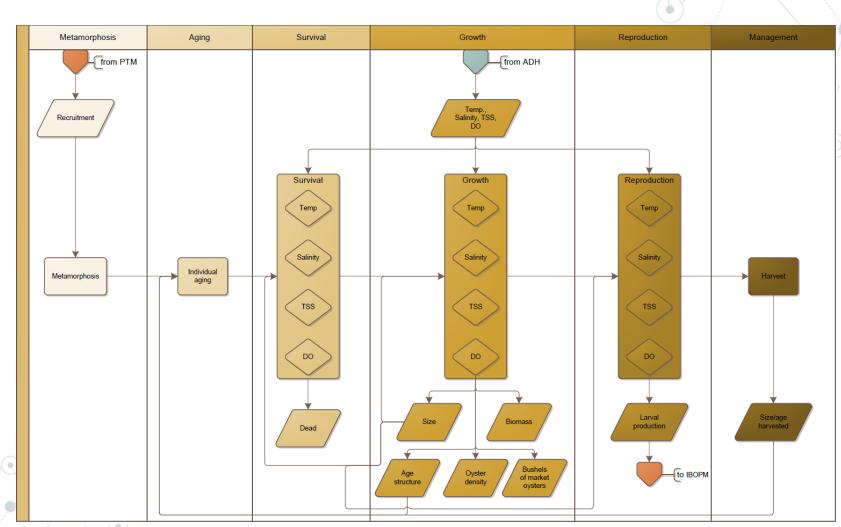
### Drilling down to points of interest.

Population Dynamics Submodel



**Processes** 

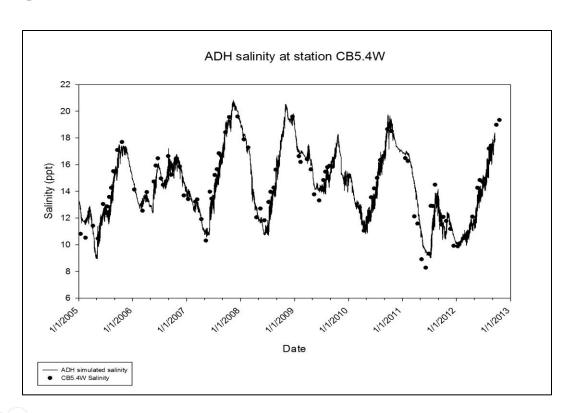
Outputs



#### **Obstacle 2 confirmed**

 Audience was interested in big picture of oyster dynamics and not underlying hydrodynamic & particle tracking models

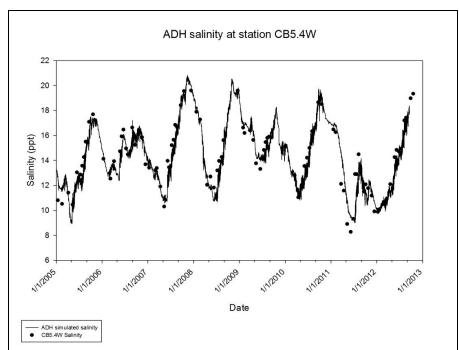
For example:



# Additional Model Communication Pitfalls Observed

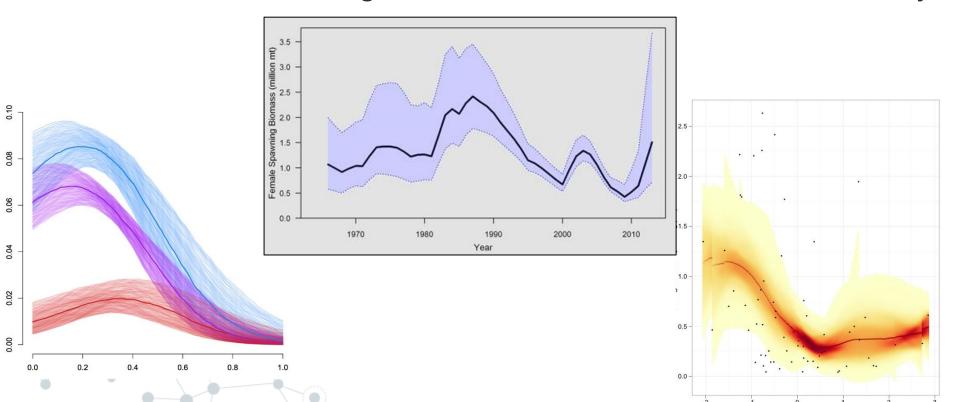
- Each team member wants to talk about how cool their stuff is
  - Audience analysis defines interests (i.e., what to talk about, what to omit)





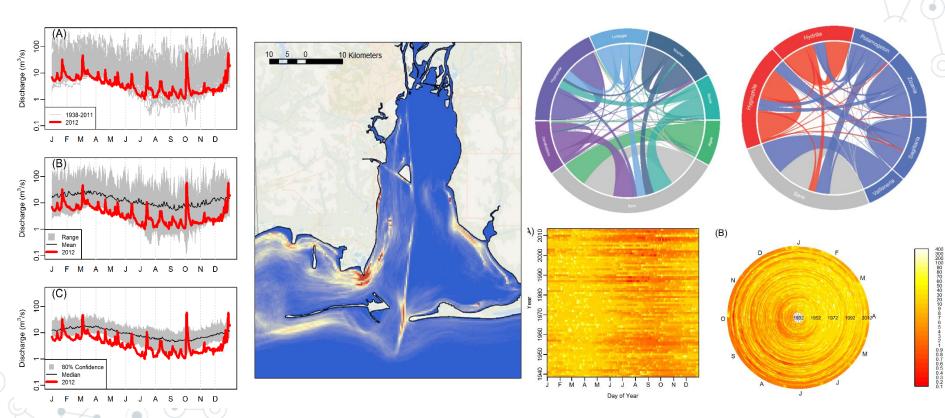
#### **Potential Pitfalls**

- Discussing, rather than just documenting, uncertainty is crucial
  - Without describing limitations, it hurts modeler's credibility



#### **Novel Visualizations**

Visual exploration takes advantage of the capacity of the human eye to rapidly detect and patterns. Use them to tell your story



Interesting to certain audiences

Colors draw eye and audience tends to pay attention

