Inviting feedback to clarify uncertainty

Elizabeth North

University of Maryland
Center for Environmental Science
Horn Point Laboratory

TRANSPORT

INGRESS

Modeling Hypoxia & Ecological Responses to Climate & Nutrients

CHRP

Our Objective: Wise use of natural resources

- healthy humans, environment, and economies
- productive public investments
- stewardship for future generations

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Models are integrative tools:

- Synthesize the best available information
- Applied to understand impacts of regulations and public policy
- Allow us to quantify uncertainty

Quantifying uncertainty in models supports the mission of both scientists and managers:

- helps scientists identify and focus on areas where new knowledge is needed
- helps managers decide how much weight to place on model results when making regulations and public policy

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Reducing uncertainty is an iterative process:

Management Need/Conceptual model

↓

Quantitative model

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Management Need/Conceptual model

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Quantitative model →

Compare with observations
Sensitivity studies

↙

Quantify uncertainty
Calculate confidence

↓

Apply to management

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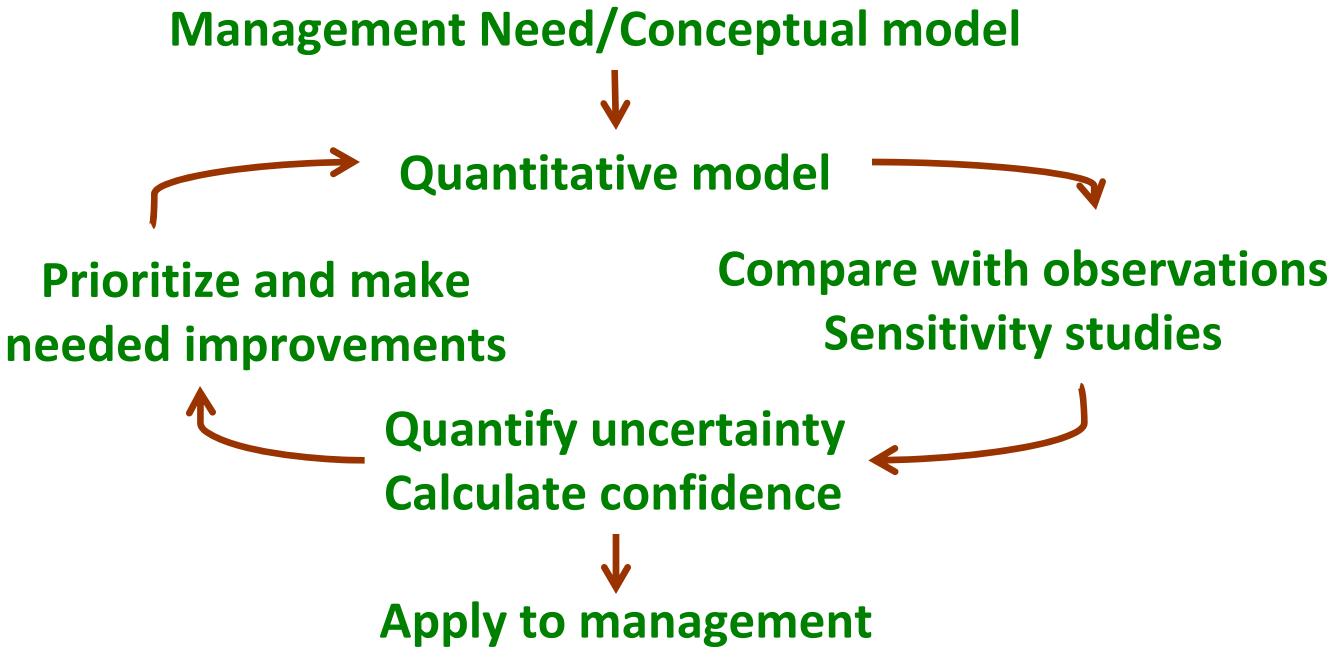

Communication is key

- Exchange of ideas and vocabulary between scientists and managers is critical for sound interpretation and application of models

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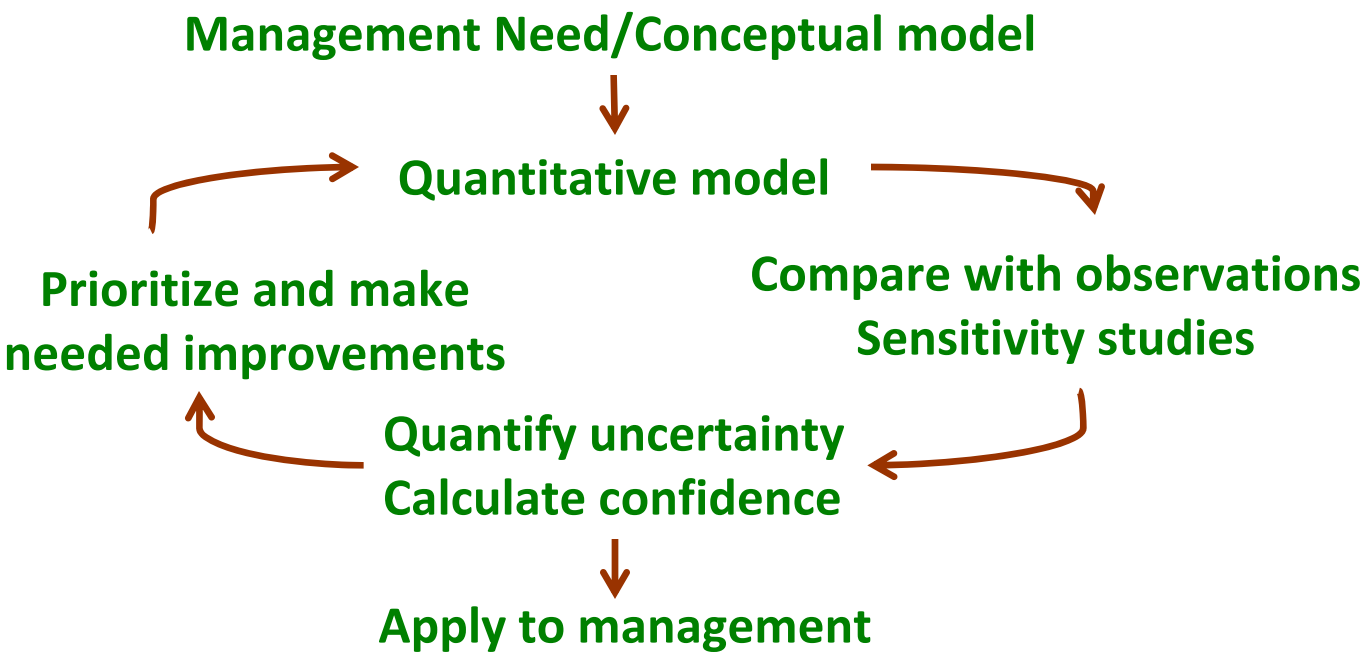
Open communication "tightens the loop":



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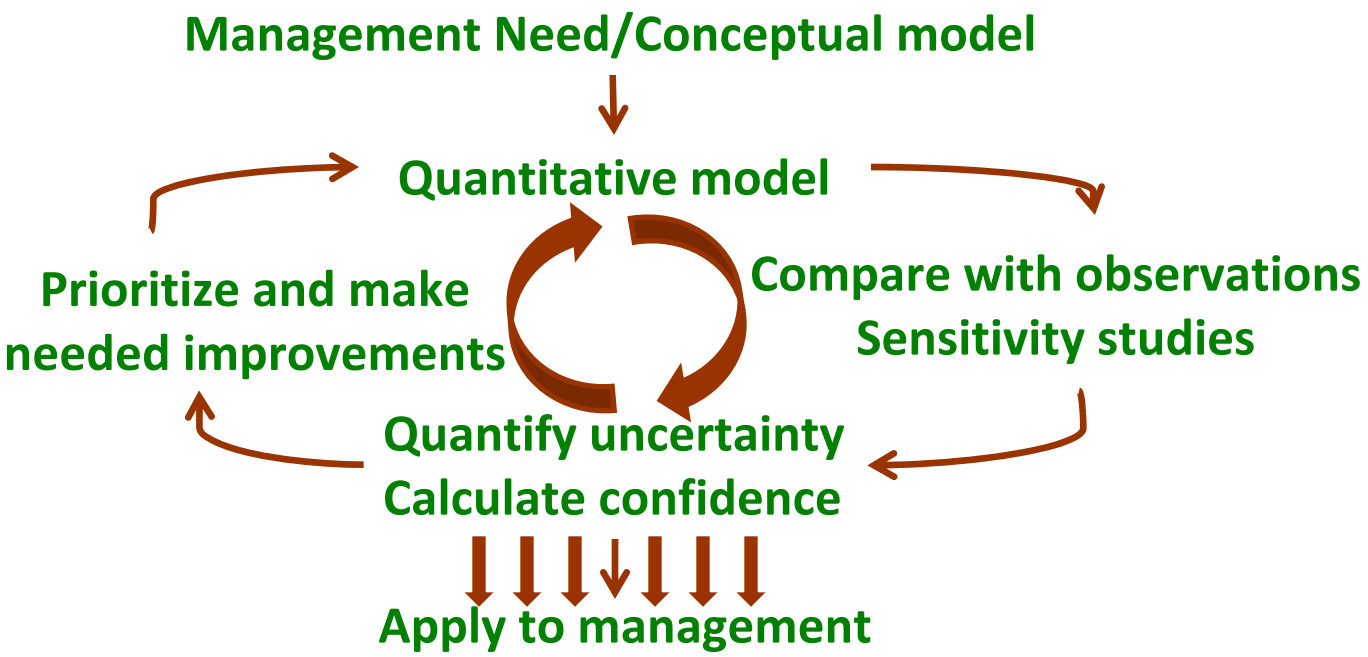


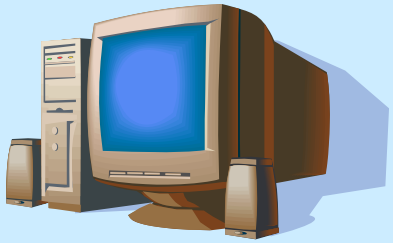
leads to faster enhancements, greater confidence

Good communication is a skill

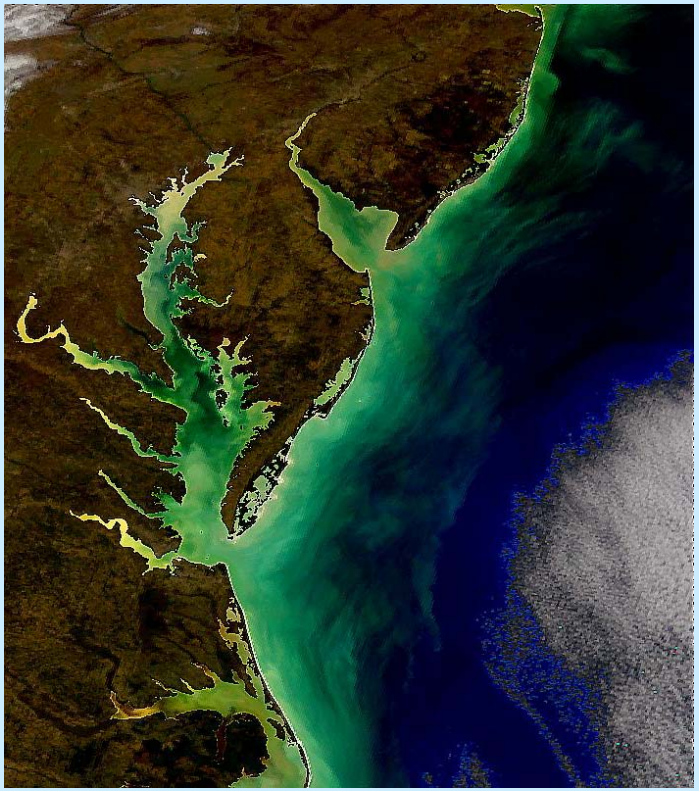
- Learn by doing (with good coaches)

For example…

For a talk to the **public**:

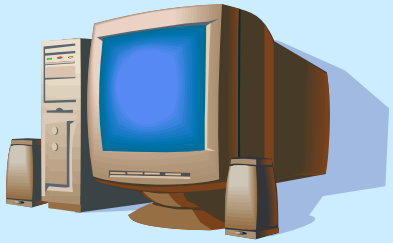


"We used computer simulations to predict how water moves in Chesapeake Bay"

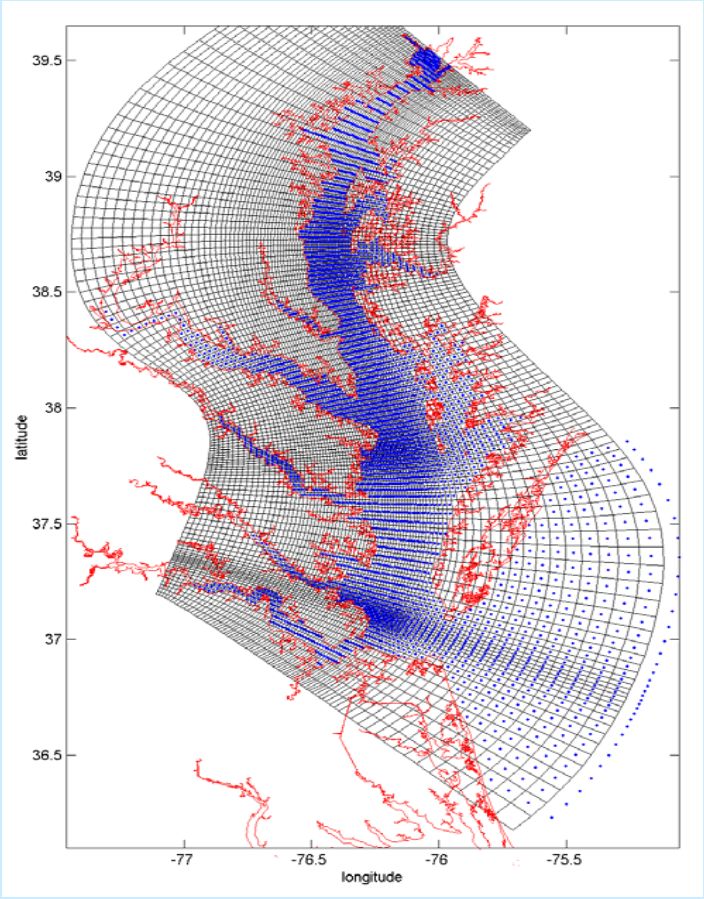


http://seawifs.gsfc.nasa.gov/SEAWIFS/

For a talk to **biologists**:



"We used a three-dimensional hydrodynamic model to predict circulation patterns in Chesapeake Bay"

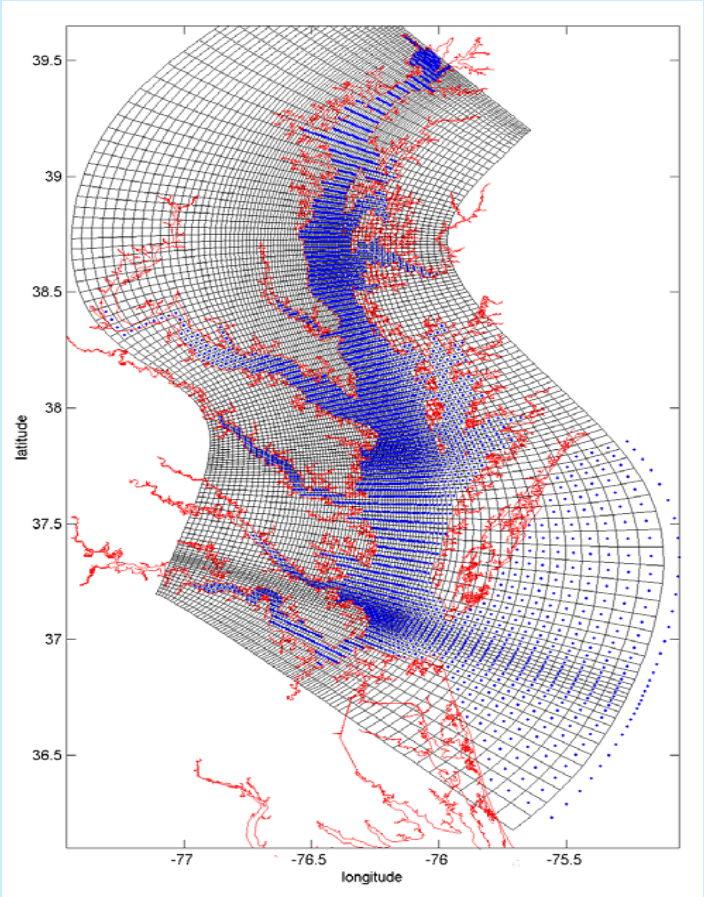


Ming Li and Liejun Zhong

For a talk to **physical oceanographers**:

"We implemented the Regional Ocean Modeling System with

- 20 s-levels in the vertical,
- 1 km or less horizontal grid
- k-epsilon turbulence closure,
- constant horizontal diffusivity."



Ming Li and Liejun Zhong

What do you get if you say this in a talk to the public?

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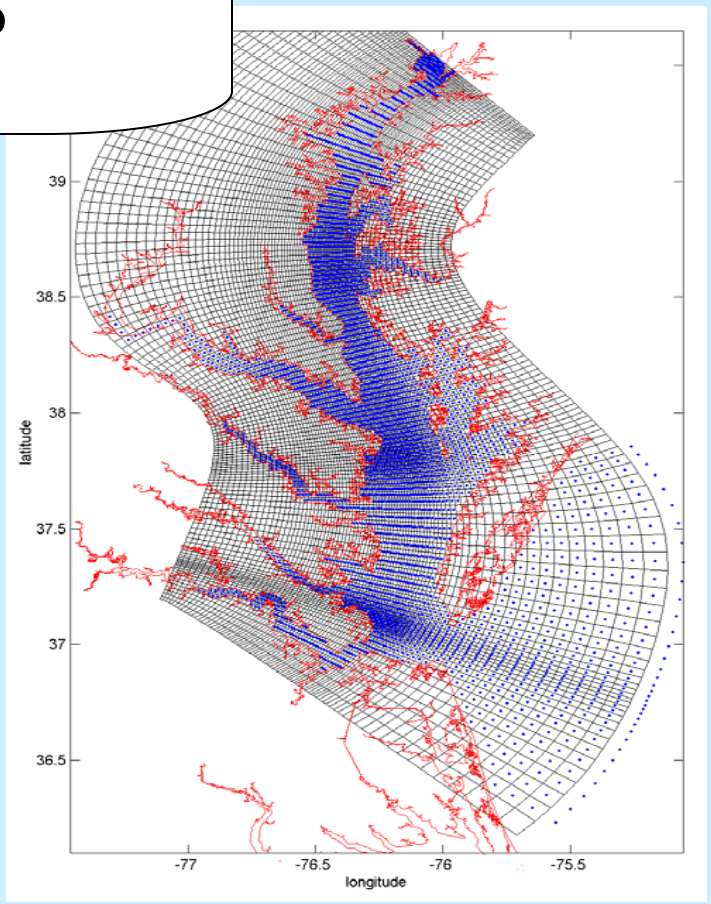

Ming Li and Liejun Zhong

What do you get if you say this in a talk to the public?

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Ming Li and Liejun Zhong

http://www.gamerevolution.com/oldsite/games/ps2/action/alien_hominid_predator.jpg

Good communication is a skill

- Learn by doing (with good coaches)
- Responsibility for successful communication rests with the speaker

"It's not what you say,
it's what they hear."
-Red Auerbach

Objective of this talk:

Enhance communication of how we present model uncertainty

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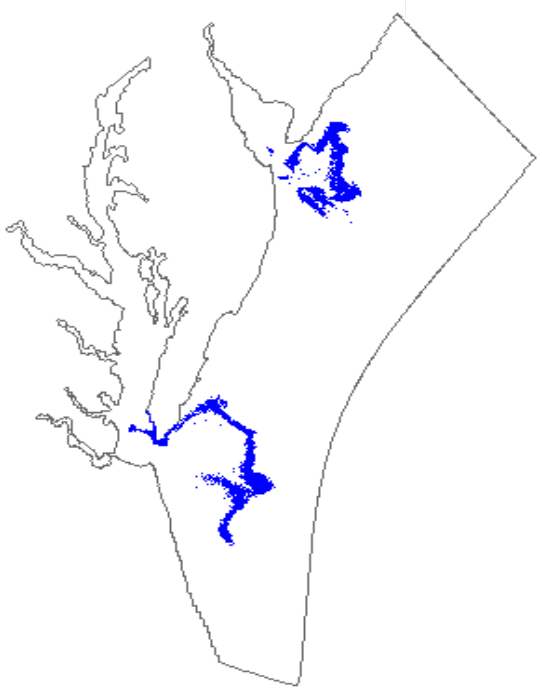
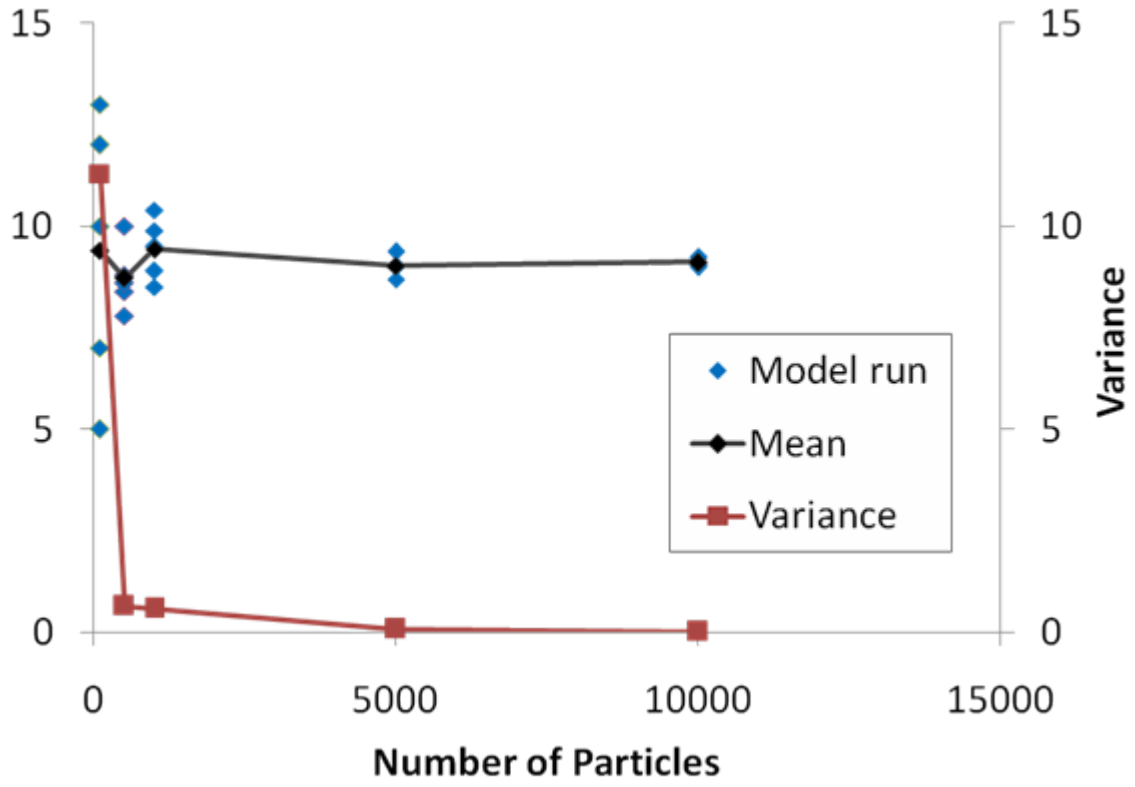
Methods:
I invite you to provide feedback on strategies for presenting model uncertainty

Examples:
A.Model sensitivity
B.Model validation
C.Model projections

A. Model sensitivity





"I conducted a model sensitivity study to determine how many particles to simulate in order to ensure a stable mean and minimal variance in model solutions."

Communicate to:

Public

Policy Makers

Managers

Modelers

Technical Report

A. Model sensitivity

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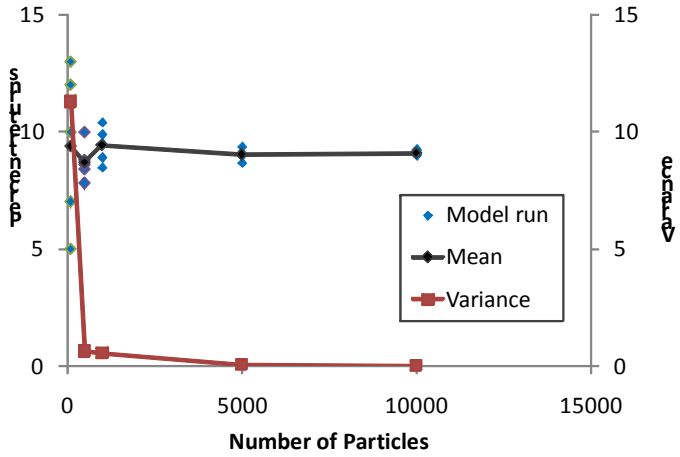

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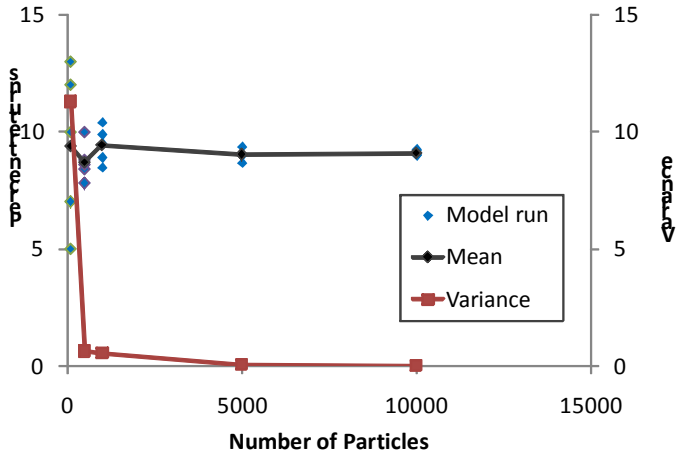

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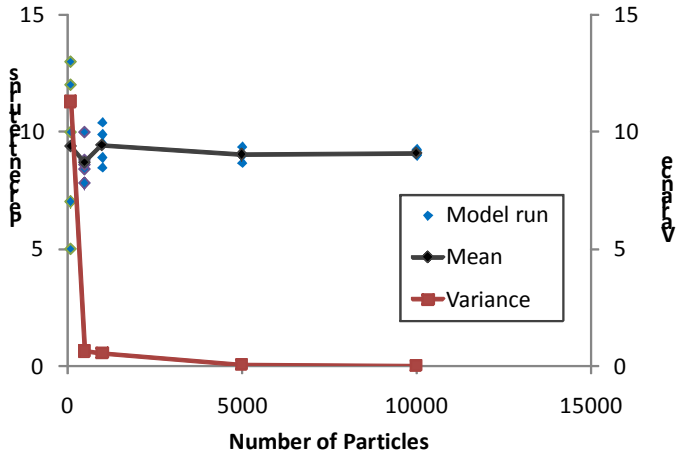

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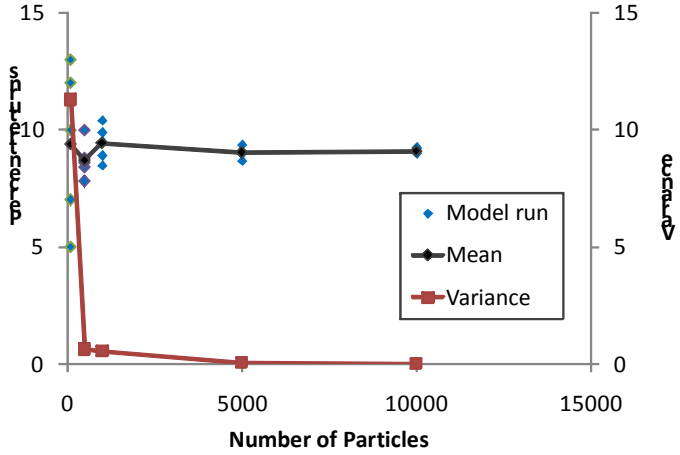
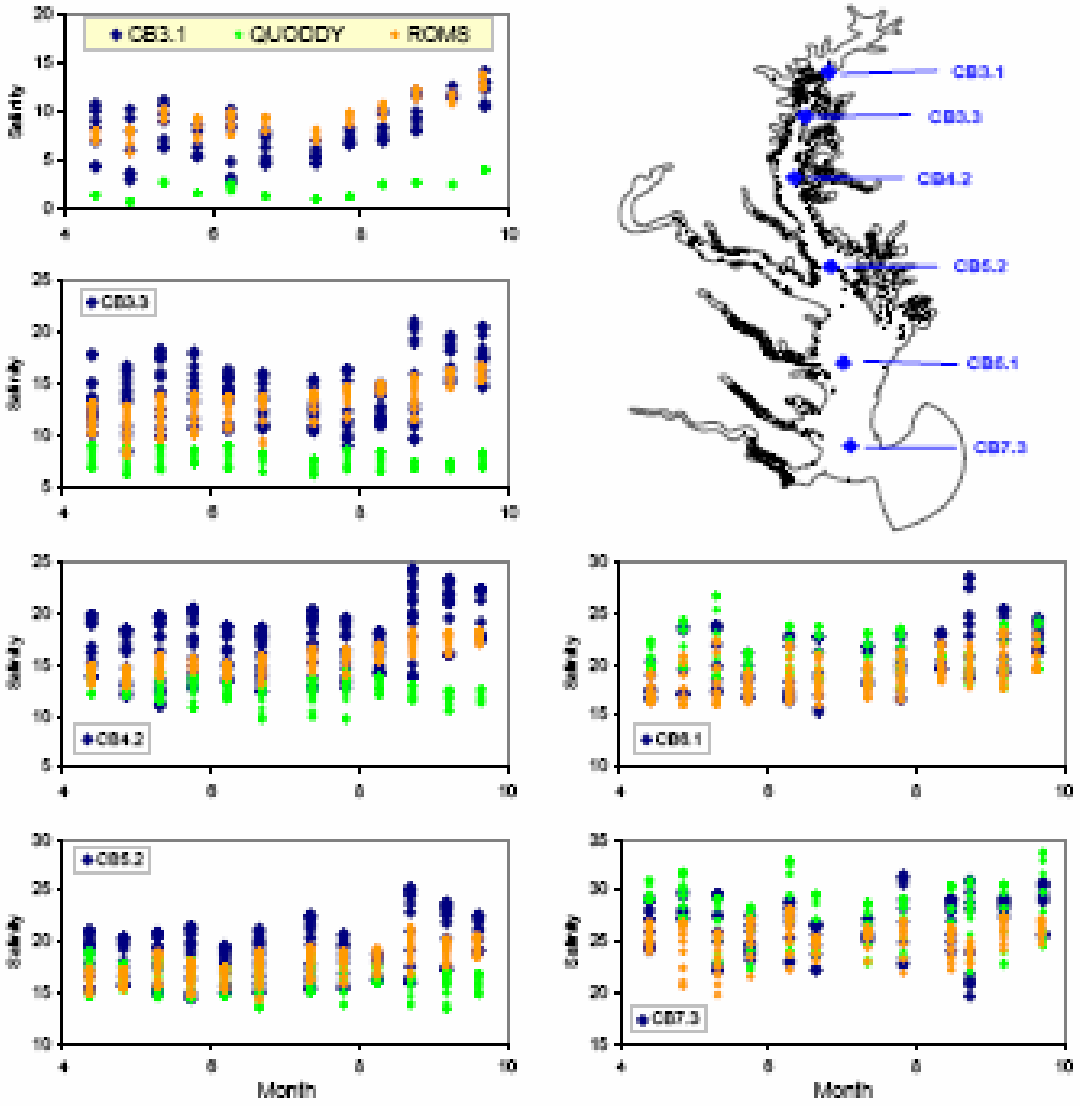


B. Model validation

"The best available model was used based on comparisons between model predictions and observations."

	1995	1996	1997	1998	1999
Root mean square error					
ROMS	1.92	2.46	2.17	2.33	2.18
QUODDY	4.16	4.77	6.01	5.50	8.33
Skill Score					
ROMS	0.95	0.93	0.95	0.94	0.94
QUODDY	0.87	0.86	0.81	0.82	0.75
Correlation (r)					
ROMS	0.94	0.91	0.94	0.92	0.91
QUODDY	0.85	0.84	0.84	0.79	0.80
Sample Size					
ROMS	2,518	1,822	1,889	1,876	1,792
QUODDY	2,895	2,091	2,156	2,140	2,043



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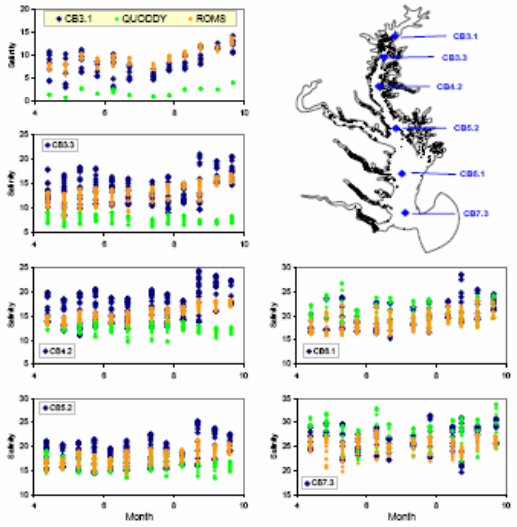

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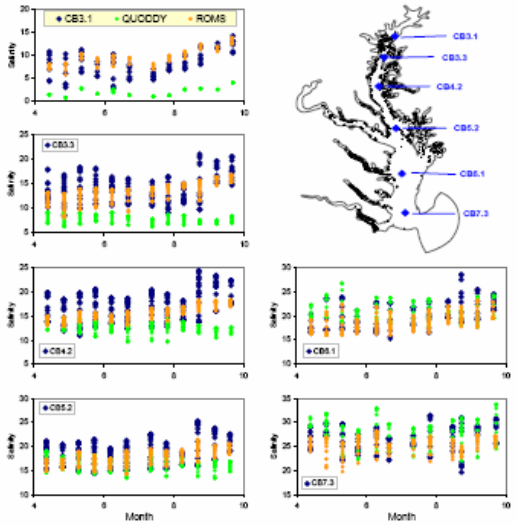

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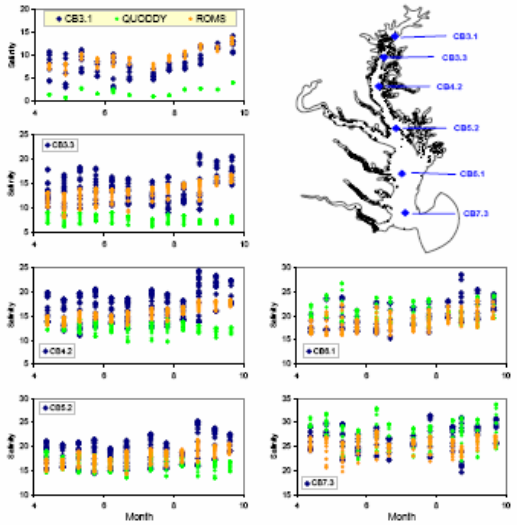

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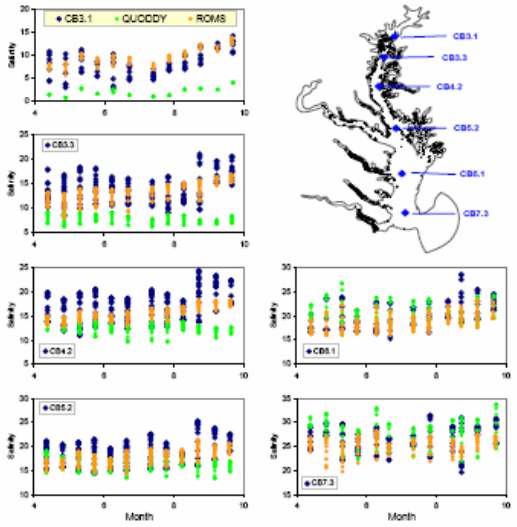
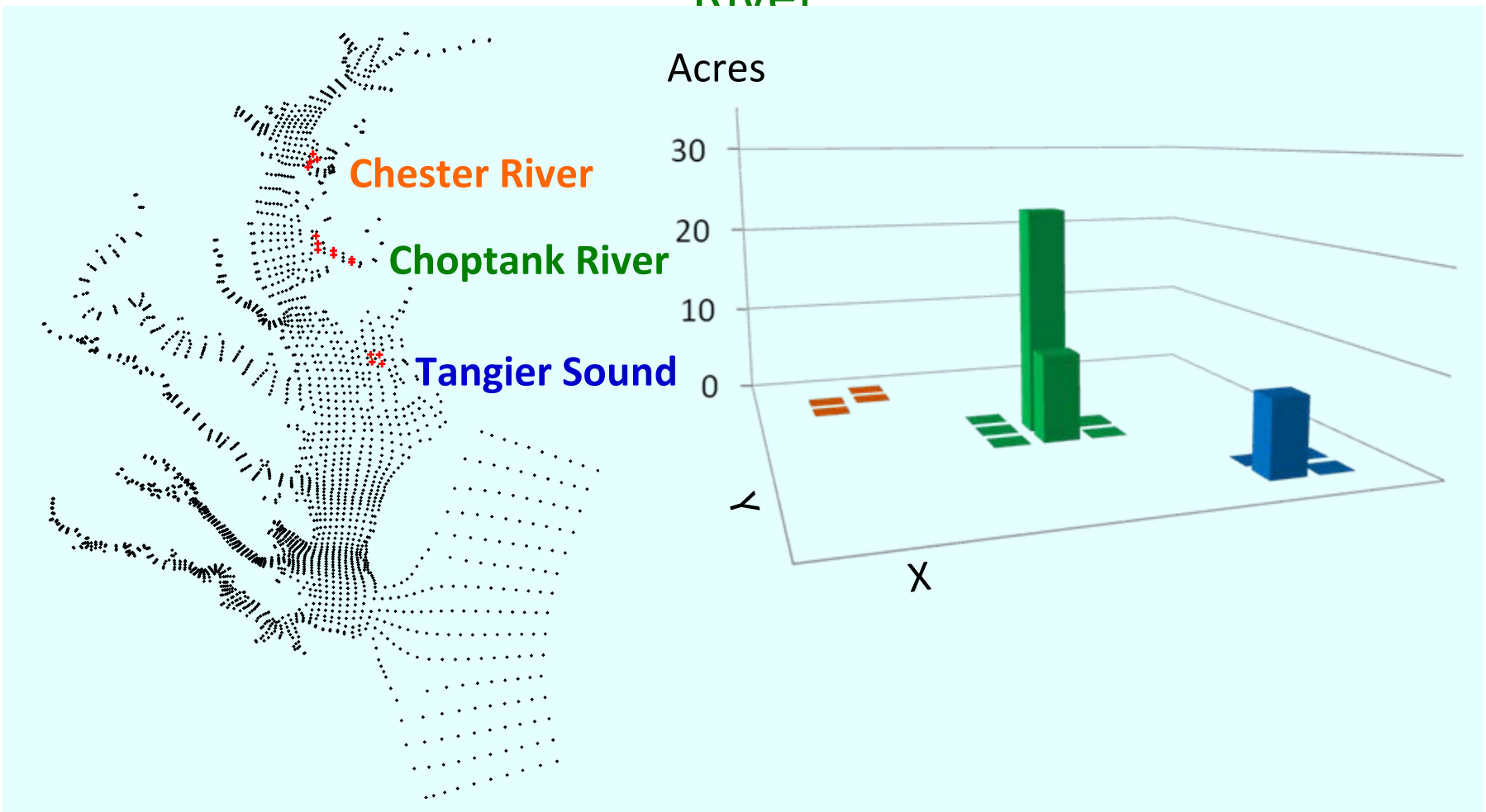


C.1. Model projections

"If have $1,000,000, the optimal place to restore oysters for population enhancement is in the Choptank River."



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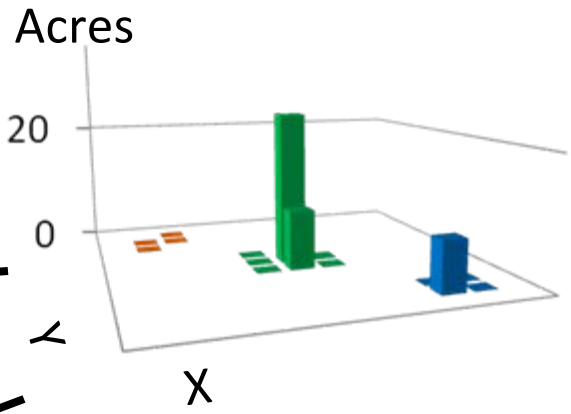

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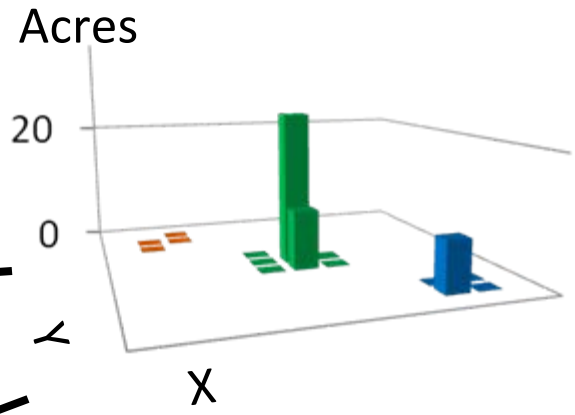
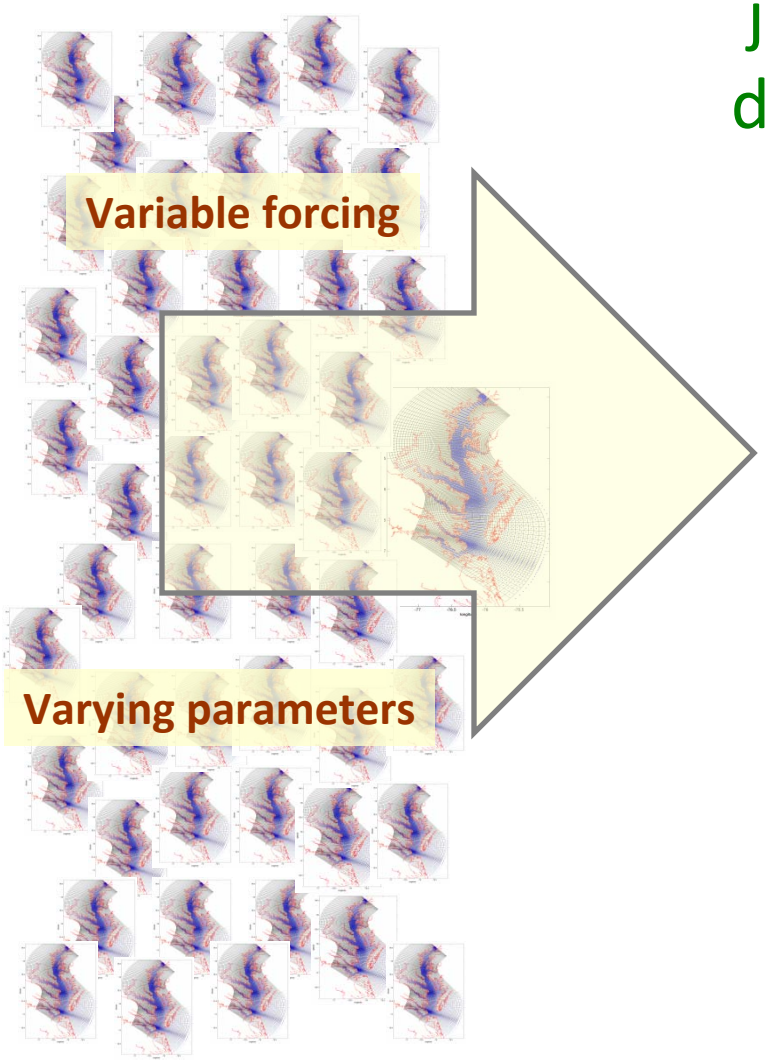
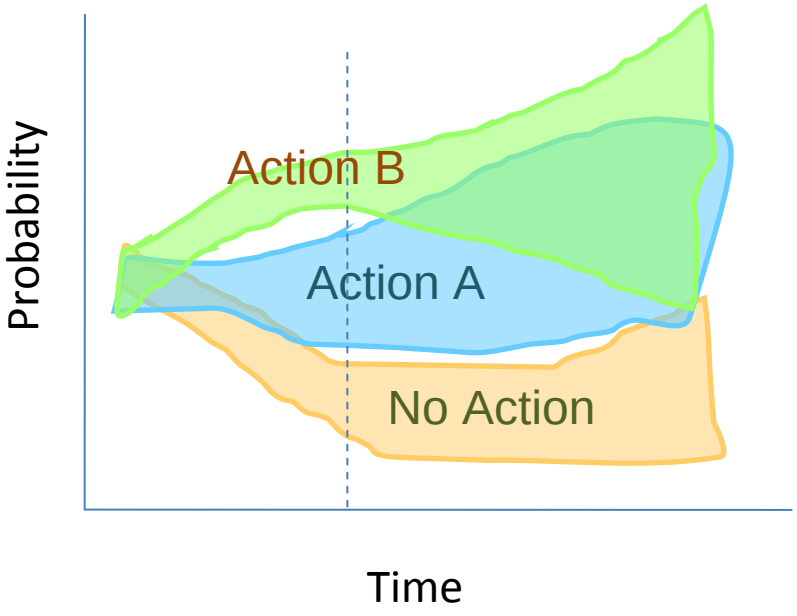


C.2. Model projections (hypothetical)

100-1000s of simulations



"There is a 60% chance that juvenile striped bass habitat will decrease by 45% in 10 years if no action is taken."



Create envelopes of possibilities

(after Kemp et al. CHRP project)

C. Model projections

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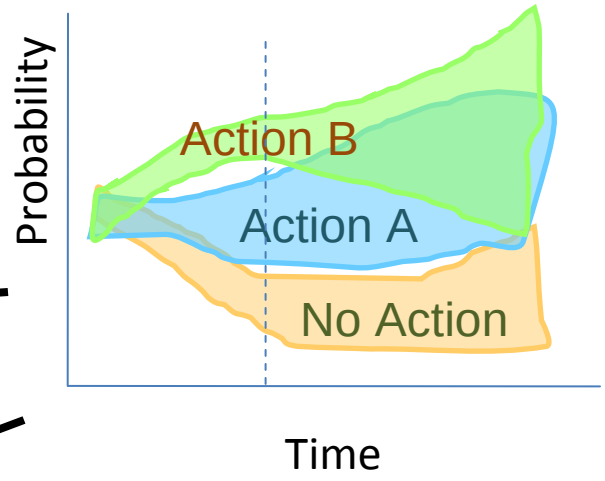

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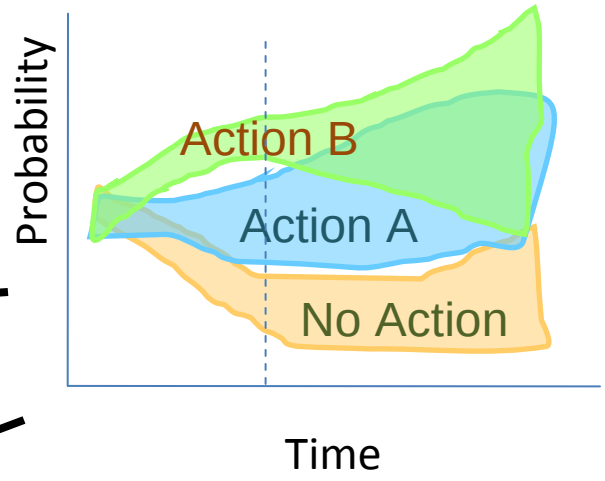

Key issues/challenges for modeling uncertainty

Recognize that

1)quantifying uncertainly is an important part of any scientific and management endeavor

2)the form of how we choose to communicate this uncertainty depends upon the audience

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Apply these same techniques to enhance the iterative process of reducing model uncertainty

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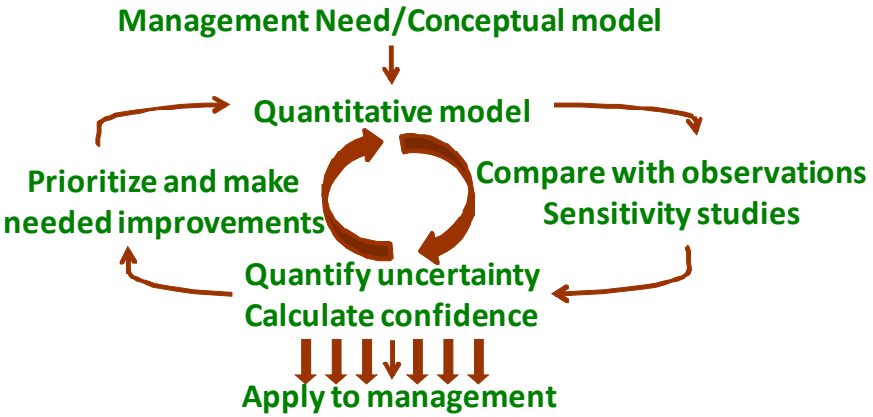

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Inviting feedback to clarify uncertainty

Exchange of ideas and vocabulary between scientists and managers is critical for sound interpretation and application of models. Scientists and managers use conceptual and numerical models to enhance our knowledge of species, ecosystems, and their interactions as well as to manage human activities and guide public investments. Even our most well-informed models are necessarily simplified versions of reality. The appropriate use of these models depends upon how well their limitations are understood and communicated.

In this presentation, managers and scientists will be invited to provide feedback on multiple techniques for presenting model uncertainty. Several case studies will be used to frame the discussion with the objective of developing agreement on effective methods for communicating uncertainty in model formulations and predictions.

Tuesday, 1:20 pm