

## Putting Uncertainty in Context

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EcoAdapt



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*Climatic change is affecting all ecosystems, and will continue to do so for centuries, so...*

- We need to *incorporate climatic change into long-term planning*
  - Minimize risk of wasting time, money, and effort
  - Maximize likelihood of success

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Ecosystem responses

Climate models

Hydrologic & Vegetation Models



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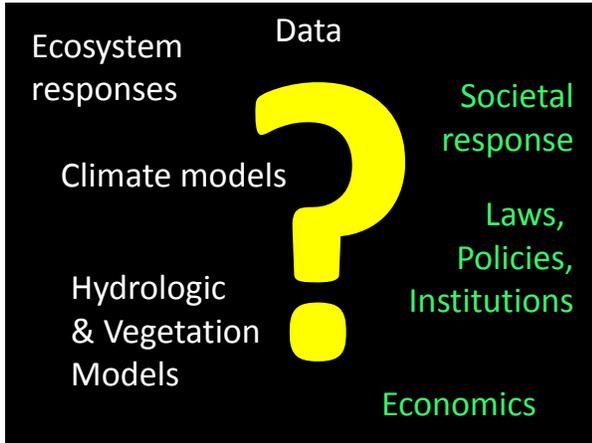
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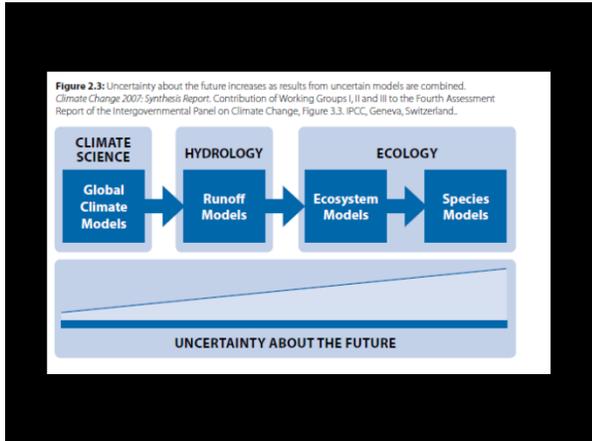
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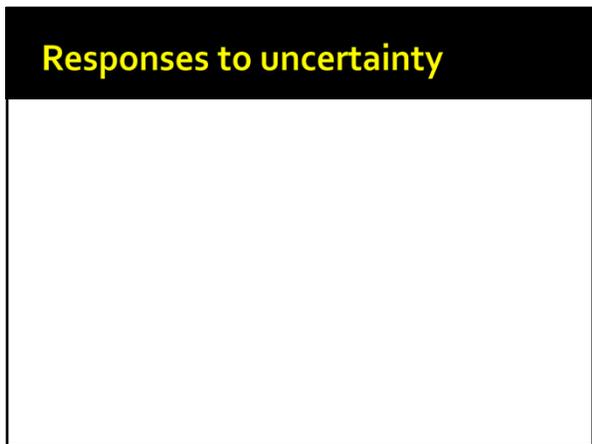
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### Responses to uncertainty

- Ignore it/wait until it disappears

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**Certain: death and taxes**  
**Uncertain: everything else**



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### Responses to uncertainty

- Ignore it/wait until it disappears
- Pretend you can get rid of it

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## Reducible vs. irreducible uncertainty

- Future greenhouse gas emissions  
vs
- How global temperatures respond to increases in GHG concentration  
vs
- How global precipitation regimes respond to increases in GHG concentration



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## The allure of downscaling

Beware spurious precision!

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**May I have the ability to reduce the uncertainties I can, the willingness to work with the uncertainties I cannot, and the scientific knowledge to know the difference.**

*Joe Barsugli, Cheis Anderson, Joel Smith and Jason Vogel*

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### Responses to uncertainty

- Ignore it/wait until it disappears
- Pretend you can get rid of it
- Understand it

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### Known unknowns vs. Unknown unknowns

- Lake level changes, temperature change
- Land use changes, boss's mood
- New technologies, ecosystem tipping points, political revolution



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### Directionality vs. magnitude

- All climate models say things will get warmer; they disagree on just how much warmer
- Models disagree on whether things get wetter or drier overall



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## Controllability

- Whether or not to buy a car
- Greenhouse gas emissions
- Massive methane belch from the deep sea



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## Uncertainty as information

Being uncertain is not the same as knowing nothing

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## Responses to uncertainty

- Ignore it/wait until it disappears
- Pretend you can get rid of it
- Understand it
- Surf the wave!
  - Adaptive management
  - Scenario planning
  - Risk management



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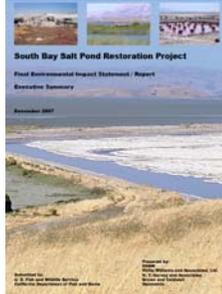
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## Adaptive Management Plan for South Bay Salt Pond Restoration Project

- Specified key uncertainties and research to address them
- Specified triggers for action
- Specified necessary science and institutional structure for adaptive management to work




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## Really cool table!

- For each goal/target:
- What they'll monitor and where
  - When they'll make decisions
  - What observations would trigger a re-examination of their plans
  - Action options once a trigger is tripped
  - Key knowledge gaps and how they're filling them

MANAGEMENT TRIGGER	APPLIED STUDIES
<ul style="list-style-type: none"> <li>• Outboard mudflat decreases greater than the range of natural variability = observational variability/error.</li> </ul>	<ul style="list-style-type: none"> <li>• Will sediment movement into restored tidal areas significantly reduce habitat area and/or ecological functioning (such as plankton, benthos, fish or bird diversity or abundance) in the South Bay?</li> <li>• Development of a 2- and 3-D South Bay tidal habitats evolution model.</li> </ul>
POTENTIAL MANAGEMENT ACTION	
<ul style="list-style-type: none"> <li>• Conduct study sessions to review and interpret findings to assess if observed changes are due to restoration actions or system-wide changes in the sediment budget (e.g. effects of sea level rise).</li> <li>• Study biological effects of loss of mudflat, subtidal shallows, and/or subtidal channel habitats.</li> <li>• Adjust restoration phasing and design to reduce net loss of tidal mudflats. Potential actions include remove hayrack levees to increase wind fetch and restrain tidal mudflat, phase berthing to match demand and supply, and/or breach only high-elevation ponds to limit sediment demand.</li> <li>• Reconsider movement up staircase.</li> </ul>	

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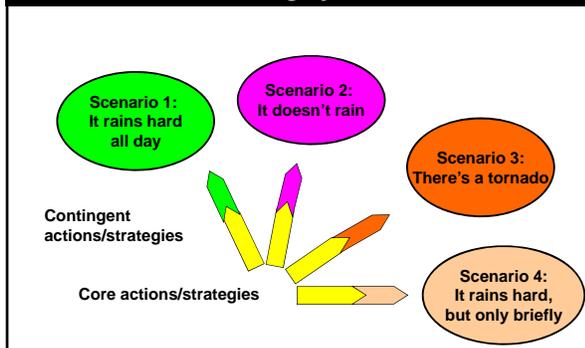
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## Scenario planning and robust decision-making, or *Should I bring my umbrella?*




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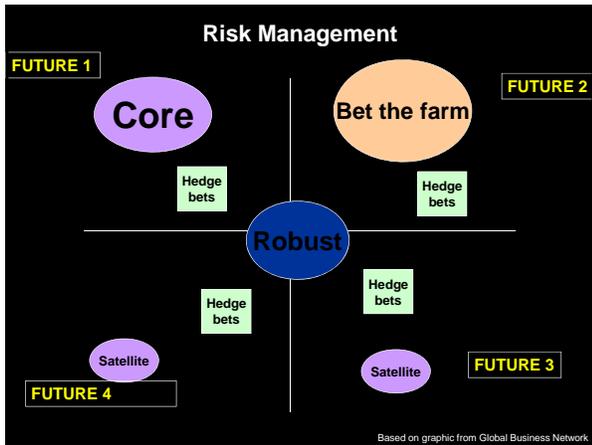
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