Putting Uncertainty in Context

K. Bruce Jones
USGS

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**

Data

Ecosystem responses

Climate models

Hydrologic & Vegetation Models

?

Data

Ecosystem responses

Societal response

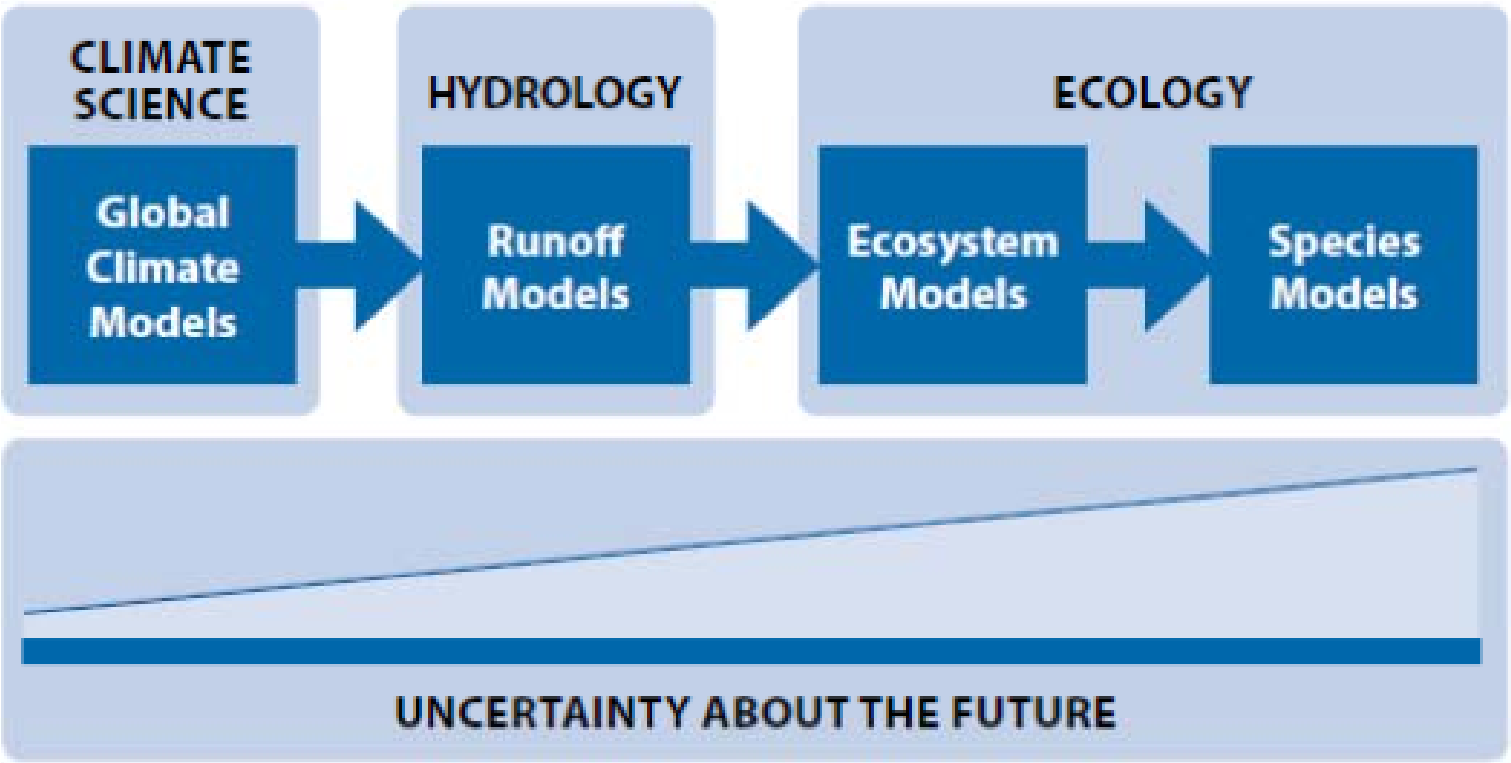
Climate models

Laws, Policies, Institutions

Hydrologic & Vegetation Models

Economics

Figure 2.3: Uncertainty about the future increases as results from uncertain models are combined. *Climate Change 2007: Synthesis Report*. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Figure 3.3. IPCC, Geneva, Switzerland.



Responses to uncertainty

- Ignore it/wait until it disappears

Certain: death and taxes

Uncertain: everything else

Responses to uncertainty

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

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

The allure of downscaling

Beware spurious precision!

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

Responses to uncertainty

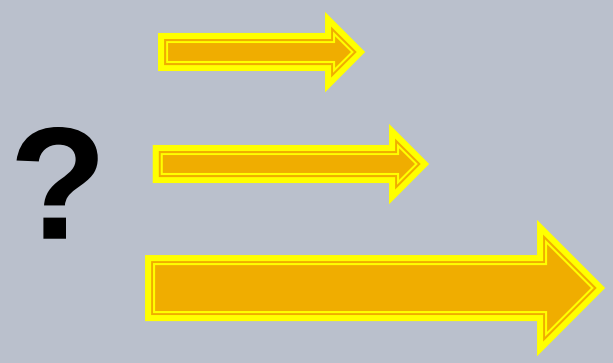
- Ignore it/wait until it disappears
- Pretend you can get rid of it
- Understand it

Known unknowns vs. Unknown unknowns

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

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



Controllability

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

Uncertainty as information

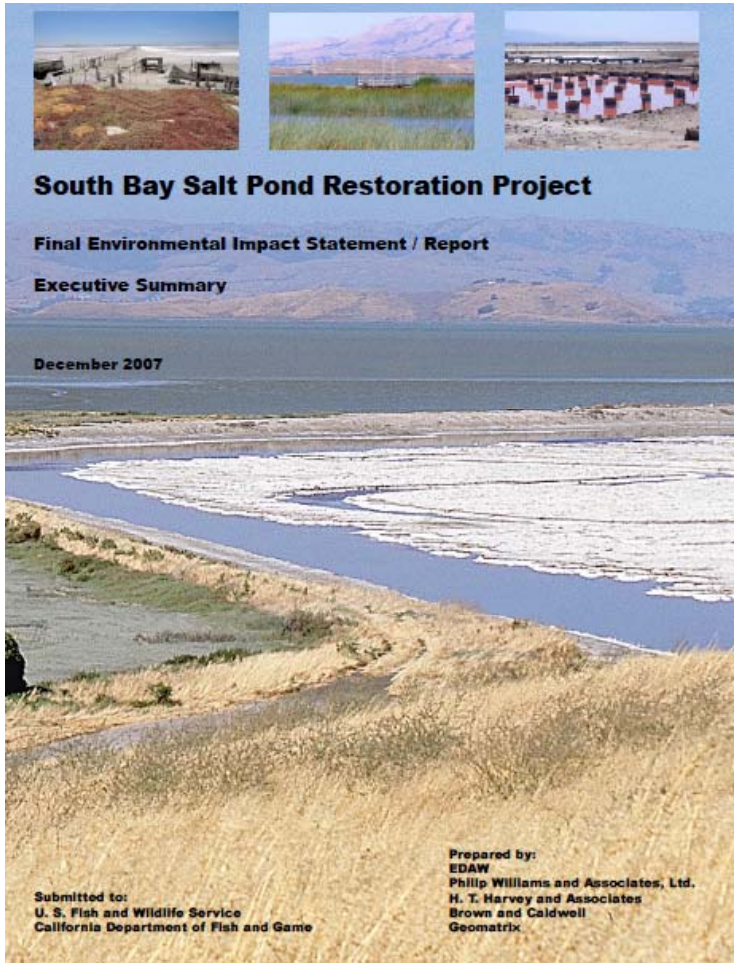
Being uncertain is not the same as knowing nothing

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**

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



Really cool table!

For each goal/target:

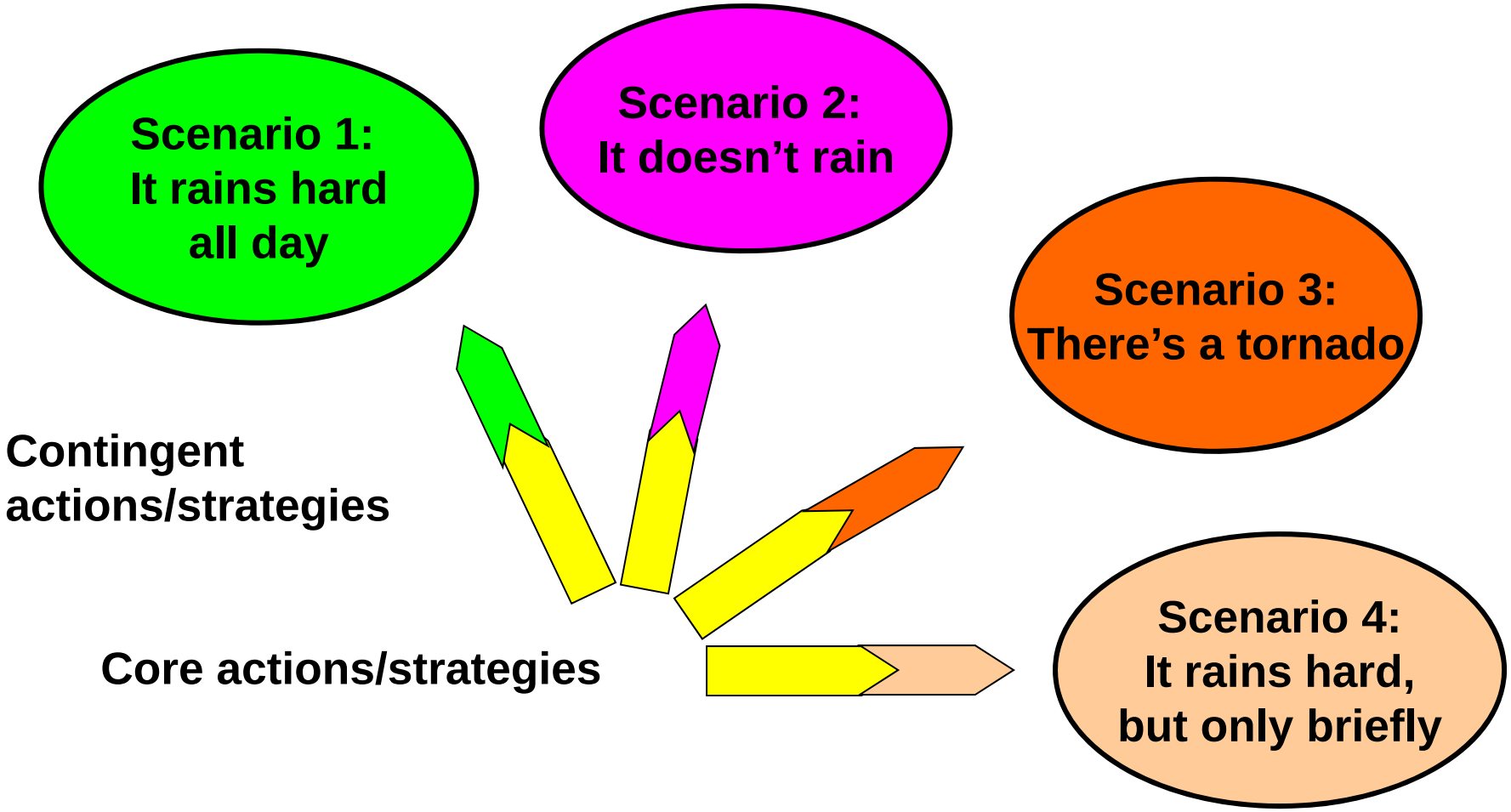
- What they'll monitor and where
- When they'll make decisions
- What observations would trigger a re-examination of their plans
- Action options once a trigger is tripped
- Key knowledge gaps and how they're filling them

MANAGEMENT TRIGGER	APPLIED STUDIES
• Outboard mudflat decreases greater than the range of natural variability + observational variability/error.	• Will sediment movement into restored tidal areas significantly reduce habitat area and/or ecological functioning (such as plankton, benthic, fish or bird diversity or abundance) in the South Bay? • Development of a 2- and 3-D South Bay tidal habitats evolution model.
POTENTIAL MANAGEMENT ACTION	
• Convene study session 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). • Study biological effects of loss of mudflat, subtidal shallows, and/or subtidal channel habitat. • Adjust restoration phasing and design to reduce net loss of tidal mudflats. Potential actions include remove bayfront levees to increase wind fetch and sustain tidal mudflat, phase breaching to match demand and supply, and/or breach only high-elevation ponds to limit sediment demand • Reconsider movement up staircase	

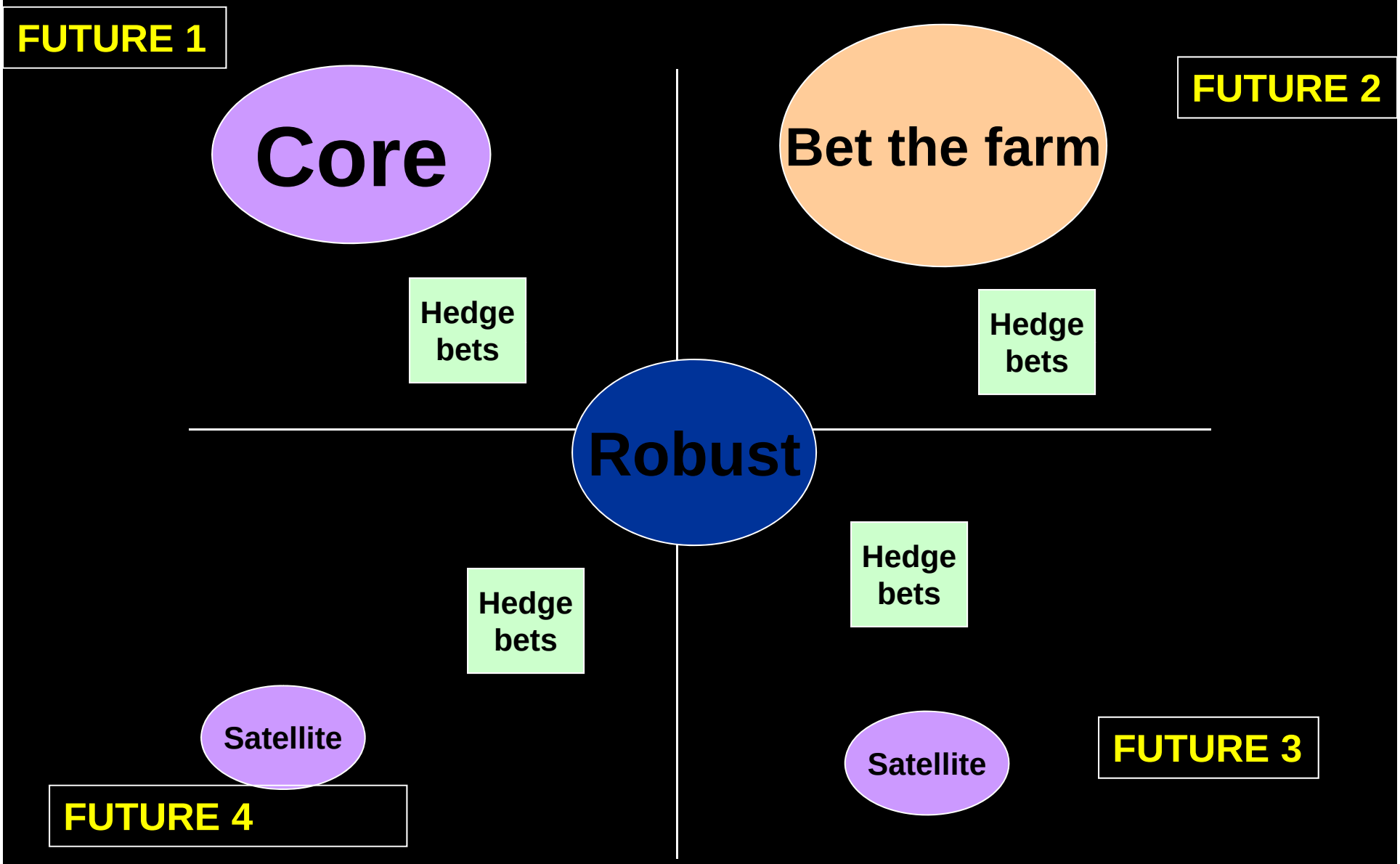
Scenario planning and robust decision-making,

or

Should I bring my umbrella?



Risk Management



Based on graphic from Global Business Network

How much Uncertainty am I Willing to Accept?

- Depends on the environmental endpoint and decisions to be made
- Important to clearly define environmental endpoints and the types of decisions that will be made using the results of the vulnerability assessment
  - Prioritization and targeting vs. prediction and forecasting
  - Structured Decision Making