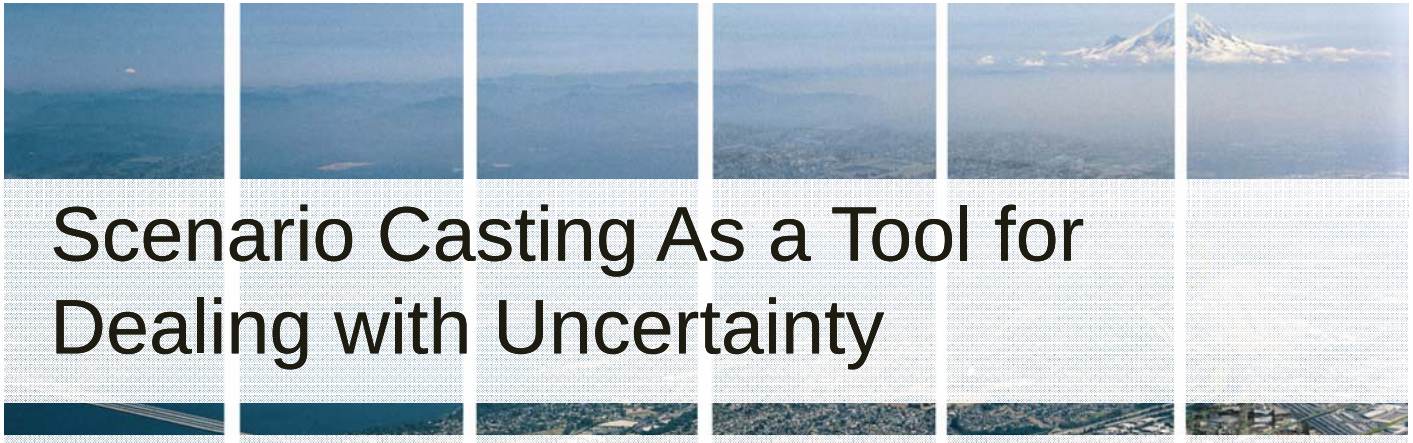
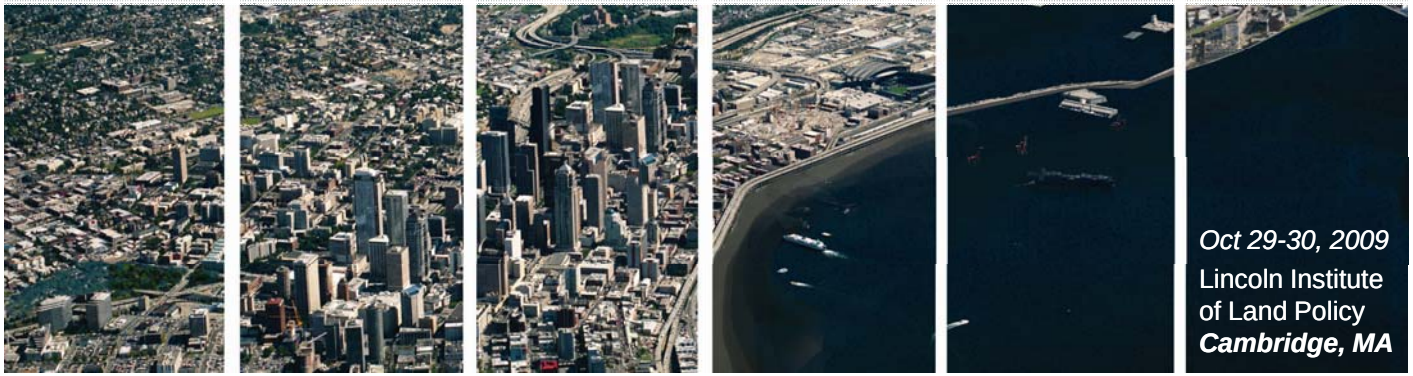


Scenario Casting As a Tool for Dealing with Uncertainty

Marina Alberti and Michal Russo

UERL, University of Washington



Oct 29-30, 2009

Lincoln Institute of Land Policy

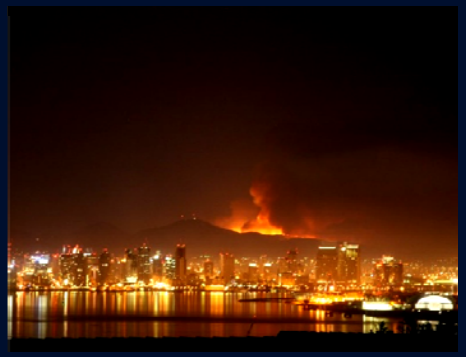
Cambridge, MA

Outline

- **The Challenge:** Risks posed by Climate Change
- Predictability and **Uncertainty:** What we know
- **Scenario** Planning: Managing complexity
- **Case Study:** The Future Without Project
- **Conclusions**

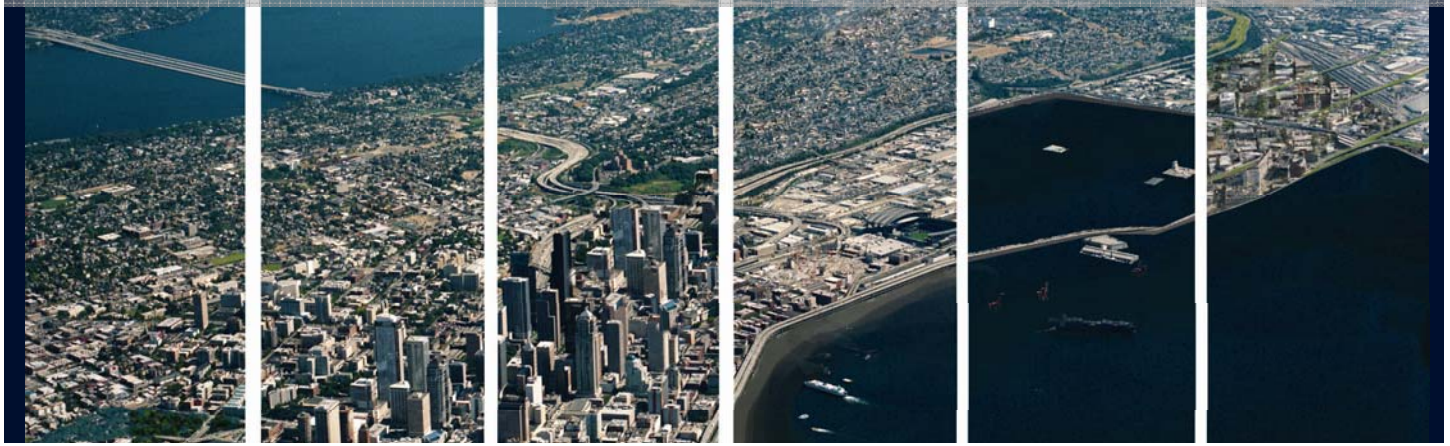
The Challenge: Managing risk posed by climate change

- Defining the problem: How to assess alternative strategies/best land management practices



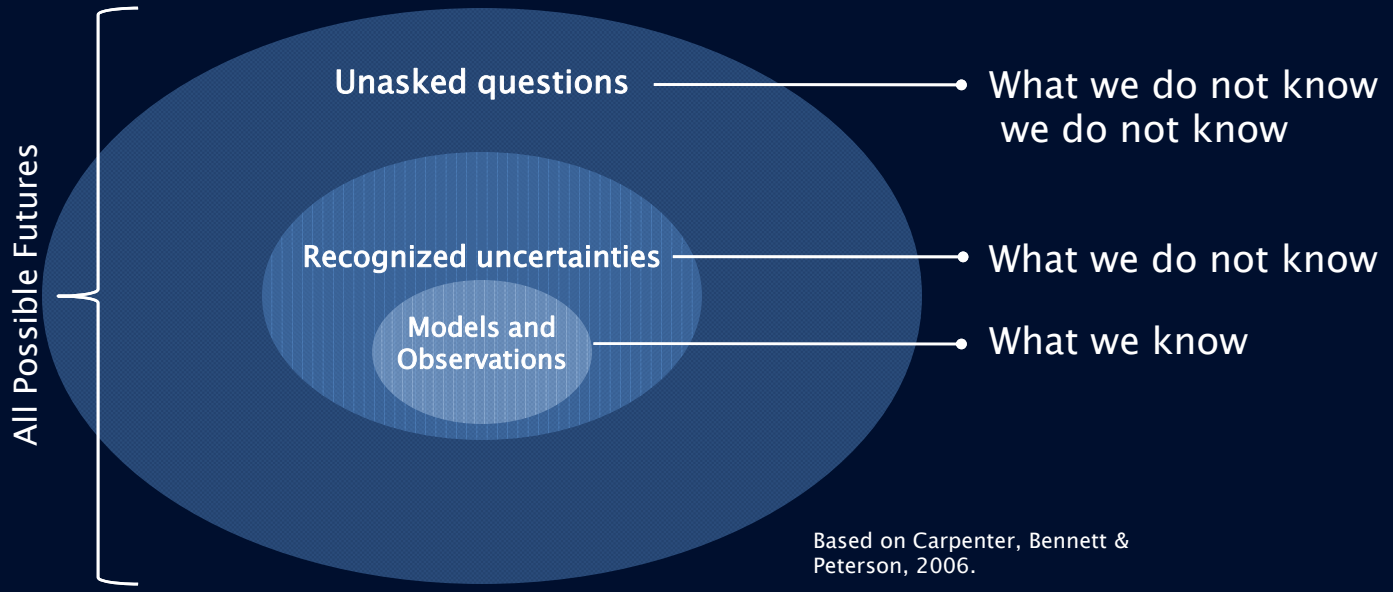
Adapting to What Future(s)

- How to think about the future.



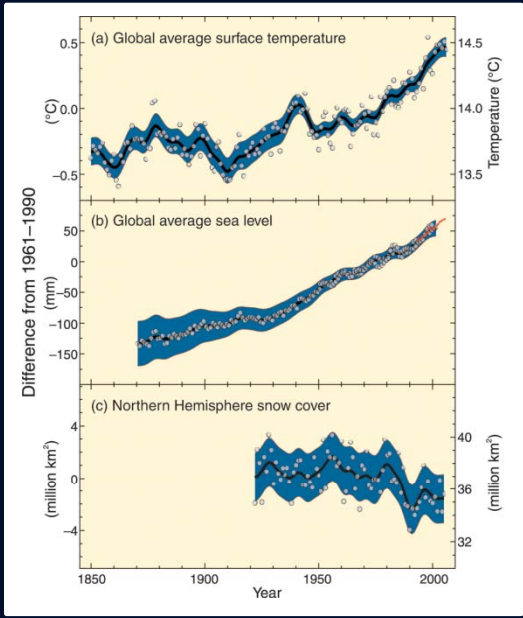
Challenge Uncertainty Scenarios Case Study Conclusions

Predictability and Uncertainty



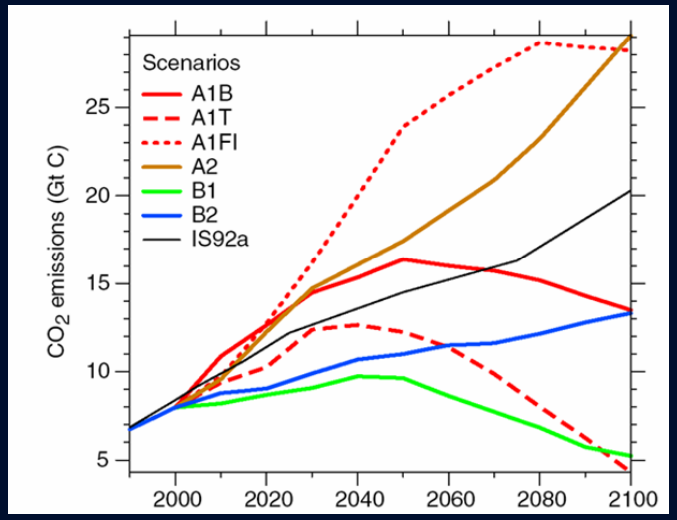
What we know: Observations

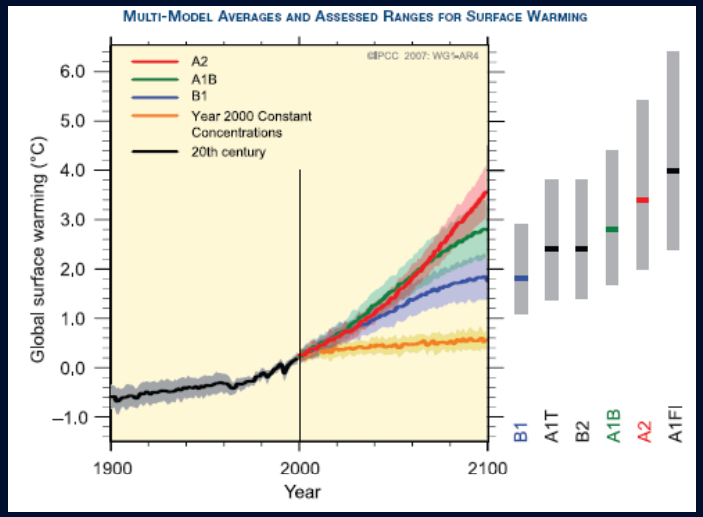
IPCC, 2007



- Human actions since the industrial age have contributed significant atmospheric emissions leading to changes in the global climate pattern.
- Instrumental observations over the past 157 years show that temperatures at the surface have risen globally, with important regional variations.
- The scientific community agrees that climatic variations will increase in magnitude and fluctuation over the next century.

What we predict: Models





IPCC 2007

What we do not know:
Accounted uncertainty

Scenario	Population	Economy	Environment	Equity	Technology	Globalisation	Climate
A1FI	↗↘	↗	↘	→	↗	→	↗
A1B	↗↘	↗	→	→	↗	→	↗
A1T	↗↘	↗	↗	→	↗	→	→
B1	↗↘	→	↗	→	↗	→	→
A2	↗	→	↘	↘	→	↘	↗
B2	→	→	↗	→	→	↘	→

Viner and Sayer, 2004

What factors control the risks associated with climate change?

What are the computable uncertainties?

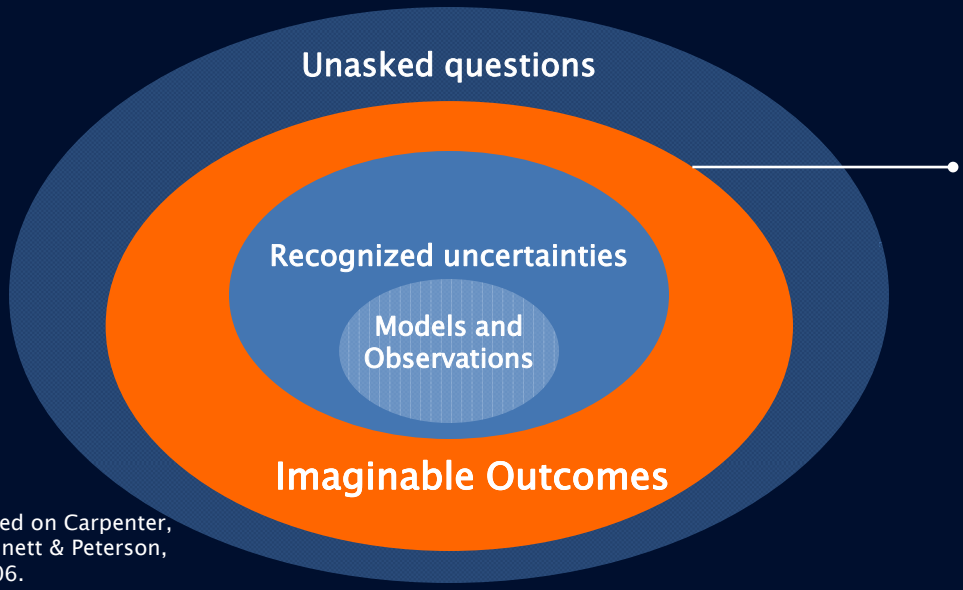
"…we do not know, over the longer term, how the oceanic biological system in the southwest Pacific will be influenced by the interaction of ENSO events with the overall warming trend…"

IPCC, 2007

What we do not know, we do not know:
Unasked questions

- What lies beyond our predictions and models?
- What synergistic outcomes have we not anticipated?
- Which critical thresholds have we ignored?
- How can the future surprise us?

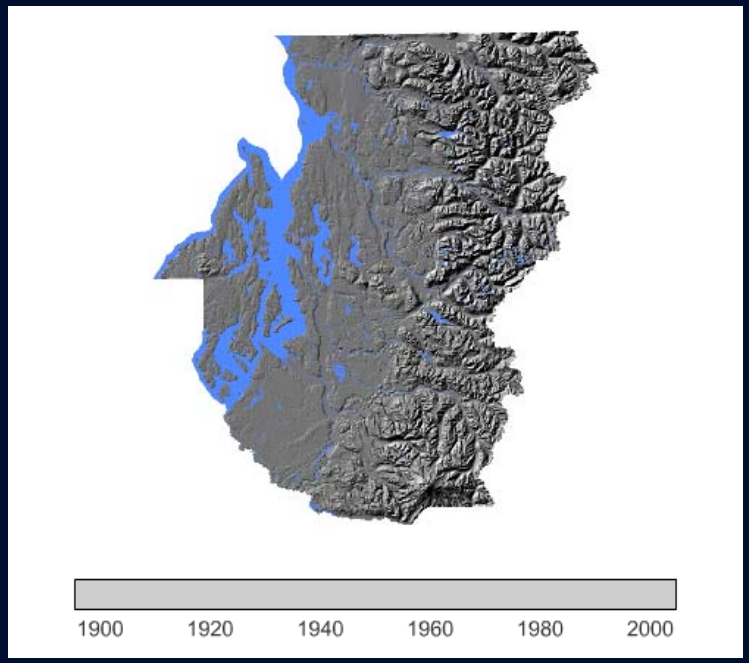
What we can imagine



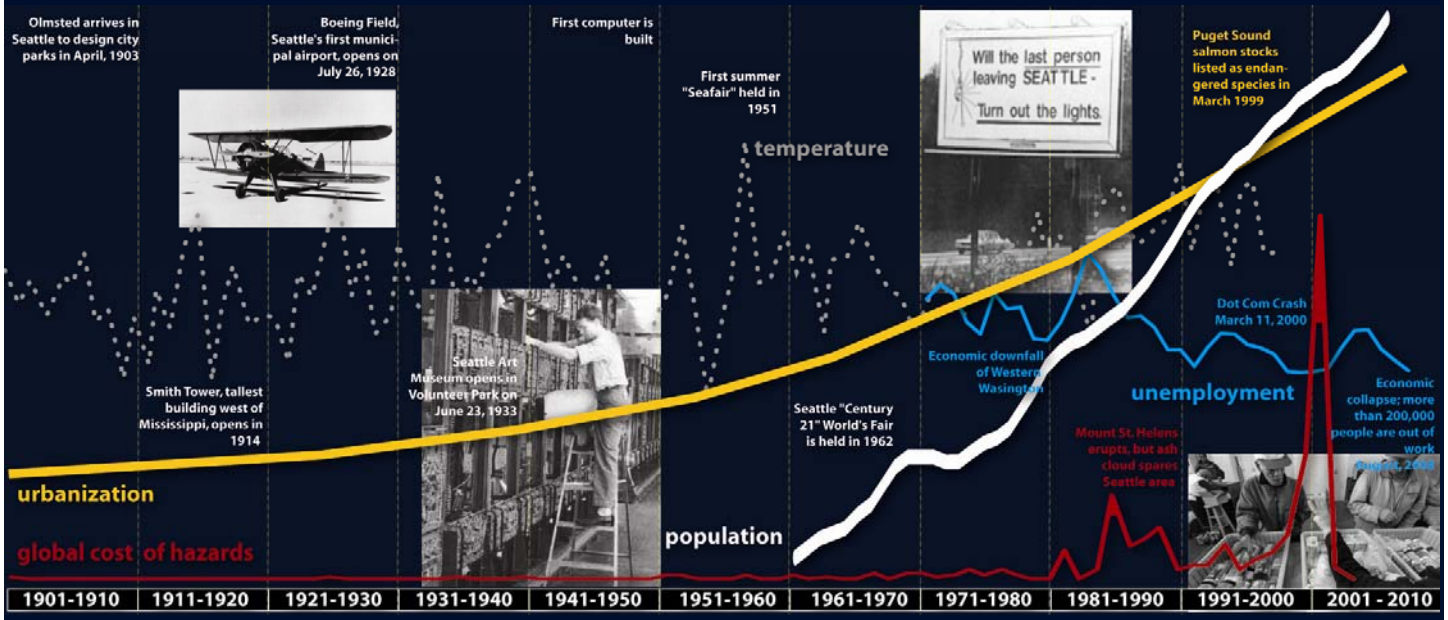
Where scenarios can help us the most

Based on Carpenter, Bennett & Peterson, 2006.

What the past can teach us about the future?



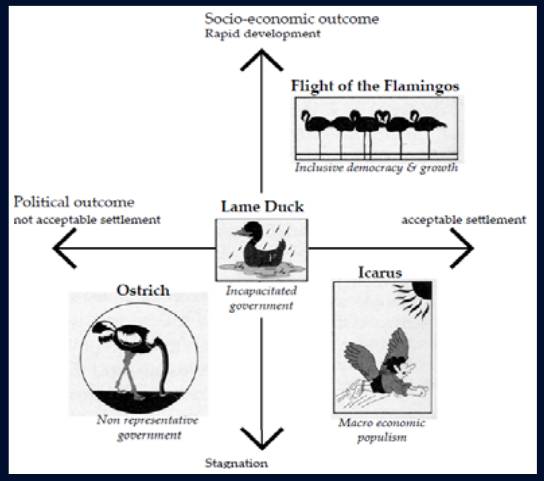
How the past can bias our view of the future



Why Scenarios

- **Complexity** of coupled human-natural systems (heterogeneity, non-linearity and emergent properties) make them highly unpredictable.
- **Limited knowledge** many of the processes underlying climate change are still poorly understood, further limiting the predictability of system response
- **Reflexivity** we must incorporate an understanding of reflexive human decision-making and behavior into the evaluation of the strategies.
- **Uncertainty** increases the further out we look

What are Scenarios



Ringland, 1998

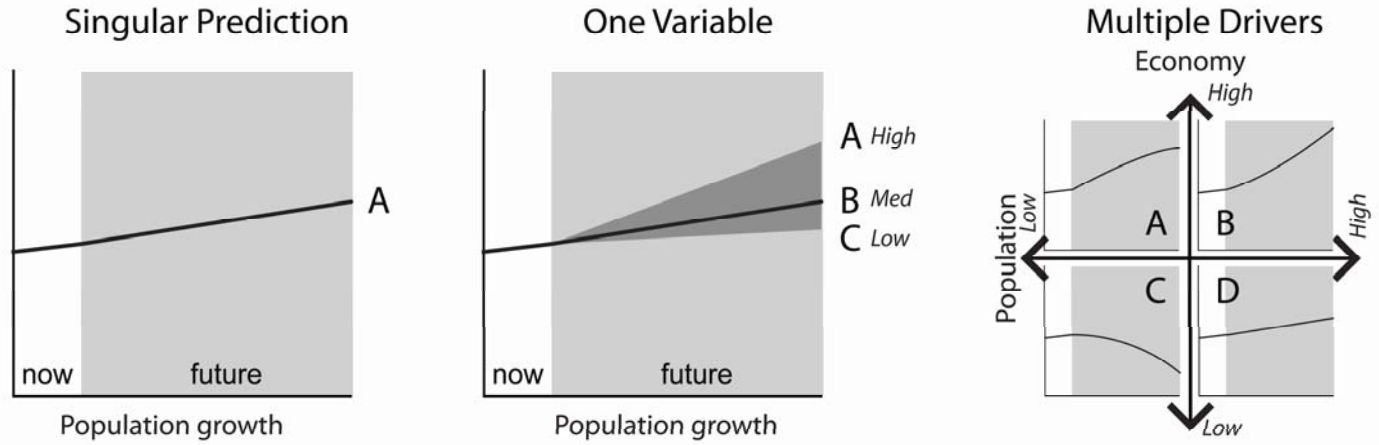
- Scenarios are illustrative accounts of multiple futures that direct our attention towards a alternative outlooks that contain the most relevant uncertainty dimensions.
- Scenarios expand an organization's understanding of future risk by systematically exploring plausible futures whose risks the organization has not yet considered
- Scenarios help us ask: If the future turns out differently than originally anticipated, will our strategy still work?

How Scenarios work

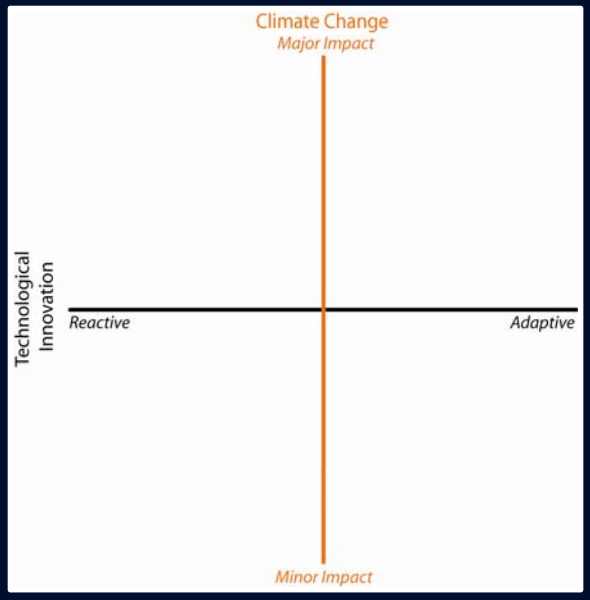
- Instead of focusing on a single prediction extrapolated from past trends, scenarios focus on uncertain drivers and expand the assumptions of predictive models to illuminate otherwise unforeseen interactions between individual trajectories.

How Scenarios Work

- **Multiple Drivers:** Scenarios explore the interaction between significant uncertain drivers



Hypothetical example



Climate Change

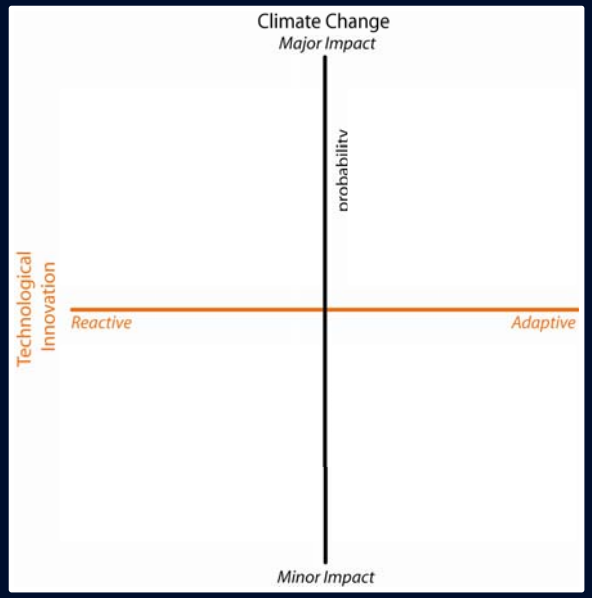
Major Impacts: *IPCC Scenario A1*

- High Sea level rise, glacial melting, temperature increase, summer draughts, winter flooding.

Minor Impacts: *IPCC Scenario B1*

- Few regional events from change in temperature and hydrology

Hypothetical example



Technological Innovation

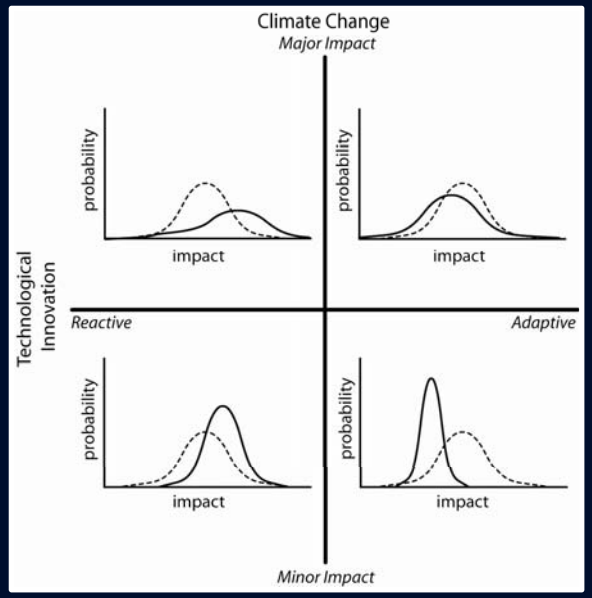
Adaptive: *Proactive, mimic natural cycle*

- Reflect context and variability, efficient, flexible, self-reliant

Reactive: *Control natural cycles,*

- Rigid, dependent on resource inputs

Hypothetical example



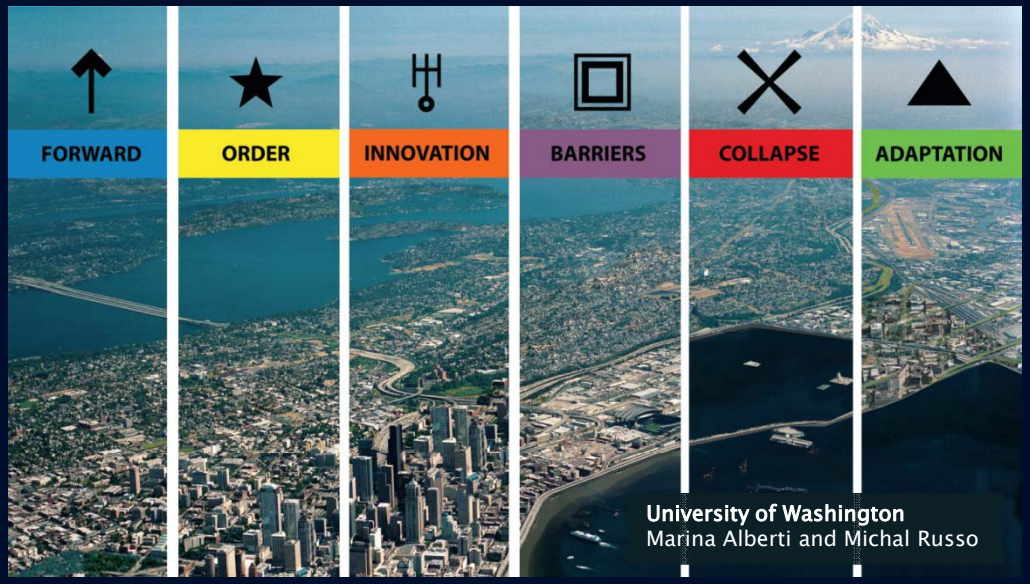
- The key benefit of the alternative scenarios comes from anticipating impacts that lie beyond the probable estimates based on past observations alone.

Scenario Development

- **Focal issue**: the question about the future that an organization is confronting.
- **Driving forces**: key variables that influence a phenomenon or focal issue
- Ranking importance & uncertainty
- **Scenario logics**: the interaction between the key driving forces creating the frame for the scenario logics.
- **Scenario Narrative**: the final plot of the scenarios, containing detailed information on the future condition.

Case Study: Puget Sound Scenarios

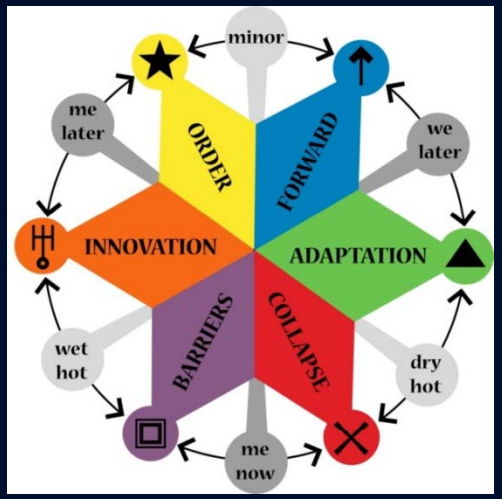
The Future Without Project



Puget Sound Scenarios: Objectives

- Define baseline future of the Puget Sound nearshore in 2050 assuming that a comprehensive, large scale ecosystem restoration strategy will not take place
- Explore potential risks and opportunities to inform the development of restoration strategies
- Provide insight towards assessing the cost and benefits of alternative restoration strategies under plausible future conditions

Final 6 Scenarios



FORWARD: *Hybrid, Equity, Flexibility*

INNOVATION: *Inspiration, Freedom, Progress*

ORDER: *Control, Consumption, Conflicts*

BARRIERS: *Division, Safety, Reaction*

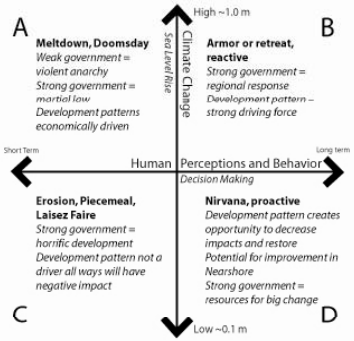
COLLAPSE: *Scarcity, Vulnerability, Depression*

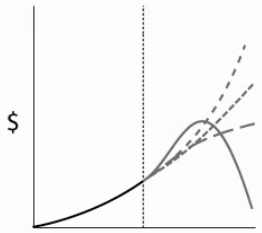
ADAPTATION: *Change, Challenge, Interdependence*

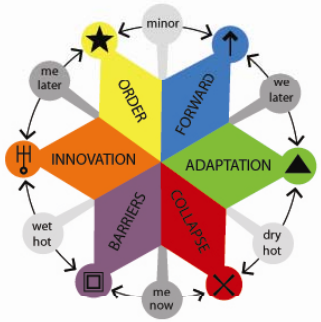
Scenario Development

PROCESS DIAGRAM

1. Climate Change
2. Demography
3. Development Patterns
4. Economics
5. Public Health
6. Human Perceptions and Behavior
7. Infrastructure and Technology
8. Knowledge and Information
9. Natural Hazards
10. Governance



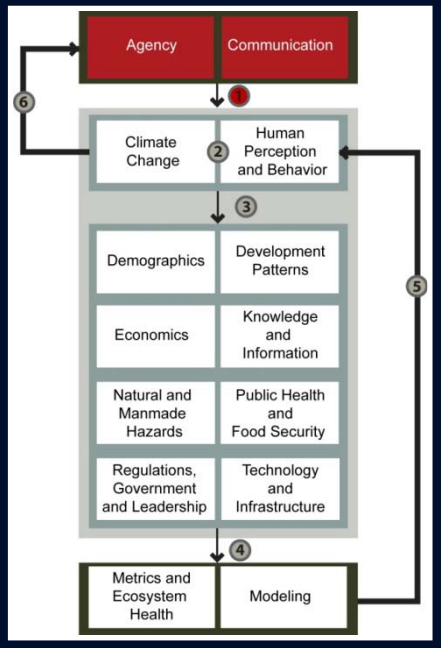




driving forces | scenario logics | alternative trajectories | scenario development

Method

- Scenarios builds on a sample of **diverse views** and bring together disciplines ranging from earth sciences to economics and from science to practice. All contribute different, but partial views of the future.
- To develop the Puget Sound Scenarios, the UERL has involved **152 experts** representing more than **88 agencies.**
- The driving forces and initial story lines were developed through an **expert workshop** involving 50 experts including scientists, policy makers, and NGOs.
- The scenario development process has involved **individual interviews, panel interviews**, and **expert focus groups.**



Key Drivers

CLIMATE CHANGE

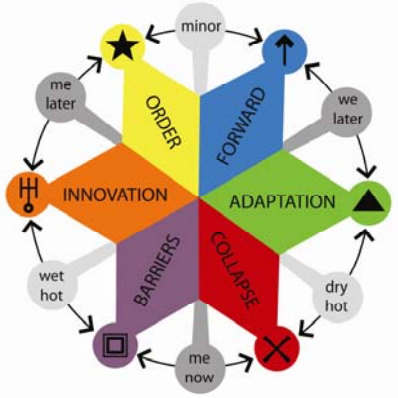
	Magnitude		Fluctuations
	Temperature	Precipitation	Variance
minor	1.75degF	0″	Historical
dry hot	4degF	1″	Historical
wet hot	4.4degF	8″	Greater

+

HUMAN PERCEPTIONS AND BEHAVIOR

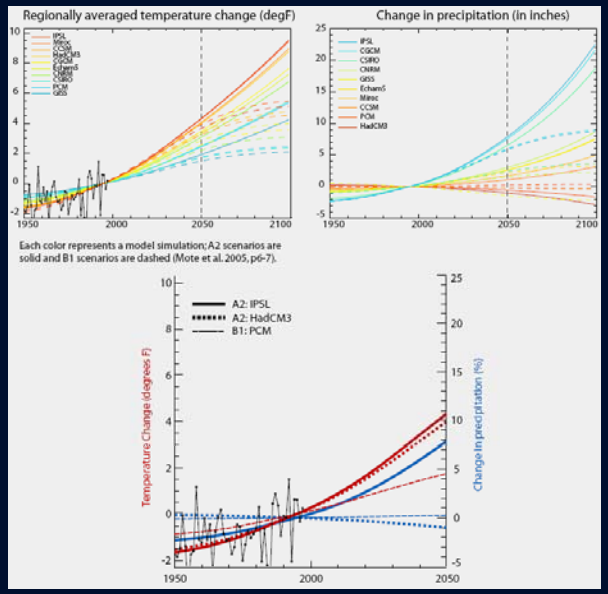
	Social Values	Future Valuation
me now	Individualistic	Short-term
me later	Individualistic	Long-term
we later	Collectivistic	Long-term

→



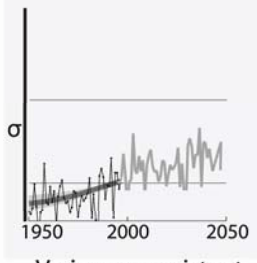
Climate Change:
Precipitation and Temperature

- The trajectories for climate change utilize previously run models for the IPCC for both precipitation and temperature.
- The 3 most divergent trajectories were selected.

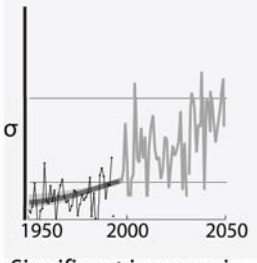


Climate Change:
Fluctuations

- Fluctuations describe the change in variance from historical trends of both temperature and precipitation patterns.
- Major fluctuations from the historical variance may lead to significant new challenges in this region from floods to windstorms and droughts.



Variance consistent w/historical pattern



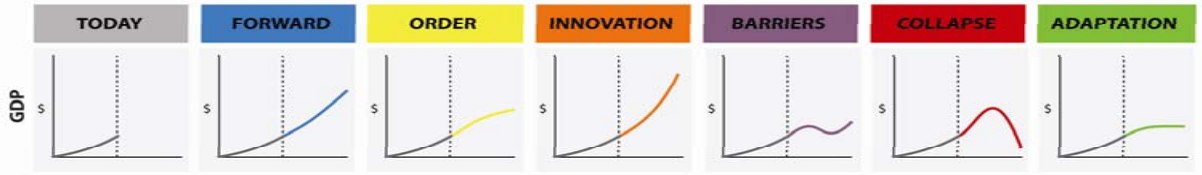
Significant increase in variance

Human Perceptions and Behavior

- **Individualism and Collectivism:** people's values concerning the distribution and allocation of regional services and goods
  - **individualistic** refers to a society which maximizes individual or household utility
  - **collectivistic** refers to a society that reduces household utility in order to maximize regional utility
- **Future valuation:** how much value people place on having resources now as opposed to in the future.
  - **Short term** describes a preference for short-term decisions that maximize utilizing resources now.
  - **Long-term decisions** invest current resources in order to have more opportunities in the future.

Supporting Driving Forces

- Supporting drivers hypothesize consequent implications for the region's:
  - Demographics
  - Development Patterns
  - Economics
  - Governance
  - Knowledge and Information
  - Natural Hazards
  - Public Health
  - Technology and Infrastructure



Driving Trajectories

- The panel discussions identified 32 indicators for the dimensions of the driving forces to help describe major differences between the final scenarios.
- General trends exhibit strong correlations among specific dimensions of the supporting driving forces.

- Four sets of relationships are divided into:
  - Growth rate: *the change in the rate of growth as compared to the recent past, focusing on overall economic, demographic and development growth.*
  - Socio-economic characteristics: *the type of growth associated with specific trajectories.*
  - Governance: *the strength of governance dominating the region and the types of partnerships that are formed.*
  - Regional investments: *the amount invested in the region including education, public health, ecosystem health, public infrastructure and social equity.*

Storylines

The **Forward** scenario portrays a paradigm shift in human-ecological interactions, where human and ecological systems are seen as interdependent and coevolving. Management policies are based on adaptive strategies that simultaneously expand the Region's economic, social and natural capitol.

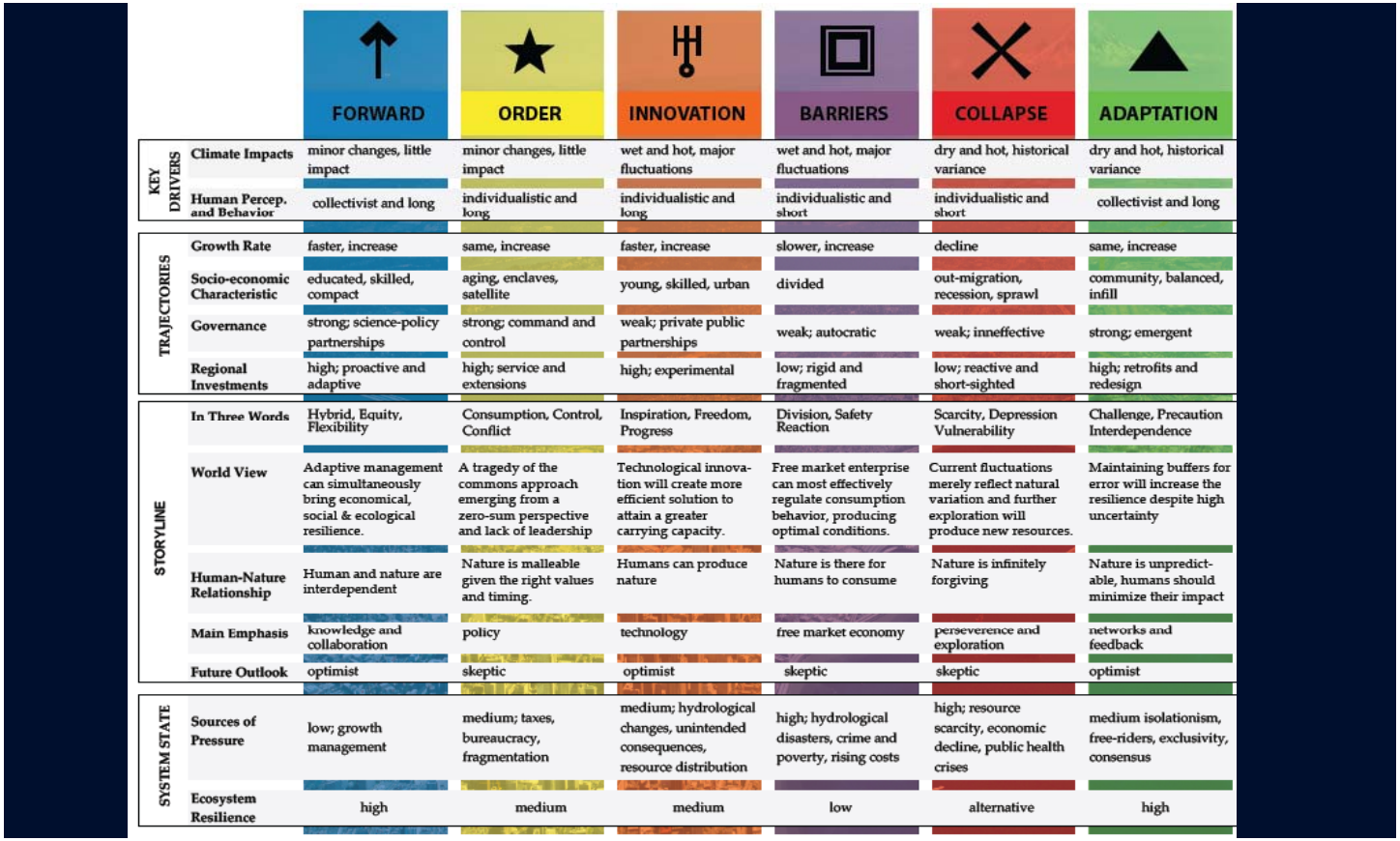
Order exposes a society that relies on regulation to govern human behavior. Heavy top-down restrictions on consumption are presumed to be most effective in maintaining a stable-state ecosystem.

Innovation reflects a technological optimist society, one based on the premise that technological innovation will be able to solve all current and future ecological problems. It reflects a perspective of human domination over nature.

Barriers portrays a society who perceives protective government as interfering with a free market and should be relegated to dealing only extreme requirements such as law enforcement and international security.

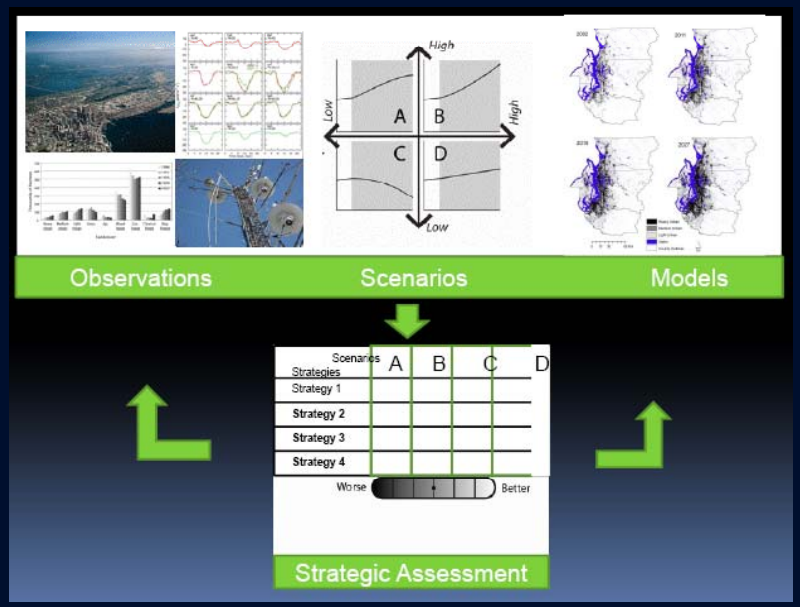
Collapse exhibits a society that assumes further exploration and exploitation will allow us to overcome declining yields and increasing costs.

Adaptation signifies a dramatic societal shift, where new challenges are met with an adaptive response. Society abides by the precautionary principle and believes that increasing uncertainty can be best handled creating buffers for error.



		FORWARD	ORDER	INNOVATION	BARRIERS	COLLAPSE	ADAPTATION
KEY DRIVERS	Climate Impacts	minor changes, little impact	minor changes, little impact	wet and hot, major fluctuations	wet and hot, major fluctuations	dry and hot, historical variance	dry and hot, historical variance
	Human Percep. and Behavior	collectivist and long	individualistic and long	individualistic and long	individualistic and short	individualistic and short	collectivist and long
TRAJECTORIES	Growth Rate	faster, increase	same, increase	faster, increase	slower, increase	decline	same, increase
	Socio-economic Characteristic	educated, skilled, compact	aging, enclaves, satellite	young, skilled, urban	divided	out-migration, recession, sprawl	community, balanced, infill
	Governance	strong; science-policy partnerships	strong; command and control	weak; private public partnerships	weak; autocratic	weak; ineffective	strong; emergent
	Regional Investments	high; proactive and adaptive	high; service and extensions	high; experimental	low; rigid and fragmented	low; reactive and short-sighted	high; retrofits and redesign
STORYLINE	In Three Words	Hybrid, Equity, Flexibility	Consumption, Control, Conflict	Inspiration, Freedom, Progress	Division, Safety Reaction	Scarcity, Depression Vulnerability	Challenge, Precaution Interdependence
	World View	Adaptive management can simultaneously bring economical, social & ecological resilience.	A tragedy of the commons approach emerging from a zero-sum perspective and lack of leadership	Technological innovation will create more efficient solution to attain a greater carrying capacity.	Free market enterprise can most effectively regulate consumption behavior, producing optimal conditions.	Current fluctuations merely reflect natural variation and further exploration will produce new resources.	Maintaining buffers for error will increase the resilience despite high uncertainty
	Human-Nature Relationship	Human and nature are interdependent	Nature is malleable given the right values and timing.	Humans can produce nature	Nature is there for humans to consume	Nature is infinitely forgiving	Nature is unpredictable, humans should minimize their impact
	Main Emphasis	knowledge and collaboration	policy	technology	free market economy	perseverence and exploration	networks and feedback
	Future Outlook	optimist	skeptic	optimist	skeptic	skeptic	optimist
SYSTEM STATE	Sources of Pressure	low; growth management	medium; taxes, bureaucracy, fragmentation	medium; hydrological changes, unintended consequences, resource distribution	high; hydrological disasters, crime and poverty, rising costs	high; resource scarcity, economic decline, public health crises	medium isolationism, free-riders, exclusivity, consensus
	Ecosystem Resilience	high	medium	medium	low	alternative	high

Linking observations, scenarios and models



Conclusions

- Complexity and uncertainty of climate change make long term predictions of human and ecological impacts highly unpredictable
- Unpredictable transitions and surprise associated with climate change are expected to become more common in shaping the future
- Complexity, uncertainty, and unpredictability challenge the assumptions of traditional approaches to risk assessment and management
- Scenario casting provides a systematic framework to explore plausible futures and assess potential risks of climate change
- SUMMARY: We propose that by using scenarios, we will be able to develop more robust climate change adaptation strategies for reducing vulnerability and increasing resilience in the face of irreducible uncertainties.