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Minding the Gap: Creating Decision-Relevant Assessments

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My Argument

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- Assessments have provided useful policy inputs and now need to support distributed adaptive management and planning
- NCA3 and the vision for the sustained assessment process advance the process of enabling support for these types of decisions
- This talk focuses on assessment of decision support processes, systems, and tools: important for evolving an understanding of good practice
- Main Takeaways: Using the sustained NCA to facilitate development and application of decision support systems is more important than recognized for successful climate risk management

In addition, …

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- I introduce three topics that I've worked on that contribute to using assessments to feed information into decision support processes
  - Confidence and uncertainty characterization: providing information about the uses and limits of available information for different types of decisions
  - Scenario methods: moving beyond top-down approaches to help decision makers envision the future and interactions between their own decisions and climate change
  - Vulnerability assessment methods: a useful first step in defining adaptation needs
- More detailed discussion of these can take place in the Q&A, or if anyone is interested, in conversations during my visit

nature climate change

REVIEW ARTICLE

PUBLISHED ONLINE: 26 OCTOBER 2012 | DOI: 10.1038/NCLIMATE1614

Narrowing the climate information usability gap

Maria Carmen Lemos*, Christine J. Kirchhoff and Vijay Ramprasad

Climate-change-related risks pose serious threats to the management of a wide range of social, economic and ecological systems. Managing these risks requires knowledge-intensive adaptive management and policy-making actively informed by scientific knowledge, especially climate science[1]. However, potentially useful climate information often goes unused[1,2]. This suggests a gap between what scientists understand as useful information and what users recognize as usable in their decision-making. We propose a dynamic conceptual model to address this gap and highlight strategies to move information from useful to usable to reduce climate-related risks.

"…the evidence suggests that we must rethink the ways in which we design and promote use-inspired basic and applied research programmes if we aim to produce usable climate information to meet societal risk and adaptive management needs."

What Are Assessments?

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- Processes that review scientific information to address policy-relevant questions (in interaction with users)
- When they are successful, assessments will…

- Evaluate the state of scientific knowledge
- Communicate level of confidence in the information provided
- Indicate when information will improve

Three Leaders in Assessment

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Traditional Scientific Assessments

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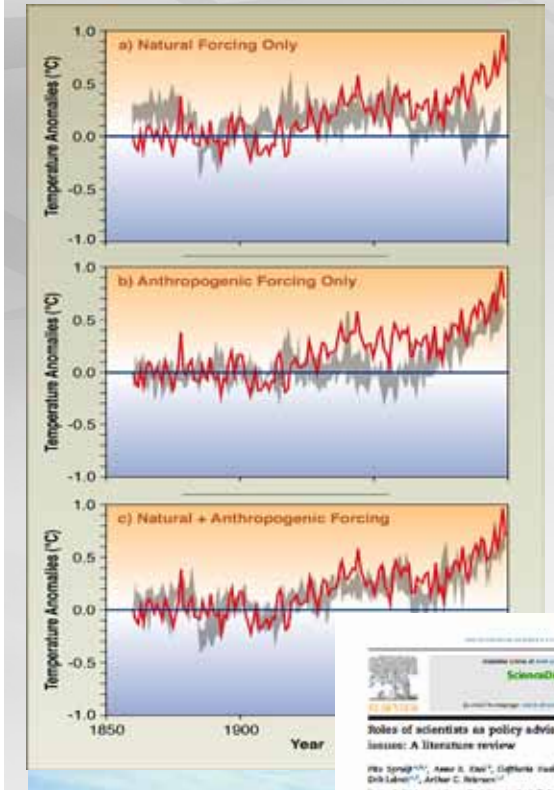

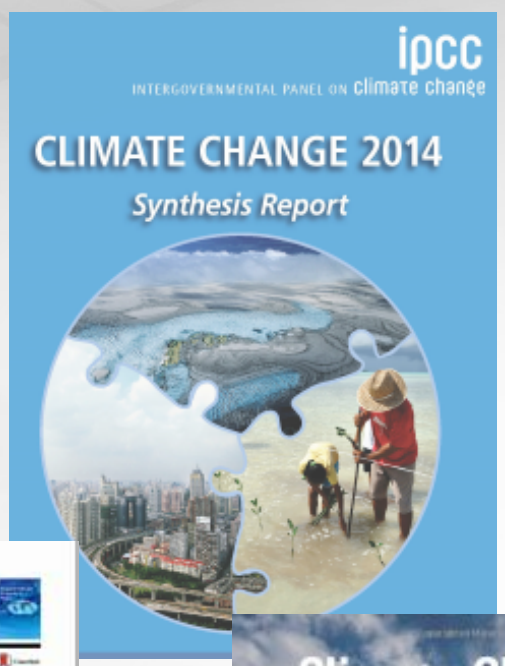

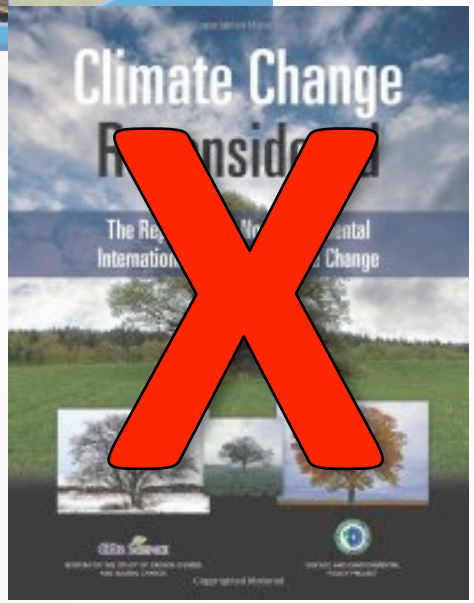

The Need for a New Approach

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- Climate change impacts are happening and many 'users' want information to plan
- The diversity of information needs cannot be met with a centralized, top-down process.

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Example Decisions from NCA3 Chapters

Water resources	• Planning reservoir capacity • Managing water levels in the Great Lakes • Improving drought preparedness
Energy	• Planning peak demand loads • Siting bioenergy plantations • Expanding conventional energy production
Transportation	• Engineering fixed-route infrastructure • Increasing resilience of airports vulnerable to storm surge • Managing flood risk to subway systems
Buildings and related infrastructure	• Setting standards and design loads for structural safety (e.g., snow loads for roofs) • Sizing drainage systems and culverts • Siting buildings and related infrastructure relative to flooding, wildfire, or other hazards
Agriculture	• Redesigning food processing and supply chains for improved water and energy use efficiency • Investing in agricultural technology development and diffusion (crop varieties, post-harvest storage) • Anticipating needs for food security early warning and disaster management
Environmental conservation	• Using coastal ecosystems sustainably to support tourism, conservation, and fisheries • Long term planning and budgeting to manage wildfires • Conservation planning to protect viable refuges with high potential to preserve biodiversity
Human health	• Establishing monitoring systems to track re-emergence of familiar disease threats or emergence of new ones • Determining what public health investments are needed to manage heat stress in indigent populations • Monitoring changes in phenology to reduce exposure of sensitive populations to increased allergens

Decision Categories, Assessments, and The Need for Additional Support Systems

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Support for three broad categories of decisions is needed

- Adaptive management: decisions for administering resources, infrastructure, or response mechanisms (given current infrastructure and policy)
- Planning infrastructure and natural resources (given current policy framework)
- Policy formulation of laws, regulations, taxes, or other public mandates (sets new policy framework)

- Providing this information is beyond the capacity of traditional assessments
- A broader range of scientifically grounded 'decision support systems' will be needed and are now rapidly emerging
- Assessments will support the process by (i) facilitating evaluation and (ii) providing a wider range of "inputs"

Decision Support – Connecting Science, Risk Perception, and Decisions

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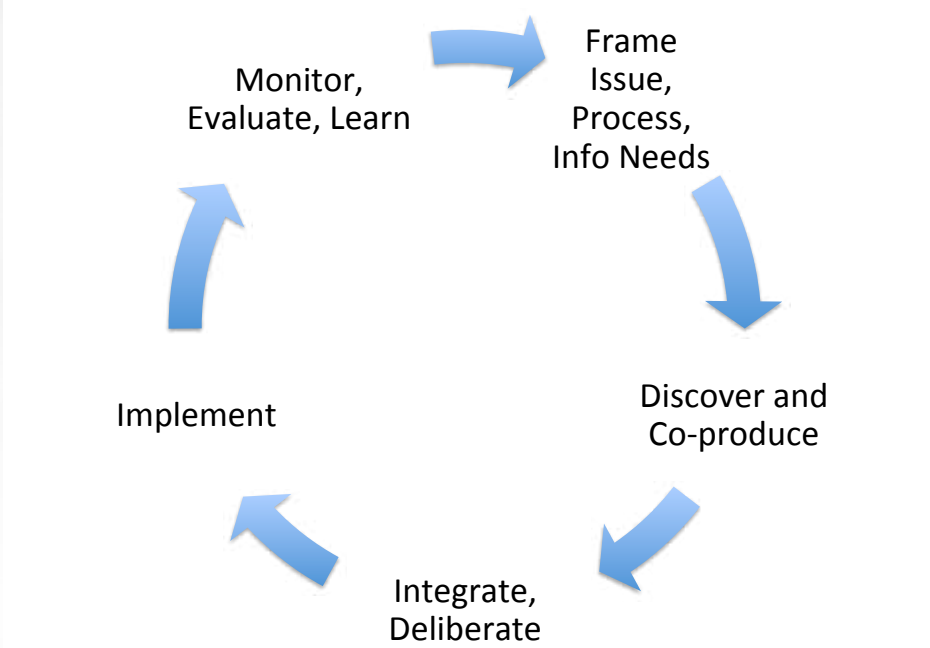
- Decision support: organized efforts to facilitate the use of knowledge to improve decision outcomes
- What DS systems do:
  - Structure decision making processes
  - Clarify information needs
  - Access and organize information
  - Integrate values and information to evaluate tradeoffs, and
  - Sustain communication



http://nca2014.globalchange.gov/report/response-strategies/decision-support

Decision Support is About Systems, Including People (Not Just Tools)

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Decision support PROCESSES include...
- Framework for decision-making
- Co-production of knowledge
- Assessments of impacts and vulnerabilities
- Boundary processes to link scientists and decision makers

Decision support TOOLS include...
- Scenarios and scenario planning
- Data management and visualization
- Comparative tradeoff methods
- Integrated assessment models
- Data management systems

Effective Decision-Making

Process Outcomes:
Strengthen relationships and build trust among participants

Decision Outcomes:
Consensus about problems, objectives, and options for action

Short-term outcomes include...
- More relevant information
- Insights
- Assessment of significance of uncertainties
- Clearer tradeoffs
- Stronger accountability

http://nca2014.globalchange.gov/report/response-strategies/decision-support

The Remainder of This Talk Will Cover…

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- Recap NCA3 and 'sustained assessment' vision
- Make a case for assessment of decision support systems and describe the potential role of the sustained NCA process

The Third National Climate Assessment

Goal

- Enhance the ability of the United States to anticipate, mitigate, and adapt to changes in the global environment.

Vision

- Advance an inclusive, broad-based, and sustained process for assessing and communicating scientific knowledge of the impacts, risks, and vulnerabilities associated with a changing global climate in support of decision-making across the United States.

NCA3 Included Many Innovations to Narrow the Usability Gap

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- Deliberate community building
- NCANet
- Focus on risk management and decision relevance/support
- Data management and web-based deployment: GCIS, other products on-line
- Spanish language version
- Transparency & Traceable Accounts
- Indicators
- Regional and SLR Scenarios
- Focusing on decision support resources assessment

"Sustained Assessment"

- "A sustained assessment is an evolving framework for connecting *scientists* and *practitioners* from government, civil society, the private sector, tribal communities, …"
- It decentralizes assessment by developing, distributing, and supporting use of a broader range of scientifically grounded and vetted products in decision making
- Facilitates adaptive management, stimulates civic engagement, and enhances the nation's capacity to respond effectively.
- Roles
  - Federal agencies provide basic and decision support science
  - Citizens, planners, managers, decision makers, …, engage and are actively involved in evaluating the suitability of information for application
  - Intermediaries (including the private sector) serve as 'science translators'
- Sustained assessment is **NOT** continuous production of big IPCC-like reports (although these will be produced periodically)

Why a *Sustained* Assessment?

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- Social science research has established that effectiveness depends on
  - *Ongoing communication* among users and experts to enhance relevance, understanding, and trust
- Key synthesis reports:
  - *Analysis of Global Change Assessments: Lessons Learned* (Board on Atmospheric Sciences and Climate)
  - *Informing Decisions in a Changing Climate* (Committee on the Human Dimensions of GEC)
  - *Advancing the Science of Climate Change* (America's Climate Choices Science Panel)
  - *Adapting to the Impacts of Climate Change (*America's Climate Choices Adaptation Panel)
  - *Informing an Effective Response to Climate Change* (America's Climate Choices, Informing Effective Responses Panel)

Preparing the Nation for Change: Building a Sustained National Climate Assessment Process

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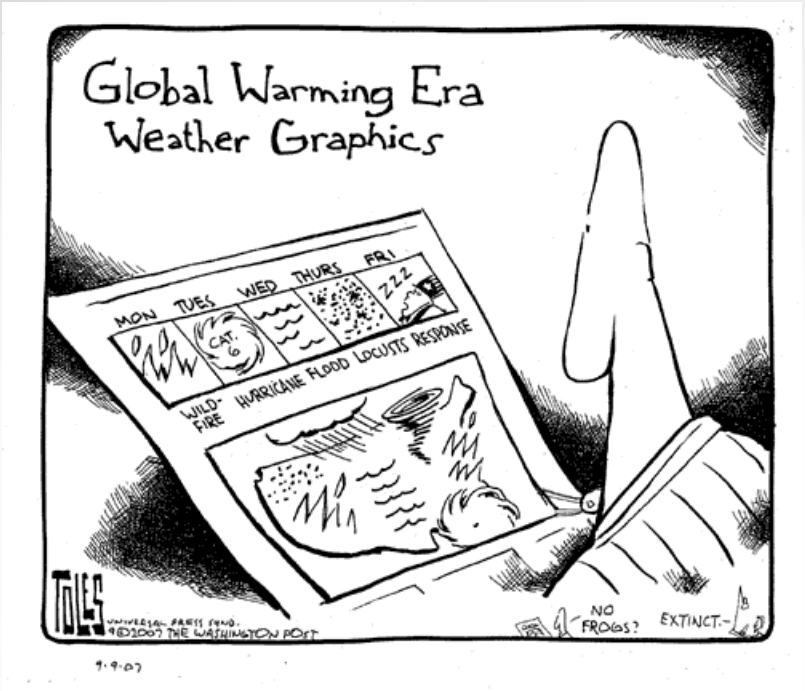
NCADAC Special report that outlines the critical elements of sustained assessment:

1. Establish mechanisms to support enduring collaborative partnerships that sustain assessment activities
2. Enhance and organize the scientific foundations for managing the risks and opportunities of climate change
3. Provide infrastructure to support a sustained assessment process
4. Diversify the resource base and set priorities

Souce: Buizer, James L., Paul Fleming, Sharon L. Hays, Kirstin Dow, Christopher B. Field, David Gustafson, Amy Luers, and Richard H. Moss, Report on Preparing the Nation for Change: Building a Sustained National Climate Assessment Process, National Climate Assessment and Development Advisory Committee, 2013. http://www.nesdis.noaa.gov/NCADAC/pdf/NCA-SASRWG%20Report.pdf

Scientific Advances Needed to Support Sustained Assessment

- *Vulnerability assessments
- Indicators
- *Scenario methods and products
- Valuation methods
- International influences
- *Confidence and uncertainty
- Adaptive learning



I turn now to something NOT highlighted in the report:

- Evaluation of research on DS systems as a component of sustained assessment

nature

www.nature.com/nature

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Validation required

Transparency and quality control are essential in the highly uncertain business of assessing the impact of climate change on a regional scale.

Climate scientists are engaged in a lively debate about how — or whether — the Intergovernmental Panel on Climate Change (IPCC) should reform itself (see *Nature* 463, 730–732; 2010). At a minimum, the panel needs to hold itself to the highest possible standards of quality control in future assessments.

But so do climate scientists themselves — especially those who study the links between global climate change and its potential regional effects on factors such as weather patterns, ecosystems and agriculture. Governments faced with the need to make difficult, disruptive and politically fraught decisions about when and how to respond to climate change are understandably eager for certainty. But certainty is what current-generation regional studies cannot yet provide. Researchers need to resist the pressures to overstate the robustness of their conclusions, and to be as open as possible about where the uncertainties lie.

As an example of the scientific challenges involved, imagine a regional authority wanting to plan for water resources in a river basin over the next four decades. An applicable study might be probabilistic in approach. It could take into account a range of global greenhouse-gas-emission trajectories, and involve multiple runs of global climate models using different values for a number of parameters. However, such models cannot reproduce some important atmospheric phenomena such as circulation trapping, and cannot be validated against real climate behaviour over decadal timescales. The multiple runs will produce a probability distribution of precipitation which itself will contain intrinsic uncertainties. These outcomes then need to be fed into a catchment model with its own range of parameters and limitations of knowledge, and which in turn needs to be coupled to models of water demand as local housing and populations change over the period (M. New *et al. Phil. Trans. R. Soc. A* 365, 2117–2131; 2007, and other papers in that issue).

Climate projections at the national level are crucial for such efforts. One such study was published last year, when the UK Met Office produced its climate projections of the next eight decades, including analysis down to a resolution of 25-kilometre squares (http://ukclimateprojections.defra.gov.uk). The British government is now conducting a national climate-change risk assessment, due for completion in early 2012, that uses the projections. But such an application could well be problematic: it is likely that the projections reflect the limitations of the models and analyses as much as probabilities intrinsic to the real world. Yet regional planners and others might easily miss the detailed discussions of uncertainties, and misguidedly seize on these projections as a solid basis for investment decisions. And depressingly for decision-makers, the more the uncertainties are explored, the greater the ranges in the projected possible outcomes are likely to become.

This combination of projections and risk analysis is one way in which an over-reliance by decision-makers on modelling may be setting up the scientific community for a loss of trust. What is more, like regional-impact studies, such analyses often appear not in peer-reviewed journals but in 'the grey literature' — in reports, or on websites. Yet they are no less important in representing the outputs of climate science, and need to be included in the IPCC assessment. For these reasons, such grey studies should be transparently peer reviewed as a part of their commission.

"Grey-literature studies should be transparently peer reviewed as a part of their commission."

Uncertainties about future climate effects do not undermine the case for action to reduce greenhouse-gas emissions. But there is a long way to go in the science before regional-impact studies provide a suitable basis for detailed planning. Whatever the pressures, statements by scientists and government agencies about such studies need to be well qualified, and policies based on them need to be kept as flexible as possible. It is intrinsic to this research, after all, that scientists' best judgements will be subject to change. ■

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The need for transparent evalation of uncertainty in information for regional decision support

Cities Impacts & Adaptation Tool (CIAT)

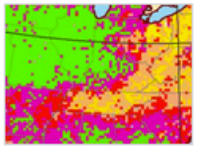
Decision makers use this tool to access a range of support and information for developing climate adaptation plans for cities in the Great Lakes Region.

Read more ›

Climate at a Glance

Generate graphs and maps of monthly temperature and precipitation values, ranks, and anomalies for the globe, contiguous U.S., states, climate divisions, and selected cities.

Read more ›



Climate Change Atlas for Tree and Bird Species

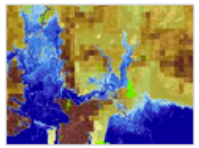
Find information about 134 tree species and 147 bird species in the eastern United States. Based on environmental characteristics that define the current ranges of species in the database, maps show where suitable (and unsuitable) habitat for these species are projected to be in the future.

Read more ›

Climate Commons

California land and resource managers can find information, maps, tools, and data to support climate-smart conservation in their regions. The California Landscape Conservation Cooperative offers resources for getting started and going deeper with adaptation plans.

Read more ›



Climate Explorer

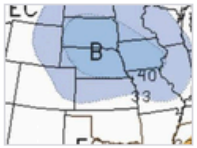
Display data-based maps of climate stressors and their impacts and compare historical records of daily temperature and precipitation observations to long-term climate normals at thousands of weather stations in the United States.

Read more ›

Climate Inspector

Use a map-based interface to explore projected changes in temperature or precipitation anyplace on the globe for four different emissions trajectories. View or download maps, trend data, or projected annual cycle data.

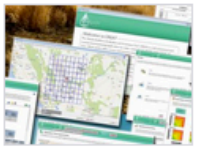
Read more ›



Climate Outlooks

Access outlook maps showing experts' judgments regarding changes for above-, below-, or near-average temperature and precipitation, as well as potential hazards and drought conditions, with timescales ranging from weeks to years.

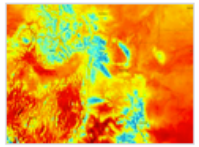
Read more ›



Climate Resilience Evaluation & Awareness Tool (CREAT)

Owners and operators of drinking water and wastewater utilities can use this downloadable tool to assess potential climate change threats and evaluate adaption options at their sites.

Read more ›



ClimateData.us

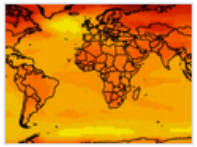
Zoom to any location in the contiguous United States and move a slider across the map to compare projected changes in temperature and precipitation. Compare conditions by decade under a mitigation scenario (reduced emissions) and a high-emissions scenario.

Read more ›

ClimateWizard

Retrieve maps of weather observations for the past 50 years or projections for temperature and precipitation in the future. Compare the projected impacts of different emissions scenarios for a single state, country, or across the entire globe.

Read more ›



CMIP5 Global Climate Change Viewer (GCCV)

Display past and future temperature and precipitation projections simulated by global climate models. Access maps for any country, model, or emissions scenario. Requires Flash.

Read more ›

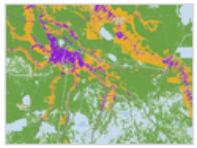
Coastal Change Analysis Program (C-CAP) Land Cover Atlas

Examine land cover classifications within coastal regions and how they changed from 1996 to 2010. Use this browser-based tool to generate maps and summary statistics that document changes such as loss of forests or expansion of impermeable surfaces.

Read more ›

Coastal Change Hazards Portal

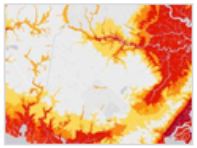
Policy makers, emergency managers, and citizens access information on hazards associated with severe storms, shoreline erosion, and sea level rise. This browser-based "mashup" provides access to historical data, publications, satellite imagery,



Coastal County Snapshots

Select a coastal county and explore summary snapshots describing its flood exposure, wetland benefits, or economic benefits from ocean jobs. Communities access these reports to benchmark current conditions and identify opportunities for building resilience.

Read more ›



Coastal Flood Exposure Mapper

Explore local maps to stimulate discussions about the people, places, and natural resources exposed to coastal flooding. Create a collection of maps showing risk from various hazards.

Read more ›

Coastal Inundation Mapping for Saco, Maine

Decision makers and residents can visualize the likely extent of inundation from water levels associated with storm-induced waves, storm surge, and sea level rise.

Read more ›

U.S. Climate Resilience Toolkit

Get Started | Taking Action | Tools | Topics | Expertise

Wide Range of DS Systems and Resources Available Through Multiple Platforms

- Loading dock ("Field of Dreams") approach
- Some systems adopt sounds principles for engagement, transparency, scientific analysis methods
- In others, basic principles for decision support or appropriate use of scientific information are ignored

NCA3 Decision Support Chapter

- Facilitated by NRC *Informing an Effective Response to Climate Change* (Liverman, et al., 2010)
- What the chapter did:
  - Began a process to explore the need and an approach for NCA dialogue on DS systems and frameworks
  - Described types of available tools around common quasi-cyclical adaptive management framework
- The chapter did not: evaluate specific tools (or classes of tools)
- Note: evolution in my thinking about importance of DS dialogue and evaluation in NCA process

Source: Moss, R., P. L. Scarlett, M. A. Kenney, H. Kunreuther, R. Lempert, J. Manning, B. K. Williams, J. W. Boyd, E. T. Cloyd, L. Kaatz, and L. Patton, 2014: Ch. 26: Decision Support: Connecting Science, Risk Perception, and Decisions. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 620-647. doi:10.7930/J0H12ZXG

http://nca2014.globalchange.gov/report/response-strategies/decision-support

Follow-up is Now Required…

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- Establish a strategy for a collective effort to promote DS tool development, assessment, and use
- Collect standardized information
- Assess example tools and frameworks in context of sectors or regions
- Establish dialogue across scientists, agencies, standards organizations, professional societies, and the private sector
- Support for fellowships, research grant competitions, etc. to develop human resources for intermediaries/translators

Four Potential Outcomes of Increased NCA Assessment of Decision Support Systems

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1. Change mindset of developers and users to include people as part of decision support systems
   - 'Facilitating use of knowledge' requires evaluating the perceptual and social dynamics through which people acquire information and evaluate it
2. Clarify information needs and sources
   - Help developers and researchers understand needs, and users to understand types of information for different problem sets
3. Improve understanding of relationship of uncertainty, risk, confidence, and values
   - Clarify difference between predictive uncertainty and values uncertainty related to aggregation of preferences and attitudes towards risk
4. Establish dialogue about monitoring, measuring, and evaluating decision support effectiveness
   - Advance practice of understanding 'what works' in context of sectors or regions where a decision support system is used

Research Roundtable Topics

TODAY OR DURING THE REST OF MY VISIT…

NCA3 Guidance

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Brief statement of conclusion, referenced to report or chapter:

1. Framing and stakeholder information needs

One or more types of stakeholder decisions (or uses of the information) have been considered in formulating the conclusion.

Yes | No

2. Initial evaluation of evidence

An evidence rating has been assigned, considering the type, amount, quality, and consistency of evidence. In light of the use of the information, the evidence is:

Strong | Moderate | Suggestive | Inconclusive

3. Preparation of conclusion

The conclusion reflects the diversity of evidence. For quantitative estimates of relevant parameters or metrics, a range is provided (in which there is a 90% chance the true value falls), and a "best estimate" is given, if warranted. High consequence outliers have been considered,

Fully | Partially

4. Identification of key uncertainties

Sources of uncertainty and steps for improving the information base have been identified.

Fully | Partially | Limited extent

5. Assessment of confidence based on evidence and agreement

In light of the potential uses of the information, a confidence level has been assigned.

V. High | High | Medium | Low

6. Indication of how likely it is that an outcome or event will occur

If you indicate how likely an event is to occur, the standardized numerical ranges and likelihood words have been used.

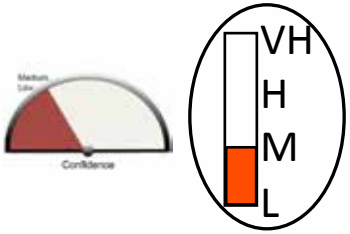
>9 in 10 Very Likely	>2 in 3 Likely	~1 in 2 Likely as Not	<1 in 3 Unlikely	<1 in 10 Very Unlikely

7. Traceable account:

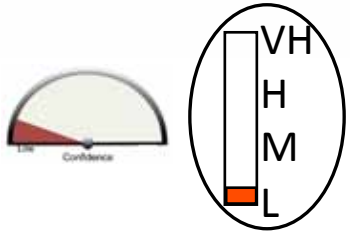
- Very high confidence

- High confidence

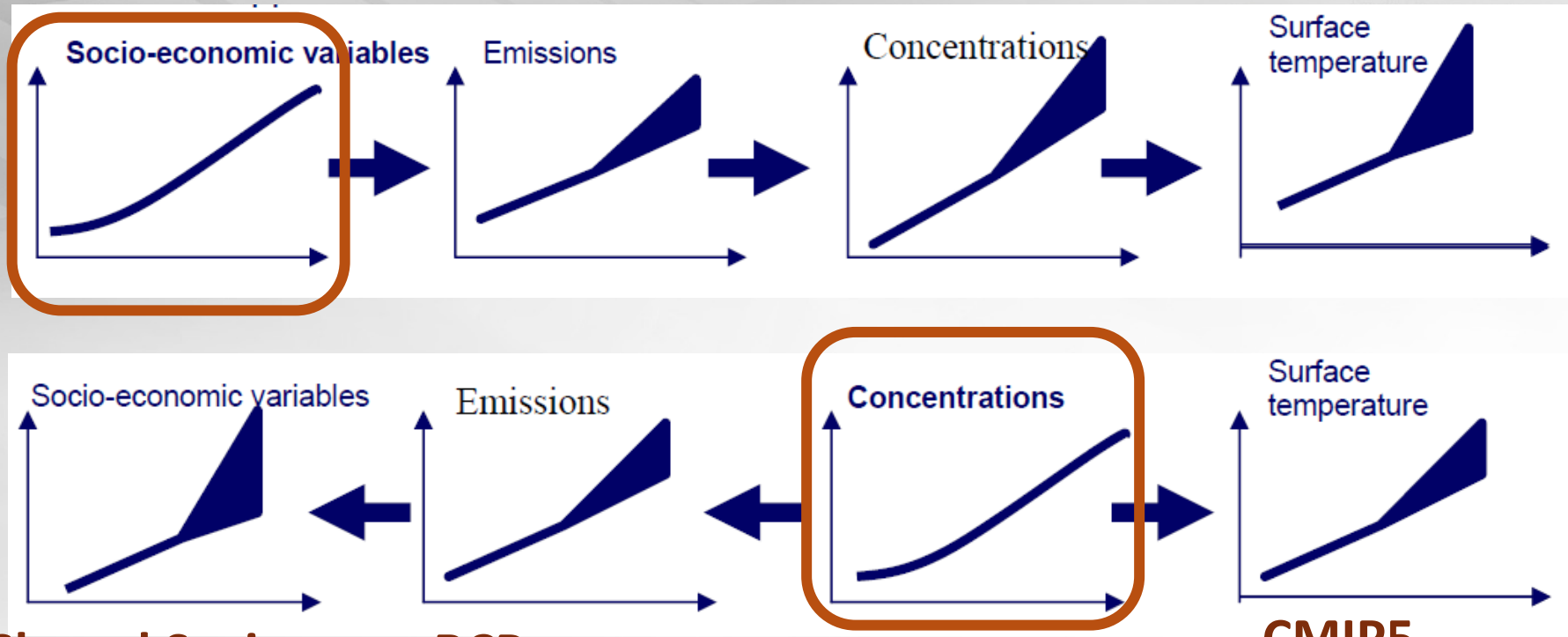
- Medium confidence



- Low confidence



Parallel Scenario Process



Shared Socio-economic Pathways (SSPs), Shared Policy Assumptions (SPAs) (in process)

RCPs (Complete)

CMIP5 (Complete)

Meehl et al. 2007, WCRP Report.

Moss et al., 2010.

Vulnerability Assessments and Climate Change: Some examples and thoughts

- Vulnerability: the degree to which infrastructure, a system, a place, or a population group is unable to cope with the effects of climate variability, extremes, or change. A function of:
  - Exposure
  - Sensitivity
  - Adaptive capacity
- Vulnerability assessment prioritizes the need for more detailed engineering analysis of adaptation
- Collecting data on these characteristics and making it relevant for decision making can be a challenge

In Closing

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- There is a clear vision for evolving the National Climate Assessment beyond production of reports to more varied ‘modes of co-production’ to support use of knowledge in climate risk management
- NCA3 initiated many important innovations
- Using the sustained NCA to facilitate development and application of decision support systems is more important than recognized for successful climate risk management

Thank you!

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