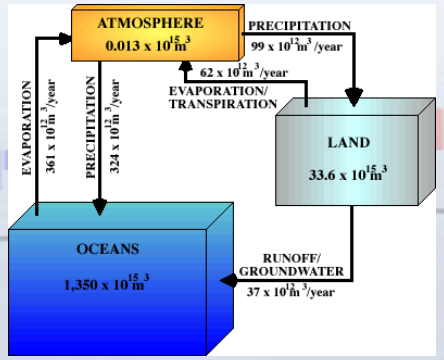
Meeting climate and societal challenges: From intelligence to security

Roger S. Pulwarty[1]

Senior Advisor for Climate, and
Director, National Integrated Drought Information System
NOAA

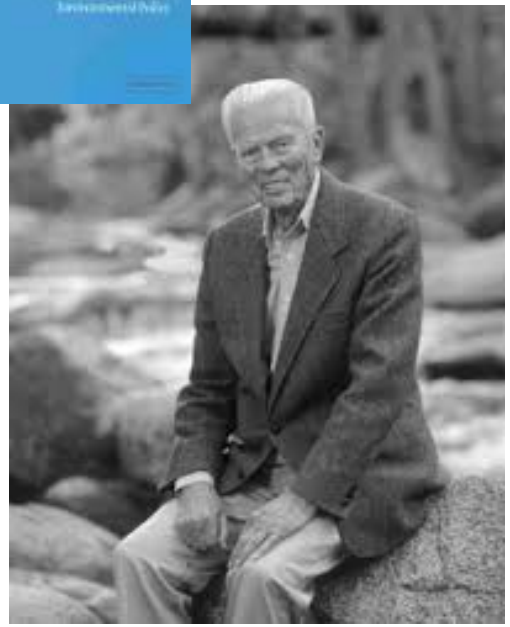


'Whole world' at risk from simultaneous droughts, famines, epidemics: scientists

Research published by US National Academy of Sciences warns climate change impacts could be worse than thought

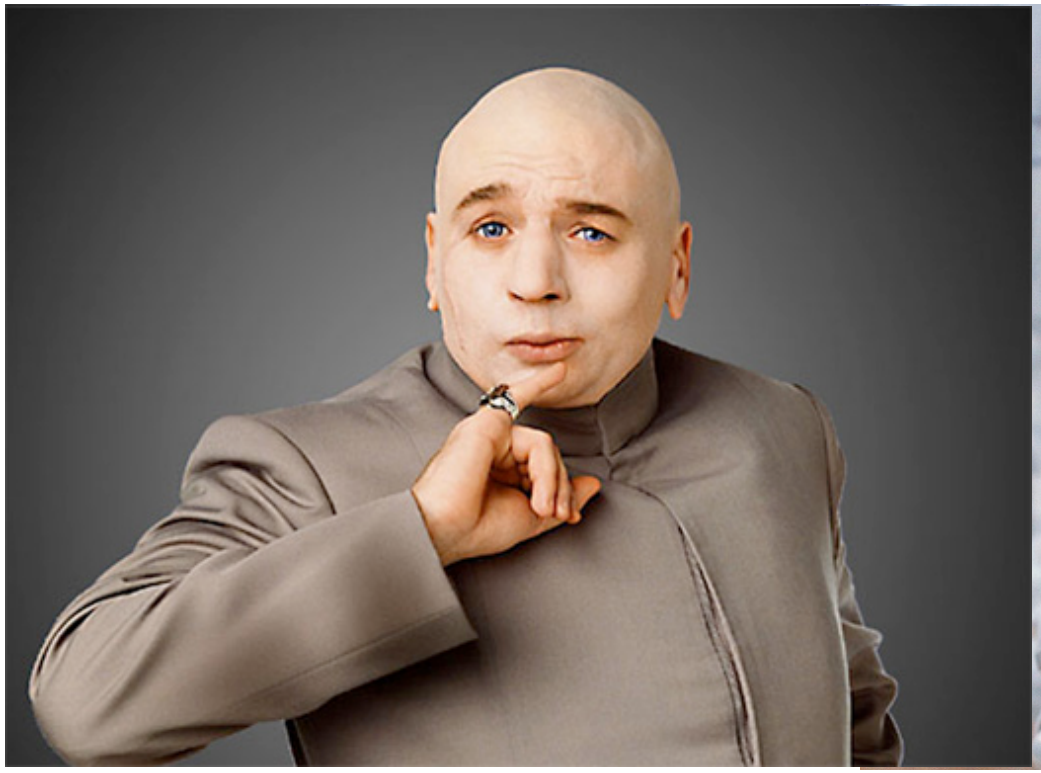

HERBERT RIEHL
Intrepid and Enigmatic S
BY JOHN M. LEWIS, MATTHEW G. FEARON, AN
EJO
THE NEBR
CHANCELLOR'S DIS

Why do we see the clouds that we do, at this time of day?, along this terrain?



Are you doing anything useful?


HERBERT RIEHL
Intrepid and Enigmatic Sc
BY JOHN M. LEWIS, MATTHEW G. FEARON, AND
Cloud Str
over
JOANNE
Caribbean Islands
Weathering Uncertainty
Traditional knowledge for climate change assessment and adaptation
Diaz - Pulwarty (Eds.)
HURRICANES
Hurricanes of the North Atlantic Ocean have left their imprint on the landscape and human cultures for thousands of years. In modern times, fewer lives have been lost due, in part, to the development of modern communication systems, and to improved understanding of the mechanisms of storm formation and movement. However, the immense growth of human populations in coastal areas at risk to hurricanes, has resulted in large increases in the amount of property damage sustained over the last decade in the Atlantic, Gulf of Mexico and Caribbean regions. This book is of interest to climatologists and meteorologists and a source of information for policymakers and emergency management planners.
The Political Ecology of Vulnerability to Hurricane-Related Hazards
Roger S. Pulwarty, William E. Riebsame
GAR
ISDR
2011
UNDER THE WEATHER
Climate, Ecosystems, and Infectious Disease
NATIONAL RESEARCH COUNCIL
Weather and Climate Extremes in a Changing Climate
Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands
U.S. Climate Change Science Program
Synthesis and Assessment Product 3.3
June 2008
Global Climate Change Impacts in the United States
U.S. Global Change Research Program
CLIMATE CHANGE AND WATER
IPCC Technical Paper VI
WMO
Intergovernmental Panel on Climate Change
UNEP
CLIMATE CHANGE 2007
IMPACTS, ADAPTATION AND VULNERABILITY
Working Group II Contribution to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change
Summary for Policymakers and Technical Summary
MANAGING THE RISKS OF EXTREME EVENTS AND DISASTERS TO ADVANCE CLIMATE CHANGE ADAPTATION
SPECIAL REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
ipcc
DELIVERING TRANSFORMATIONAL CHANGE 2011-21
FULL REPORT
Implementing the CARICOM 'Regional Framework for Achieving Development Resilient to Climate Change'
March 2012
CLIMATE CHANGE 2014
Impacts, Adaptation, and Vulnerability
Volume II: Regional Aspects
WG II
WORKING GROUP II CONTRIBUTION TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



Dr. Richard Evil and Darth Meehl

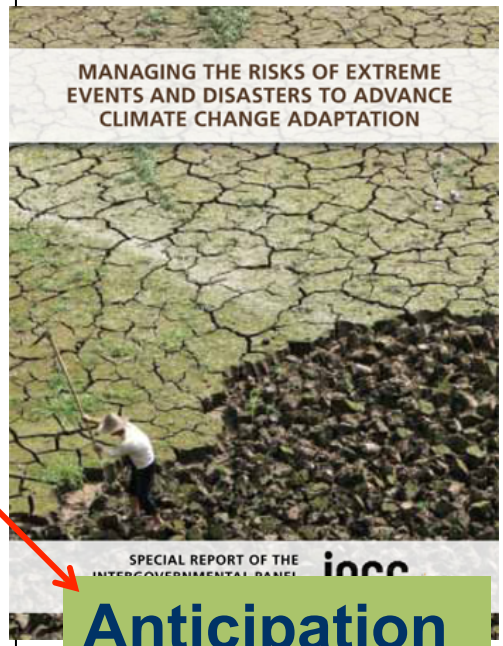
(Tor)-mentors

“Harry” Katzenberger

'No or low regrets' practices with demonstrated evidence of having integrated observed trends in disaster risks to reduce the effects of disasters	Practices that enhance resilience to projected changes in disaster risk
• Effective early warning systems and emergency preparedness (*very high confidence*) • Integrated water resource management (*high confidence*) • Rehabilitation of degraded coastal and terrestrial ecosystems (*high confidence*) • Robust building codes and standards reflecting knowledge of current disaster risks (*high confidence*) • Ecosystem-based/nature-based investments, including ecosystem conservation measures (*high confid* • Micro-insurance, including weath indexed insurance (*medium confi* • Vulnerability-reducing measures s pro-poor economic and human development, through for exampl improved social services and prot employment, wealth creation (*ver confidence*)	ance ces • Integrated coastal zone management integrating projections of sea level risk and weather/climate extremes (*medium confidence*) • National water policy frameworks and water supply infrastructures, incorporating future climate extremes and demand projections (*medium high*

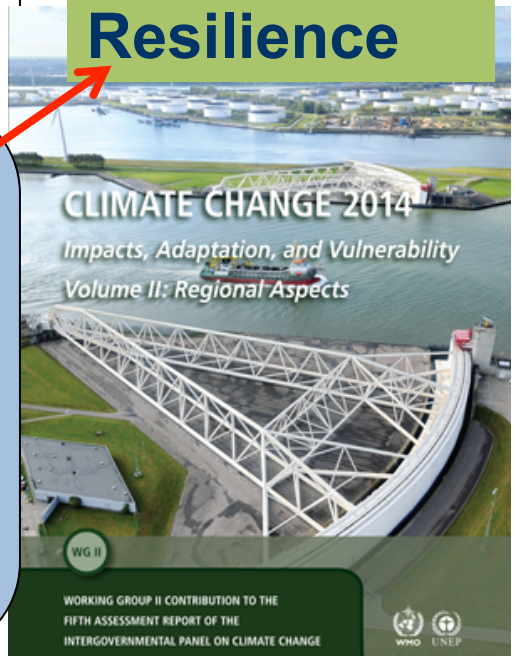
Effective early warning systems and emergency preparedness

Vulnerability reducing measures such as pro-poor economic and human development, through improved social services and protection



Anticipation

Resilience

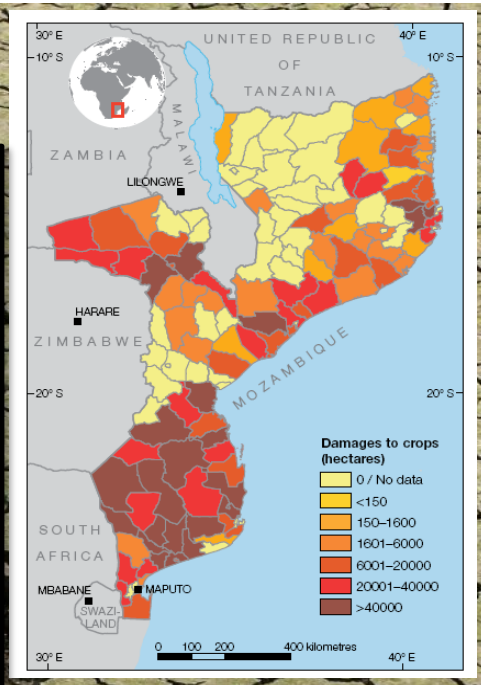


hidden risks

Most estimates of disaster losses exclude indirect losses – livelihoods, informal economies, intangible losses including ecosystem services, quality of life and cultural impacts

In some areas drying due to climate change will be overlain on the periodic droughts those areas have always experienced

Limited evaluation/appraisals of implementation

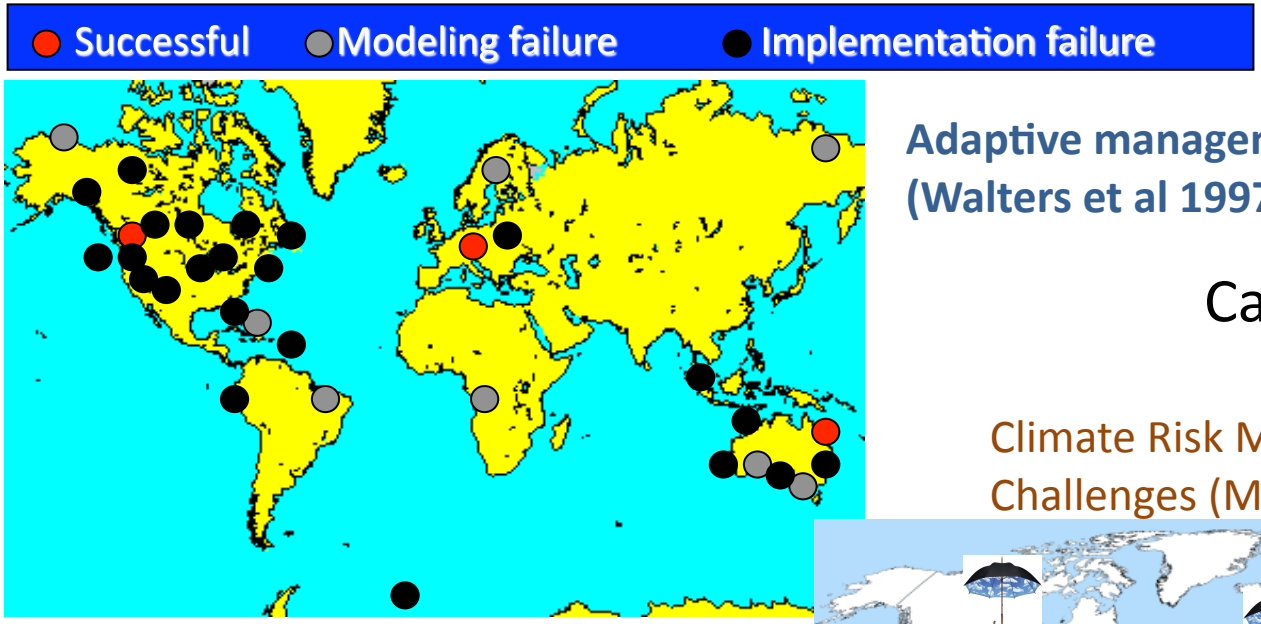


Short-term actions do not always provide long term risk reduction- can reduce or increase longer-term risks

For exposed and vulnerable communities, even non-extreme weather and climate events can have extreme impact

UNISDR

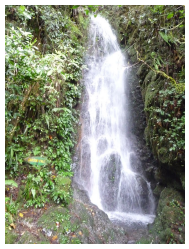
ipcc INTERGOVERNMENTAL PANEL ON climate change

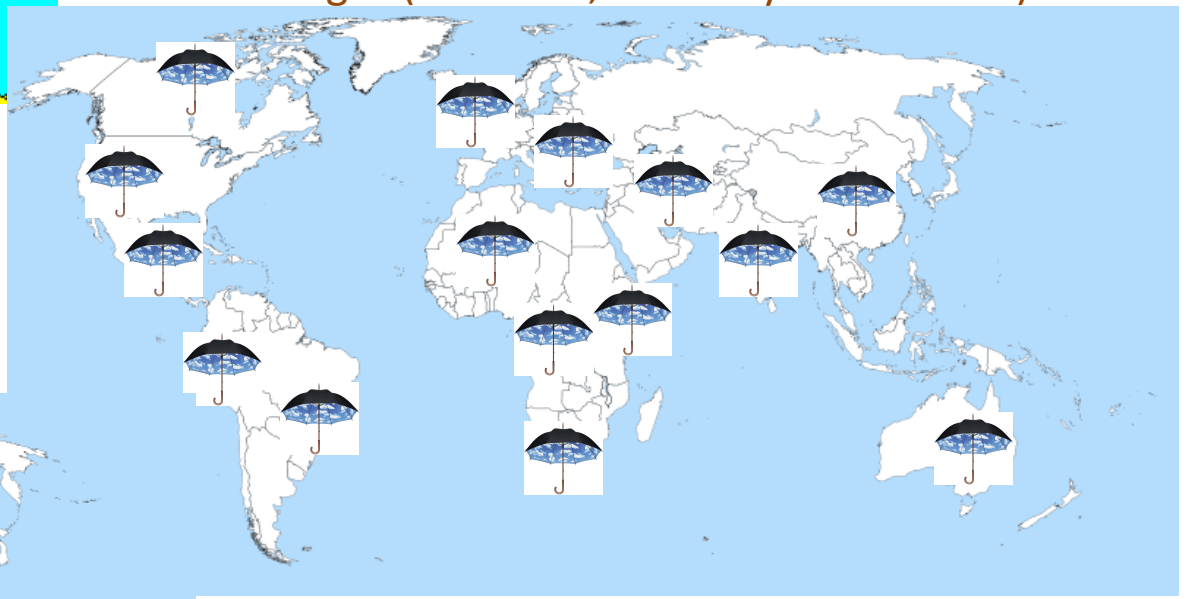


Adaptive management (Walters et al 1997; 2001)

Cases and Contexts

Climate Risk Management - Current Issues and Challenges (Martinez, Pulwarty… et al 2012)





Drought Early Warning Information Systems: Cases (Pulwarty and Sivakumar, 2014)

Adaptation: Crisis, learning and redesign

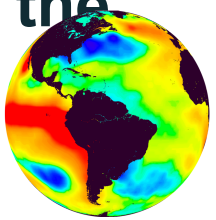
What has led to being "proactive"?

1. Focusing events and windows of opportunity- extremes, legal decisions etc.

3. Leadership at different levels and the public are engaged

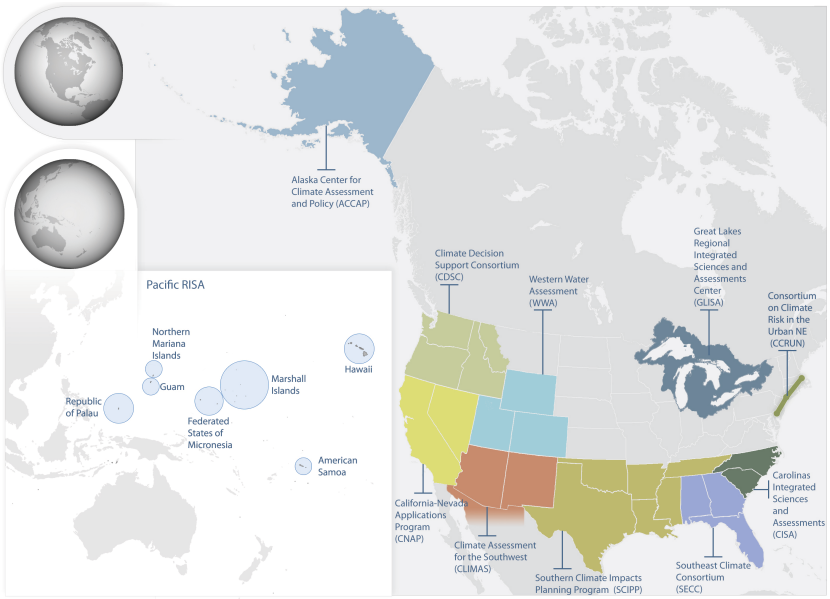
5. Supported framework for collaboration between research and management-

6. Existing social basis or even pressure for securing the common good: equity, procedure/participation, growth, environment

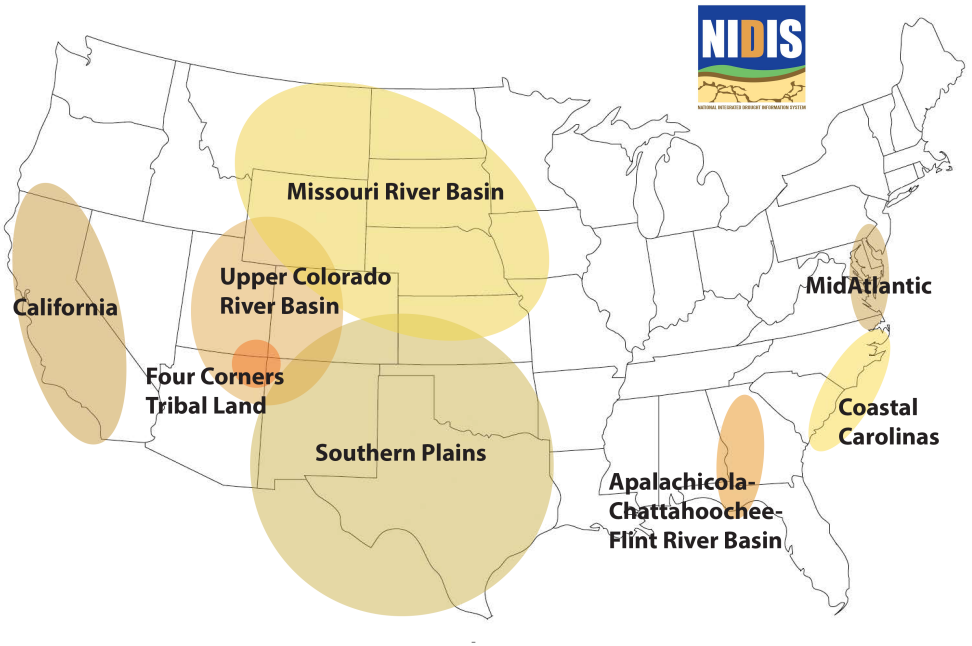


mad rush to the “Trans-ition Express”

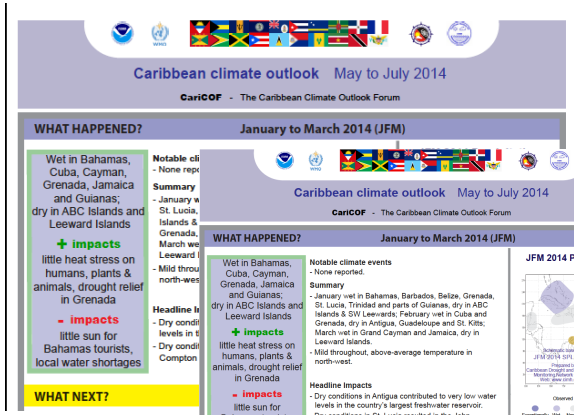
Demand for Climate Knowledge and Information is Increasing

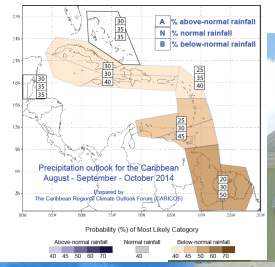


Regional Integrated Sciences and Assessments (RISA)



National Integrated Drought Information System





Caribbean Community Climate Centre

Improving the Flow of Climate Information in the West

California Nevada Applications Program, Western Regional Climate Center and Southwest Climate Science Center

Nina S. Oakley, Kelly T. Redmond, Tamara U. Wall, Timothy J. Brown
Western Regional Climate Center, Desert Research Institute, Reno NV • California Nevada Applications Program

NOAA Regional Climate Centers (RCCs)
- Operational delivery of climate services, information
- Climate monitoring and analysis
- Clientele: All sectors of society

DOI Climate Science Centers (CSCs)
- Seek answers to questions from DOI agencies
- Natural resource management emphasis
- Interact with Landscape Conservation Cooperatives

NOAA Regional Integrated Science Assessments (RISAs)
- Obtain better understanding of decision context
- Employ a "learning by doing" experimental approach
- Utilize university-based social and physical climate science

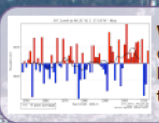
Western Regional Climate Center (WRCC)

Southwest Climate Science Center
CA, NV, UT, AZ focus + CO, NM

CNAP
CA and NV focus

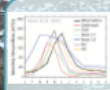
Climate-related decision support for stakeholders in the West

"How has the timing of snow melt changed over time at this location?"

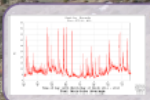


WRCC provides data on freezing level change through time

SW-CSC analyzes effect of snow melt changes on conifer forests



CNAP analyses snow melt timing effect on summer stream flow

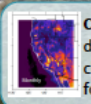


WRCC examines trends in fuel moisture and energy release component

CNAP studies how the fire community forms a consensus strategy on climate adaptation

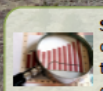
"Is this vegetation changing due to climate?"

SW-CSC researches which species are most suitable for restoration in this area



CNAP produces downscaled climate projections for the area

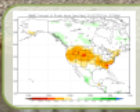
WRCC assesses changes in drought frequency in the area



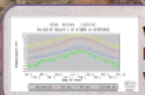
SW-CSC interprets data, modeling studies to inform policies and decisions of DOI agencies

"We need to retain sage grouse habitat. What will the fire regime be 20 years from now?"

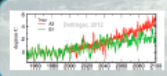
"What will water temperature and quality be like this summer?"



SW-CSC explores how agencies can make use of operational forecasts over the next four months



WRCC examines the historical likelihood of an extreme heat wave in the area



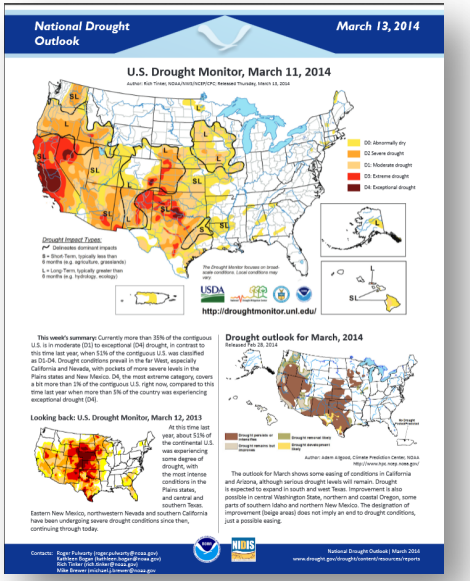
CNAP uses models to assess if early snow melt will result in higher August temperatures

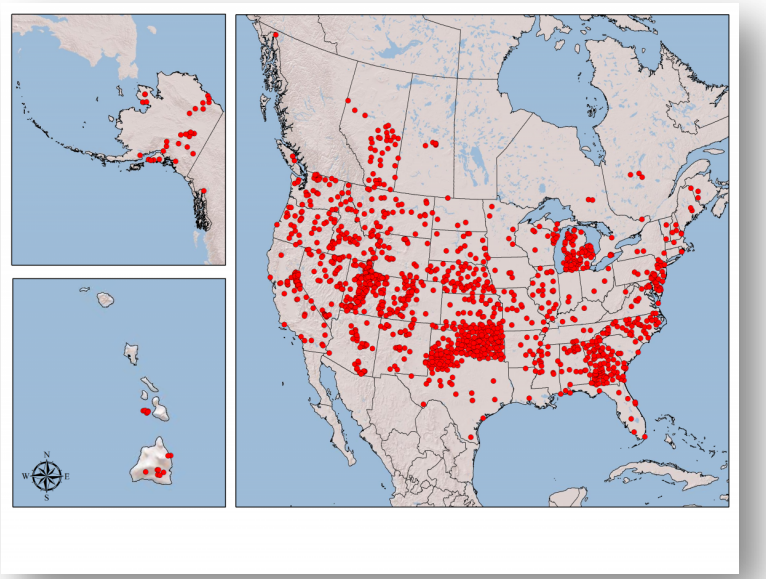
Contact: Nina Oakley nina.oakley@dri.edu • (775) 673-7932
Acknowledgements: NOAA RCC and RISA Programs, Department of the Interior

Informing Decisions

National Drought Outlook March 2014

"…making sure science is on the table when decisions are made…" (J. Lubchenco)

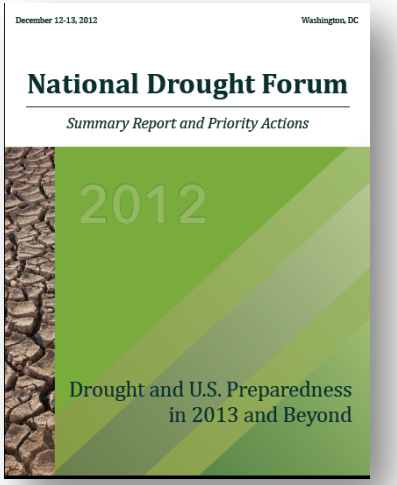




Build on the work of others to create a Coordinated Nation[al] Soil Moisture Network

WESTERN GOVERNORS' ASSOCIATION

Memorandum of Understanding
Western Governors' Association and NOAA
Collaboration on Drought, Flooding, and Wildfire Preparedness: Building Resilience in Planning for Extreme Events
June 2011, 2014



Congressional hearings

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

HEARING CHARTER

Drought Forecasting, Monitoring, and Decisio[n]
Integrated Drought Infor[mation]

Wednesday, July 25th
10:00 a.m. to 12:00
2318 Rayburn House Offi[ce]

PURPOSE

On Wednesday, July 25th, 2012, the Committee on Scie[nce] legislative hearing to examine the state of drought forec[asting] and the role the National Integrated Drought Informatio[n] planning. Additionally, the Committee will receive testi[mony] National Integrated Drought Information System Reauth[orization] been asked to provide comments on, and suggestions to

United States Senate Committee on
AGRICULTURE
NUTRITION
& FORESTRY

ng Statement of Chairwoman Debbie Stabenow (D-Mich)

nd Freeze: The Economics of Disasters for America's Agricultural Producers

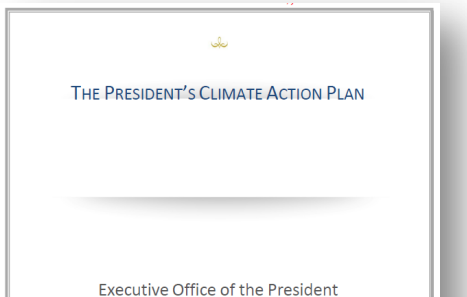
February 14, 2013

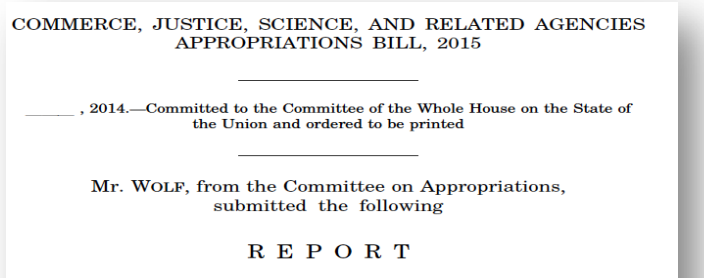
NIDIS was reauthorized by Congress in 2014

"Today, I signed the National Integrated Drought Information System Reauthorization Act into law…. ***to help communities better prepare for droughts in the long term, and prevent the worst impacts on families and businesses"*** ***March 6, 2014. President Obama***

Appropriations bill passed both the House and Senate subcommittees

", the recommendation includes support for the National Integrated Drought Information System (NIDIS) to support competitive research grants, maintain existing NIDIS activities and develop and expand the Regional Drought Early Warning Information System" ***May, 2014***
http://appropriations.house.gov/uploadedfiles/hrpt-113-hr-fy2015-cjs.pdf

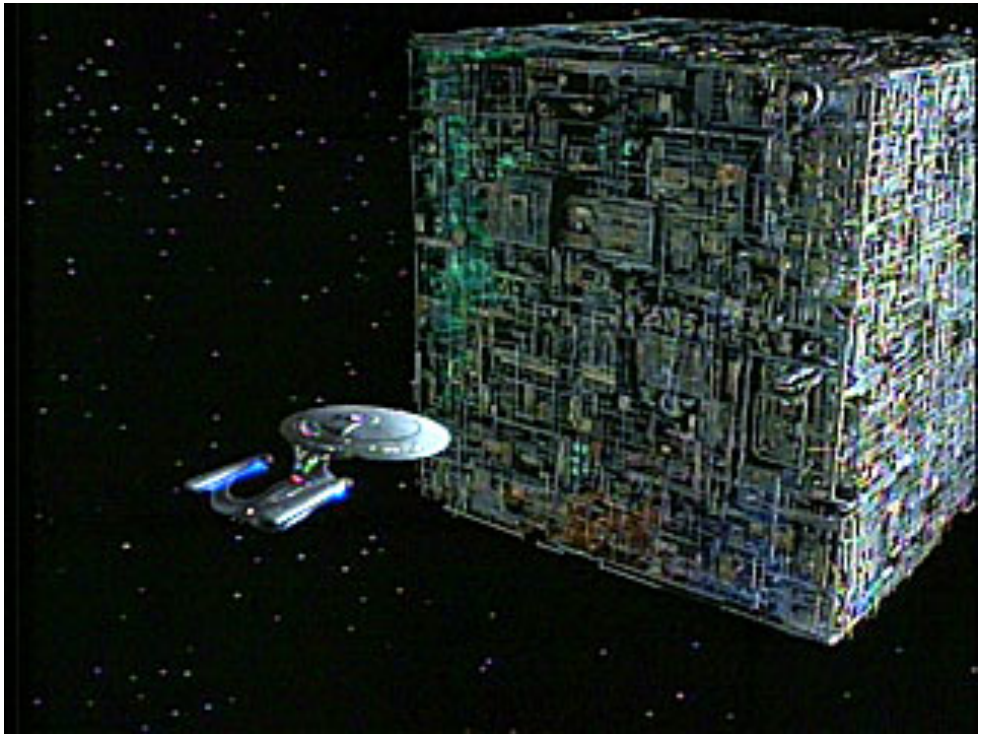




If it’s so easy why is it so hard? (I)

Dreadnaught-class Starship

Meet “The Borg”



Strong risk of underestimating the complexity of adaptation

- Increasing recognition of adaptation buffers arising from ecosystems, but very little commensurate action to support this awareness

- Lack of coordination on implementation across the scales of governance with unclear division of tasks and responsibilities of actors, especially under conflicting timescales of interventions, and response

When was the Summer of Love, Watergate?-”the climate, it is a-changin’

The year is 2014

We are closer to 450 ppm and 9 000 000 000 000 people than to either of these

Crafting Adaptation: considerations

The cumulative nature of hazards, extremes and disasters-risk profiles

- Systems may change faster than the models can be recalibrated-Projections may be most unreliable in precisely the situations where they are most desired

Proactive decision-making: Learning and policy windows

- **"Co-production"- valuable concept but can be an incentive for mis-placed advocacy and co-optation**
- **"Information use" as symbolic commitment to rational choice**
- **Win-win not always easy to implement in practice**

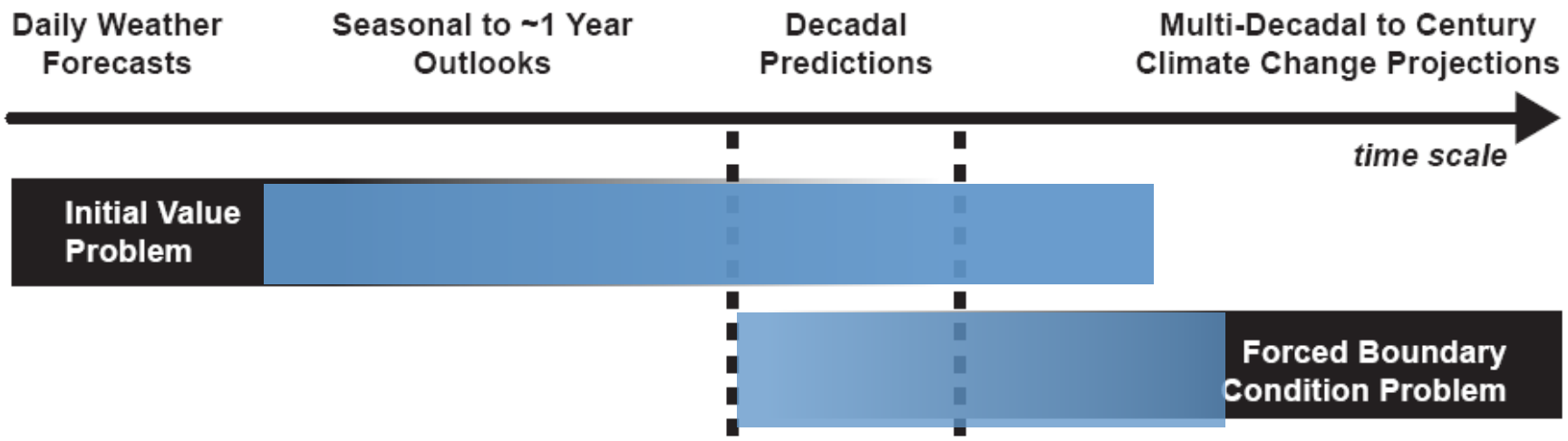
Information services to support adaptation in changing environments

- Joint fact-finding, development and diffusion of technology and information
- Where do science and policy talk to each other-what do they say? Clarify benefits of participation in design, implementation and maintenance

1. Acknowledge the cross-scale nature of climate, of early warning information-and corresponding monitoring and research needs

Decadal prediction lies between initialized weather or ENSO forecasts, and future climate change projections-not just "extremes" or "trends"

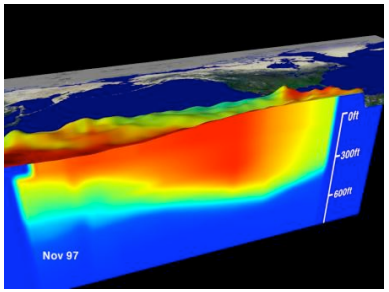
•Approach climate model output far more critically than at present, especially for impact assessment and scenario development



Pathways to Predictability

SST anomalies → Global-Scale Atmospheric Changes → Regional Forcing and land feedbacks → Local Impacts, user needs

Key Phenomena, variables



Modeling Issues

Improvements in global coupled models, estimates of ocean variability and predictability, GHGs

Reduce uncertainties in atmos. response to SST, water cycle, atmos. variability and predictability

Reduce uncertainties in modeling land/ atmosphere interactions, predictability of weather “regimes”, regional climate phenomena

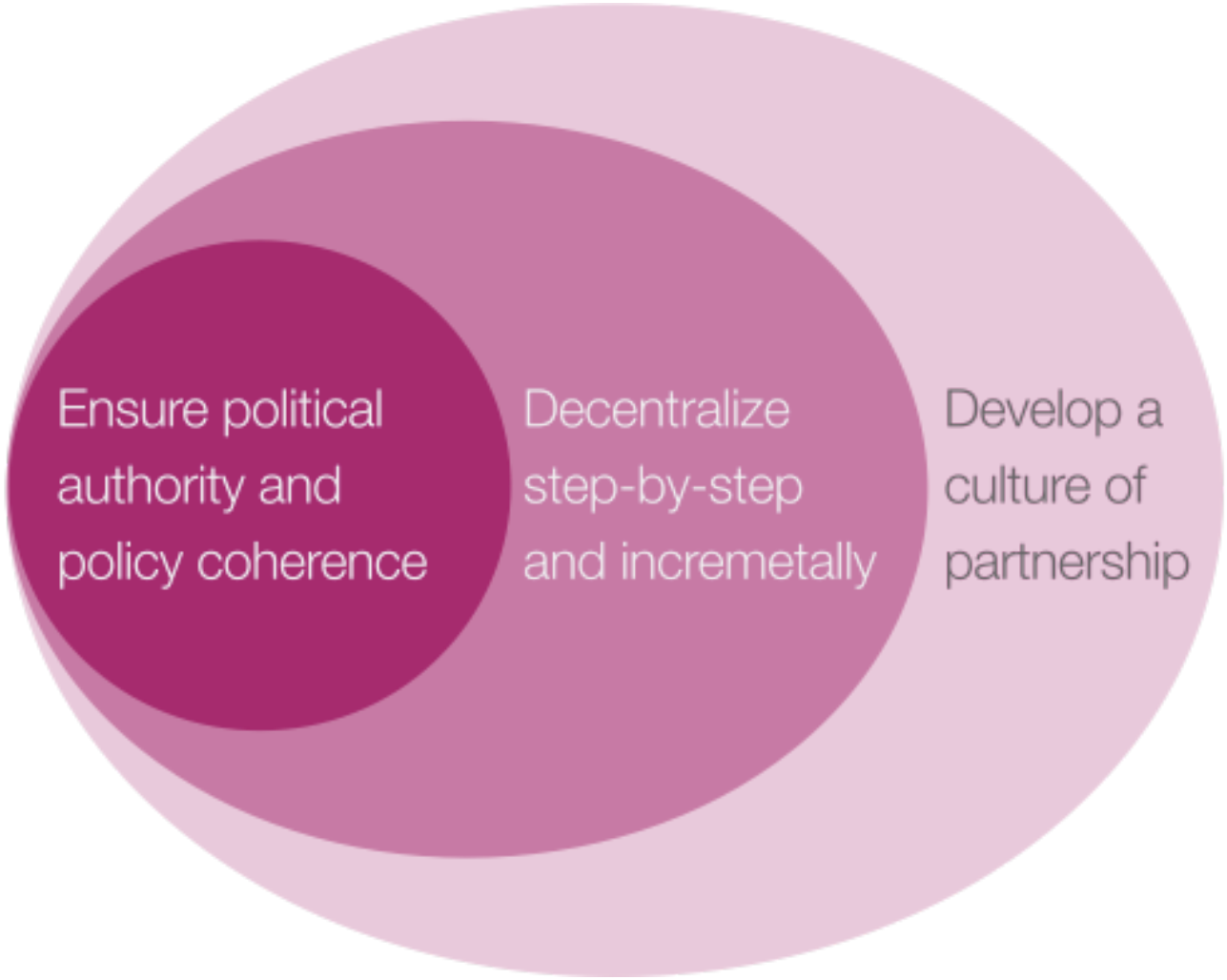
Improved modeling of “downstream” impacts on land hydrology, higher resolution

2. Recognize "communication" as critical but not sufficient

Broad societal processes that create dynamic pressures and unsafe conditions are not easy to change, yet are fundamental to human vulnerability

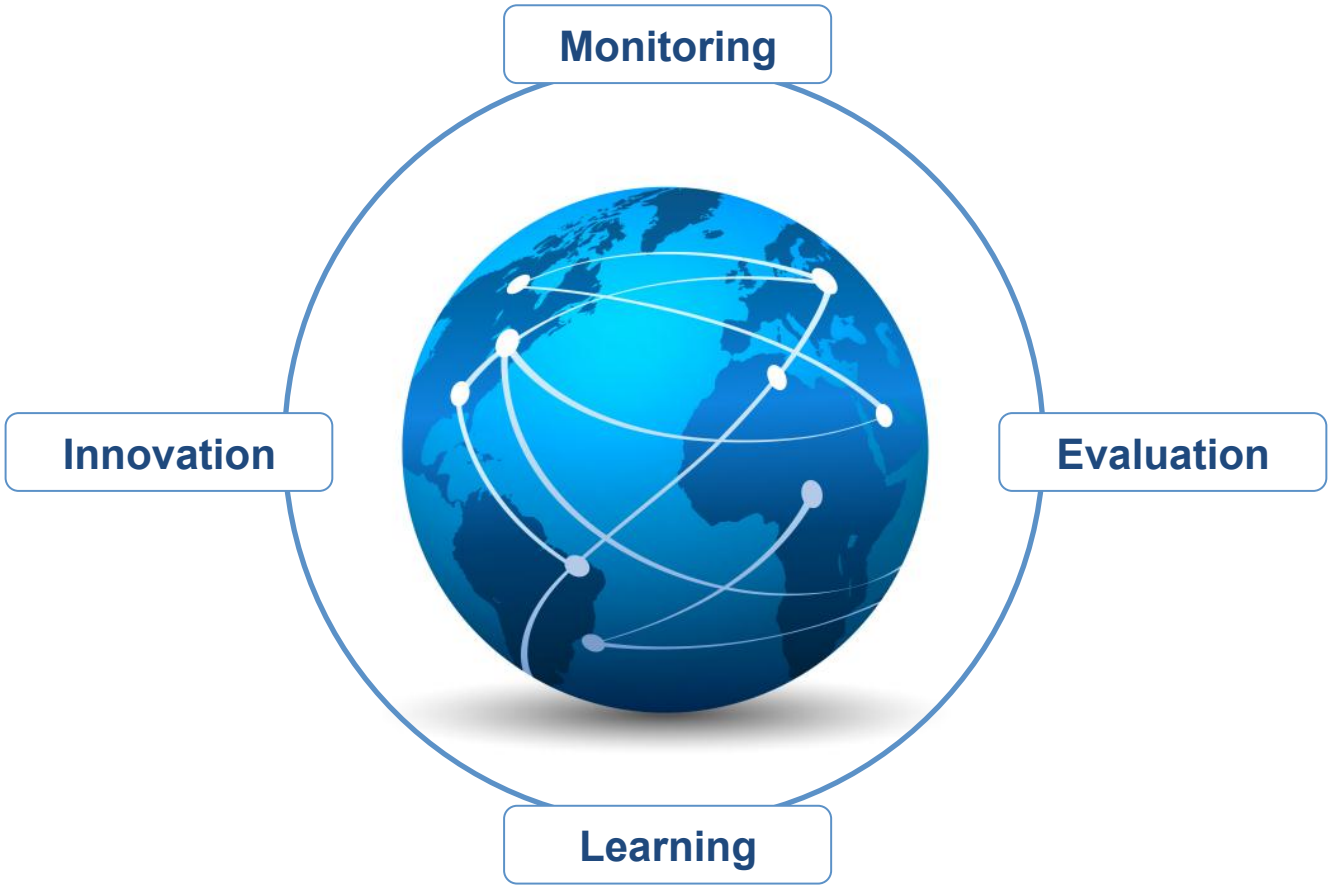
- Social process(es) of risk communication are more than "one-way" AND more than "two-way"
- The "push" supply of new information by would-be providers of information/technology , and the "pull" demand for new information from would-be learners is never linear
- More challenging is an understanding the socialization of lessons learned by particular individuals and organizations through their own, direct trial and error experiences

3. Reframing risk governance



Frame the goals and objectives of international and country and local-level program intervention strategy in terms of "securities" – water, food, energy, national

How does learning take place?



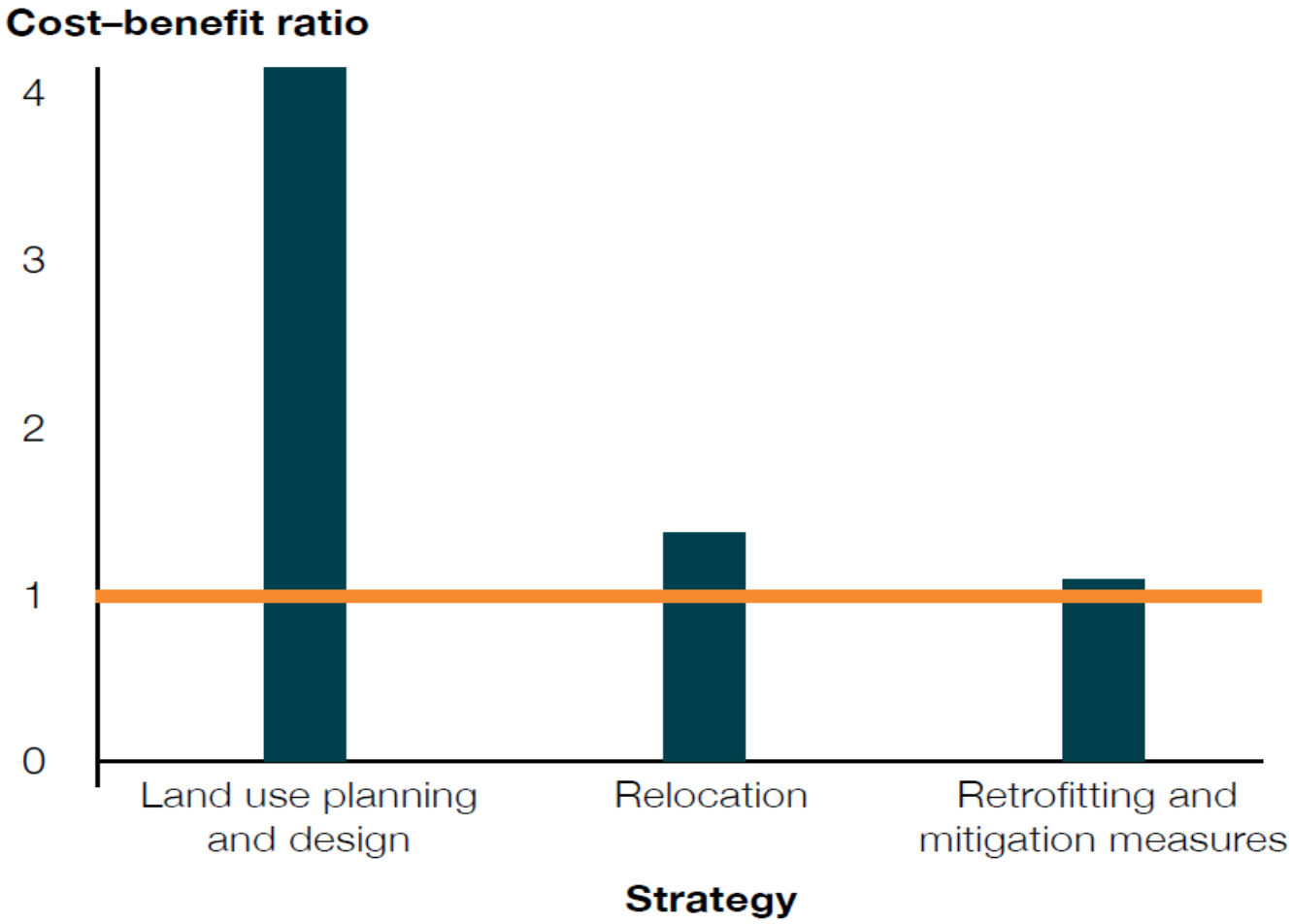
How often should criteria for "robustness" be (re)considered?

Recognize when our assumptions are failing

If it is so easy why is it so hard ? (II)

The need to “change” in the light of new information is not widely acknowledged

Use public investment planning



NOAA's Climate Goals: Societal Challenges

Monitoring, Prediction and Risk assessment
Decision support for risk management and adaptation
Cross-cuts- Health, Water-Energy nexus, others…

Coasts and Climate

Weather-Climate Extremes

Water Resources (Drought)

Marine Ecosystems

Weather-climate continuum and adaptation deficits

So what is needed?

Jolene Tallsalt Robertson
Hydrologist, Navajo Nation
Department of Water Resources

Dr. Margaret Hiza
US Geological Survey

Rachael Novak
US Environmental
Protection Agency

Casey Kahn-Thornbrugh
instructor of Geography
Tohono O'odham Community College
&
PhD Candidate, UA School of Geography & Regional Development

Capacity and coordination: sustaining networks of local policy entrepreneurs

- **Make risks and benefits transparent**
- **Conduct post-audits**
- **Do this for a long time**

This usually ticks-off "institutional" folks

Let's Not Wait Too Long!

photo courtesy K. Dixon, NOAA GFDL

Strong impacts of underestimating the complexity of adaptation and of claims of sustainability

Climate Change 2014: Impacts, Adaptation, and Vulnerability

SUMMARY FOR POLICYMAKERS

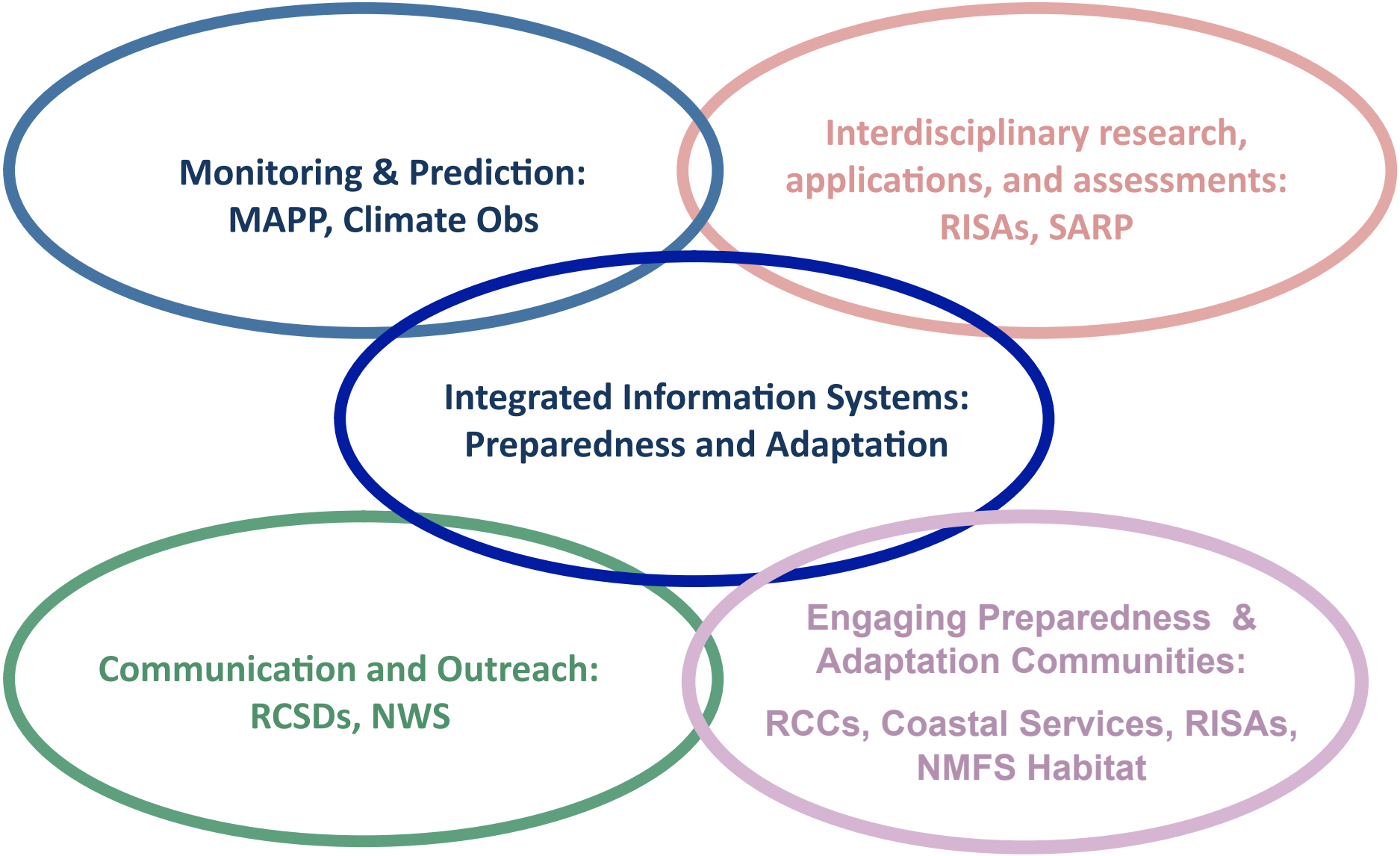
C-1. Principles of Effective Adaptation

A first step towards adaptation to future climate change is reducing vulnerability and exposure to present climate variability (high confidence). Strategies include actions with co-benefits for other objectives. Poor planning, overemphasizing short-term outcomes results in maladaptation

Adaptation planning and implementation at all levels of governance are contingent on societal values, objectives, and risk perceptions (high confidence). **Recognition of diverse interests, circumstances, social-cultural contexts, and expectations can benefit decision-making processes.**

Indigenous, local, and traditional knowledge systems and practices…….are a major resource for adapting to climate change, but these have not been used consistently in existing adaptation efforts. Integrating such forms of knowledge with existing practices increases the effectiveness of adaptation.

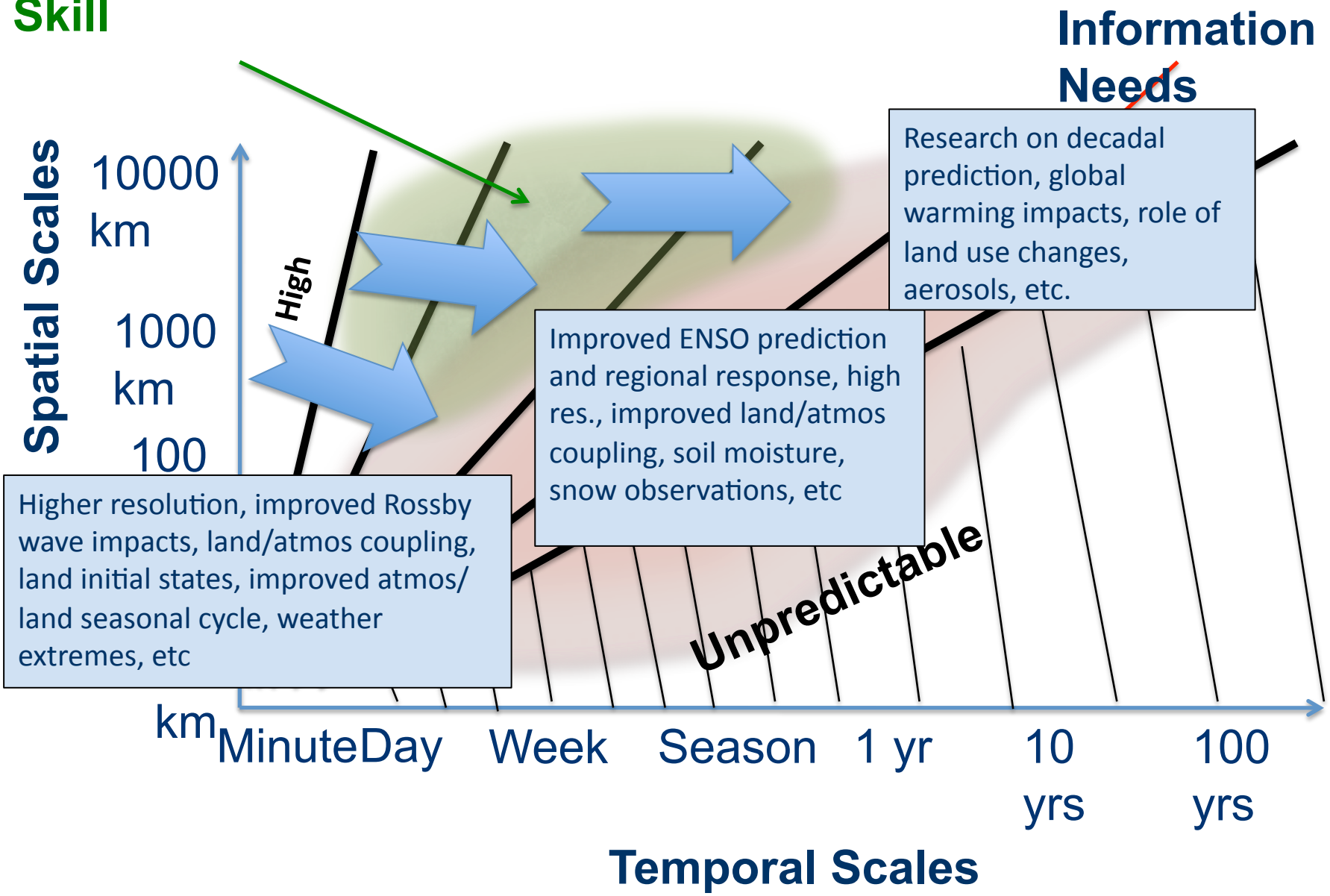
backups


Monitoring & Prediction:
MAPP, Climate Obs
Interdisciplinary research, applications, and assessments:
RISAs, SARP
Integrated Information Systems:
Preparedness and Adaptation
Communication and Outreach:
RCSDs, NWS
Engaging Preparedness & Adaptation Communities:
RCCs, Coastal Services, RISAs, NMFS Habitat

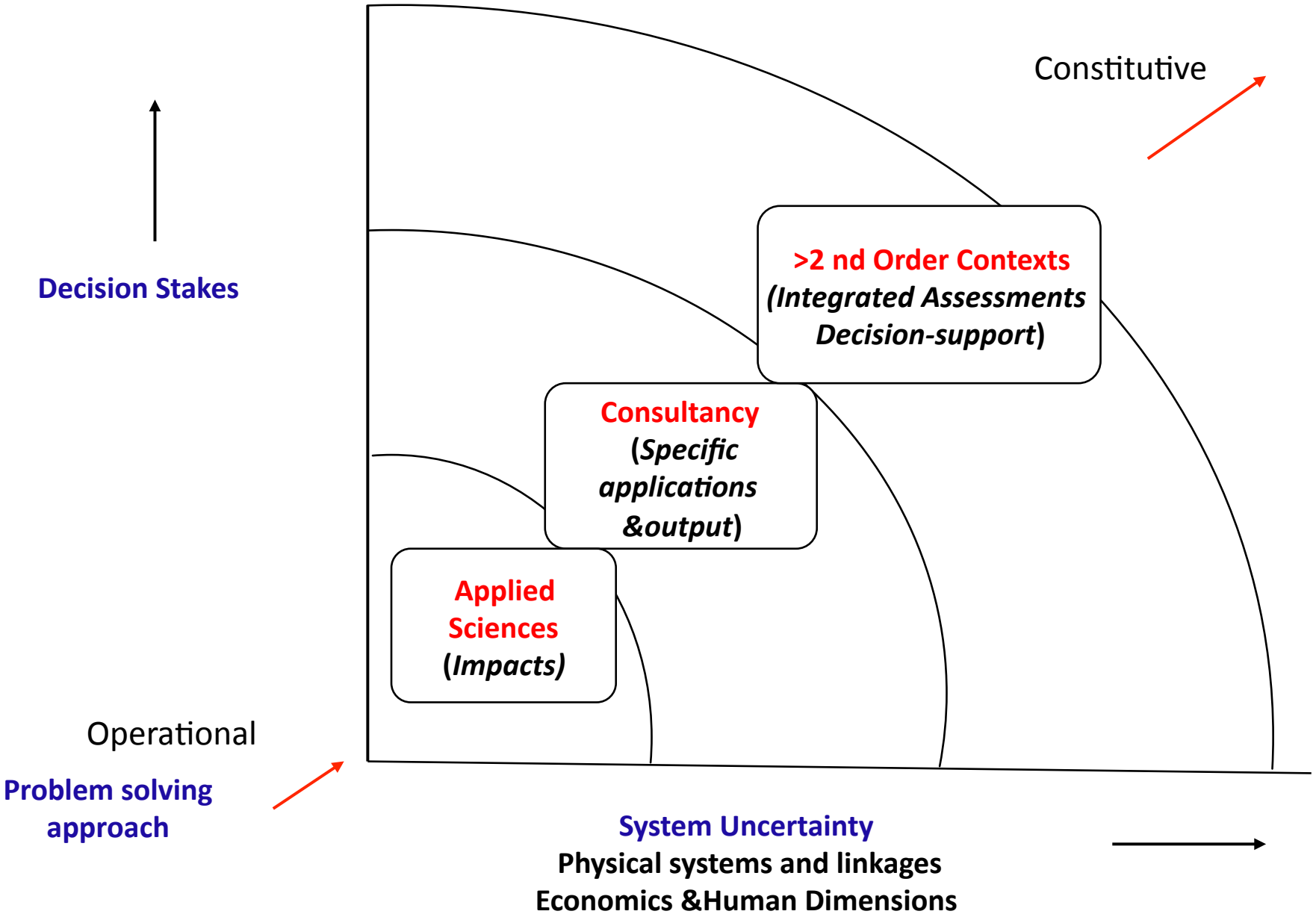
Resources	Vulnerability	Capability
<u>Physical/material</u> What hazards, skills, productive resources exist?		
<u>Social/Organizational</u> What are the relations and organizations among people? gender, age, class…		
<u>Behavioral/Incentives</u> How does the community view its ability to create change?		

Capabilities and vulnerabilities matrix

Predictability

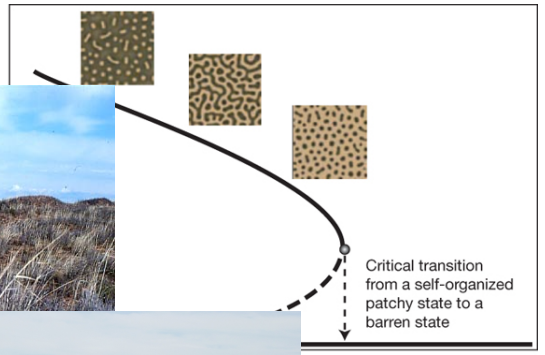


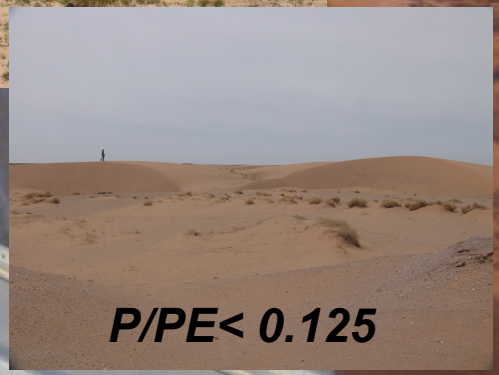
Problem-solving approaches conditioned by system uncertainty and decision stakes (Adapted with permission Functowicz and Ravetz, 1990)



Colorado Basin

Operational Activity	Decisions
Long-term Planning	Operating Criteria and Guidelines
Mid-term Operations	Annual Operating Plan
Short-term Scheduling	Water and Power Schedules
Real-time Control	Automatic Generation and Control





Sharp increase in adaptation literature and plans

- 1741 articles published between (2006 and 2009)
- At least 62 different adaptation plans publicly released in the United States, Canada
- Over 300 adaptation actions United Kingdom and Australia (doubled from 2005 to 2010)

- The gray literature reports a growing number of adaptation plans and strategies at the national and subnational level in developed countries, and at a lower pace in developing countries.

- **Limited evaluation of implementation**