Research Priorities on Vulnerability and Adaptation to Climate Change in California

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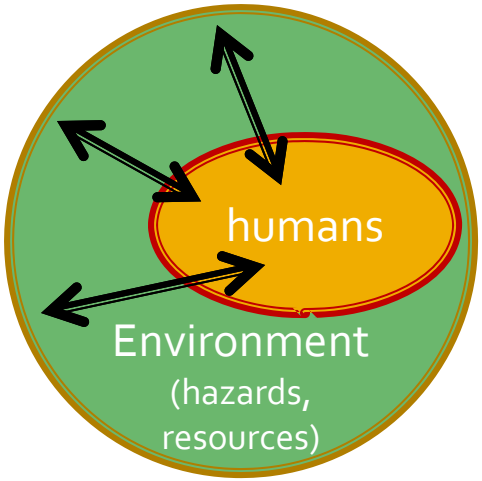
Scope of Topic

- Vulnerability and adaptation as the interface between humans and the environment



Mutual influence for benefit or detriment

- Basis of all existence, economic activity, welfare, well-being, and culture

Scope of Topic (cont.)

Vulnerability

- Susceptibility to harm or potential for change and transformation
- Applies to any region, community, population, economic sector, technological or social-ecological system
- Conceptualizations, scale of analysis, influences considered, operationalization, available data at each scale or in different contexts, and assessment methodologies differ widely
- Persistent division:
  - vulnerability as context or initial condition of a system which will then experience a hazard
  - vulnerability as outcome or net impact of a (climatic) threat after the exposed system has experienced a disturbance and implemented adaptive responses
- Research foci:
  - Mapping vulnerability
  - Determinants /causality of vulnerability
  - Multiple stressors
  - Vulnerability reduction

Sources: AP, NASA

Scope of Topic (cont.)

Source: USGS

Adaptation

- Processes, actions or outcomes in a system in order for it to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity
  - Coping – shorter-lived, relatively minor responses to climate variability and extremes
  - Adaptation – deeper, longer-term, structural, incl. cultural and evolutionary, responses
- Incidental, unplanned, uncoordinated and reactive activities or purposeful, planned, integrated and proactive
- Planned adaptation: anticipation, preparation for, prevention or minimization of potential negative impacts and taking advantage of possible opportunities
- Goal: Vulnerability reduction, impact minimization, overall resilience
- Research foci:
  - adaptive capacity
  - barriers/limits to adaptation
  - cross-scale as well as cross-sector interactions among adaptive responses
  - interactions between mitigation and adaptation
  - Mainstreaming adaptation to climate change into ongoing planning and decisions

Scope of Topic (cont.)

Adaptation Needs Assessments

Hazards-based approach	Vulnerability-based approach
Focus • incremental impacts of climate change	**Focus** • social factors determining the exposure, sensitivity and coping capacity
Starting point • model-based climate change projections	**Starting point** • experience with managing climate in the past
Benefits • Critical for identifying climate change risks • Useful for identifying research priorities • Useful in long-term decisions, especially where projections are quite reliable already • Particularly useful if sufficient data and resources are available for high-resolution projections	**Benefits** • Involve stakeholders often from the start • Can produce useful results even in the absence of good climate change projections • Useful for identifying priority areas for action • Useful for assessing the relative effectiveness of different interventions
Drawbacks • Consideration of non-climatic factors is limited, • Strong reliance on model-based climate and impacts projections • Long timeframe of projections are of little relevance to management today • Insufficient consideration of current climate risks • Insufficient consideration of key uncertainties	**Drawbacks** • Greater reliance on expert judgment • Limited comparability across regions, sectors, contexts • Wide range of methodologies produce different results • Requires non-climatic data which are also often unavailable, unreliable, or difficult to integrate
Common in • IPCC, UNEP adaptation assessments • California climate (impacts) research to date	**Common in** • UNDP-GEF Adaptation Policy Framework • Local vulnerability & adaptation assessments

Past, Ongoing, Future PIER Research and Accomplishments

Source: Sea Grant

- Past Accomplishments: Limited work to date
  - Luers & Moser, 2006: Framework for assessing the level of preparedness of resource managers
  - Moser & Tribbia, 2007a,b,c: Assessment of coastal sector preparedness, attitudes, adaptive capacity decision support needs, and barriers to adaptation
- Ongoing Research (Addt.'l projects currently being selected)
  - Knowles – inundation of coastal areas by flooding after sea-level rise
  - Bromirski et al. – Delta region flooding probabilities with SLR and runoff changes
  - Gleick et al. – econ. cost of future flooding, maybe also examination of cost of flood protection
  - Adams and Inman – erosion hotspots under different SLR scenarios
  - Pendelton et al. – econ. impact of beach width loss on beach going, cost of beach nourishment
  - Several projects using WEAP, CALVIN and CalSim to assess impacts and adaptation options in water resource management
  - Forestry – impacts, land use changes, owner preferences and adaptation options
  - Public health – differential vulnerability to heat and air pollution

Relevant Non-PIER Efforts

- **Academic research on VAR in California**
  - No centralized convergence of relevant expertise, no highly visible "go-to" institution or research center for vulnerability, adaptation, and resilience
  - Considerable amount of relevant and related (but presently not necessarily climate change-focused) social science research
  - Need for collective stock-taking and research agenda-setting in this area would be extremely promising step forward
- **National/international research efforts**
  - Extensive and rapidly expanding literature and understanding of vulnerability and adaptation
  - Limited focus on VAR in developed nations (CA no exception)
  - Research need for "global North" now acknowledged
- **Efforts in other California state agencies**
  - Department of Water Resources – engineering adaptation options
  - Ocean Protection Council – policy and statutory changes to adapt to SLR
  - Department of Public Health – social vulnerability mapping (county level)
  - Generally: uneven concern with climate change, social science input, lack of social science expertise in physical science/engineering-dominated staff

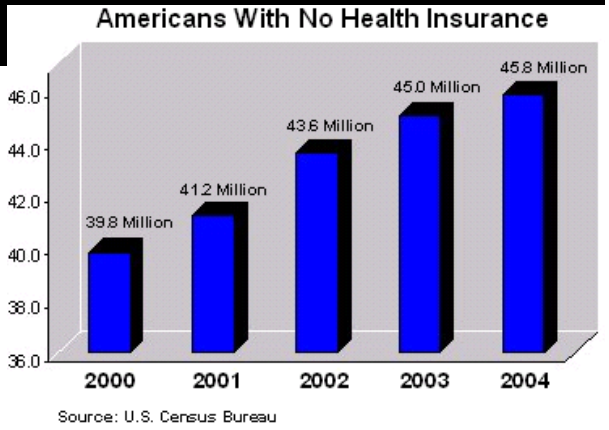
Source: DWR

Research Gaps: Basic Assessment

- Understanding the real importance and potential severity of climatic change for California requires placing climate change into the real-world context of
  - multiple stressors
  - on-the-ground vulnerabilities
  - the actual capacity of communities, businesses, individuals, local and state government institutions to respond to change and extremes
- Standard technological and economic assessments do not fully address social, socio-economic, demographic, institutional, legal, ethical, organizational and cultural aspects of societal functioning, management, human behavior, and policy-making.
- Knowledge base is partial at best, leaving California ill-prepared to face these changes effectively.
- Almost all research would be better than none

Source: dnr.metrokc.gov

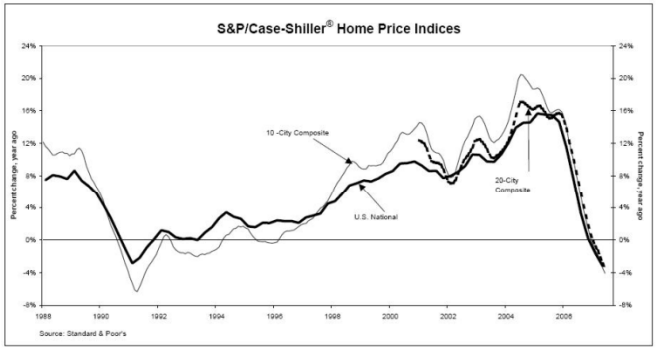
Research Gaps: Vulnerability



Source: U.S. Census Bureau

- Developing, inventorying, and monitoring of key vulnerability indicators
  - Indicators will differ by sector, scale, context
- Improving understanding of all components of vulnerability (exposure, sensitivity, and response capacity)

- Improving understanding of multi-stressor causes of vulnerability
- Determining distributional impacts of environmental changes in key sectors

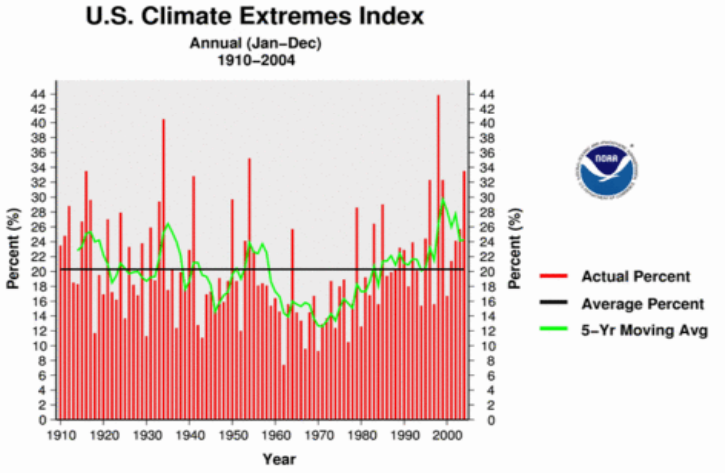


Sources: US Census Bureau, AP, The Wall Street Index

Research Gaps: Vulnerability (cont.)

- Investigating ripple effects and higher-order impacts

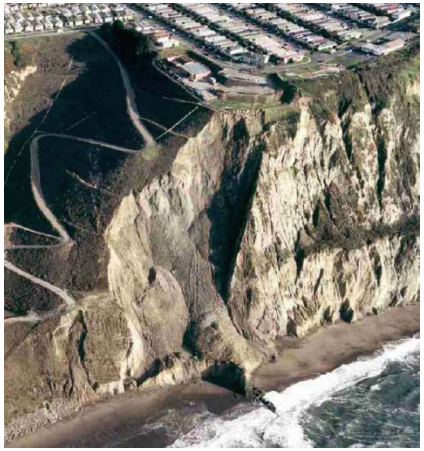
- Understanding impacts in the "forgotten" sectors
- Horizontal impacts within sectors under stress conditions



Sources: Scholars and Rogues; NOAA; Fleur de Lis

Research Gaps: Adaptation

- Developing methodologies for integrated, cross-sector impacts of climate change and of adaptation responses
- Understanding the factors that allow, facilitate, and speed up adaptive learning
- Exploring feasibility (limits) of adaptation strategies

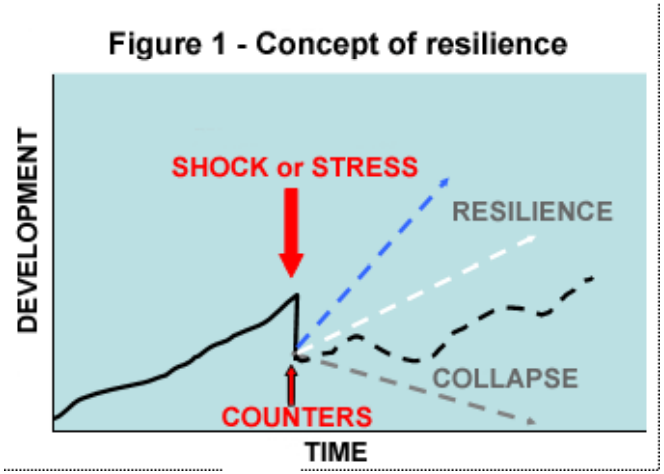


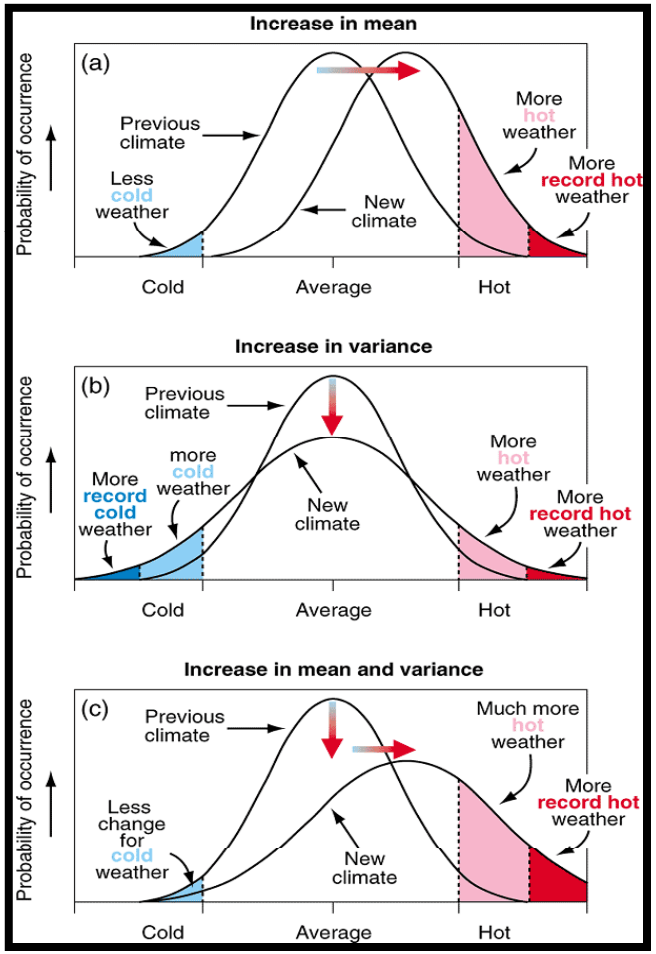
Sources: Cotton, Shires, and Associates, Inc., UCS/ESA (1999)

Research Gaps: Adaptation (cont.)

- Assessment of capacity and limits to short-term coping responses under increasing frequency of extreme events

- Prospects of adaptation to abrupt change (climatic or otherwise)





Sources: DFID (UK), Trenberth et al. (2007)

Prioritization: Considerations

- Researchers, sponsors, decision-makers, stakeholders have different criteria, assign different weights; criteria not weighed
- Policy-relevance not clearly defined (which policy goals?)
- Criteria for achieving programmatic balance ?
  - balance relative to stated program goals
  - balance by sector
  - balance by relevance to short-term decision needs vs. basic research
  - balance between filling research gaps in areas previously not addressed vs. deepening existing understanding
- Results of research proposed here will shape subsequent research prioritization
  - unexpected economic impacts
  - social inequalities
  - unacceptable levels of compound risk from multiple stressors

Final Thoughts

- Vulnerability and adaptation research ought to assume a high priority in next PIER research plan
  - past neglect
  - impact assessments conducted in a "vacuum" (insulated from social, economic, institutional, political and behavioral realities) will undoubtedly misrepresent the real risks and opportunities faced by Californians
  - rapidly growing need for social science insights to support the development of adaptation plans in the state
- Better understanding of the distribution and causes of vulnerability and identification of vulnerability hotspots is best foundation for adequate development of adaptation options and for priority setting
- Critical opportunity to develop a comprehensive social science research agenda

Thank you!

Acknowledgments

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