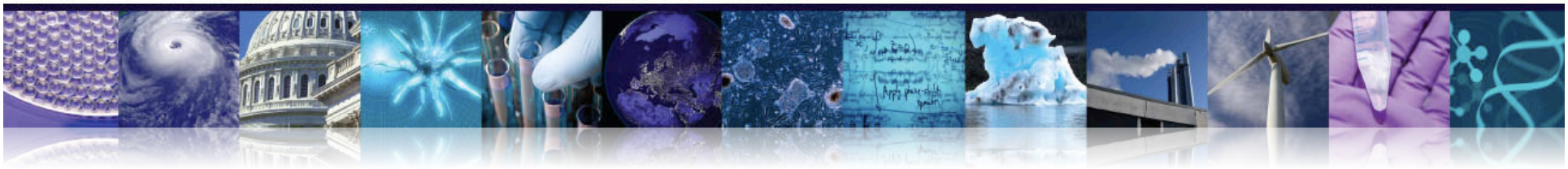


The Dynamics of Vulnerability and Implications for Climate Change Adaptation: Lessons from Urban Water Management

University of Colorado Boulder: Lisa Dilling, Meaghan Daly, William Travis, Roberta Klein, Doug Kenney

National Center for Atmospheric Research: Olga Wilhelmi and Kathy Miller

NOAA Earth Systems Research Lab: Andrea Ray

Funding from the SARP of NOAA

A common assertion…

Action taken to reduce vulnerability to current climate variability will help in adapting to climate change.

e.g. Ribot 1996; Schipper and Pelling 2006; Thomalla et al. 2006

…but is this true in all cases?

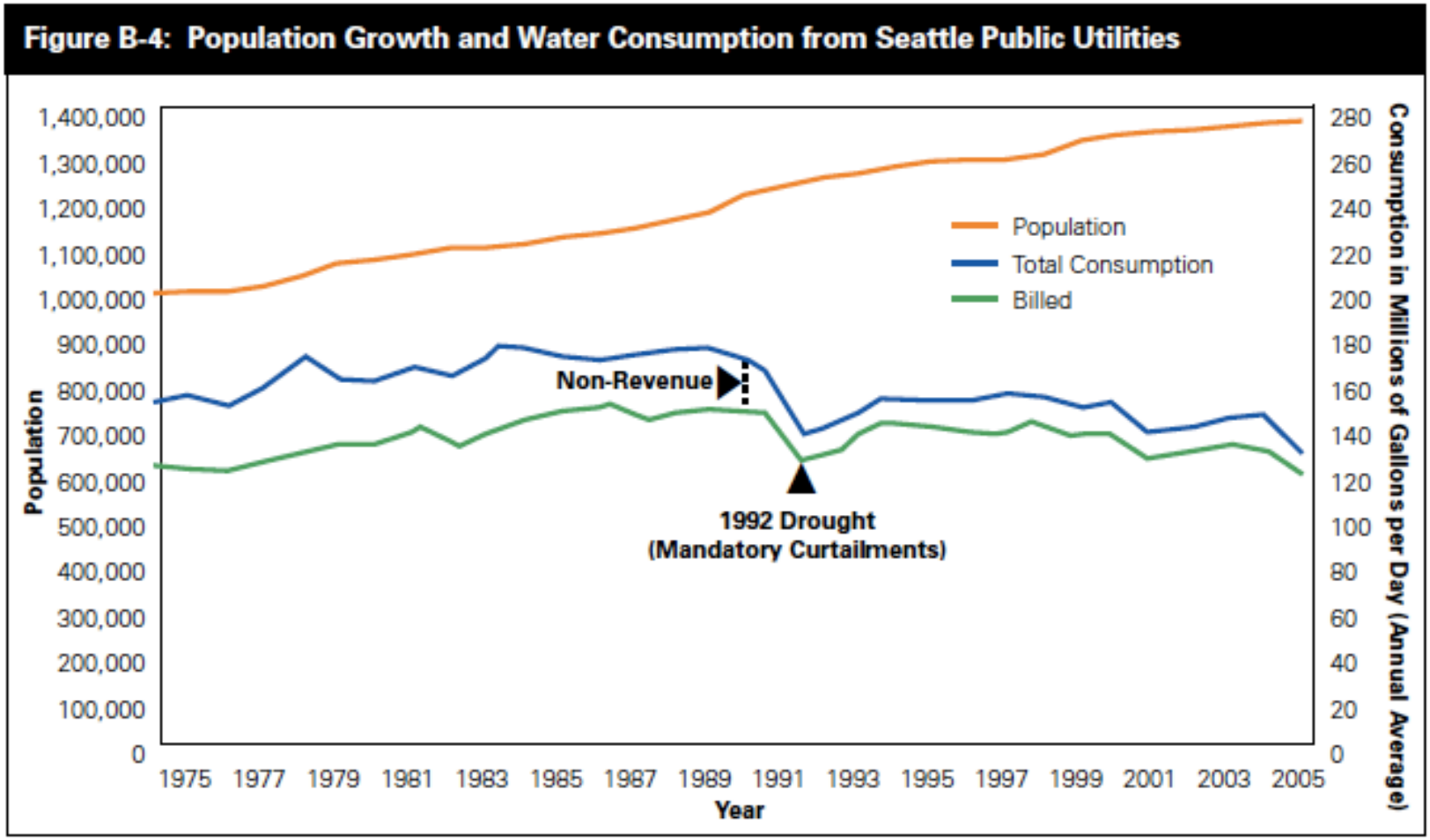
IPCC SREX (2012):

- "Attention to **the *temporal and spatial dynamics*** of exposure and vulnerability is particularly important given that…disaster risk management strategies and policies can reduce risk in the short term, but may increase exposure and vulnerability over the longer term."
- "It is, however, difficult to make conclusive assessments about the effectiveness of disaster risk management in a changing climate, as overall the evidence base…remains limited and fragmented."

- Put another way, are there really "no regrets" actions?

Urban Water Systems and Drought

Water conservation is catching on…

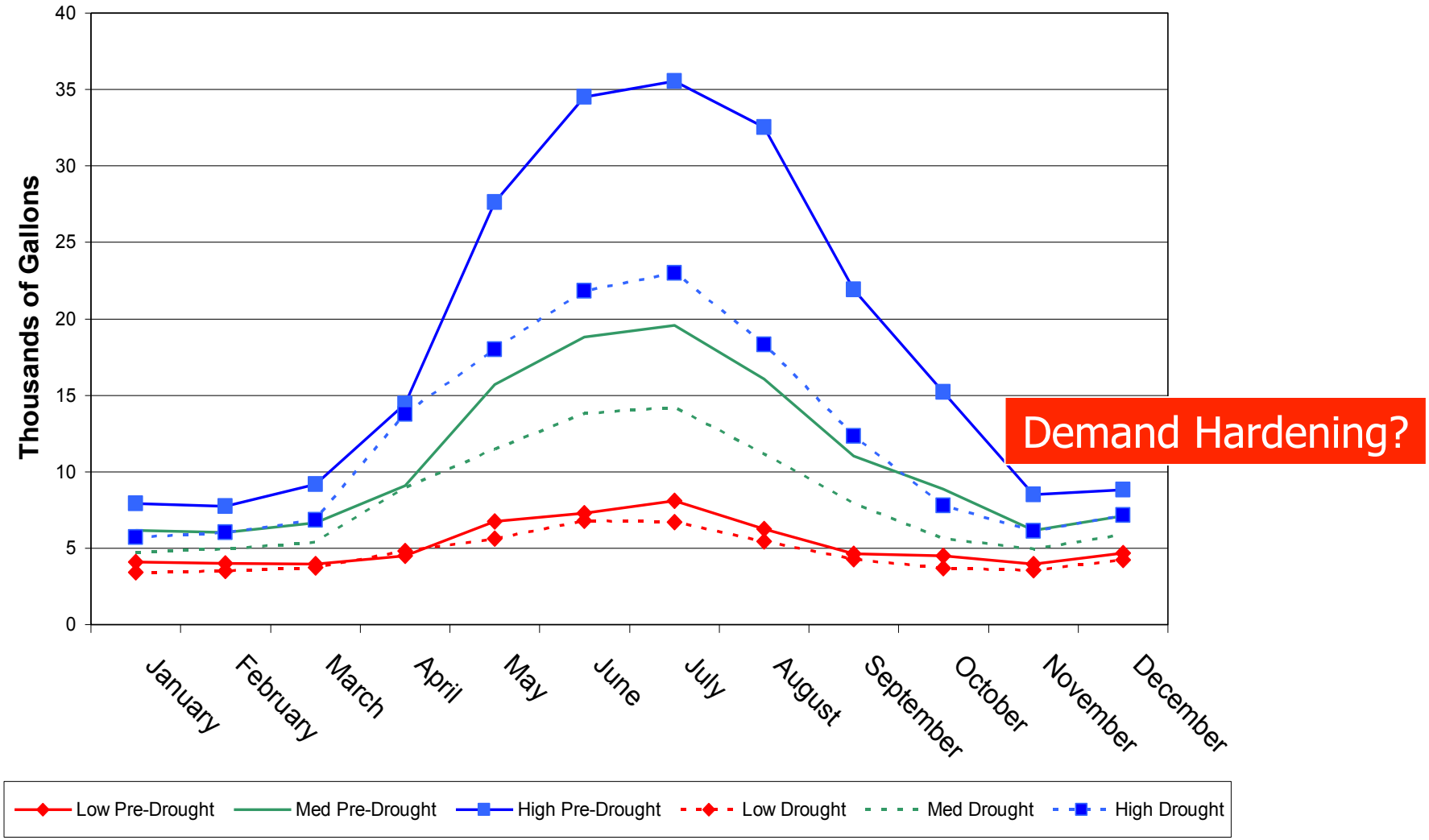


Source: Pg. 2-15. Seattle Public Utilities, 2007 Water System Plan, Public Review Draft. Online access: http://www.cityofseattle.net/util/About_SPU/Water_System/Plans/2007WaterSystemPlan/index.asp.

From NRDC 2007

CENTER FOR SCIENCE & TECHNOLOGY POLICY RESEARCH · CIRES · Colorado University of Colorado at Boulder · Western Water Assessment

But…are there limits?



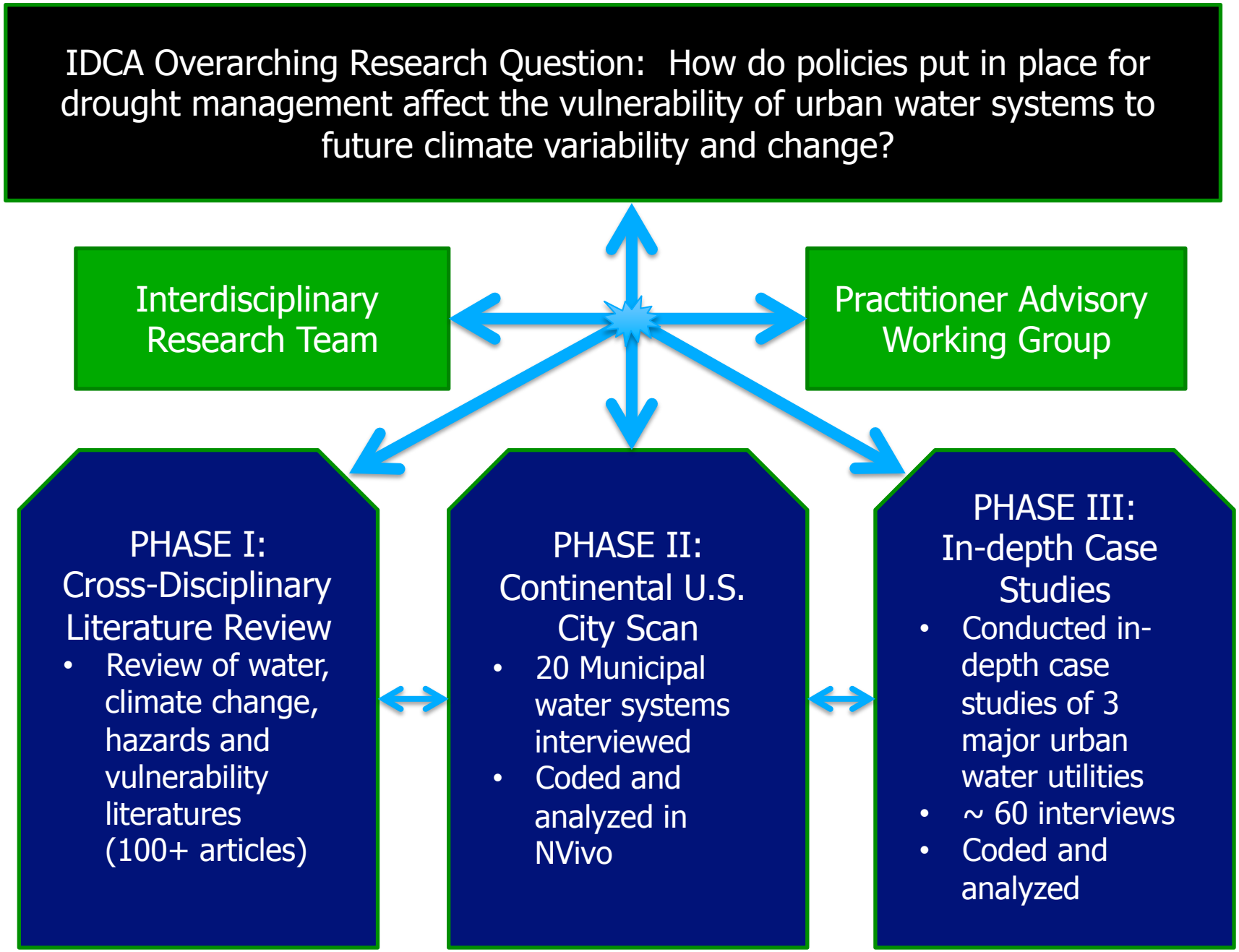
Demand Hardening?

Kenney et al. 2008

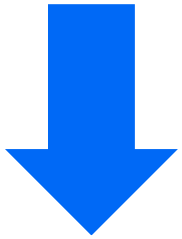
Interactions of Drought and Climate Adaptation for Urban Water

Main Research Question:

How do policies put in place to reduce short-term drought vulnerability in urban water systems affect capacities to respond to long-term climate change?

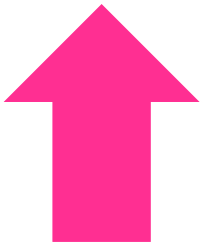

IDCA Overarching Research Question: How do policies put in place for drought management affect the vulnerability of urban water systems to future climate variability and change?
Interdisciplinary Research Team
Practitioner Advisory Working Group
PHASE I: Cross-Disciplinary Literature Review
• Review of water, climate change, hazards and vulnerability literatures (100+ articles)
PHASE II: Continental U.S. City Scan
• 20 Municipal water systems interviewed
• Coded and analyzed in NVivo
PHASE III: In-depth Case Studies
• Conducted in-depth case studies of 3 major urban water utilities
• ~ 60 interviews
• Coded and analyzed

To Reduce Vulnerability:



Exposure and/or

Sensitivity and/or



Adaptive capacity

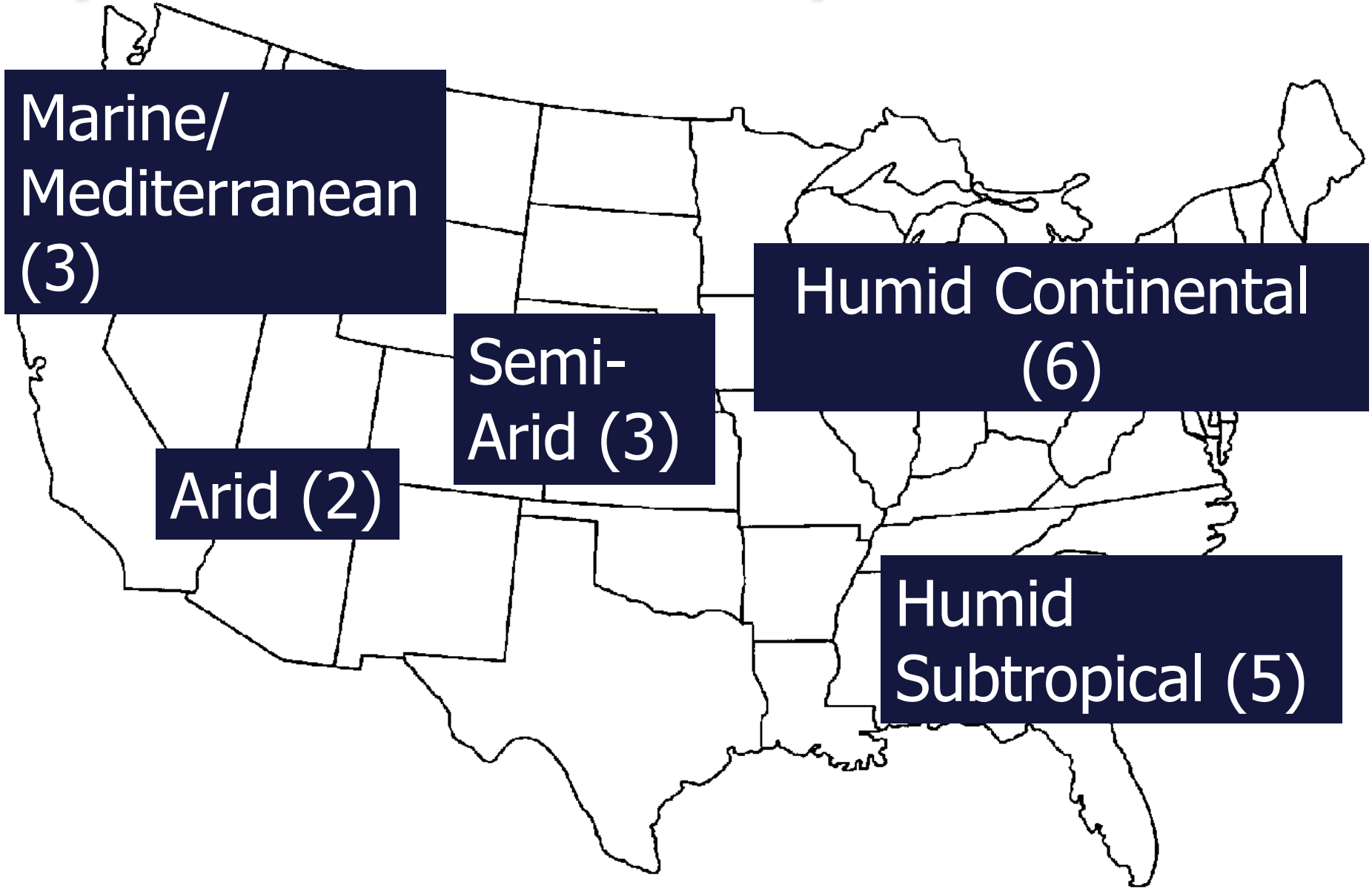
Following Adger 2006 and others

Lit Review: Why Adapting to Climate Variability May Not Always Prepare Us for Climate Change

1. Vulnerability is different at different levels of exposure
2. Coping with routine climate variability is not equivalent to adaptation to longer term change
3. The socioeconomic context is constantly changing
4. The perception of risk associated with climate variability does not necessarily promote adaptive behavior in the face of climate change
5. Adaptations made to short term climate variability may reduce the flexibility of the system in the long term
6. Adaptive actions may shift vulnerabilities to other parts of the system or to other people

Dilling et al. to be submitted to WIRES CC

Municipal water systems climate zone (# of cities interviewed)



Drought Responses

Top Responses	# of Cities (out of 19)
Conservation - Not during drought	15
Mandatory Reductions	13
Messaging/Public Relations	10
Augment Supply	9
Enforcement	8
Incentives for Conservation	7
Planning	7
Legal	7
Changed system triggers	6
Rate structure	6
Voluntary reductions	6

Perceived Effectiveness

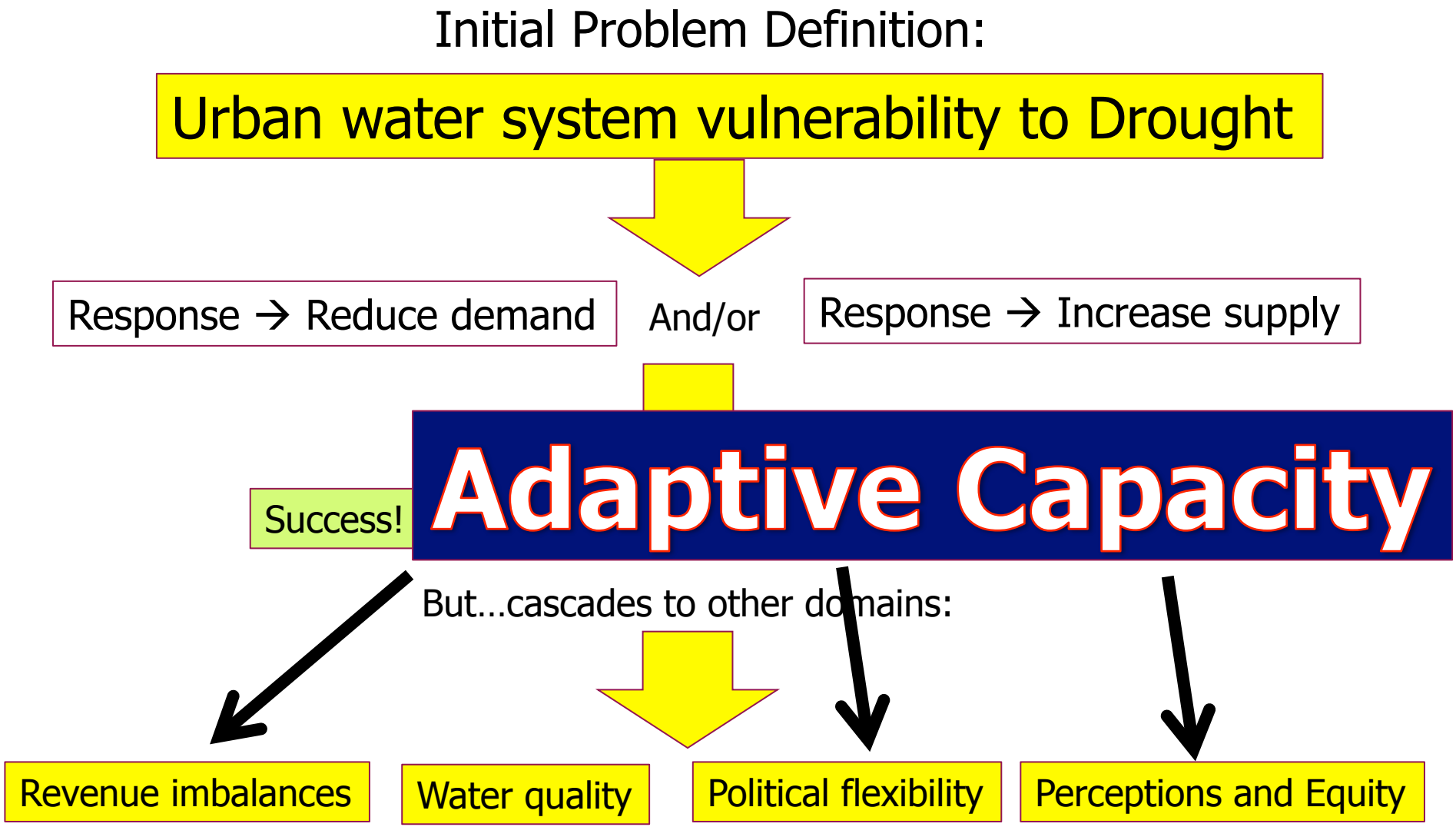
Top Effectiveness measure	# of Cities (out of 19)
Reduction in water use	15
Enabling*	12
System-wide reduction	11
Better Positioned	9
Per capita reduction	7
Long-term conservation	6
Discontinuation of policy	5

* Not measure per se but rather mention of supporting effectiveness

Perceived Limitations

Top Limitations	# of Cities (out of 19)
Social	14
Economic	13
Political	11
Limits Flexibility	10
Physical or Technical	10
Industry or Business	9
Equity	8
Perception	8
Legal	7
Behavior	7

So, back to our question



And this can therefore affect adaptation success, defined as…

- Effective
  - "Robustness" to uncertainty
  - Flexibility
- Efficient
  - Costs/benefits
  - Time scale
- Equitable
  - Identifying who wins and who loses
- Legitimate
  - Are solutions acceptable to those affected

Adger 2005

Implications:

- Wide variety of responses, vary across country but some general patterns
- Vulnerability is dynamic– water supply is part of a linked system (revenue, quality, energy, fire safety, quality of life)
- Decisions made for one reason have other consequences
- Some negatives reported but overall satisfaction with conservation "to do the right thing"
- How important will demand hardening be as climate continues to change?
- Move away from "no regrets" to tradeoffs, balance of goals, at least for well-resourced system e.g. industrialized countries

Next steps and thanks

- Next steps: Finish coding 3 case studies of larger metropolitan water systems to examine how responses to drought correspond to perceptions about future preparedness

Thanks:

- IDCA team: Meaghan Daly, Bill Travis, Bobbie Klein, Olga Wilhelmi, Kathy Miller, Andrea Ray, Doug Kenney
- NOAA Regional Integrated Sciences and Assessment program and Sectoral Applications Research Program
- NOAA Western Water Assessment
- Questions?
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