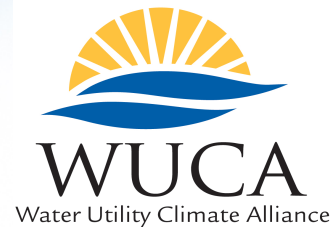
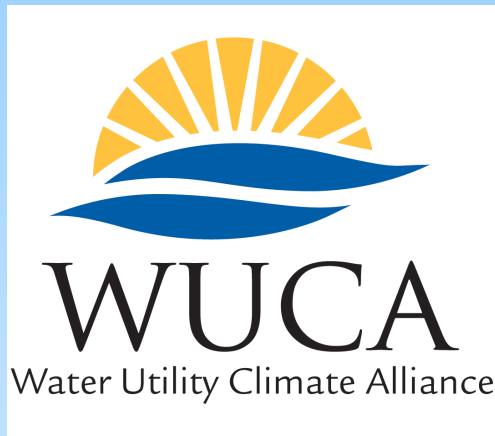


# Options for Improving Climate Modeling & Decision Support Methods to Assist Water Utility Planning

**CPAS 8<sup>th</sup> Annual Workshop  
March 2, 2010  
San Diego, California**

**Lorna Stickel  
Portland Water Bureau  
& Water Utility Climate  
Alliance Member**





**Formed in 2008**

**Deliver water to 43 Million people**

**Currently has 10 large metropolitan water provider members**

**Central Arizona Project  
Denver Water  
Metropolitan of Southern  
California  
New York City Department of  
Environmental Protection  
Portland Water Bureau  
San Diego County Water Authority  
San Francisco PUC  
Seattle Public Utilities  
Southern Nevada Water Authority  
Tampa Bay Water**





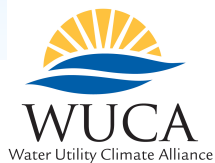
# Water Utility Climate Alliance

## Mission Statement

**Dedicated to providing leadership and collaboration on climate change issues affecting drinking water utilities by improving research and developing adaptation strategies.**

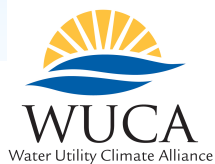
### Goals:

- Improve and expand climate change research so water managers can consider the potential implications climatic changes may have on water resource planning;
- Promote and collaborate in the development of adaptation strategies and tools to reduce the impacts of rising temperature and changes in precipitation patterns on our infrastructure and water supplies; and
- Identify and minimize greenhouse gas emissions resulting from the operations of WUCA member agencies.



# WUCA Activities

- Recognition of the issue of climate change and how we collectively can advance both the science and the actions of municipalities to adapt and mitigate.
- Participating in federal efforts to strategically plan and to improve the accessibility and utility of programs and information for decision makers.
- Working directly with climate modelers to improve understanding of both what these models are currently capable of and what our needs are for “actionable science”.

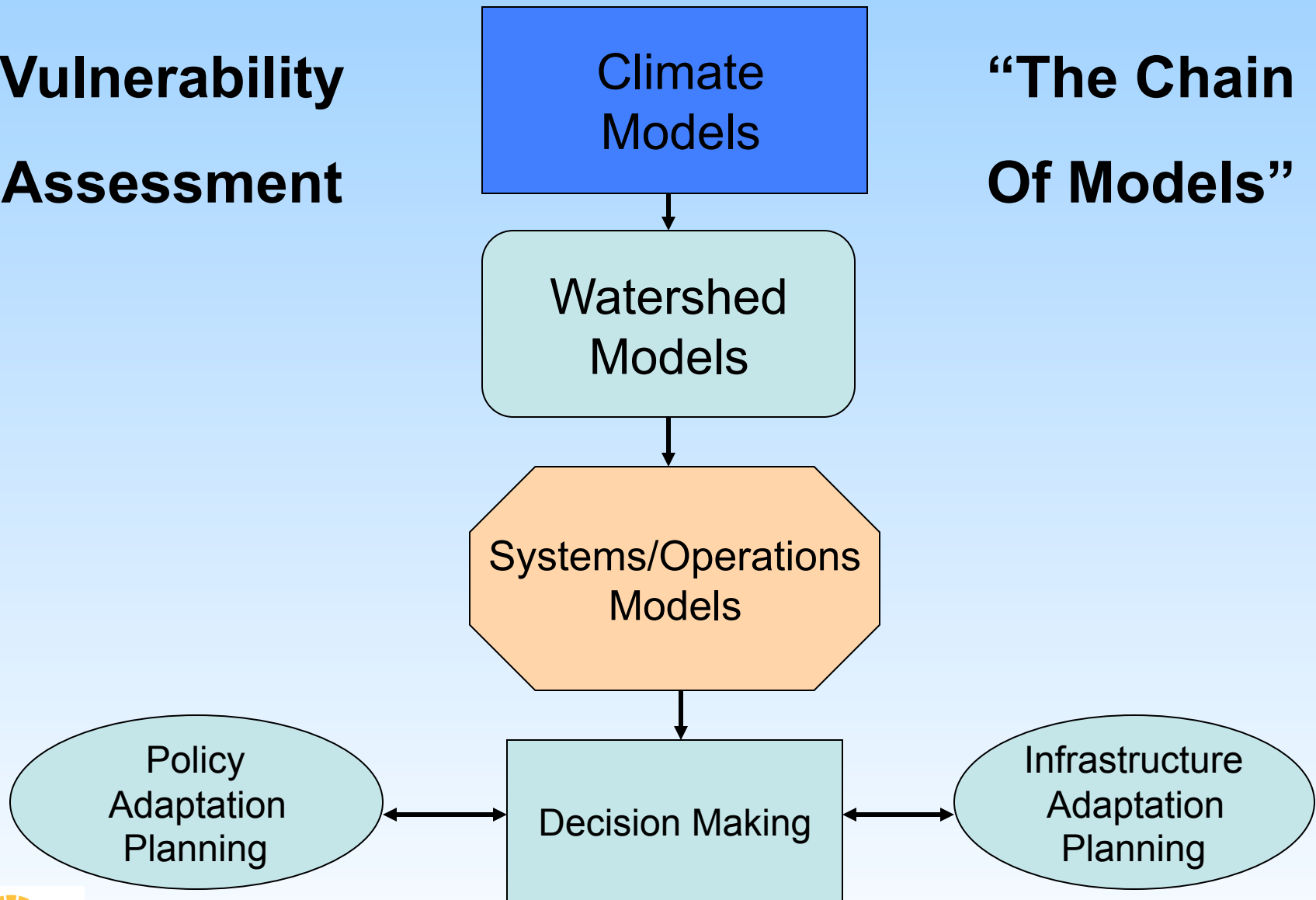


# Impacts of Climate Change on Municipal Water Supplies

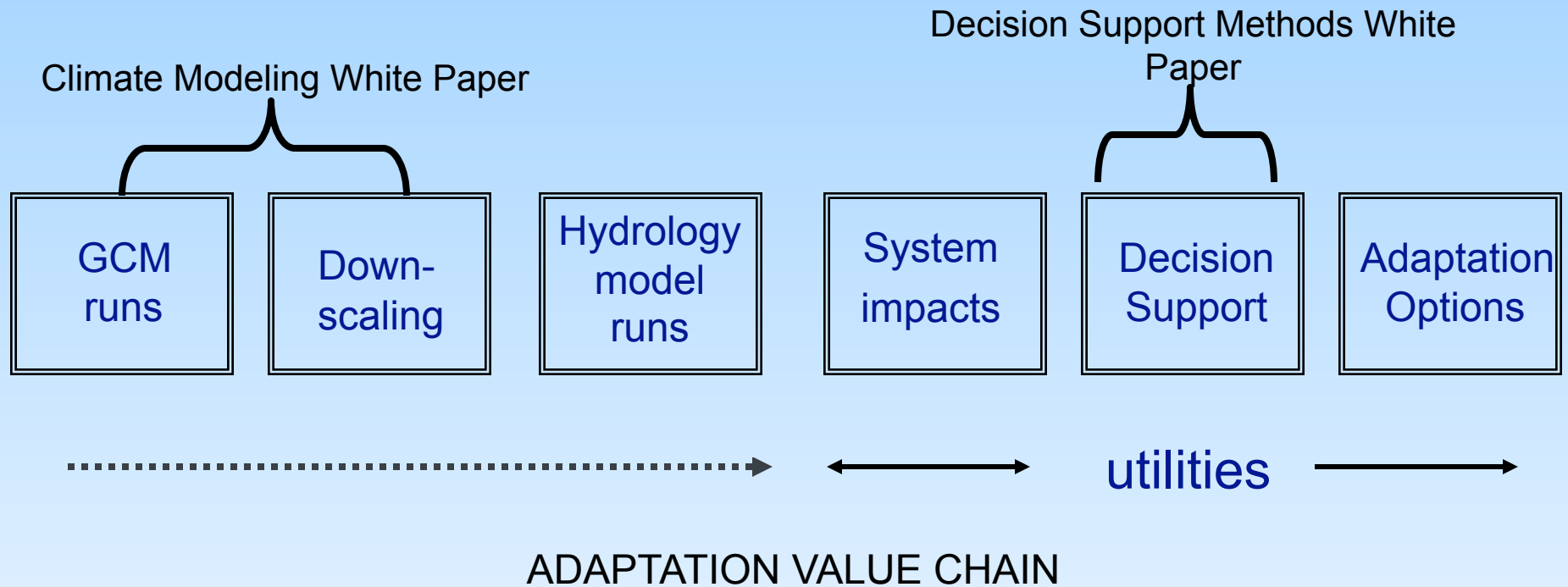
- Changing hydrographs outside the historic ranges
- Increased precipitation intensity
- Hotter, longer summers – impacts on demand patterns
- Changes in vegetative patterns (fire, invasives, hydrologic impacts)
- Sea Level rise impacts
- Regulatory impacts

# Vulnerability Assessment

# “The Chain Of Models”



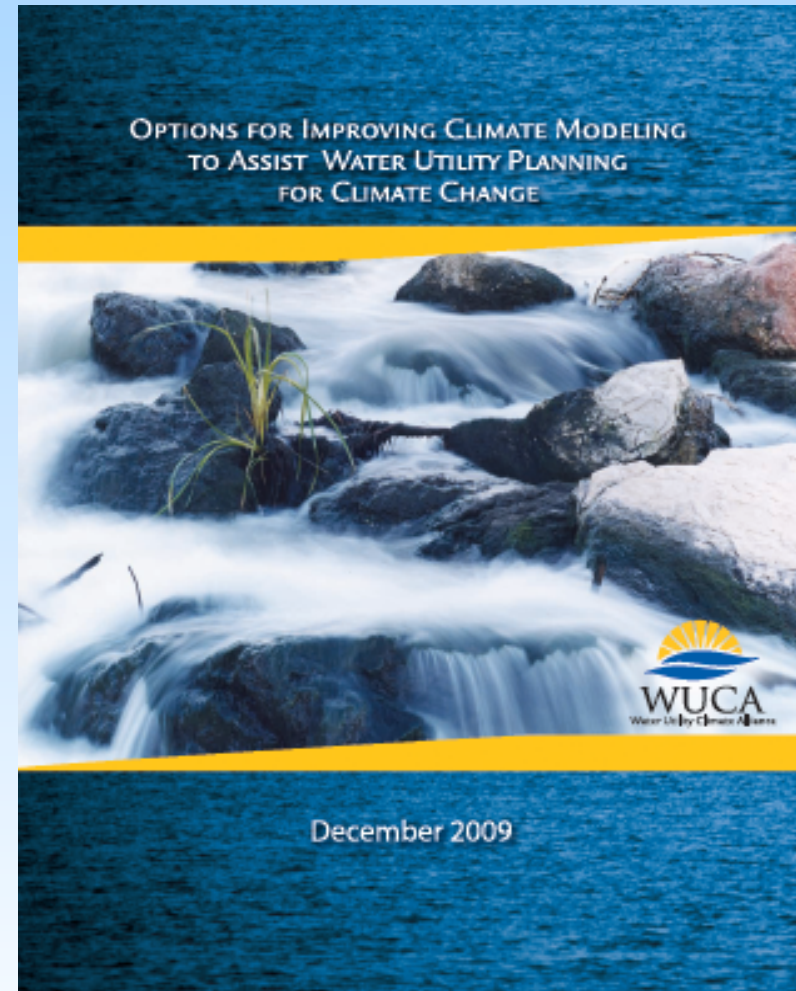
# WUCA Focus on Products to Assist Utilities



*The value chain is also a storyline of what the projected impacts are and what are appropriate adaptation options*

# Modeling White Paper

- Options for Improving Climate Change Modeling to Assist Water Utility Planning for Climate Change
- Prepared by Barsugli, Anderson, & Smith/Vogel of Stratus Consulting
- Released December 2009
- Available on WUCA website as a pdf file





# Contents of WUCA Modeling White Paper

- How utilities are studying climate change and information needs. Case studies from Denver, New York, Portland, San Francisco, Seattle, and Southern Nevada Water Authority.
- The science of climate modeling
- What water utilities would like from climate science
- Options for improving modeling to create more useful and reliable projections

# What Utilities Would Like From Climate Science - 1

- Model agreement on change in key parameters

*“Such improvements may take years to be realized. In the meantime, we can better understand the sources of uncertainty about regional climate change and improve techniques for analyzing and applying climate models.”*

- Narrowing the range of model output

*“Only modest progress is expected....Enhanced use of observational data to constrain GCMs may help progress on this matter.”*

# What Utilities Would Like From Climate Science - 2

- **Climate model resolution at a spatial and temporal scale that matches water utilities current system models**  
*"The range of GCM resolution used in the climate projections will likely improve over the next few years, but for the most part this resolution will be more coarse than that currently used in utility system models. Note that increased resolution alone does not guarantee increased accuracy."*
- **Improved projections within water utility planning horizons**  
*"...in the first few decades of model projections, simulations of natural modes of climate variability typically have a larger effect on climate projections than GHG concentrations."*

# Options for Improving Models

- **GCM Options**

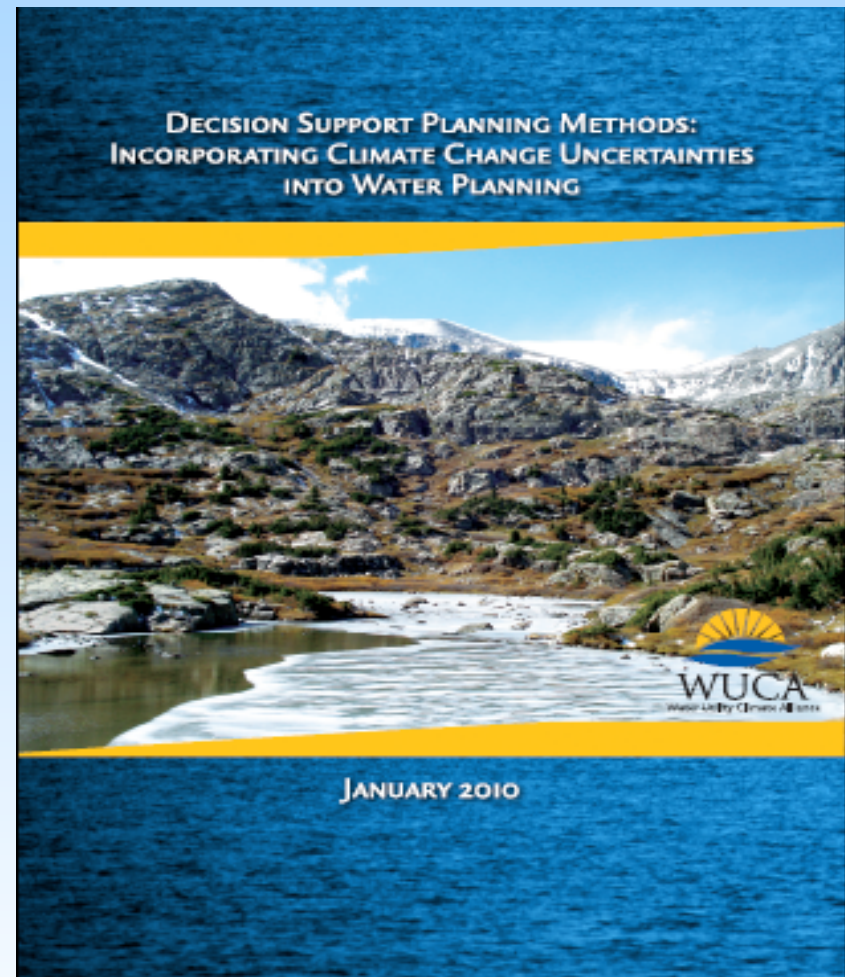
- Development and enhancement of global climate model ensembles
- Improved use of observations to constrain climate model projections
- Improved modeling of the Tropical Pacific
- Improved decadal prediction

- **Downscaling Options**

- Development of regional ensembles
- Development of regional climate model components
- Development of statistical downscaling techniques for probabilistic downscaling, extremes, and daily data

# Decision Support White Paper

- Decision Support Planning Methods: Incorporating Climate Change Uncertainties into Water Planning
- Prepared by Malcolm Pirnie and Denver Water
- Released January 2010
- Available on WUCA website as a pdf file



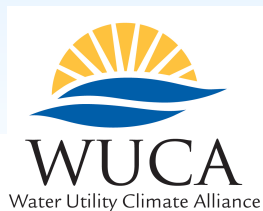


# Four Adaptation Steps

- **Understand** – climate science and model projections both what they might be telling us and what they don't
- **Assess** – water system vulnerabilities to potential climate change
- **Plan** – Incorporate climate change uncertainty into water utility planning
- **Implement** – adaptation and mitigation strategies in the face of climate uncertainties

# Five Planning Methods Evaluated in the DSM White Paper

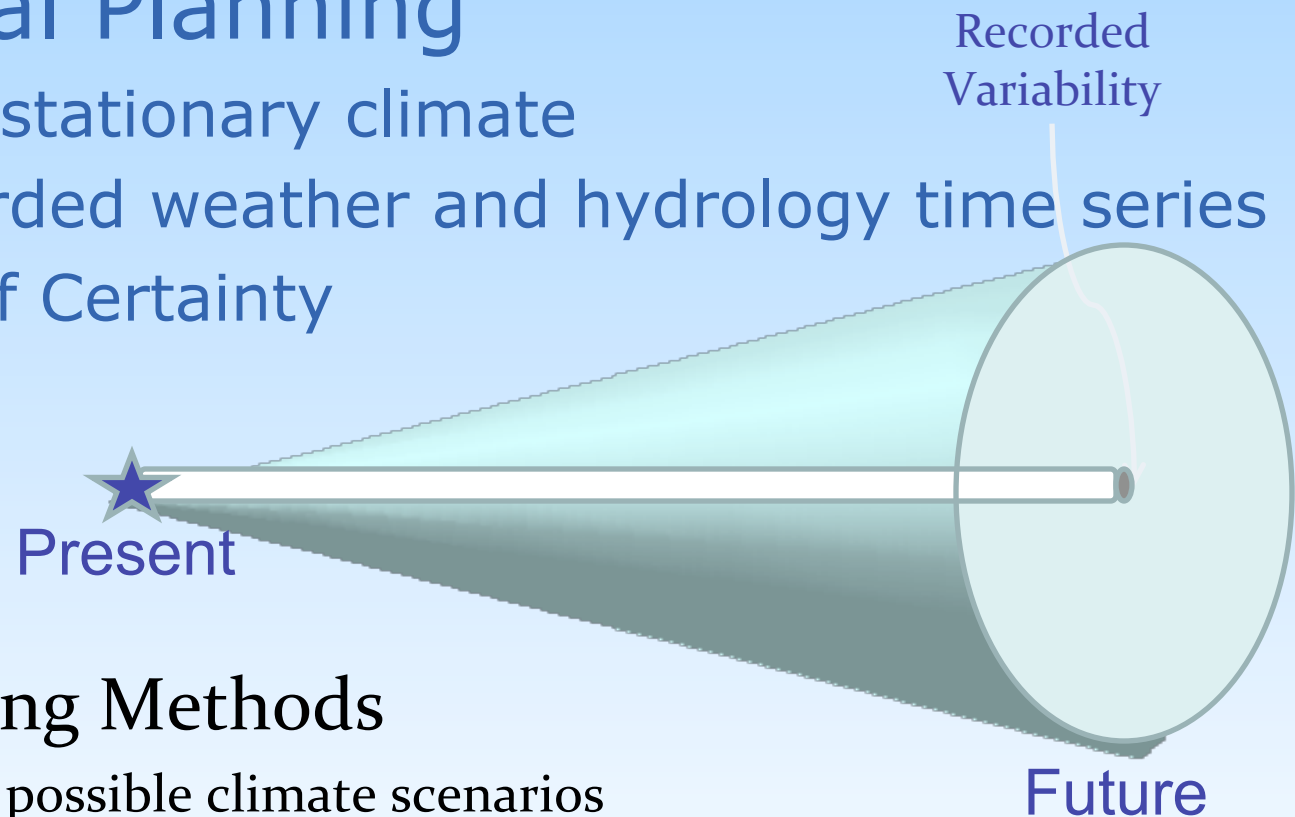
- Classic decision analysis
- Traditional scenario planning
- Robust decision making
- Real options
- Portfolio planning



# Cone of Uncertainty

- **Traditional Planning**

- Assumes stationary climate
- Uses recorded weather and hydrology time series
- Cylinder of Certainty



- **New Planning Methods**

- Hundreds of possible climate scenarios
- Multi-outcome planning
- Robust over optimal

## Decision Analysis

- Decision trees, probabilities and costs
- Minimize expected costs



# Scenario Planning

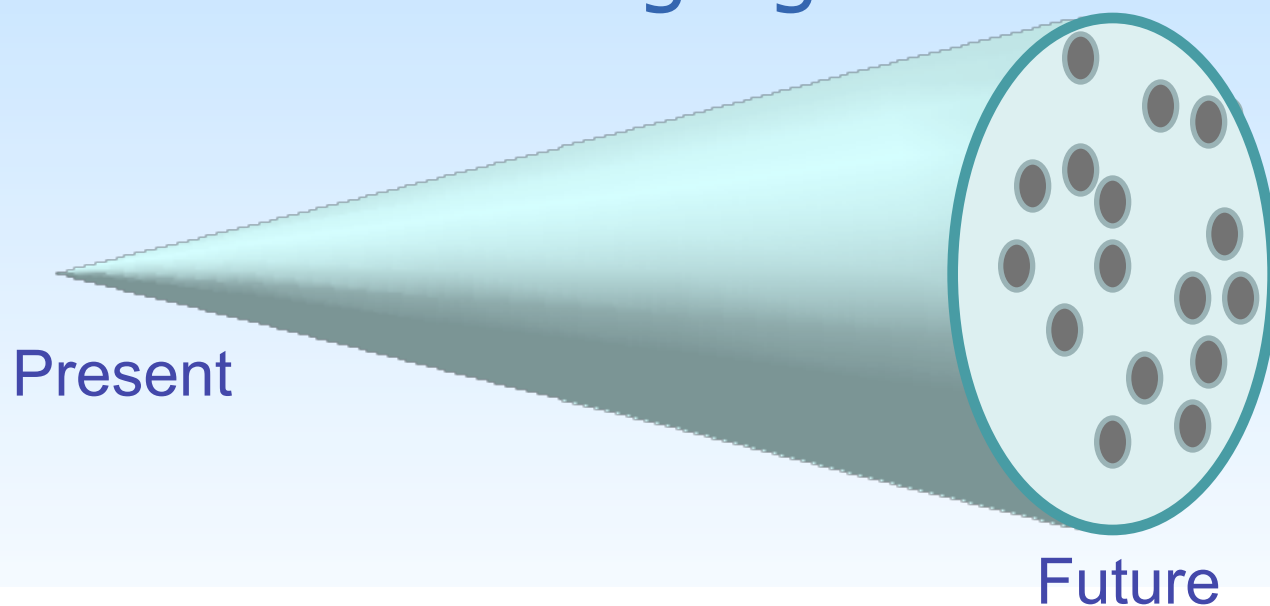
- Small number of equally likely scenarios [A, B, C, D]
- Common strategies (no regrets)
- Sign posts





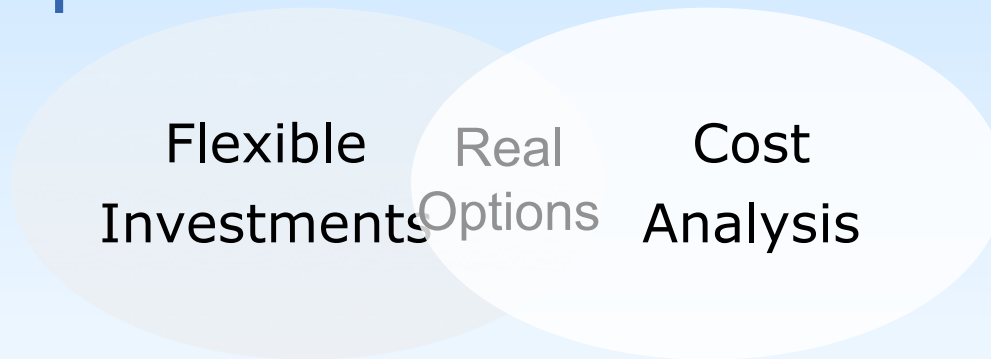
# Robust Decision Making

- Computer analysis of many plausible likely scenarios
- Iteration and hedging



# Real Options

- Combines decision analysis and financial theory
- Decision tree and financial hedging concepts



# Decision Methods Considerations

No one size fits all circumstances

- Decision analytics - familiar but requires estimates of probabilities
- Scenario planning - relatively simple but only a few scenarios can be considered
- Robust Decision Making - considers many uncertainties but is highly computational and requires outside expertise
- Real Options – Perth, Australia is using this, but not yet written up.

# Decision making in the face of climate uncertainty

- Mitigation for GHGs – while not adaptation there is a gray area between mitigation & adaptation particularly in the water/energy nexus.
- Strategic Adaption Types
  - Planning Methods
  - Infrastructure Development and Use
  - Programmatic and Institutional Actions

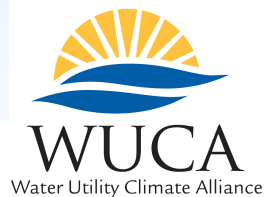
# WUCA Activities - Next Steps 1

- Continued interaction with climate scientists and ensuring that municipal water providers have a seat at the table as research protocols and governmental structures are defined (eg. National Climate Service, DOI Climate Centers, RISA programs). Perfect storm, presents both challenges and opportunities.
- Working at the international, federal, state, regional, and local level to improve data observations, collection and analysis vital to both modeling and identifying climate trends.



# WUCA Activities - Next Steps 2

- Working with other water organizations to collectively advocate for both “actionable science” and to identify effective adaptation decision support tools and strategies including:
  - Pilot case studies of climate change and storm water and water supply planning and decision making by some WUCA members and international water providers.
  - More potential white papers or studies on:
    - ✓ decision making in the face of uncertainties that are likely to remain over the near and longer term even with downscaled modeling.
    - ✓ Use of hydrologic models with downscaled GCM/RCM data sets
  - Collective communication with AWWA, AMWA, WRF, and IWA on issues of mutual importance to be more effective.



# Contact Information

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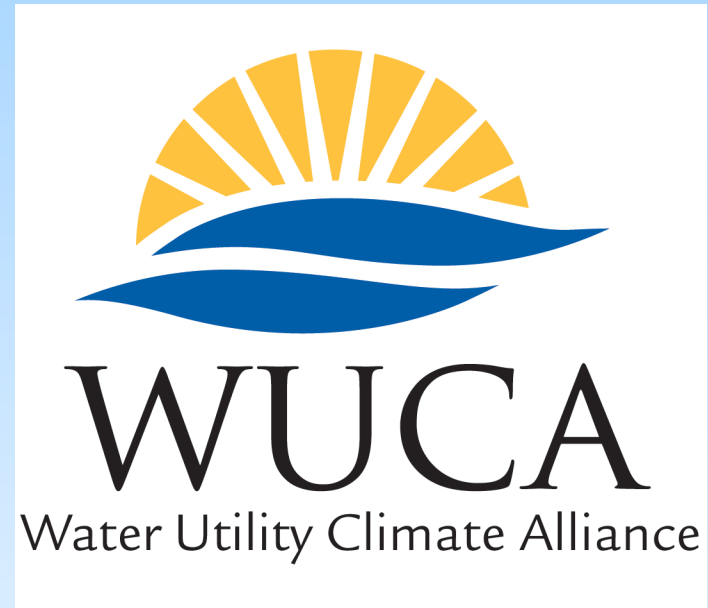
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