Collaborative Water Resources Decision-Making through Participatory Modeling in the Rio Sonora Basin, Mexico

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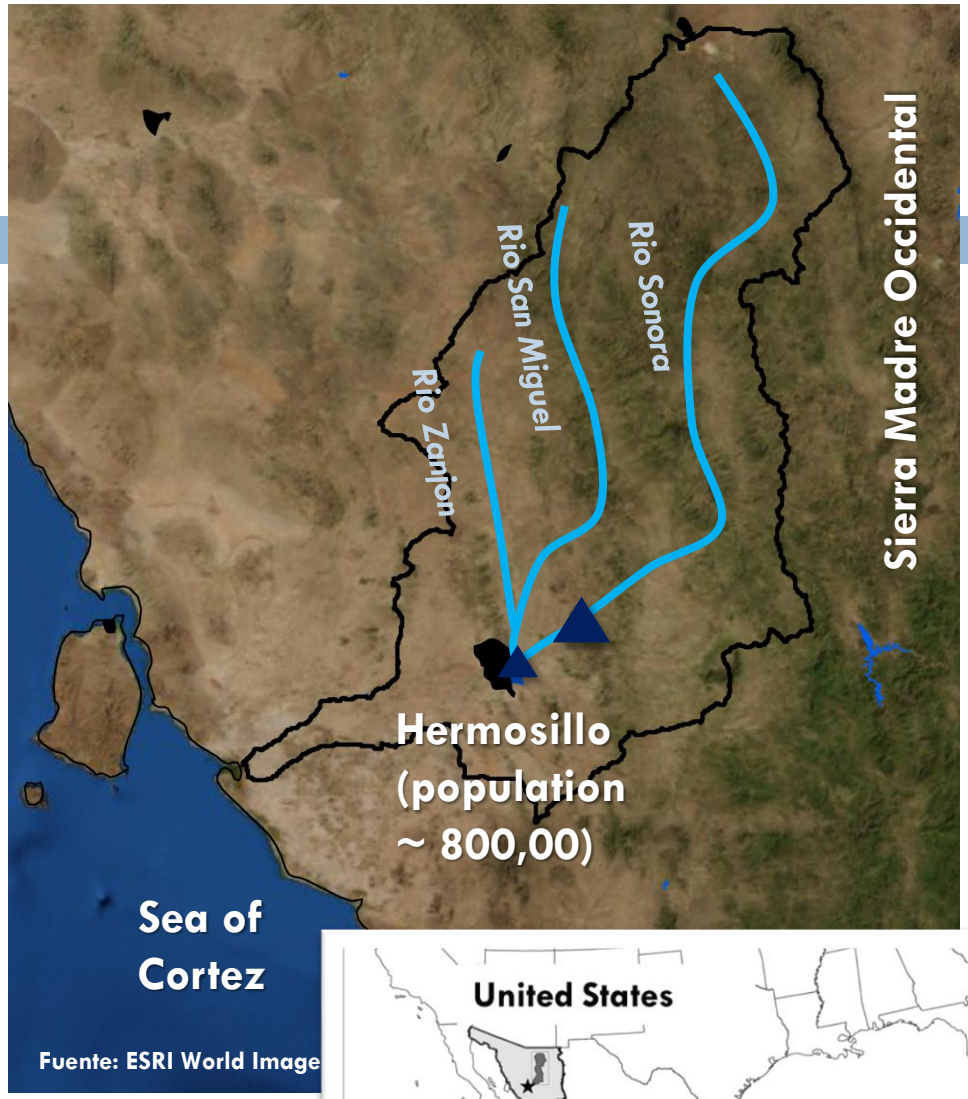
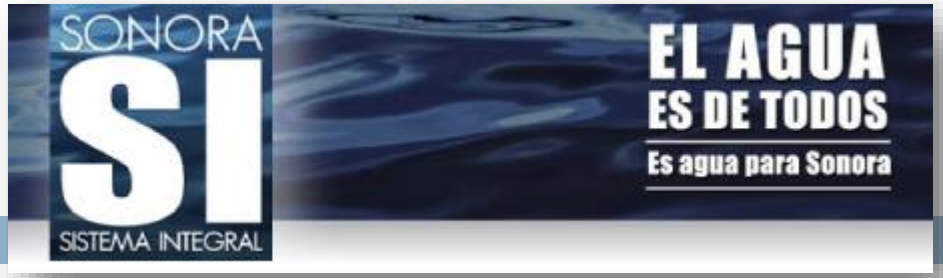
Rio Sonora Basin (RSB)

- Climate is semi-arid, highly variable, with frequent, severe droughts.
- Major water uses include large-scale irrigated agriculture and large urban area.
- Water resources infrastructure system struggles to deliver sufficient water.



Rio Sonora Basin (RSB)

- Water resources management is controversial, due to perceptions of water scarcity, conflicts among water users, and political backdrop.



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Project overview

- We are studying decision-making for water resources management in anticipation of climate change in the Rio Sonora River Basin, Sonora, Mexico.
- Primary question:

  Can water resources systems modeling, developed within a participatory framework, contribute to management strategies in a context of **water scarcity, conflicting water uses** and **highly variable and changing climate conditions**?

Project focus: Participatory modeling

- Definition: process of collaboratively constructing a shared representation of a natural resources management system.
- Designed to:
  - gather and integrate a diversity of viewpoints from participants in the development of models…

….so that a collective management vision can be established and adapted as conditions change in the future.

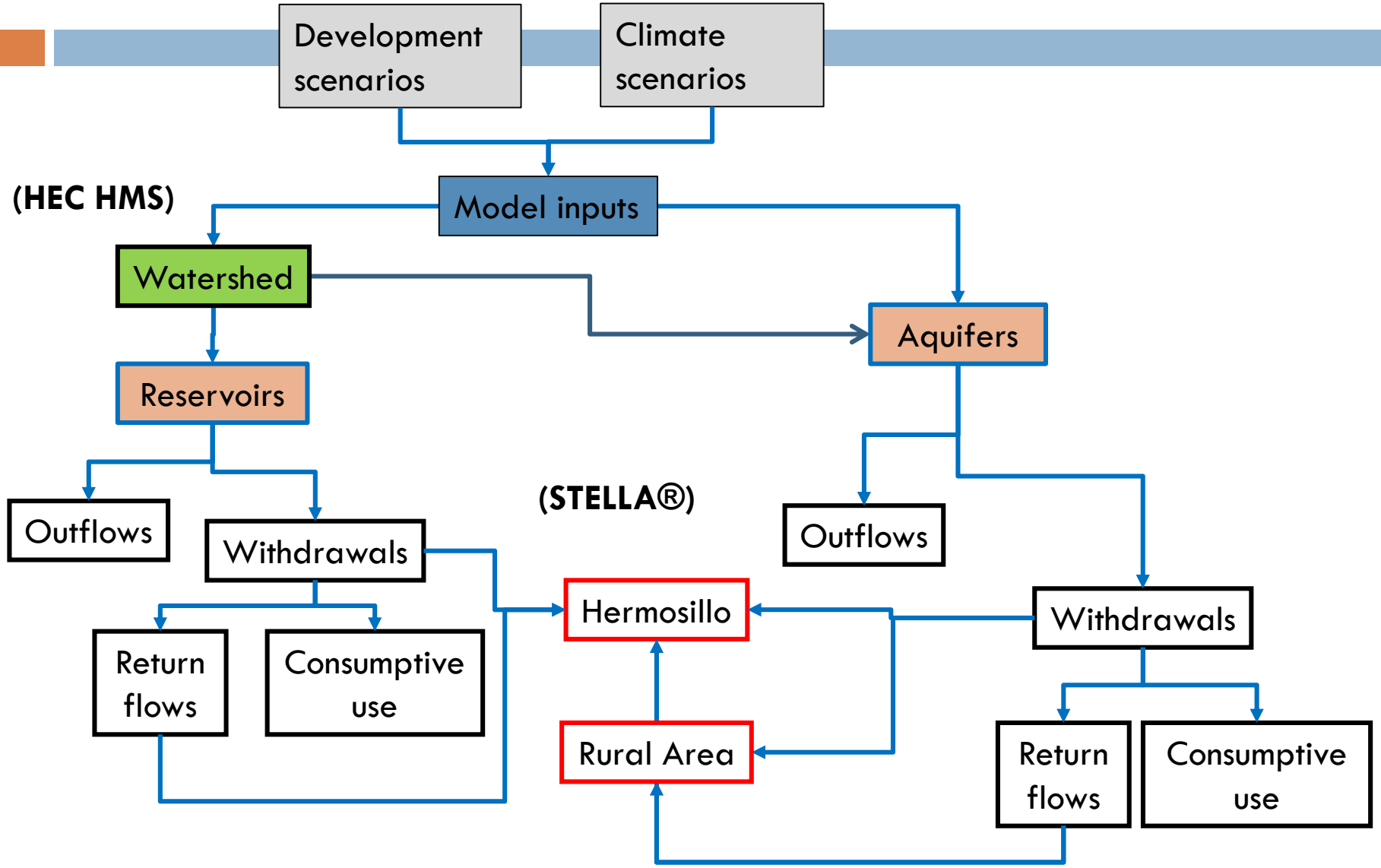
Scientific Gap

- Participatory modeling (PM) has been used in many ncontexts.
- But, evaluation of the outcomes is rarely done systematically (Robles-Morua et al. 2013).
- Many PM organizers assert outcomes with little empirical data to support their findings.
- Some conduct post-workshop qualitative interviews, but without pre-workshop baselines, causality is problematic.
- Gold standard is pre- versus post-workshop surveys, but rarely done (Robles-Morua et al. 2013).

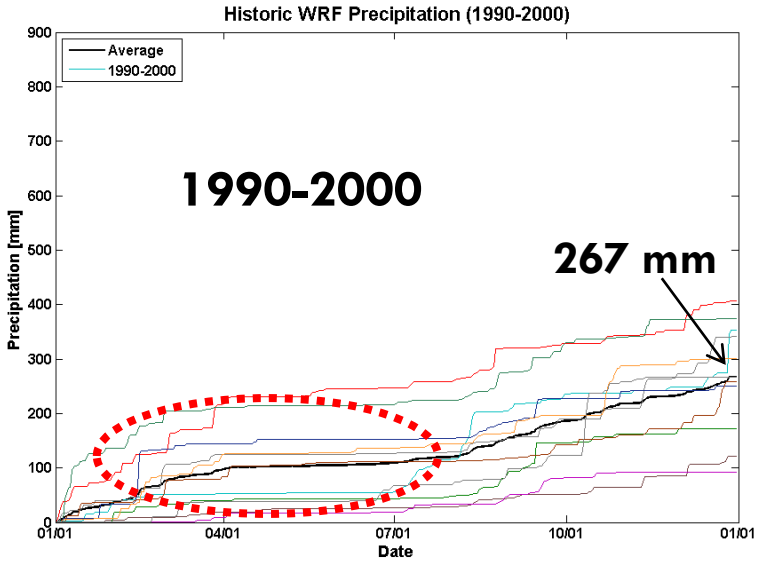
Methods: Research Design

- Develop and assess conceptual models of beliefs about models
  - create, implement and analyze pre- and post-workshop surveys to analyze impact of workshops
- Develop models and forcings
  - hydrology: surface water and groundwater models
  - water resources system: supply and demand management, including infrastructure system
  - climate scenarios: downscaled climate predictions
- Conduct three participatory modeling workshops in 2013.

Baseline model of RSB water resources system



Climate forcings

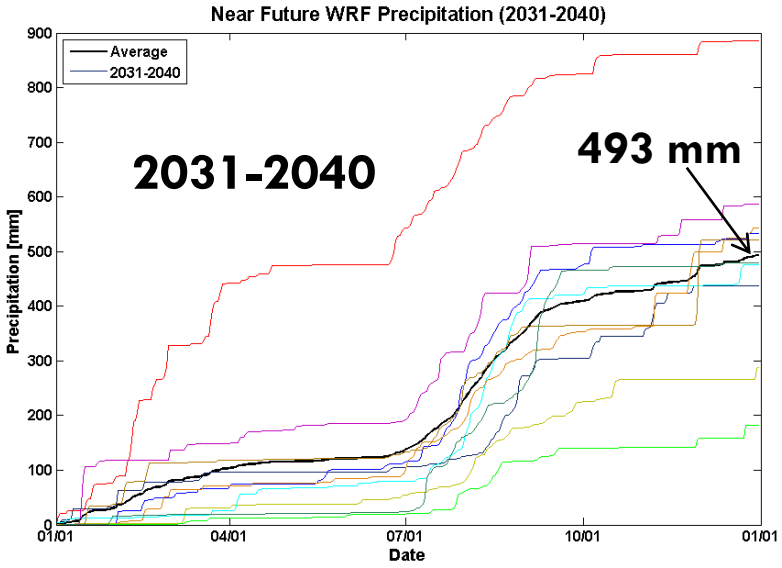


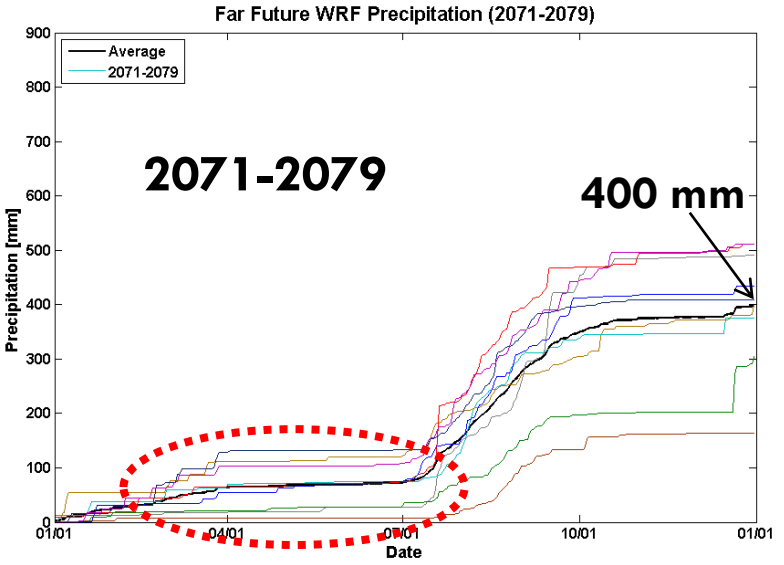
Weather Research and Forecasting (WRF) model

Boundary conditions from GCM

Regional Climate Model(WRF)

IPCC Projections

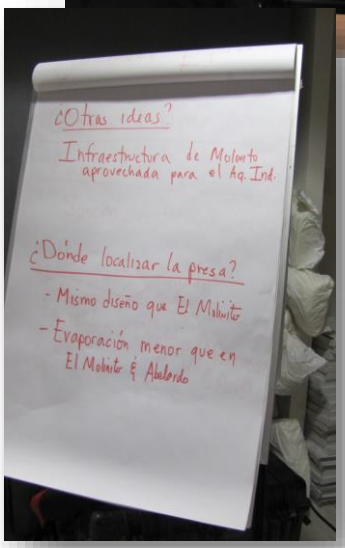




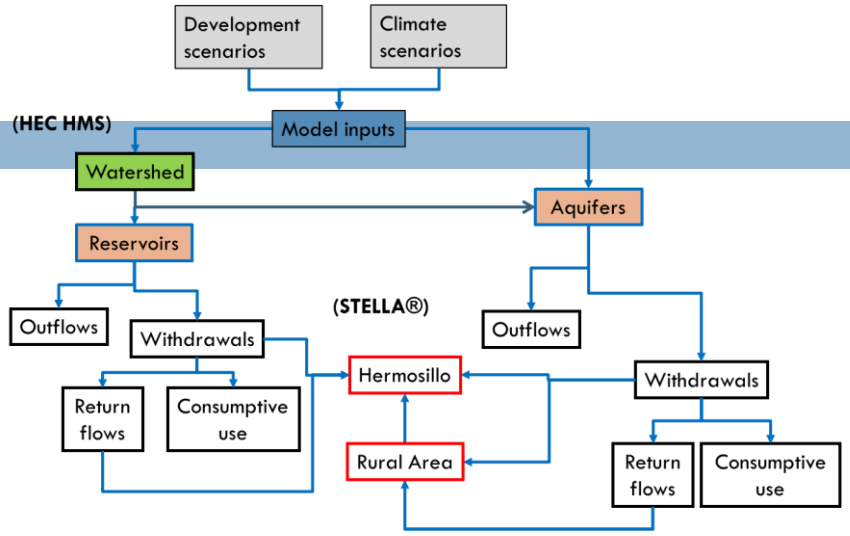
Workshop participants

- Participants included water agencies, academics, NGOs
- Number of participants:
  - workshop 1/2/3: 53/28/30
  - represented 18 organizations

➔ 18 participants attended all three workshops and completed surveys



Workshop description



- Format
  - Seminars and discussion
  - Practical modeling activties
  - Iterative model development

- Topics
  - RSB hydrology, climate, and water management system
  - Climate change in the RSB
  - Hydrologic systems modeling
  - Elaboration of future development scenarios
  - Supply and demand management in the RSB

pre-survey

post-survey

Survey scales summary

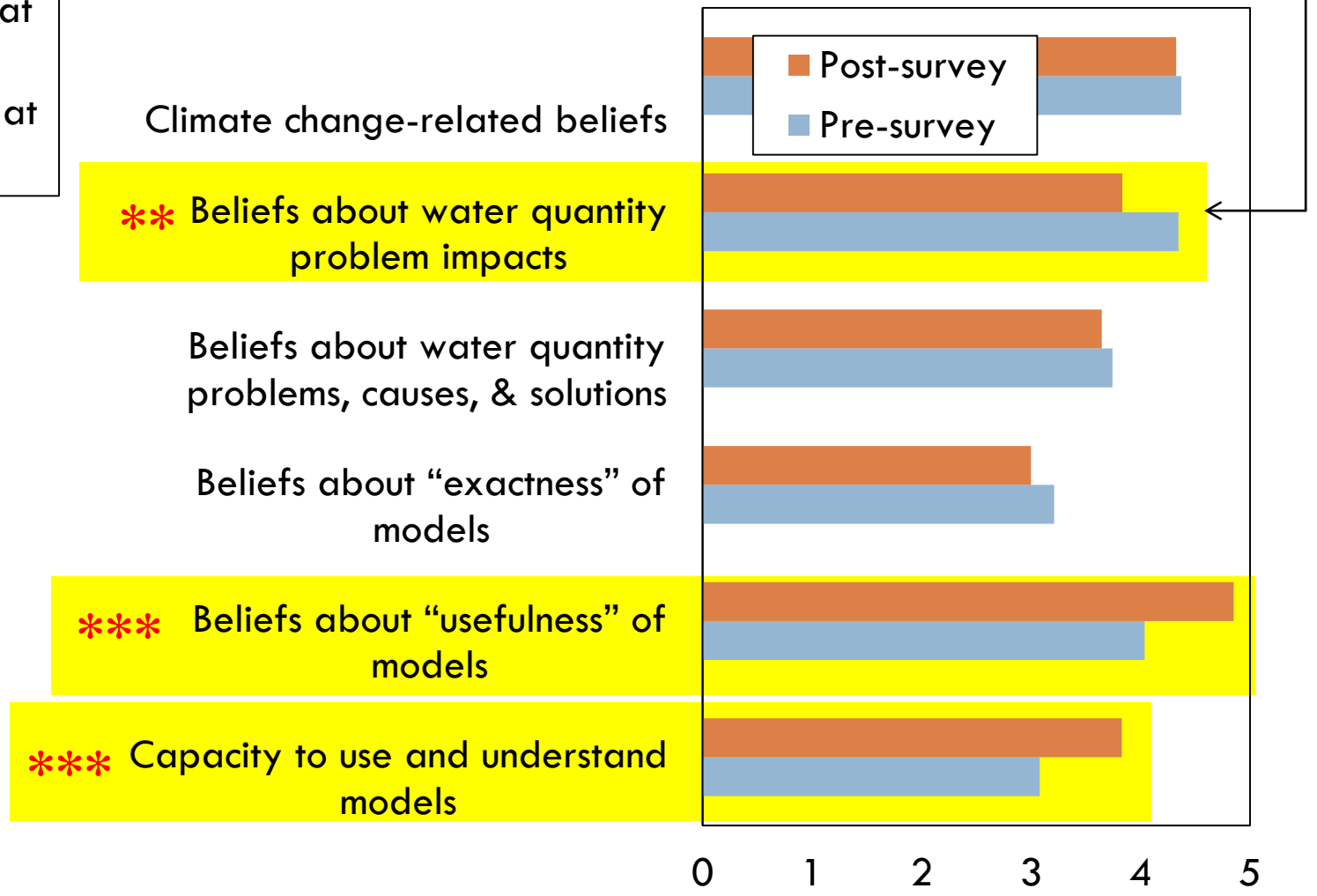
Theme/Scale
Participant's prior experience with models
Beliefs about personal capacity to use and understand models
Beliefs about "usefulness" of models
Beliefs about "exactness" of models
Beliefs about water quantity problems, causes, and solutions
Beliefs about water quantity problem impacts
Climate change-related beliefs
Results of the workshops & Evaluation of the process
Total questions: Pre: 44 Post: 49

Overall scale results

The lack of water hurts agriculture and industry and reduces economic development in our region.

*** significant at $p < 0.01$

** significant at $p < 0.025$



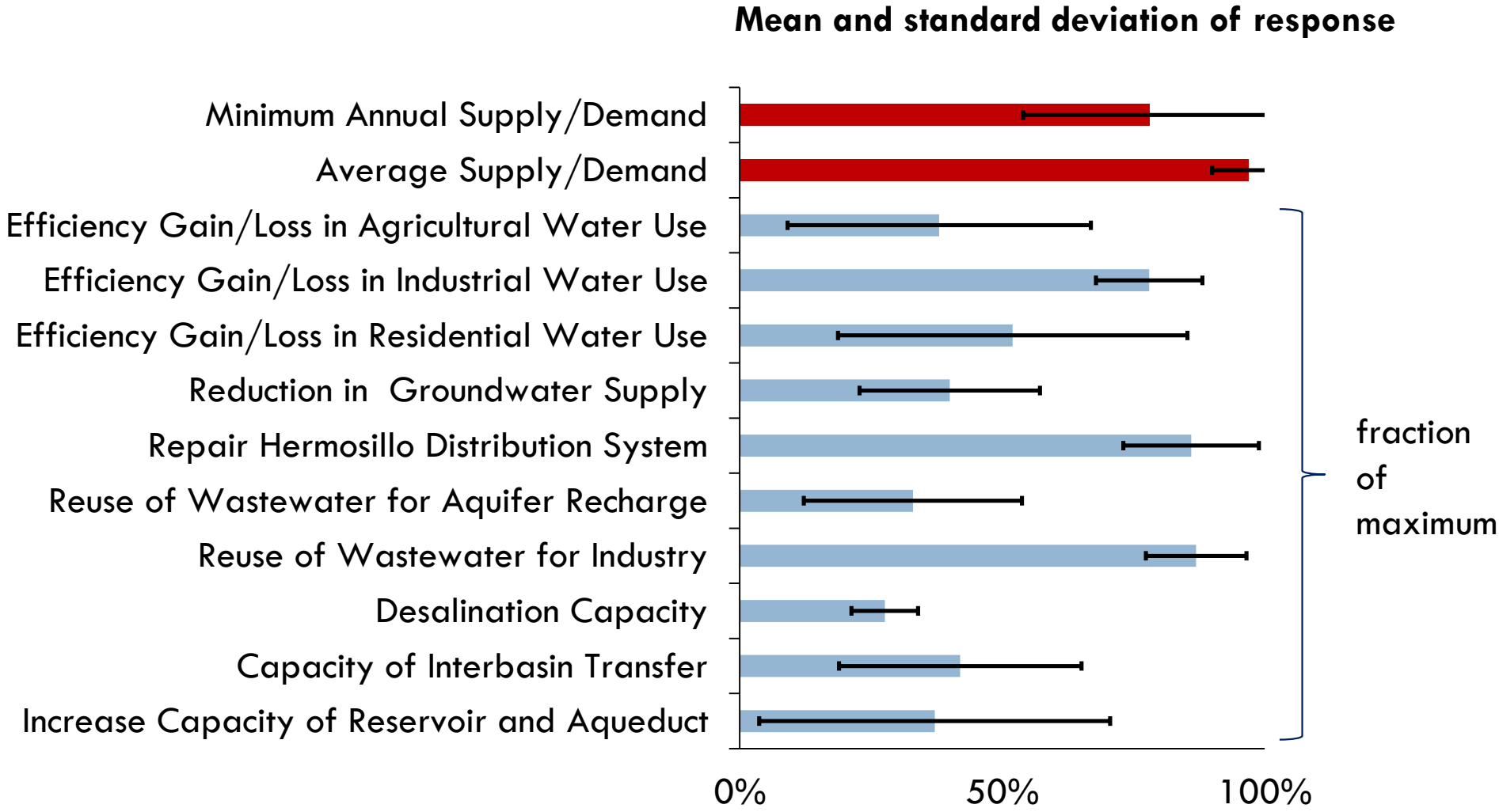
Selected pre- and post-survey results

- Impacts of the problems
  - More people believe that lack of water can cause ecological problems.
  - Fewer people believe that the lack of water can result in reduction in population in the region.
  - Fewer people believe that excessive exploitation of water **does not** exist in the Río Sonora.
- Social impacts of water resources decision making
  - More people believe that when there are conflicts between uses of water, priority should be given to domestic use.

Water management strategy options

- Increase Capacity of Reservoir and Aqueduct
- Capacity of La Independencia Interbasin Transfer
- Desalination Capacity
- Reduction in Hermosillo Groundwater Supply
- Reuse of Wastewater for Industry or Aquifer Recharge
- Repair Hermosillo Distribution System
- Efficiency Gain/Loss in Residential, Industrial or Agricultural Water Use

Management strategies: Results



Conclusions/Observations/Questions

- Most people were highly satisfied with the conduct of the workshop.
- Most people believed that they had contributed to the development of the models and that the models are useful.
- Full, rich, open dialogue about water resource decision making in the basin occurred.
- Preference of supply- and demand-side options was roughly equal.
- How do we increase participation in workshops?
- What will a broader array of climate projections reveal?