Sustainable Water Resources for Communities under Climate Change: Can State-of-the-Art Forecasting Inform Decision-Making in Data Sparse Regions?

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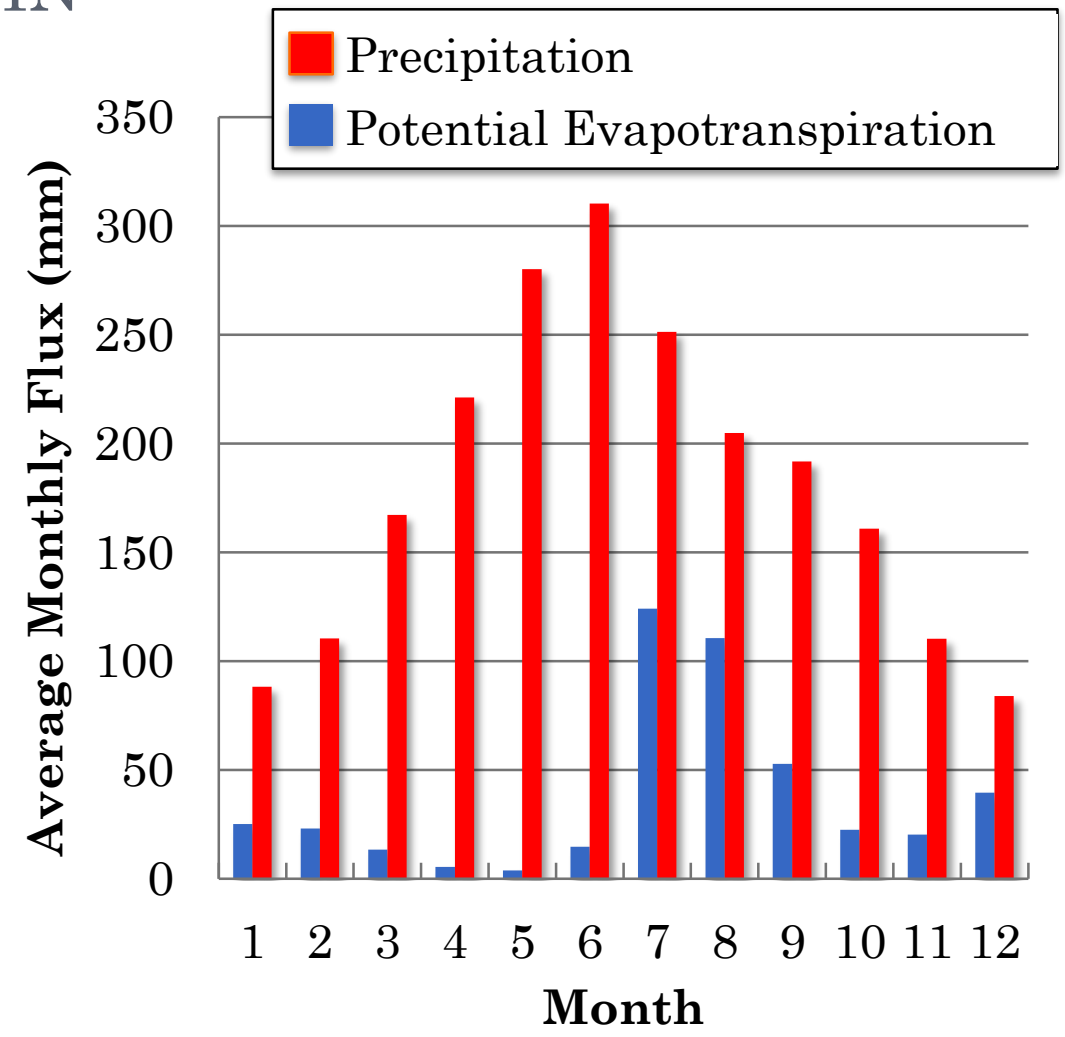
Rio Sonora Basin (RSB)

Rio Sonora Basin

- Highly variable, semi-arid climate, frequent severe droughts
- Large-scale irrigated agricultural water users and large urban area
- Water resources infrastructure and management struggles to deliver sufficient water.



Project Focus: Participatory Modeling

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

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

Motivation: Participatory Modeling

- Infrequently used in third world settings
- Infrequently rigorously assessed
- Provides platform for exploring beliefs, attitudes, perceptions of water resources issues.

Motivation: Prior Work in Region

- Policies leading to water quality and wastewater management problems
- Community perceptions of water quality and quantity problems
- Hydrologic and water quality modeling and hydro-meteorological studies
- Pilot water quality and quantity participatory modeling workshop

Research questions

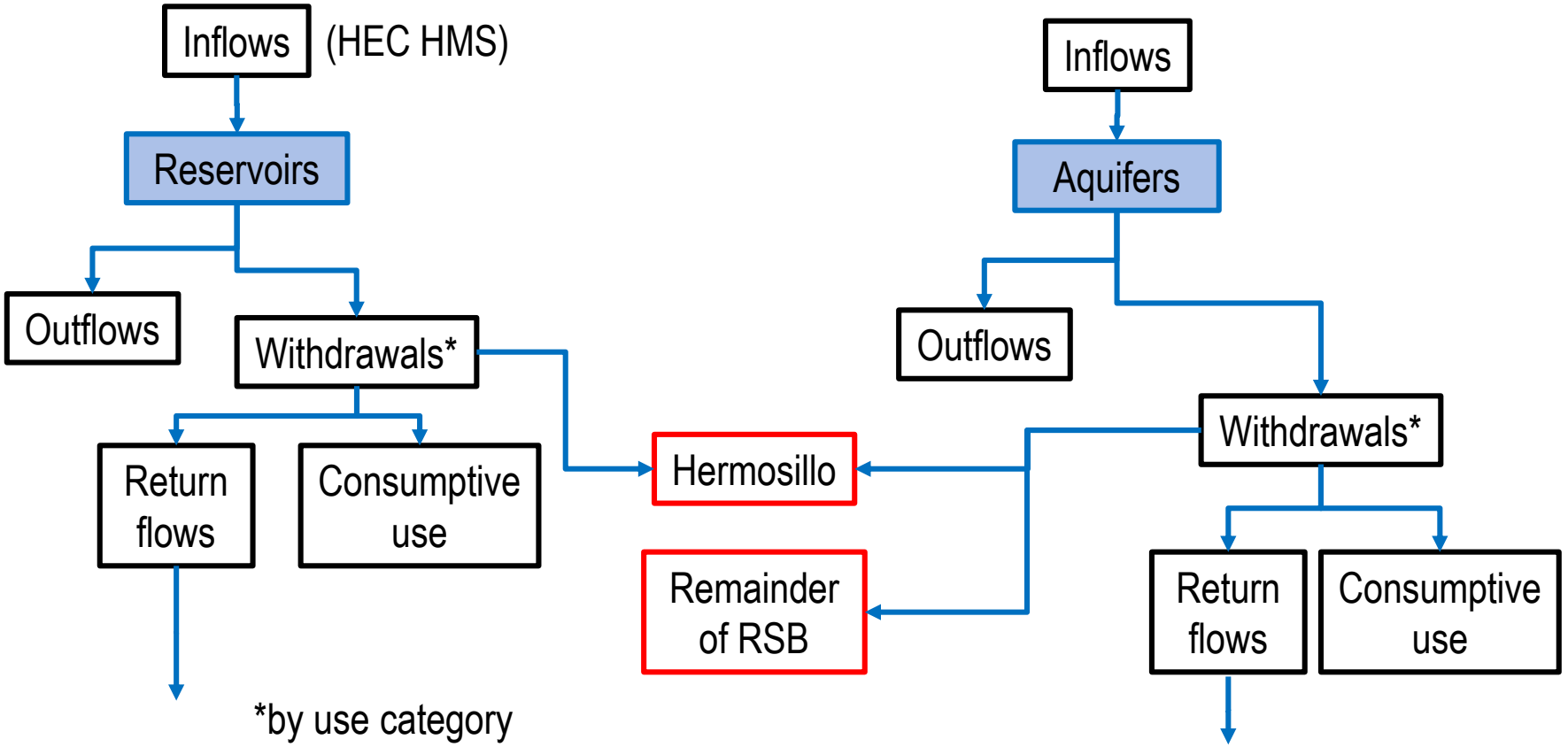
- What, if any, participant impacts can water resource-oriented participatory modeling have regarding participant model comfort and self-efficacy?

- Will exposure to increased information about climate change and water-related problems, causes, and solutions within a highly deliberative environment change participants' water-related beliefs?

Research Design

- Initial field trip, informal interviews with water academics and agency staff (2011)
- Semi-structured interviews with 35 water users and water agency staff (2011)
- Three workshops with water agency staff, academics, NGOs (March, May, June 2013)
- Onsite pre- and post-surveys

- Models utilized to date include
  - hydrologic model for simulating streamflows in the USRB driven by historic and future climate (HEC HMS)
  - water resources systems model of water infrastructure and potential changes to it (STELLA).



Annual Simulations for Cuenca Rio Sonora and Hermosillo

Run

Climate Year

- 1990: Historical "Wet"
- 1996: Historical "Dry"
- 2037: Future "Dry"
- 2038: Future "Wet"

Water Management for Hermosillo

Total Desired Withdrawals for Hermosillo (millions of cubic meters): 76

Fraction of Total Desired Withdrawals for Hermosillo Met by Water Supply: 1.46

Reduction of Baseline Hermosillo Groundwater

Hermosillo Withdrawal

Domestic	52
Industrial	2
Commercial	8
Water Lost	49
Total	111
Surface Water Return Flows for Hermosillo	57

Cuenca Rio Sonora With

Agricultural	211
Pecuario	61
Public Water Supply	50
Industrial	5
Commercial	7

Fractional Increase in El Molinito Storage Capacity

Fractional Increase in El Molinito-Hermosillo Aqueduct Capacity

Hermosillo Withdrawals

Presa El Molinito	23
Mesa del Seri Acuifero	45
Pesqueira Acuifero	7
La Manga Acuiifero	36
Total	111

Study design

- The survey instrument will take the form of pre- and post-surveys with three goals:
  1. assess changes in knowledge regarding RSB water quantity problems and solutions, as well as potential climate change impacts;
  2. assess changes in beliefs about water models and comfort with using/understanding them and
  3. assess participant perceptions of the value, quality, accessibility, and usability of the model and workshops.
- The survey instrument has been constructed to measure major variables through suites of five to seven questions designed to be combined into indices during analysis.

Pre-Survey Results: Modeling Experience

- 51% do not work with models regularly.
- 51% have no prior water modeling experience.
- 38% do not know the difference between hydrologic and water resources systems models.

Pre-Survey Results: Climate change-Related Beliefs

- 83% agree or agree strongly that climate change is happening
- 68% believe that climate change is going to create enormous problems for Mexico
- Majority (64%) expect greater Rio Sonora droughts, only 32% expect greater flooding due to climate change

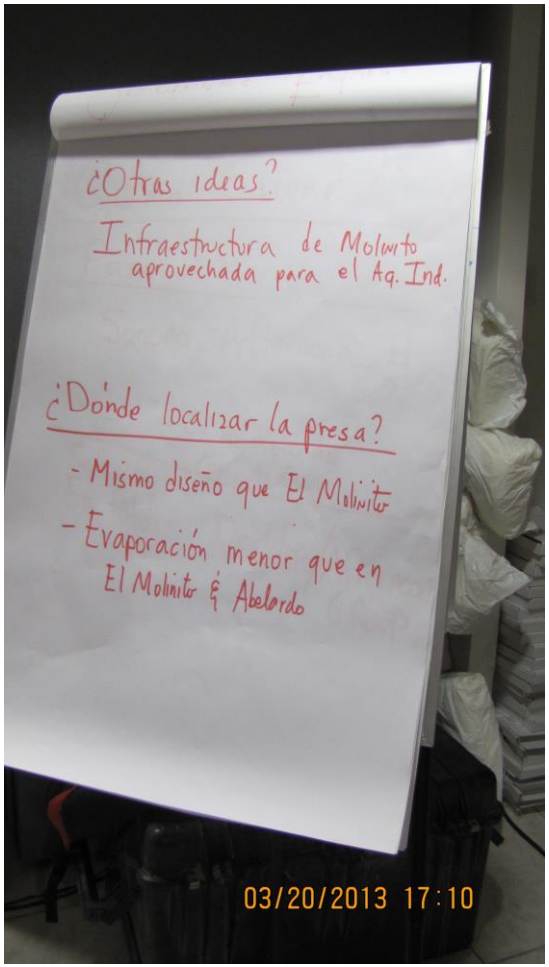
Pre-Survey Results: Water Quantity Problems

- 66% believe that regional water demand exceeds Rio Sonora watershed supply.
- 62% believe that inefficient agricultural water use is causing regional water scarcity.
- 83% believe that Rio Sonora basin water scarcity is causing ecological problems .

Deliberation and Requests for Model Components and Additions

- Full, rich, open dialogue about water resource decision making in the basin

- Through experience in model, participants requested desired model components, additions, changes for Workshops 2 (May) and 3 (June)



Conclusions

- stay tuned!

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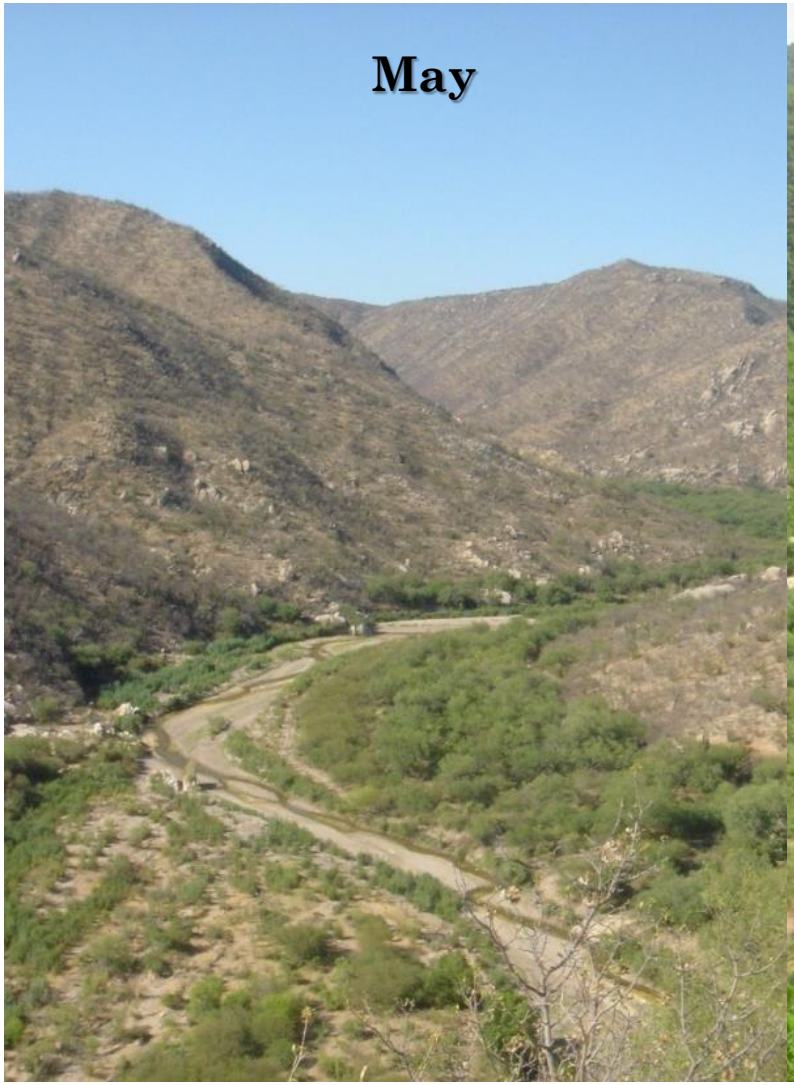
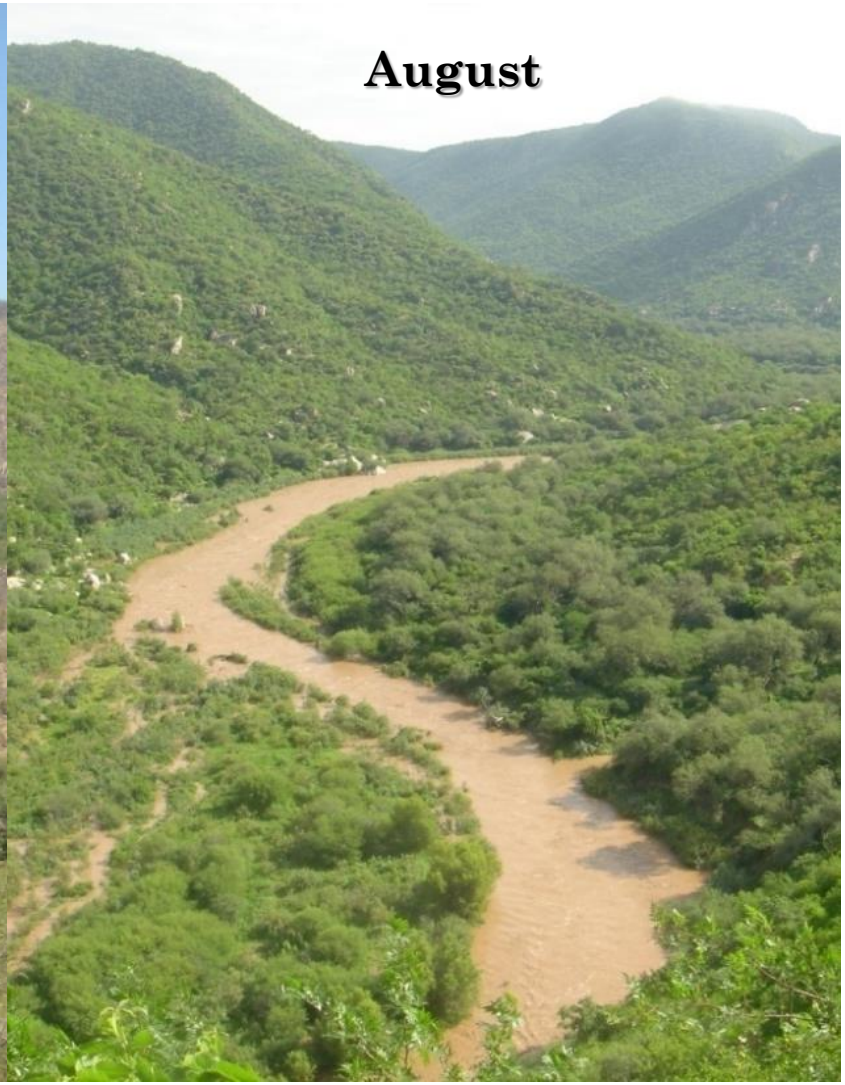

May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