

# **Incorporating Climate Information and Stakeholder Engagement in Groundwater Resources Planning and Management**

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**Funded by, NOAA – SARP Award Number: NA12OAR4310092**

**Webinar 21 November 2013**

**Sponsored by The NOAA Sectoral Applications Research Program (SARP),**

**US National Integrated Drought Information System (NIDIS),**

**Water Research Foundation (WRF), Water Environment Federation (WEF),**

**Water Environment Research Foundation (WERF) and**

**American Water Works Association (AWWA)**



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# **Incorporating Climate Information and Stakeholder Engagement in Groundwater Resources Planning and Management or GCASE – Groundwater, Climate and Stakeholder Engagement**

## **Presentation Outline**

1. Project Goals and Approach, including stakeholder engagement and transferability - Megdal
2. Modeling Approach and Case Study Results - Shamir
3. Next steps – Megdal/Shamir
4. Questions/discussion

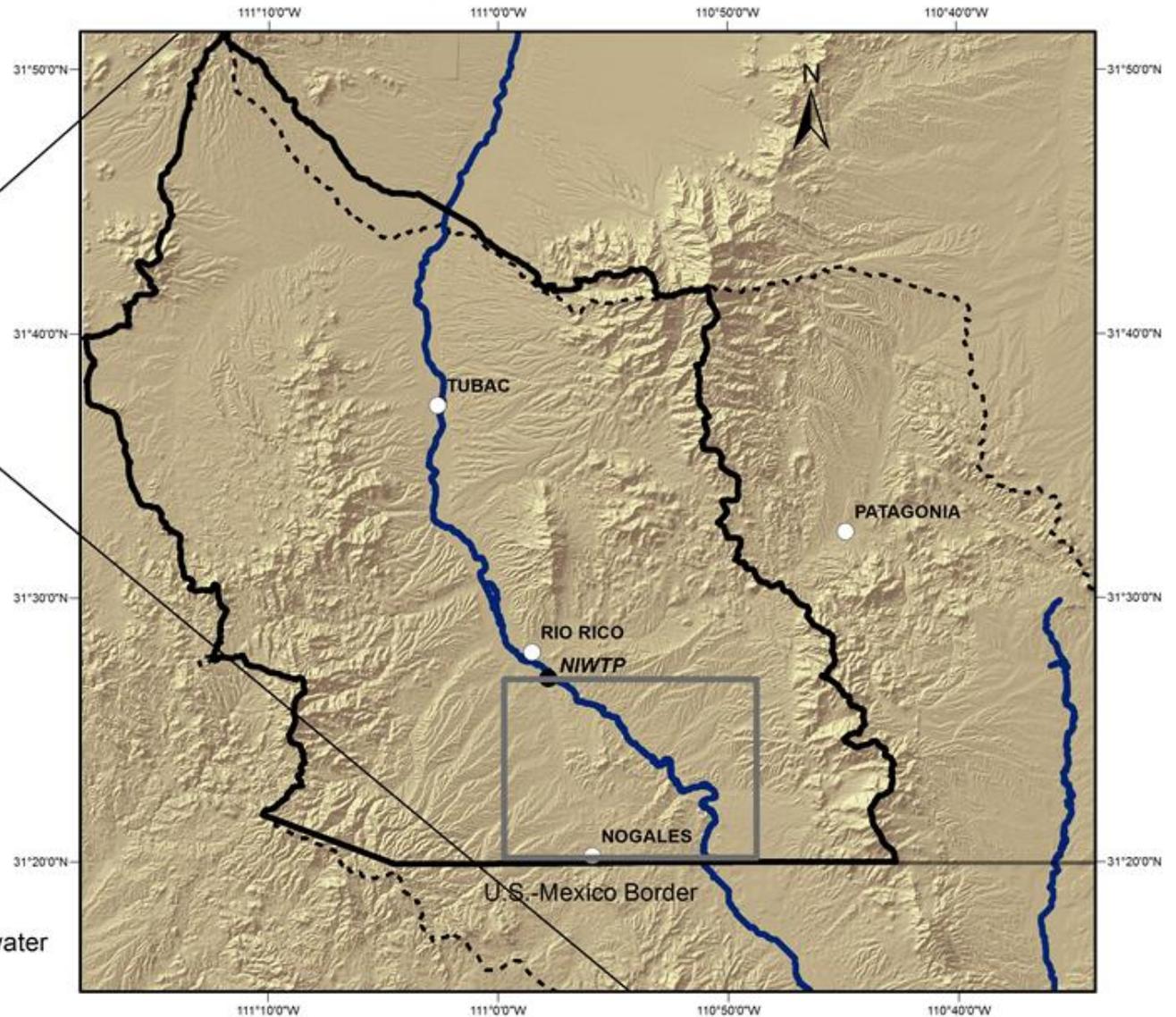
# Project Goals and Approach

1. Develop water resources decision support modeling framework that addresses future climate uncertainties
  - Climate scenarios and surface water flows
  - Linkages to groundwater recharge
  - Linkages to water management decisions
2. Increase stakeholder capacity to adapt water planning and management to future climate uncertainties
3. Establish transferability of the modeling approach and stakeholder engagement

# Project Team

- Principal Investigators and Co-PIs – Sharon B. Megdal, WRRC; Eylon Shamir, HRC; Susanna Eden, WRRC; Christopher Castro, Atmospheric Sciences (ATMO); Karletta Chief, Soil, Water, and Environmental Science
- Additional personnel – Graduate Outreach Assistant, Jacob Prietto, WRRC; Graduate Research Assistant, Carlos Carillo, ATMO; Research Associate, Hsin-I Chang, ATMO
- Project Advisory Committee – Representatives from Arizona Dept. of Water Resources, US Geological Survey, Salt River Project, and City of Nogales, AZ
- Stakeholders

# Location of Study Area



## Legend

- Towns
- Nogales International Wastewater Treatment Plant
- Santa Cruz River
- ▭ Study Area Boundary
- ▭ Santa Cruz AMA Boundary
- ▭ Santa Cruz Watershed Boundary

0 3 6 12 Miles



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# Santa Cruz Active Management Area (SCAMA)

“The management *goal* of the Santa Cruz AMA is to maintain a safe-yield condition in the active management area and to prevent local water tables from experiencing long term declines.”

**Arizona Revised Statutes**



<http://www.azwater.gov/azdwr/WaterManagement/AMAs/SantaCruzAMA/default.htm>

# Web Site [wrrc.arizona.edu/GCASE](http://wrrc.arizona.edu/GCASE)



HOME ► GROUNDWATER, CLIMATE AND STAKEHOLDER ENGAGEMENT (GCASE)

## Groundwater, Climate And Stakeholder Engagement (GCASE)

### Project Summary

Planning to meet water demands in semi-arid regions is particularly challenging for groundwater dependent communities where aquifers are being replenished by intermittent streamflow events. Projected and observed climatic changes for the Southwest increase uncertainties. The project, Incorporating Climate Information and Stakeholder Engagement in Groundwater Resources Planning and Management, employs a novel modeling framework and extensive stakeholder interactions to achieve the following three objectives: (1) Address climate uncertainties with a sophisticated modeling framework; (2) Increase stakeholder capacity to adapt water planning and management to future climate uncertainties; and (3) Establish the transferability of the modeling framework and capacity building approach. [More>>](#)

[WRRC](#)

[Team](#)

[Documents](#)

[Links](#)

[Workshops](#)

[Discussion](#)



Ultralight photograph of the Santa Cruz River facing northwest over the northern portion of Rio Rico. (background: Tumacácori Mountains)



This work is funded under a grant from the Sectoral Applications Research Program (SARP) of the National Oceanic and Atmospheric Administration (NOAA) Climate Program Office. The views expressed represent those of the authors and do not necessarily reflect the views or policies of NOAA.

## WRRC Home Page Feature



HOME ► WRRC TO HOST NOV. 20 GCASE MILESTONE WORKSHOP

## WRRC to Host Nov. 20 GCASE Milestone Workshop

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The WRRC and the Hydrologic Research Center are conducting research designed to help water managers deal with climate uncertainties through a collaborative model development process. Groundwater, Climate And Stakeholder Engagement (GCASE) is a project combining an innovative modeling framework with extensive stakeholder participation. The WRRC will host a Nov. 20 Milestone Workshop in Tucson (Sol Resnick Conference Room, 350 N. Campbell). The workshop will present the results of a case study focusing on the Upper Santa Cruz River and the shallow groundwater aquifers near Nogales, Ariz. Updates on water management and climate studies will also be discussed with a diverse group of stakeholders.

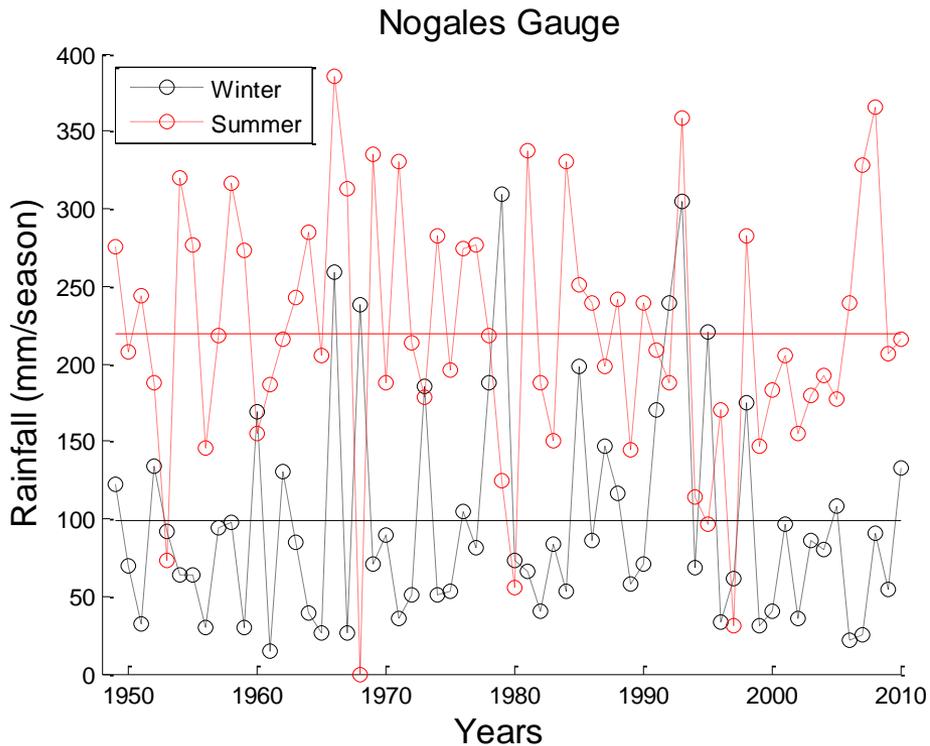
# Project Workshops

- Kickoff Workshop
  - October 18, 2012
    - Presented modeling framework and developed case study; discussed stakeholder concerns
- Milestone No. 1 Workshop
  - April 11, 2013
    - Presented case study for comments and revised modeling framework; presented climate projection findings for the region
- Milestone No. 2 Workshop
  - November 20, 2013
    - Presented revised case study and discussed transferability
- Four additional workshops
  - Transferability

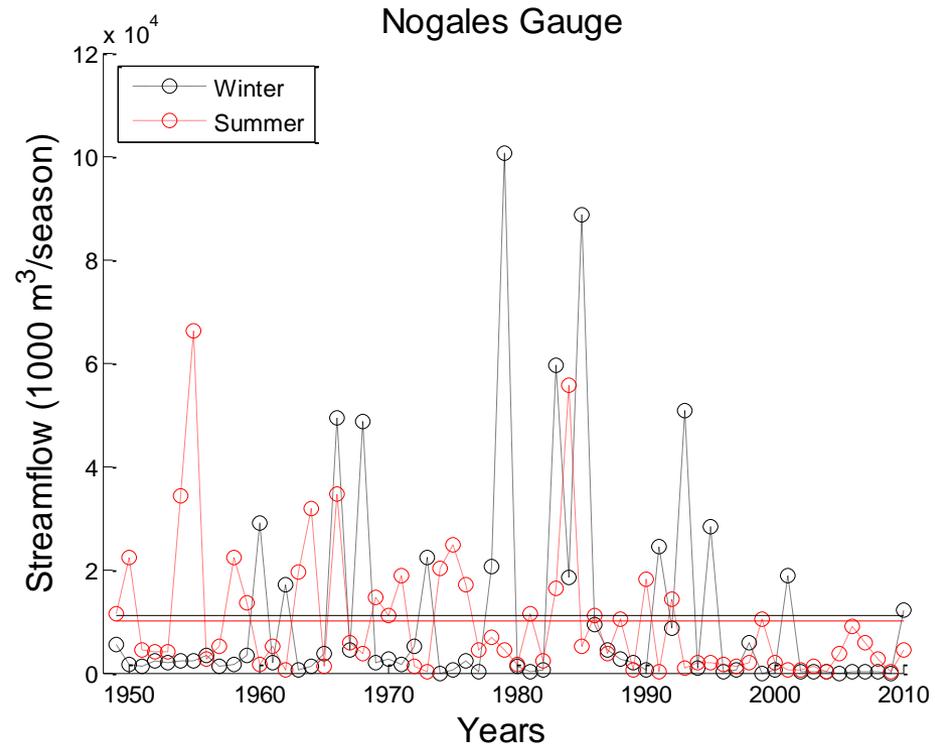


# Seasonal Precipitation & Streamflow

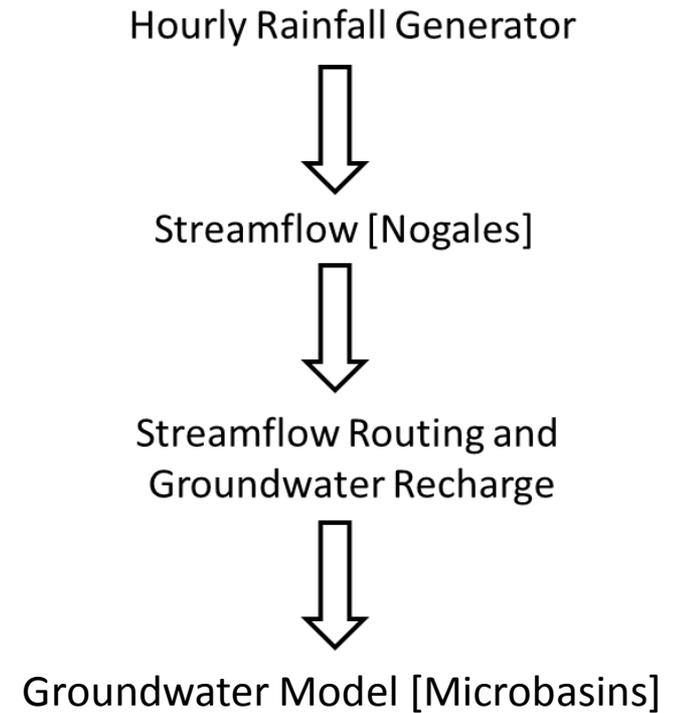
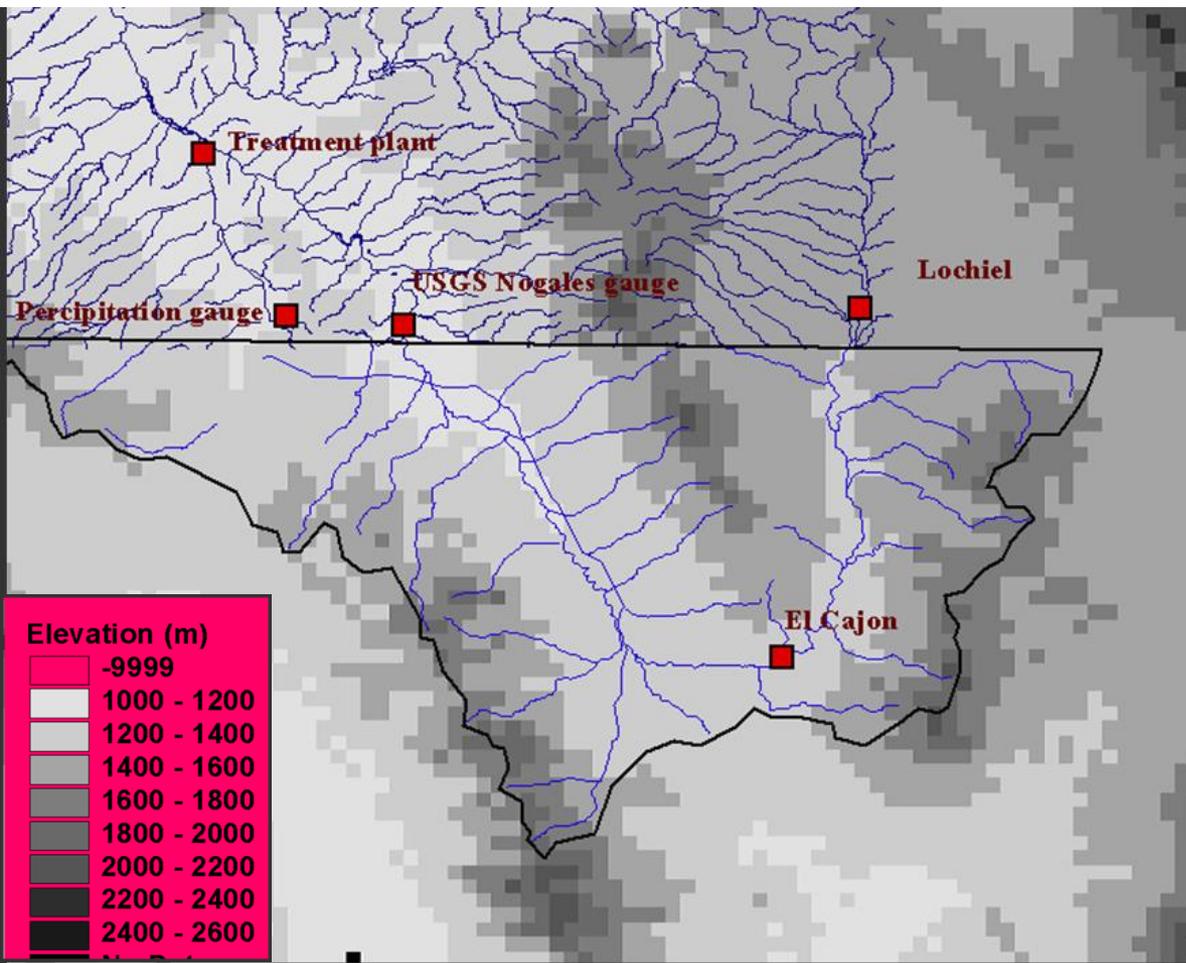
## RAINFALL



## STREAMFLOW



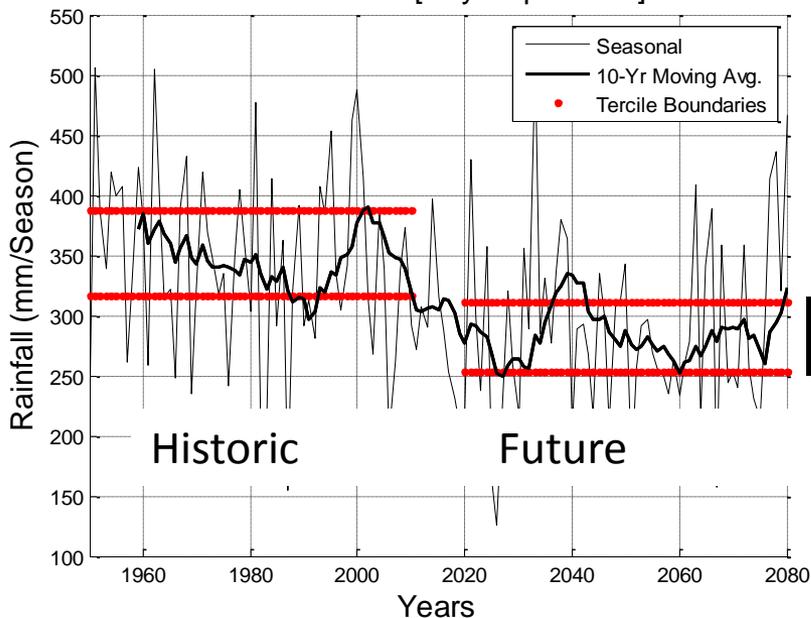
# Regional Hydrological Modeling Framework



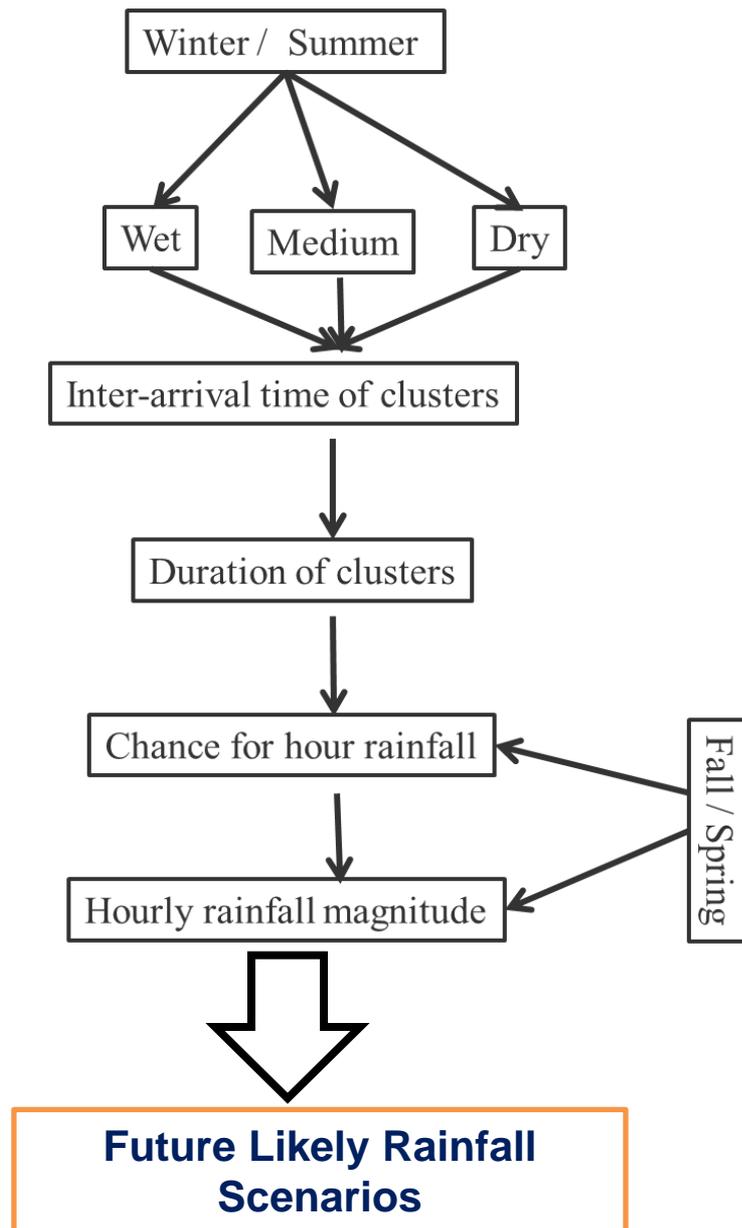
# Hydrologic Projections

## Regional climate model output

MPI Summer [July-September]

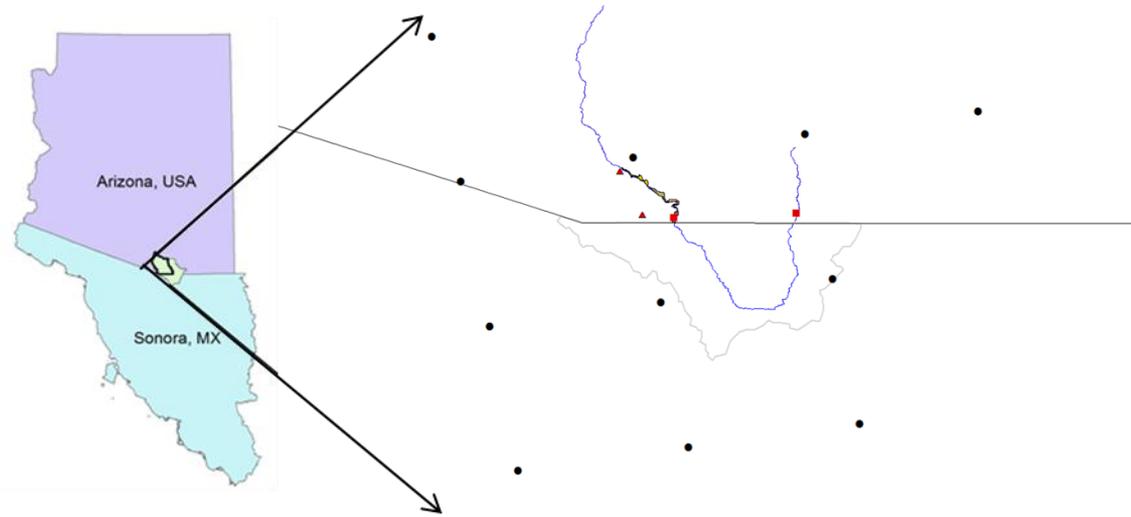


## Rainfall Generator



# Projections of Wetness Categories from Eight Regional Climate Models

- U of Arizona: Dynamically (WRF) downscaled (Castro et al. 2012)
  1. Hadley center
  2. Max Planck Institute
- North American Regional Climate Change Assessment Program, Six models (Bukovski et al. 2013)



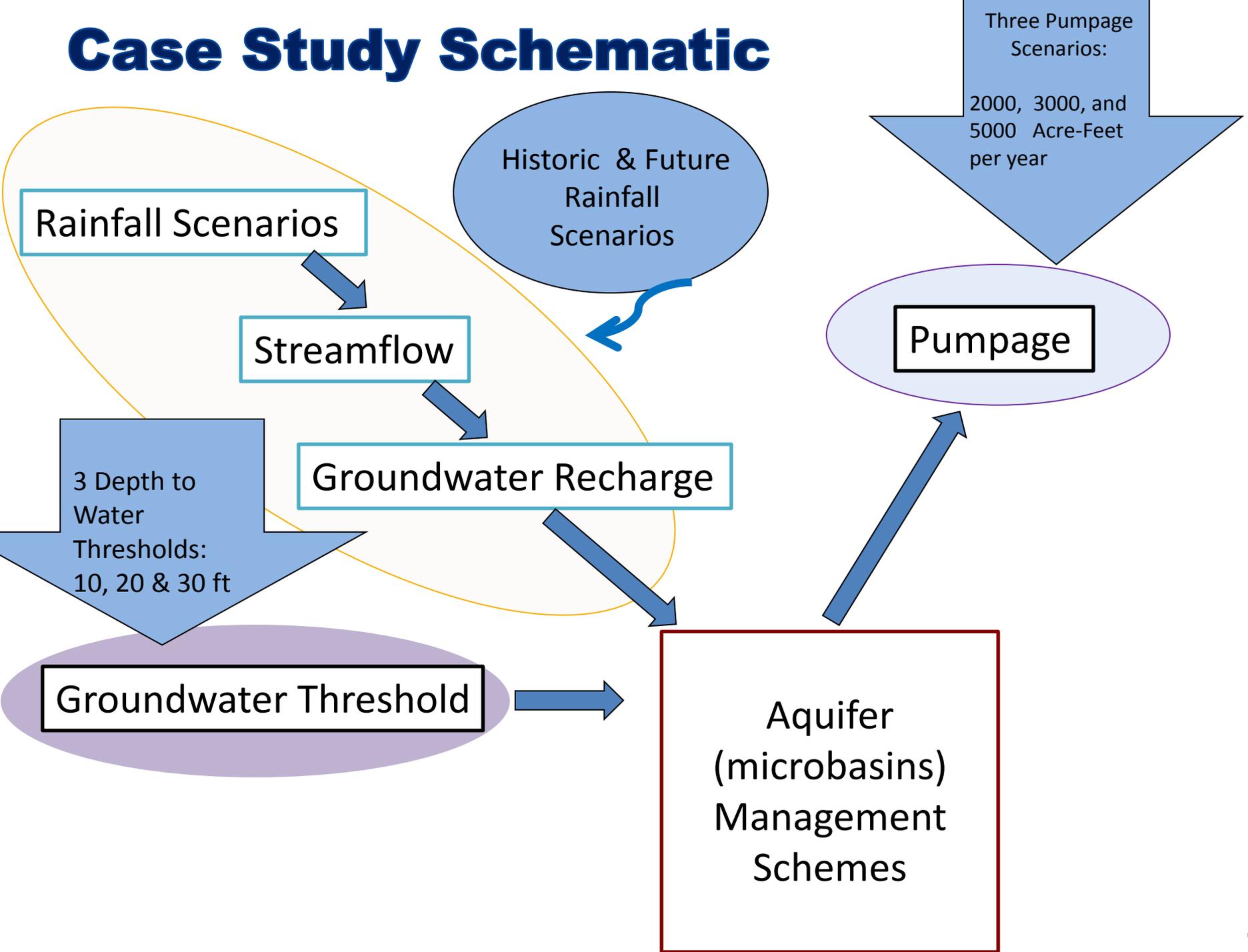
## SUMMER

- 7 models indicate higher frequency of dry summer
- 6 models indicate lesser frequency of wet summer

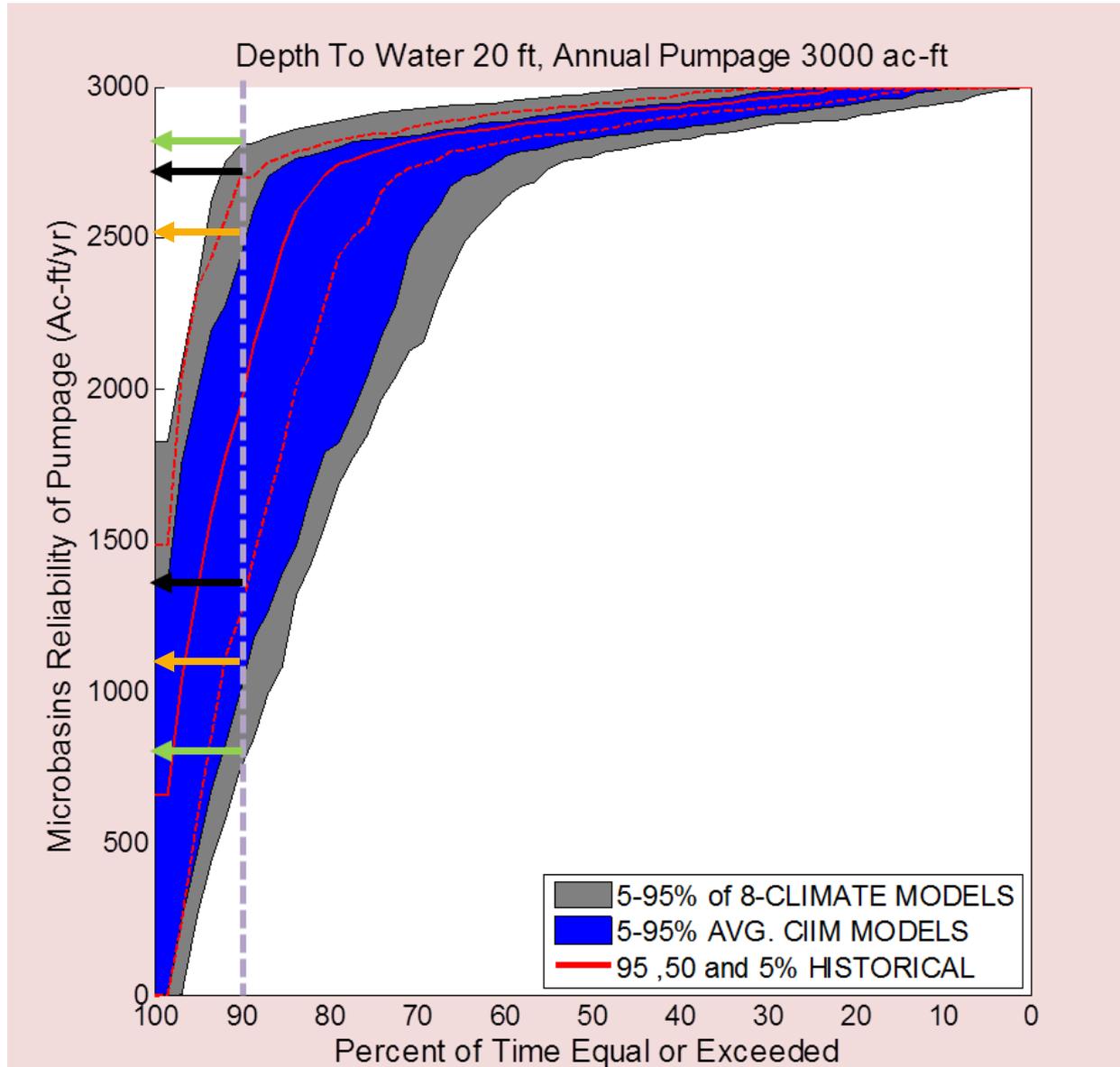
## WINTER

- 8 models indicate higher frequency of dryer winter
- 6 models indicate higher frequency of wet winter

# Case Study Schematic

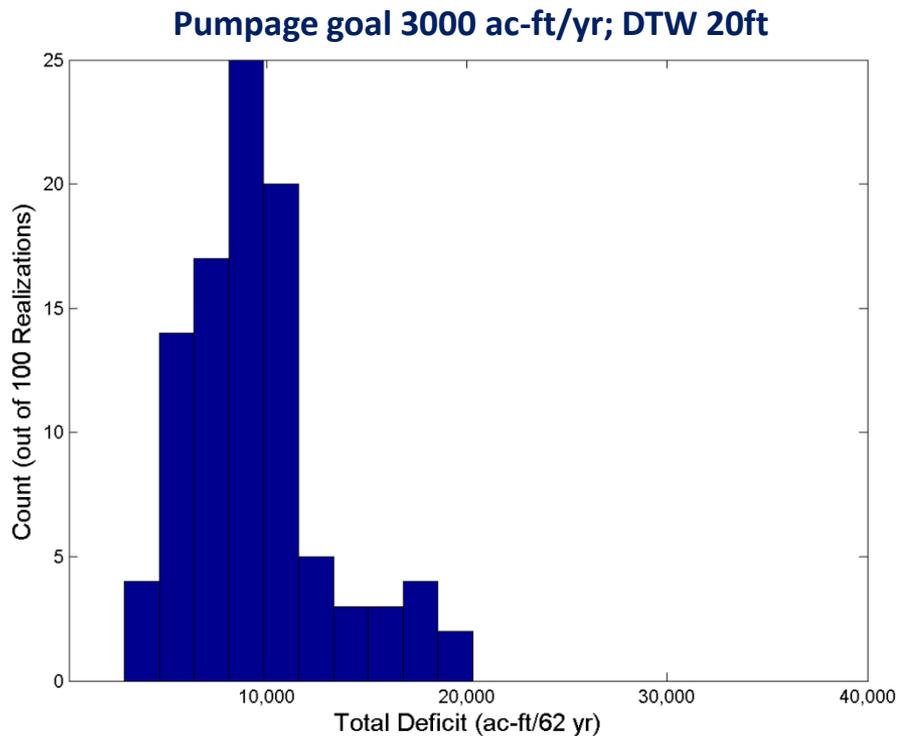


# Supply Reliability Considering Eight Regional Climate Models

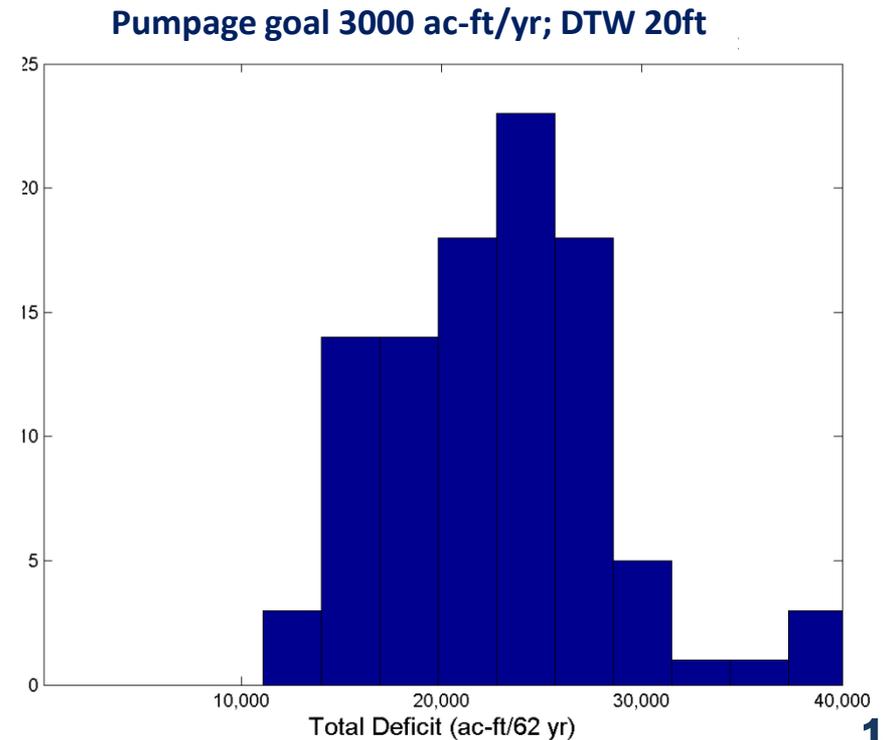


# 62-year Total Water Deficit [based on 100 likely realizations]

## Historic Data



## Future Projection



# Accomplishments to Date

- Incorporated downscaled climate information into integrated surface water-groundwater model for an arid to semi-arid environment along the US-MX border
- Established robust dialogue with informed stakeholders throughout development of the case study, which involves multiple scenarios
- Connecting the scientific results to water resources planning and management

# Next Steps

- Case study documentation
  - Technical and scientific documentation
  - Materials for stakeholders of diverse backgrounds
- Transferability workshops in four locations
  - Locations under consideration
    - Upper San Pedro watershed
    - Gila River watershed
    - Hassayampa/Tonopah Region
    - Prescott-Verde River area
    - Oro Valley region
    - Santa Cruz River downstream of the current study area, which receives outflows of binational wastewater treatment plant
    - Others?
- Additional workshop prior to transferability workshops