



Groundwater, Climate and Stakeholder Engagement (GCASE): Santa Cruz AMA

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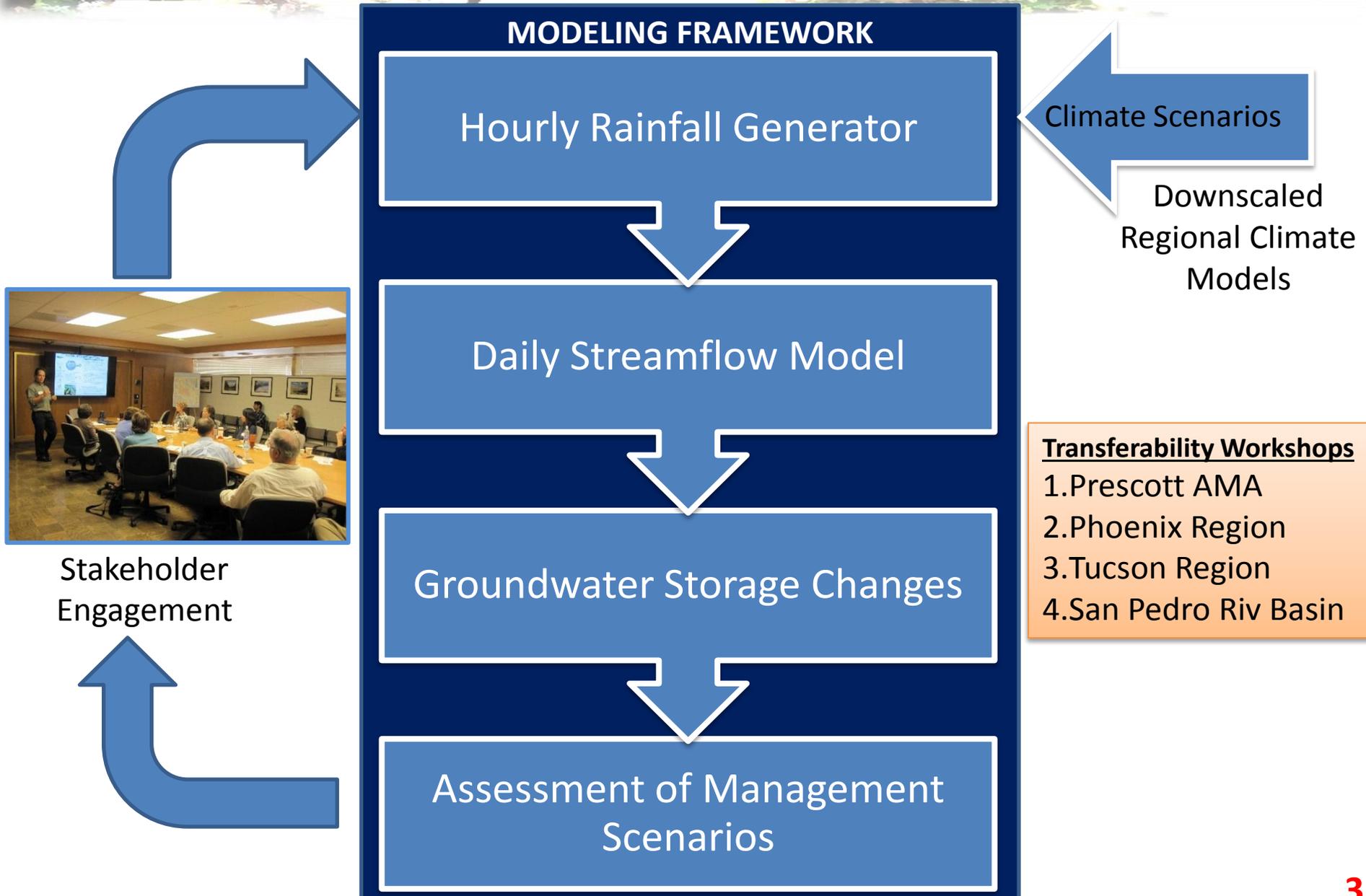
*Funded by, NOAA Climate and Societal Interactions Sectoral Applications Research
Program (SARP)*



Project Goals

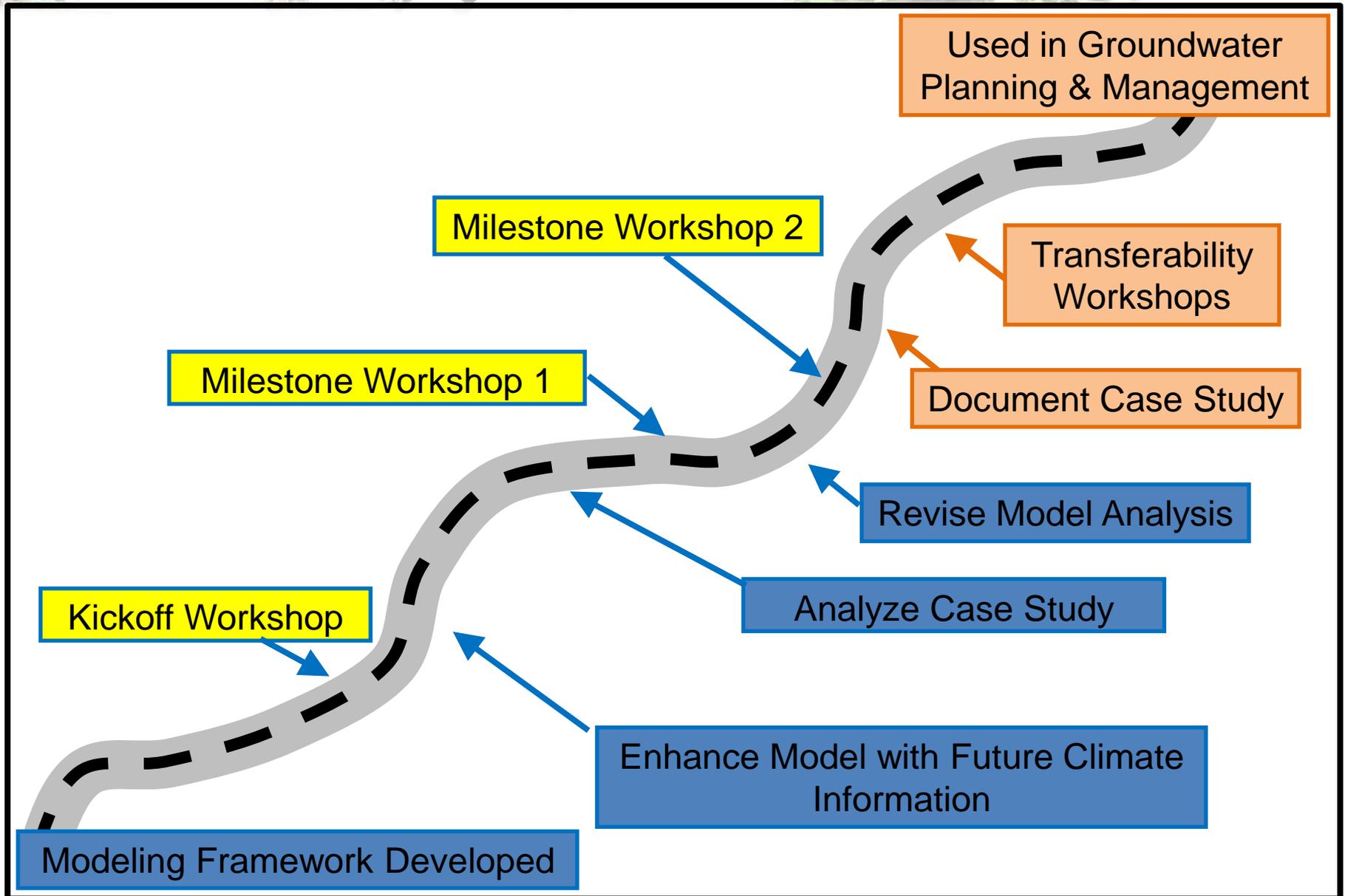
1. Enhance water resources decision support modeling framework to address future climate uncertainties
2. Increase stakeholders' capacity to adapt water planning and management to future climate uncertainties
3. Establish transferability of the modeling approach and stakeholder engagement

GCASE Project Approach



Stakeholder Engagement

GCASE Roadmap



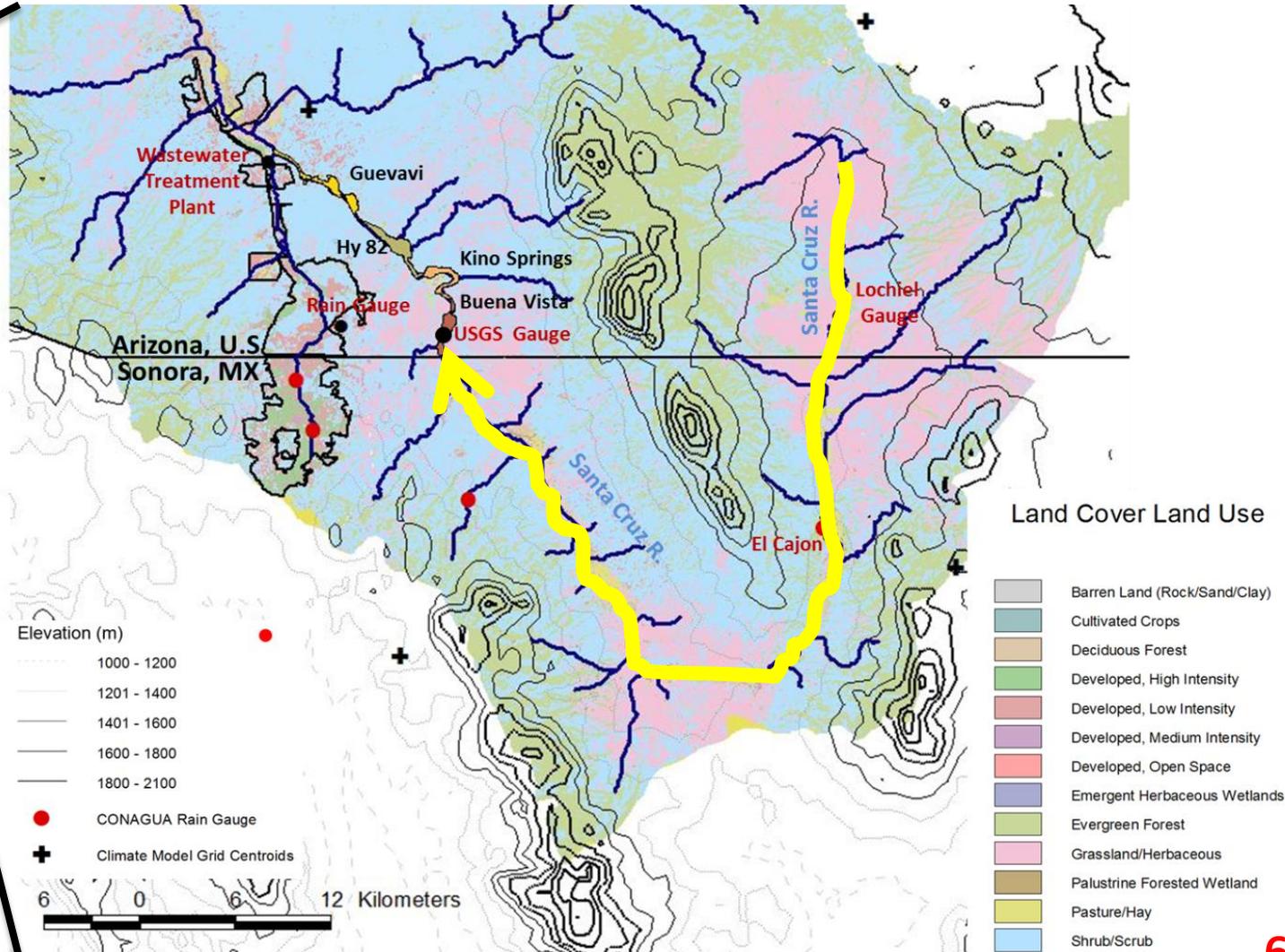
Santa Cruz AMA Goal



- To maintain a safe-yield condition in the active management area
- To prevent local water tables from experiencing long term declines

Assured Water Supply Rules on hold under statewide moratorium on rule making

Santa Cruz River Aquifer Microbasins



Microbasins Highly Responsive to River

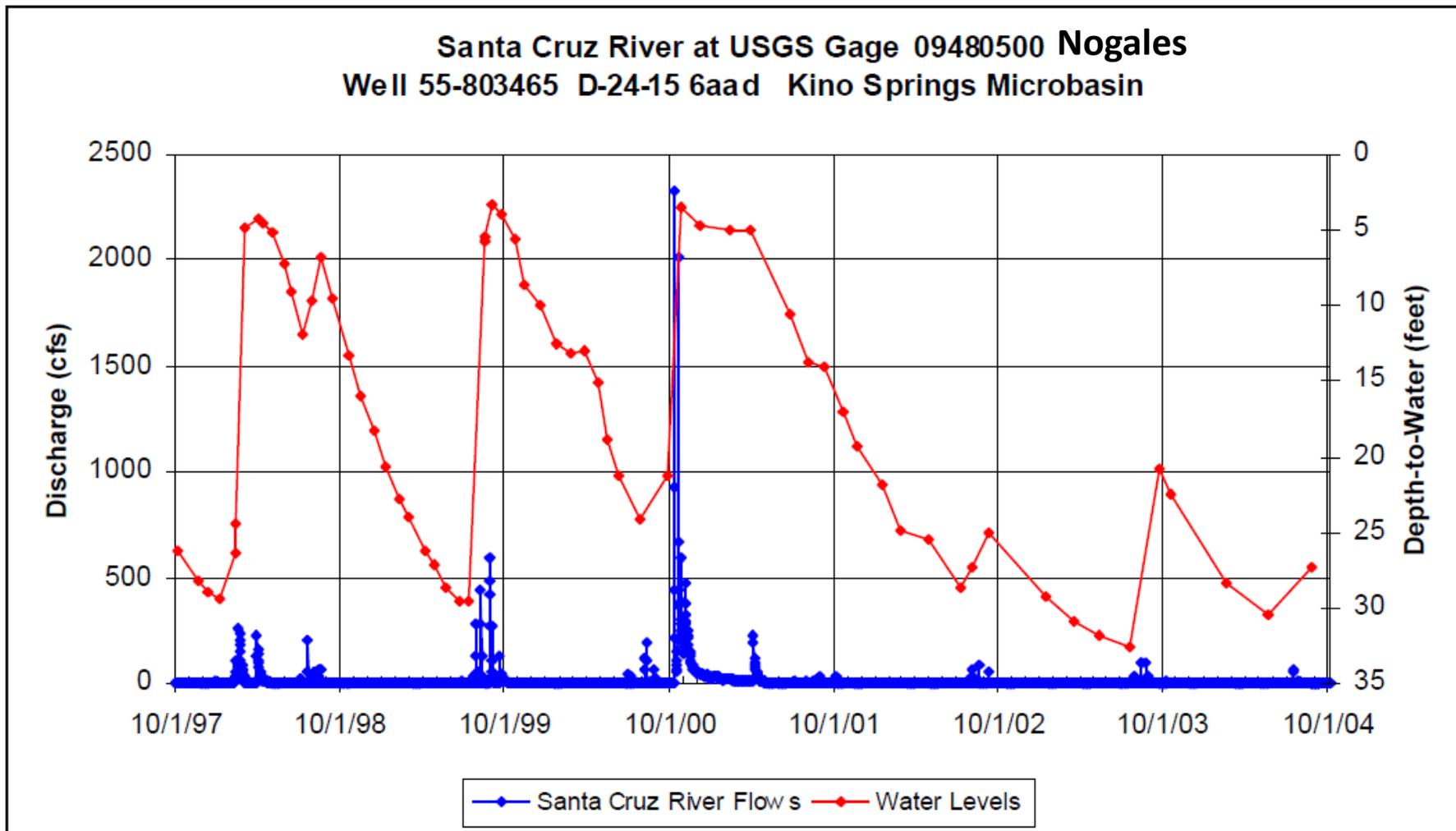
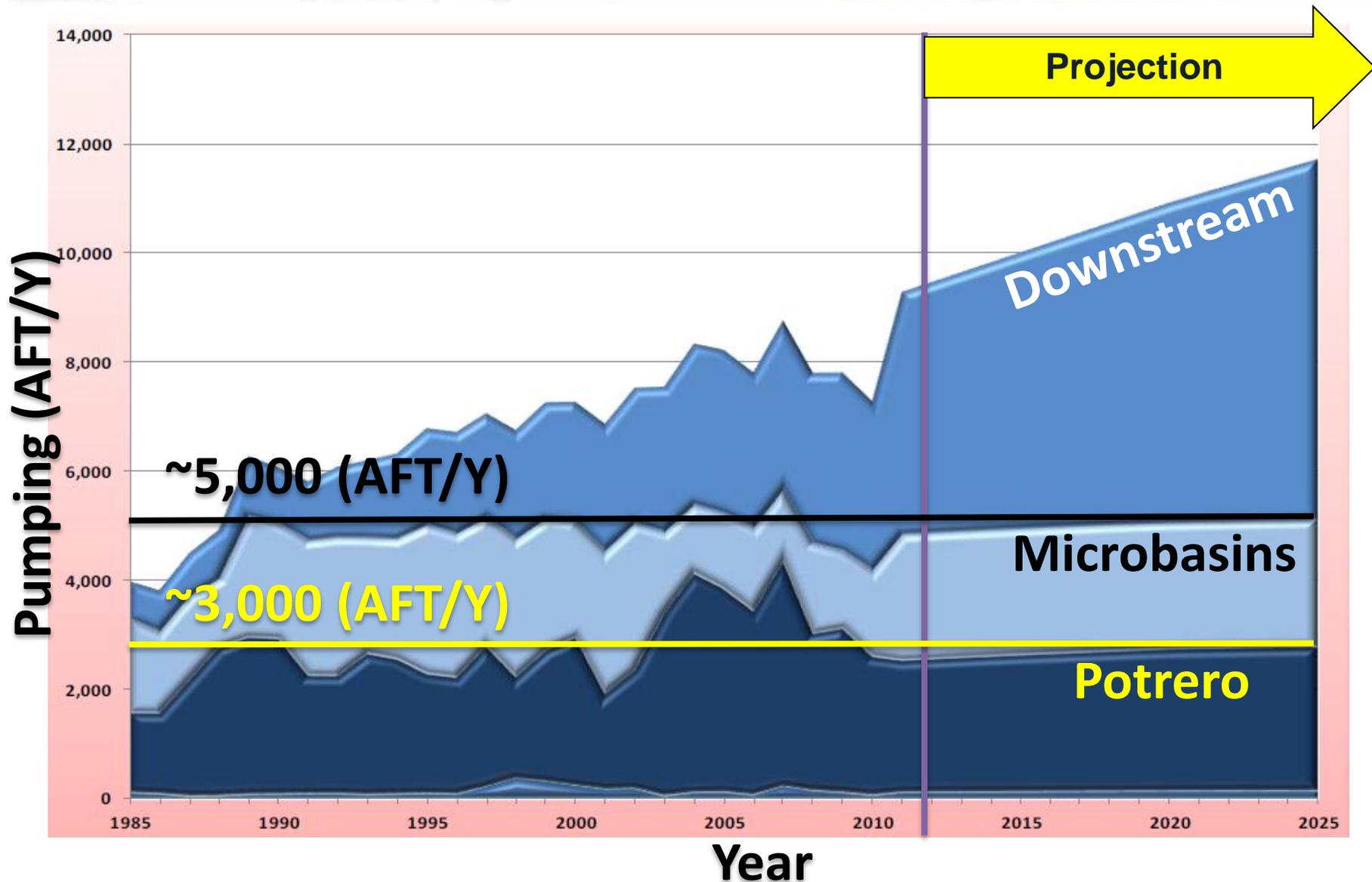
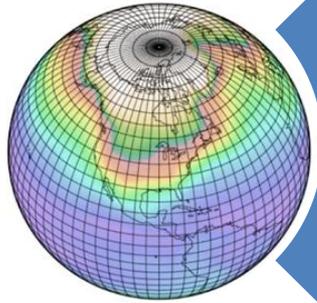


Figure 3-D. Hydrograph showing Seasonal Character of Microbasin Water Levels in the Kino Springs Microbasin and Response to Flow in the Santa Cruz River.

Predicted Pumping to 2025



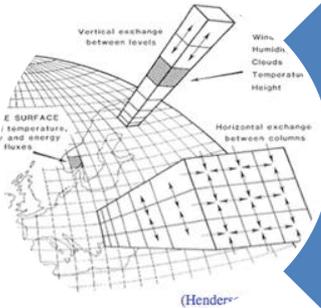
Climate and Hydrologic Models



Global Circulation Models

- General climatology patterns ocean-land
- Pacific sea surface temperature and relations to SW climatology
- Trade wind, atmospheric rivers etc.
- General climatology of temperature and precip.

Downscale



Regional Mesoscale Models

- Spatial distribution of climatological variables due to terrain and microclimate
- Special regional features
- Summer rainfall, snow
- Regional prevalent synoptic conditions

Input



Watershed Hydrologic Models

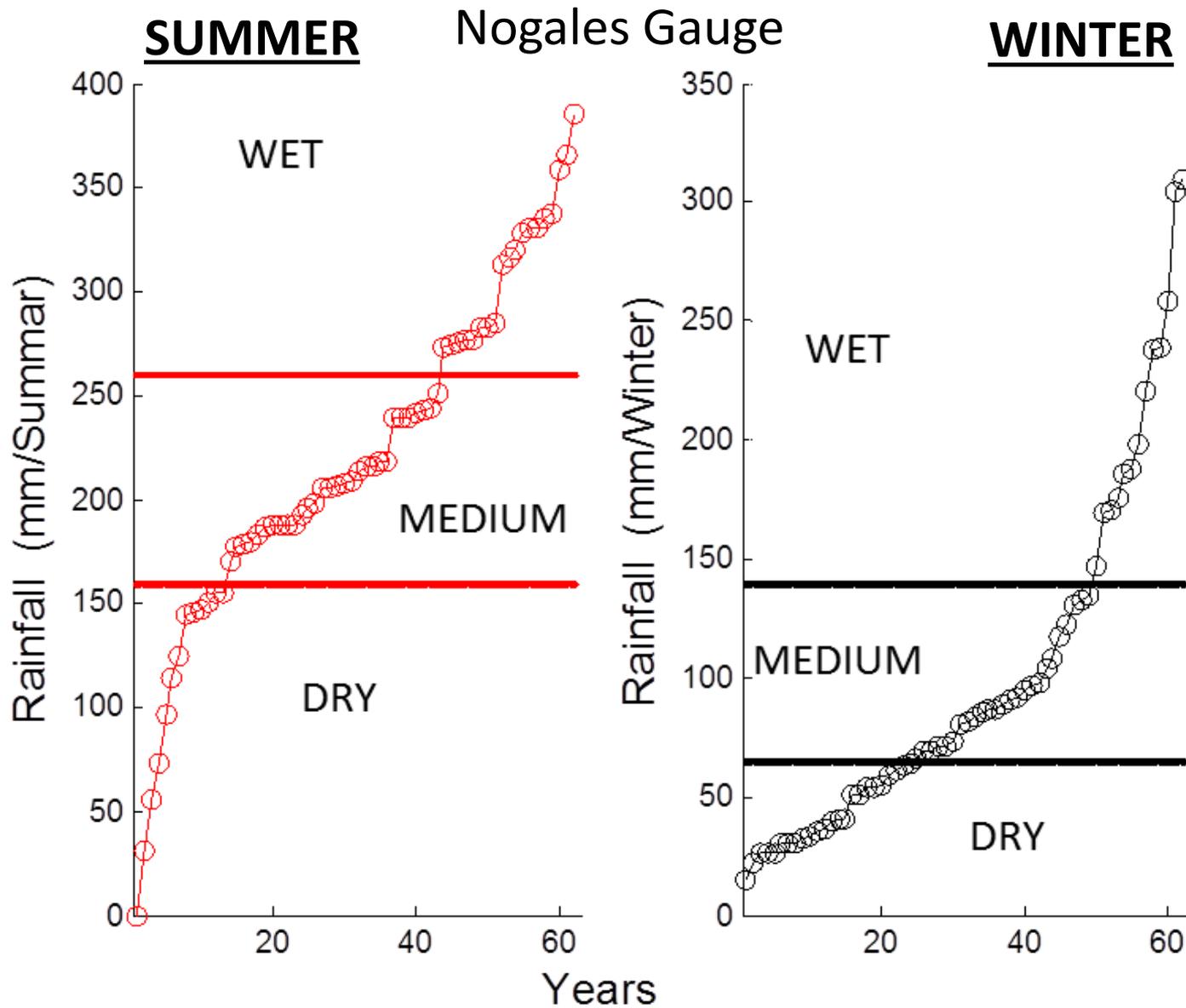
- Developed using local high resolution data
- Further refinement of microclimate features
- Interaction – surface –Groundwater
- Feedback with management decision

Precip from 8 Regional Climate Models

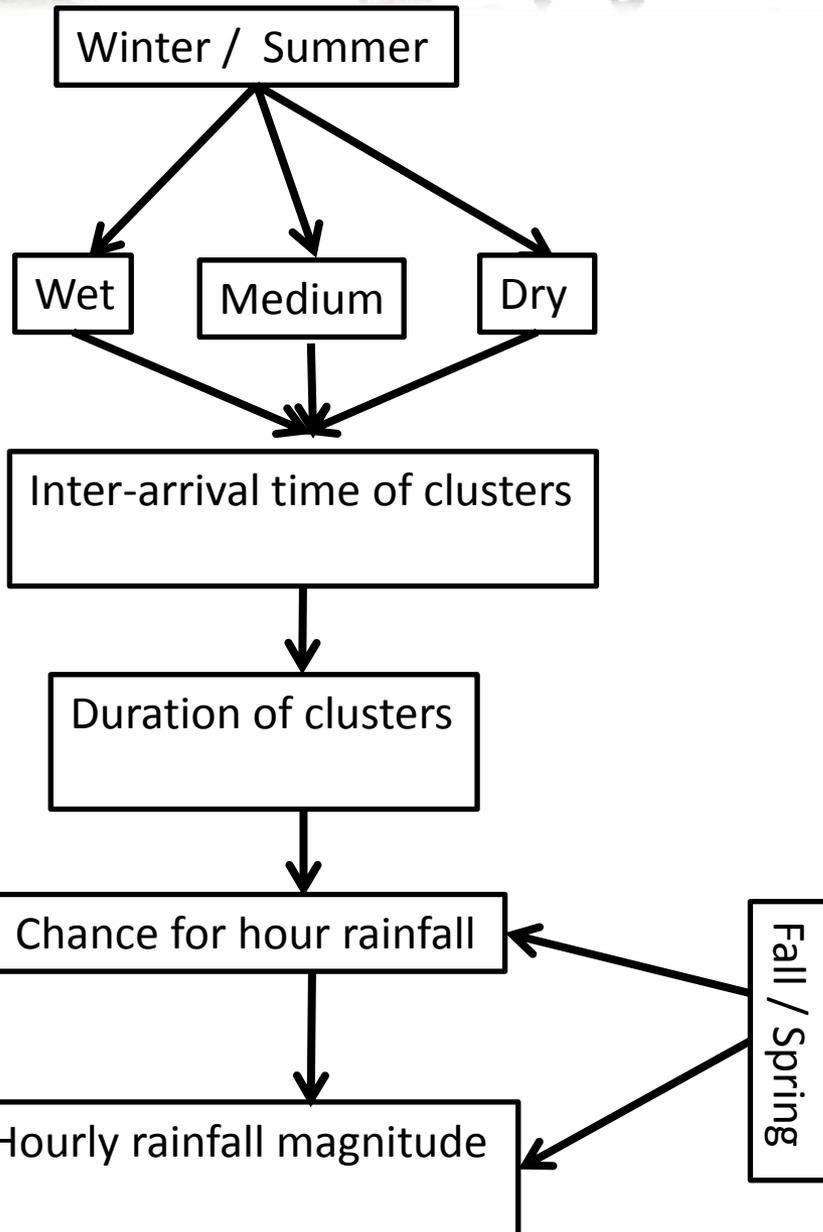
- Dynamic (WRF) downscaling
- A2 emission scenario

No.	Regional Model	Resolution
1	Max Planck Institute (MPI) 	35 km ² , 6 h,
2	Hadley center (HADCAM3) 	1950-2100
3-8	North American Regional Climate Change Assessment Program [NARCCAP]	50km ² , 3 h, 1970-2000 2040-2070

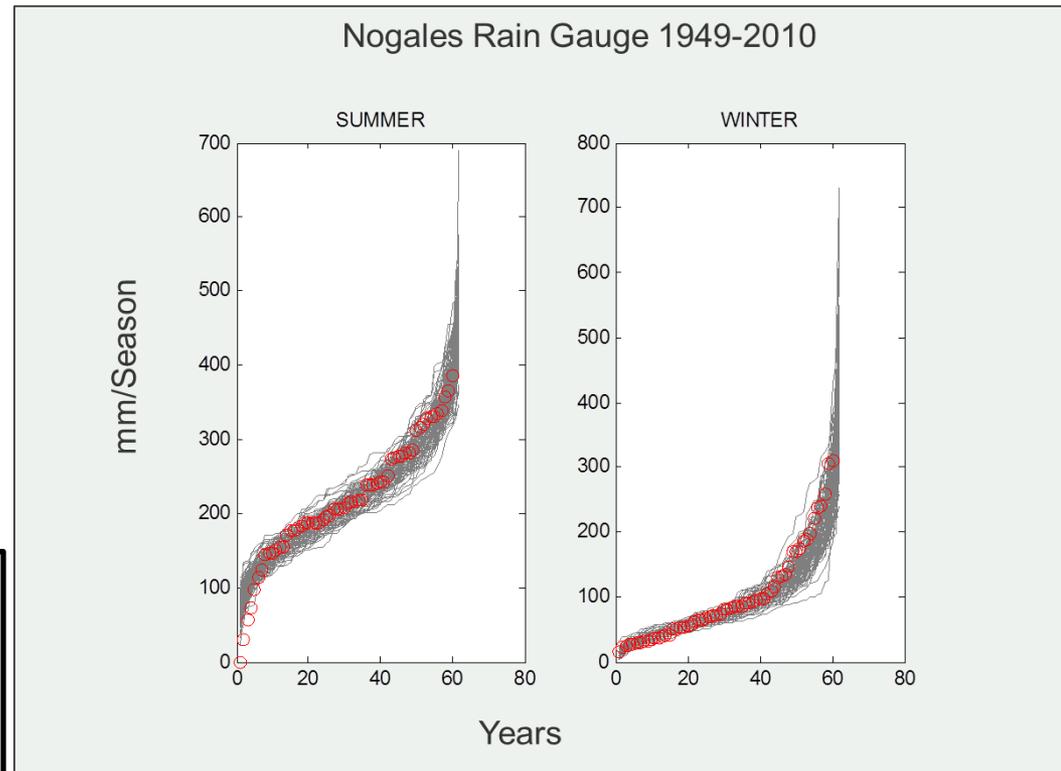
Precipitation Categorization



Rainfall Generator



- Generates rainfall for likely precipitation events
- Developed from Hourly precipitation data
- 100 realizations
- Each realization is 60-year of hourly rainfall



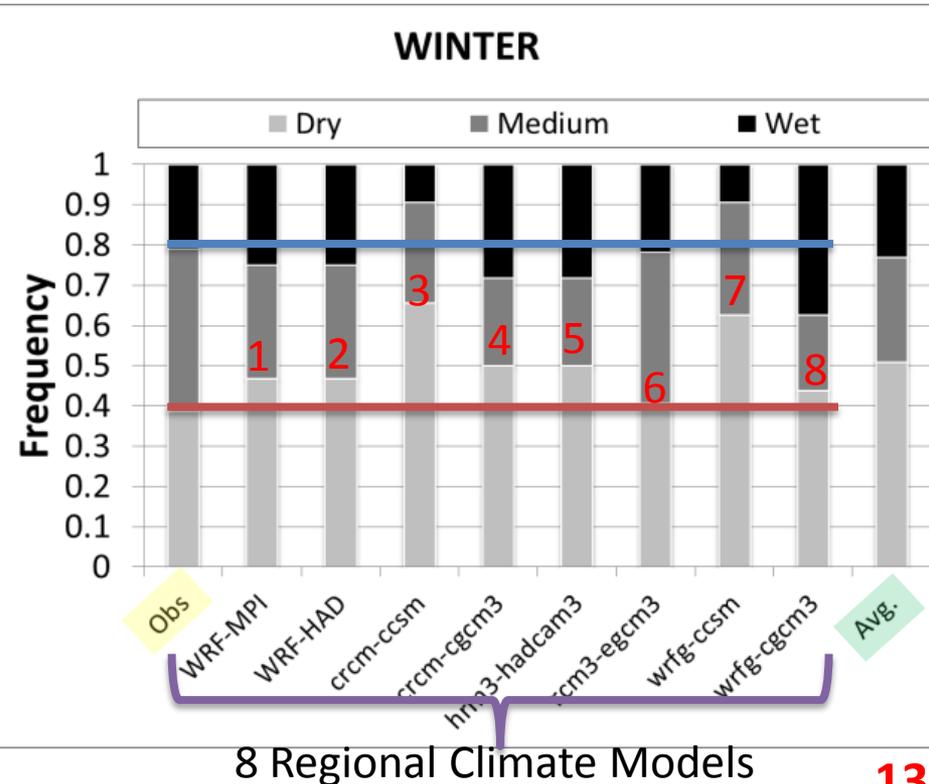
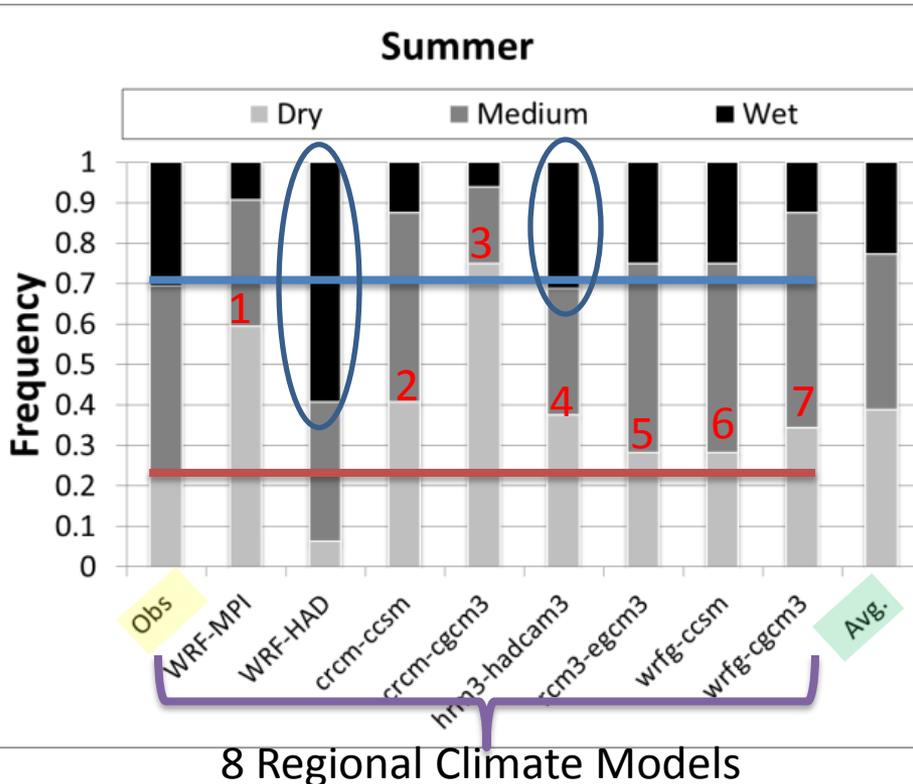
Projected Wetness by 8 models

SUMMER

- 7 models projected **MORE DRY** summers
- Only 2 models projected **MORE WET** summers

WINTER

- 8 models projected **MORE DRY** winters
- 6 models projected **MORE WET** winters

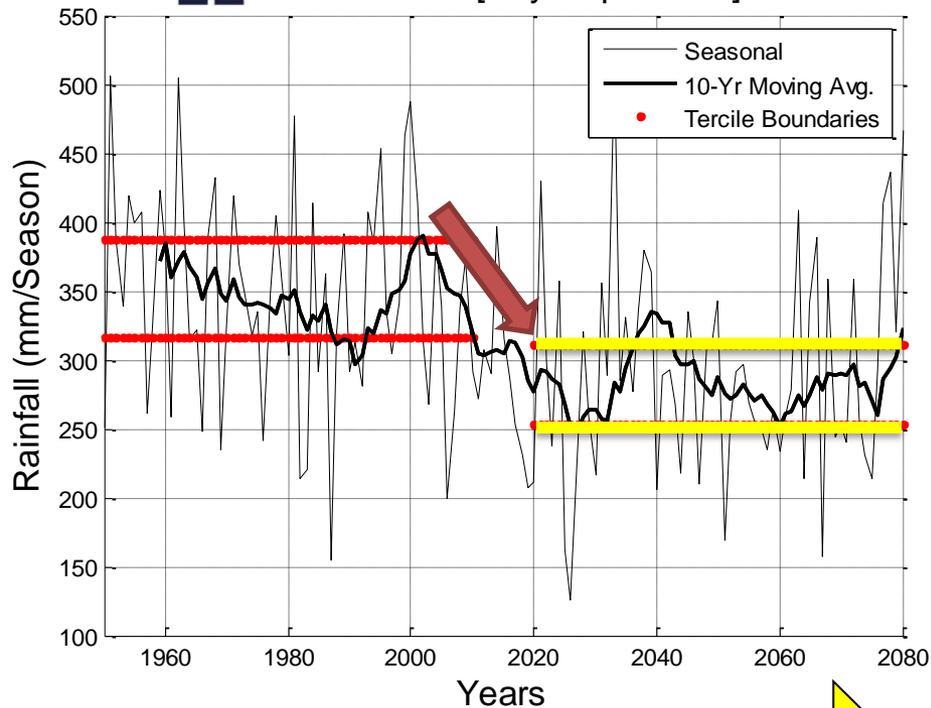


Regional Climate Model

Clear reduction in Summer

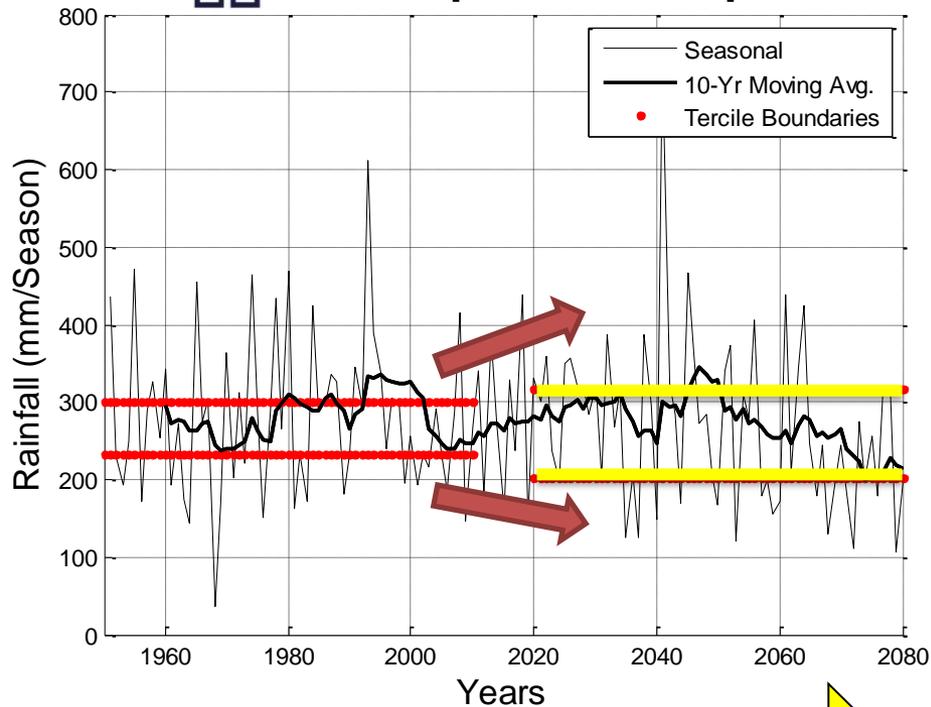
Higher variability in Winter

#2  MPI Summer [July-September]



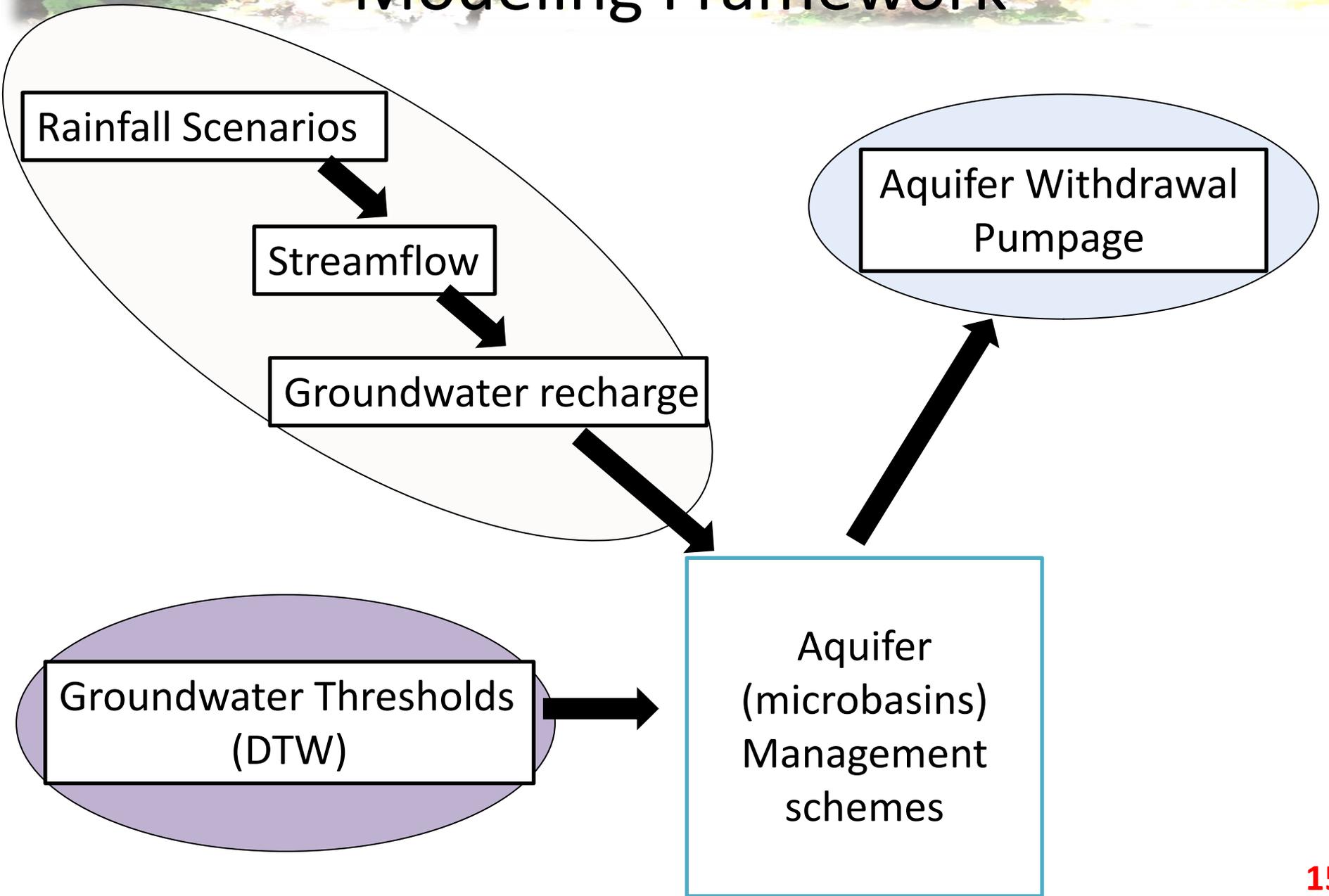
Projection

#2  MPI Winter [November-March]



Projection

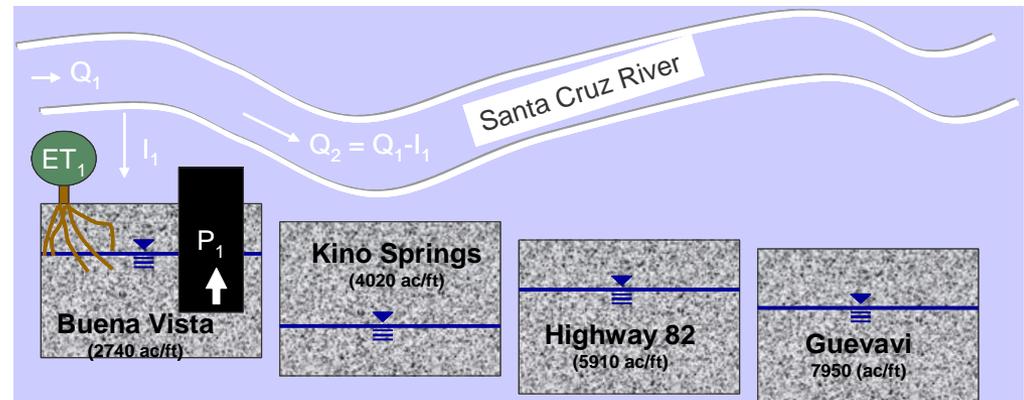
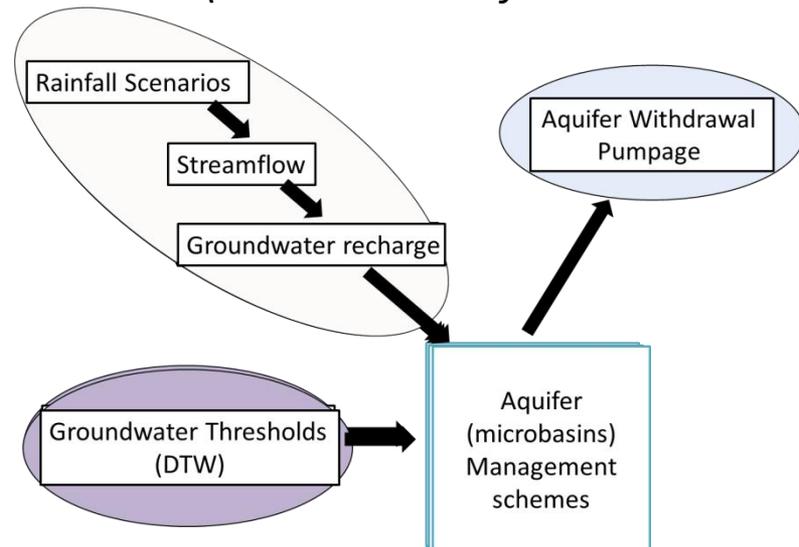
Modeling Framework



18 Scenarios

Rainfall:	Observation	1 Regional Climate Model	
DTW:	10 ft	20 ft	30 ft
Pumpage Goal:	2,000 AFY	3,000 AFY	5,000AFY
Storage Capacity:	4,000 ac-ft	7,300 ac-ft	11,000 ac-ft

(an ensemble of 100 realizations of hourly record each extends for 62 years)

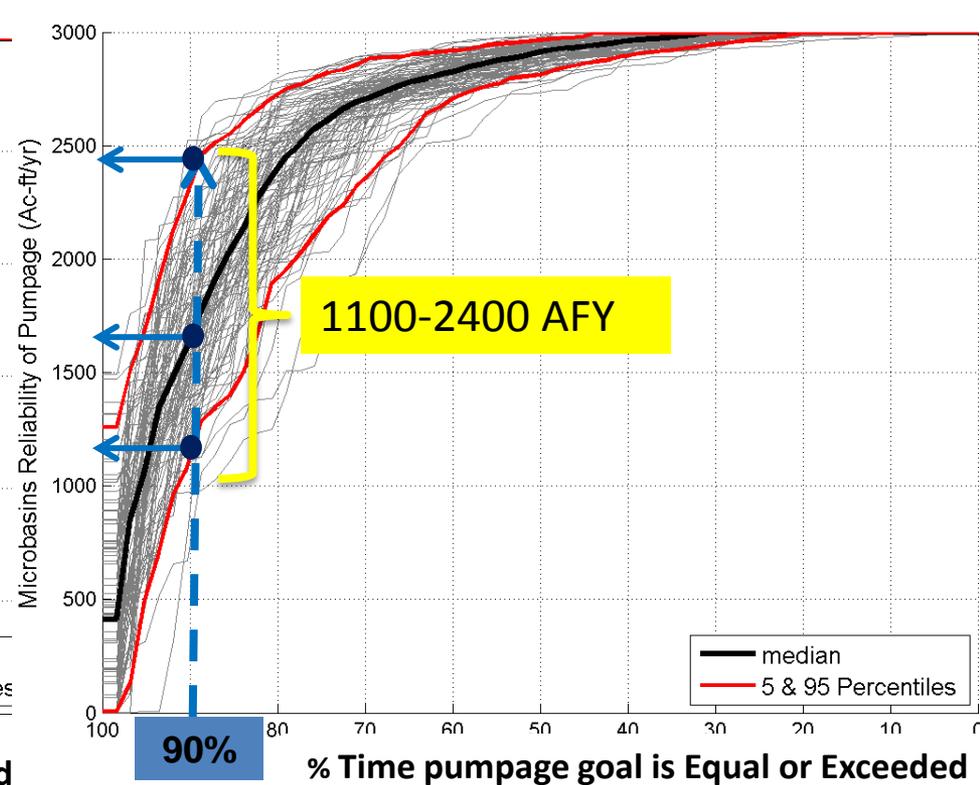
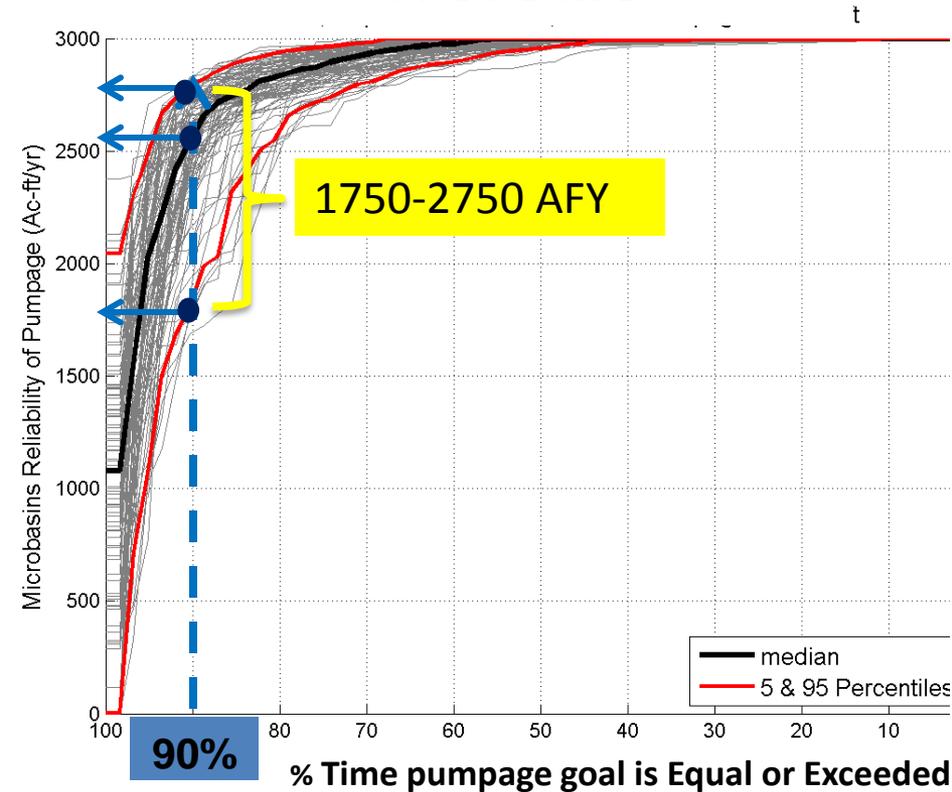


Reliability (1)

- DTW=20 ft, Q=3,000 AFY
- 100 realizations each 62-Year

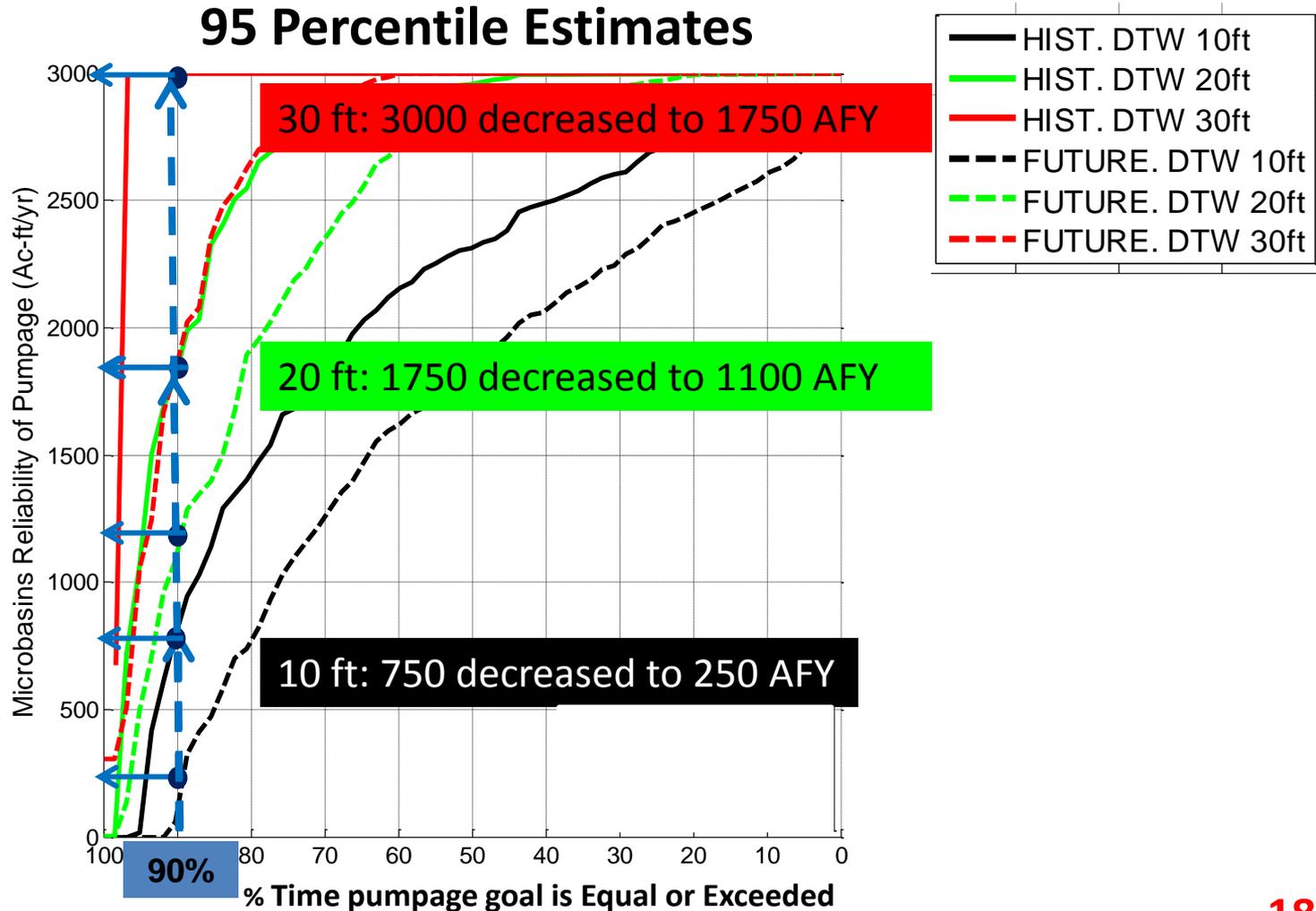
HISTORIC

FUTURE



Reliability (3)

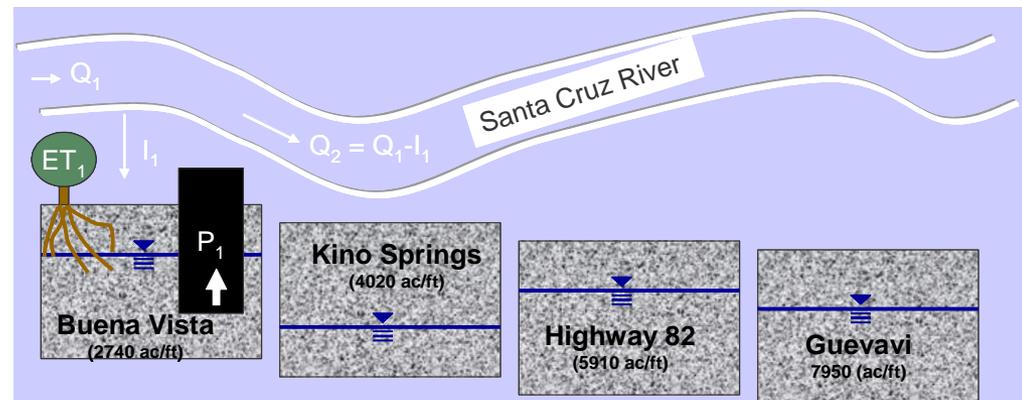
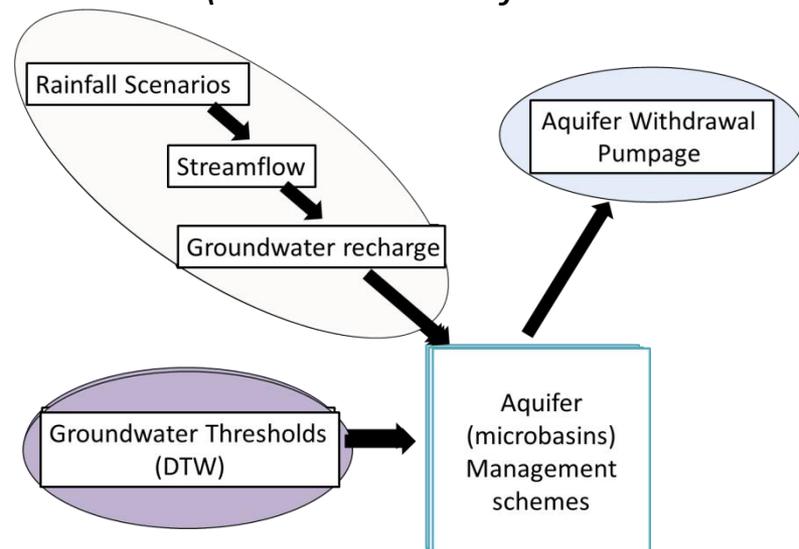
- DTW=10, 20 ft and 30 ft, Q=3,000 AFY



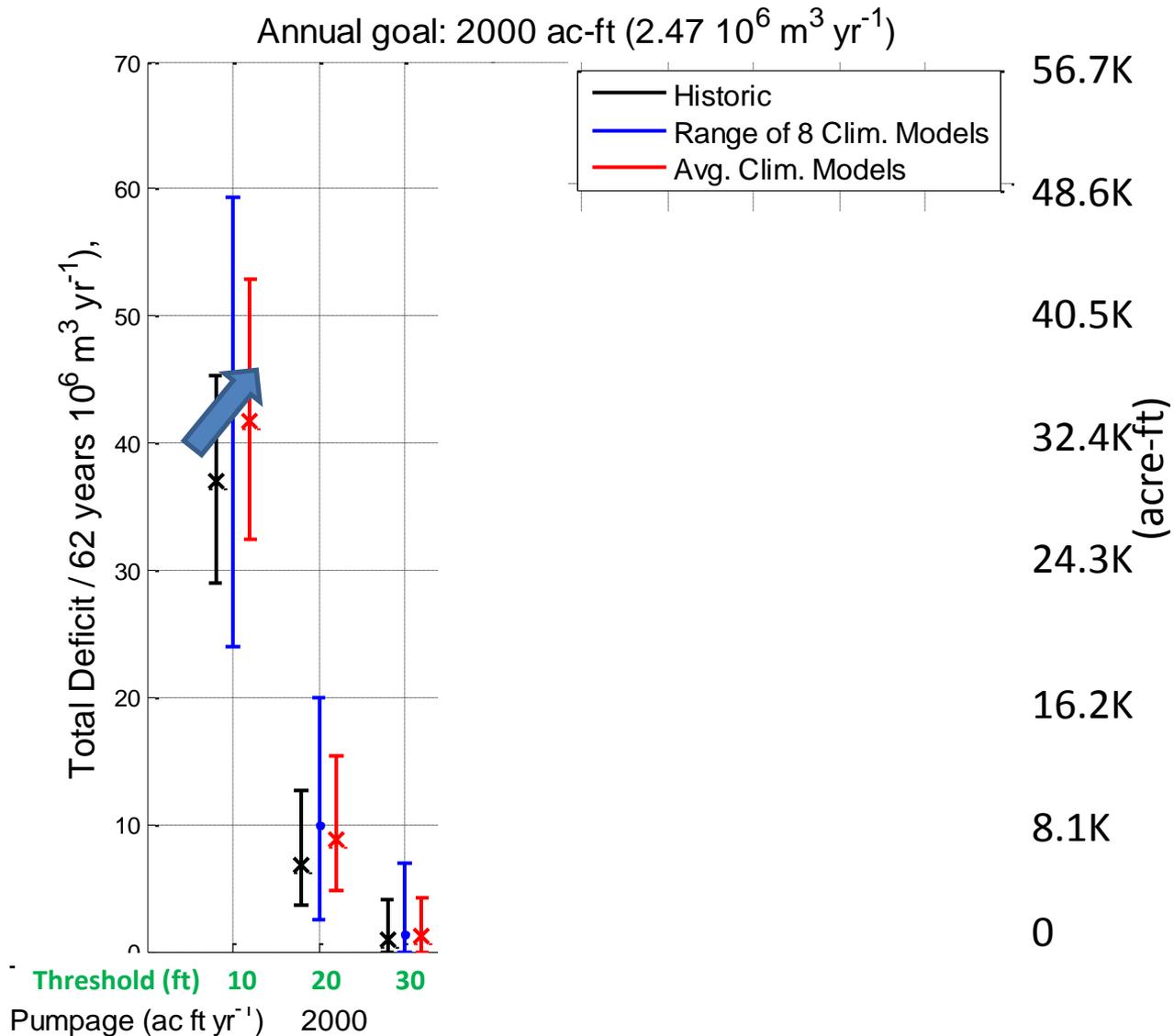
90 Scenarios

Rainfall:	Observation	8 Regional Climate Models	Avg of Regional Climate Models
DTW:	10 ft	20 ft	30 ft
Pumpage Goal:	2,000 AFY	3,000 AFY	5,000AFY
Storage Capacity:	4,000 ac-ft	7,300 ac-ft	11,000 ac-ft

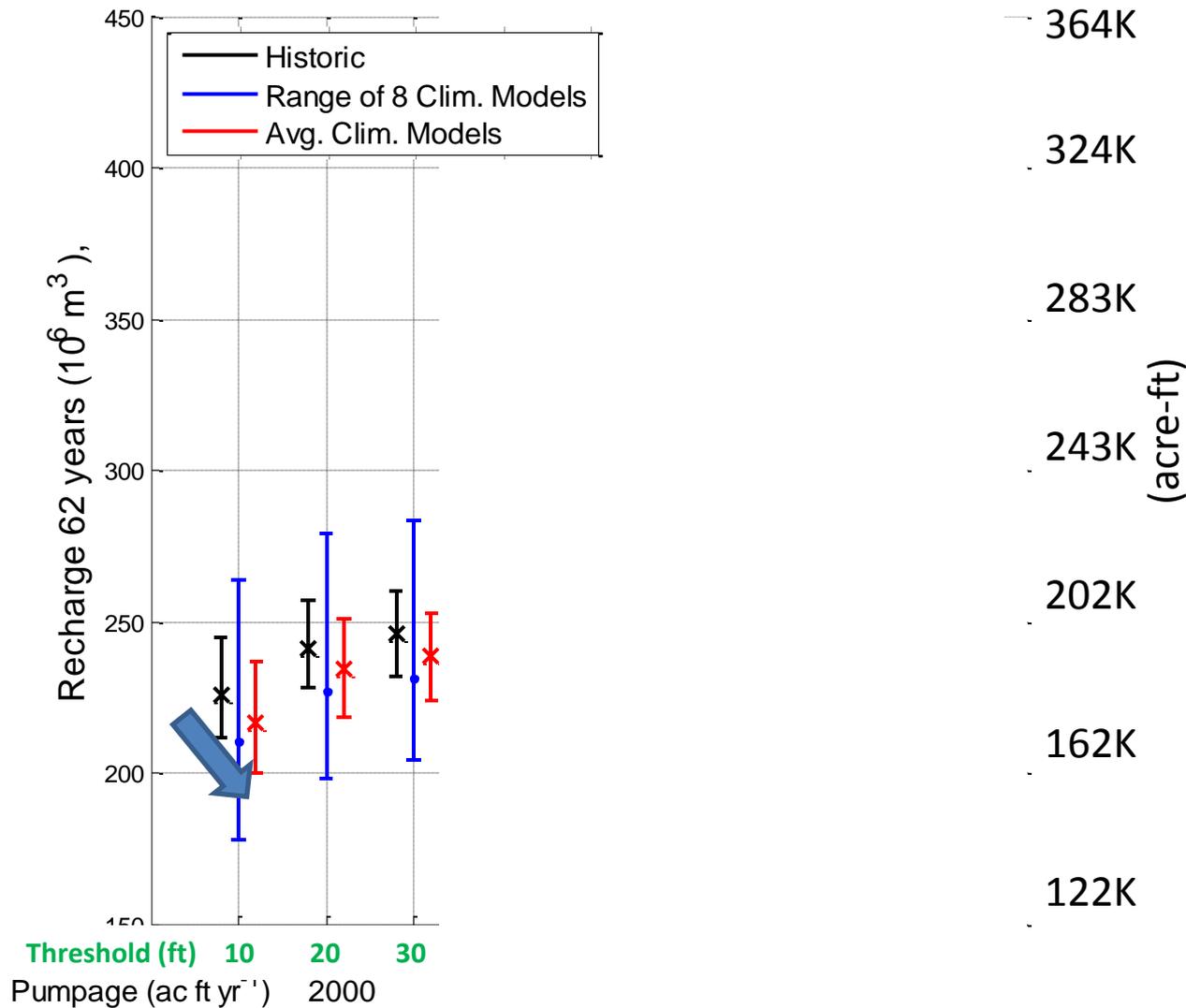
(an ensemble of 100 realizations of hourly record each extends for 62 years)



Cumulative Annual Deficit



Cumulative Recharge to Microbasins





Conclusions

- Climate projections indicate drier summers and increased variability in winter precipitation.
- Climate projections indicate greater uncertainty and spread of recharge deficit
- The recharge is highly dependent on the water management scheme that is applied
- Stakeholder engagement from the beginning facilitates an improved hydrologic framework and provides feedback on considerations for management schemes.



Questions?

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



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WATER RESOURCES
RESEARCH CENTER



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