

**Lower Santa Cruz River Basin Study
All Teams Webinar
Climate Metrics
DRAFT NOTES**

December 1, 2017, 1:30 to 3:30 pm

1. Welcome & Introductions

Eve Halper, Reclamation	Kathy Chavez, Pima County
Subhrendu Gangopadhyay, Reclamation	Hsin-I Chang, UA
Eylon Shamir, Hydrologic Research Center	Chris Castro, UA
Selso Villegas, Tohono O'odham Nation	Bob Hedden, USC/PUG
Melanie Alvarez, Pima Assoc. of Gov'ts	Ken Seasholes, CAP
John McKinney, FICO	Gita Bodner, TNC
Marie Light, Pima County DEQ	Jeanmarie Haney, TNC
Wally Wilson, Metro Water	Asia Philbin, Town of Marana
Evan Canfield, Pima County RFCD	Kathy Jacobs, UA/CASS
Jeff Yockey, Tucson Electric Power	

2. Status of Basin Study, Purpose and Outcomes of Today's Webinar

- a. Eve Halper reviewed the purpose and desired outcomes of the webinars, which is to recommend a list of climate metrics that will be used to identify the climate models projections for the best and worse-case scenarios (also referred to as "climate futures")

3. Presentation:

- a. Climate Metrics and Their Role in Selecting Climate Futures for Hydrologic Modeling – Eve Halper (Reclamation) – see presentation
- b. Hsin-I Chang (UA) presentation on climate projections comparisons for study area – see presentation
 - 1) A process called downscaling is used to develop climate projections that can be used for basin-scale hydrologic modeling from Global Climate Models
 - 2) There are two types of downscaling: dynamical downscaling (DD) and statistical downscaling, UA is providing DD climate projections for this study, Reclamation is providing statistically downscaled projections
 - 3) Of the DD projections, the WRF-MPI model performs best for summer and winter precipitation, including monsoon timing
 - 4) Performance varies among the available DD projections. What are some baseline metrics that models should simulate well for water demand/supply projections?

4. Discussion of Climate Criteria – Dr. Chris Castro and Dr. Hsin-I Chang (UA Atmospheric Sciences), Dr. Eylon Shamir (Hydrologic Research Center), Dr. Subhrendu Gangopadhyay (Bureau of Reclamation Technical Services Center)

5. Summary of suggested metrics to evaluate climate model performance:

- a. Infrequent but intense winter storm events
- b. Effects of atmospheric rivers (if applicable)
- c. Monsoon precipitation, especially time of onset
- d. Models' ability to reproduce the spatial variability within the study area should be examined
- e. Intensity of precipitation (affects groundwater recharge)

- Seasonal evapotranspiration rate (affects municipal and ag demand)
- Length of pre-monsoon dry season
- Length and timing of winter freeze (affects pecan agriculture)

Discussion Detail:

- Ken – the ADWR Tucson AMA groundwater flow models has not performed well in some ways; it did not account for important infrequent but intense winter events (e.g, 1983 and 1993 floods). Infrequent, large winter flood flows have a significant impact on natural recharge. Chris- This is a metric that is of a higher order than seasonal variation and average precipitation, but it is possible to look at this. Ken – these high flows affect streambed recharge by scouring out the fine sediments in river beds. Do some models perform better for infrequent storms? These events are full on frontal storms that produce rain over a few days.
- Jeanmarie - these types of storms are often from atmospheric rivers (AR). Can we bring this mechanism into the model selection? Hsin-I - winter precipitation can be driven by AR, but the Santa Cruz may be a little too far south to be greatly affected by them. The UA group can look into this more.
- Wally - generally, for this study, we should look at models that mimic monsoonal precipitation.
- Bob Hedden – there is a larger impact of rainfall on the Santa Rita Mts than in lower elevations. These can cause groundwater to stabilize and are of significant size. The monthly average precipitation shown on Hsin-I's chart is from the Tucson Airport, which is at a low elevation in the basin. Monthly rainfall is higher in the Santa Ritas. Chris – This highlights the importance of spatial variability. Bob - Summer monsoons also have a significant impact in Green Valley
- Marie Light - Onset of monsoons is important for landscape management for supplemental watering. Important to have model that shows onset of monsoons, especially if it will be delayed. Also, is it possible to show what the 90th percentile of the probability distribution is, not just the predicted average? Hsin-I - The more high risk (RCP8.5) does show more variability in monsoon onset. Eylon - we can use the weather generator and generate a probability distributions associated with each climate future.
- Wally - Do we want run that shows a dry summer?
- Asia Philbin - Stream recharge and wells levels are affected by intensity
- Eve – what is the group's feeling about the most important season for precipitation: is summer or winter more important, or are they equally important? Wally – a delayed monsoon, coinciding with high temperatures will drive more municipal water demand. Bob - delay of monsoon, just over a short period of time affected municipal water demand in Green Valley and put pressure on water providers.
- Ken - Much municipal demand is (not?) tied to well pumping so they are insulated from supply problems. Changes in ET are key components in supply (to wells) and demand. Chris – part of the climate model is a land surface model that computes ET, the performance of the models in simulating ET could be evaluated. There could be sidebar meeting to talk about the data sources that could be used to compare simulated and actual ET. Recommended website for evapotranspiration data in Arizona - <https://cals.arizona.edu/azmet/> .
- Gita Bodner - length of dry pre-monsoon is important for vegetation, plus rainfall intensity and total
- John McKinney - timing of freeze affect FICO pecans. Irrigation season for FICO is March through October, so length of monsoons important. Eve - Number of freezing days, beginning of freeze may be important for agriculture
- Eve – are there any temperature metrics of concern? Chris - models can project temperature in 6-hr intervals. In downscaled models, temperature is not as different from the original global models as it is for precipitation. (There is more agreement between global and regional models and they

all indicate increasing temperature.) Therefore, the metrics used to evaluate models are precipitation-centric.

- How do models differ in seasonality of predicted temperature changes? Chris- models predict the greatest temperature changes in later part of the cool season going into summer. Wally - that will be a significant factor in municipal water demand (early summer onset). In that case, peak demand will be longer (five months versus two), you could see a hot June to wet July to hot dry fall
- Wally - Does the climate staff have information they need to move forward? Chris - Higher moments (timing, frequency, spatial) are important in considering selection of models, we may want to examine this further. Subhrendu – We may need additional information, but got a sense of the importance of the onset of monsoon, spatial resolution
- Wally – The groundwater model is an annual model and doesn't account for seasonality, so some of this information will not be reflected in the groundwater modeling results. Ken – it can still show the relative contribution of infrequent, large flood events to groundwater recharge. Change in intensity could affect natural recharge in the simulation period. Kathy J - will not just impact groundwater model, but also informs adaptation for riparian impacts. Increased demand may increase use of groundwater wells during peak times in some areas and also may have impacts to riparian areas, like in the northeast part of Tucson.
- Risks: reduced frost days for pecans, lengthening period of high demand, flooding, groundwater levels falling below root zone in riparian areas

6. Next Steps – All

Kathy C and Eve will develop draft of metrics and circulate to everyone

7. Basin Study Updates -

- a. Demand Sub Team (December 6 re: CAP:SAM and CAP futures)
- b. Environmental Sub Team (December 7 re: Economic Value of Riparian Habitat and Climate Metrics)
- c. Outreach & Communication
 - 1) Project Team (January re: Supply/Demand Matrix)
 - 2) Stakeholder Advisors (February re: Input on Supply/Demand Matrix)
 - 3) Public Meeting (March)