18TH ANNUAL CAP
LTER ALL SCIENTIST MEETING
AND POSTER SYMPOSIUM
15 JAN, 2016
SCOTTSDALE, AZ

The Adaption to Drought Sustainable Future Scenario:
simulations using WaterSim 6

David A. Sampson[1,2], David M. Iwaniec[2], Melissa Davidson[2], Elizabeth Cook[2,3]

[1] Decision Center for a Desert City, ASU; [2]Julie Ann Wrigley Global Institute of Sustainability, ASU; [3]Instituto de Ciencias Ambientales y Evolutivas, Universidad Austral de Chile

Background:

- The Colorado River and its tributaries provide water to nearly 40 million people; the Salt-Verde Rivers add about 1 million acre-feet annually to our water supply

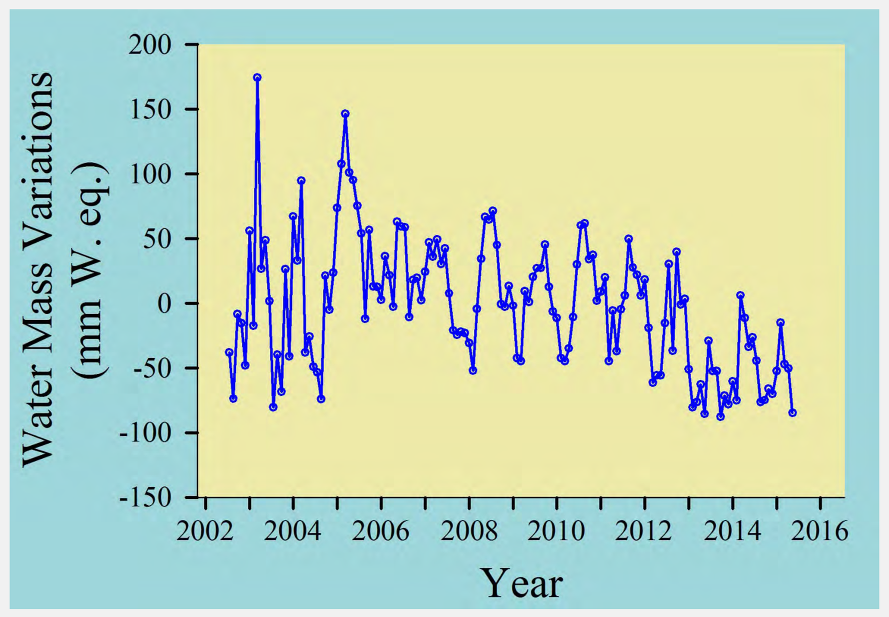
CO River Basin

- Sixteenth year of drought in the Basin
- The Sustainable Futures Scenarios project has co-developed a set of potential future scenarios for 2060 with local community leaders
- The Adaptive drought scenario (2015-2060) represents one of the plausible, although unpopular, pathways to cope with diminishing water supplies (Fig.1)
- This drought scenario is characterized by:
  - Rainwater/ gray water/ storm water harvesting
  - Urban infill/ increased residential density/ integrated development (see artists future rendition)
  - Reductions in large scale agriculture
  - Shifting energy sources to more renewable forms
  - Education regarding water conservation

We used WaterSim 6 to explore three of the water conservation strategies: we focused on rainwater, gray water, and storm water capture/ harvesting

Water Supplies are diminishing

Figure 1. GRACE water mass variation[1] for the Colorado River Basin (courtesy of Susanna Werth)



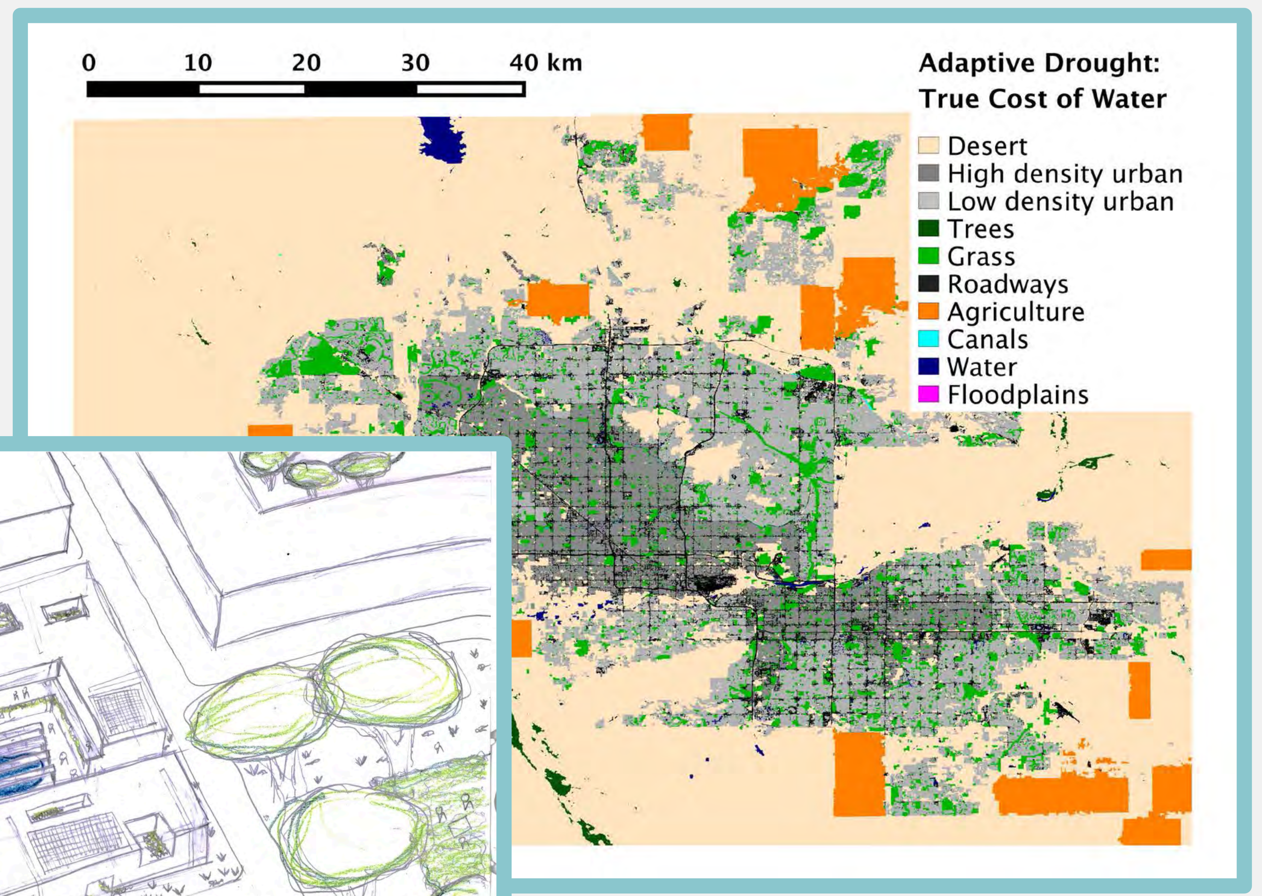
[1]Regional average of water mass variations inside the Colorado River basin observed by Gravity Recovery And Climate Experiment (GRACE). Data from the processing center GFZ were decorrelated and smoothed using the method DDK3 [Kusche and Schrama, 2005] and a mean gravity field for the period 2003-2014 was removed.

Methods:

Adaption to Drought Scenario

[A]2060 Land Form

Figure 2a & 2b. Adaptive drought scenario



[B]Artists Future Rendition

Integrating the Drought Scenario into WaterSim

- Water harvesting techniques added to the model
- [A]Rainfall data at the water utility scale now incorporated into the modeling
- Incorporated storm water capture/ use
- Enhanced land cover/ land form drivers

New Functionality

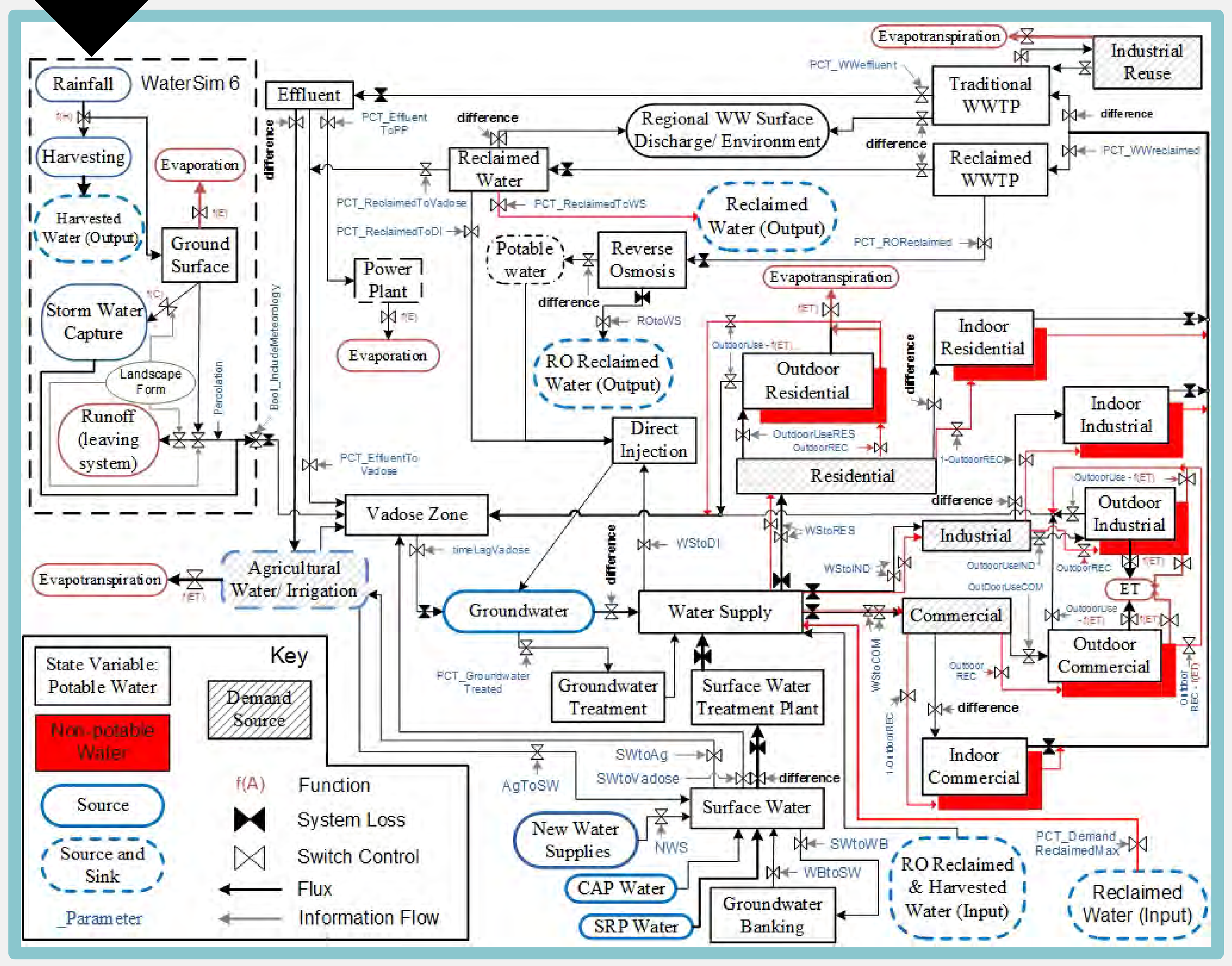


Figure 3. "City-water" module of WaterSim 6

Preliminary Results:

Figure 4. Rain water harvesting and (surface and groundwater) savings

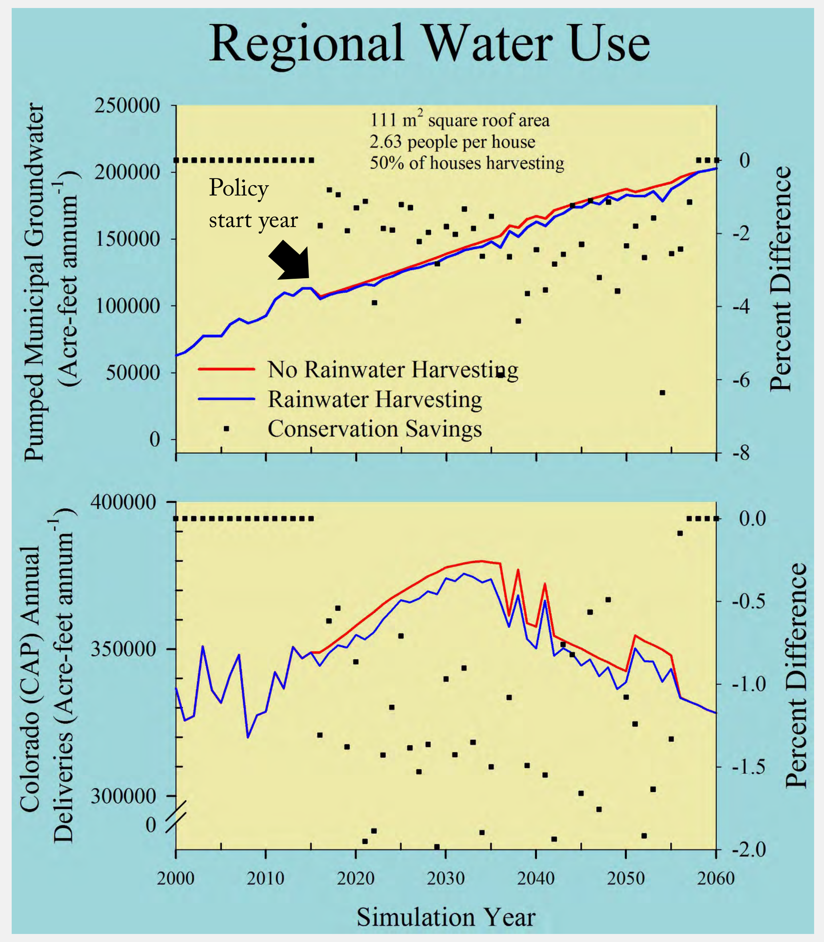


Figure 5. Reduction in personal water use (gallons per capita per day) with gray water capture/use

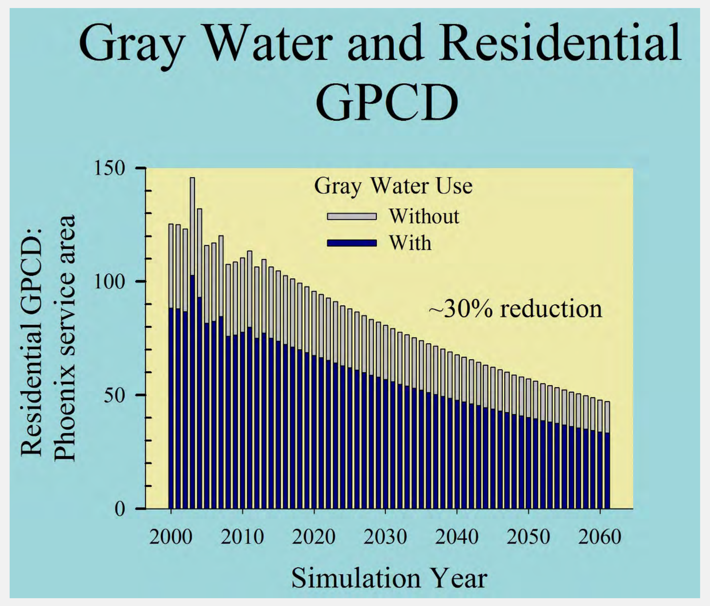
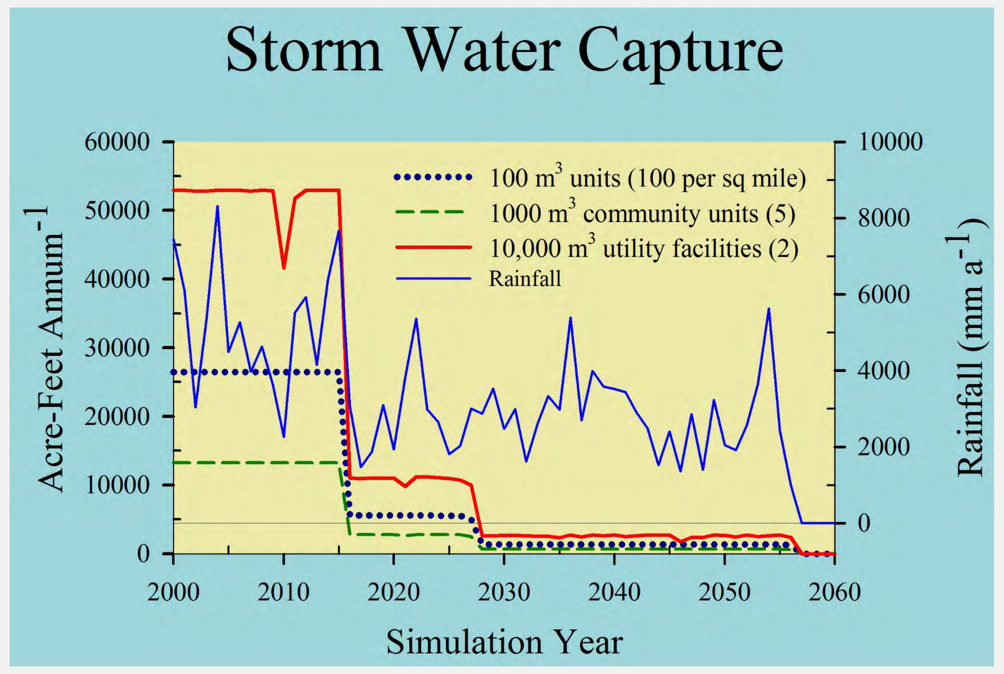


Figure 6. Storm water capture for three different unit sizes and the number of units installed per square mile, and rainfall

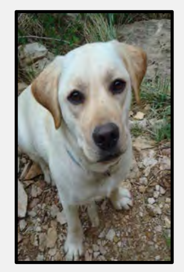


Early Conclusions

- WaterSim 6 allows us to explore the impact of policies and strategies designed to meet water sustainability goals in the face of climate change and drought.
- Water conservation (including rainwater harvesting and storm water capture) can play an important role; the direct impact will depend on adoption and design.
- The Adaptation for Drought scenarios does appear that it could add resilience to drought (current simulations sans drought). This suggests the importance of the three urban water strategies examined (i.e., rainwater, gray water, & storm water capture). Ongoing integration with WaterSim will allow us to better assess water sustainability and drought resilience of the scenario set.

Acknowledgment

We thank Matt Boylan and Xiaoxiao Li for creating the illustrated vignette and the land use land cover maps for the scenarios, and participants of the Sustainable Future Scenarios workshop series. This material is based upon work supported by the National Science Foundation under Grant No. SES-0951366 Decision Center for a Desert City II: Urban Climate Adaptation (DCDC). Any opinions, findings and conclusions or recommendation expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation (NSF).



References

- Sampson, D.A., R. Quay, D. White. 2016. Anticipatory modeling for water supply sustainability in Phoenix, Arizona. Env. Science and Policy 55: 36-46.

A
- We used records with >25 years of the rain gages managed by the Flood Control District of the Maricopa County.
- A Gamma distribution was fitted to represent the statistical distribution of the spatial mean annual rainfall in the valley.
- A random component was added to account for the spatial variability of the annual rainfall at each gage.
- The effect of gage elevation was taken into account.
- The time series of annual rainfall for each water provider were obtained by averaging the rainfall at the gages included within the water provider.