A coupled food-energy-water model for the Phoenix AMA

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Project Design

- The food-energy-water (FEW) sectors (as networked material and energy flows) co-occur in the urban metabolism system (UM) along with (1) Governance networks, (2) Urban infrastructure and form, and 3) Socio-Economic drivers. This holistic representation of the FEW system provides a robust conceptual model.

- Our team will focus on the FEW nexus as influenced by climate change, agricultural dynamics, growth, and the role of governance in the Phoenix Active Management Area (AMA).

- We are developing a FEW framework: a user interface & visualization tool coupled to a FEW model:
  - WEAP (plus MABIA)
  - LEAP
  - Statistical Crop Model (SCM)

- Scenarios (a few):
  - Cropping patterns, extent, & water use
  - A energy sectors and the impact on farming
  - Urban water dynamics, and population growth and efficiencies: regional water use

Research Directions

1) We are using two off-the-shelf programs and one statistical model to create a credible, integrated model that captures the metropolitan-scale FEW interactions.
2) We will explore the notion that integrative modeling can improve governance across food, energy, and water sectors.
3) Human-computer-interactions along with alternative visualizations will assess what technologies can best support sense making when analyzing the FEW nexus.
4) The potential role of climate change impacts on land shares under different crops in the Phoenix metropolitan region will be examined.

Conceptual Models

WEAP

SCM

LEAP

Simulations/ Analyses conducted for this poster

What We Simulated

AMA Agriculture
- 12 Irrigation Districts (ID)
- 14 Crops
- Ten years (calibration period)

Outputs We Examined

Agricultural Water
- Groundwater Pumped
- Crop Transpiration

Agricultural Energy Use
- Energy Used in Pumping

Empirical Data: Crops
- Relative Area and Value

Preliminary Results & Discussion

Simulated

Groundwater Pumped by ID

Water & Energy Pumped/ Used

Empirical

"Modeled" Crops-AMA Level*

Roosevelt Irrigation District

Crop Area

Cotton/ Alfalfa Transpiration

Crop Transpiration

*Available Empirical Data

Discussion

1) Four irrigation districts dominate the AMA (for groundwater): Roosevelt ID
2) Cotton plantings are declining
3) Alfalfa plantings are increasing
4) In general, increased transpiration rates across all crops (dominated by alfalfa)
5) Differences in the transpiration rate per unit area between cotton and alfalfa
6) Alfalfa uses more water on a per unit basis
7) We will conduct scenarios to look at various policies/management (such as cropping patterns and water use)

Acknowledgment

This material is based upon work supported by the National Science Foundation (NSF) under Grant No. 1639227: Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS). Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

Publications


CAP-LTER: All Scientists Meeting and Poster Symposium
17 Jan 2020, Scottsdale, AZ