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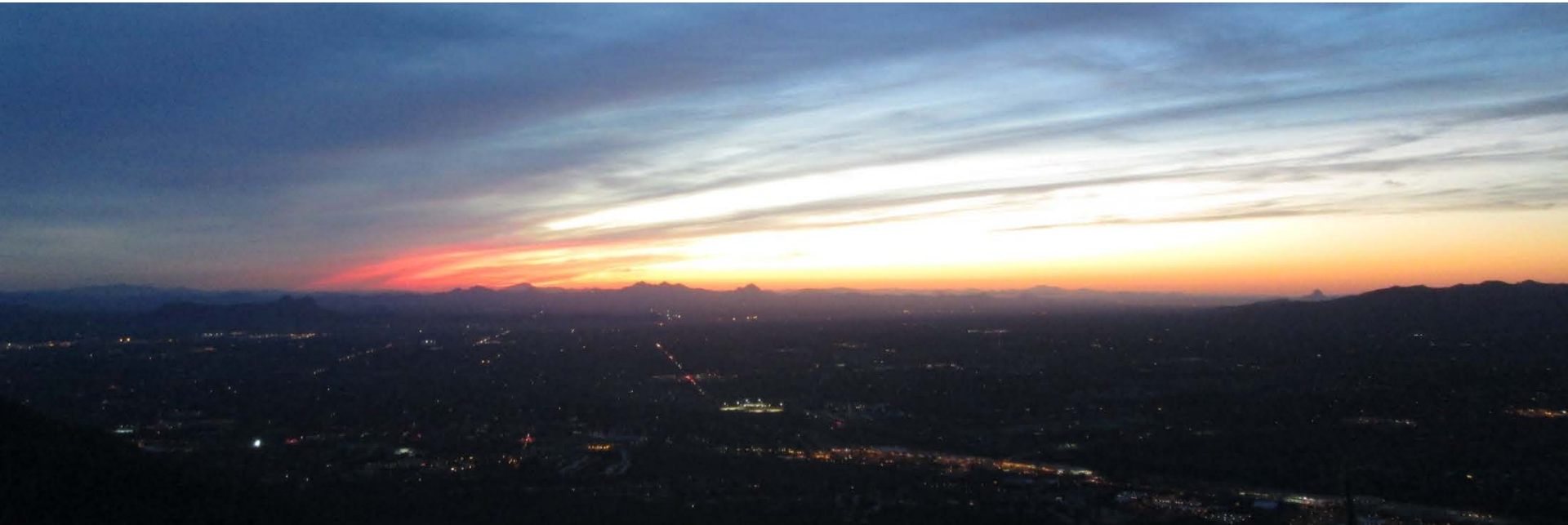
Water Management in the Tucson Region



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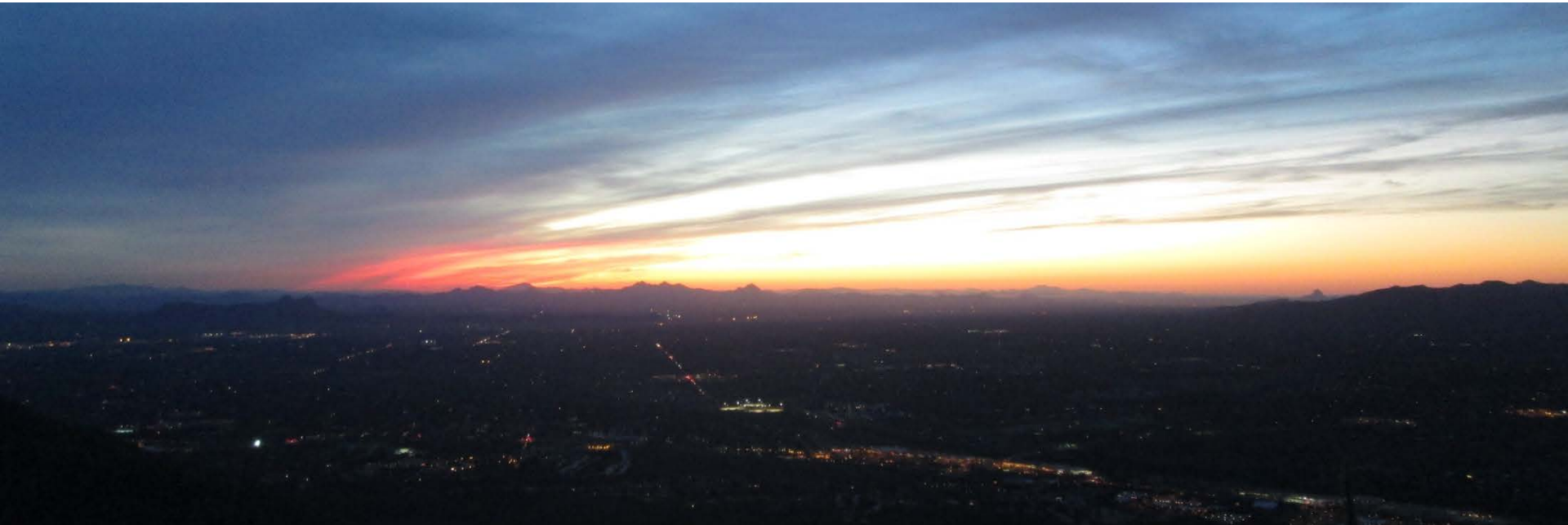
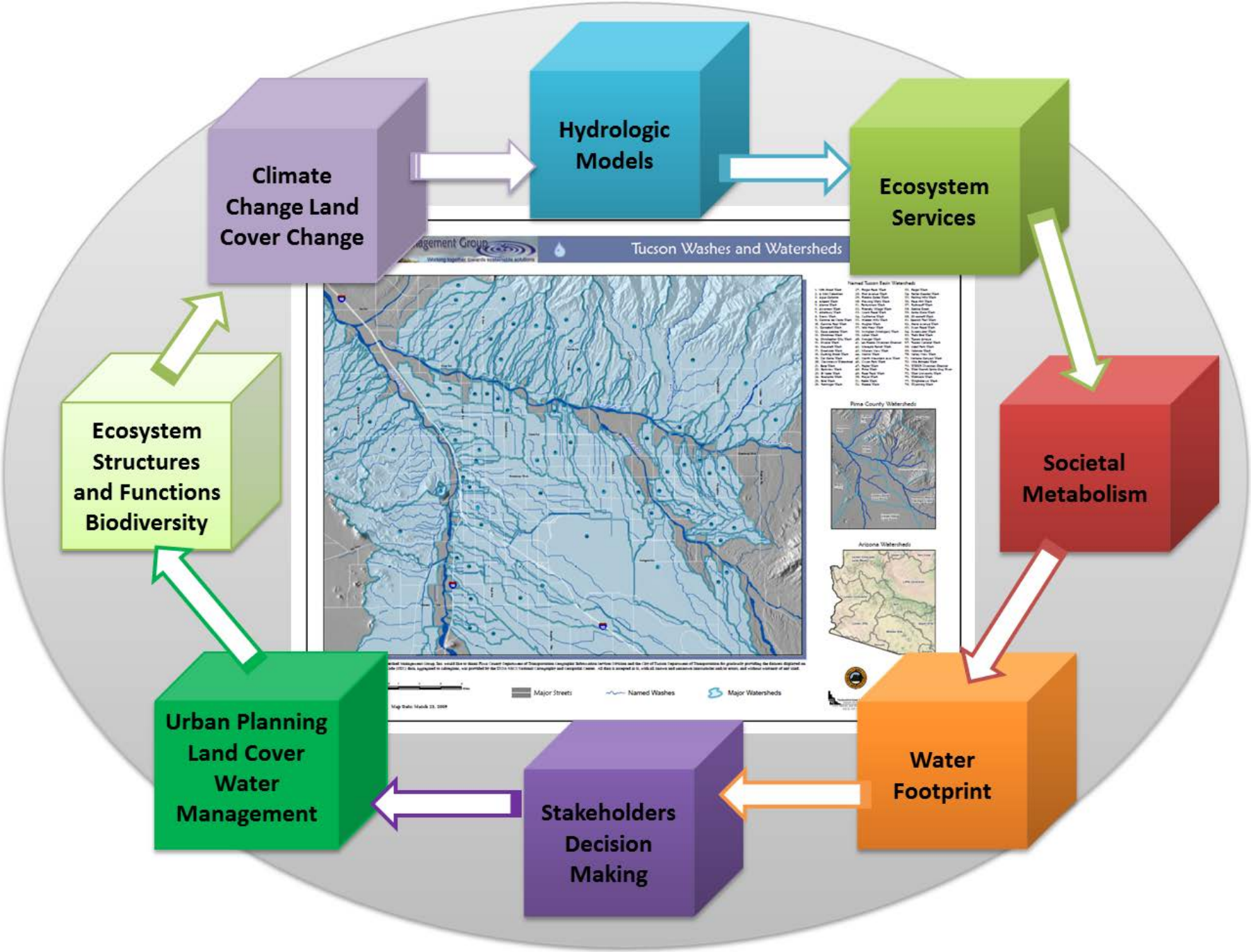
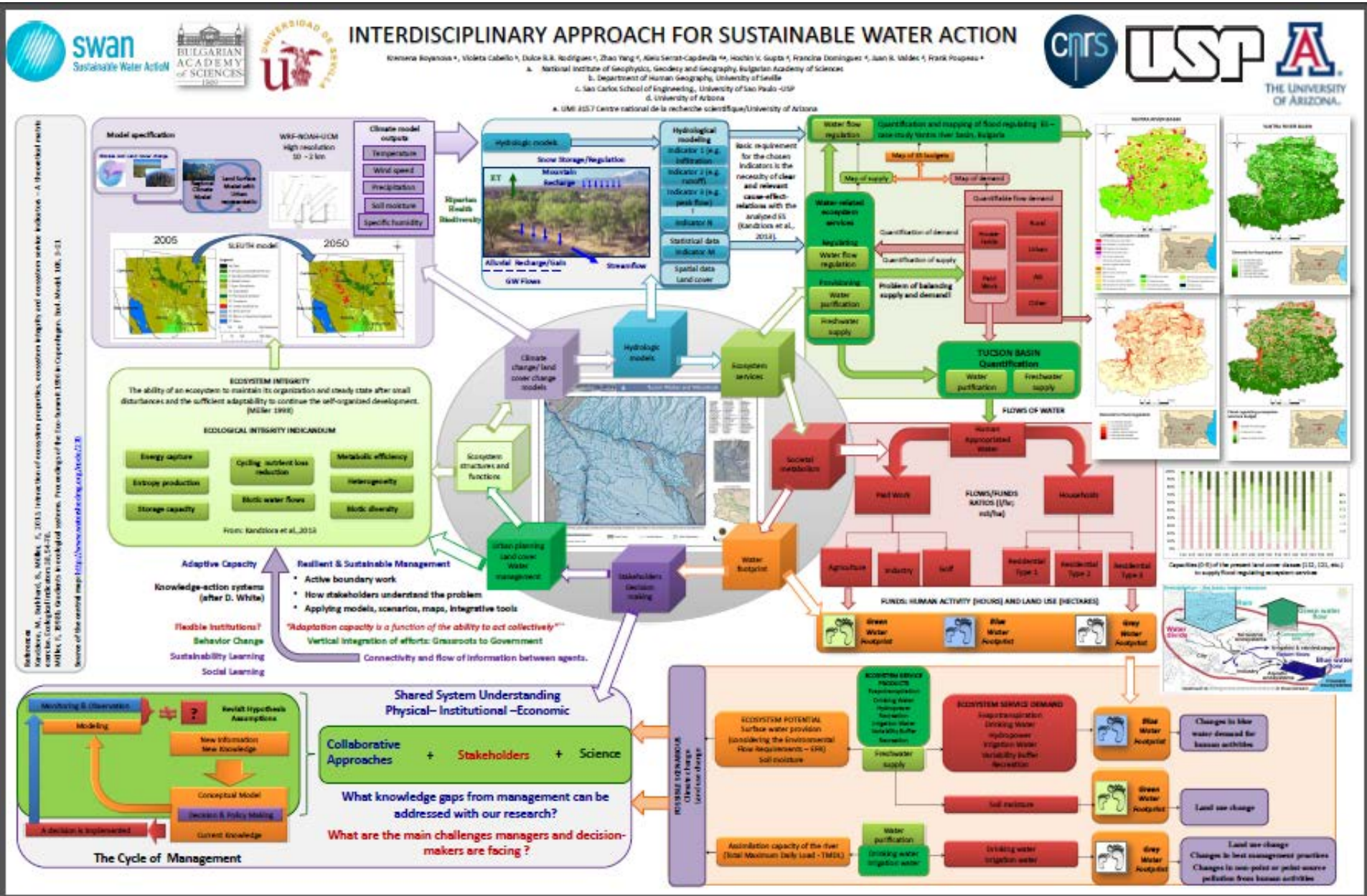
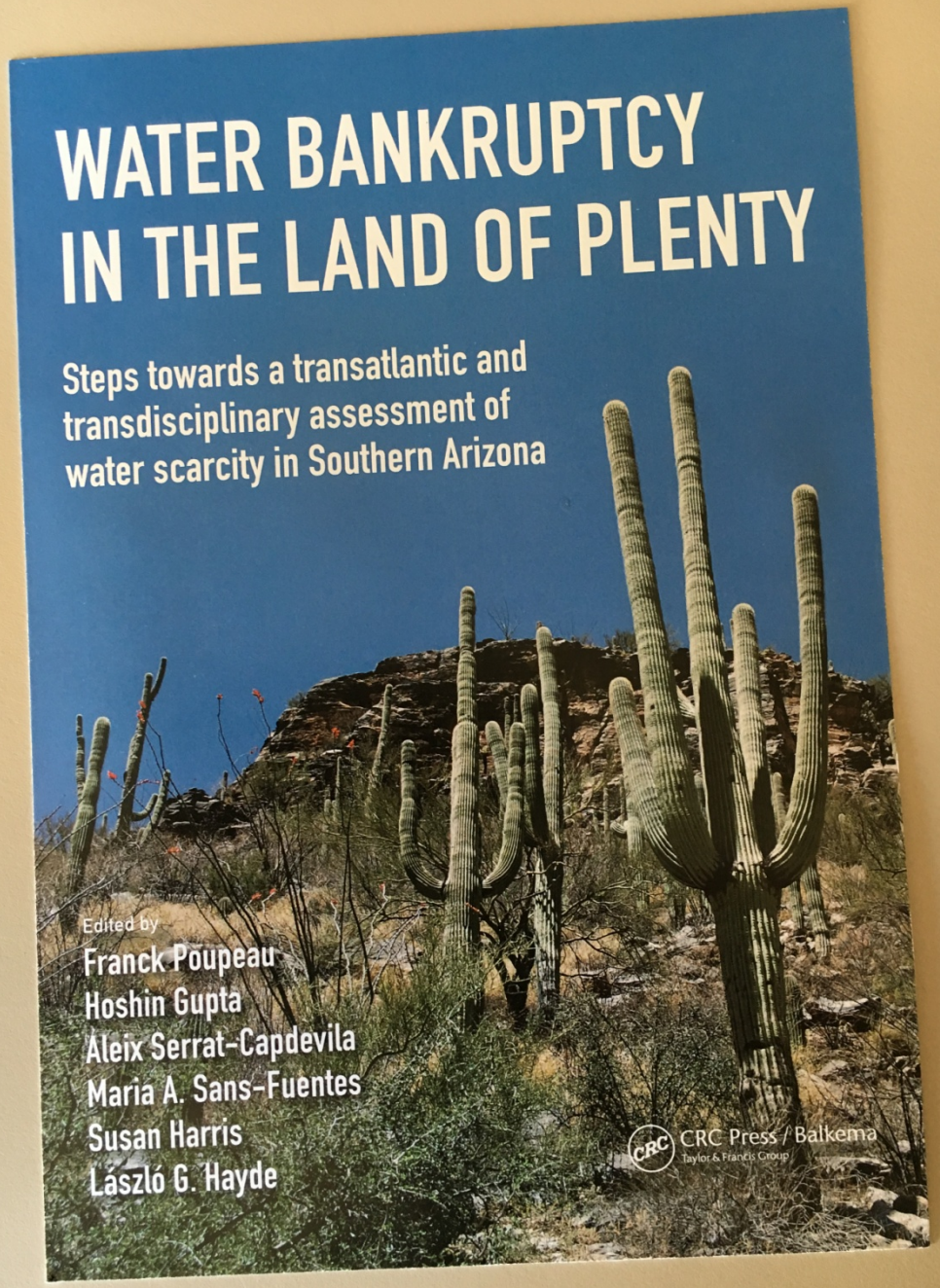
The SWAN Project &
The Tucson Basin Case Study




Climate Change Land Cover Change
Hydrologic Models
Ecosystem Services
Societal Metabolism
Water Footprint
Stakeholders Decision Making
Urban Planning Land Cover Water Management
Ecosystem Structures and Functions Biodiversity
Tucson Washes and Watersheds
Major Streets
Named Washes
Major Watersheds

SWAN working group – Integration Poster





Collaborative efforts of the last 4 years.

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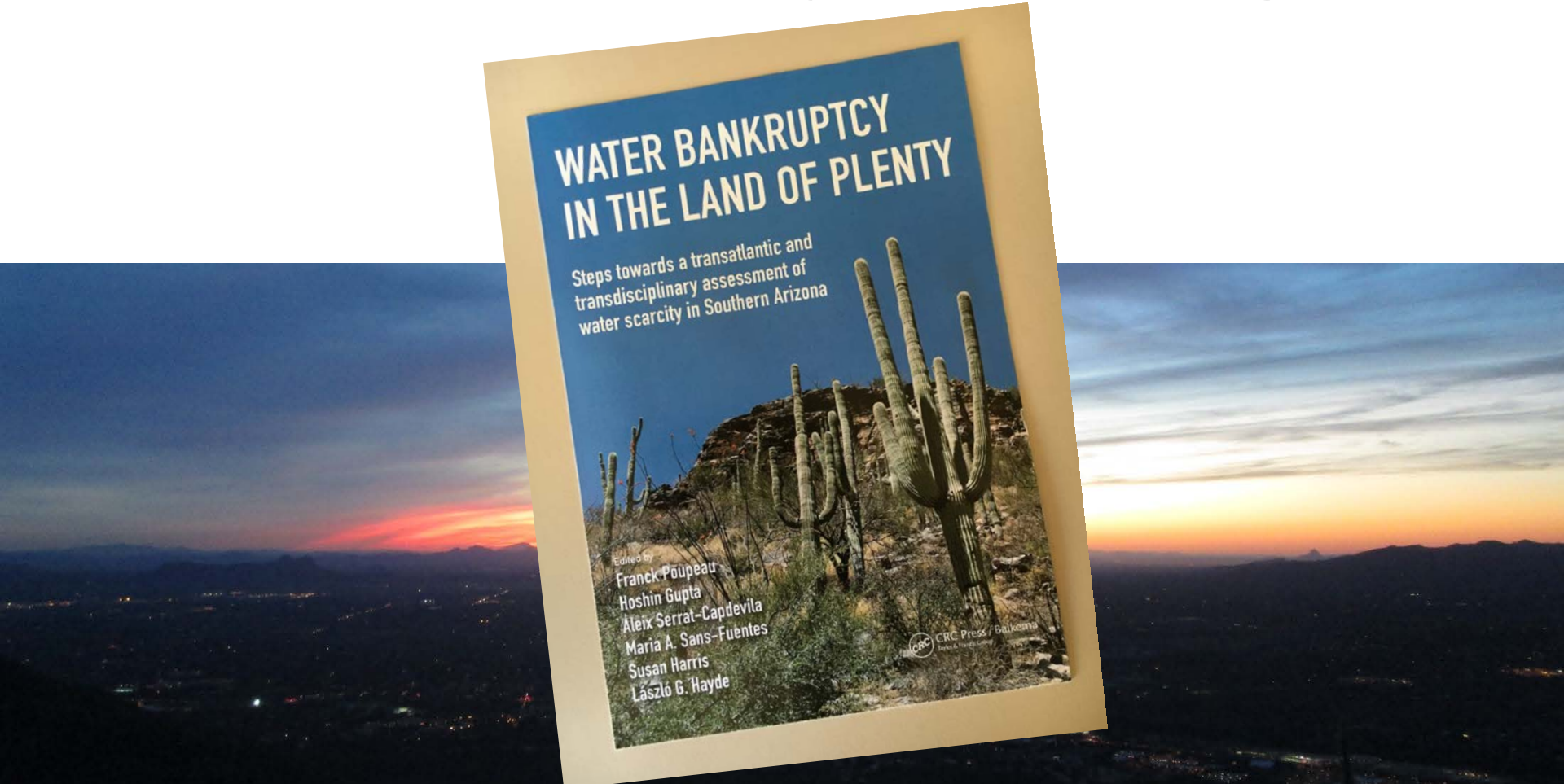
SWAN Key Findings



We did not get here alone:

- Edward Curley
- Claire Zucker
- Julia Fonseca
- Evan Canfield
- Brian Powell
- Tom Buschatzke
- David Modeer
- Randy Serraglio
- Ralph Marra
- Gita Bodner
- Eve Halper
- Kathy Chavez
- Charlie Ester
- David Godlewsky
- Greg Harris
- Brad Lancaster
- Michael McNulty
- Mohammed Mahmoud
- Michelle Moreno
- Claire Zugmeier
- Linda Stitzer
- Jeff Tannler
- Wally Wilson
- Mead Mier

…and others

THANK YOU !

SWAN case study:

Coalitions in Water Management in Arizona

Murielle Coeurdray
Joan Cortinas
Brian O'Neill
Franck Poupeau

- General objectives of the research

Analysis on contemporary water conflicts in Arizona:

- Drought
- Water management model

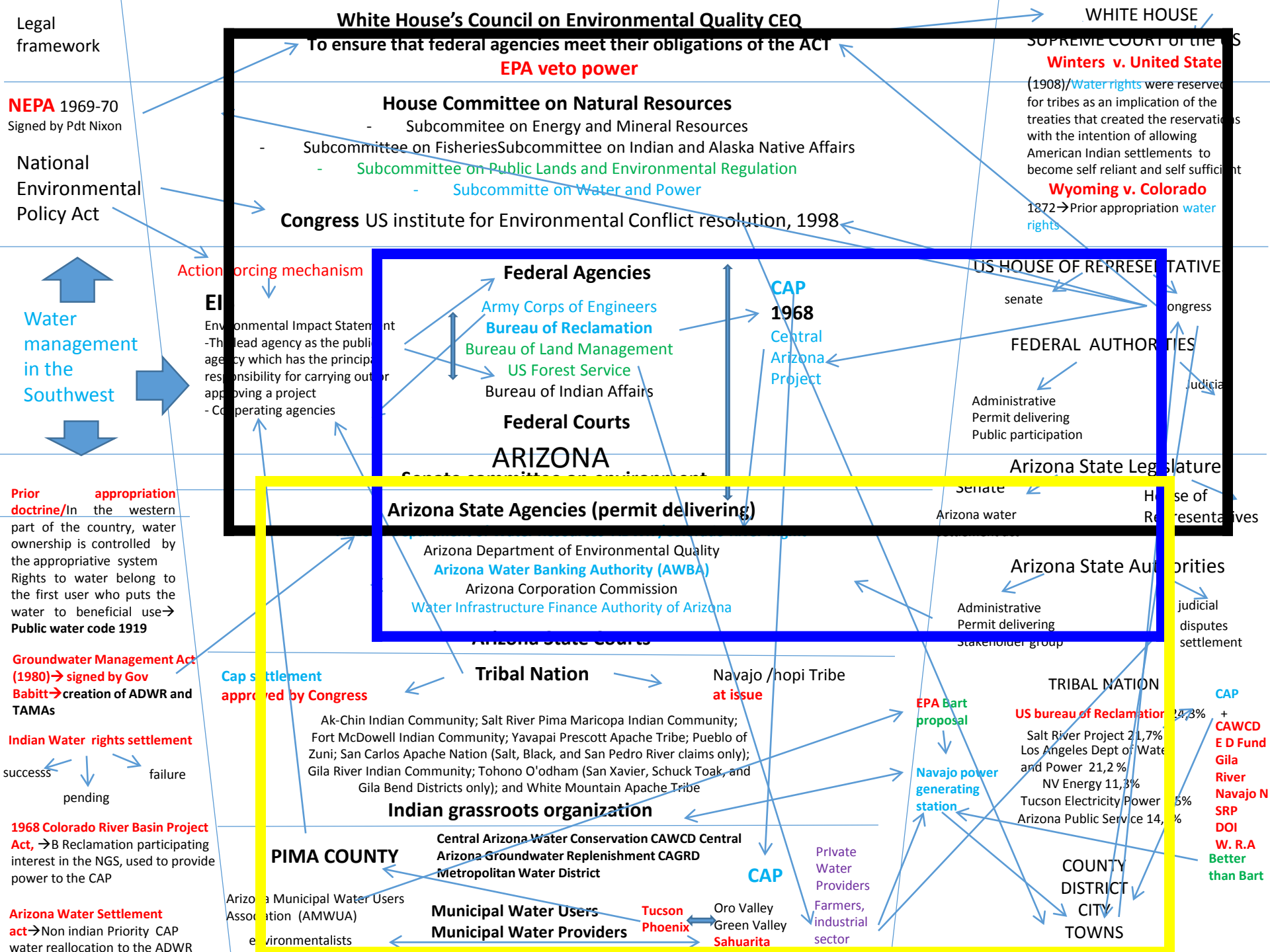
- Key research questions

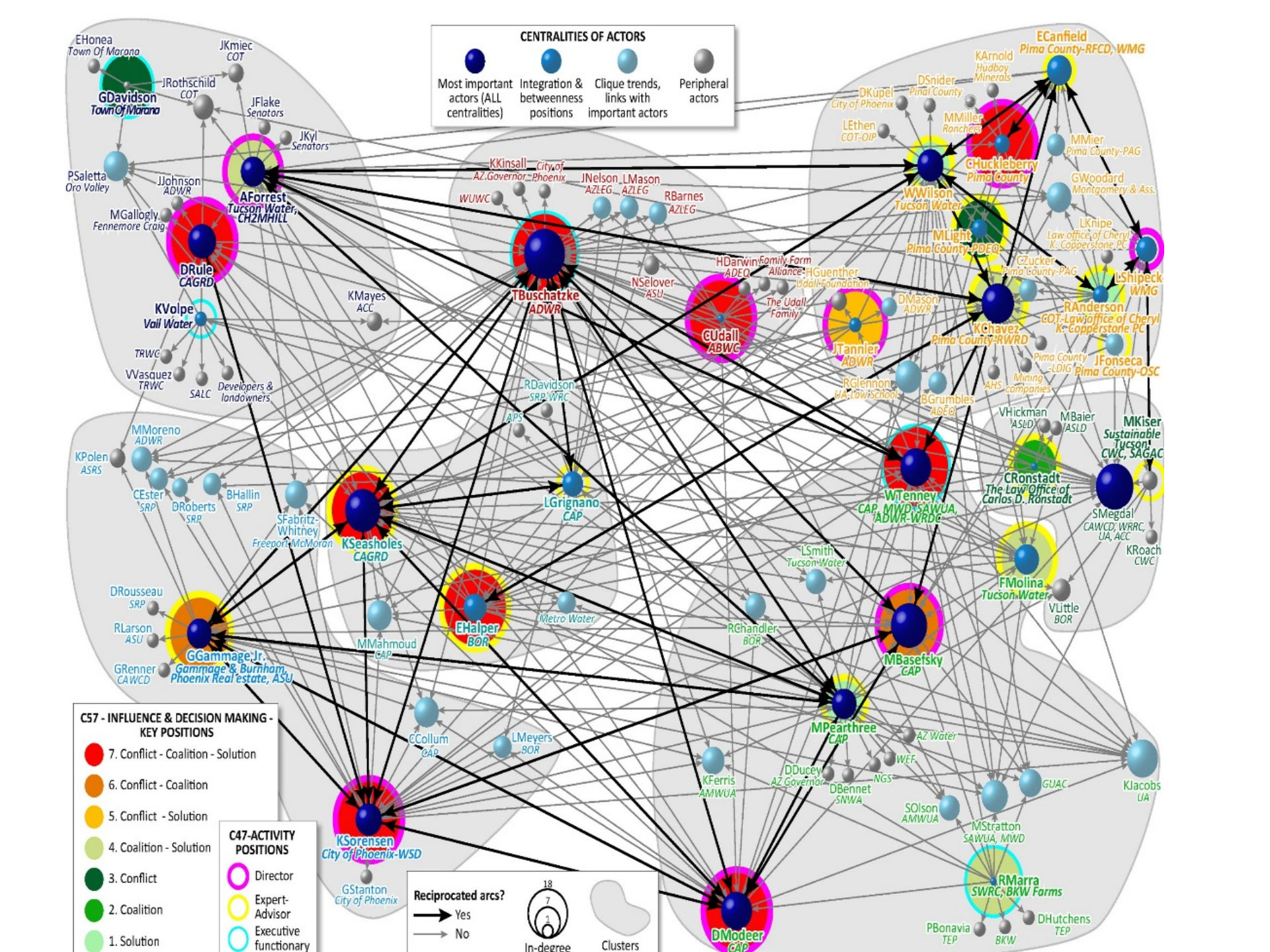
i- How can we understand the emergence of water conflicts in Arizona

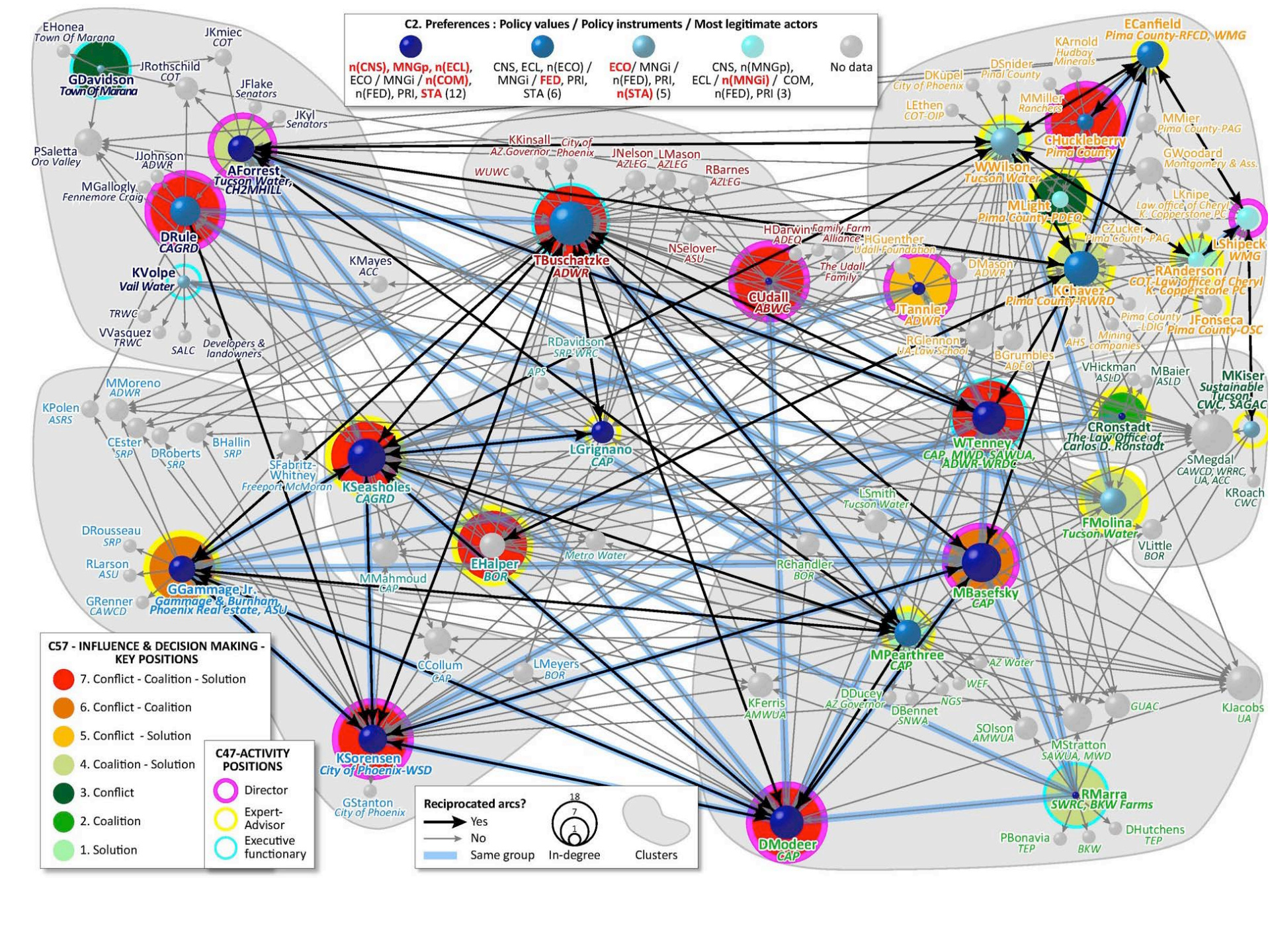
ii- Which are the social agents involved in those conflicts? What are their resources, their positions, their system of beliefs and the structure of the political subsystem in which they evolve?

Genesis and structures of the field of water management

PERIOD	STRUCTURAL HISTORY	DOMINANT COALITIONS
1890s-1920s	Federal Level Water for a New America	Government Agencies, Local Elites of the Western Economy
1920s-1960s	Inter-States Level Legal issues to share the Colorado River	Governors, Senators, Lawyers, State Commissions & Agencies
1960s-2010s	Local Levels CAP in Tucson: Urban Sprawl, Water Quality and Mega-Drought	Municipal/County Administrations, Developers


Legal framework
White House's Council on Environmental Quality CEQ
To ensure that federal agencies meet their obligations of the ACT
EPA veto power
WHITE HOUSE
NEPA 1969-70
Signed by Pdt Nixon
House Committee on Natural Resources
- Subcommitee on Energy and Mineral Resources
- Subcommittee on FisheriesSubcommittee on Indian and Alaska Native Affairs
- Subcommittee on Public Lands and Environmental Regulation
- Subcommitte on Water and Power
Congress US institute for Environmental Conflict resolution, 1998
National Environmental Policy Act
Winters v. United State
(1908)/Water rights were reserved for tribes as an implication of the treaties that created the reservations with the intention of allowing American Indian settlements to become self reliant and self sufficient
Wyoming v. Colorado
1872→Prior appropriation water rights
Water management in the Southwest
Action forcing mechanism
EI
Environmental Impact Statement
-The lead agency as the public agency which has the principal responsibility for carrying out or approving a project
- Cooperating agencies
Federal Agencies
Army Corps of Engineers
Bureau of Reclamation
Bureau of Land Management
US Forest Service
Bureau of Indian Affairs
Federal Courts
CAP
1968
Central Arizona Project
US HOUSE OF REPRESENTATIVE
senate
congress
FEDERAL AUTHORITIES
Administrative
Permit delivering
Public participation
ARIZONA
Arizona State Legislature
Arizona State Agencies (permit delivering)
Arizona water
Arizona Department of Environmental Quality
Arizona Water Banking Authority (AWBA)
Arizona Corporation Commission
Water Infrastructure Finance Authority of Arizona
Arizona State Authorities
Administrative
Permit delivering
Stakeholder group
judicial
disputes
settlement
Prior appropriation doctrine/In the western part of the country, water ownership is controlled by the appropriative system Rights to water belong to the first user who puts the water to beneficial use→ Public water code 1919
Groundwater Management Act (1980)→ signed by Gov Babitt→creation of ADWR and TAMAs
Indian Water rights settlement
success
failure
pending
1968 Colorado River Basin Project Act, →B Reclamation participating interest in the NGS, used to provide power to the CAP
Arizona Water Settlement act→Non indian Priority CAP water reallocation to the ADWR
Cap settlement approved by Congress
Tribal Nation
Navajo /hopi Tribe at issue
Ak-Chin Indian Community; Salt River Pima Maricopa Indian Community; Fort McDowell Indian Community; Yavapai Prescott Apache Tribe; Pueblo of Zuni; San Carlos Apache Nation (Salt, Black, and San Pedro River claims only); Gila River Indian Community; Tohono O'odham (San Xavier, Schuck Toak, and Gila Bend Districts only); and White Mountain Apache Tribe
Indian grassroots organization
PIMA COUNTY
Central Arizona Water Conservation CAWCD Central Arizona Groundwater Replenishment CAGRD Metropolitan Water District
CAP
Municipal Water Users
Municipal Water Providers
Arizona Municipal Water Users Association (AMWUA)
environmentalists
Tucson
Phoenix
Oro Valley
Green Valley
Sahuarita
Private Water Providers
Farmers, industrial sector
EPA Bart proposal
Navajo power generating station
TRIBAL NATION
US bureau of Reclamation 24,3%
Salt River Project 21,7%
Los Angeles Dept of Water and Power 21,2 %
NV Energy 11,3%
Tucson Electricity Power 6%
Arizona Public Service 14, %
CAP + CAWCD E D Fund Gila River Navajo N SRP DOI W. R.A
Better than Bart
COUNTY
DISTRICT
CITY
TOWNS


CENTRALITIES OF ACTORS
Most important actors (ALL centralities)
Integration & betweenness positions
Clique trends, links with important actors
Peripheral actors
C57 - INFLUENCE & DECISION MAKING - KEY POSITIONS
7. Conflict - Coalition - Solution
6. Conflict - Coalition
5. Conflict - Solution
4. Coalition - Solution
3. Conflict
2. Coalition
1. Solution
C47-ACTIVITY POSITIONS
Director
Expert-Advisor
Executive functionary
Reciprocated arcs?
Yes
No
In-degree
Clusters
EHonea Town Of Marana
JKmiec COT
GDavidson Town Of Marana
JRothschild COT
JFlake Senators
JKyl Senators
PSaletta Oro Valley
JJohnson ADWR
AForrest Tucson Water, CH2MHILL
MGallogly Fennemore Craig
DRule CAGRD
KVolpe Vail Water
TRWC
VVasquez TRWC
SALC
Developers & landowners
KMayes ACC
KKinsall City of AZ.Governor Phoenix
WUWC
JNelson AZLEG
LMason AZLEG
RBarnes AZLEG
TBuschatzke ADWR
NSelover ASU
HDarwin ADEQ
Family Farm Alliance
HGuenther Udall Foundation
The Udall Family
CUdall ABWC
JTannler ADWR
ECanfield Pima County-RFCD, WMG
KArnold Hudbay Minerals
DSnider Pinal County
DKüpel City of Phoenix
LEthen COT-OIP
MMiller Ranchers
CHuckleberry Pima County
WWilson Tucson Water
MLight Pima County-PDEQ
MMier Pima County-PAG
GWoodard Montgomery & Ass.
LKnipe Law office of Cheryl K. Copperstone PC
CZucker Pima County-PAG
LShipeck WMG
DMason ADWR
KChavez Pima County-RWRD
RAnderson GOT-Law office of Cheryl K. Copperstone PC
JFonseca Pima County-OSC
Pima County -LDIG
AHS
Mining companies
RGlennon UA Law School
BGrumbles ADEQ
VHickman ASLD
MBaier ASLD
MKiser Sustainable Tucson CWC, SAGAC
CRonstadt The Law Office of Carlos D. Ronstadt
SMegdal CAWCD, WRRC, UA, ACC
KRoach CWC
RDavidson SRP, WRC
APS
MMoreno ADWR
KPolen ASRS
CEster SRP
DRoberts SRP
BHallin SRP
SFabritz-Whitney Freeport McMoran
KSeasholes CAGRD
LGrignano CAP
WTenney CAP, MWD, SAWUA, ADWR-WRDC
LSmith Tucson Water
FMolina Tucson Water
VLittle BOR
DRousseau SRP
RLarson ASU
GRenner CAWCD
GGammage Jr. Gammage & Burnham, Phoenix Real estate, ASU
EHalper BOR
Metro Water
MMahmoud CAP
RChandler BOR
MBasefsky CAP
CCollum CAP
LMeyers BOR
MPearthree CAP
AZ Water
WEF
DDucey AZ Governor
DBennet SNWA
NGS
KFerris AMWUA
GUAC
KJacobs UA
SOlson AMWUA
MStratton SAWUA, MWD
KSorensen City of Phoenix-WSD
GStanton City of Phoenix
RMarra SWRC, BKW Farms
PBonavia TEP
BKW
DHutchens TEP
DModeer CAP


C2. Preferences : Policy values / Policy instruments / Most legitimate actors
n(CNS), MNGp, n(ECL), ECO / MNGi / n(COM), n(FED), PRI, STA (12)
CNS, ECL, n(ECO) / MNGi / FED, PRI, STA (6)
ECO/ MNGi / n(FED), PRI, n(STA) (5)
CNS, n(MNGp), ECL / n(MNGi) / COM, n(FED), PRI (3)
No data
C57 - INFLUENCE & DECISION MAKING - KEY POSITIONS
7. Conflict - Coalition - Solution
6. Conflict - Coalition
5. Conflict - Solution
4. Coalition - Solution
3. Conflict
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JRothschild COT
JFlake Senators
JKyl Senators
PSaletta Oro Valley
JJohnson ADWR
AForrest Tucson Water, CH2MHILL
MGallogly Fennemore Craig
DRule CAGRD
KVolpe Vail Water
TRWC
VVasquez TRWC
SALC
Developers & landowners
KKinsall City of AZ.Governor – Phoenix
JNelson AZLEG
LMason AZLEG
RBarnes AZLEG
WUWC
TBuschatzke ADWR
NSelover ASU
HDarwin ADEQ
Family Farm Alliance
HGuenther Udall Foundation
The Udall Family
CUdall ABWC
KMayes ACC
JTannler ADWR
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ECanfield Pima County-RFCD, WMG
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DRousseau SRP
RLarson ASU
GRenner CAWCD
GGammage Jr. Gammage & Burnham, Phoenix Real estate, ASU
EHalper BOR
Metro Water
MMahmoud CAP
RChandler BOR
MBasefsky CAP
MPearthree CAP
AZ Water
WEF
NGS
DDucey AZ Governor
DBennet SNWA
KFerris AMWUA
SOlson AMWUA
GUAC
KJacobs UA
MStratton SAWUA, MWD
RMarra SWRC, BKW Farms
PBonavia TEP
BKW
DHutchens TEP
CCollum CAP
LMeyers BOR
KSorensen City of Phoenix-WSD
GStanton City of Phoenix
DModeer CAP

Outcomes

- Analyzing the social conditions of production of water policy: how coalitions shape mobilizations, conflict, consensus
- In the TCS, the interest is to understand the emergence and dissemination of a water conservation policy => role of Pima County and apparition of a new coalition (with State agencies and other public institutions, including Phoenix)
- From Tucson/Phoenix antagonism to an understanding of the role of growing peripheral cities

The Social Logic of Urban Sprawl

Eliza Benites – SWAN Meeting, February 17th

The Social Logic of Urban Sprawl

LAND OWNER
Private or State

LAND (=raw)

Investors
Could be doctors, business acquaintances or friends, other developers, anyone with cash.
(can use loans)

PUBLIC ENTITIES
Requires approval by the municipality or county. Planning department (usually in charge of dispatching to utilities, development and engineering services), Public Hearings (might trigger residents' opposition)

DEVELOPER
Private companies or individuals with assets (local or national)

LAND (=Improved/ subdivided)

HOMEBUILDER
National publicly traded companies or local

HOMES

HOMEOWNER

Lawyers, Lobbyists, Sales' Agents
+
Engineering, planning consulting firms

Contractors infrastructure and utilities

Lawyers, Lobbyists, Sales' Agents
+
Engineering, planning consulting firms

Contractors, architects, engineers

Sales' agents

Results

→ Real estate industry, not only developers but a close network of private (contractors, builders) and public actors (planning and water services)

→ Existence of a "pro-growth" coalition composed of public and private actors

- ❖ Growth is embedded into the functioning of public entities.

Results

→ The real estate community does not express much concern regarding the future of water supply (even when going to events on UA campus!)

→ The technological improvement argument (technology will solve the water problem) is used to legitimize the "no concern for the future of water" discourse.

Interview with Paul G., development community

"I see water management as a success story. As of 2015, we have the same average consumption than in 1987. Even with CAP water, in Tucson, we can have 140,000 acre feet a year, we use only 100,000 acre feet a year, 40,000 just back into the ground, so we are good! We have declining water consumption, and even on a conservative trend, we still have till 2040-2050 and then we can use the water stored. Water is an important commodity, so we need to be efficient in water uses, and we are."

Recommendation

- Being able to change certain norms and practices requires **understanding** of how **institutional** and **human actions** come about.

- Make a friend, adopt a sociologist:
  - to understand the **positions of actors** and **institutions involved**, and the potential elements that can lead to **resistance** and **conflict** regarding any proposed project.

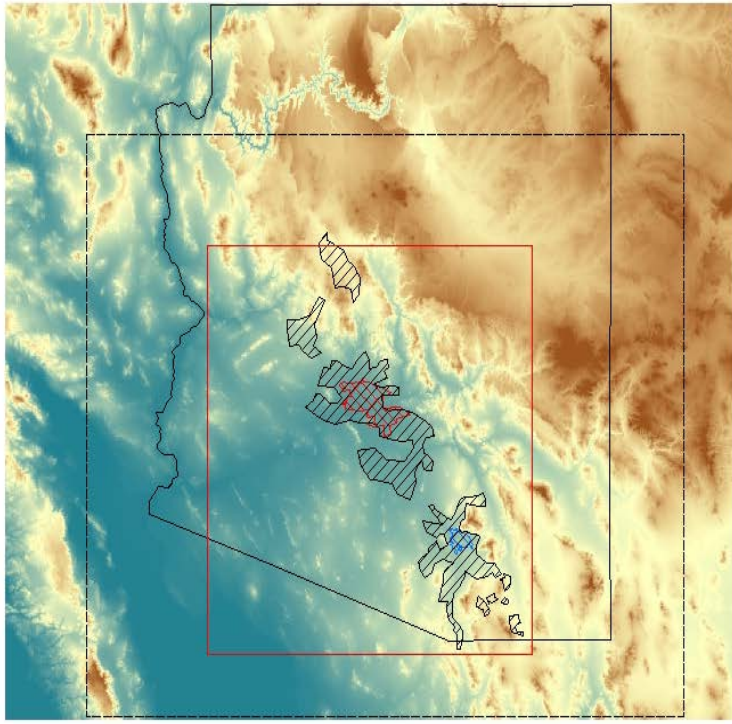
Urban Effects on Regional Climate: A Case Study in the Phoenix and Tucson 'Sun' Corridor.

Zhao Yang[1], Francina Dominguez[1], Hoshin Gupta[2], Xubin Zeng[1], Laura Norman[3]

1 Atmospheric Science, University of Arizona
2 Hydrology and Water Resource, University of Arizona
3 U.S. Geological Survey, Western Geographic Science Center, Tucson, Arizona

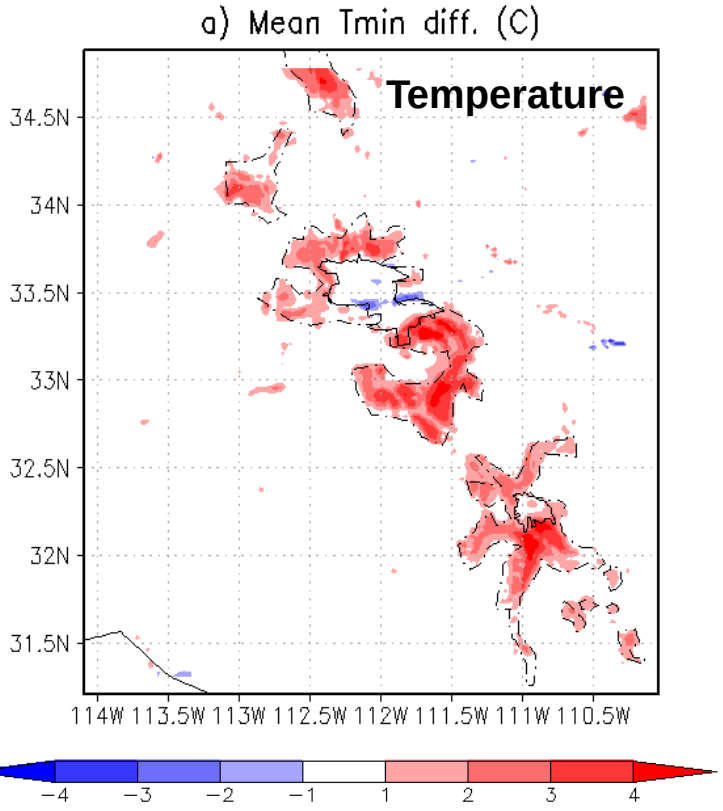
Motivation: to study the hydroclimate impact of urbanization

- **Phoenix metropolitan area: one of the fastest growing areas in the US for the past 30 years**
- **The projected urban area in 2050 is about 7 times greater than current under most intense case scenario.**
- **6 million more people expected in the 'Sun' corridor in 2030 (US Census, 2005)**

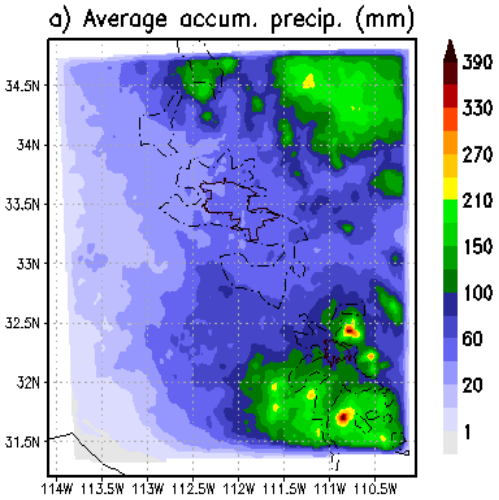


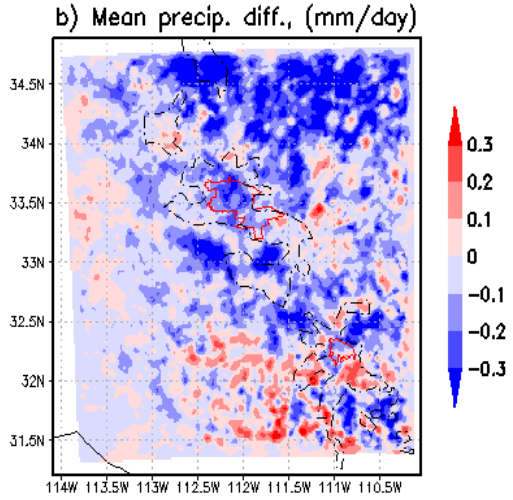
Urban heat island is well simulated, suggesting that it will be warmer during the nighttime.

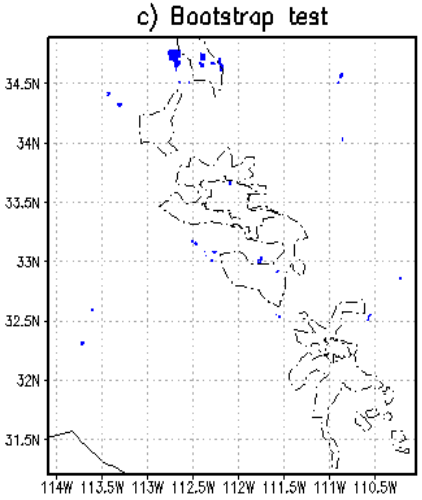
Decreasing pattern is dominant in our domain but the pattern is not statistically significant.

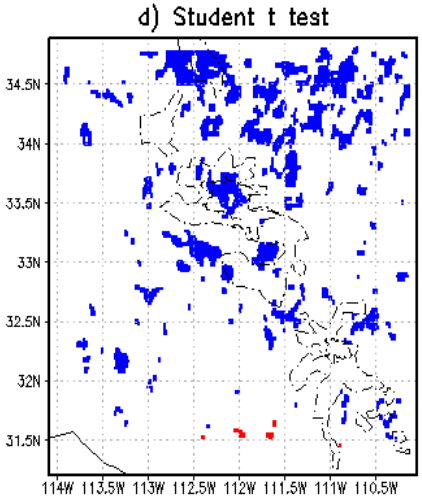


Precipitation





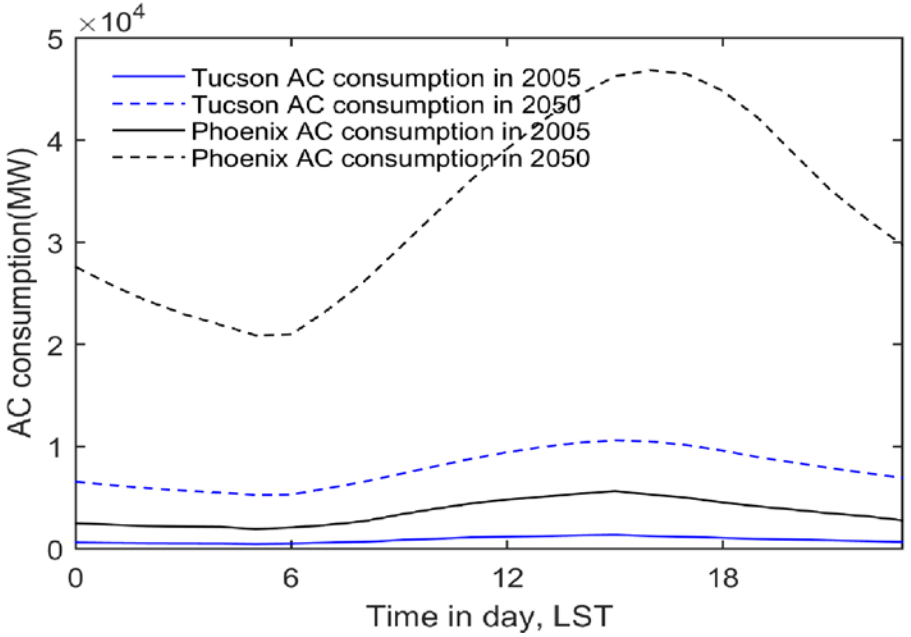




Future Demand Projection

Projected future **AC consumption** considering warmer temperature and area enlargement.

- Tucson AC consumption increases **by 9.2 times**.
- Phoenix AC consumption increases **by 9.4 times**.

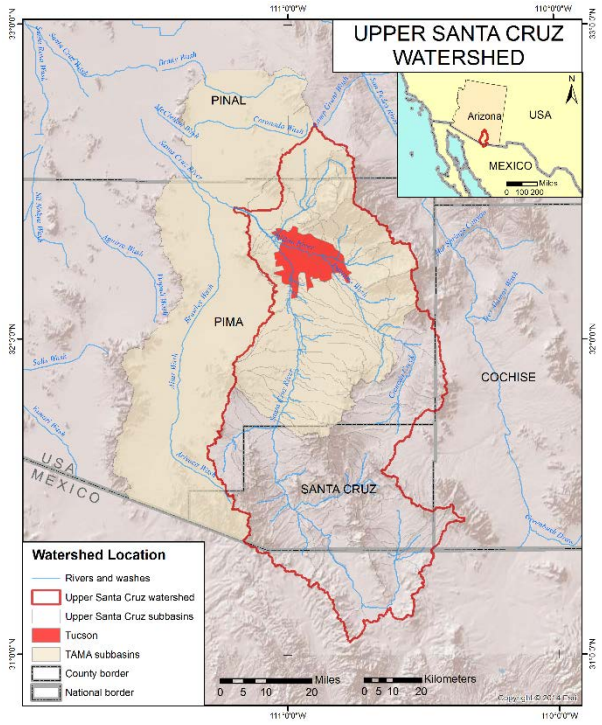


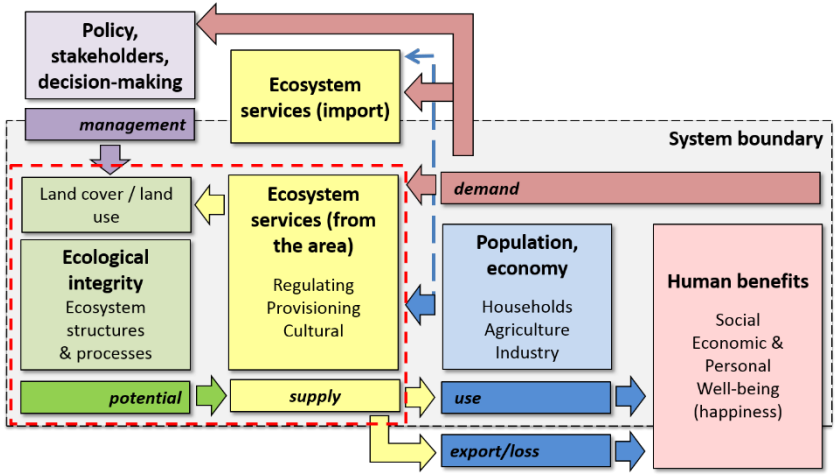
Water demand is projected to be **7 times** larger due to urbanization assuming only areal enlargement

Ecosystem Services in the Santa Cruz Basin: Changes with Urban Growth

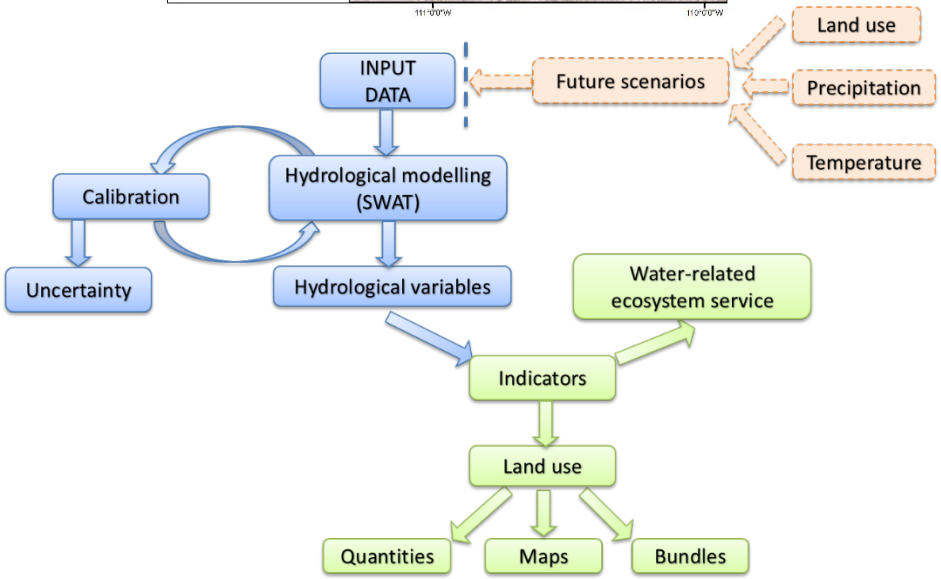
Kremena Boyanova

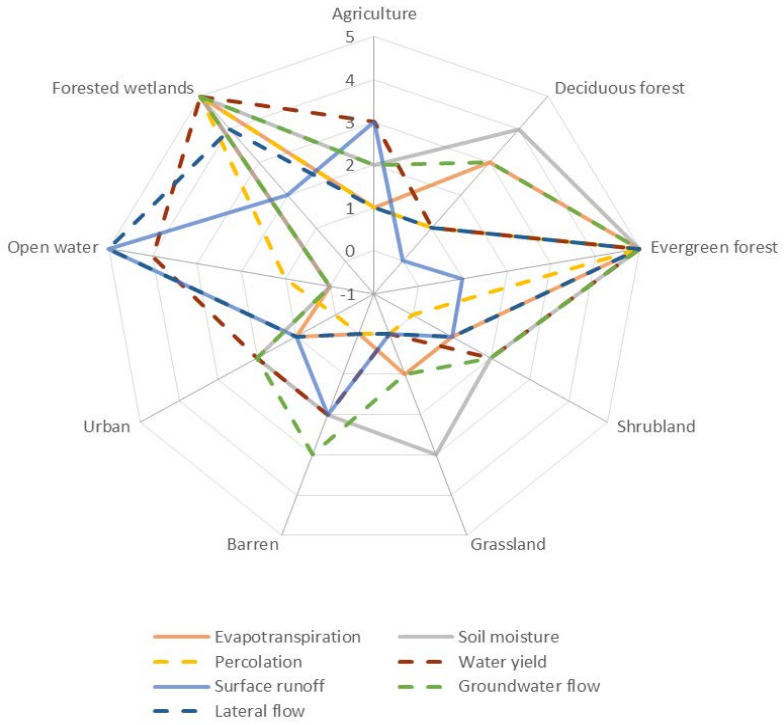
Changes in Ecosystem Services



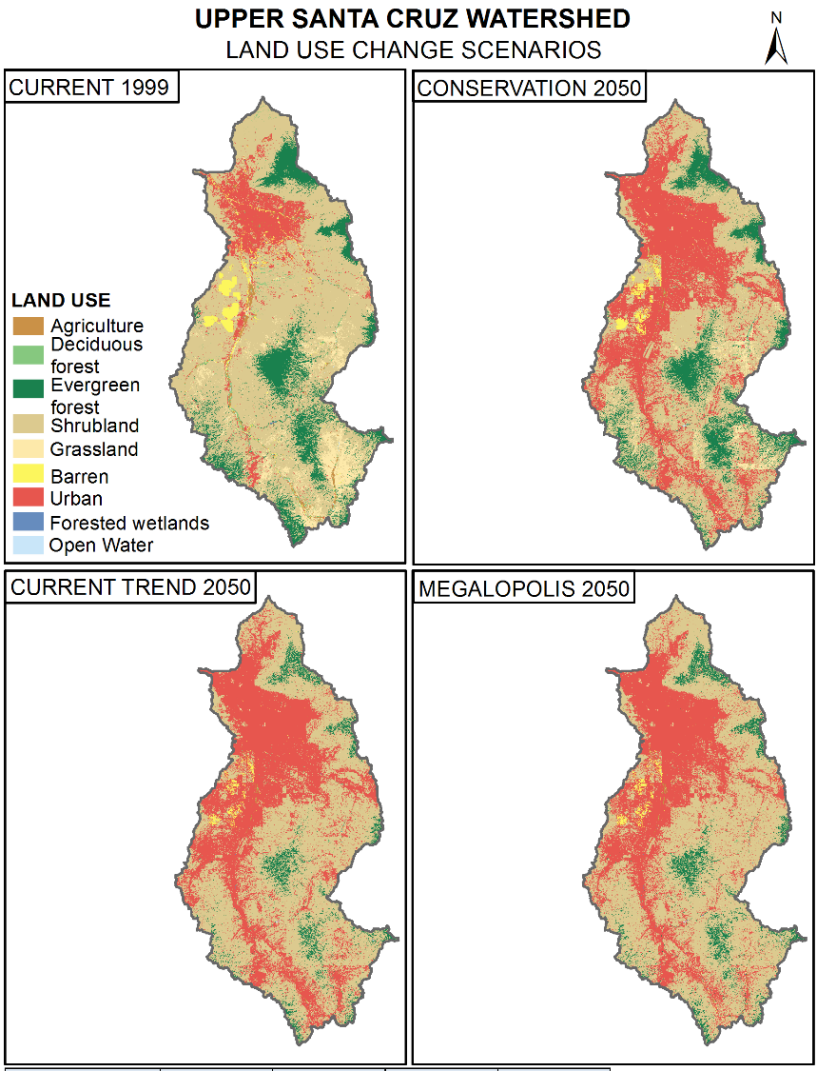


Land use WRES indicators supply classes

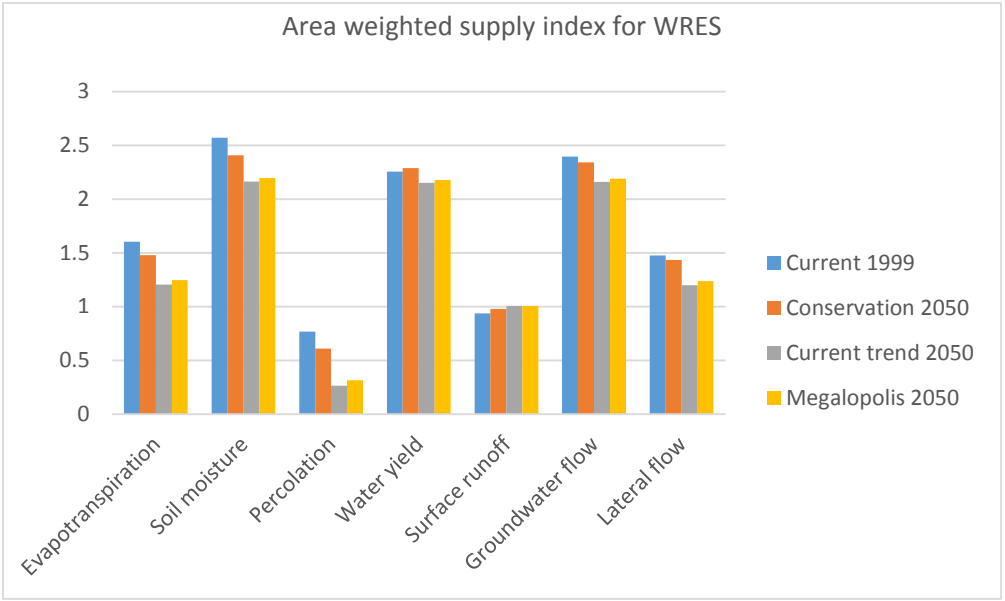




Changes in Ecosystem Services



- **Evergreen forests** and **forested wetlands** decrease significantly in all 3 LU scenarios for 2050
- **Urban areas increase** by 3 times in 2050 for all scenarios – **increase in the demand**
- **Decrease in the supply** - the supply of WRES is negatively influence by all 3 LU scenarios for 2050



Changes in Ecosystem Services

- **Evergreen forests** and **forested wetlands**:
  - are **key suppliers** of multiple ES, including the water-related ones, and are biodiversity hotspots
  - contribute most significantly to the **natural aquifer recharge** with their high percolation rate
  - **mitigate floods** by having highest water storage capacity and soil moisture rate

- The presented **LU scenarios**, in combination with the **ongoing drought**, need **careful consideration** in relation to the**:**
  - **increased demand** for WRES, due to the **urban growth**
  - **decreased supply** of WRES, due to **loss of key suppliers**
- In the period 2001 – 2006 the **CAP recharged water** in the Tucson AMA aquifers is **33% more** than the **natural recharge** in the Upper Santa Cruz Watershed:
  - the area is **significantly dependent** on allocated water from the **CAP**
  - its **water independence** can be supported by land management practices that **conserve, preserve and restore** the **key suppliers** of WRES

Assessing feasible options for sustainable water resource use to increase resilience in a semi-arid environment

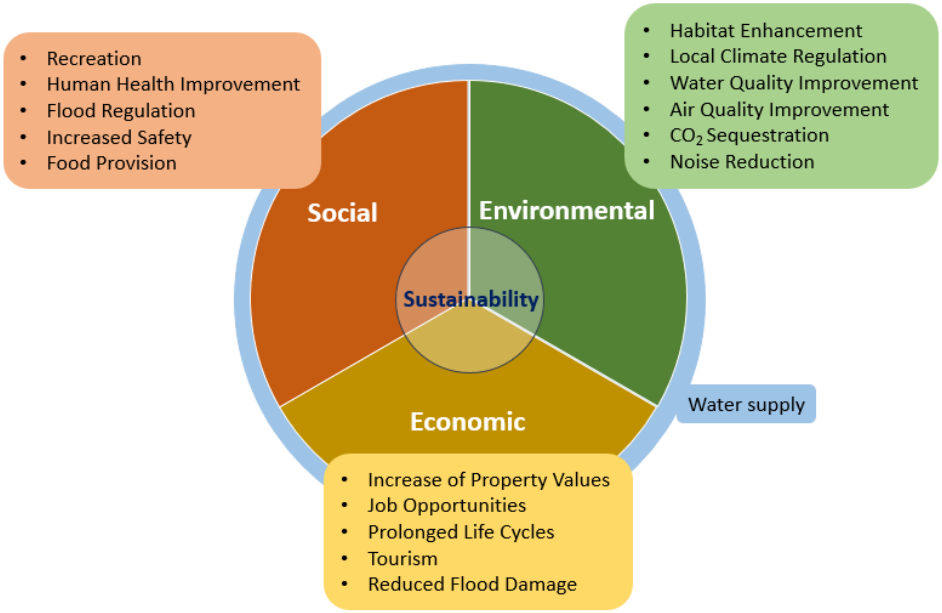
Kristin Kuhn
M.Sc. Ecohydrology

	Renewable	Local	Reliable	Potable	No impact on water quality of the aquifer	Absence of instit. conflicts	In-dependent of energy intense system	Feasibility (cost)	Feasibility (effort)	Ease of use
Ground-water	-	+	-	++	+	-	+	+	+	++
CAP Water	+	-	-	++	-	-	-	++	-	++
Reclaimed water	++	++	++	+	-	+	+	-	-	+
Rainwater	++	++	+	++	++	++	++	-	++	+
Storm-water	++	++	+	-	++	+	++	+	++	-
Graywater	++	++	++	-	++	+	++	-	++	-

- The utilization of rainwater and stormwater has the potential to cover more than 20% of municipal water demand in the TAMA. Graywater re-use could contribute up to 2% without affecting sewer flows.

- Cost-effectiveness is currently the main challenge for the utilization of rainwater, stormwater and graywater.

Green infrastructure with curb cut
(Lancaster, 2015)

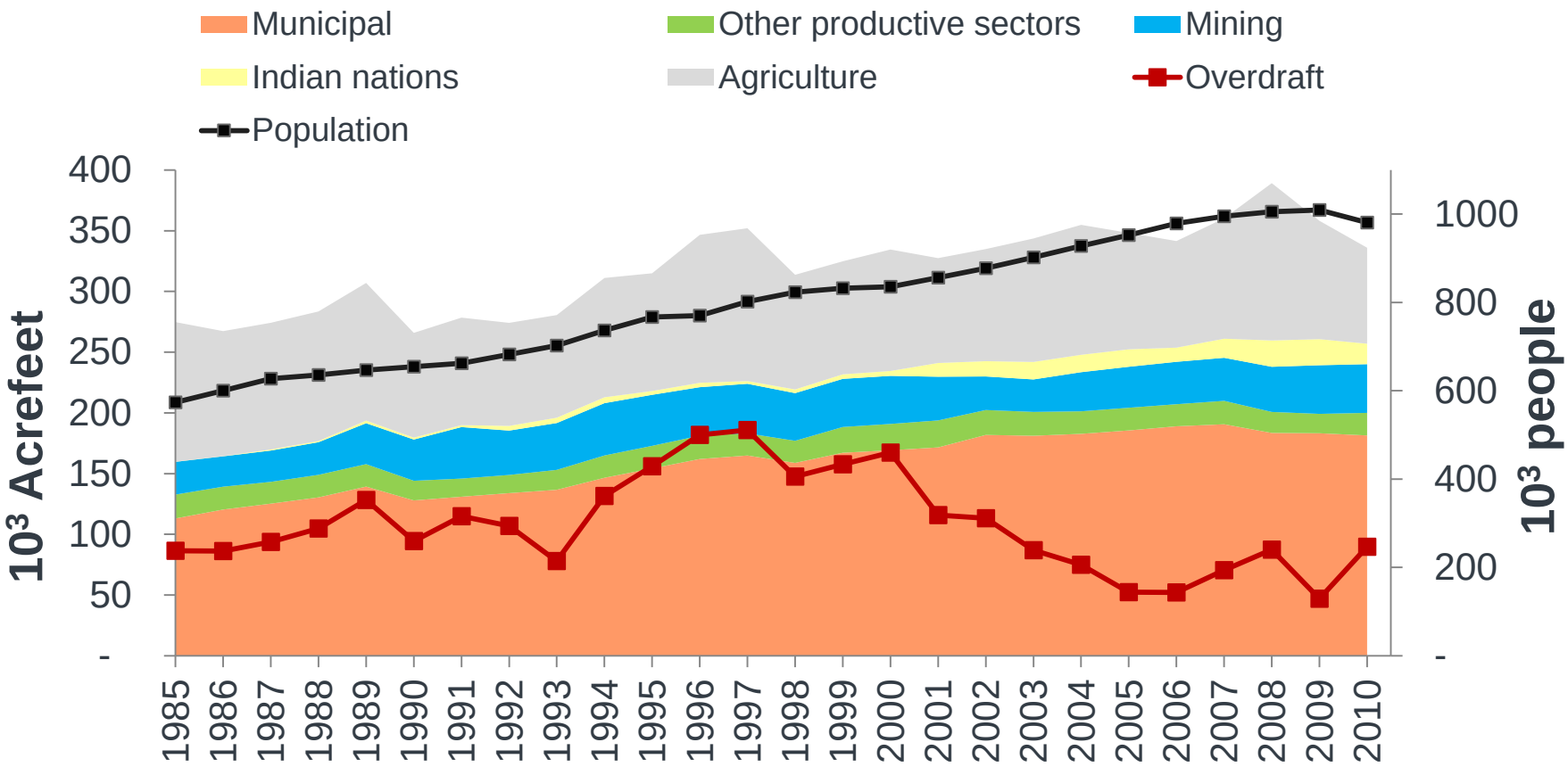


- The integration of ecosystem services and the contribution of both riparian ecosystems and urban greenery to human well-being should be better integrated in cost-benefit analyses and water resources planning.

Water Use, Safe Yield, and Shallow Groundwater Areas

Violeta Cabello Villarejo

Progress towards safe yield

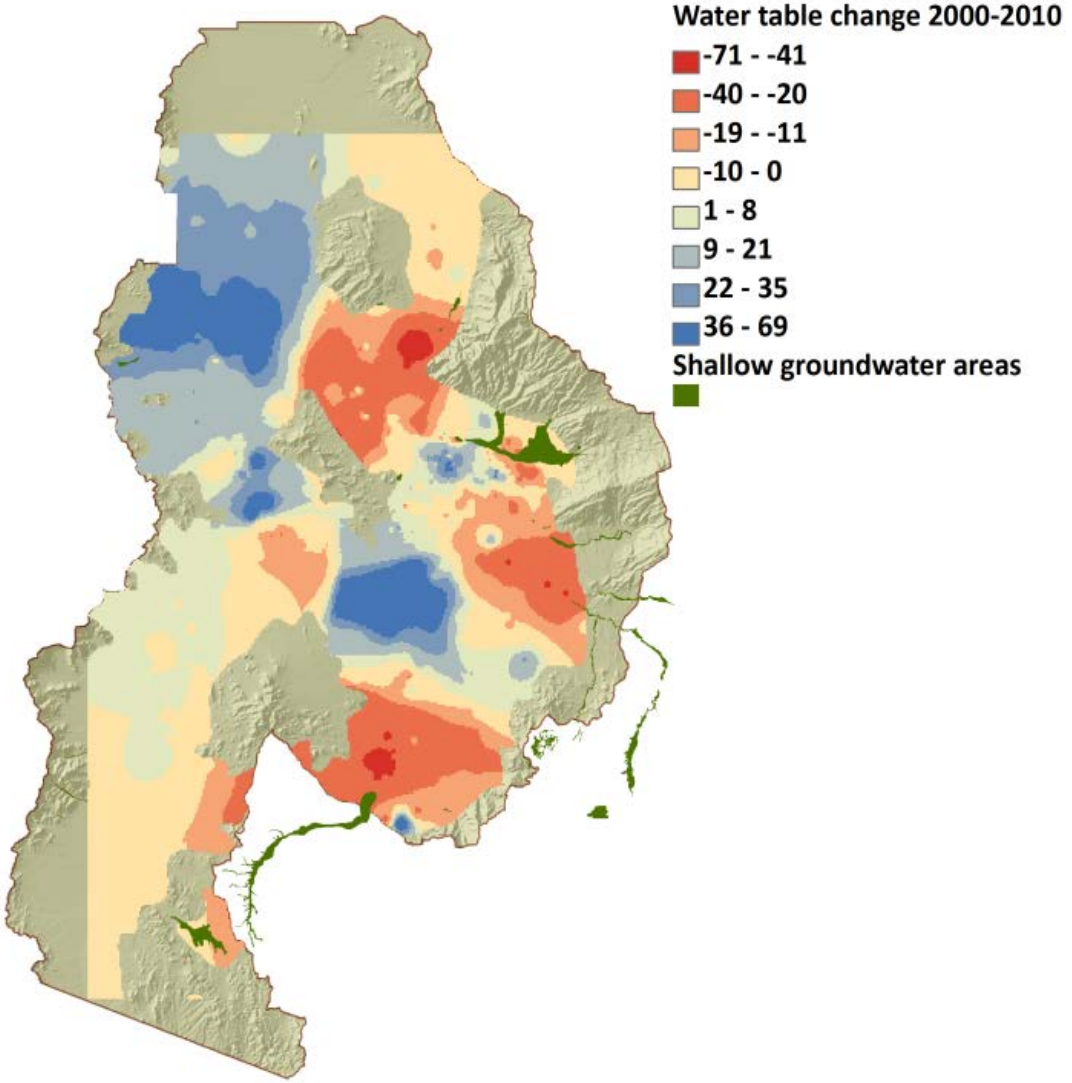


Conservation programs are enabling urban growth without mirroring municipal demand. Not that significant in agriculture

CAP-water partially replacing groundwater

Spatial distribution of safe yield

- Uneven achievement of safe yield
- Partial disconection between recharge and recovery
- Role of the CAGRD
- Lack of spatialiased data



Questions for debate

- Environmental implications of the spatially neutral definition of safe yield for the whole TAMA?

- Implications of the reactivation of the building sector for spatial inequalities in safe yield?

- Progress towards water accounting areas?

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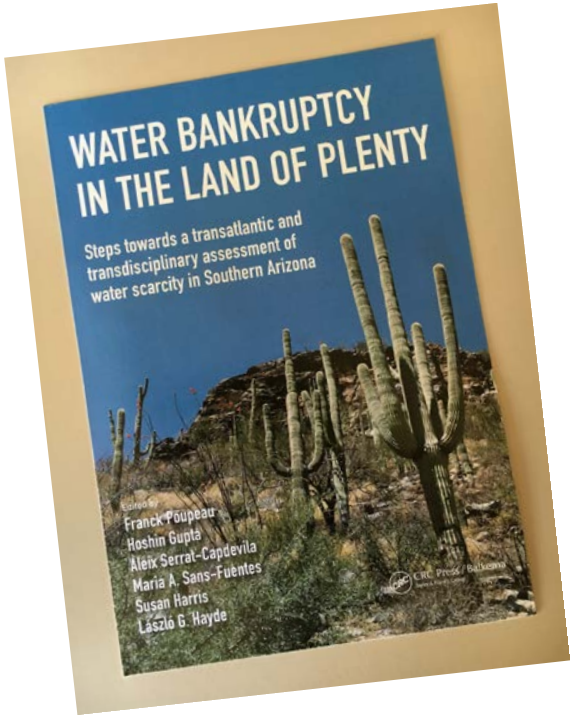
Sustainable Water ActioN

Where do we go from here ?



Current and future water issues ?

How can research help?

Breakout Groups

Breakout groups will allow the participants to review and discuss the policy and practical issues presented by Mr. Huckelberry and the researchers and to answer key questions posed by each group moderator.

- 10:40 – Participants divide into equal-sized groups and introduce themselves. Based on the key questions, participants will discuss and prepare recommendations on current water issues in the Tucson Basin.
- 11:30 – How can research assist in dealing with these challenges? Suggest two research topics!
- 12:00 – Groups present recommendations to the entire group.

Assigned Stakeholders

- **Group 1:** Tim Thomure, Mark Murphy, Rita Mercer, Julia Fonseca, Jackson Jenkins
- **Group 2:** John Kmeic, Marcelino Flores, Mark Taylor, Gary Woodard.
- **Group 3:** Prevatt, Placido dos Santos, Chuck Graf, Kathy Chavez.
- **Group 4:** Mead Mier, Jim Dubois, Ian Pepper, Evan Canfield.