Session 3: Stakeholder-based climate research programs in South Florida

Mike Sukop

FIU FLORIDA INTERNATIONAL UNIVERSITY
Earth and Environment

Presentations:

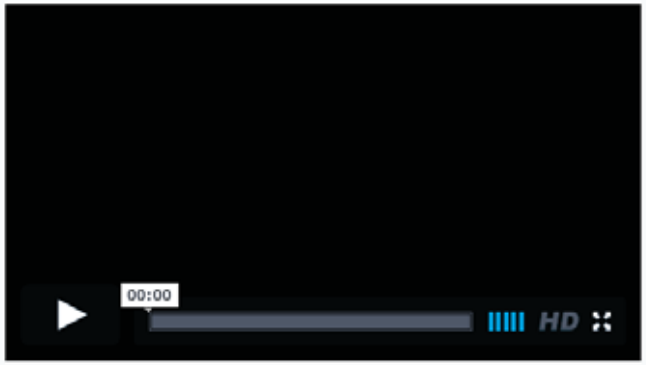
- **Urban Resilience to Extremes Sustainability Research Network (UREx SRN), (Dr. John Kominoski)**
- **South Florida Water, Sustainability, and Climate Project (SFWSC) (Dr. Mike Sukop)**
- **Urban Water Innovation Network Sustainability Research Network Project (U-WIN SRN) (Dr. Mike Sukop)**
- **SFWSC and U-WIN Stakeholder-based Research Plans (Dr. Jessica Bolson)**
- **Project Management and Facilitation (Alicia Lanier)**
- **Discussion - What it all means to FloridaWCA participants (insights, research, activities)**

FWCA Workshop September 18, 2015, Tampa Bay Water, Clearwater, Florida

Urban Resilience to Extremes Sustainability Research Network

The UREx SRN focuses on integrating social, ecological, and technical systems to devise, analyze, and support urban infrastructure decisions in the face of climate uncertainty.

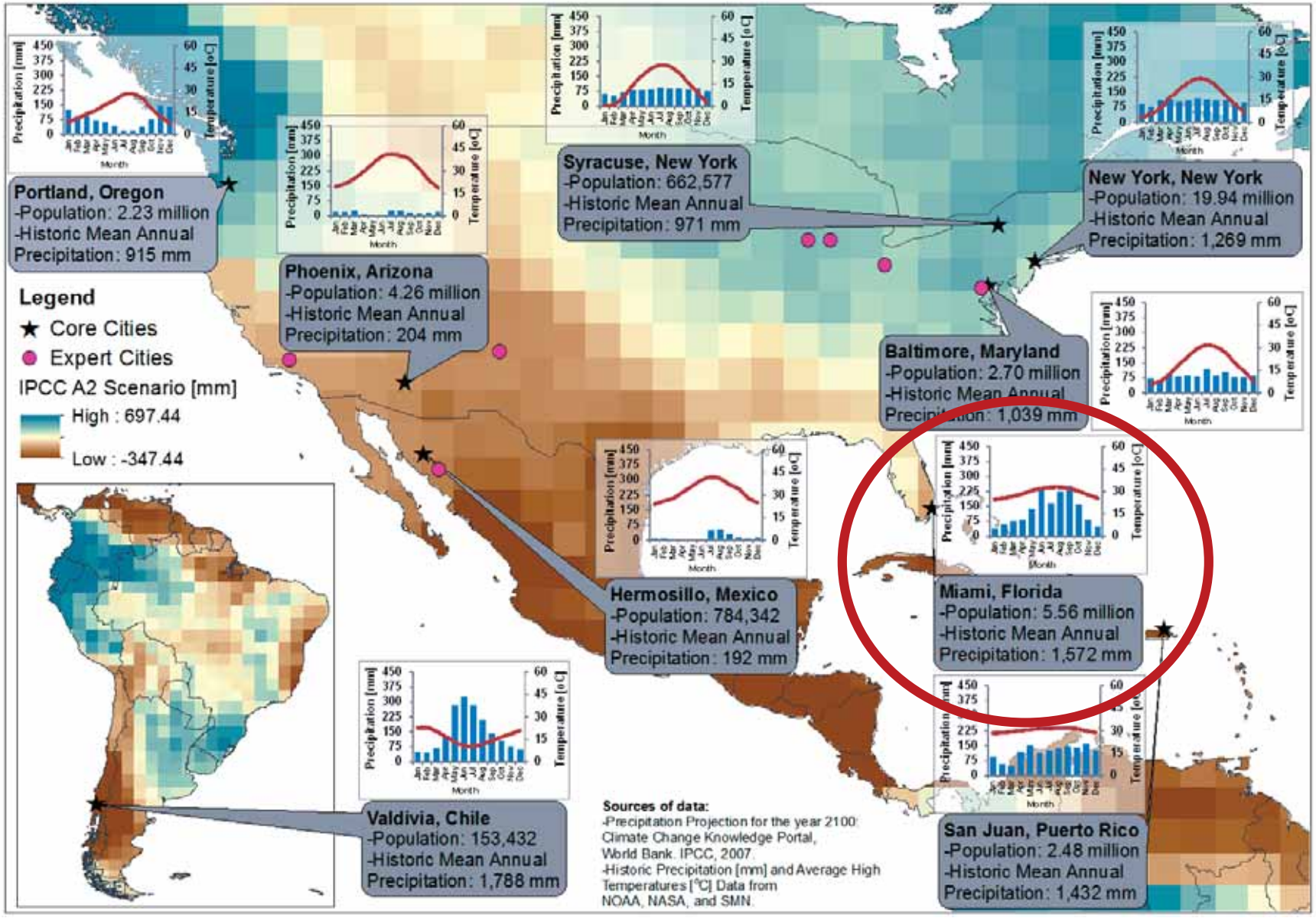
Challenges & Solutions



UREx SRN Network Cities:

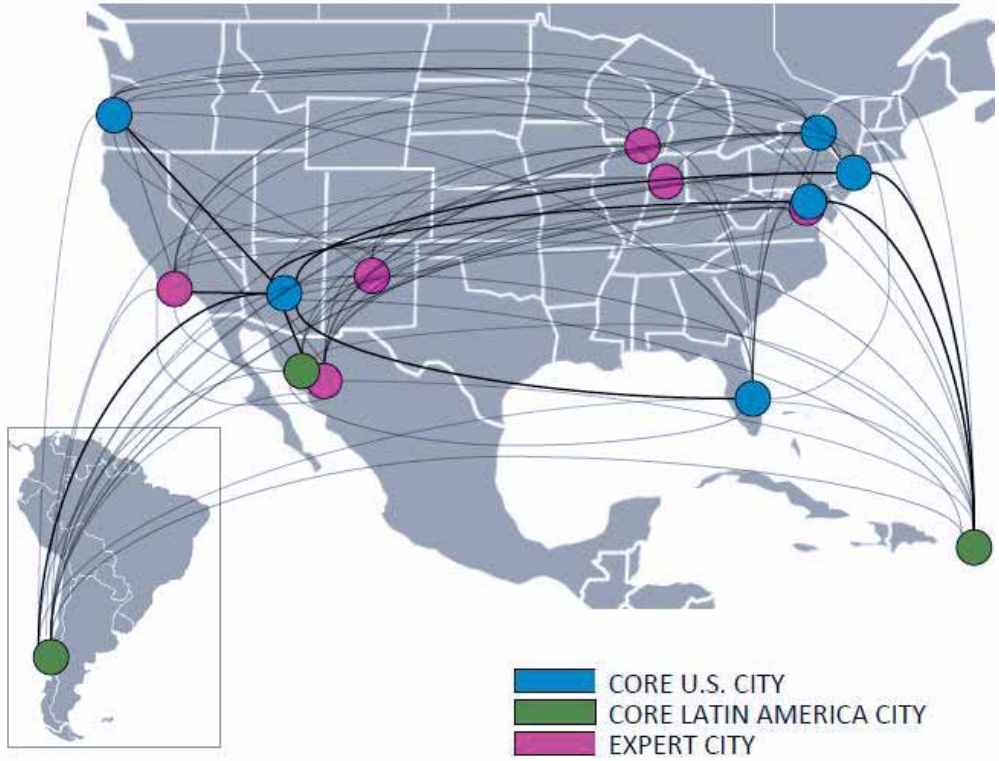
Baltimore, Maryland
Hermosillo, Mexico
Miami, Florida
New York, New York
Phoenix, Arizona
Portland, Oregon
San Juan, Puerto Rico
Syracuse, new York
Validivia, Chile

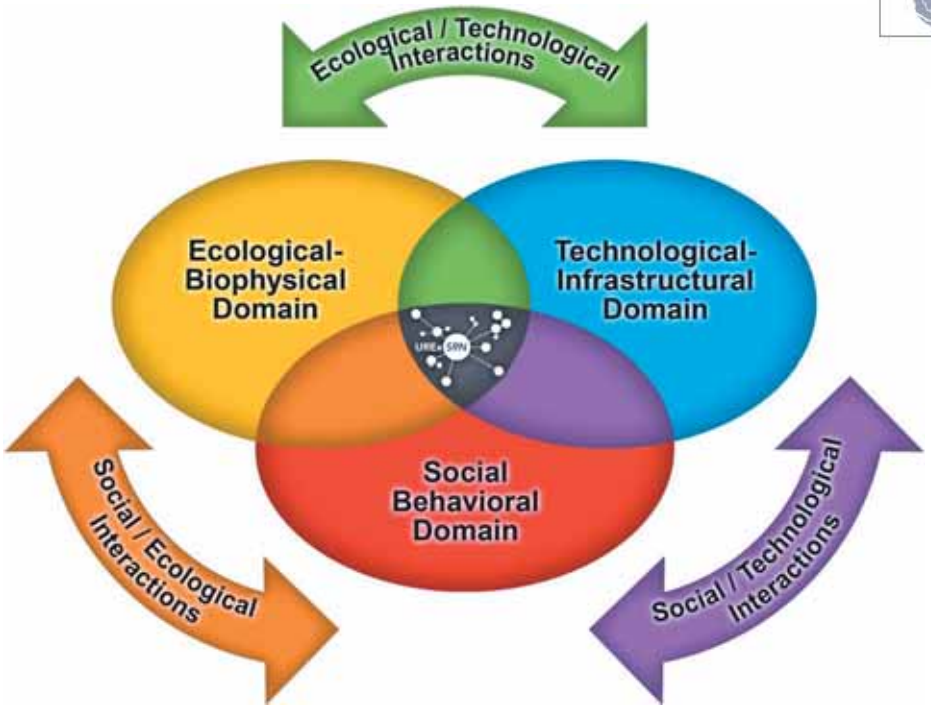
Exposure to Extremes



UREx SRN

- A network of diverse cities
- A network of experts in Working Groups
- A holistic conceptual framework
- Inclusive, participatory approaches
- A workflow, education program, and evaluation plan that produces results and continually learn

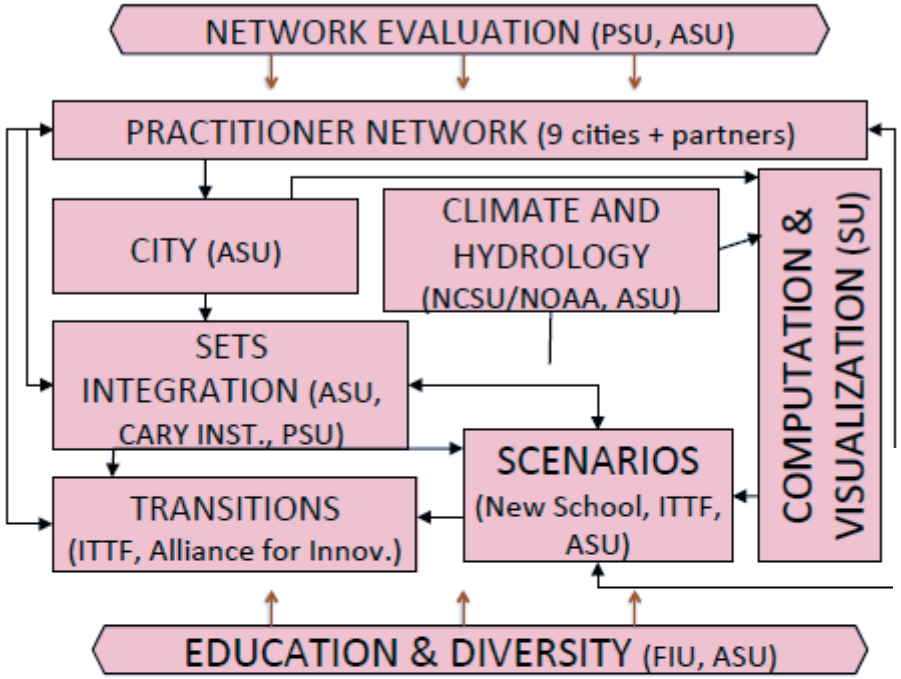




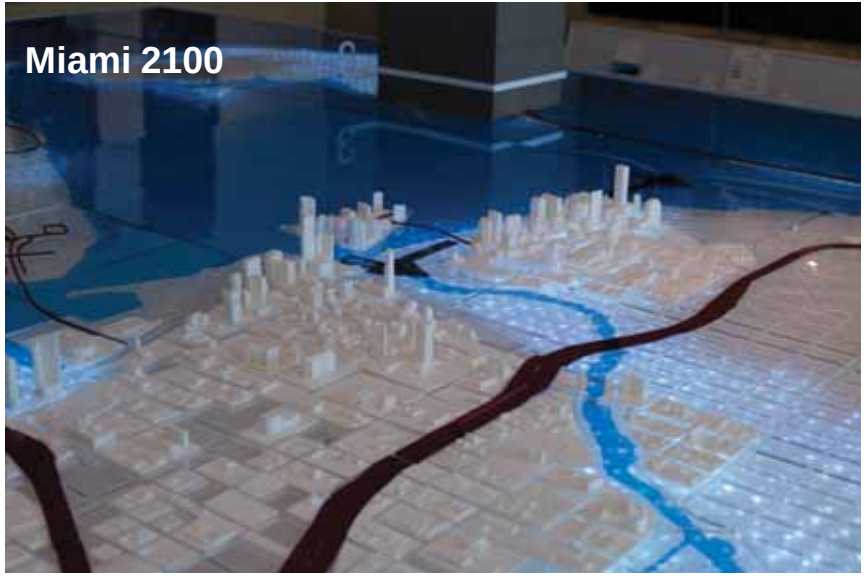
Central Question:

How do SETS domains interact to generate vulnerability or resilience to climate-related extreme events, and how can urban SETS dynamics be guided along more resilient, equitable, and sustainable trajectories?

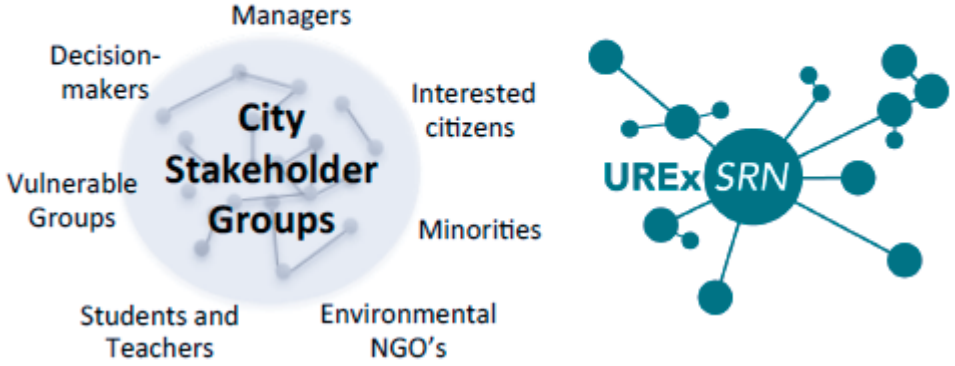
UREx SRN Work Flow



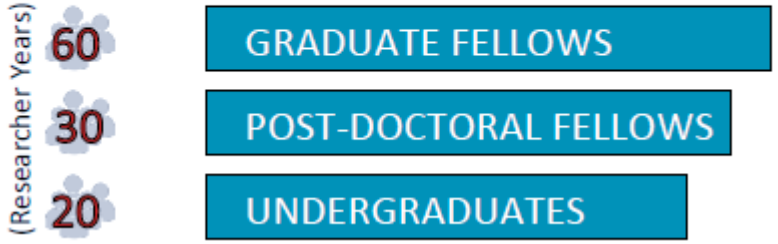
- Nine cities, 15 institutions, 65 participants
- 10 partner institutions and numerous stakeholder partners
- Ecologists, social scientists, engineers, planners, designers, climatologists, physical scientists
- Downscaled climate extremes projections
- Geodatabase, computation, visualization used for comparison, sustainable future scenarios
- Transitions work to implement strategies
- Embedded IGERT-like graduate program



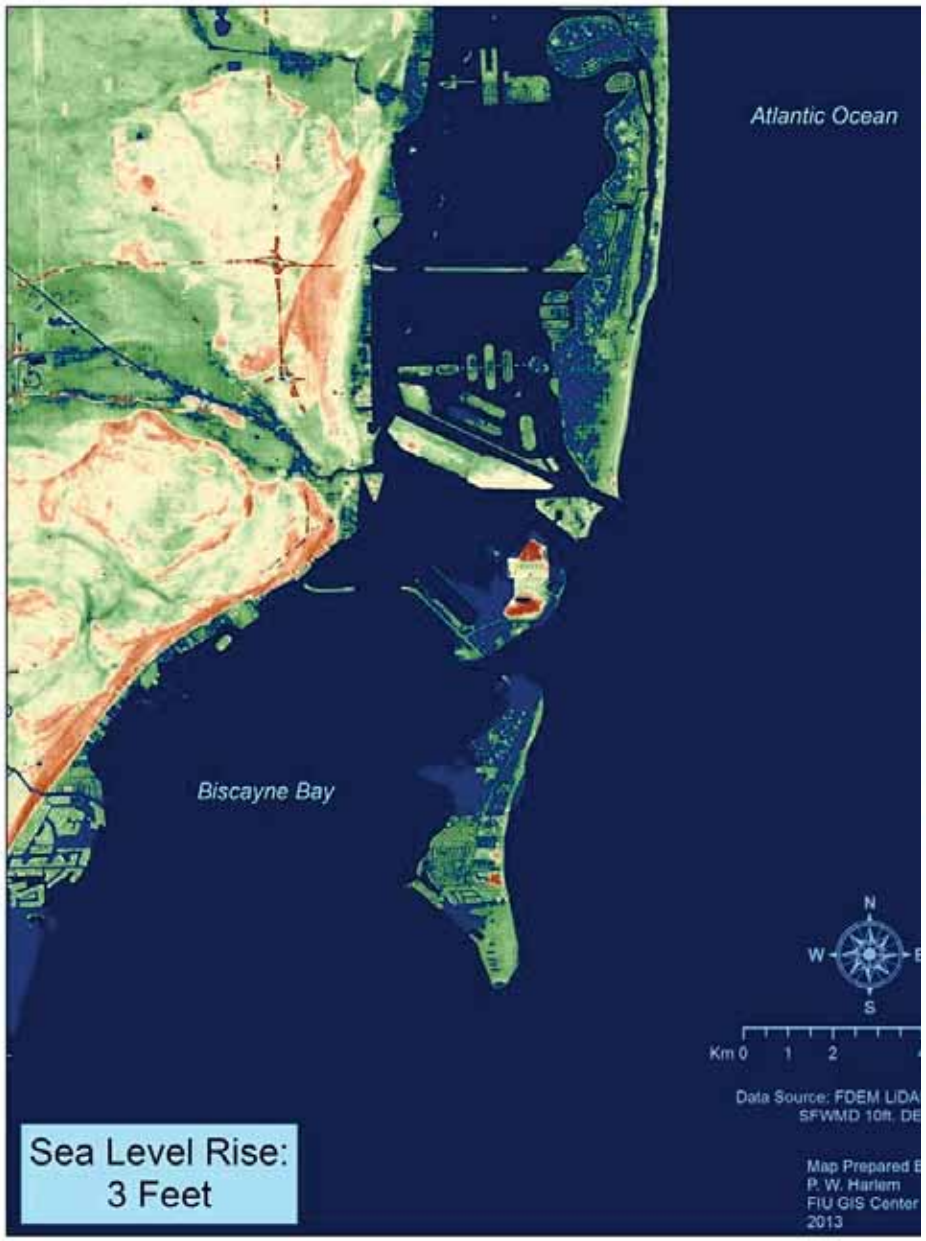
Working with diverse stakeholders

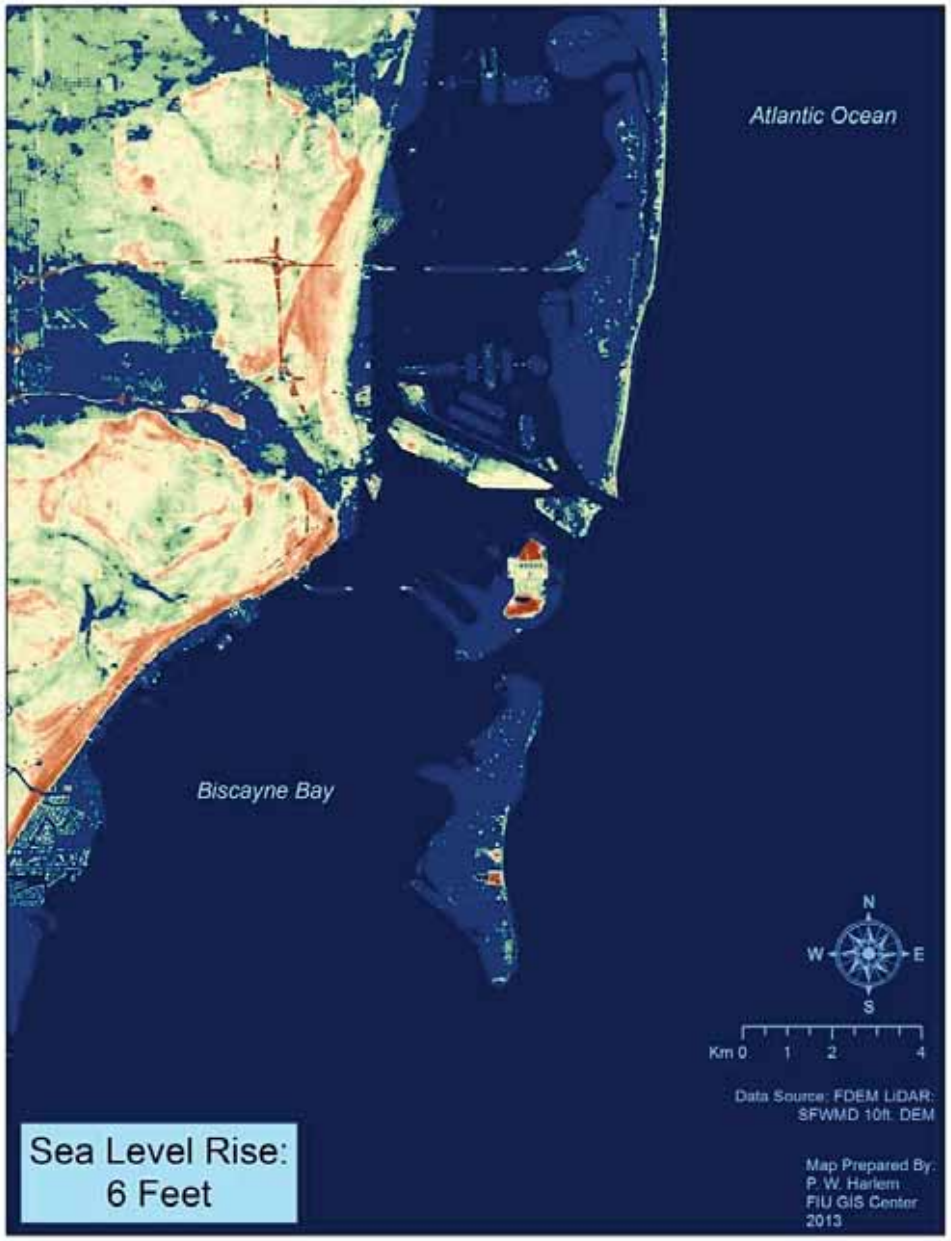


Training the next generation of leaders



Miami Threats: *hurricanes, urban flooding, coastal flooding*





Forecast maps: Pete Harlem, FIU

Miami's Extreme Climate Threats
hurricanes, urban flooding, coastal flooding

Partnerships:

Miami-Dade County

Southeast Florida Regional Climate Compact

Florida Water & Climate Alliance

National Hurricane Center

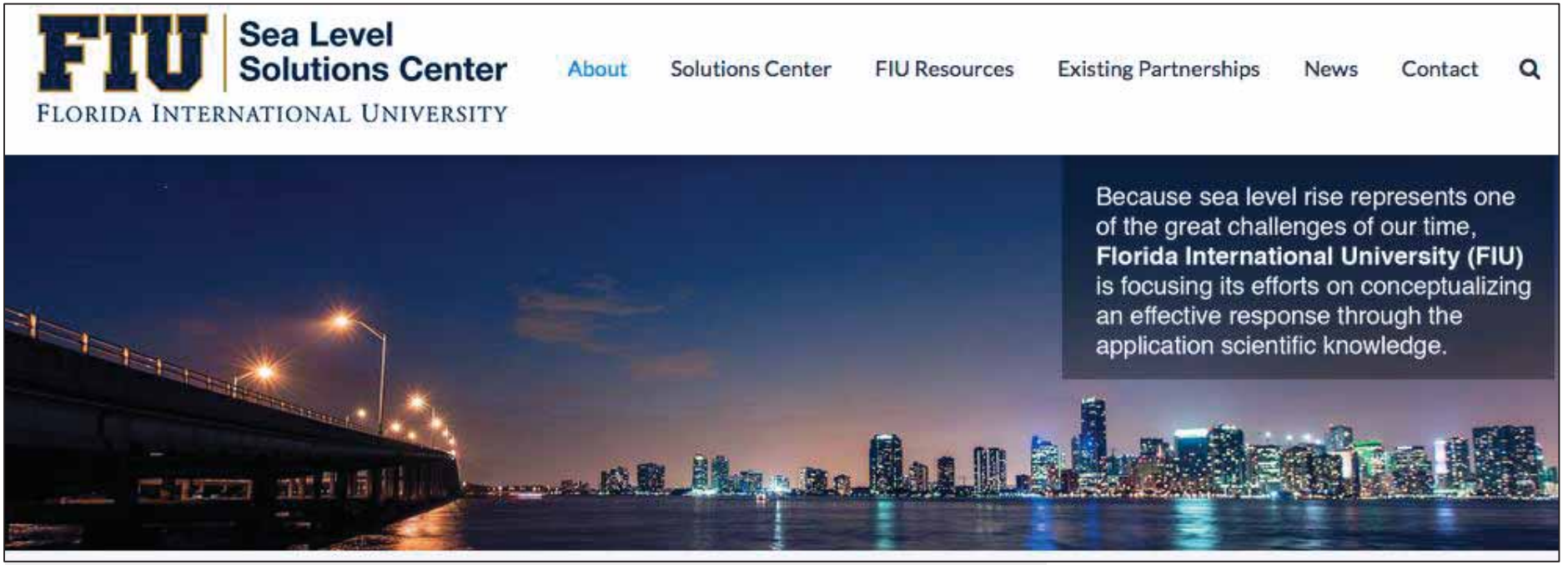
Tools & Data:

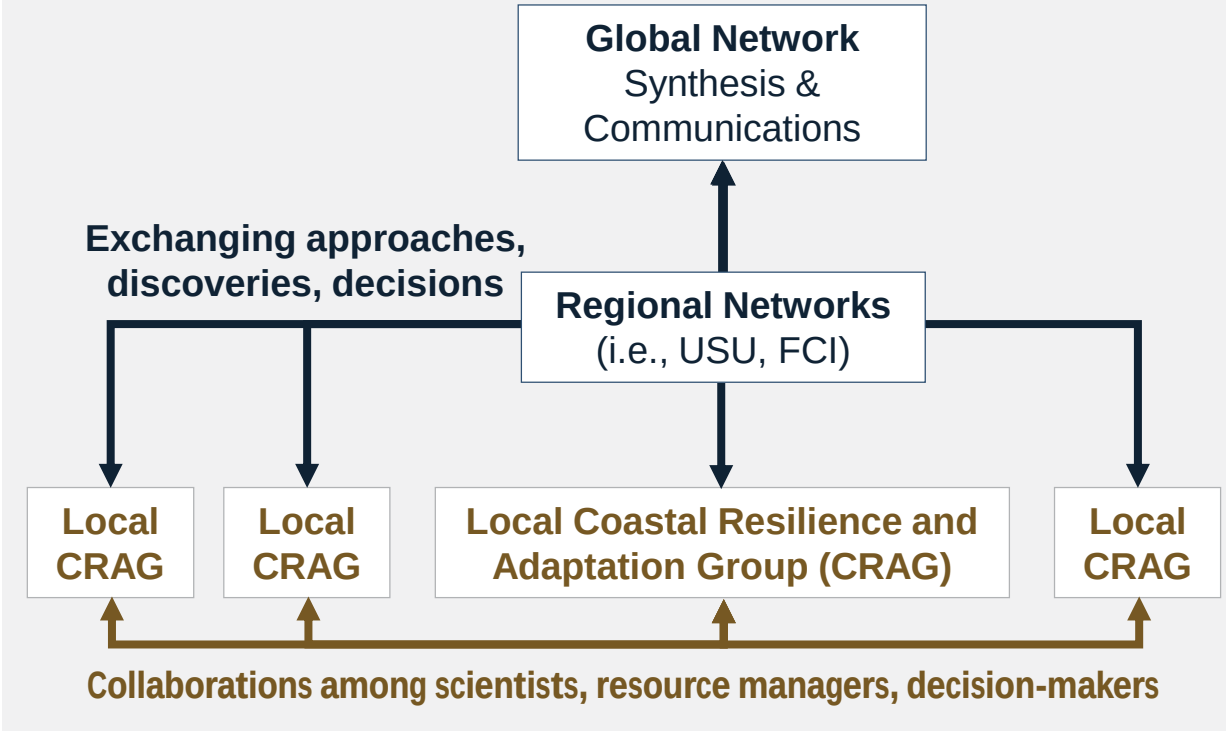
U.S. DOT CMIP5 Climate Data Tool

TNC Coastal Resilience Tool

FCE-LTER socio-ecological datasets

Various city-based datasets





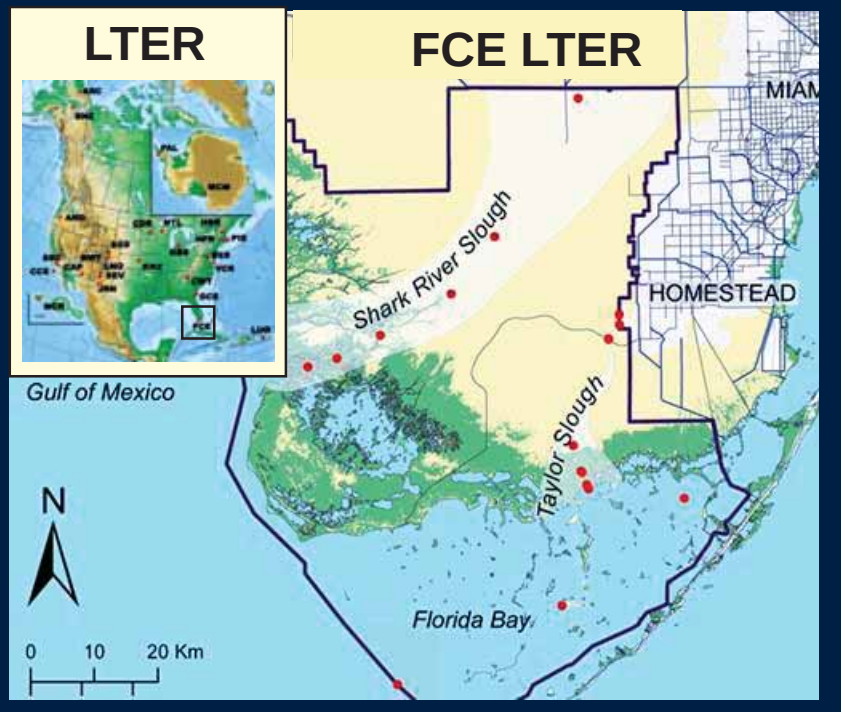
5 Year Plan

- Develop *a tool chest for cities* to address sea level rise
- Create *cutting-edge science* & education resources
- Become the *go-to-hub for media*
- *Impact policies* through briefings
- *Expand knowledge of leaders* for effective actions
- Develop & *share practical methods* for preparing for climate change

FIU FLORIDA INTERNATIONAL UNIVERSITY

Florida Coastal Everglades Long Term Ecological Research

Where….



Who…

What…

Long-term studies to determine the interaction of decisions about water management and sea level rise on the Everglades and its services to people.

FCE Facts

- **500 pubs, 5 books**
- **90 graduate degrees**
- **135 datasets**
- **80 undergrads in labs**
- **1,200 K-12 students and teachers each year**

Why…

There is only one Everglades, its restoration is vital to the people of Florida and the world.

FIU School of Environment, Arts and Society (SEAS)
College of Arts & Sciences

*Funding from National Science Foundation and agency partners**

Urban Water Innovation Network (UWIN)

Arizona State University (ASU)

Cary Institute of Ecosystem Studies (CIES)

Colorado State University (CSU)

Florida International University (FIU)

Howard University (HU)

Oregon State University (OSU)

Princeton University (PU)

University of Arizona (UA)

University of California-Berkeley (UCB)

University of California-Riverside (UCR)

University of Maryland Baltimore County (UMBC)

University of Miami (UM)

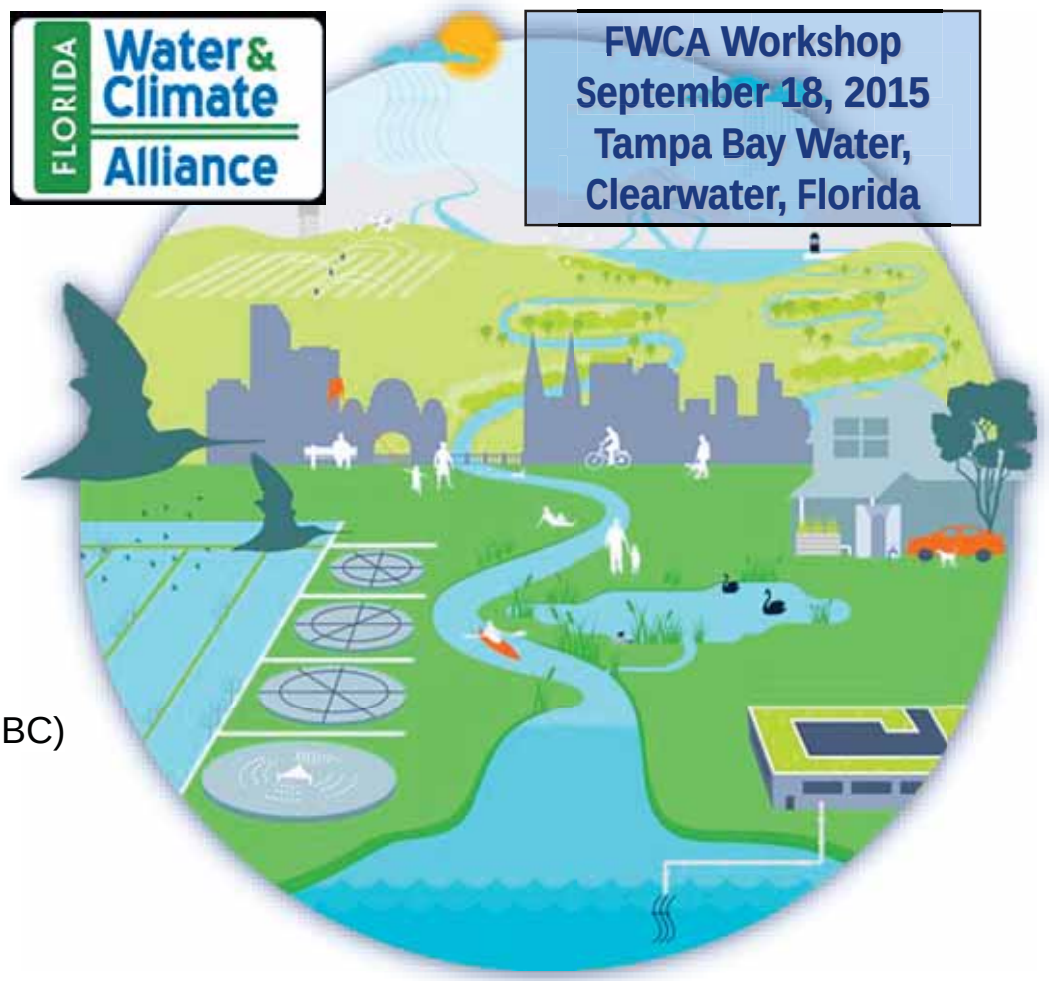
University of Oregon (UO)

University of Pennsylvania (UPENN)

Water Environment Research Foundation (WERF)

FLORIDA Water & Climate Alliance

FWCA Workshop
September 18, 2015
Tampa Bay Water,
Clearwater, Florida




Urban Water Innovation Network (UWIN)

U-WIN Vision and Mission

Making a global impact by creating science, guidance and champions of innovation for integration of urban water systems and resilient cities

- Discover technological and socio-political solutions to forge integration of urban water
- Create an agile research network to engage urban water hubs and the global water community
- Train scientists, policy leaders, and citizens as change agents for urban sustainability

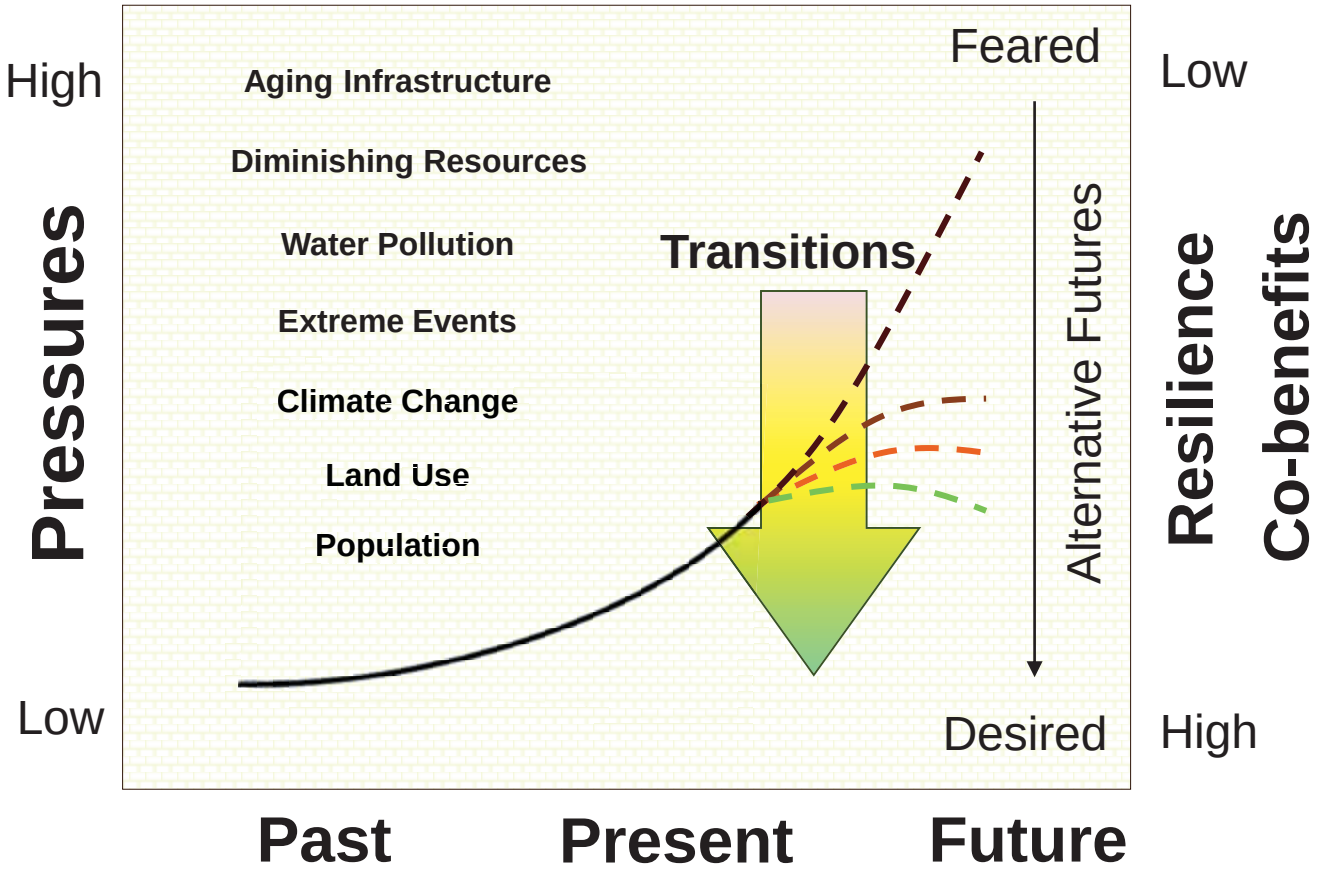
U-WIN will make a difference

- ✓ A suite of sustainable urban water solutions
- ✓ Blueprint for action
- ✓ Stronger community capacity to adapt
- ✓ Six regional Urban Water Sustainability hubs
- ✓ Online Global Urban Water Hub
- ✓ Train a new generation of scientists and policymakers
- ✓ Engage citizen scientists
- ✓ Develop leadership, communication and facilitation skills

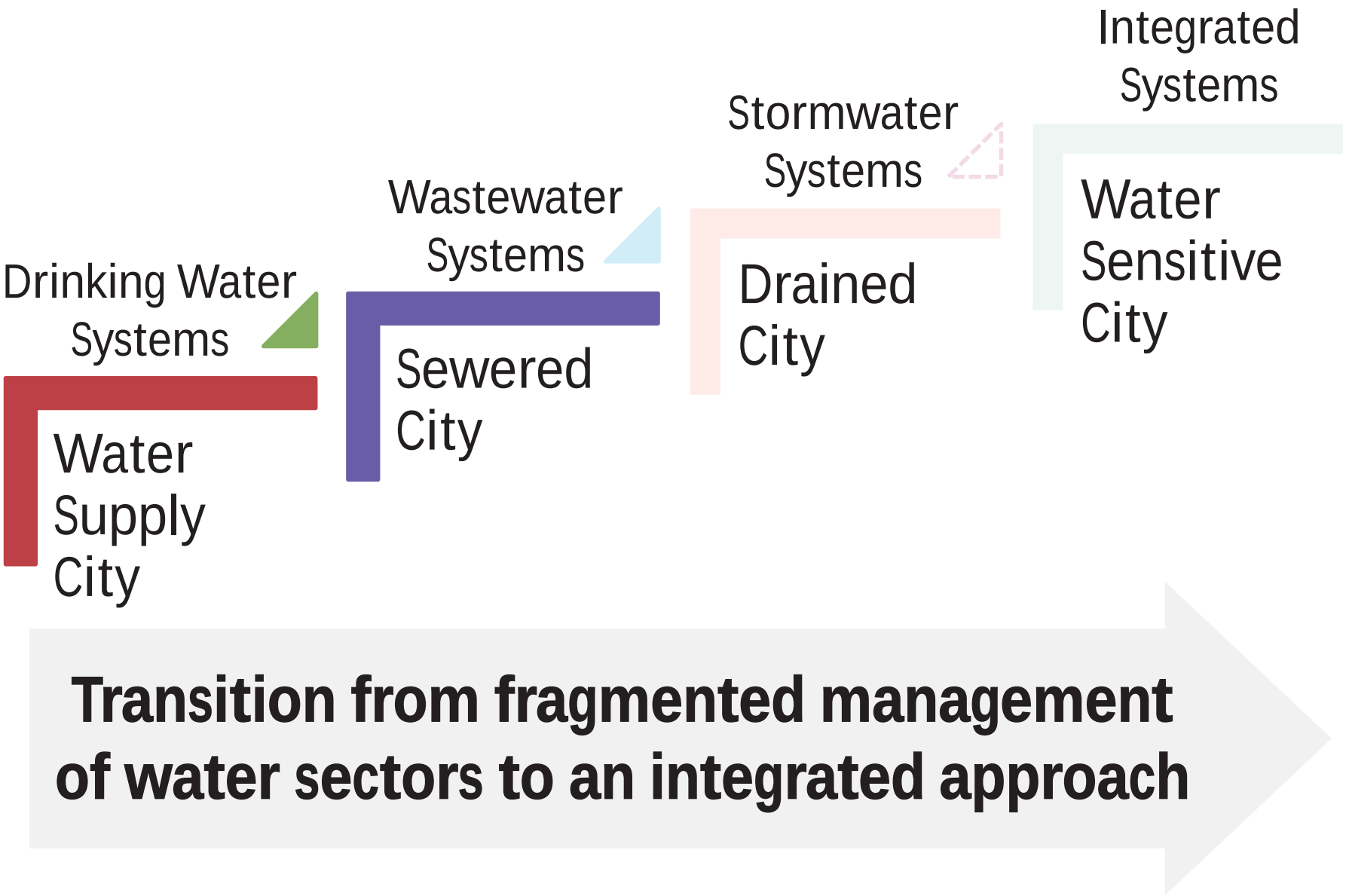
Urban Water & Linked Systems

Urban Water Systems	Socio-political Systems	Linked Urban Systems
▪ Drinking water ▪ Wastewater ▪ Stormwater ▪ Water reuse ▪ Floodplains ▪ Streams ▪ Aquifers	▪ Social and Economic Sectors ▪ Institutions ▪ Equities	▪ Climate ▪ Heat Island ▪ Energy ▪ Biodiversity ▪ Health ▪ Livability

The Sustainability Framework

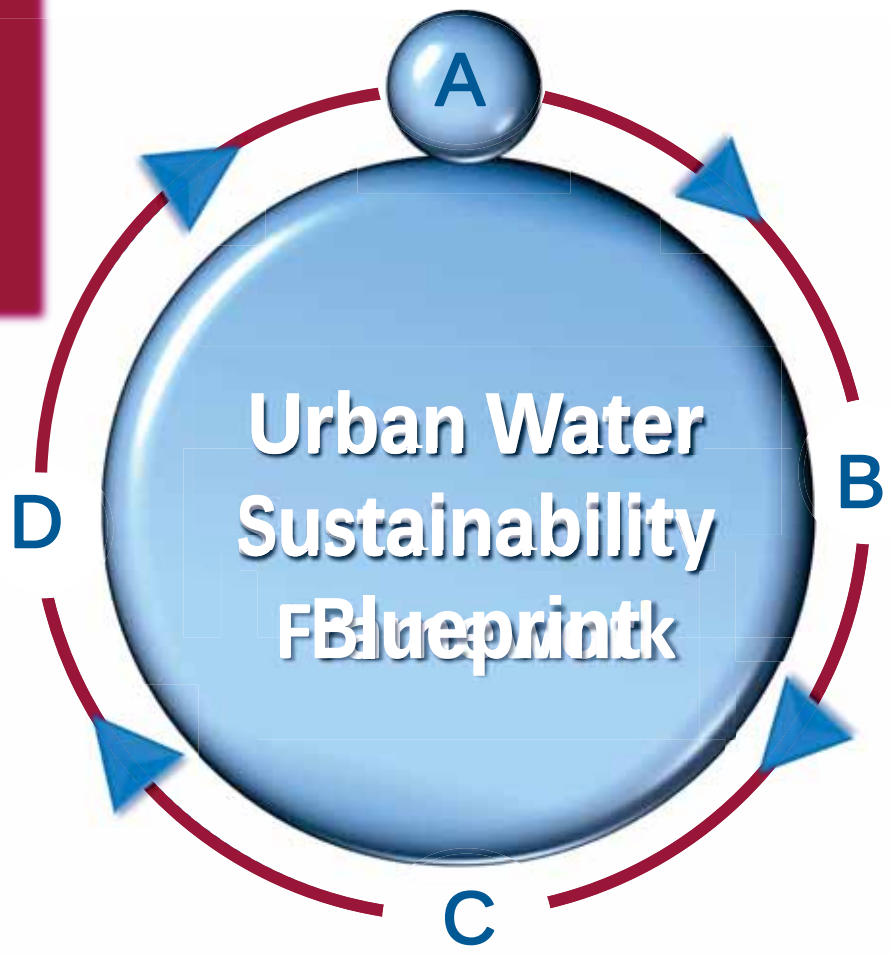


Evolution of Water Systems



Research Plan: Thrusts

Community Learning and Societal Assessment



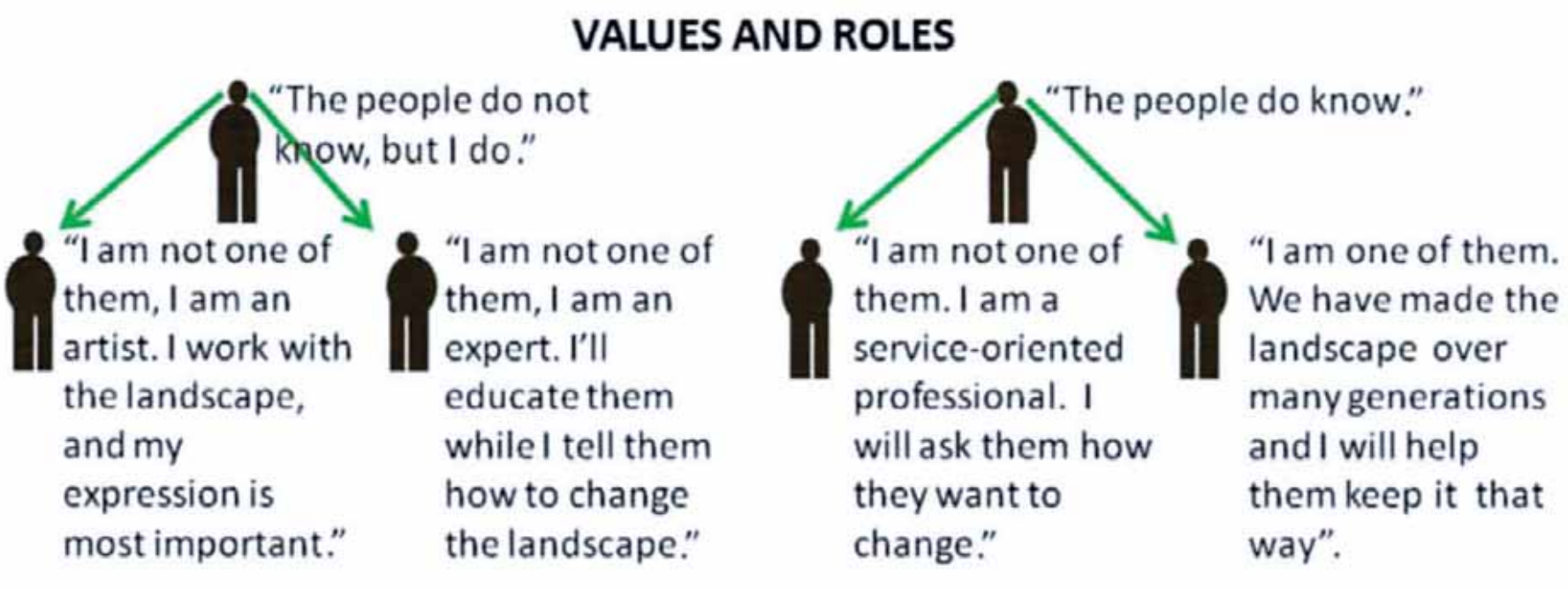
Assess Effects & Tradeoffs

Identify Technological Solutions

Identify Institutions & Transitions

Urban Water Blueprint

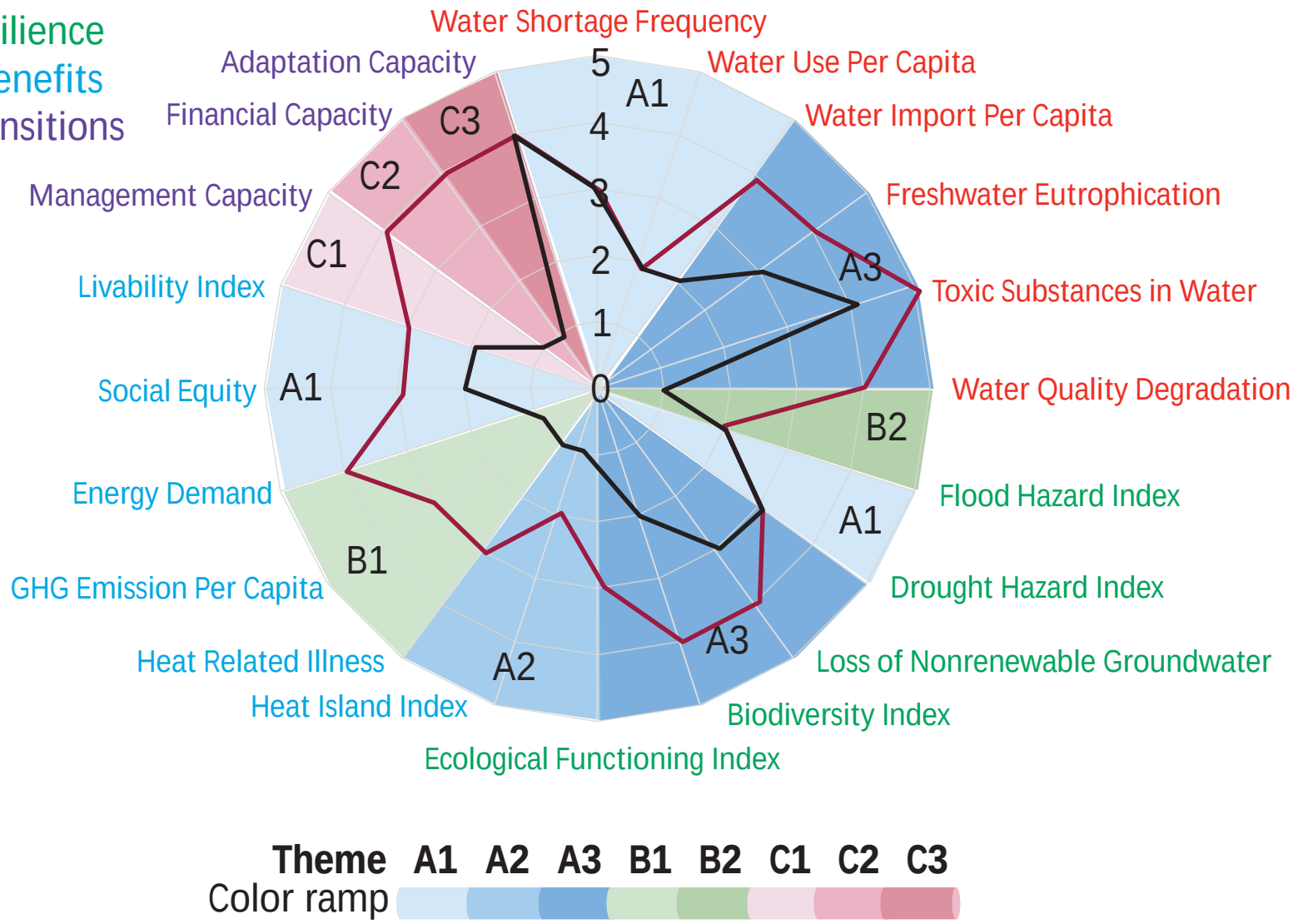
- Define essential characteristics → Data
- Point decision makers toward best practices
- Share experiences → Peer learning
- Stay agile in responding to future needs



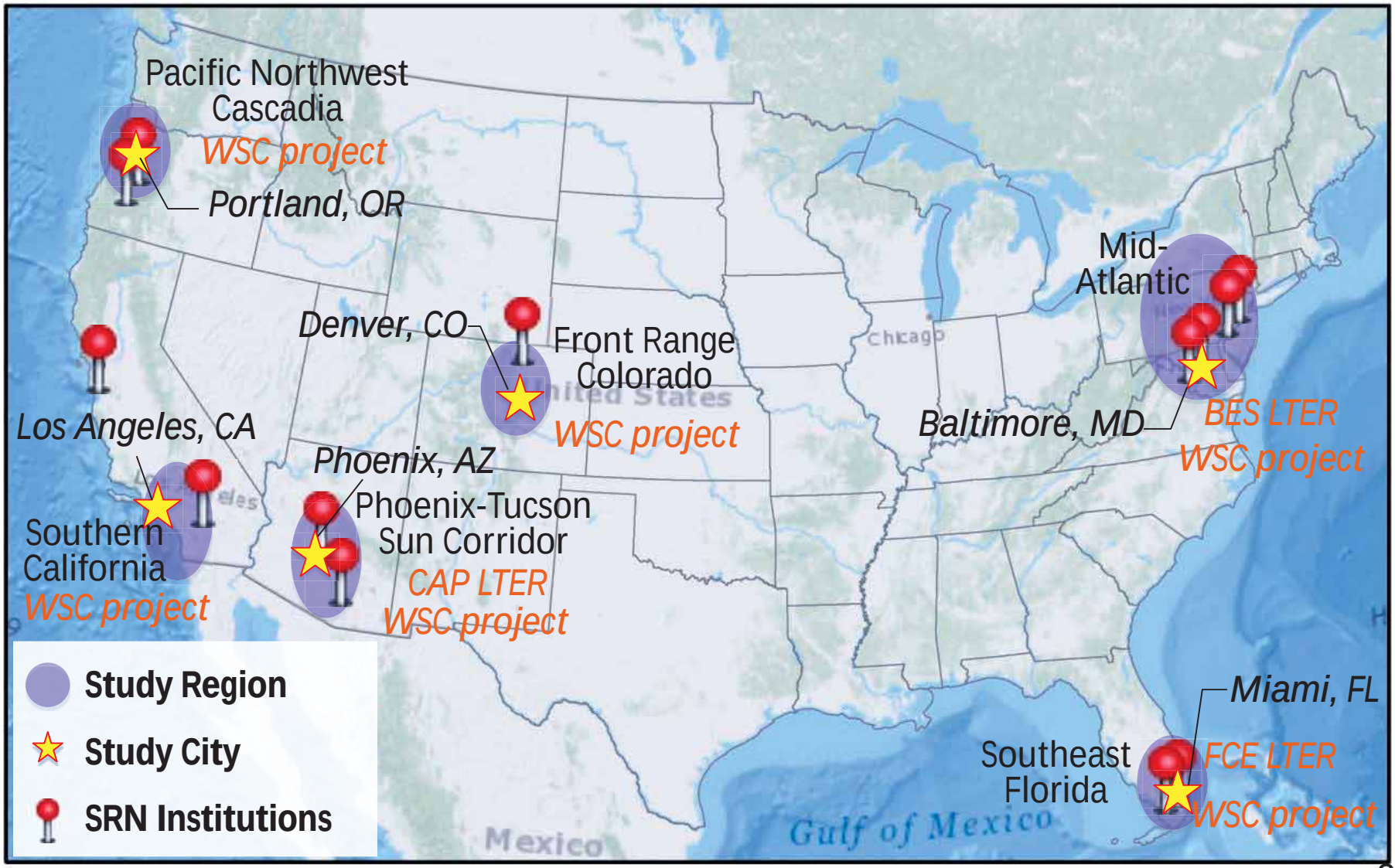
Adapted from C. Steinitz. 2012. *A Framework for Geodesign*

Blueprint Indicators (preliminary)

Red: Pressures
Green: Resilience
Blue: Co-Benefits
Purple: Transitions



Learning from diverse regions



Partner Institutions

Through our partners, we have capacity in place to make a difference at the global scale

- **Water Environment Research Foundation (WERF)**: more than 280 water utilities in the U.S.
- **Urban Sustainability Directors Network (USDN)**: 130 cities in the U.S.
- **NETWERC H2O**: More than 100 cities worldwide
- **Urban League of Cities**
- **Water Now**

ECOSYSTEM SERVICE VALUATION AND HYDRO-ECONOMIC OPTIMIZATION OF SOUTH FLORIDA WATER RESOURCES

Mike Sukop

FIU FLORIDA INTERNATIONAL UNIVERSITY

Earth and Environment

- **Motivation**
- **Research objectives**
- **Project components**

NSF National Science Foundation WHERE DISCOVERIES BEGIN

USDA NIFA United States Department of Agriculture National Institute of Food and Agriculture

FWCA Workshop
September 18, 2015
Tampa Bay Water,
Clearwater, Florida

WSC Category 2: $5 M, 5 Years

Robust decision-making for South Florida water resources by ecosystem service valuation, hydro-economic optimization, and conflict resolution modeling

14 Institutions, 21 PIs, and 5 Collaborators

Social/Behavioral/Economics

R. Meyer, J. Czajkowski, J. Bolson/UPenn Wharton

K. Broad, D. Letson/UM Center Ecosys. Sci. & Policy

J. Harrington/FSU Center for Economic Forecasting

M. Flaxman/Geodesign R. Weisskoff/UM

P. Mozumder, Mahadev Bhat/FIU

Engineering/Modeling

D. Watkins/MTU

J. Obeysekera/SFWMD

J. Hughes/USGS

Climate/Ecosystem Science

M. Mann, J. Fuentes/PSU

V. Engel/USGS

C. Martinez/UF

J. Smoak/USF

J. Ault/UM

R. Hinkle/UCF

J. Barr/NPS

D. Ho/UHI

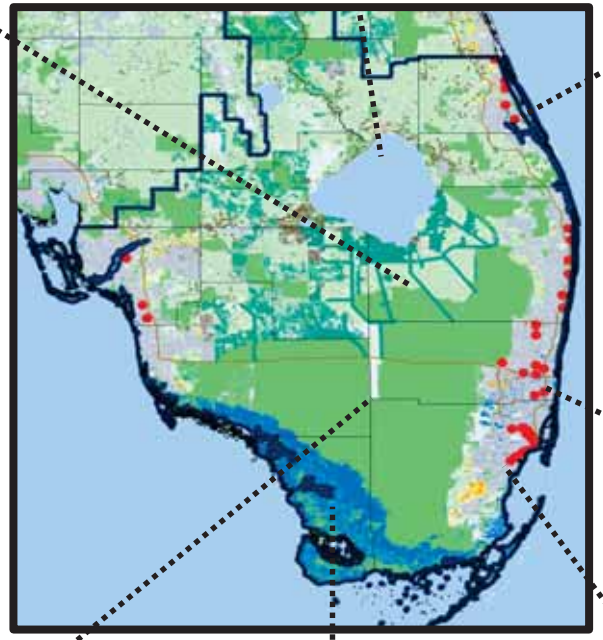
R. Jaffe, J. Rehage/FIU

Water Dependencies

Agricultural supply, drainage, runoff, cleanup

Lake O.

Estuary health



Threatened and Endangered species, trophic dynamics

Flood risk

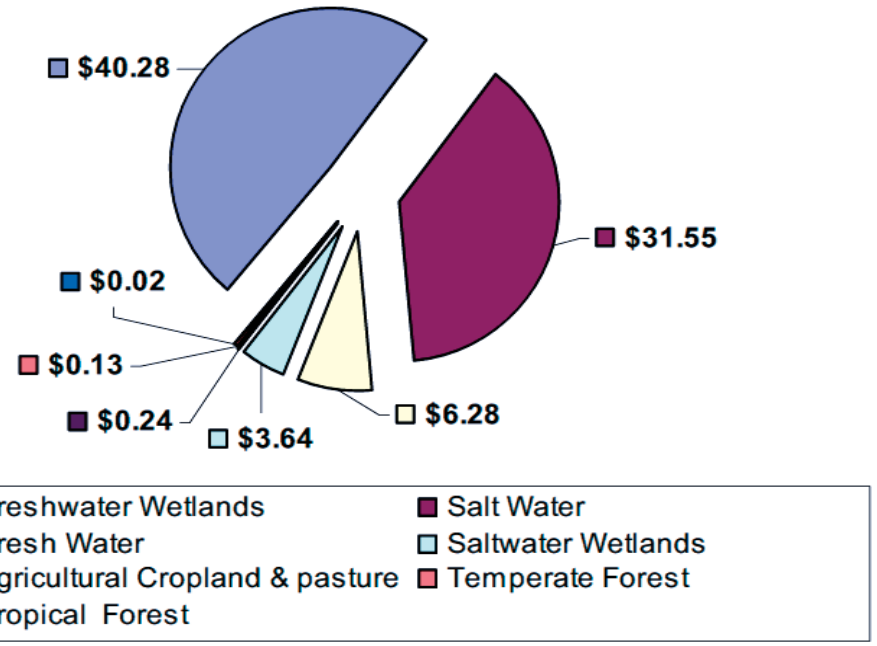
Southern estuaries

Municipal water supplies

South Florida Water Economics

SECTOR	VALUE
Agric. Crop Value (2010)	$3.4B
State Restoration Strategy (STAs, etc. by 2020)	$880M
SFWMD Budget (FY15)	$720M
Miami-Dade Water Supply Adaptation Costs for Salt Water Intrusion (2010)	$274 -$649M
Miami Beach Investments in Floodwater Pumps (2015)	~$400M
Flood Damage Hurrricane Irene (2012)	$70M
ENP Budget (FY10)	$35M

Total Annual Value of Ecosystem Services Produced by Everglades Biomes, 2007, $B (~$80 B total)



Source: Weisskoff (2005). p. 174. Values updated to 2007 $ using Consumer Price Index.

As presented by: Alpert, L., Stronge, W.B., 2009. *The Economics of the Everglades Watershed and Estuaries. Phase I — Review of Literature and Data Analysis* Prepared by the Center for Urban and Environmental Solutions at Florida Atlantic University for the Everglades Foundation.

Organisation for Economic Co-operation and Development

OECD RMS University of Southampton

2070s

RANKING OF THE WORLD'S CITIES MOST EXPOSED TO COASTAL FLOODING TODAY AND IN THE FUTURE

Executive Summary

$3.5 *Trillion*

20% of 2014 US GDP

= $17.4 *Trillion*

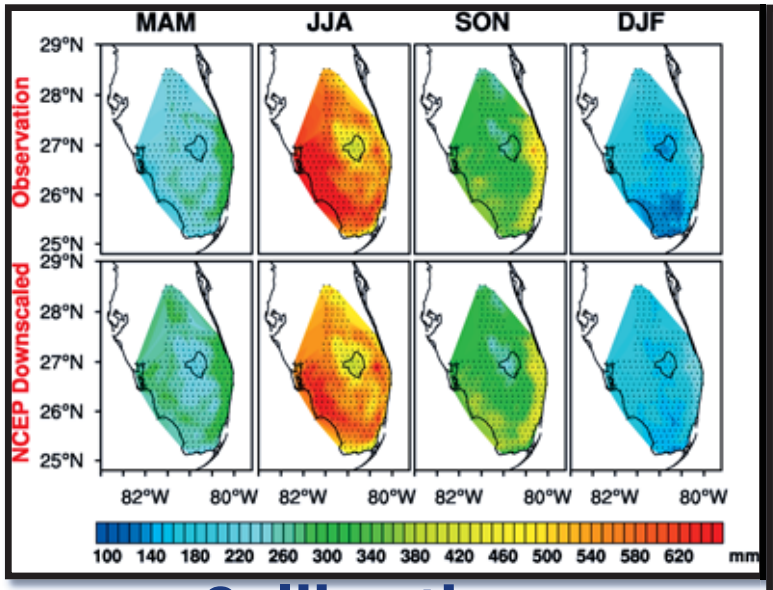
C.I.R.E.D. METEO FRANCE Toujours un temps d'avance

Rank	Country	Urban Agglomeration	Exposed Assets, Current ($Billion)	Exposed Assets, Future ($Billion)
1	USA	Miami	416.29	3,513.04
2	CHINA	Guangzhou	84.17	3,357.72
3	USA	New York-Newark	320.20	2,147.35
4	INDIA	Kolkata (Calcutta)	31.99	1,961.44
5	CHINA	Shanghai	72.86	1,771.17
6	INDIA	Mumbai	46.20	1,598.05
7	CHINA	Tianjin	29.62	1,231.48
8	JAPAN	Tokyo	174.29	1,207.07
9	CHINA,	Hong Kong	35.94	1,163.89
10	THAILAND	Bangkok	38.72	1,117.54
11	CHINA	Ningbo	9.26	1,073.93
12	USA	New Orleans	233.69	1,013.45
13	JAPAN	Osaka-Kobe	215.62	968.96
14	NETHERLANDS	Amsterdam	128.33	843.70
15	NETHERLANDS	Rotterdam	114.89	825.68
16	VIETNAM	Ho Chi Minh City	26.86	652.82
17	JAPAN	Nagoya	109.22	623.42
18	CHINA	Qingdao	2.72	601.59
19	USA	Virginia Beach	84.64	581.69
20	EGYPT	Alexandria	28.46	563.28

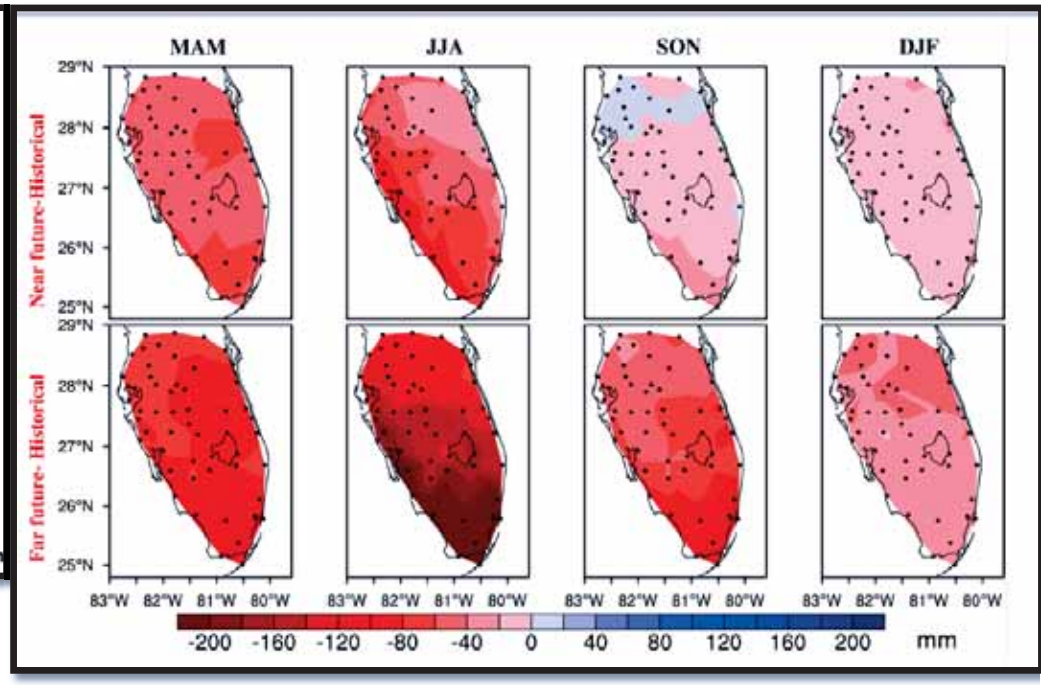
Table 2: Top 20 cities ranked in terms of assets exposed to coastal flooding in the 2070s (including both climate change and socioeconomic change) and showing present-day exposure

2007, http://www.centre-cired.fr/IMG/pdf/OECD_Cities_Coastal_Flooding.pdf

Long term climate forecasts



Calibration



CMIP5-based Forecast*

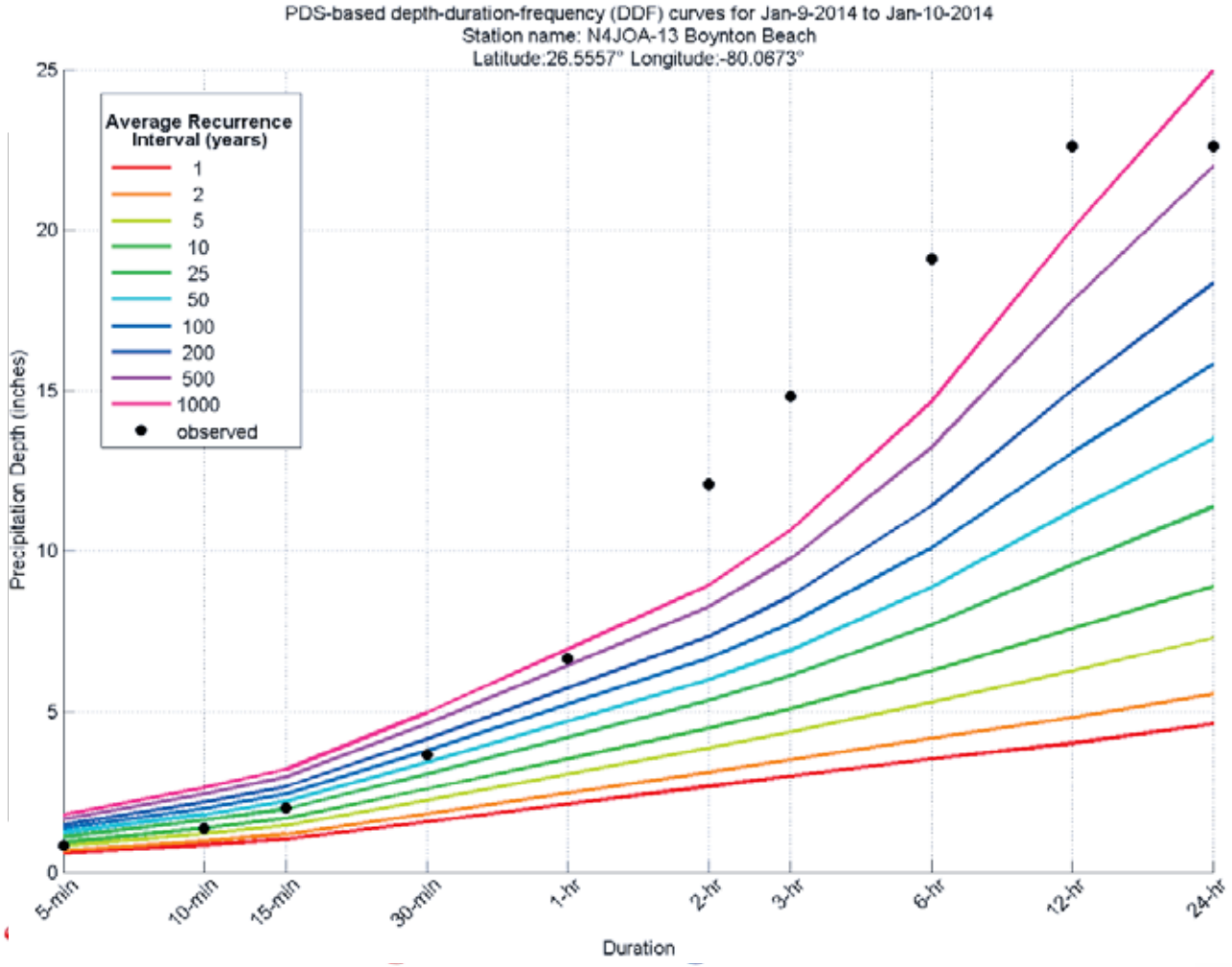
(*preliminary*)

**To be compatible with SFWMM*

Downscaled GCMs predict a *drying* climate

Downscaling Workshop: June 22-23, 2015

Challenges of climate variability



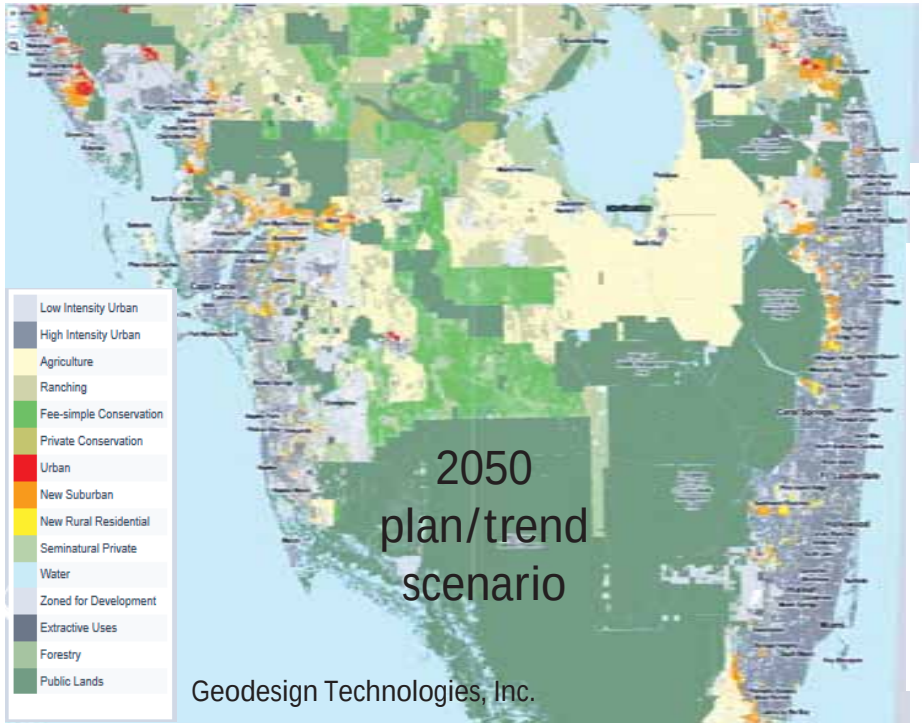
Greg Lovett / www.PalmBeachPost.com

January 10, 2014

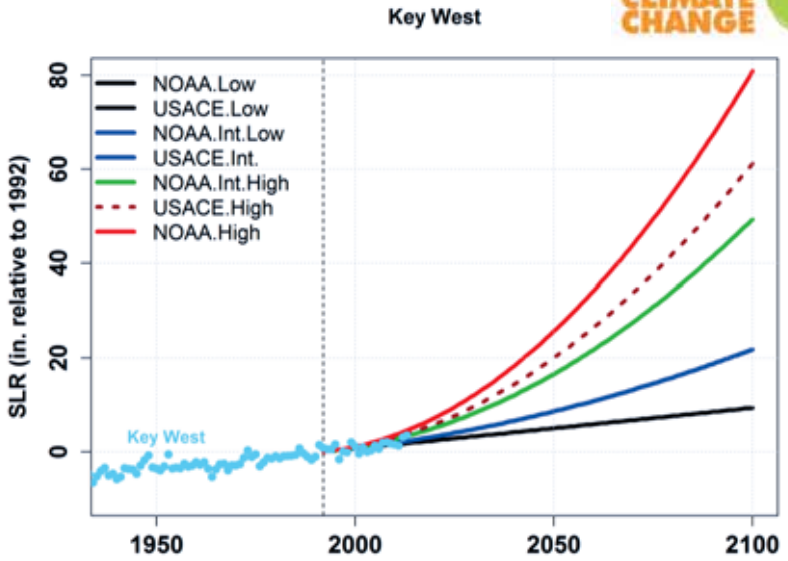
"... for durations between roughly 1.5 and 18 hours, the rainfall was more rare than a 1000 year Average Recurrence Interval ..."

http://www.srh.noaa.gov/mfl/?n=palm_beach_flood_010914

What else does the future hold?



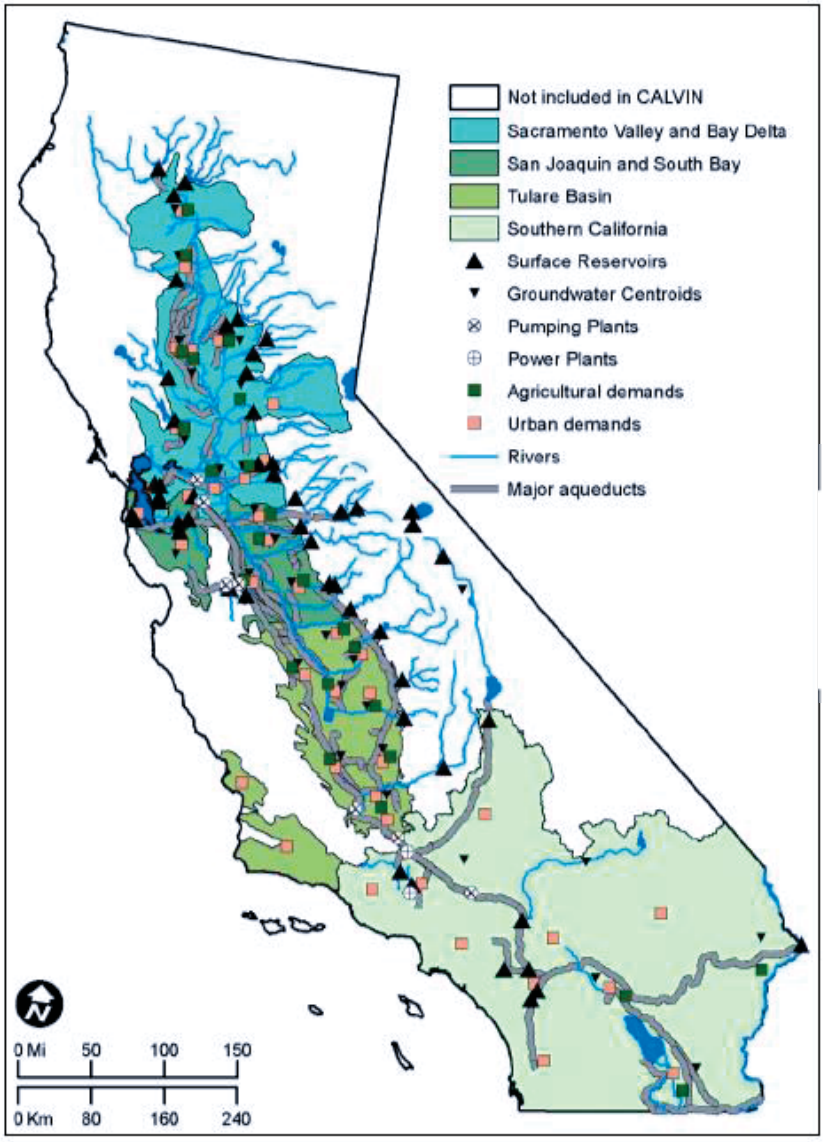
- Population and land use change
- Sea level rise



- *How can South Florida water supplies be made more resilient ?*
- *How can economic dimensions of water allocation influence management alternatives?*
- *What are the costs of maintaining built and natural attributes under different socio-economic, climate, and SLR scenarios?*

Hydro-economic optimization

California Value Integrated Network Model (CALVIN)



From: Bartolomeo, 2011. UC Davis

Climatic Change (2008) 87 (Suppl 1):S75–S90
DOI 10.1007/s10584-007-9355-z

Adaptability and adaptations of California's water supply system to dry climate warming

Josué Medellín-Azuara · Julien J. Harou ·
Marcelo A. Olivares · Kaveh Madani · Jay R. Lund ·
Richard E. Howitt · Stacy K. Tanaka ·
Marion W. Jenkins · Tingju Zhu

WATER RESOURCES RESEARCH, VOL. 46, W05522, doi:10.1029/2008WR007681, 2010

Economic consequences of optimized water management for a prolonged, severe drought in California

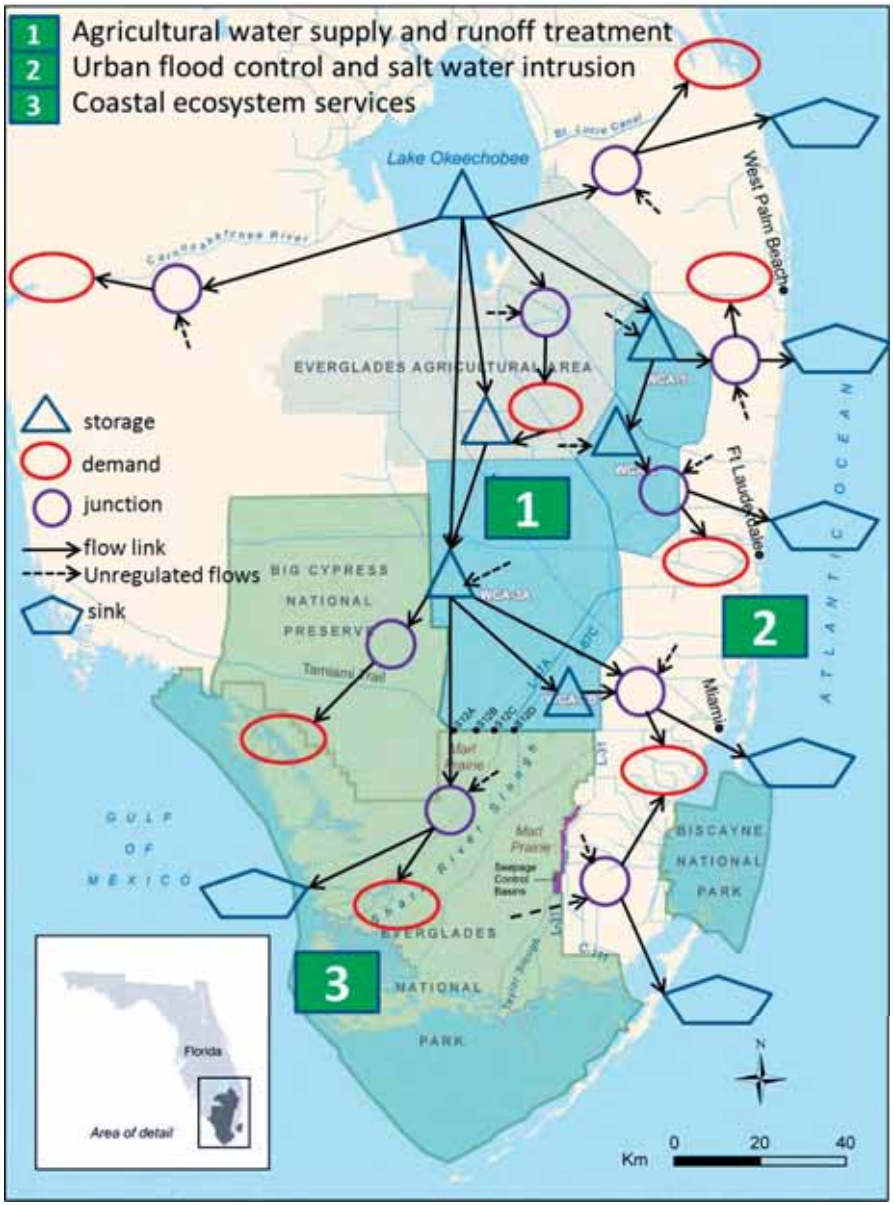
Julien J. Harou,[1] Josué Medellín-Azuara,[2] Tingju Zhu,[3] Stacy K. Tanaka,[4] Jay R. Lund,[2] Scott Stine,[5] Marcelo A. Olivares,[6] and Marion W. Jenkins[2]

Hydrogeology Journal (2008) 16: 1039–1055

Ending groundwater overdraft in hydrologic-economic systems

Julien J. Harou · Jay R. Lund

Hydro-economic optimizati

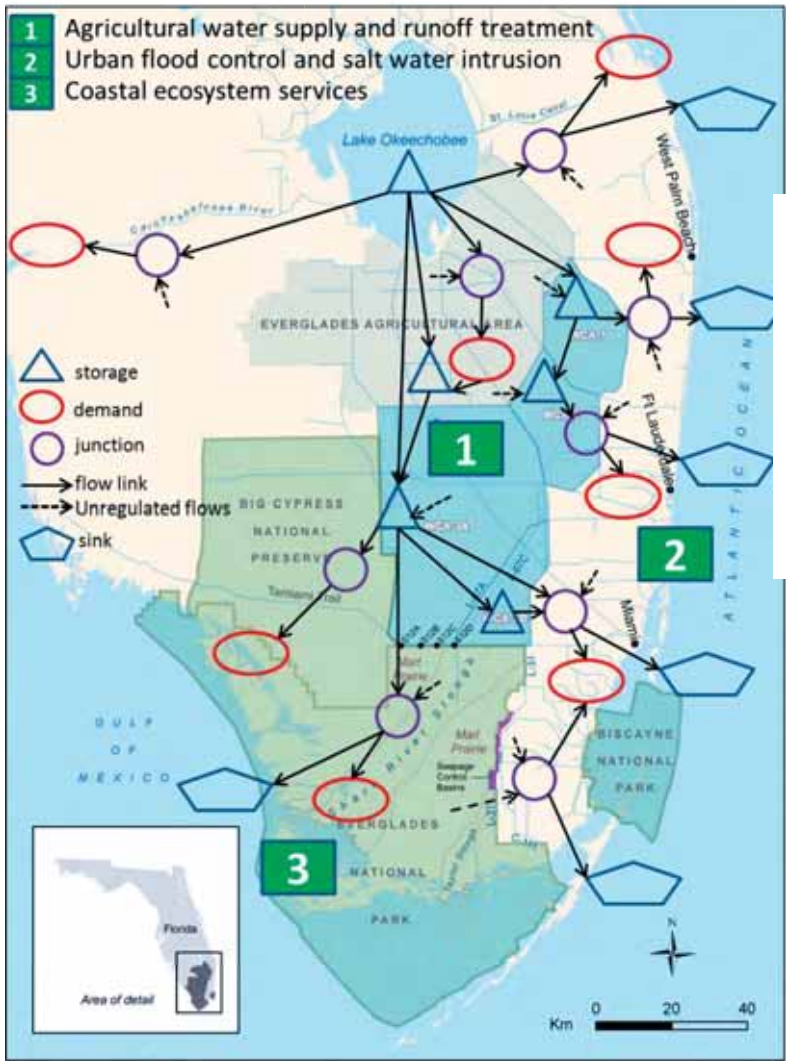


Objectives:

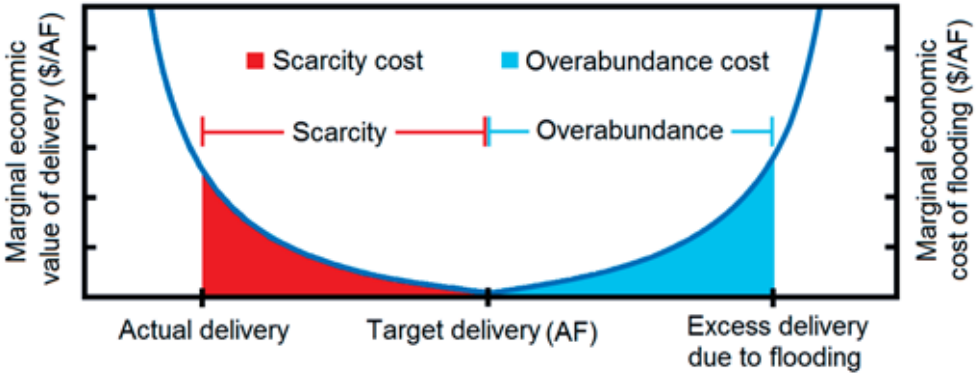
- Develop regional scale linked-node network model
- Optimize ecological and economic value of water allocations
- Quantify regional-level trade-offs
- Examine long term "robustness" of optimized solutions under different scenarios

Watkins, D., Kirby, K., and Punnett, R. (2004). "Water for the Everglades: Application of the South Florida Systems Analysis Model." J. Water Resour. Plann. Manage., 130(5), 359–366. doi: 10.1061/(ASCE)0733-9496(2004)130:5(359)

Hydro-economic optimization

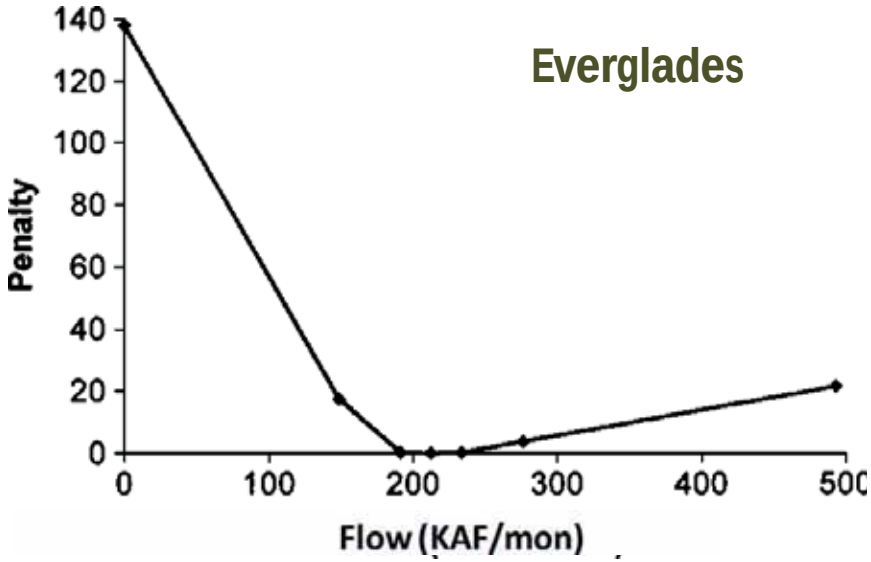


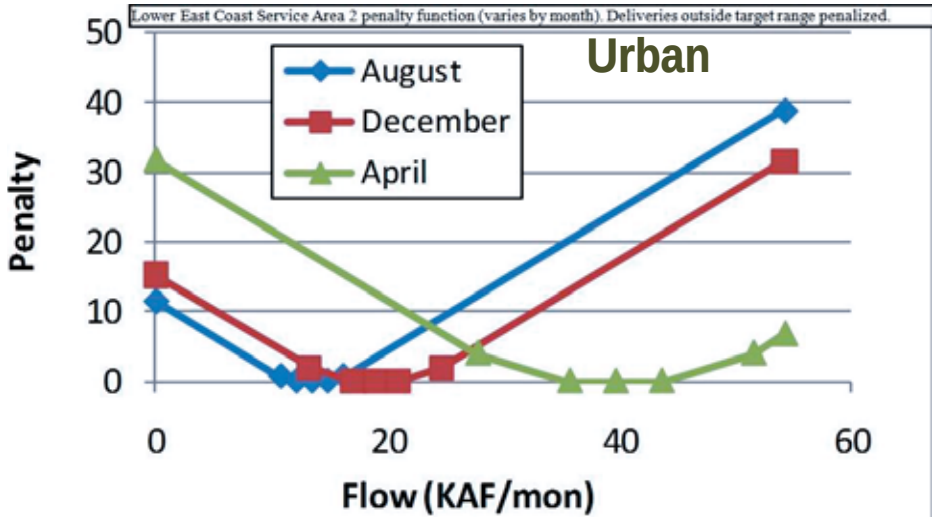
- **"Trade-off functions" at each node**



- **Flow or other hydrologic target and shape of function must be defined**
- **Stakeholder participation in trade-off function development/weighting**

Hydro-economic optimization

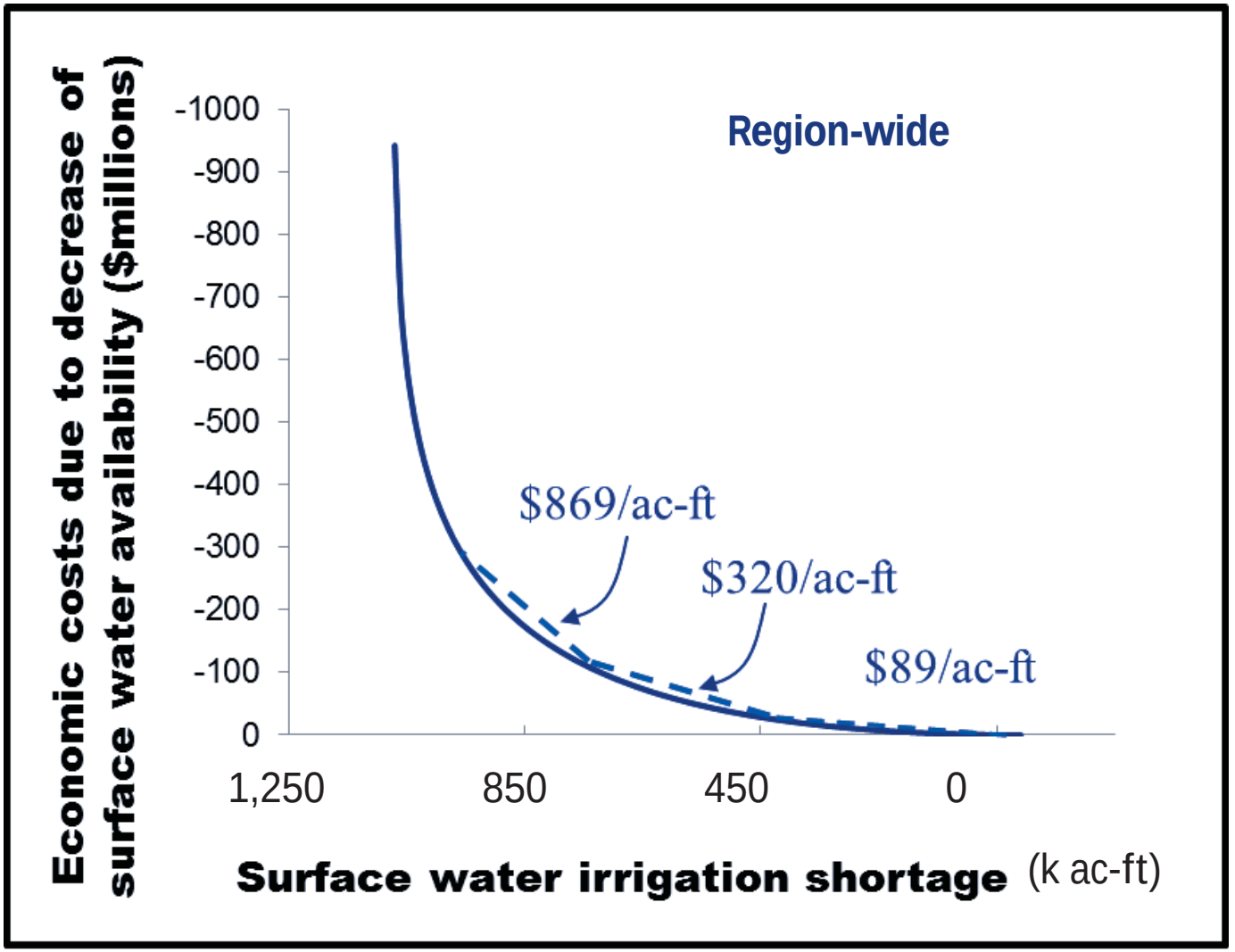




Watkins, D., Kirby, K., and Punnett, R. (2004). "Water for the Everglades: Application of the South Florida Systems Analysis Model." J. Water Resour. Plann. Manage., 130(5), 359–366. doi: 10.1061/(ASCE)0733-9496(2004)130:5(359)

Hydro-economic optimization

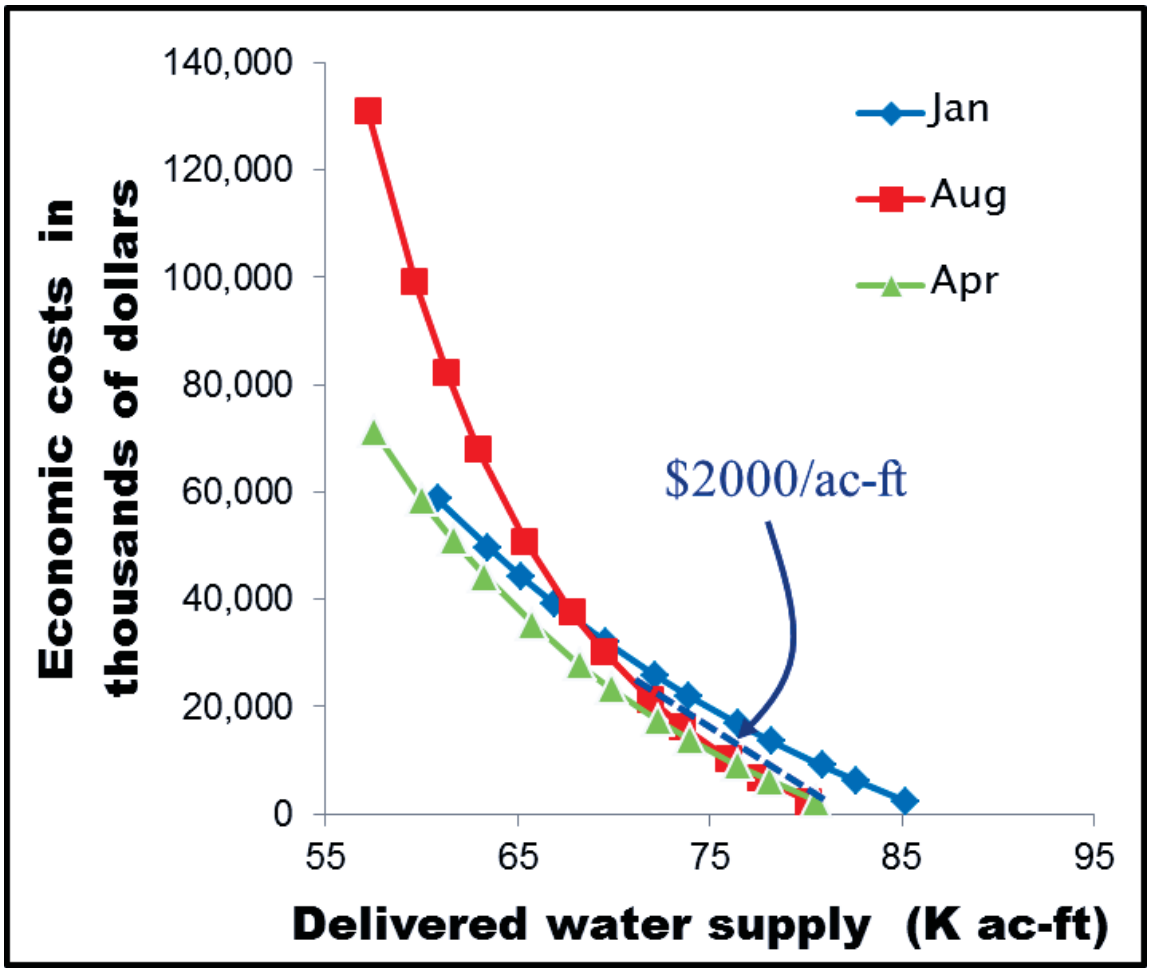
Reductions in agricultural water supply



Hydro-economic optimization

UNIVERSITY OF MIAMI

Reductions in potable water supply

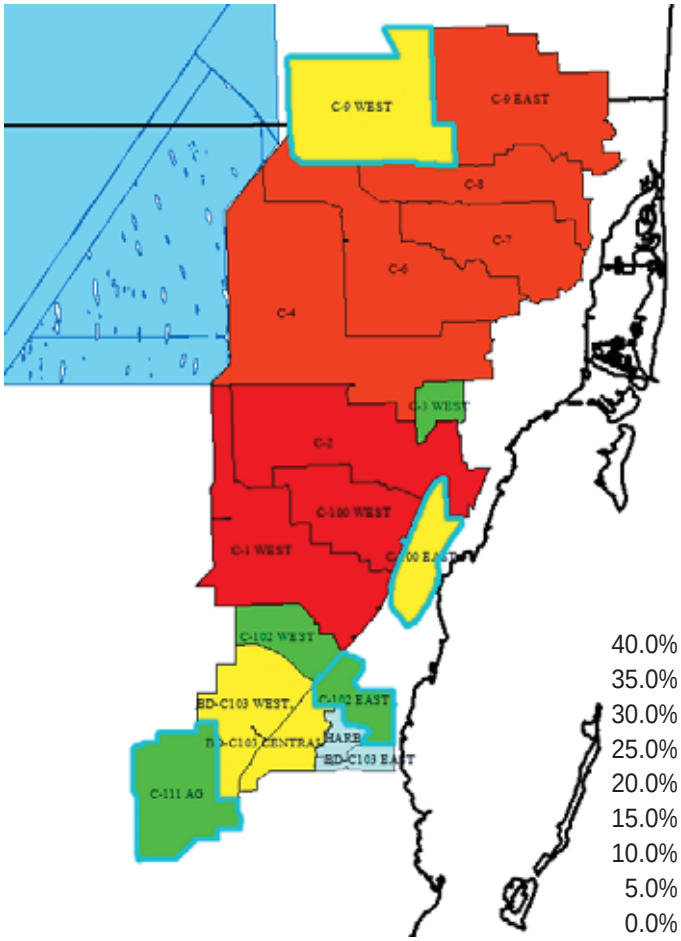


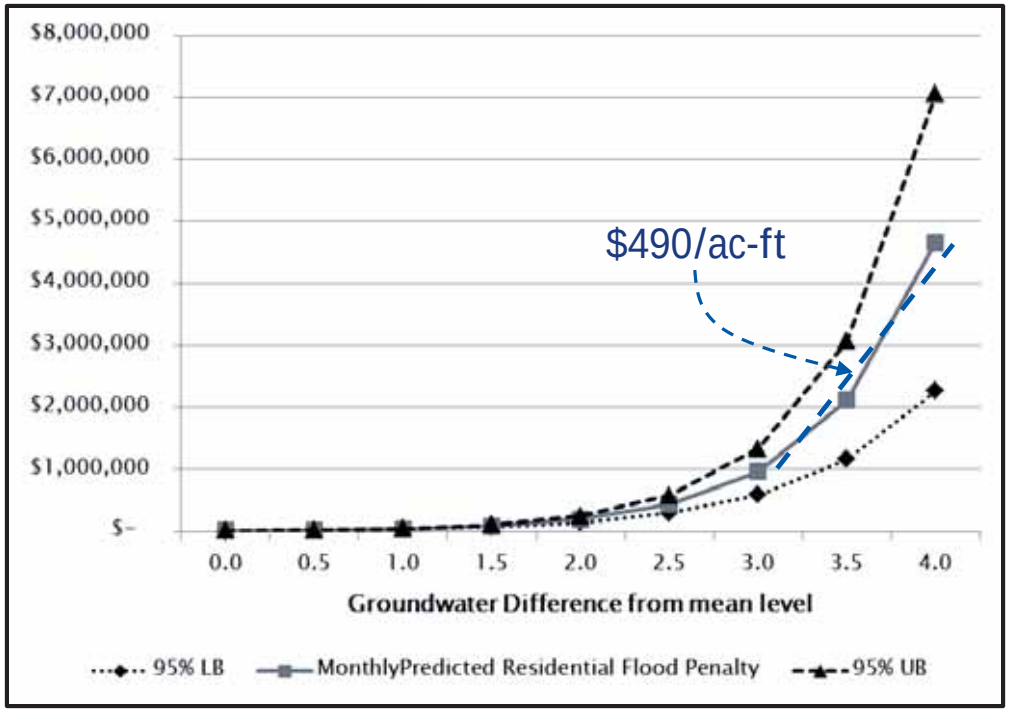
- Price elasticity
  - Winter: -0.35 (January)
  - Summer: -0.15 (August)
  - Intermediate: -0.25 (April)
- $\eta = \frac{dQ/Q}{dP/P}$
- Water demands are generally *higher* in winter months
- Consumption is *least* sensitive to cost in summer months

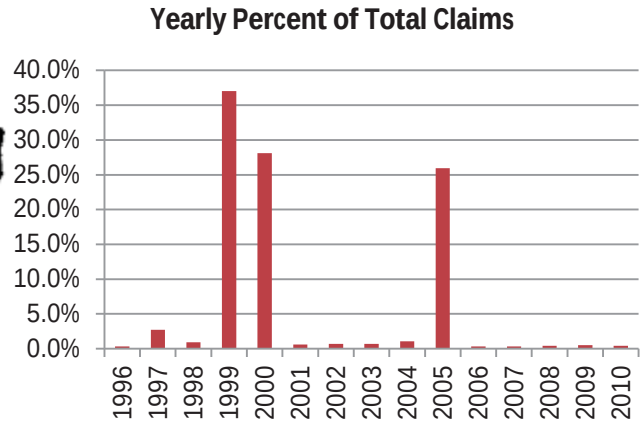
Hydro-economic optimization

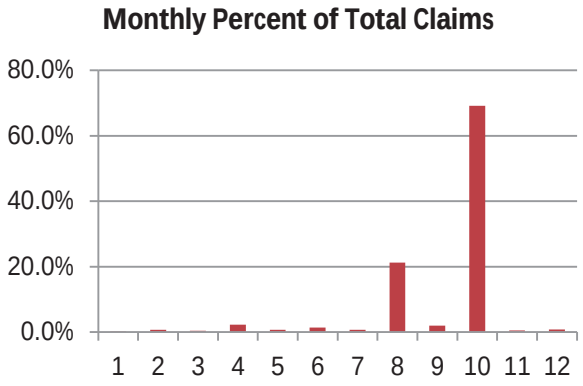
Wharton
University of Pennsylvania

Flooding costs









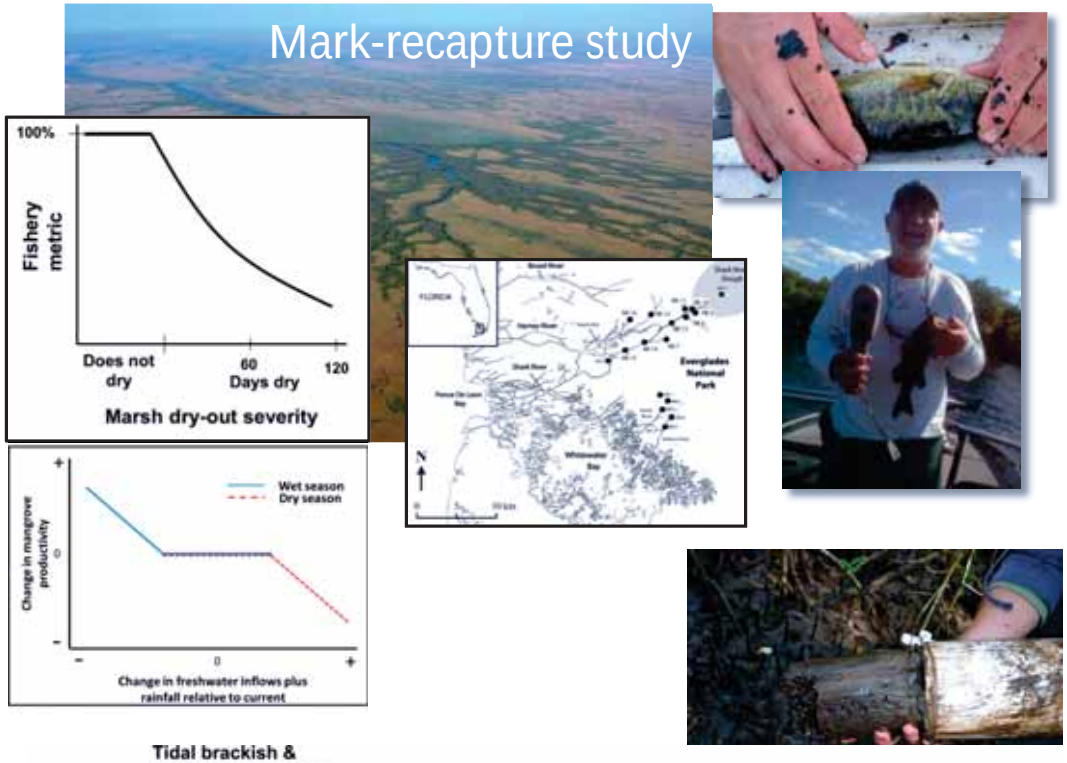
Hydro-economic optimization

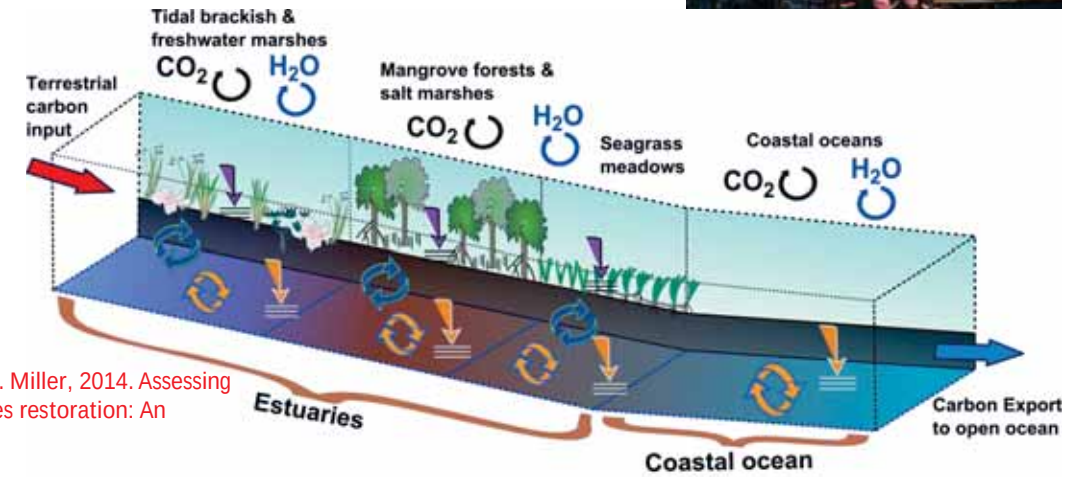
Ecosystem Services target functions (TBD)

- Fisheries
- Carbon cycling
- Flow volumes
- SERES, MARES
- Richardson et al. 2014

Valuation and Preferences

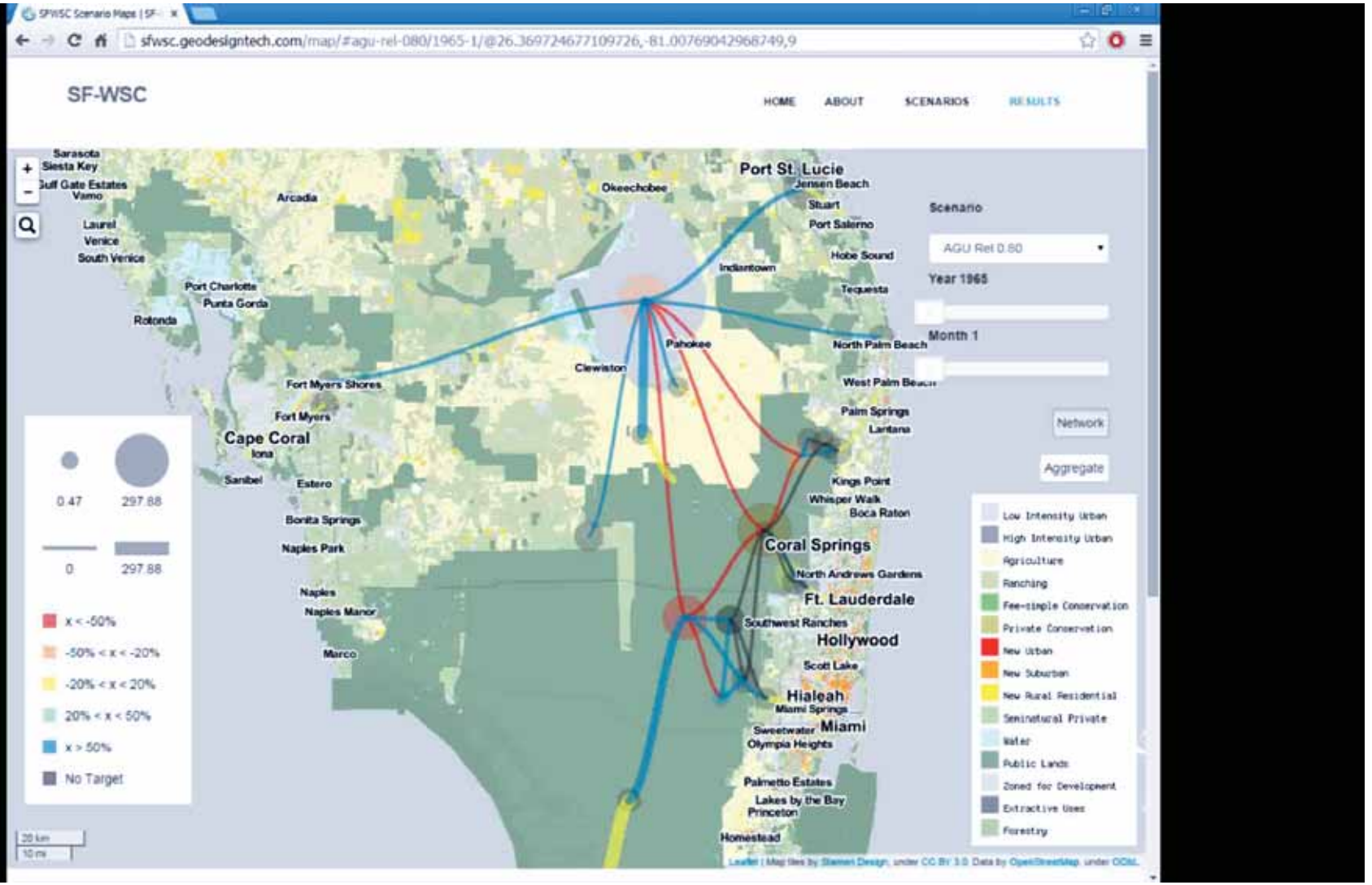
- Stated-choice surveys
- WTP assays
- Behavioral analyses



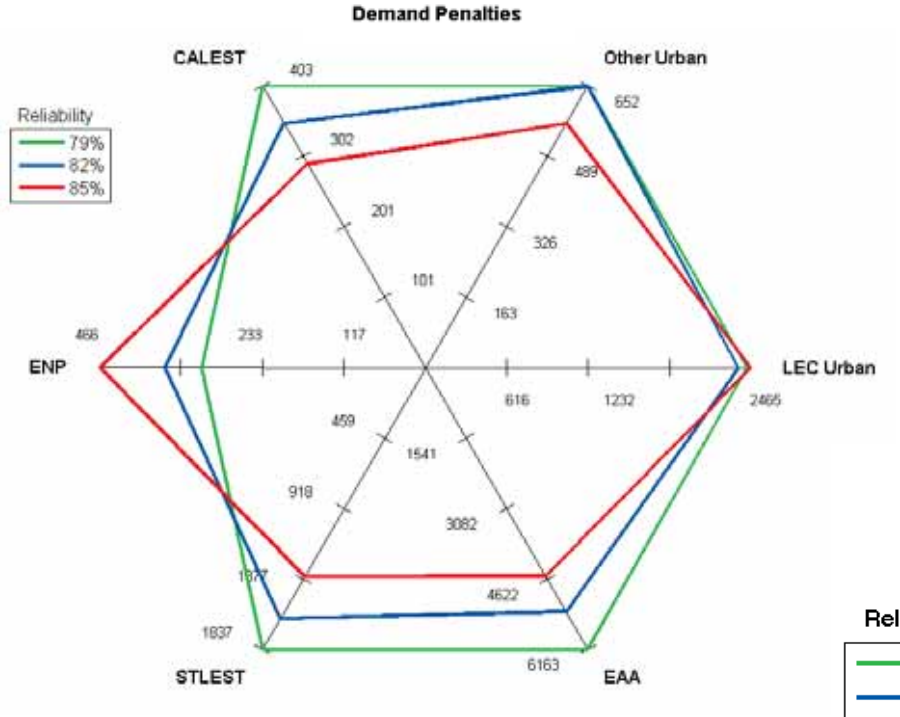


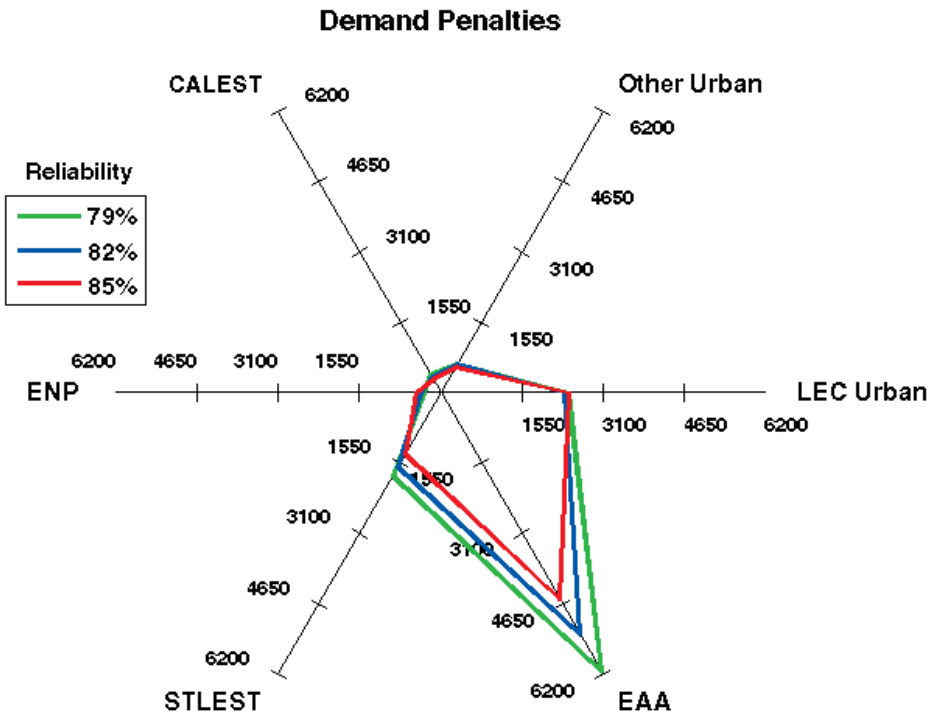
Richardson, L.K. Keefe, C. Huber, L. Racevskis, G. Reynolds, S. Thourot, I. Miller, 2014. Assessing the value of the Central Everglades Planning Project (CEPP) in Everglades restoration: An ecosystem service approach, Ecological Economics, 107:366-377, http://dx.doi.org/10.1016/j.ecolecon.2014.09.011.

Hydro-economic optimization

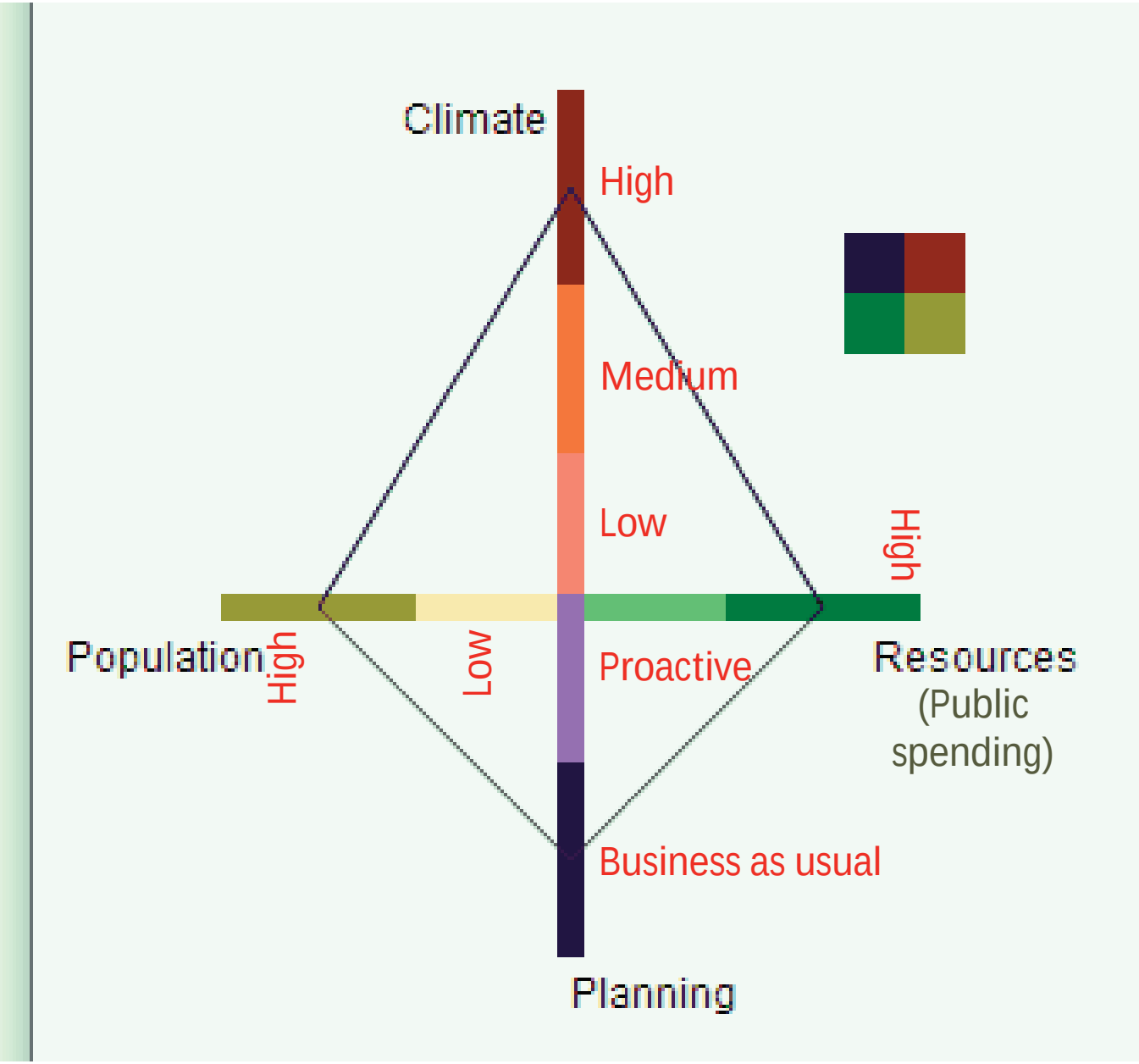


Hydro-economic optimization





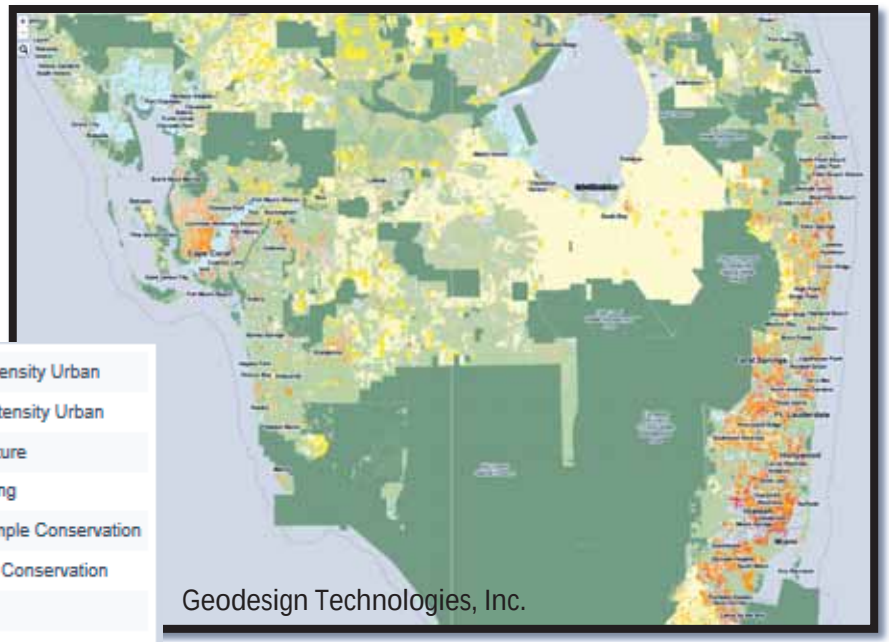
Scenario generation

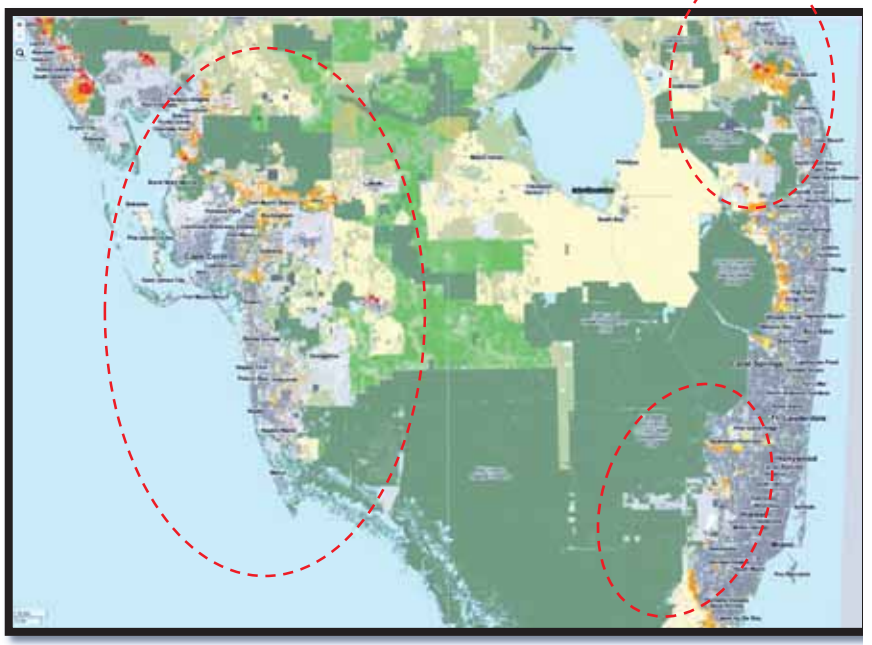


Scenario generation

Land use change

Peninsular Florida Landscape Conservation Cooperative





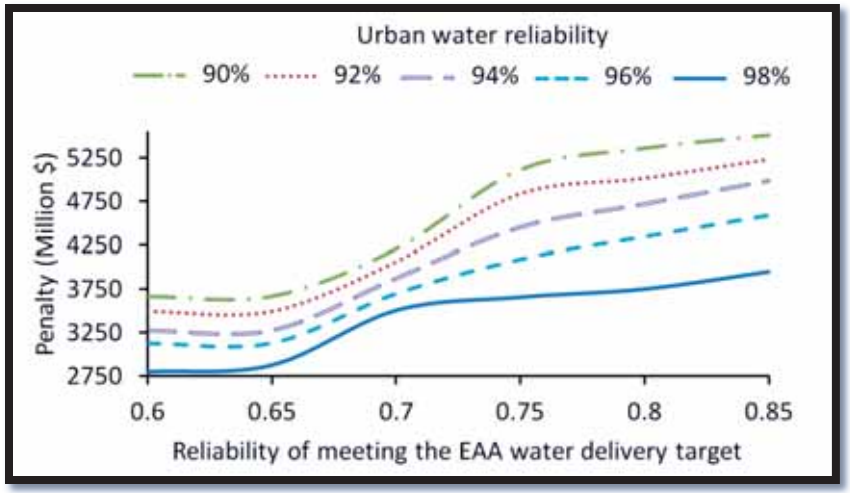
2015

2050

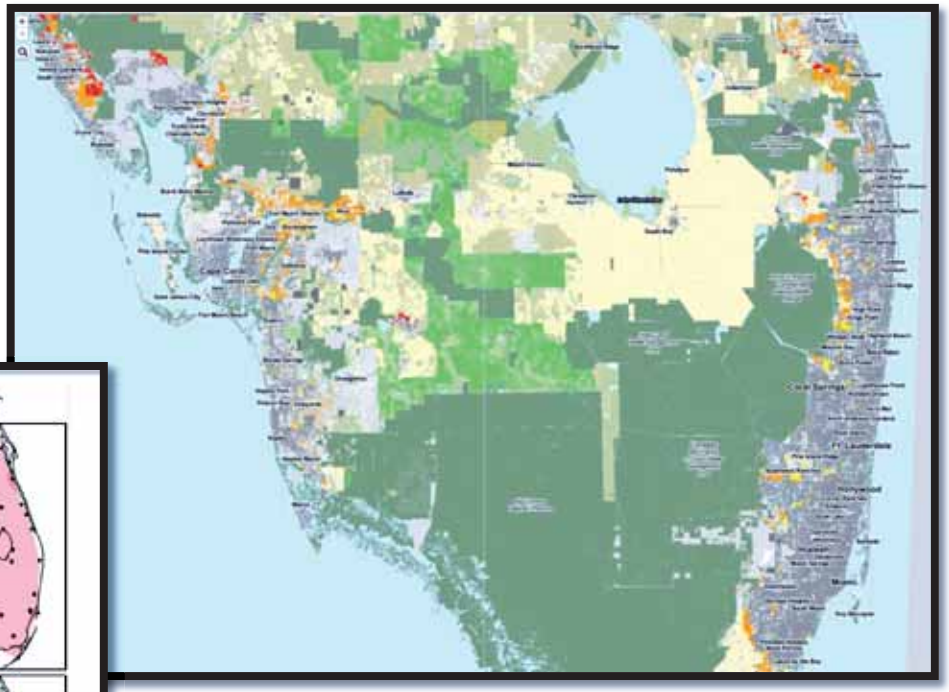
- Low Intensity Urban
- High Intensity Urban
- Agriculture
- Ranching
- Fee-simple Conservation
- Private Conservation
- Urban
- New Suburban
- New Rural Residential
- Seminatural Private
- Water
- Zoned for Development
- Extractive Uses
- Forestry
- Public Lands

Resilience of optimization schemes to be tested under different scenarios of climate, land use change, population growth , SLR, and economic setting

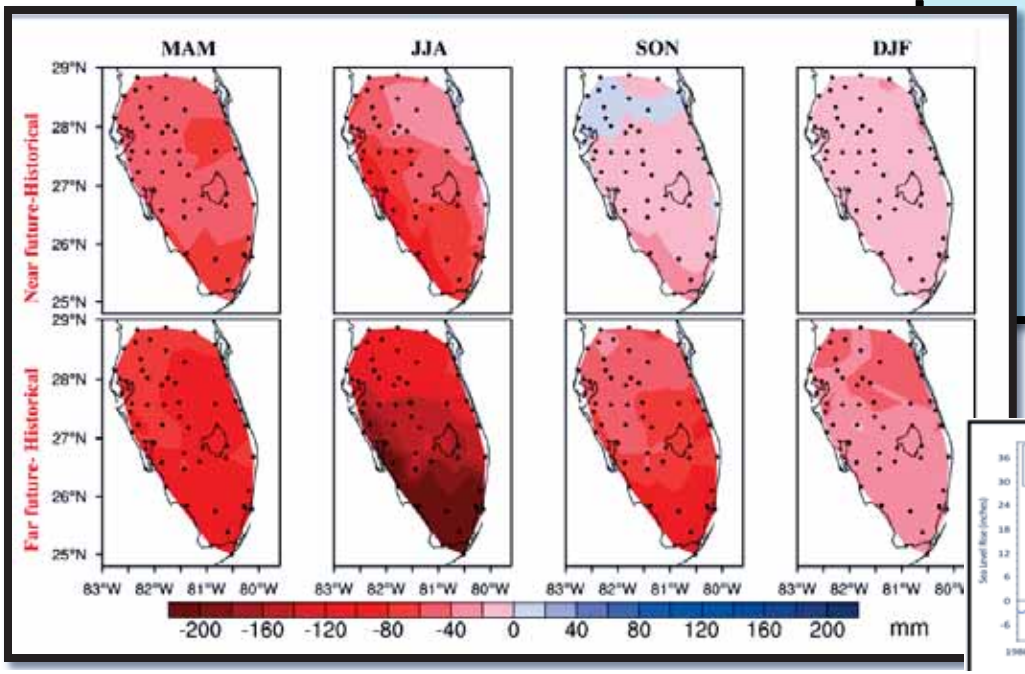
Scenario testing

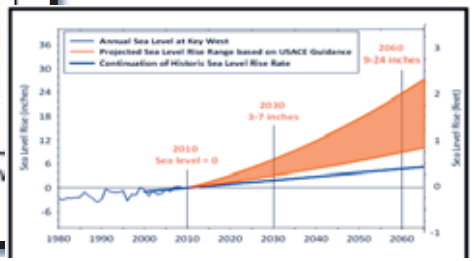


How will trade-offs change in the future?

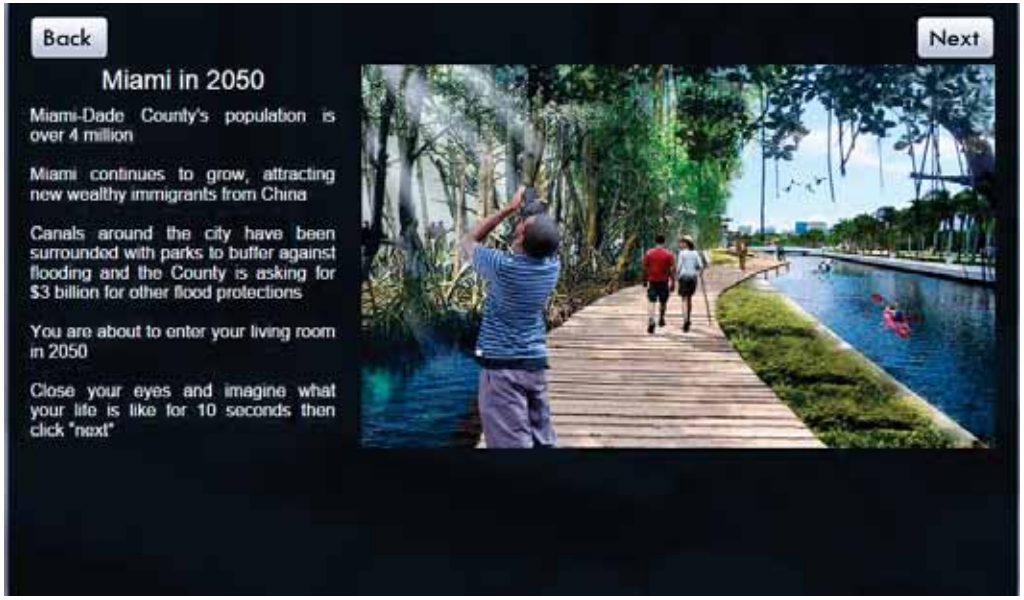


2050





Decision Acceleration



http://nodejs-hazsim.rhcloud.com/#!/sim/C5k0JZOZSf?redirectURL=http:%2F%2Fwww.cesp.miami.edu%2F