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



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

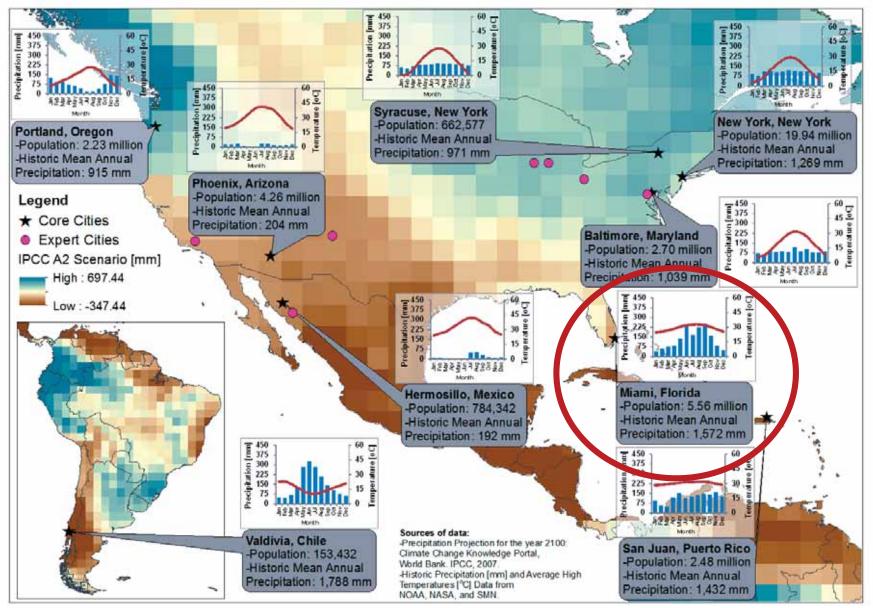




UREx SRN Network Cities: Baltimore, Maryland Hermosillo, Mexico Miami, Florida New York, New York Phoenix, Arizona Portland, Oregon San Juan, Puerto Rico Syracuse, new York Validivia, Chile

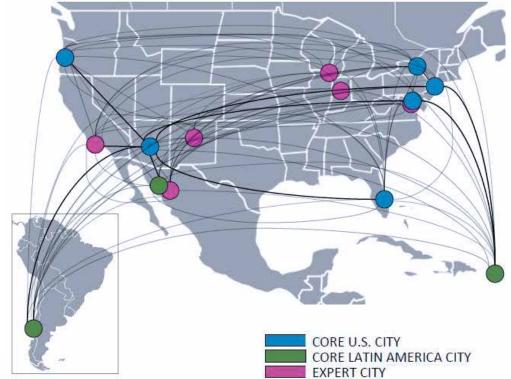


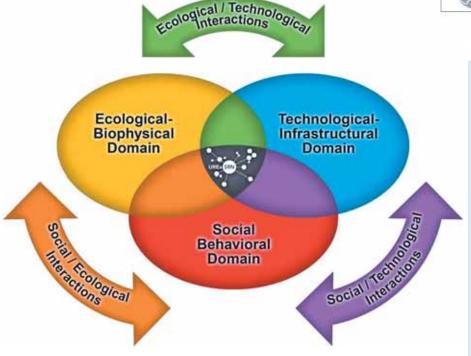
Exposure to Extremes



UREx SRN

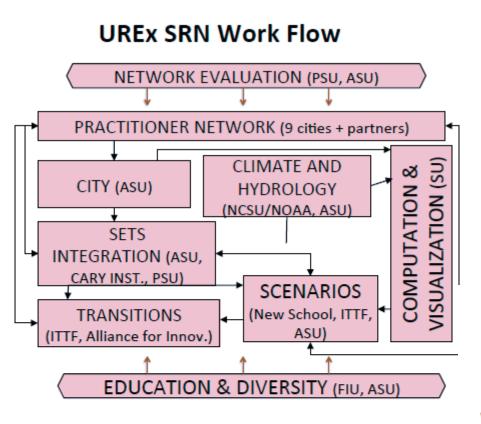
- A network of diverse cities
- A network of experts in Working Groups
- A holistic conceptual framework
- Inclusive, participatory approaches
- A workflow, education program, and evaluation plan that produces results and continually learn



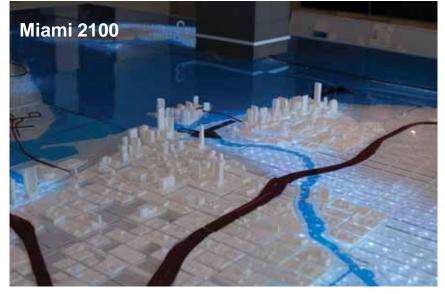


Central Question:

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?



- 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



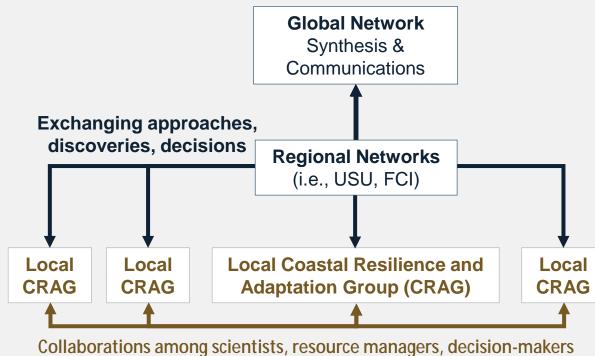
Tools & Data: U.S. DOT CMIP5 Climate Data Tool TNC Coastal Resilience Tool FCE-LTER socio-ecological datasets Various city-based datasets





Solutions Center

FIU Resources



5 Year Plan

Existing Partnerships

• Develop a *tool chest for cities* to address sea level rise

News

Contact

a

- 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





Florida Coastal Everglades Long Term Ecological Research

Where....

Why...

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



Who...



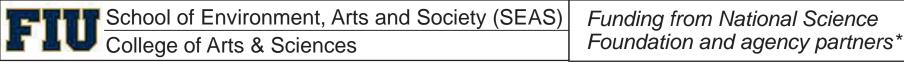
What...

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



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)





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

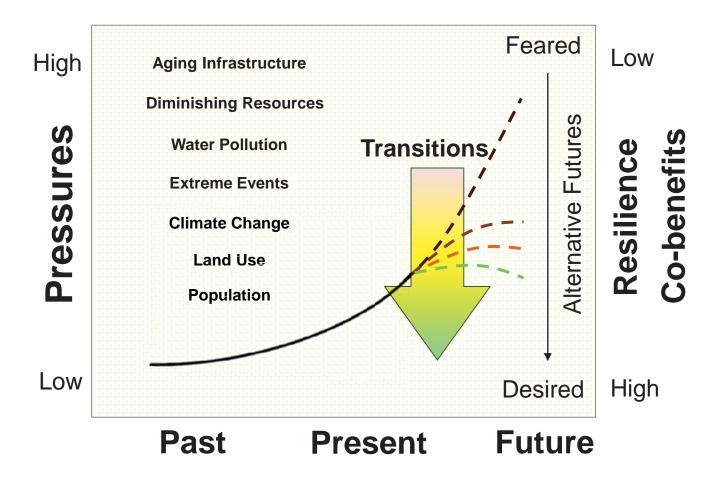
U-WIN will make a difference

- ✓ 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
- \checkmark Train a new generation of scientists and policymakers
- ✓ Engage citizen scientists
- \checkmark Develop leadership, communication and facilitation skills

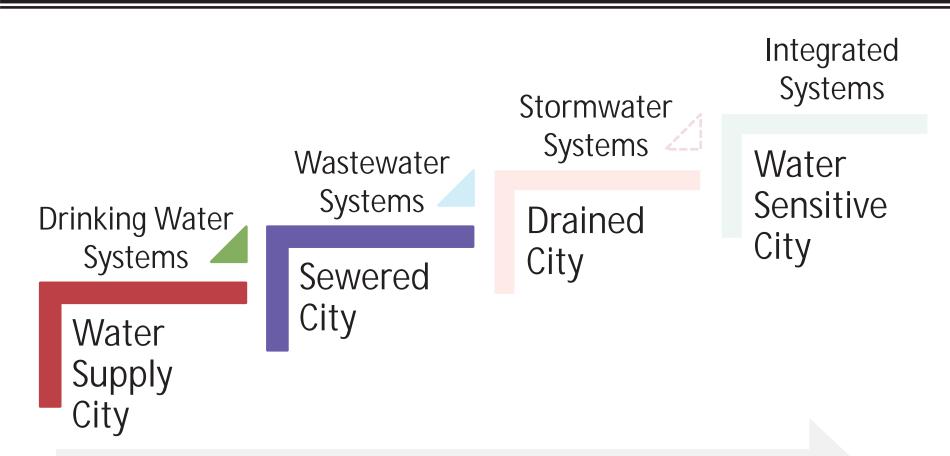
Urban Water & Linked Systems

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

The Sustainability Framework



Evolution of Water Systems



Transition from fragmented management of water sectors to an integrated approach

Research Plan: Thrusts

Assess Baseline

Community Learning and Societal Assessment

Assess Effects & Tradeoffs

D

Urban Water Sustainability FBluepnintk Identify Technological Solutions

B

Identify Institutions & Transitions

Urban Water Blueprint

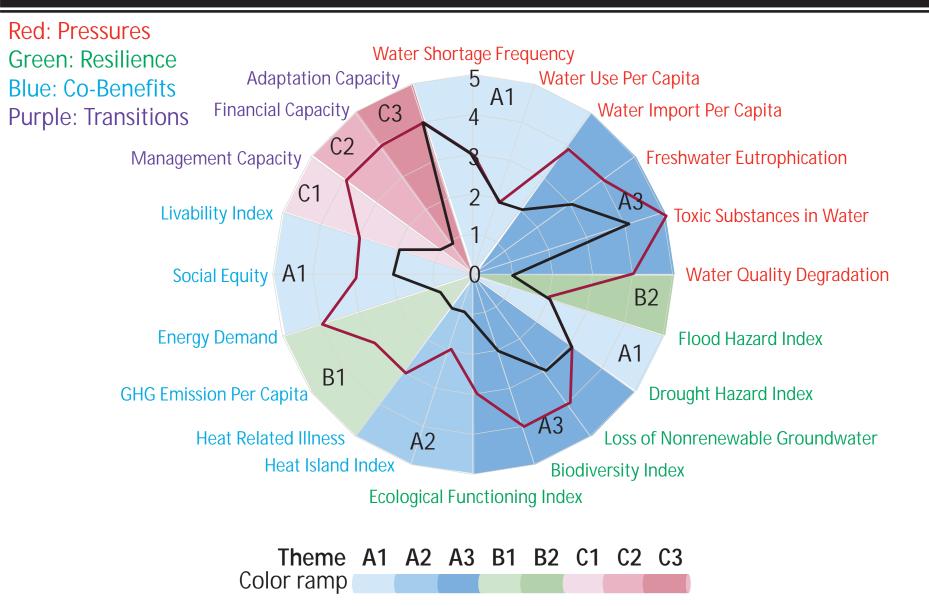
Define essential characteristics → Data Point decision makers toward best practices Share experiences → Peer learning

Stay agile in responding to future needs

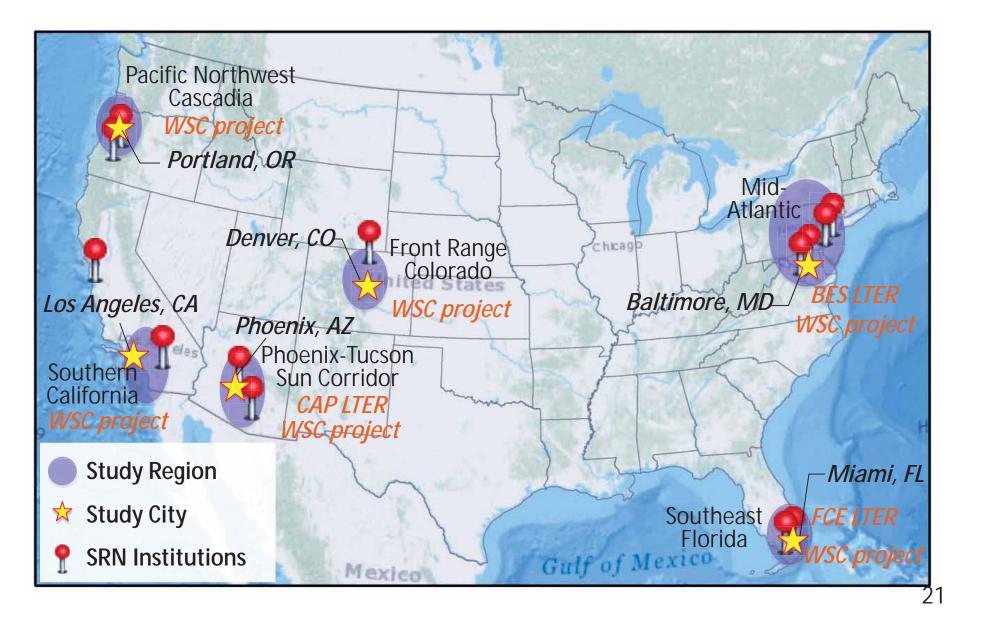


Adapted from C. Steinitz. 2012. A Framework for Geodesign

Blueprint Indicators (preliminary)



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

- Motivation
- Research objectives
- Project components

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

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



SOUTH FLORIDA WATER, SUSTAINABILITY, AND CLIMATE

FLORIDA

Farth and Environment

INTERNATIONAL

WSC Category 2: \$5 M, 5 Years

Robust decision-making for South Florida water resources by ecosystem service valuation, hydroeconomic 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

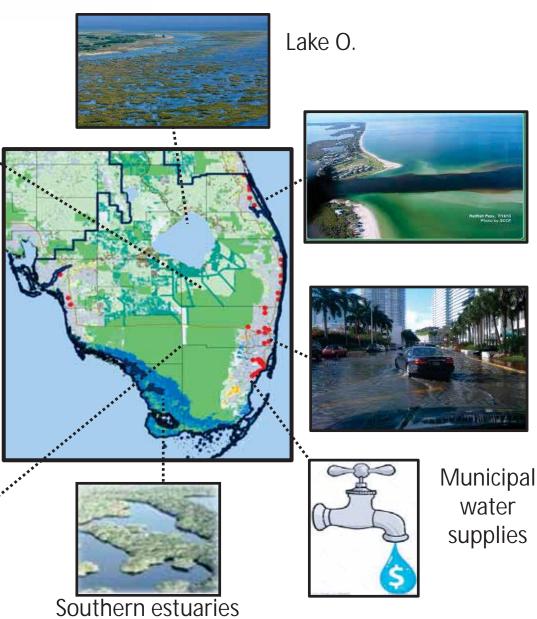
Water Dependencies



Agricultural supply, drainage, runoff, cleanup

Threatened and Endangered species, trophic dynamics





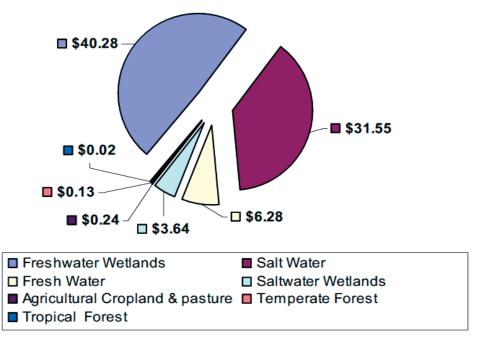
Estuary health

Flood risk

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



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*



Rank	Country	Urban Agglomeration	Current (\$Billion)	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	1,013.48
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	652.83
17	JAPAN	Nagoya	109.22	623.43
18	CHINA	Qingdao	2.72	601.59
19	USA	Virginia Beach	84.64	581.6
20	EGYPT	Alexandria	28.46	563.2

Evnosad Accets

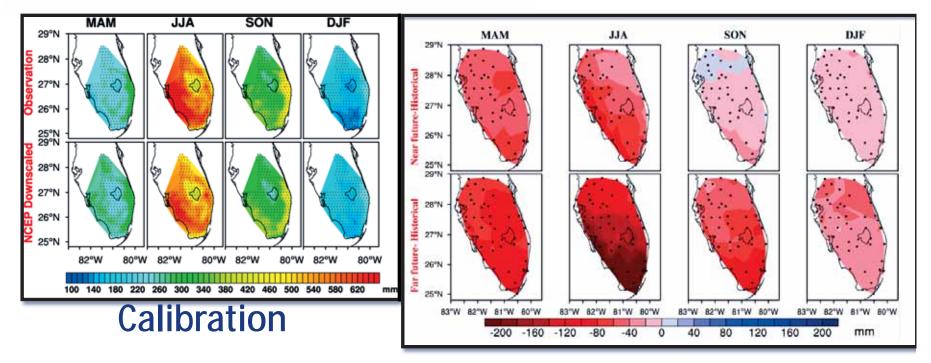
Exposed Asset

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

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

Long term climate forecasts





Downscaled GCMs predict a *drying* climate

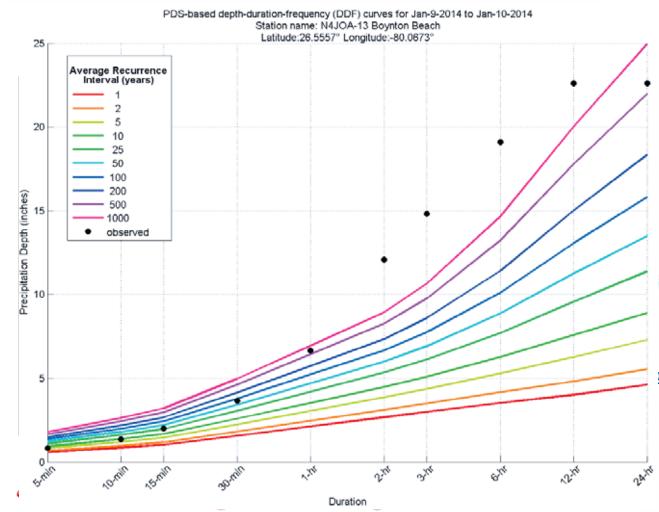
CMIP5-based Forecast*

(preliminary)

*To be compatible with SFWMM

Downscaling Workshop: June 22-23, 2015

Challenges of climate variability



Greq Lovett / www.PalmBeachPost.com

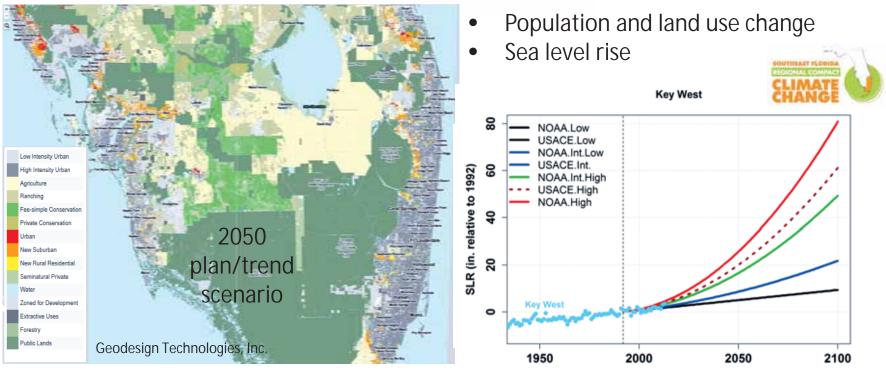
January 10, 2014

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

<u>http://www.srh.noaa.gov/mfl/?n=palm_beach_flood_0109</u> <u>14</u>

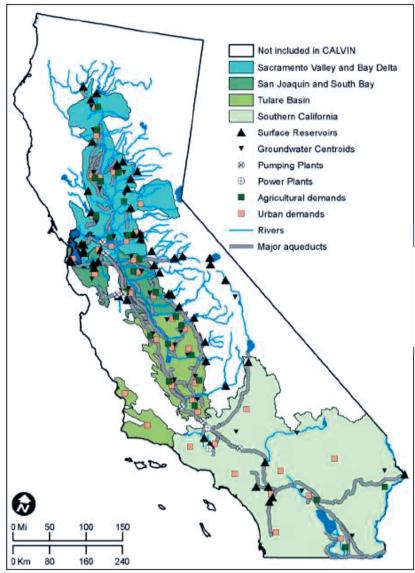
What else does the future hold?





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

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 Medellin-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

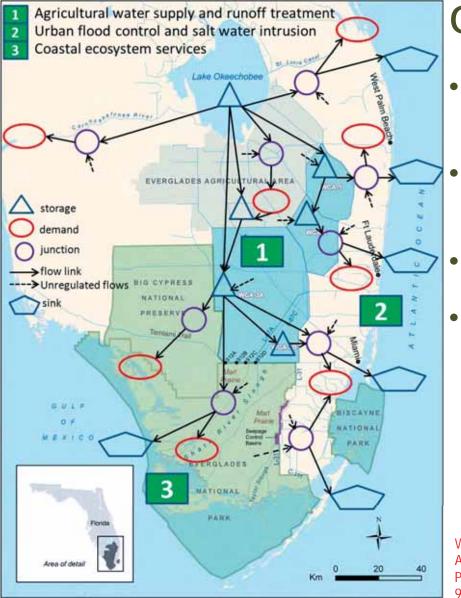
Economic consequences of optimized water management for a prolonged, severe drought in California

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. Jenkins²

Hydrogeology Journal (2008) 16: 1039-1055

Ending groundwater overdraft in hydrologic-economic systems

Julien J. Harou - Jay R. Lund

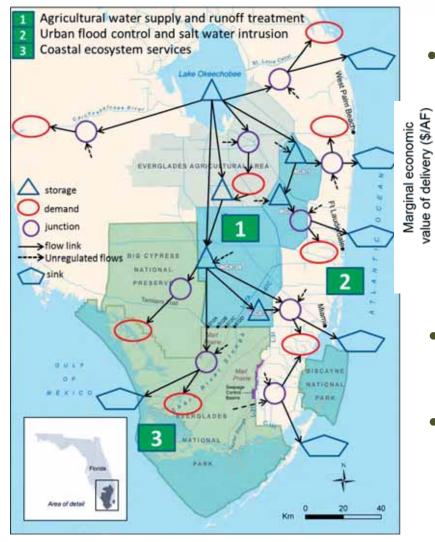


Objectives:

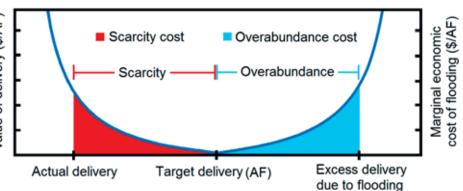
- Develop regional scale linkednode network model
- Optimize ecological and economic value of water allocations
- Quantify regional-level trade-offs
- Examine long term "robustness" of optimized solutions under different scenarios

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)



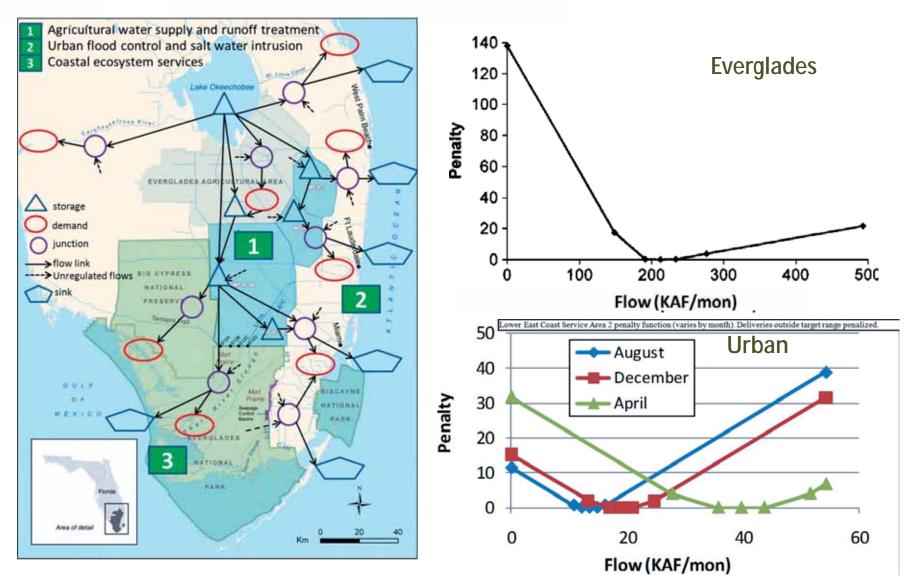


• "Trade-off functions" at each node



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

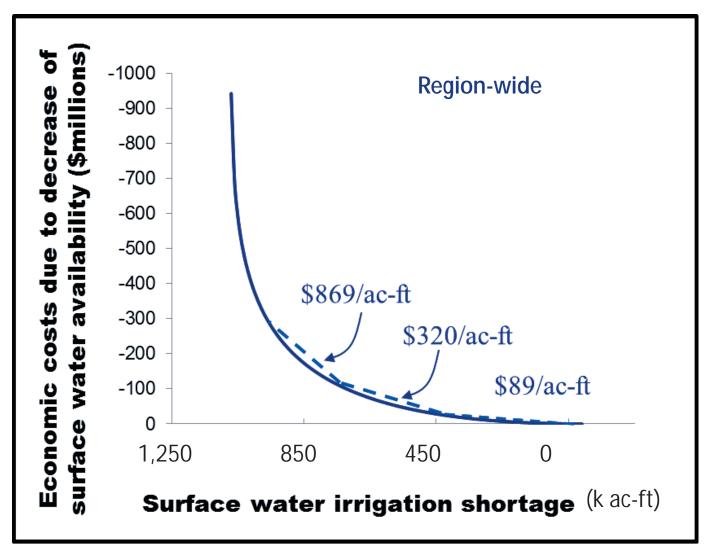


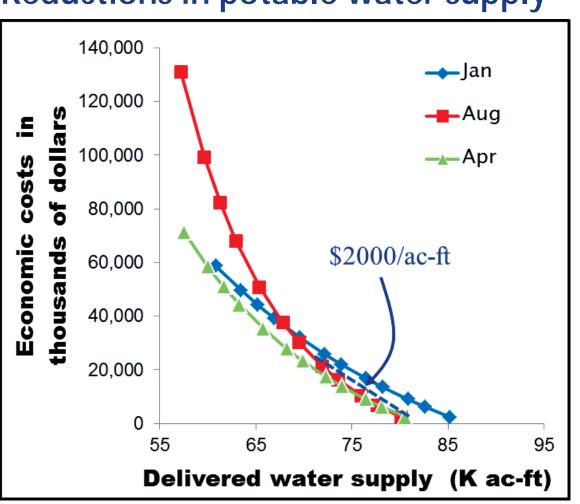


Watkins, D., Kirby, K., and Punnett, R. (2004). "Water for the Everglades: Application of the South Florida Systems Analysis Model." J. Water Resour. Plann. Manage., 130(5), 359–366. doi: 10.1061/(ASCE)0733-9496(2004)130:5(359)



Reductions in agricultural water supply





Reductions in potable water supply • Price elasticity

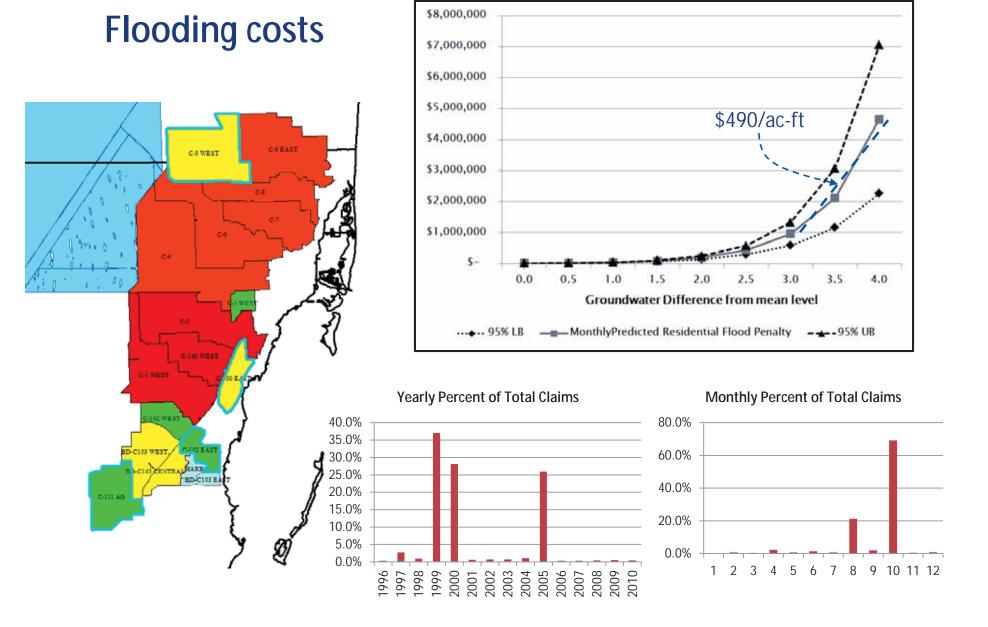
- Winter: -0.35 (January)
- Summer: -0.15 (August)
- Intermediate: -0.25 (April)

UNIVERSITY

•
$$\eta = \frac{dQ/Q}{dP/P}$$

- Water demands are generally *higher* in winter months
- Consumption is *least* sensitive to cost in summer months







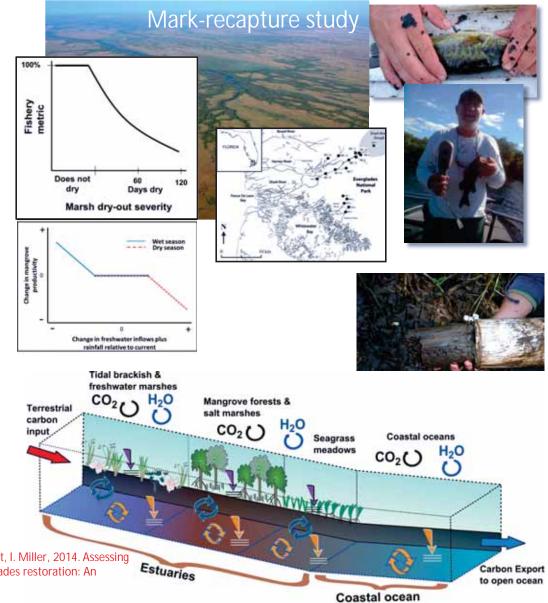
Ecosystem Services target functions (TBD)

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

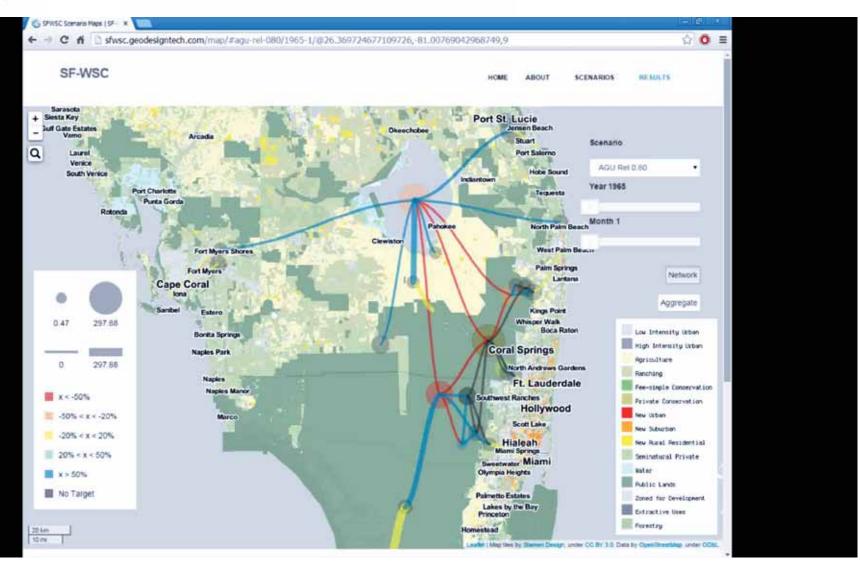
Valuation and Preferences

- Stated-choice surveys
- WTP assays
- Behavioral analyses

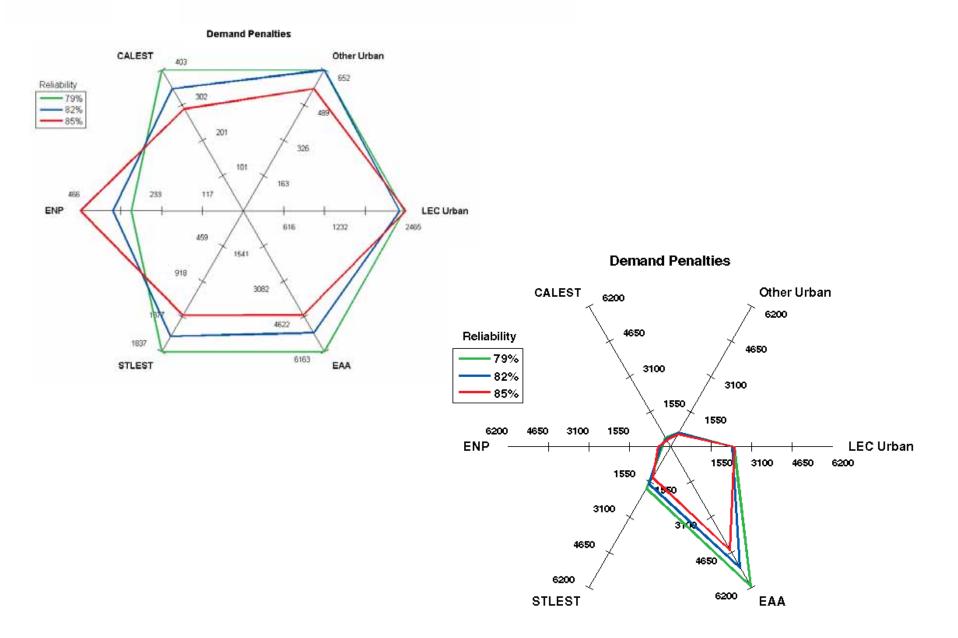
Richardson, L.K. Keefe, C. Huber, L. Racevskis, G. Reynolds, S. Thourot, I. Miller, 2014. Assessing the value of the Central Everglades Planning Project (CEPP) in Everglades restoration: An ecosystem service approach, Ecological Economics, 107:366-377, http://dx.doi.org/10.1016/j.ecolecon.2014.09.011.





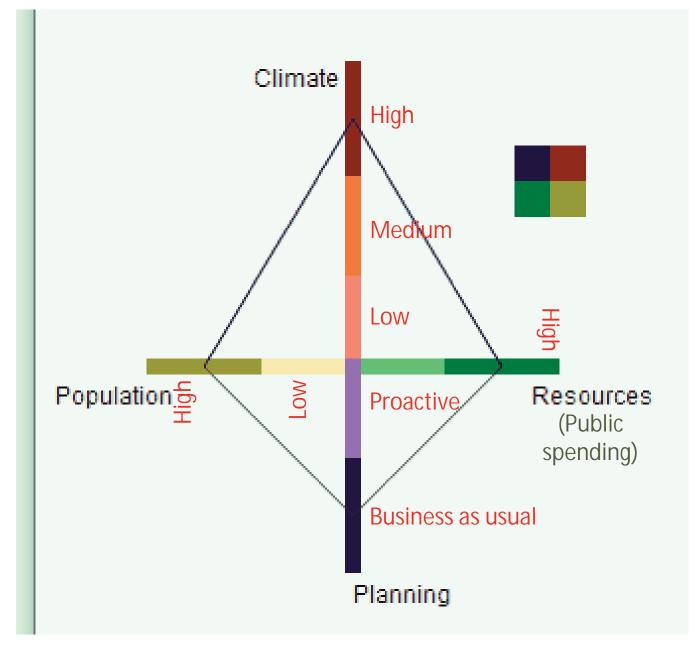


MichiganTech



Scenario generation



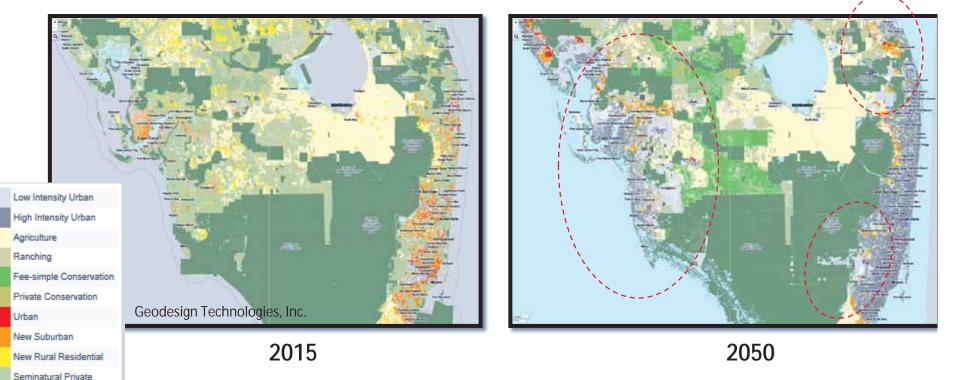


Scenario generation



Land use change

PENINSULAR FLORIDA LANDSCAPE CONSERVATION COOPERATIVE

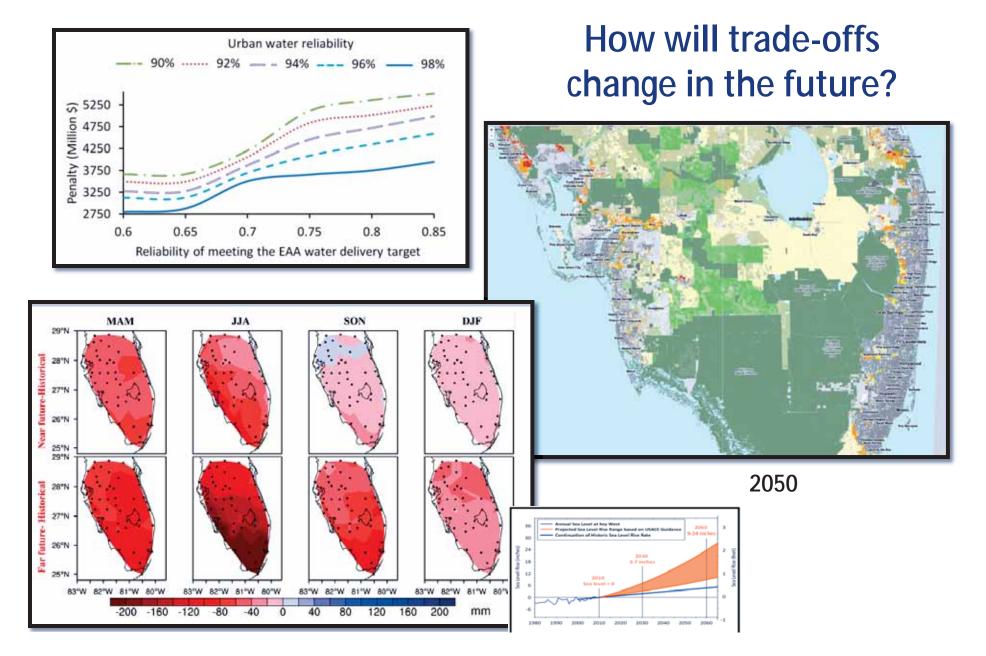


Water Zoned for Development

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



Decision Acceleration





Back

Miami in 2050

Miami-Dade County's population is over 4 million

Miami continues to grow, attracting new wealthy immigrants from China

Canals around the city have been surrounded with parks to buffer against flooding and the County is asking for \$3 billion for other flood protections

You are about to enter your living room in 2050

Close your eyes and imagine what your life is like for 10 seconds then click "next"



<u>http://nodejs-</u> <u>hazsim.rhcloud.com/#!/sim/C5k0JZOZSf?re</u> <u>directURL=http:%2F%2Fwww.cesp.miami.</u> <u>edu%2F</u>