Water Research Overview

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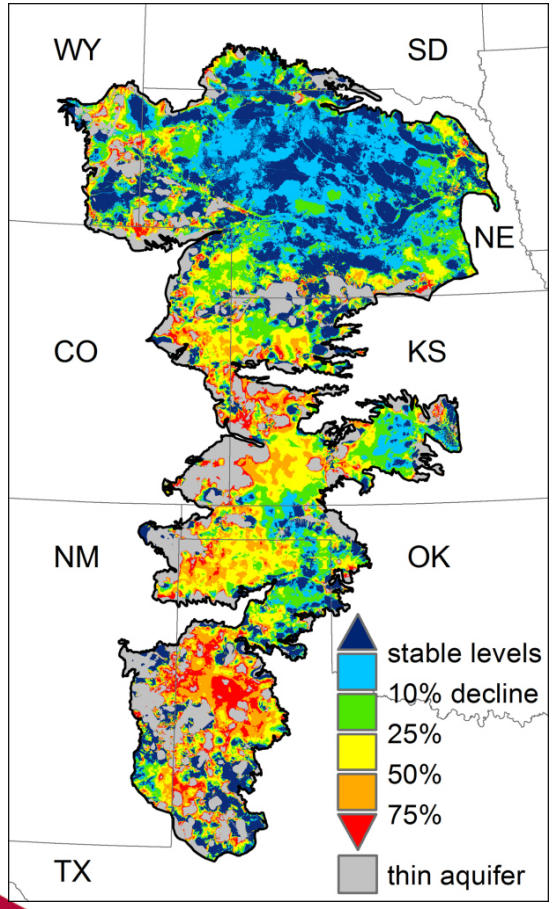
Economics, environment and sustainability background

Selected water research topics:

- Drought and agriculture (shadow price of water)
- Economic value of weather and environmental monitoring (OK Mesonet)
- Sustainability of water management
- Economics of desalination
- Evaluation of ecosystem services

Shadow price of water for irrigation – Example TX HP

Ogallala water levels change, 2011-2013

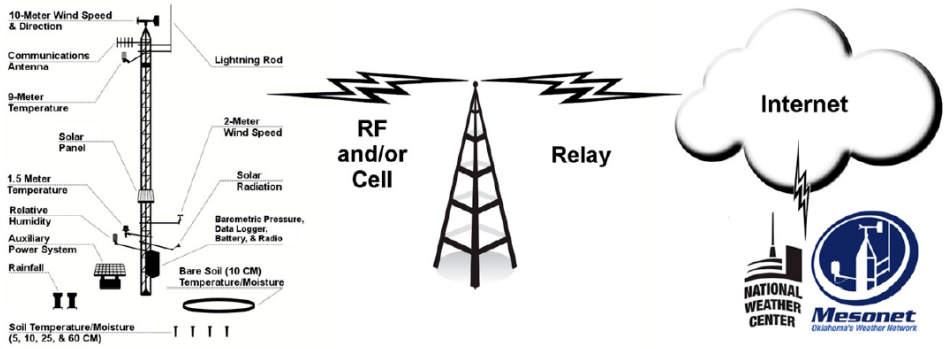


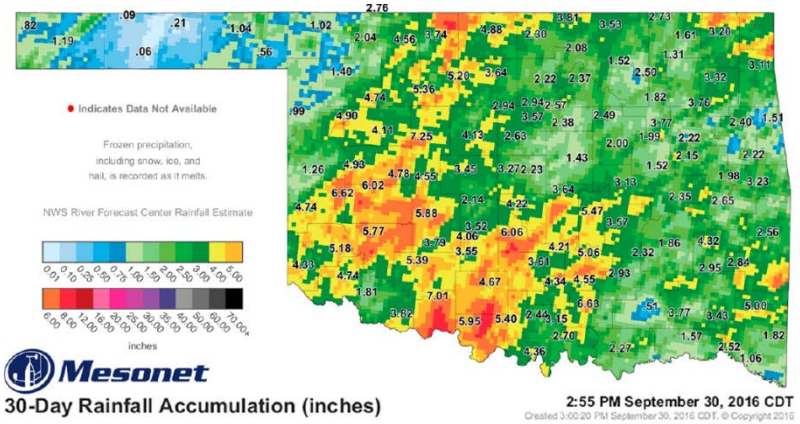
MSU, 2013

Crop	Yield (bu/ac)	Net returns (mi $)	**Shadow price of water ($/af)**	Yield (bu/ac)	Net returns (mi $)	**Shadow price of water ($/af)**
Northern HP						
	2010			**2011**		
Corn	214.5	89.4	**92.02**	138.4	53.7	**38.46**
Cotton	1,111.8	95.8	**865.99**	667.8	27.5	**73.20**
Wheat	187.6	-52.8	**-170.71**	173.1	-32.8	**-70.14**
Soybeans	55.1	0.38	**18.61**	34.1	-0.5	**-26.37**
Sorghum	102.6	-10.3	**-166.85**	75.0	-7.6	**-85.53**
Southern HP						
Corn	194.8	3.4	**5.13**	142.1	3.4	**5.01**
Cotton	953.7	81.5	**66.10**	499.7	-228.5	**-129.31**
Wheat	176.4	-27.6	**-90.73**	164.4	-16.8	**-40.87**
Soybeans	35.0	-17.5	**-685.17**	40.0	-6.4	**-520.43**
Sorghum	82.1	-6.1	**-84.94**	60.0	-11.4	**-135.54**

Ziolkowska, 2015

Economic value of weather monitoring with OK Mesonet





Source: Ziolkowska et al. (2017)

Improved profits, prevented losses and total benefits (economic value) of Mesonet information in Oklahoma in different scenarios (Factor P = 3.7%).

	Improved profits ($)			Prevented losses ($)			Total benefits ($)		
Year	73%	50%	30%	73%	50%	30%	73%	50%	30%
2006	550,009	376,719	226,031	(13,526,227)	(9,264,539)	(5,558,723)	14,076,236	9,641,258	5,784,755
2007	4,463,805	3,057,401	1,834,440	(8,181,958)	(5,604,081)	(3,362,448)	12,645,763	8,661,481	5,196,889
2008	11,962,332	8,193,378	4,916,027	(1,727,448)	(1,183,183)	(709,910)	13,689,780	9,376,562	5,625,937
2009	4,363,547	2,988,731	1,793,238	(25,363,031)	(17,371,939)	(10,423,163)	29,726,577	20,360,670	12,216,402
2010	7,616,872	5,217,036	3,130,222	(17,044,518)	(11,674,327)	(7,004,596)	24,661,390	16,891,363	10,134,818
2011	–	–	–	(27,466,933)	(18,812,968)	(11,287,781)	27,466,933	18,812,968	11,287,781
2012	3,354,080	2,297,315	1,378,389	(4,496,184)	(3,079,578)	(1,847,747)	7,850,264	5,376,893	3,226,136
2013	5,566,099	3,812,396	2,287,438	(16,919,757)	(11,588,874)	(6,953,325)	22,485,855	15,401,271	9,240,762
2014	3,453,969	2,365,732	1,419,439	(27,055,851)	(18,531,405)	(11,118,843)	30,509,820	20,897,137	12,538,282
Sum	**41,330,713**	**28,308,707**	**16,985,224**	**(141,781,905)**	**(97,110,894)**	**(58,266,536)**	**183,112,618**	**125,419,601**	**75,251,761**

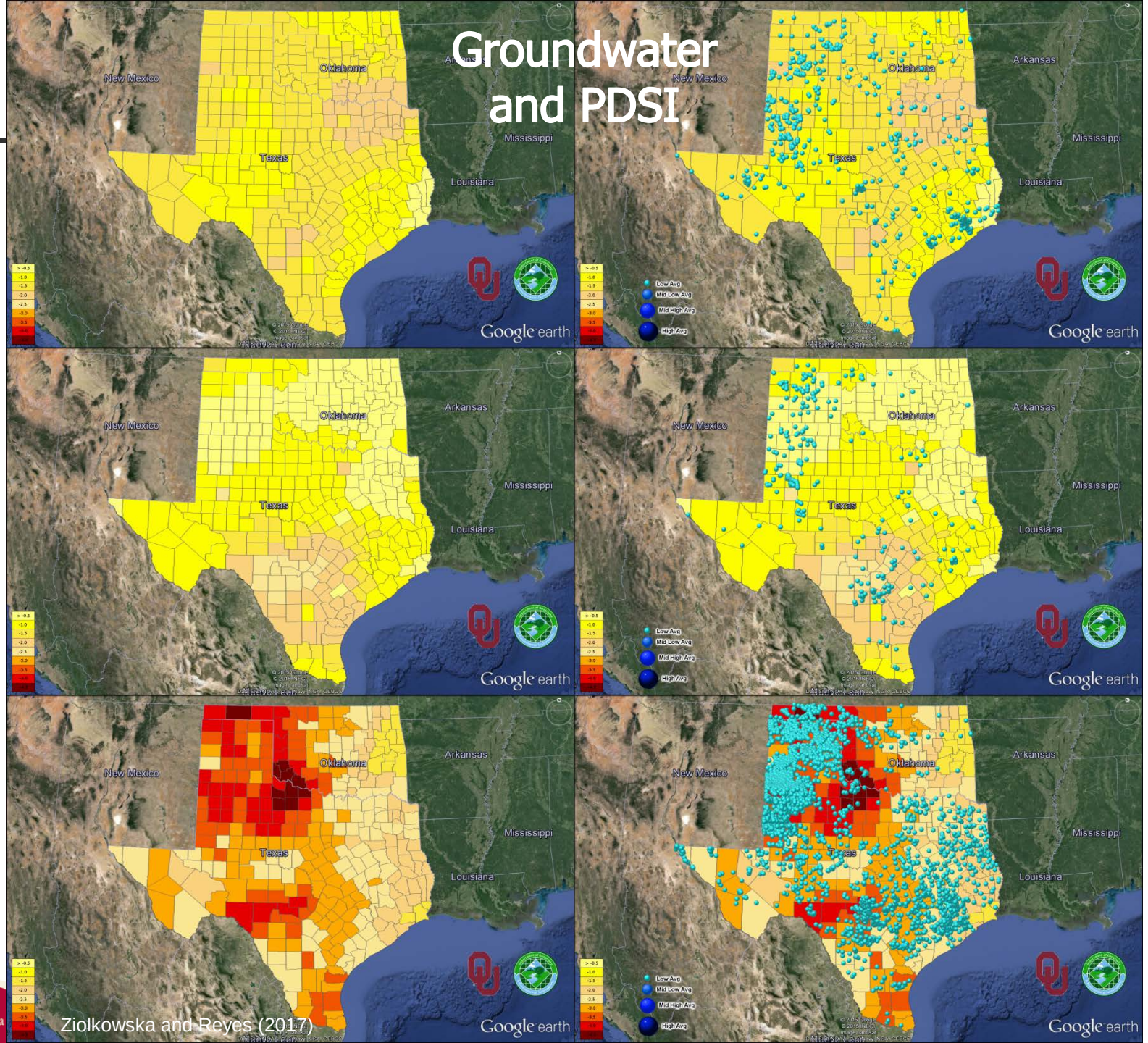
Ziolkowska (2018)

Groundwater and PDSI

2003-2006

2007-2010

2011-2014



Ziolkowska and Reyes (2017)

Socio-economic implications of drought

Drought Effects on Texas economy

Impact Type	Employment (# jobs)	Labor Income (in million $)	Value Added (in million $)	Output (in million $)
Direct Effects	-106,437	-679.8	-2,076.3	-8,284.0
Indirect Effects	-42,305	-1,567.8	-3,197.8	-6,349.2
Induced Effects	-18,152	-784.8	-1,449.7	-2,354.1
Total Effects	-166,895	-3,032.5	-6,723.8	-16,987.3

Ziolkowska (2016)

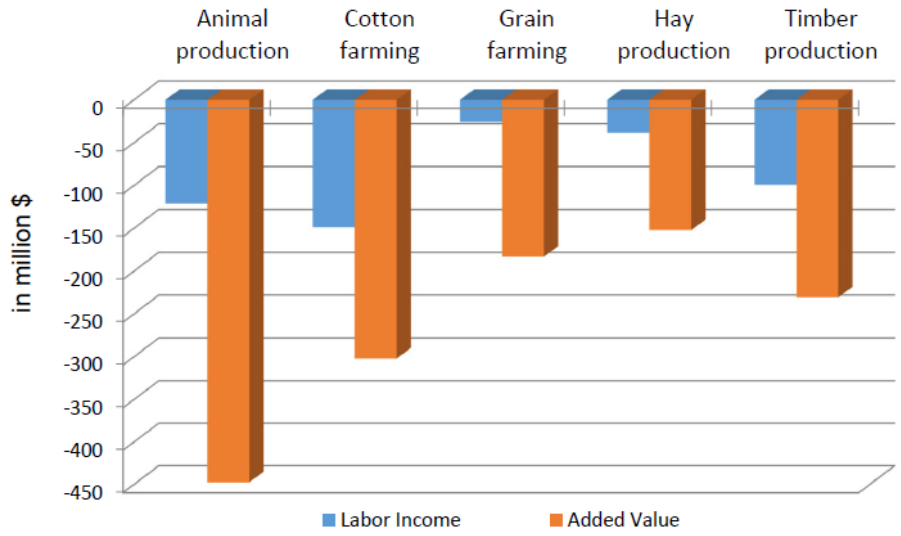
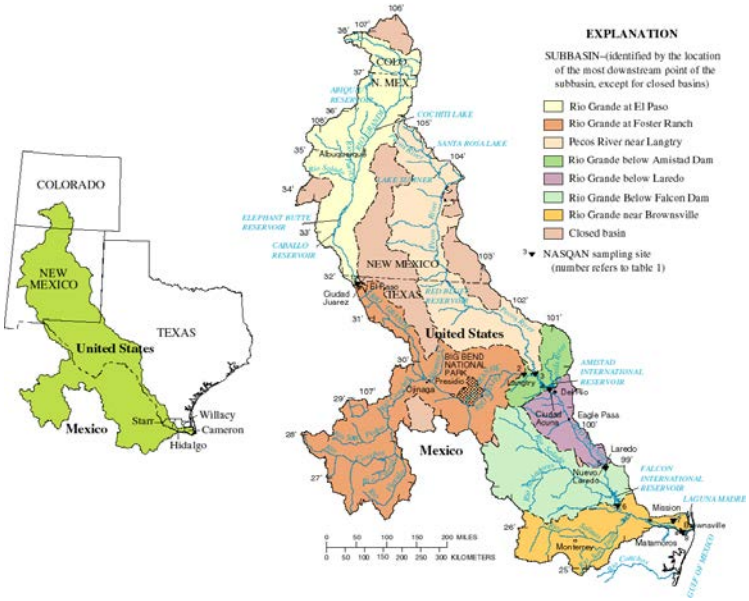


Figure 3. Losses in added value and labor income in the agricultural sector in Texas.

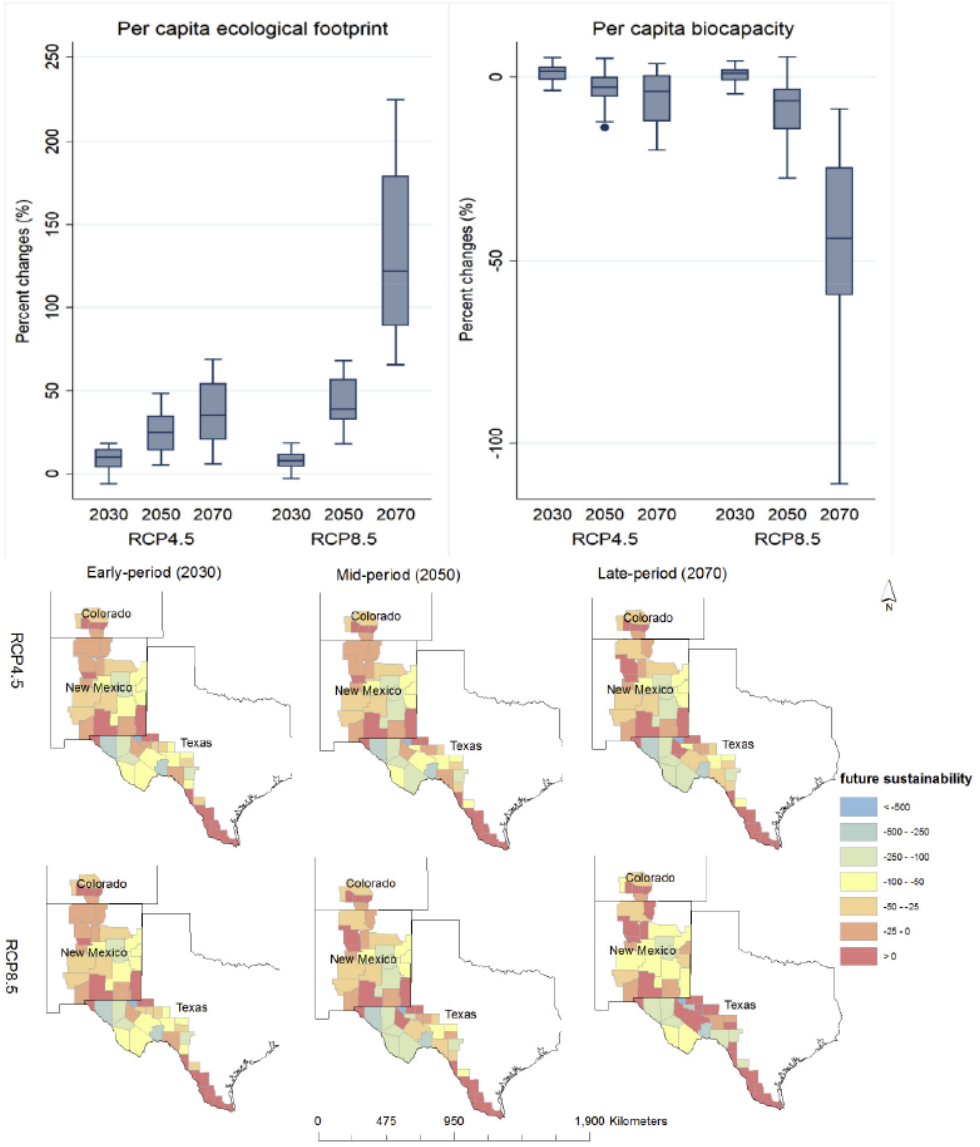
WTP for ecosystem services in the Rio Grande Basin



Willingness to pay (WTP) ($/year from annual income donation)	Obs.	Mean	Std. Dev.	Min	Max
Total ecosystem services	74	**82.77**	117.56	0	600
Fresh water supplies	56	**38.64**	74.44	0	400
Cultural heritage (hunting, plant collecting)	56	**8.60**	16.56	0	75
Wildlife habitat	55	**46.02**	64.43	0	350
Recreational activities (fishing, rafting, etc.)	56	**13.96**	26.31	0	150

Ziolkowska and Mu (under review)

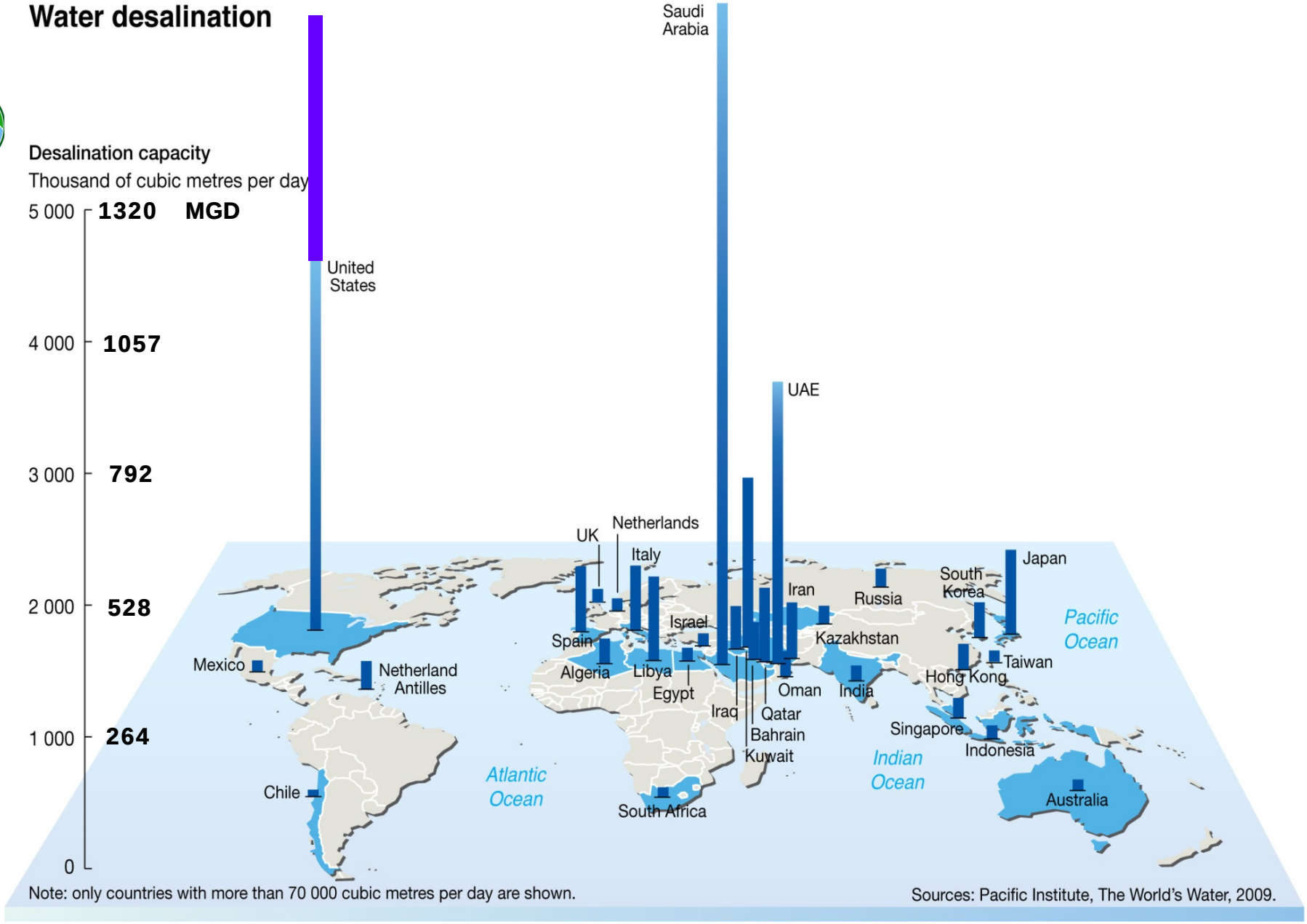
Sustainability and Environ. Footprint in the RG Basin



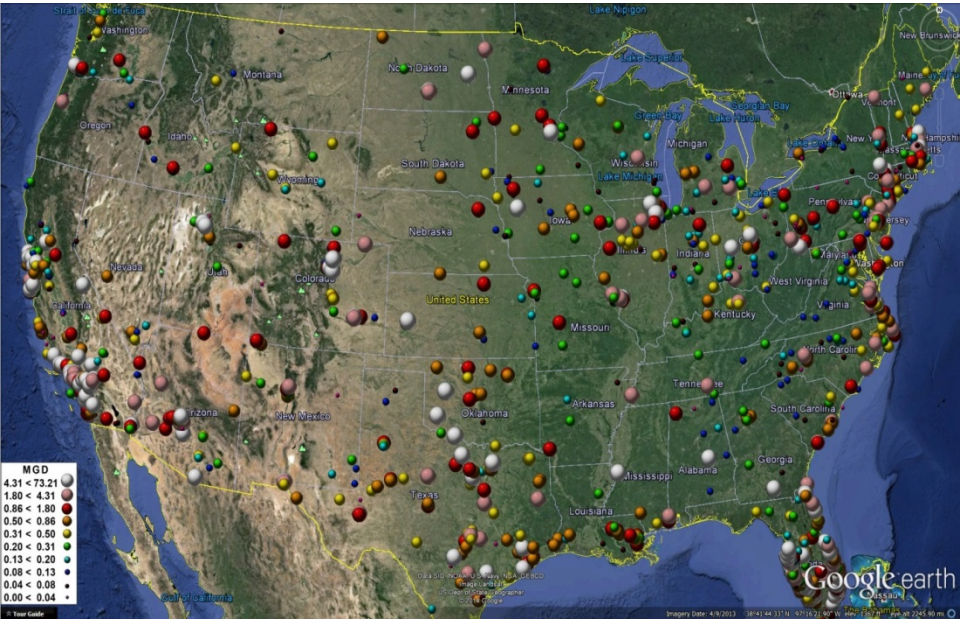
Mu and Ziolkowska (2018)

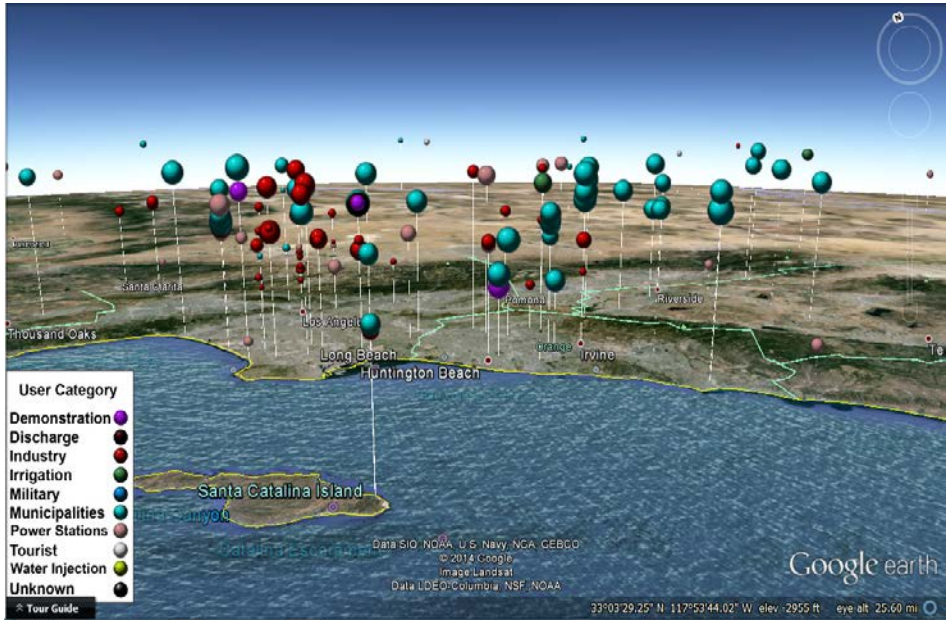
Fig. 5. Geographic distribution of the future sustainability levels in the Rio Grande Basin (Note: Values are aggregated across 20 global climate models in the Rio Grande Basin; the sustainability indicator is defined as the difference between the per capita ecological footprint and the per capita biocapacity. Negative values show sustainable conditions, while positive values indicate unsustainable conditions).

Water desalination



Interactive models for desalination





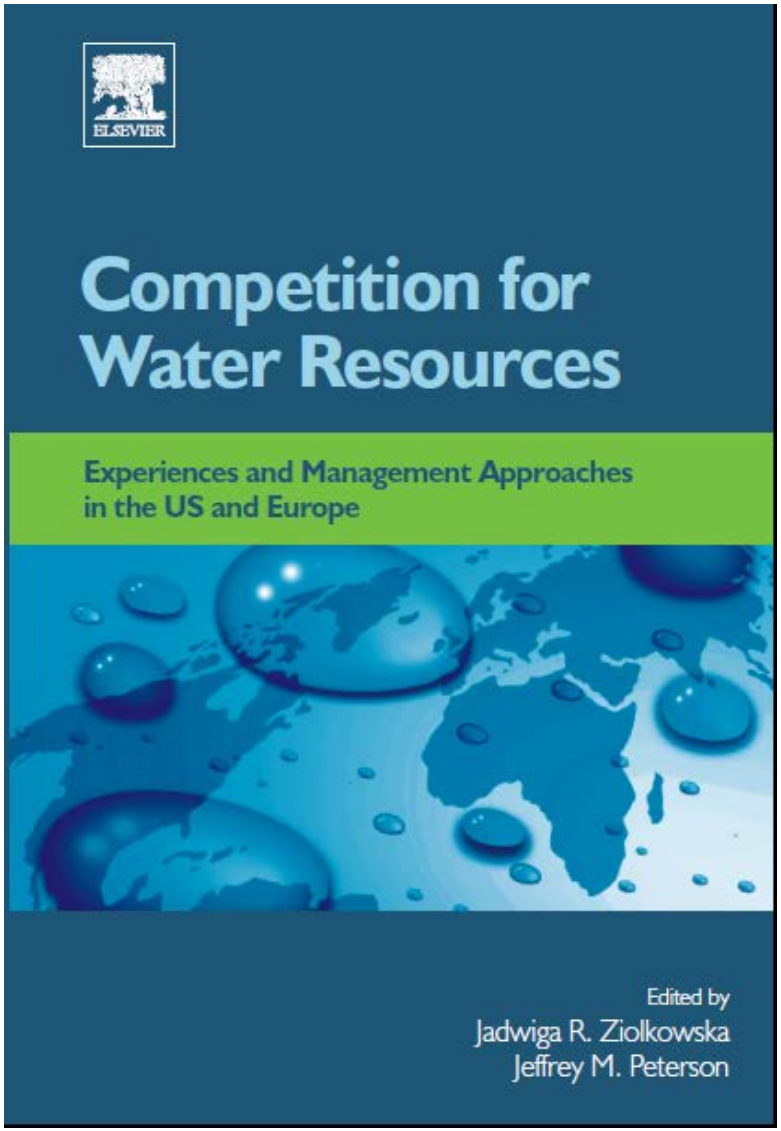
Ziolkowska and Reyes (2016)

Model website with explanation:

http://www.hitechmex.org/US_desal/US_desal.html

Open access model of desalination plants in the US:

http://www.hitechmex.org/US_desal/US_Desal.kmz



Dr. Jad Ziolkowska & Dr. Jeff Peterson

KEY FEATURES

- Provides a national and regional perspective through the use of country specific case study examples
- Includes a comparative analysis between the US and Europe, illustrating experiences in water management from two sides of the Atlantic
- Covers interdisciplinary topics related to water, such as agriculture and energy

International perspective on water scarcity problems and useful management methods and best practices in the US and Europe