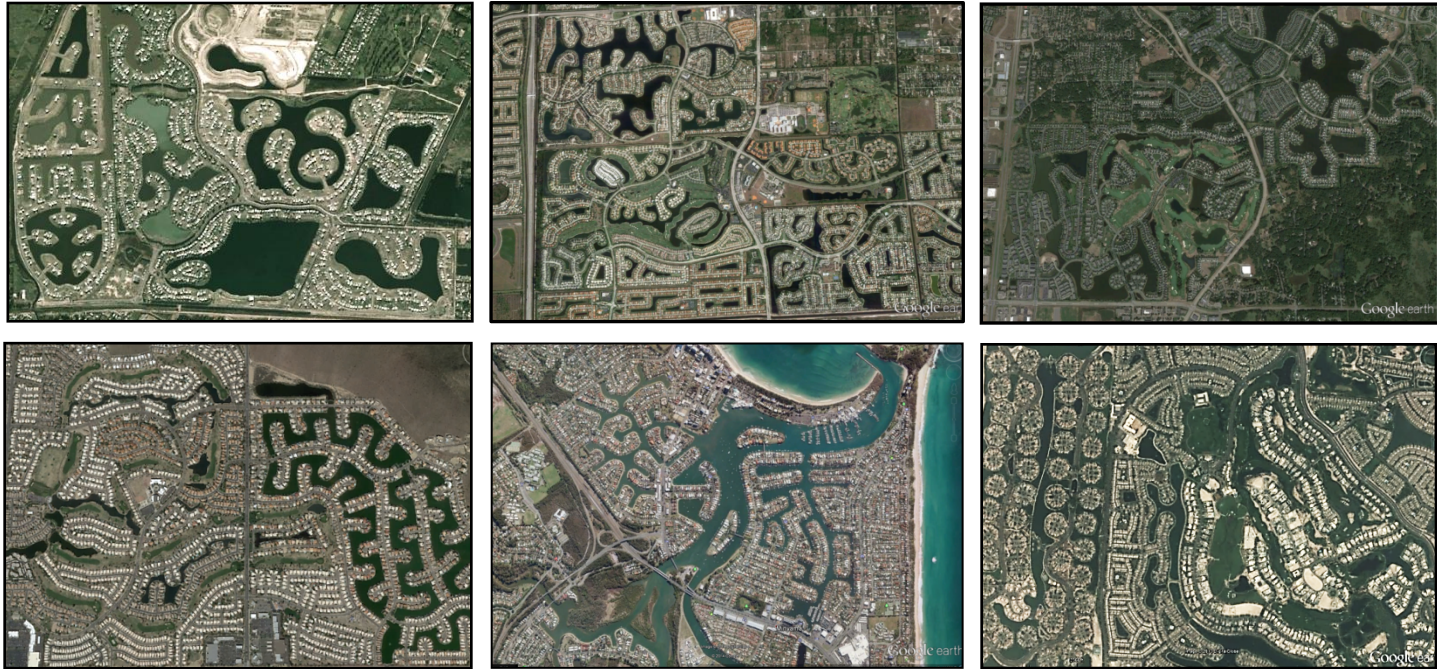


# Converging surface water distributions in US cities and agriculture



Meredith K. Steele

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Crop and Soil Environmental Sciences

OGIS 2014

# Ecological Homogenization of Urban America

NSF Macrosystems Biology Program

## Convergent Surface Water Distributions in U.S. Cities

Ecosystems

DOI: 10.1007/s10021-014-9751-y

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P. M. Groffman,<sup>2</sup> J. M. Grove,<sup>4</sup> S. Hall,<sup>5</sup> S. E. Hobbie,<sup>3</sup> K. Larson,<sup>6</sup>  
J. L. Morse,<sup>7</sup> C. Neill,<sup>8</sup> K. C. Nelson,<sup>9,10</sup> J. O'Neil-Dunne,<sup>11</sup> L. Ogden,<sup>12</sup>  
D. E. Pataki,<sup>13</sup> C. Polsky,<sup>14</sup> and R. Roy Chowdhury<sup>15</sup>

**Morphological characteristics of urban water bodies:  
mechanisms of change and implications for ecosystem function**

MK Steele<sup>1\*</sup> and JB Heffernan<sup>1</sup>

Ecological Applications DOI:10.1890/13-0983.1

Jim Heffernan  
Duke University



MACROSYSTEMS ECOLOGY

## Ecological homogenization of urban USA

Peter M Groffman<sup>1\*</sup>, Jeannine Cavender-Bares<sup>2</sup>, Neil D Bettez<sup>1</sup>, J Morgan Grove<sup>3</sup>, Sharon J Hall<sup>4</sup>,  
James B Heffernan<sup>5</sup>, Sarah E Hobbie<sup>2</sup>, Kelli L Larson<sup>6</sup>, Jennifer L Morse<sup>1</sup>, Christopher Neill<sup>7</sup>, Kristen Nelson<sup>8</sup>,  
Jarlath O'Neil-Dunne<sup>9</sup>, Laura Ogden<sup>10</sup>, Diane E Pataki<sup>11</sup>, Colin Polsky<sup>12</sup>, Rinku Roy Chowdhury<sup>13</sup>,  
and Meredith K Steele<sup>5</sup>

*Front Ecol Environ* 2014; 12(1): 74–81, doi:10.1890/120374

PNAS

## Assessing the homogenization of urban land management with an application to US residential lawn care

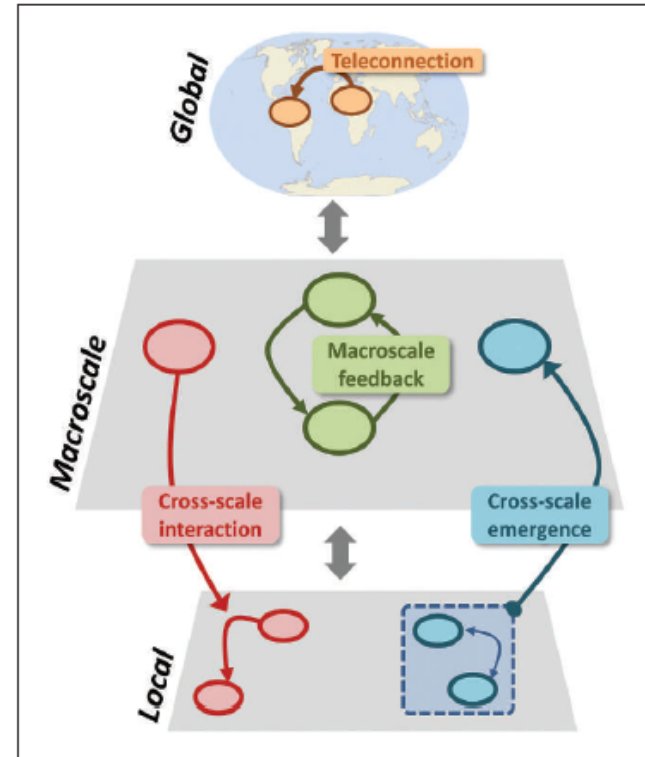
Colin Polsky<sup>1\*</sup>, J. Morgan Grove<sup>3</sup>, Chris Knudson<sup>3</sup>, Peter M. Groffman<sup>5</sup>, Neil Bettez<sup>2</sup>, Jeannine Cavender-Bares<sup>4</sup>,  
Sharon J. Hall<sup>4</sup>, James B. Heffernan<sup>5</sup>, Sarah E. Hobbie<sup>2</sup>, Kelli L. Larson<sup>6</sup>, Jennifer L. Morse<sup>1</sup>, Christopher Neill<sup>7</sup>,  
Kristen C. Nelson<sup>8</sup>, Laura A. Ogden<sup>10</sup>, Jarlath O'Neil-Dunne<sup>9</sup>, Diane E. Pataki<sup>11</sup>, Rinku Roy Chowdhury<sup>13</sup>,  
and Meredith K. Steele<sup>9</sup>

Peter Groffman  
Cary Institute



# Macrosystems Ecology

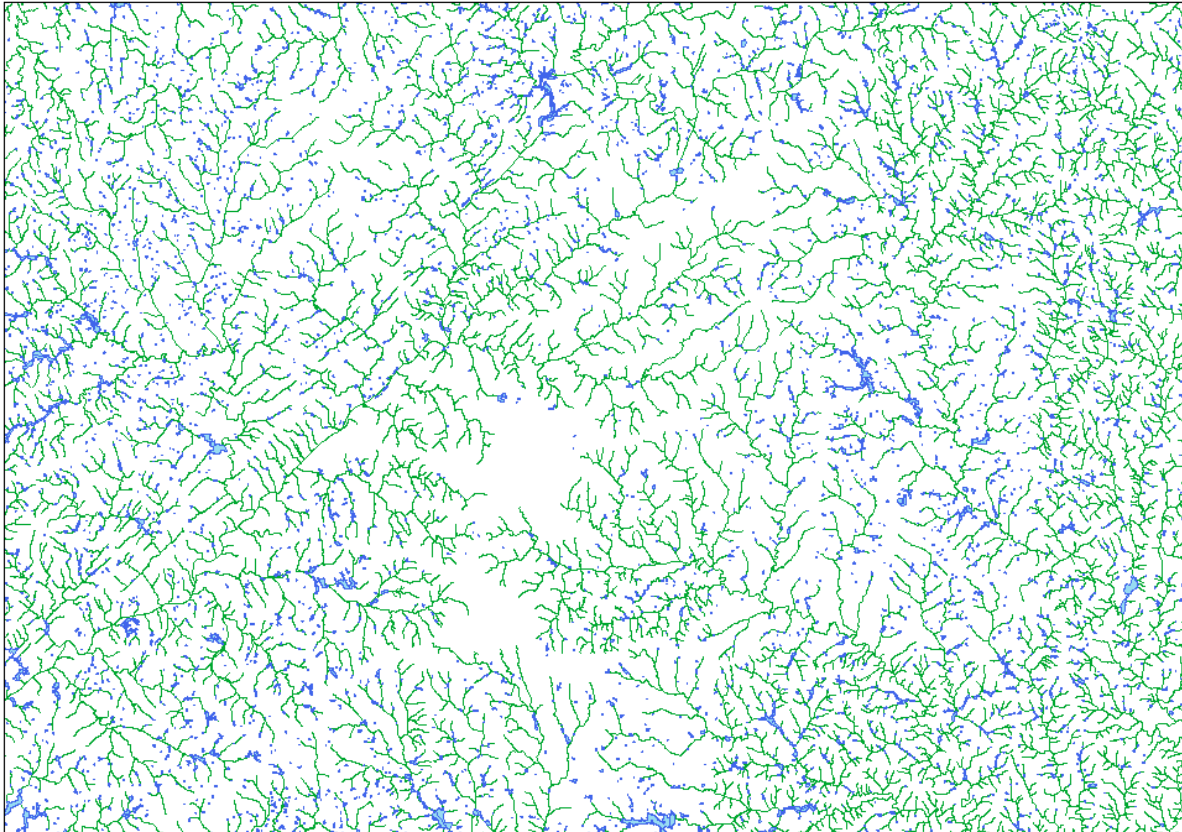
- Understanding ecological patterns and processes at continental scales
- Developed landscapes: urban and agricultural
- Water resources: hydrography



Heffernan, Soranno, et al. (2014) Macrosystems ecology: understanding ecological patterns and processes at continental scales. *Frontiers of Ecology and the Environment* 12(1):5-14.

# What is a Hydroscape?

- The collection of water features (streams, rivers, channels, lakes, ponds, wetlands) in a landscape.

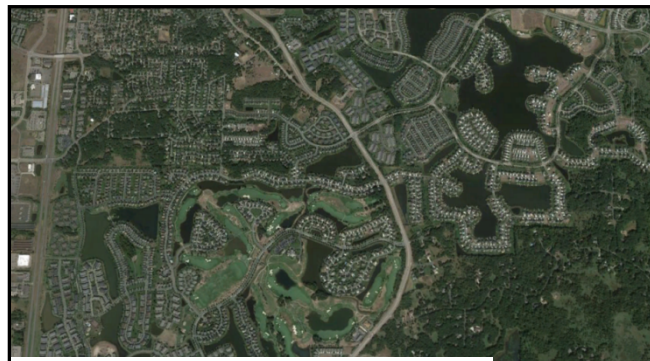




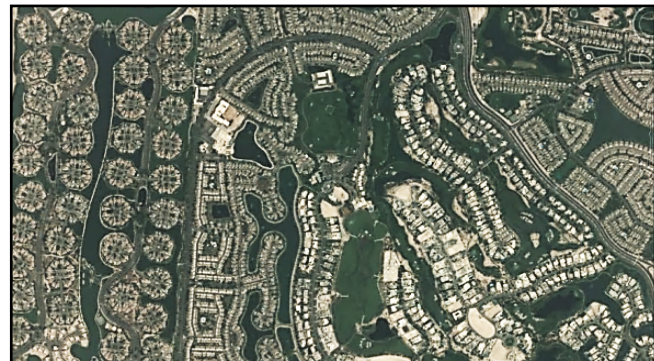
Boynton Beach, FL, USA



Buenos Aires, Argentina



Minneapolis, MN, USA



Dubai, United Arab Emirates



Phoenix, AZ, USA



Minyama, Australia

# Southwest Houston 2012

10/2012

4000 ft

Google earth

Imagery Date: 10/27/2012 29°38'45.22" N 95°28'15.37" W elev: 63 ft eye alt: 18062 ft

Tour Guide



# Surface Water Abundance

Dry

Wet



Natural

## Convergence



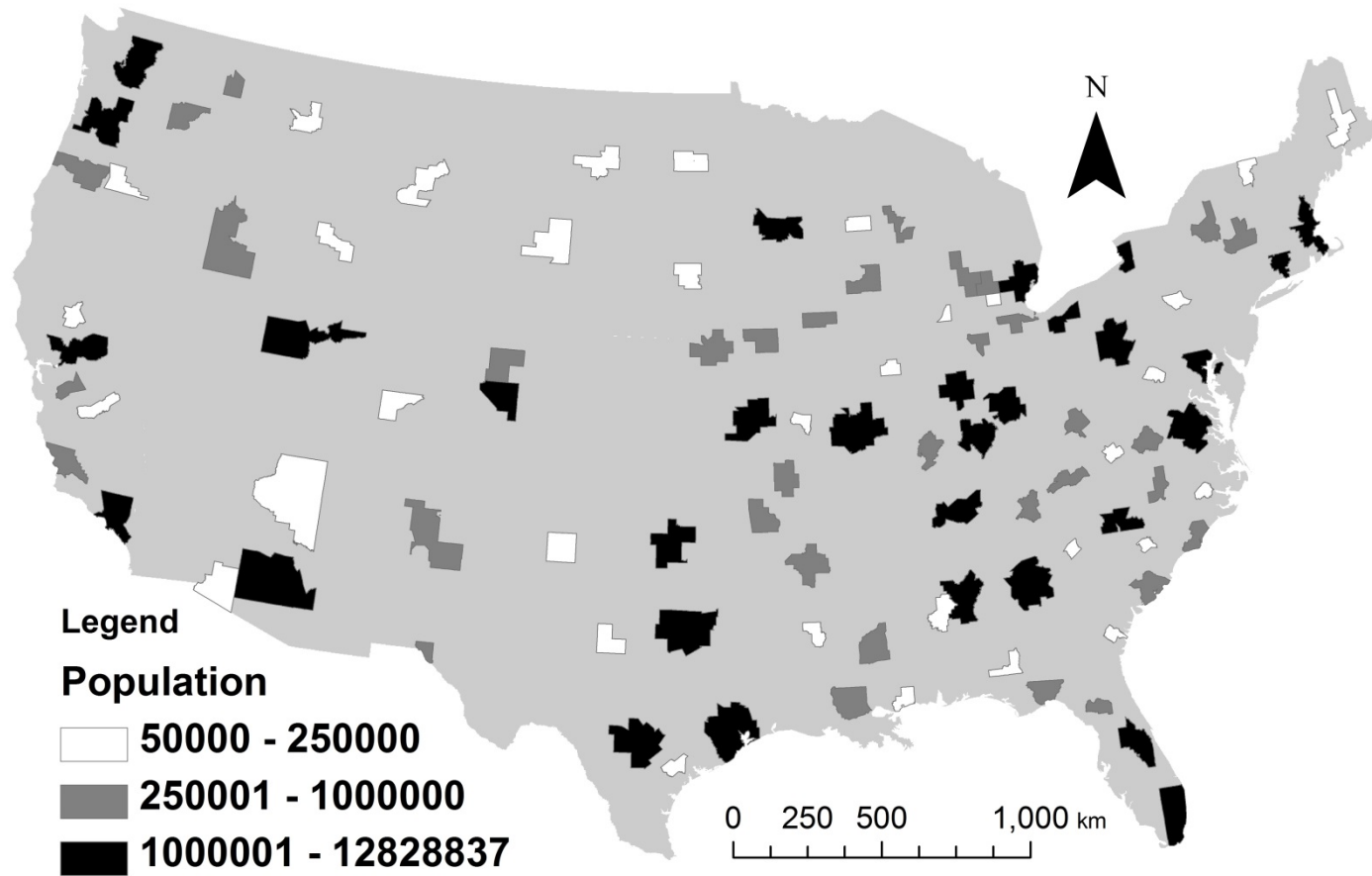
Natural

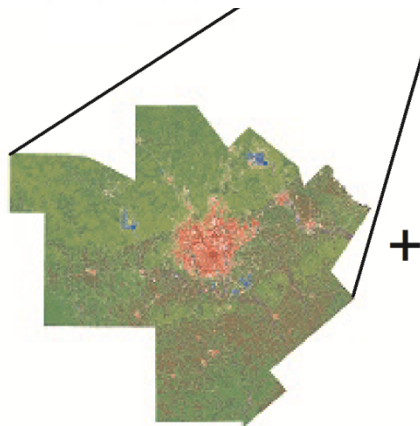
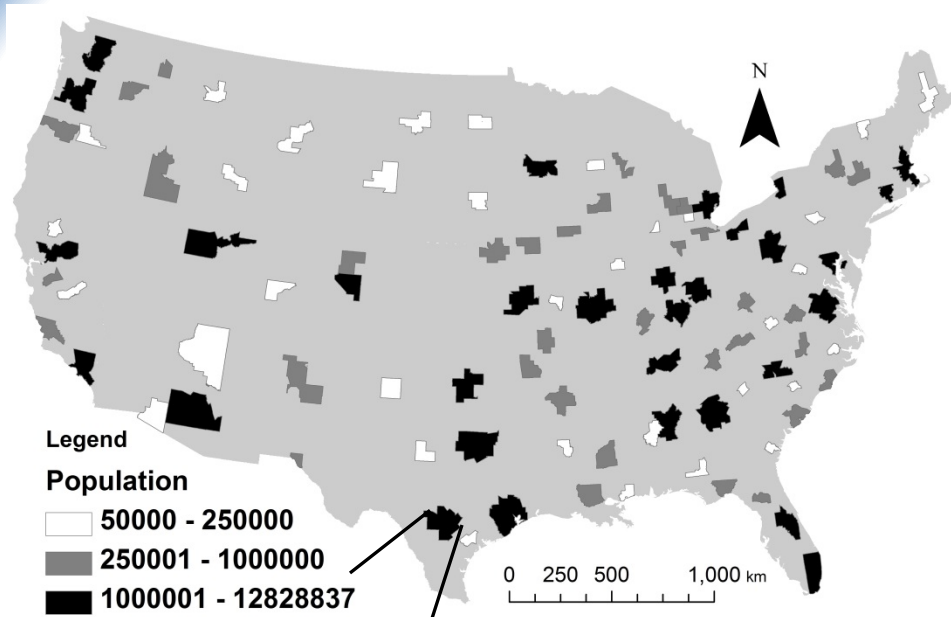
Does urbanization *converge* hydroscapes  
→ characteristics? ←

H1: Urban hydroscapes characteristics become more similar.

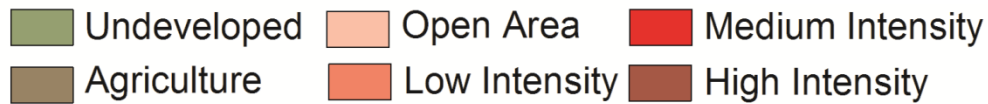


# 100 Metropolitan Statistical Areas



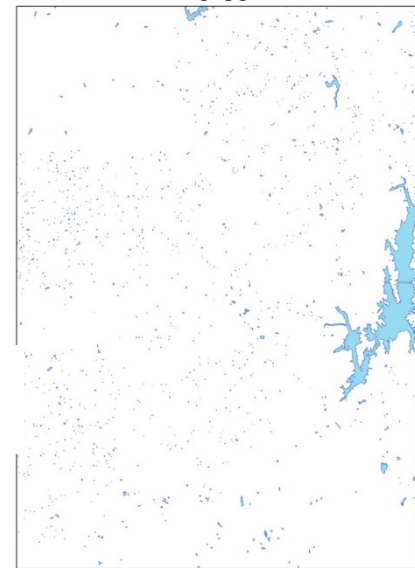


2006 National Land Cover Data



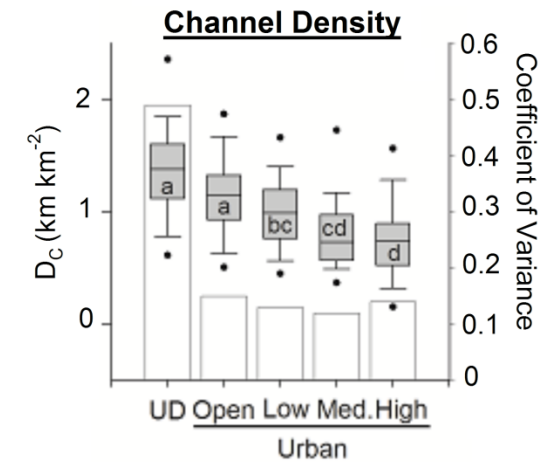
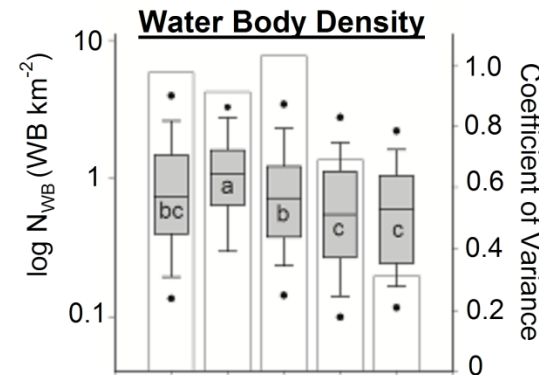
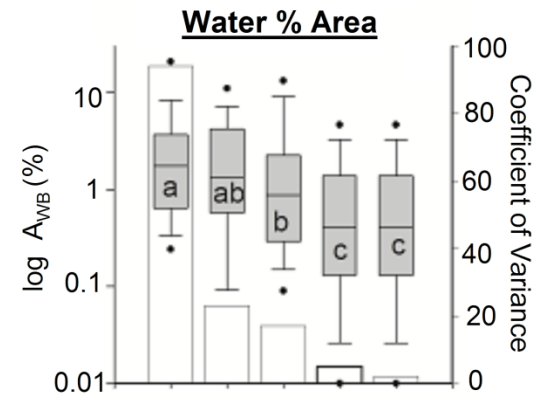
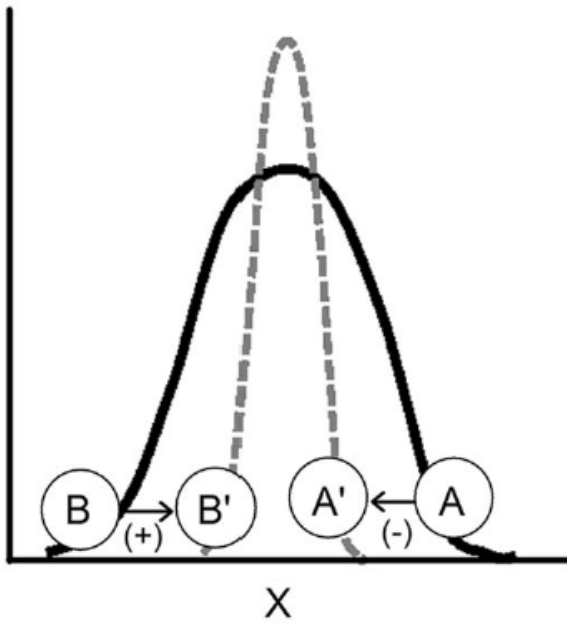
Urban

National Hydrography Data



# Evidence of Convergence

1. Variance decreases.



Open Area

Low Intensity

Medium Intensity

High Intensity

Water Body Coverage

Water Body Density

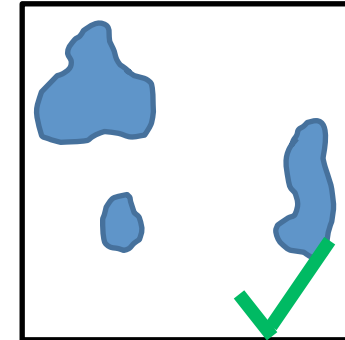
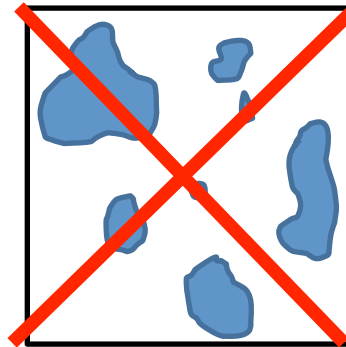
Channel Density

# Mechanisms Shaping Hydroscaapes

1. Physical Alteration:  
Reshaping  
Construction



2. Choice of Location



What are the characteristics of agricultural hydroscapes?

# Adding Water

“The ubiquitous farm pond.”



Photo by USDA NRCS

# Draining Water

## IPNAS Recent land use change in the Western Corn Belt threatens grasslands and wetlands

Christopher K. Wright<sup>1</sup> and Michael C. Wimberly

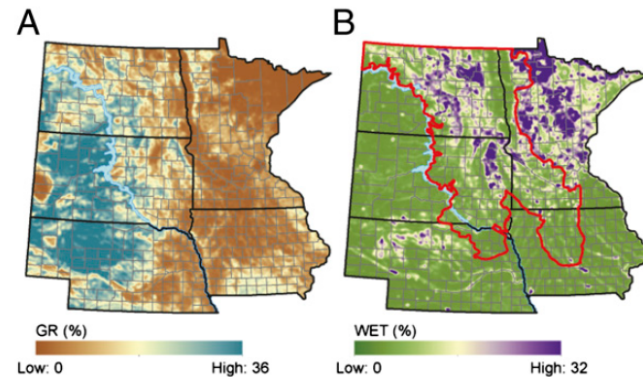
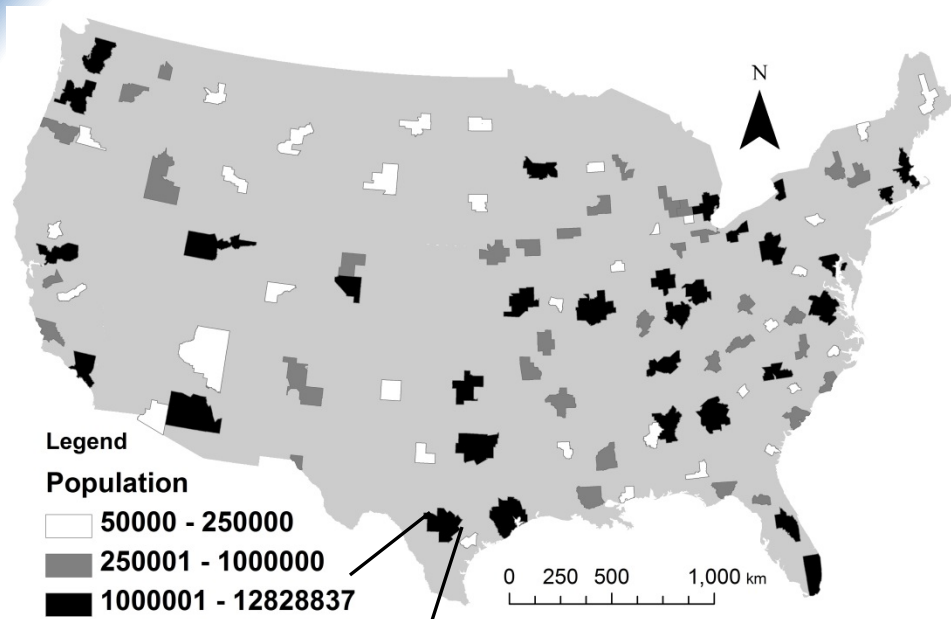


Fig. 1. Grasslands and wetlands in the WCB. Each map consists of smoothed percent cover at 560-m spatial resolution. (A) Percent grassland cover from the 2006 NASS CDL. (B) Percent wetland cover from the 2006 National Land Cover Dataset (53). The red outline indicates boundaries of the PPR within the WCB (52).



Gradient from 0 to 79% agricultural land cover.



+



→



+



2006 National Land Cover Data

Census Block Groups

Majority Sampled Land Cover

- |             |               |                  |
|-------------|---------------|------------------|
| Undeveloped | Open Area     | Medium Intensity |
| Agriculture | Low Intensity | High Intensity   |

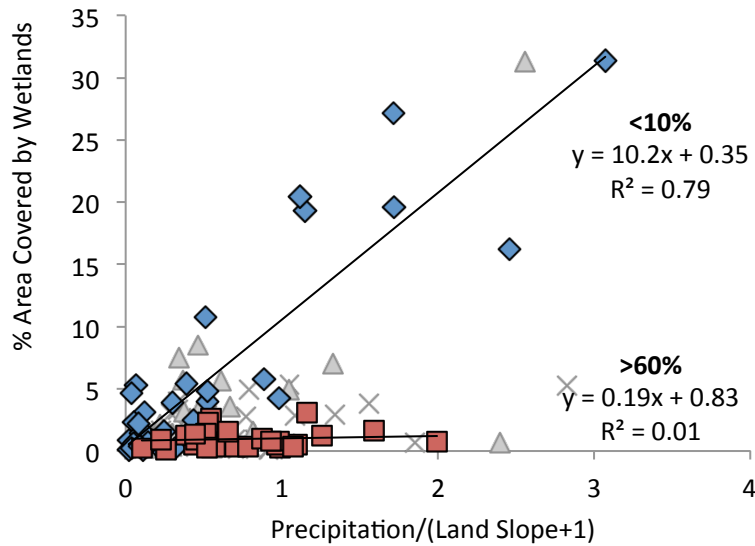
Urban

National Hydrography Data



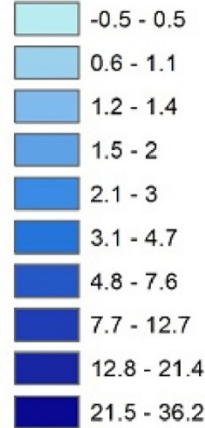
1. Agricultural hydroscapes are complex.
2. Driving hydroscape characteristics:  
Precipitation, the land slope, and the intensity of agriculture.

### Wetland Area

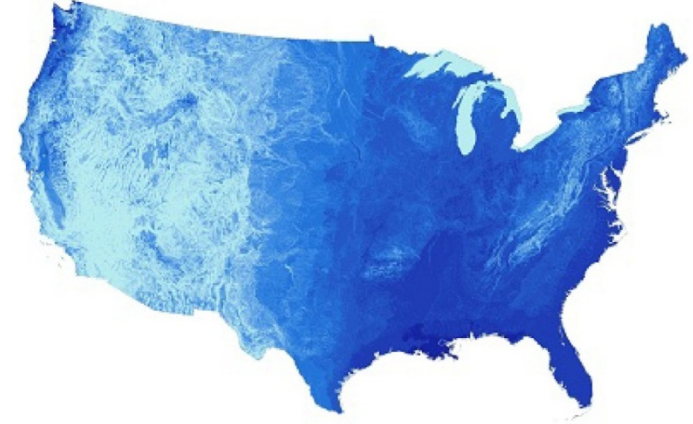


### % Area Covered by Wetlands

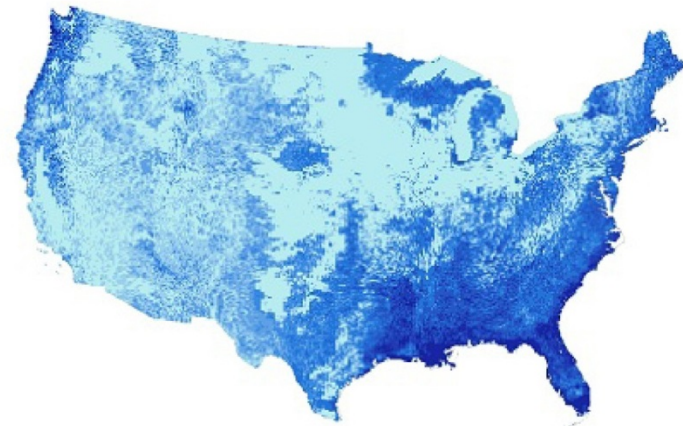
#### Legend



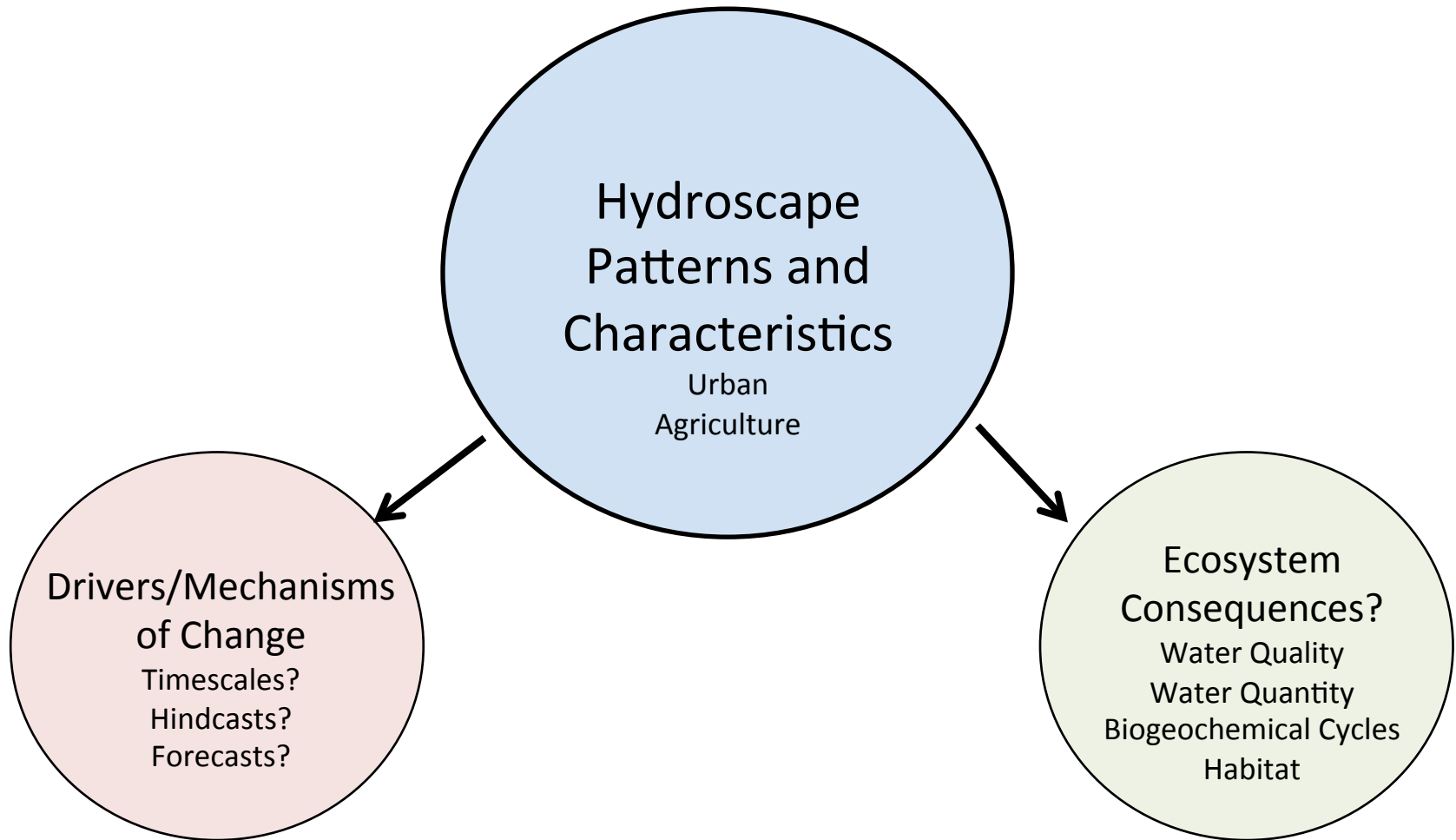
#### Without Agricultural Development



#### With Agricultural Development

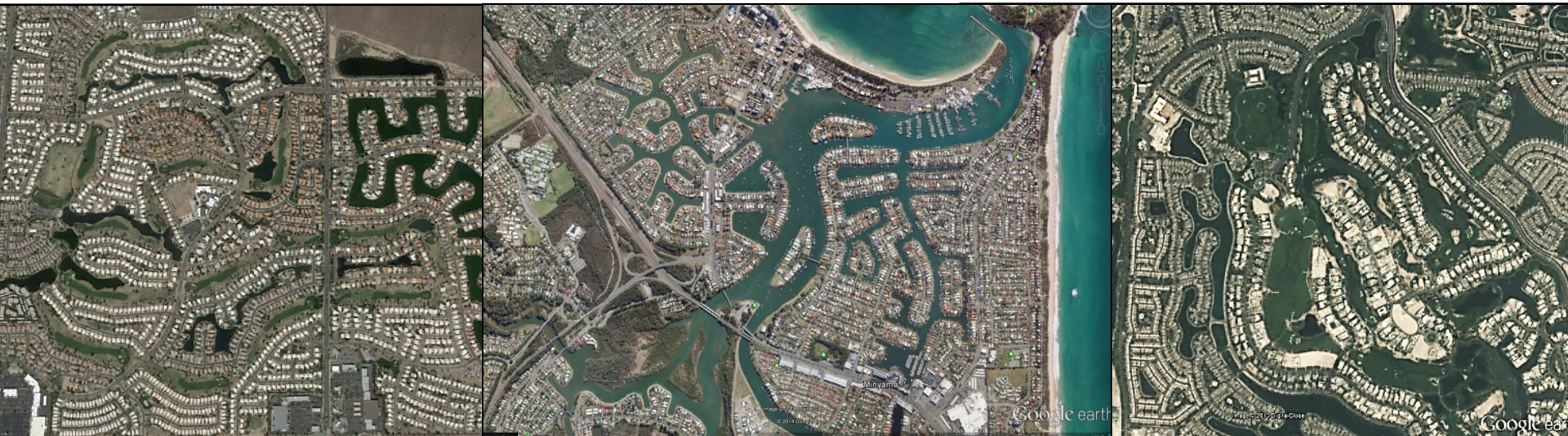


# Moving Forward

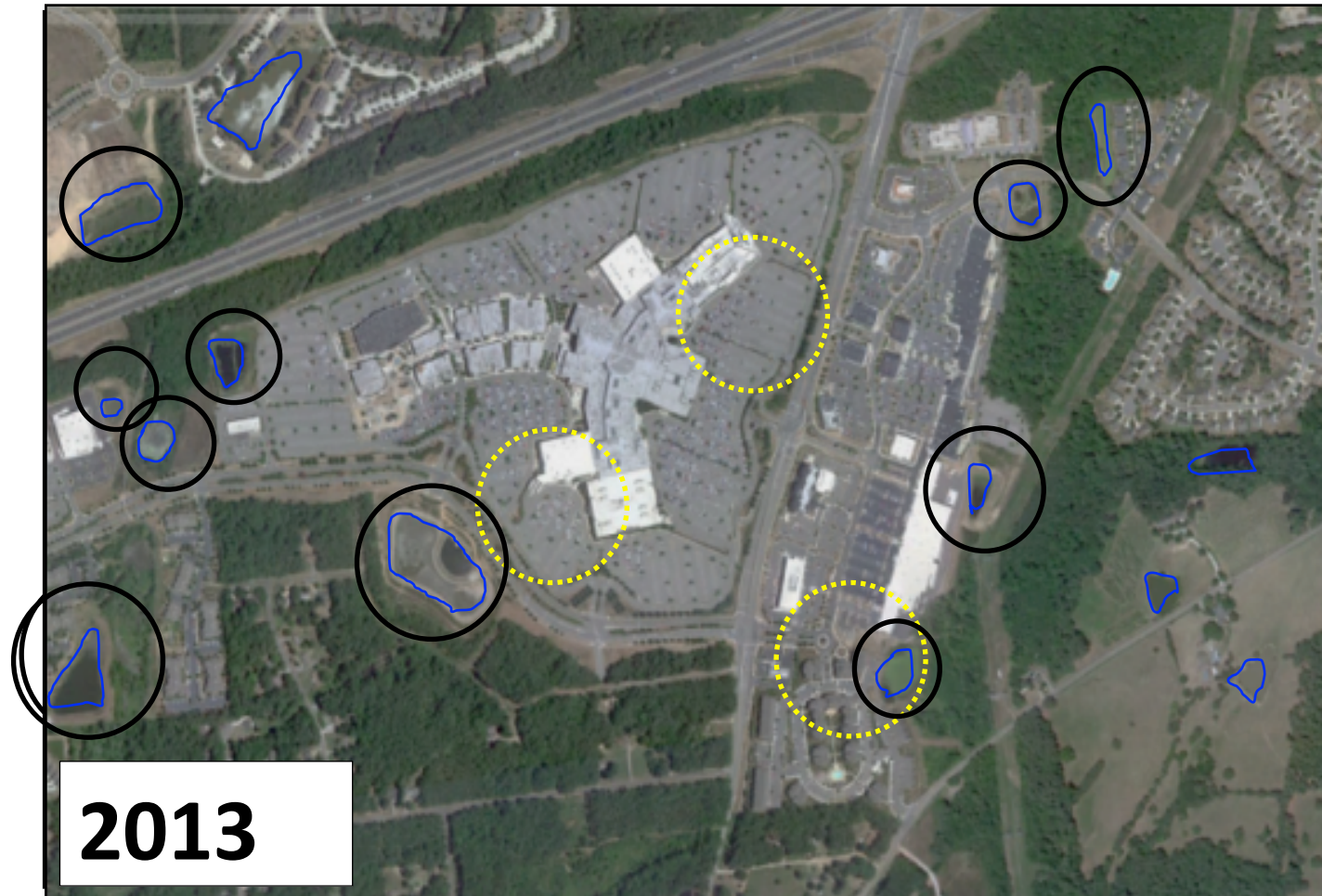




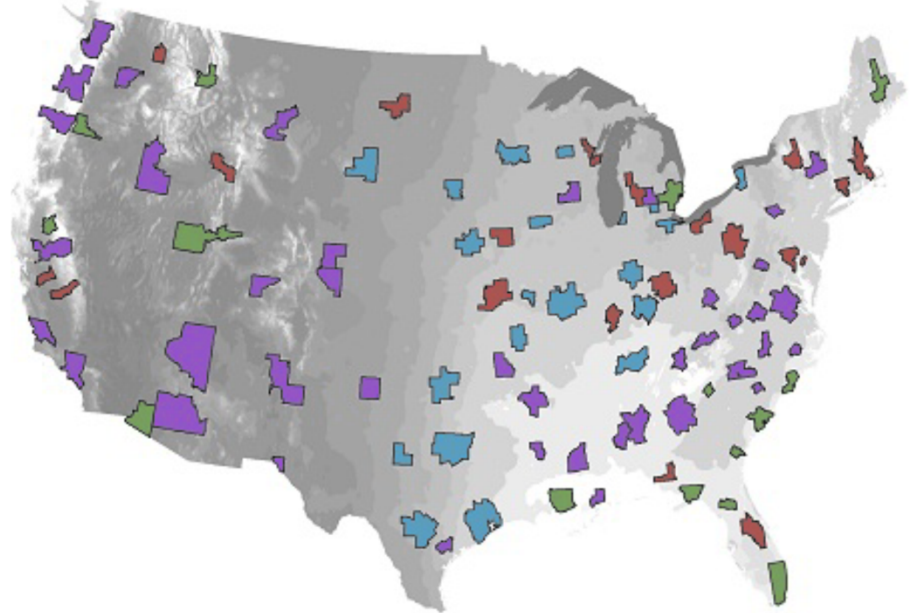
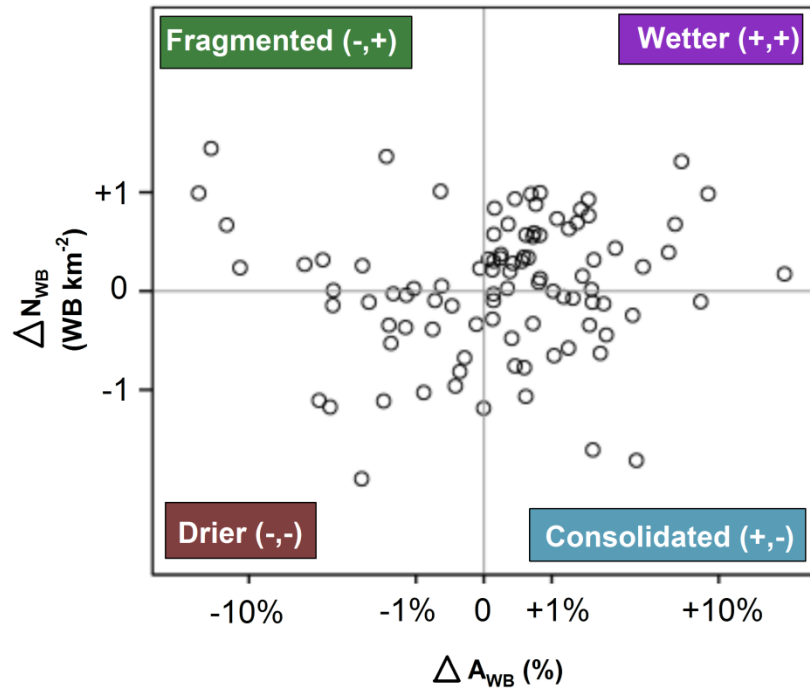
**Thank you.**



# A Matter of Time.....



# Differences in water body number and size



# Surface Water Abundance

Dry

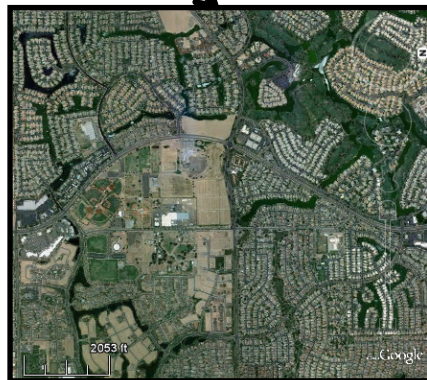
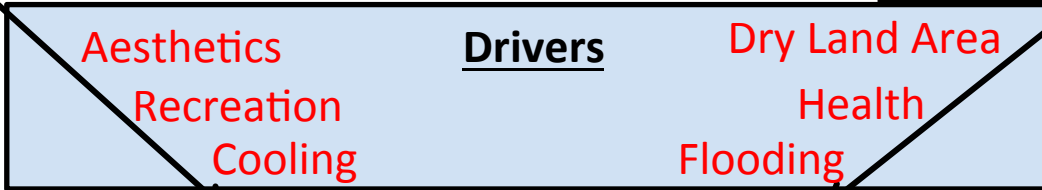
Wet



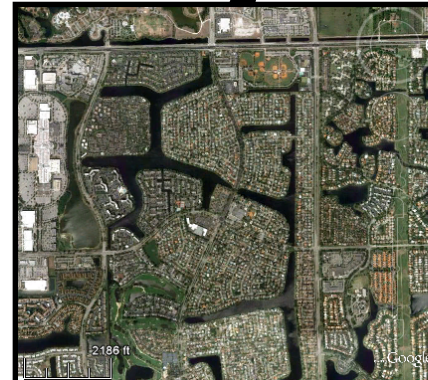
## Convergence

Natural

Natural



Phoenix, AZ



Miami, FL