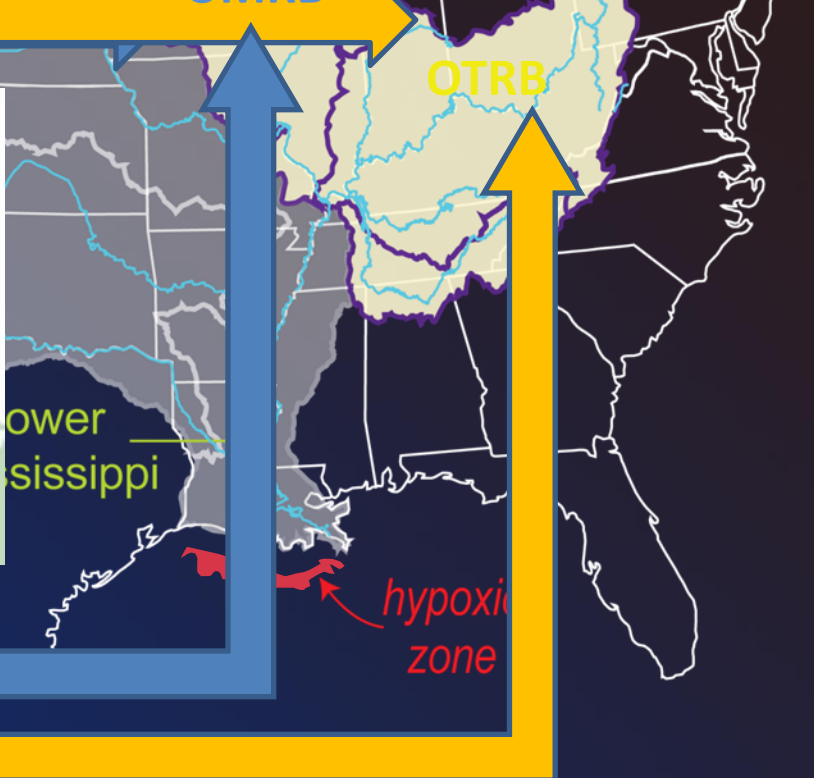
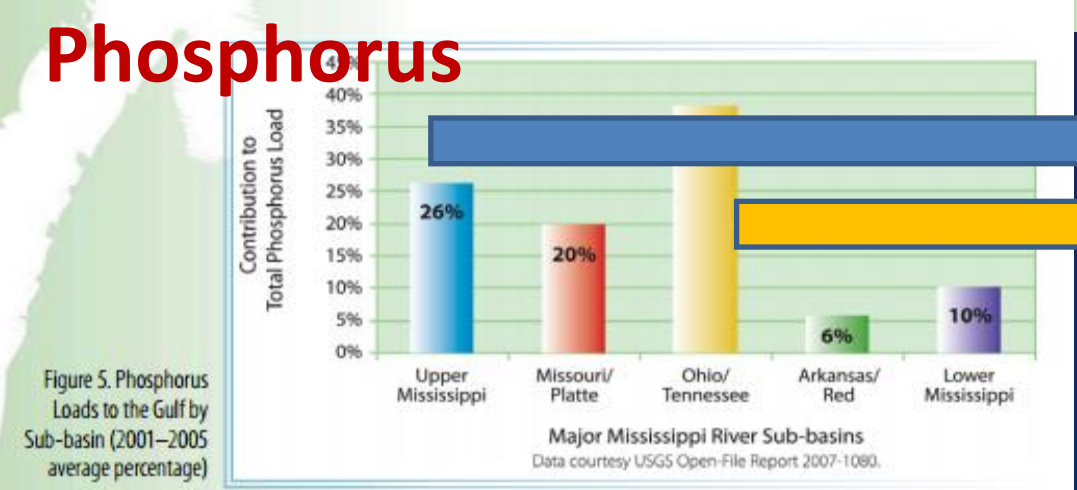
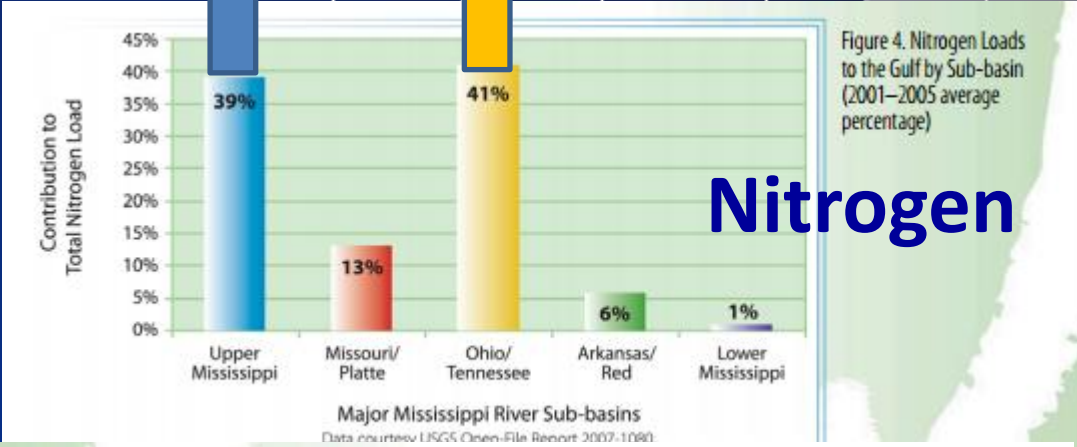


# N and P sources to the hypoxic zone



Source: [http://water.epa.gov/type/watersheds/named/msbasin/upload/2008\\_8\\_28\\_msbasin\\_ghap2008\\_update082608.pdf](http://water.epa.gov/type/watersheds/named/msbasin/upload/2008_8_28_msbasin_ghap2008_update082608.pdf)

# U.S. Water Quality: Lakes

- Lakes, Reservoirs, Ponds:
  - 42% assessed, 65% inadequate water quality to support uses.
  - Over 11 million acres are “impaired.”
  - Agriculture third highest source of impairment.



**A cyanobacteria bloom in a  
Midwestern lake**

# Water Quality: Rivers and Streams



*Photos courtesy Iowa DNR*

- Rivers and streams:
  - 26% assessed, 50% inadequate water quality to support designated uses.
  - Nearly ½ million stream miles are “impaired.”
  - **Agriculture** is the leading source of impairment (identified as cause of 22%; unknown sources are second highest cause)

Source: EPA National Summary of Assessed Waters Report. Available at:  
[http://ofmpub.epa.gov/waters10/attains\\_nation\\_cy.control#causes](http://ofmpub.epa.gov/waters10/attains_nation_cy.control#causes)

## Des Moines water quality suit slated for trial in 2016

[Donnelle Eller, deller@dmreg.com](#)

11:56 a.m. CDT July 15, 2015



(Photo: Michael Zamora/The Register)

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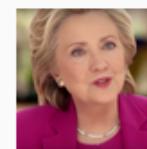
The Des Moines Water Works lawsuit against three northwest Iowa counties over water quality is scheduled to be heard by a federal trial judge, beginning Aug. 8, 2016, unless a continuance is sought, a court document indicates.

U.S. District Court Judge Mark Bennett expects the bench trial in Sioux City to last up to two weeks.

The Des Moines utility is suing Buena Vista, Calhoun and Sac counties, claiming drainage districts there act as conduits for nitrates to move from farm fields into the Raccoon River, one of two sources of drinking water for 500,000 residents in the Des Moines metro area.

The utility seeks federal oversight of the drainage districts, and indirectly farmers, under the Clean Water Act. Attorneys for the counties have denied the field tiles are

### MORE STORIES



**Political ad onslaught has only just begun**

Oct. 12, 2015, 6:52 a.m.



**2016 Candidate Match Game: Who should you vote for?**

Oct. 12, 2015, 11:32 a.m.



**Largely white police forces fuel minority distrust**



109



26



22

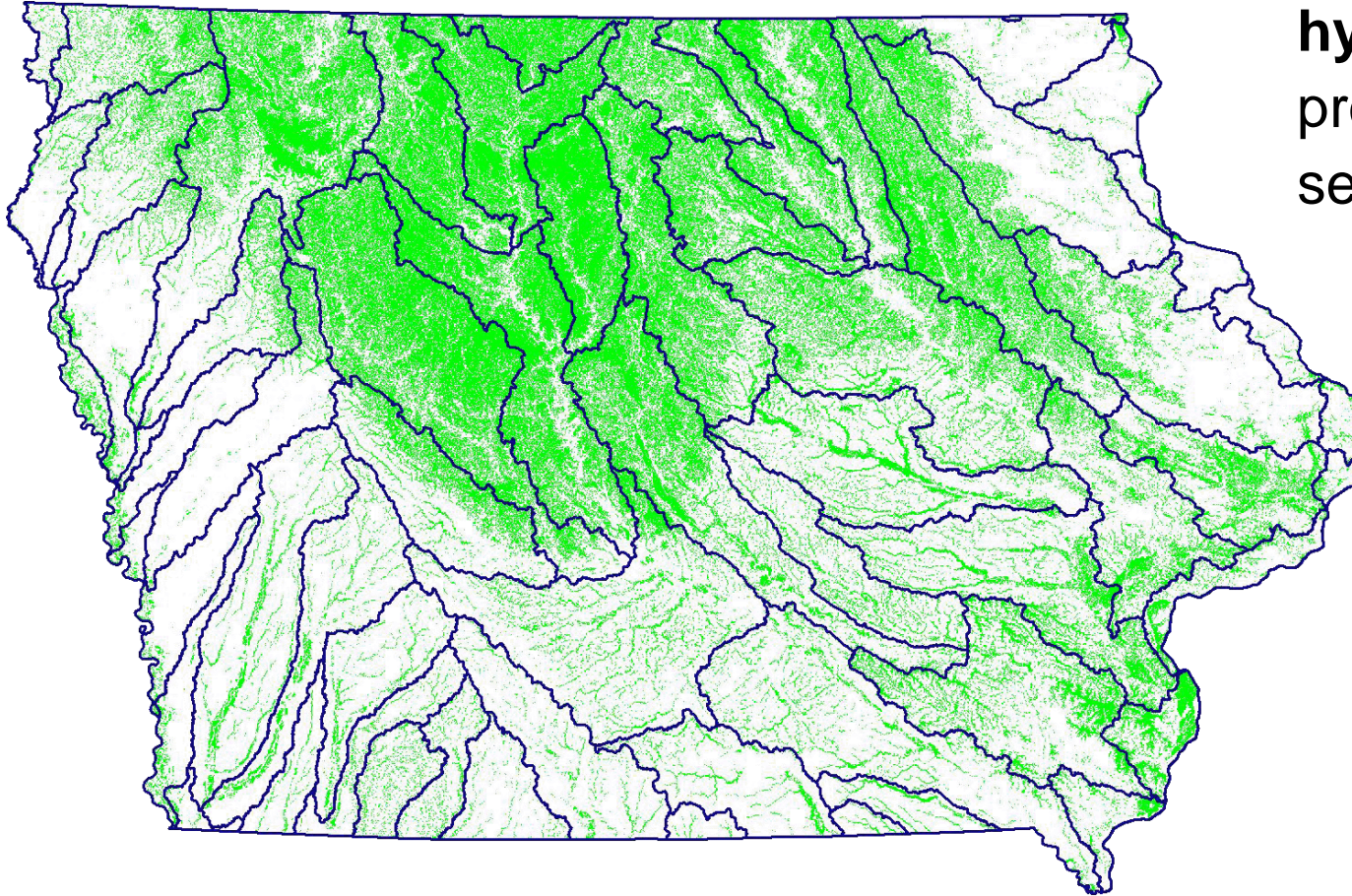


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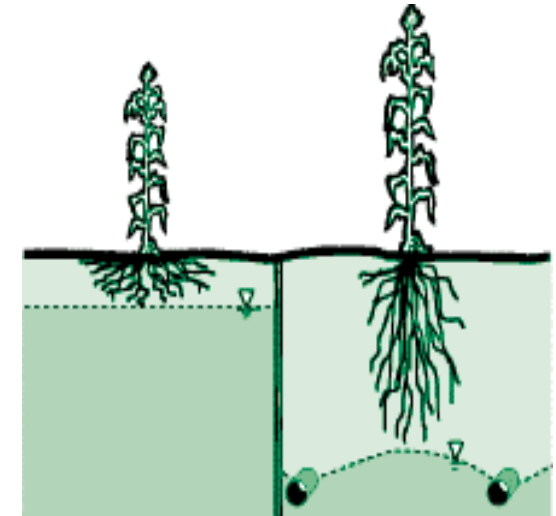
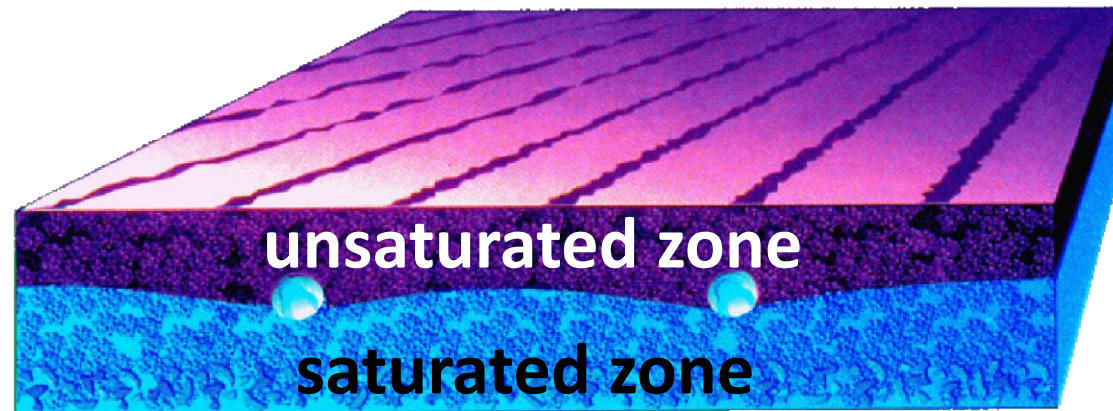
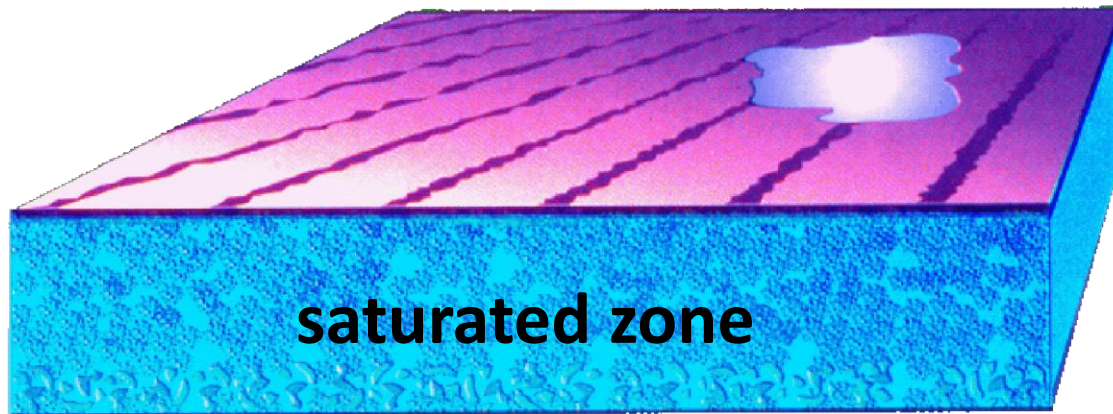
# Locations of hydric soils in Iowa



**hydric** soils are prone to annual or seasonal saturation

Data generated by C. Wolter, Geological Survey, Iowa Dept. of Natural Resources, Iowa City, Iowa;  
Software developed by D. James, USDA Natl Laboratory for Agriculture and the Environment, Ames, Iowa

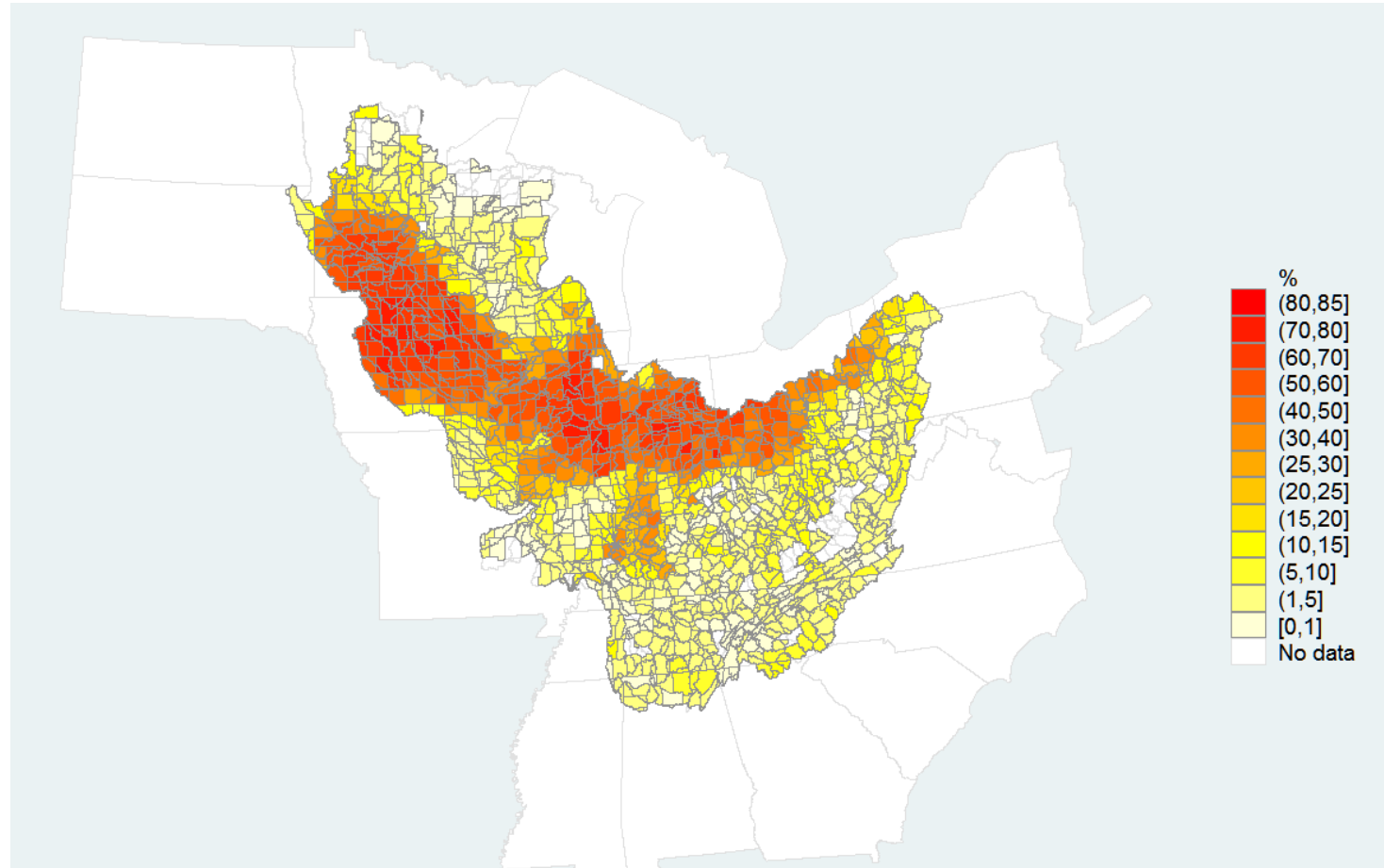
# Tile drainage allows crops to be grown on soils prone to saturation



Adapted from: Zucker, L.A. and L.C. Brown (eds.). 1998. Agricultural Drainage: Water Quality Impacts and Subsurface Drainage Studies in the Midwest. Ohio State University Extension Bulletin 871. The Ohio State University.

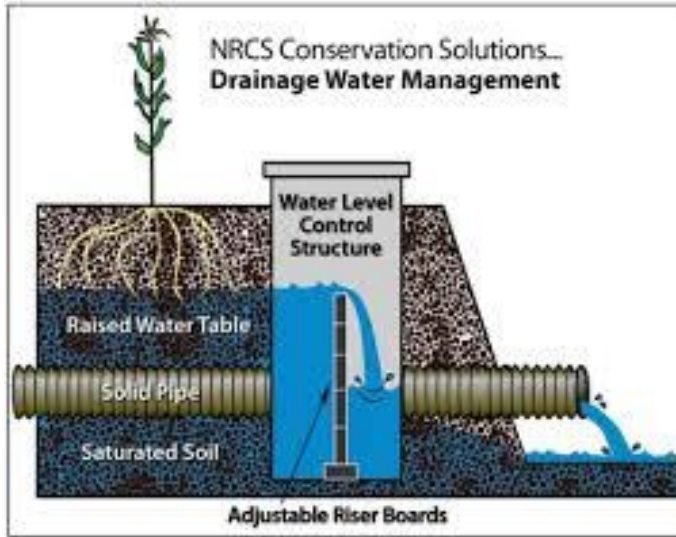


# Percentage of cropland with tile drainage



# Nitrate reduction methods

## Controlled drainage



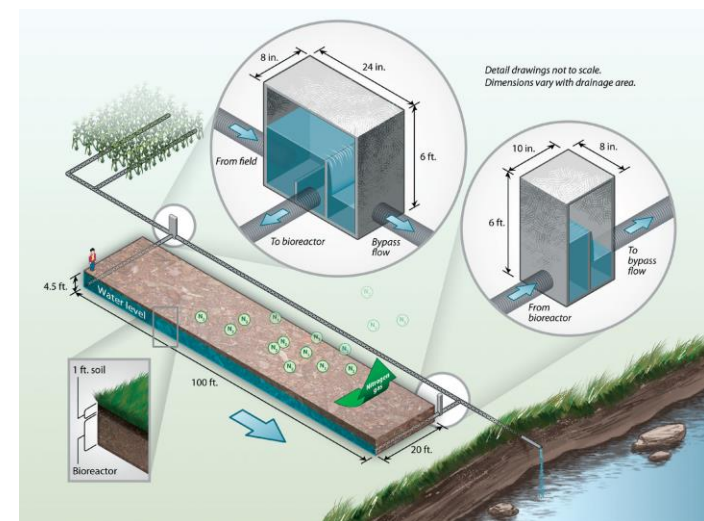
## Constructed wetlands



## Woodchip bioreactors

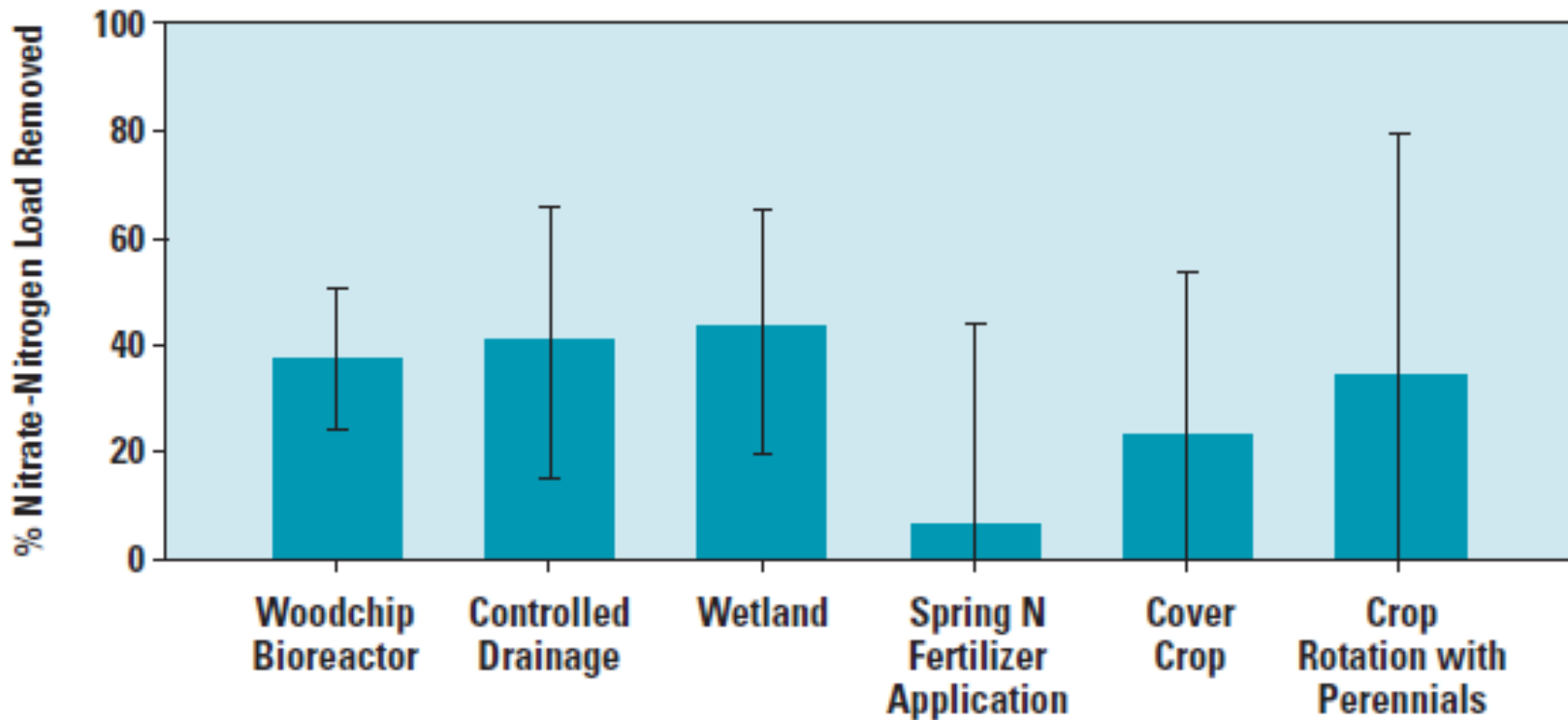


## Cover crops





# Effectiveness of nitrate removal practices

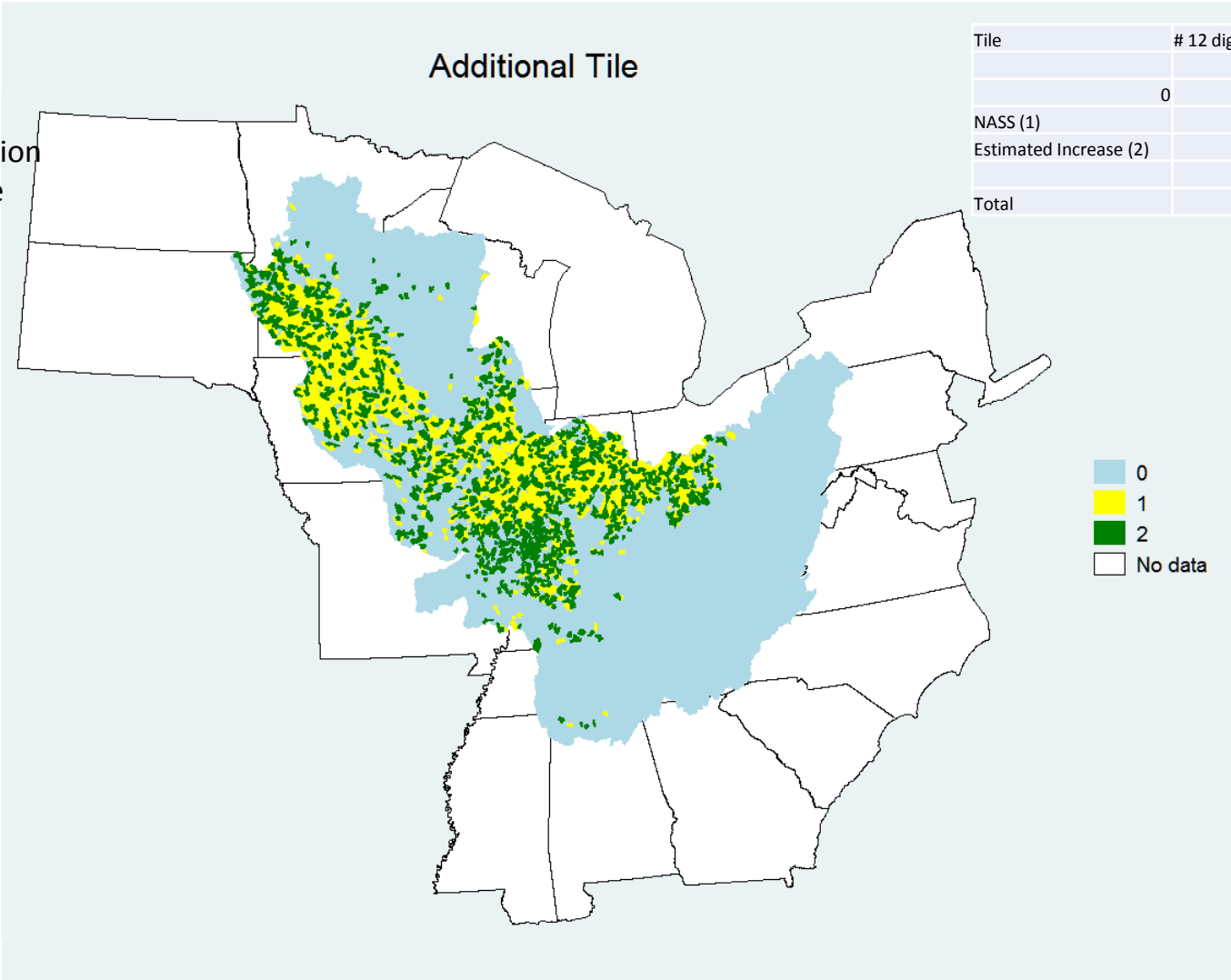


Source: Christianson, L. and M. Helmers. 2011. Woodchip bioreactors for Nitrate in Agricultural Drainage. PMR 1008. Iowa State Univ. Extension & Outreach. Available at: <http://www.sare.org/Learning-Center/Project-Products/North-Central-SARE-Project-Products/Woodchip-Bioreactors-for-Nitrate-in-Agricultural-Drainage>

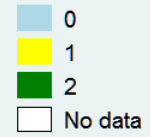


## Additional Tile

1: old  
 2: new addition  
 0: no change

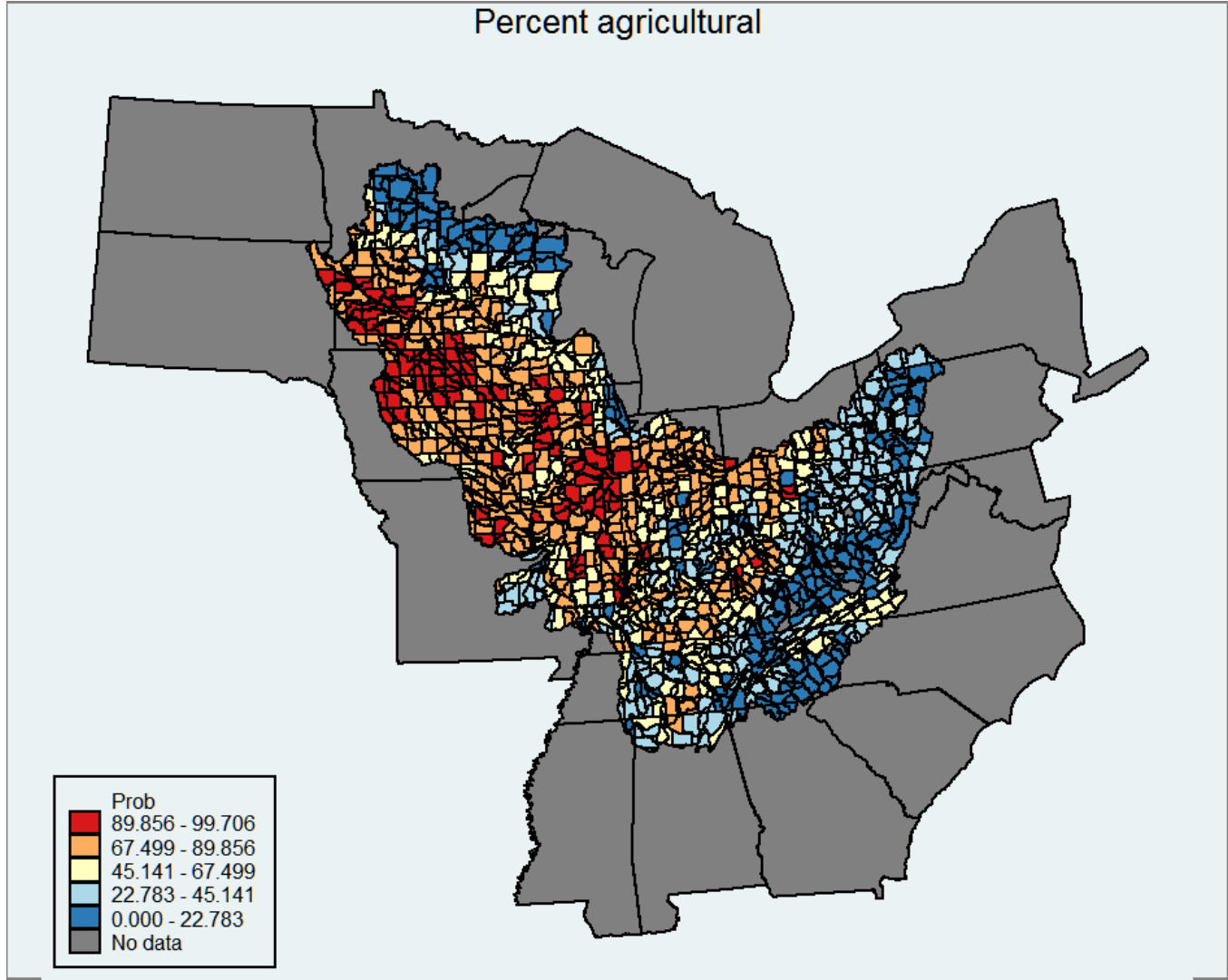


Tile	# 12 digit wat.	Percent	Cum.
	0	8,919	73.84
NASS (1)	<b>1,922</b>	15.91	89.75
Estimated Increase (2)	<b>1,238</b>	10.25	100
<b>Total</b>	<b>12,079</b>	<b>100</b>	



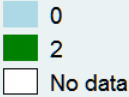
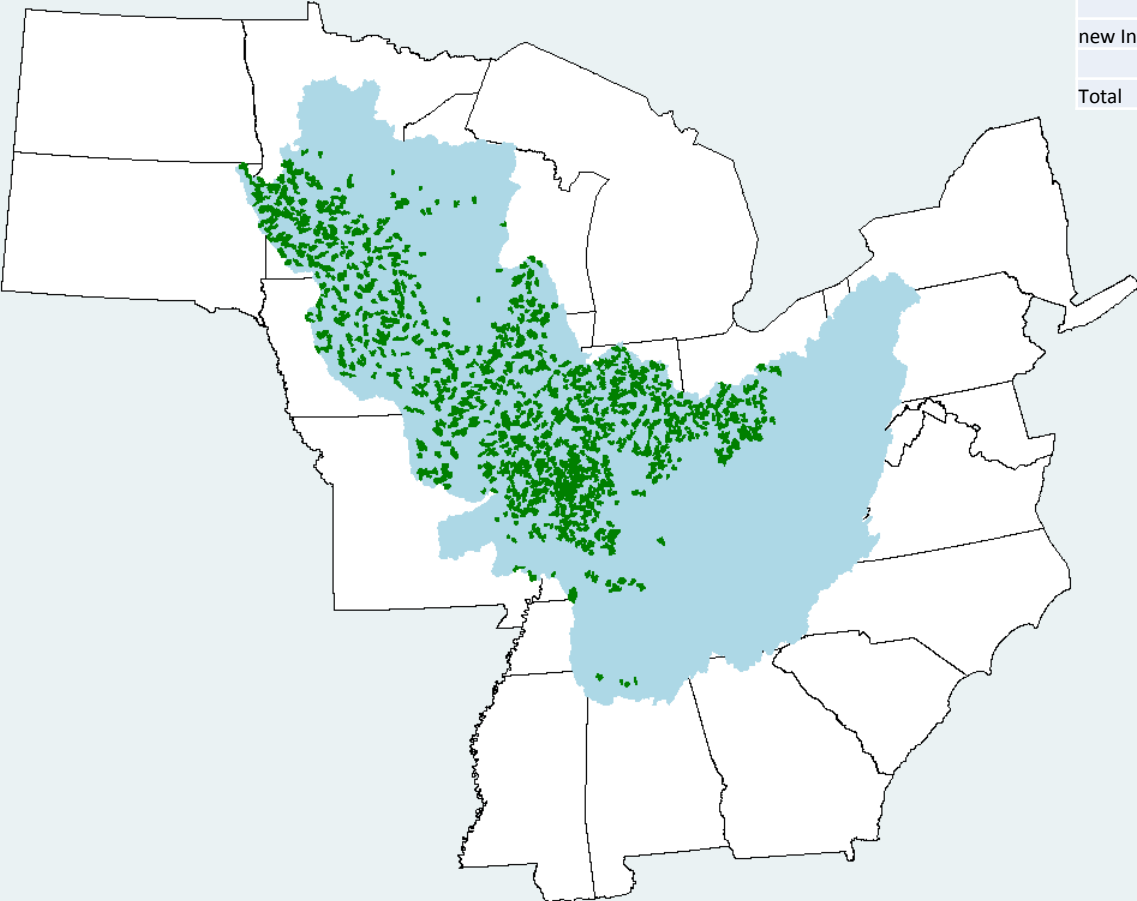


# Percent agricultural

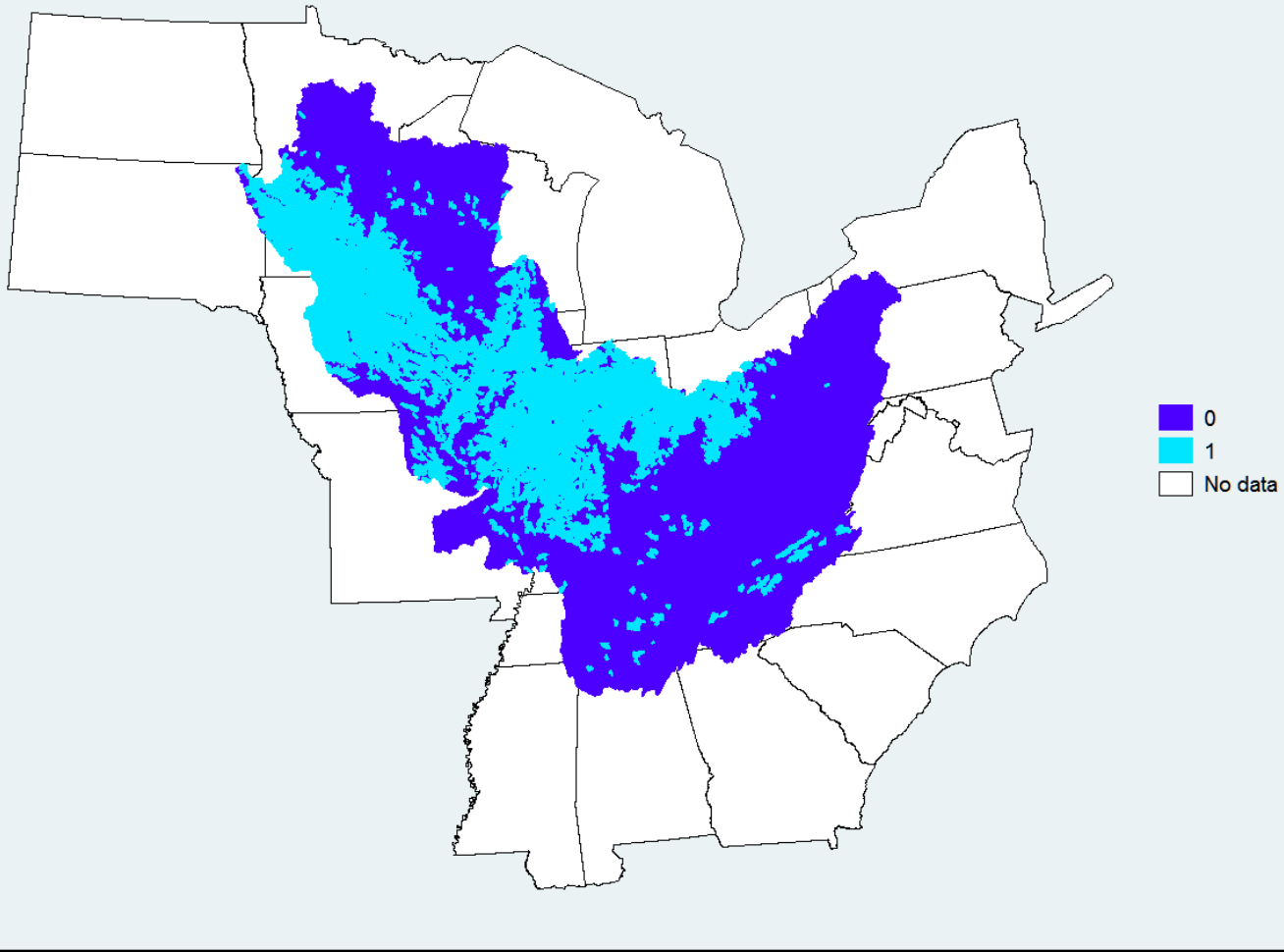


# Additional Tile Only

Tile	#12 digits	Percent	Cum.
	0	10,841	89.75
new Increase (2)	1,238	10.25	100
Total	12,079	100	

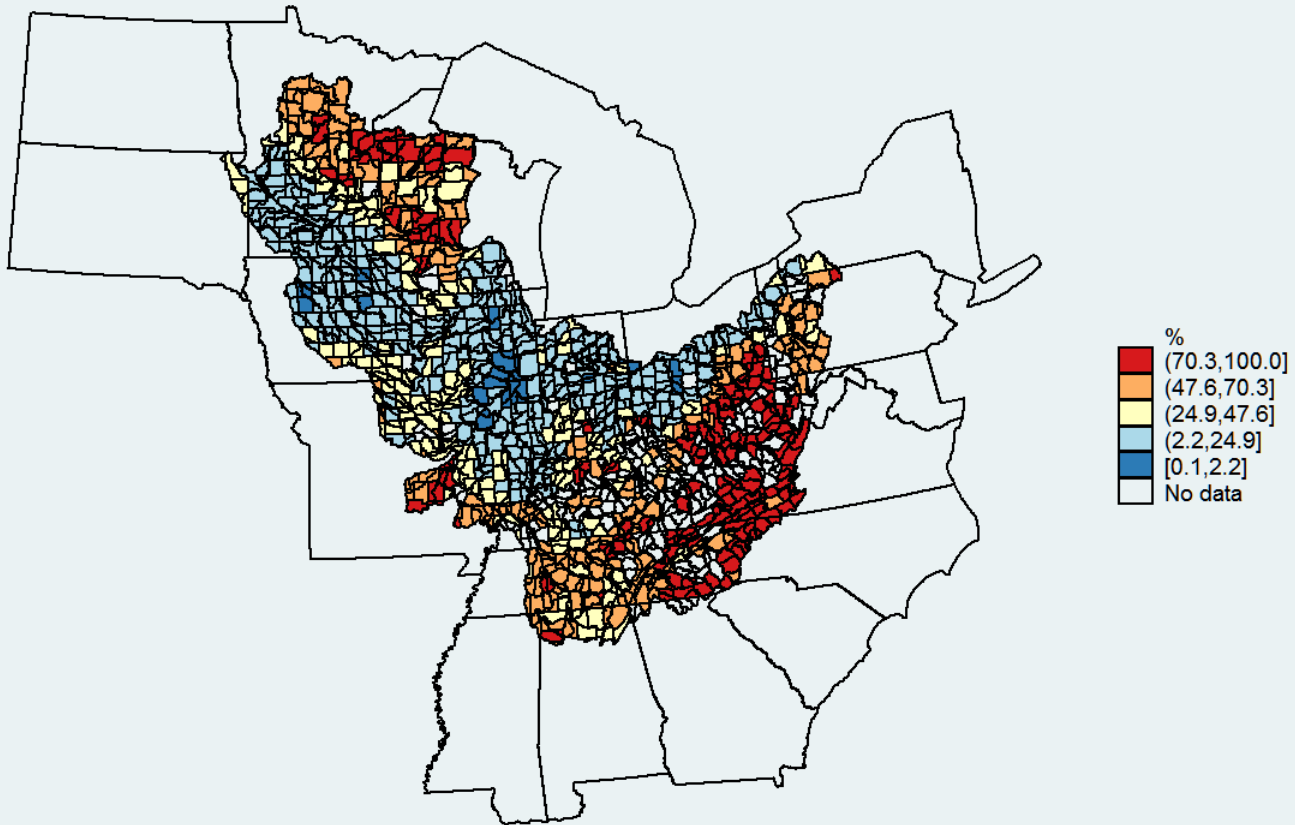


12-digit watershed cropland and hay, not including pasture



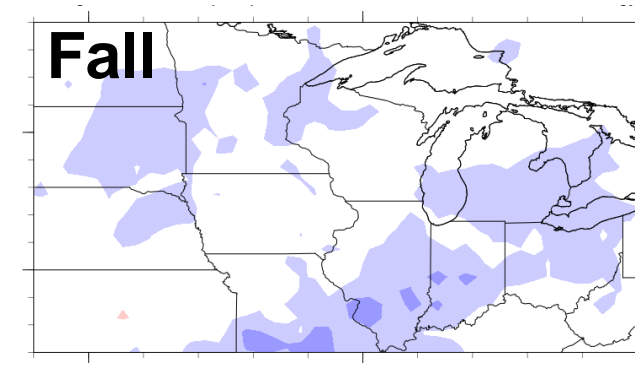
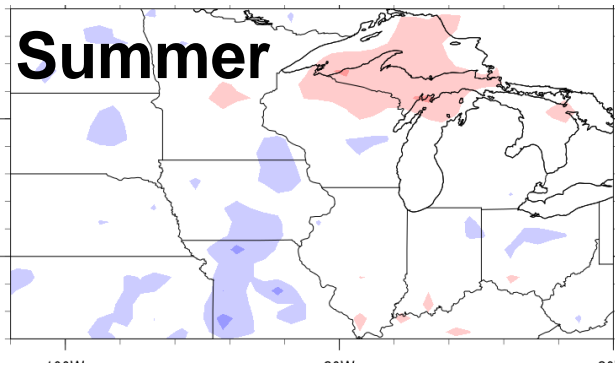
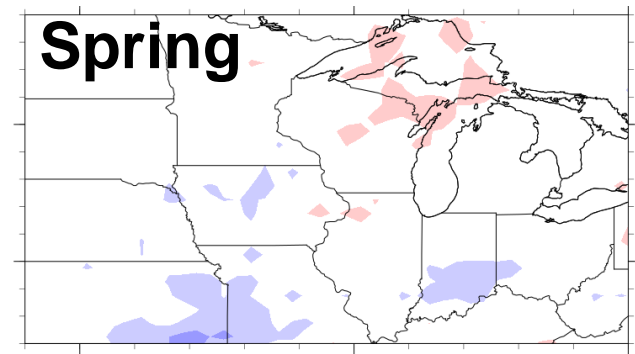
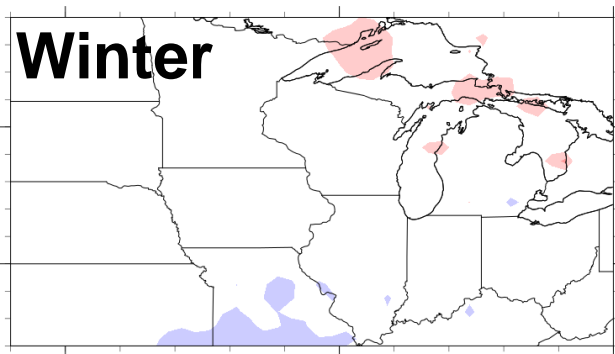
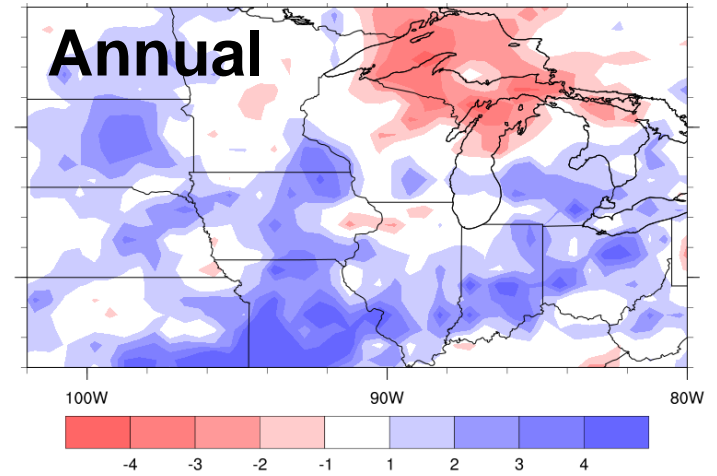


### Percent land LCC 4 and above

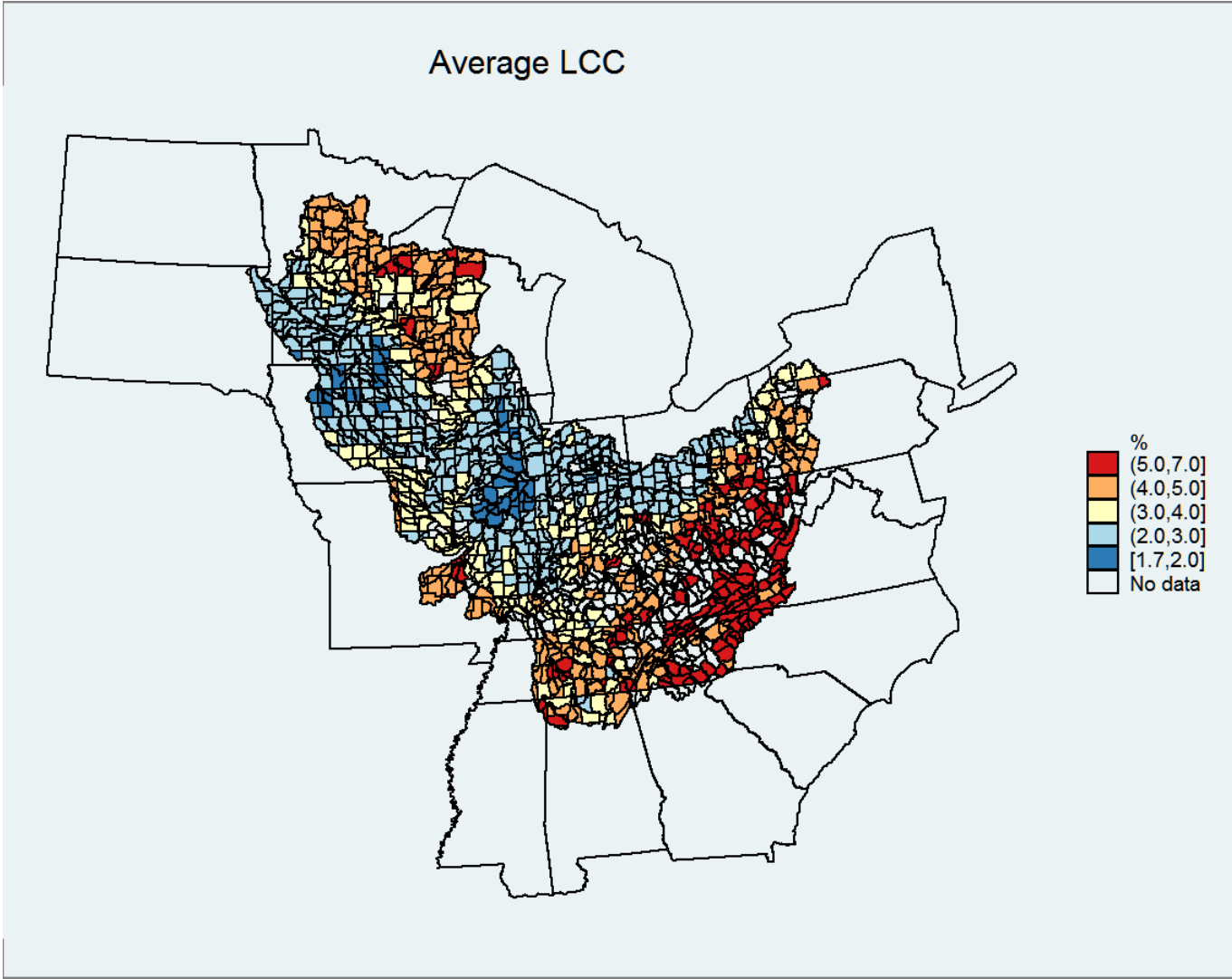


# Mean precipitation has increased slightly over most of the Corn Belt

Observed change for 1981-2010 versus 1951-1980, inches



### Average LCC

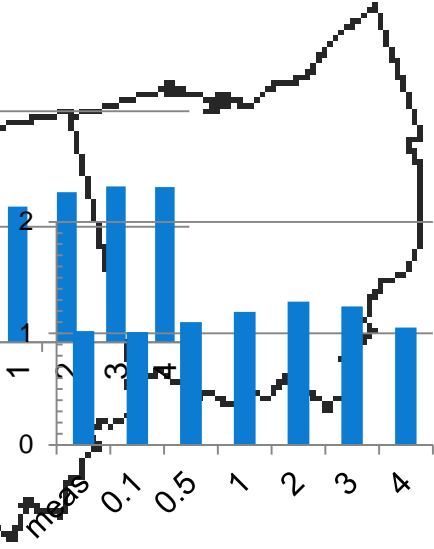
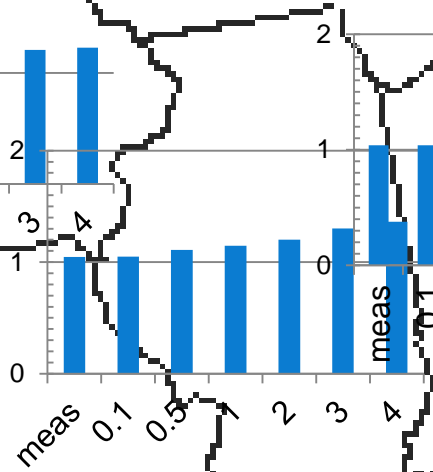
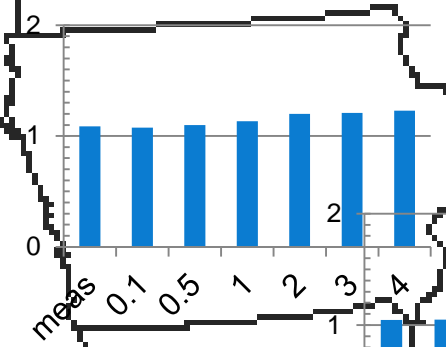
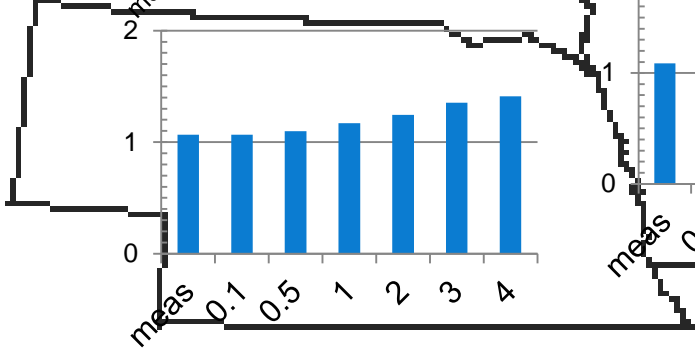
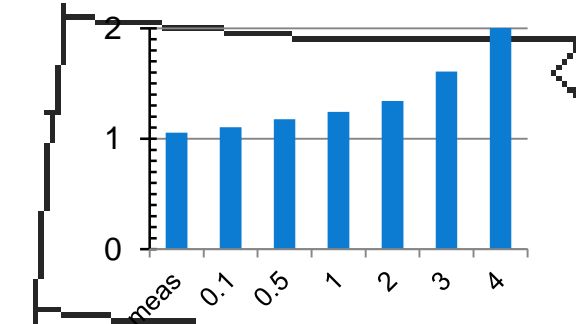






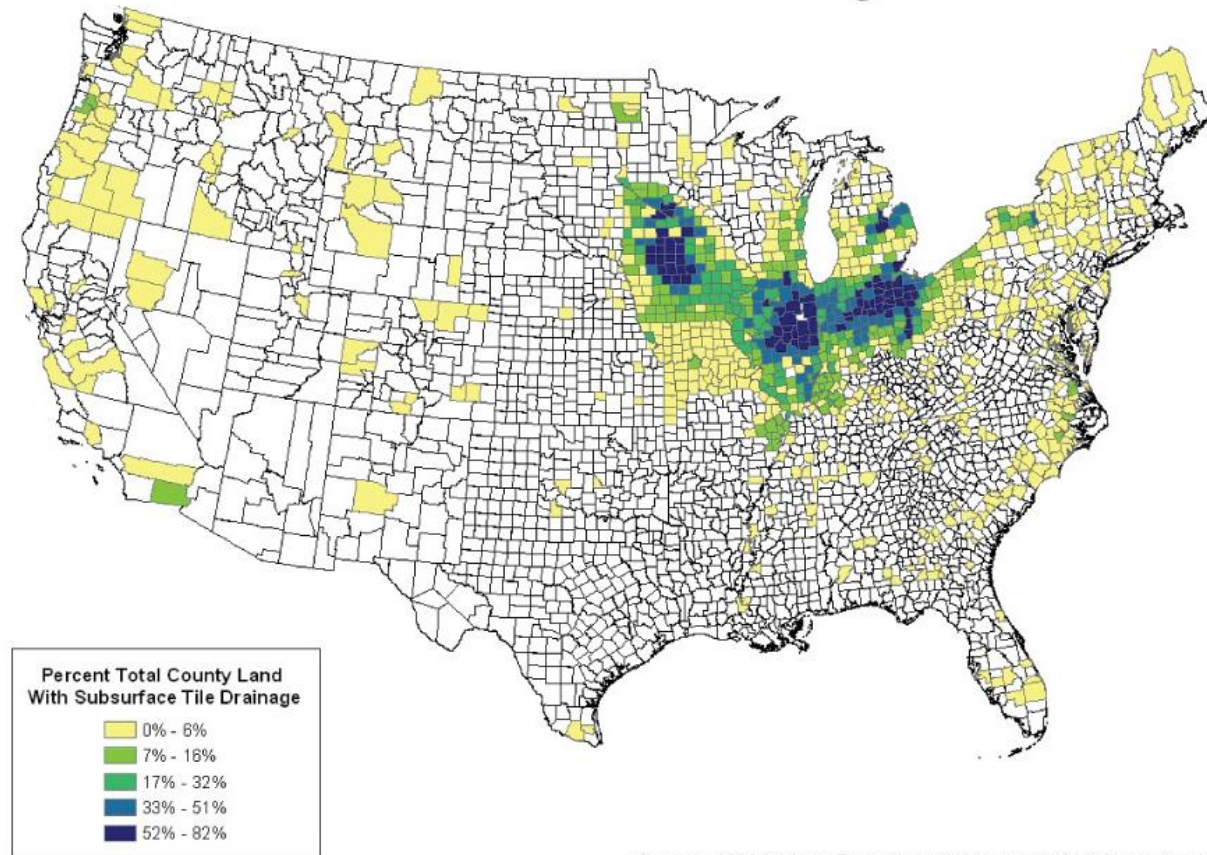






# Subsurface tile drainage by county

## Subsurface Tile Drainage



Sources: 1992 National Resources Inventory and World Resources Institute

Source: Sugg, Z. 2007. Assessing U.S. Farm Drainage: Can GIS Lead to Better Estimates of Subsurface Drainage Extent? World Resources Institute, Washington, D.C. [http://pdf.wri.org/assessing\\_farm\\_drainage.pdf](http://pdf.wri.org/assessing_farm_drainage.pdf).