Quantifying the Environmental Benefits of Kernza

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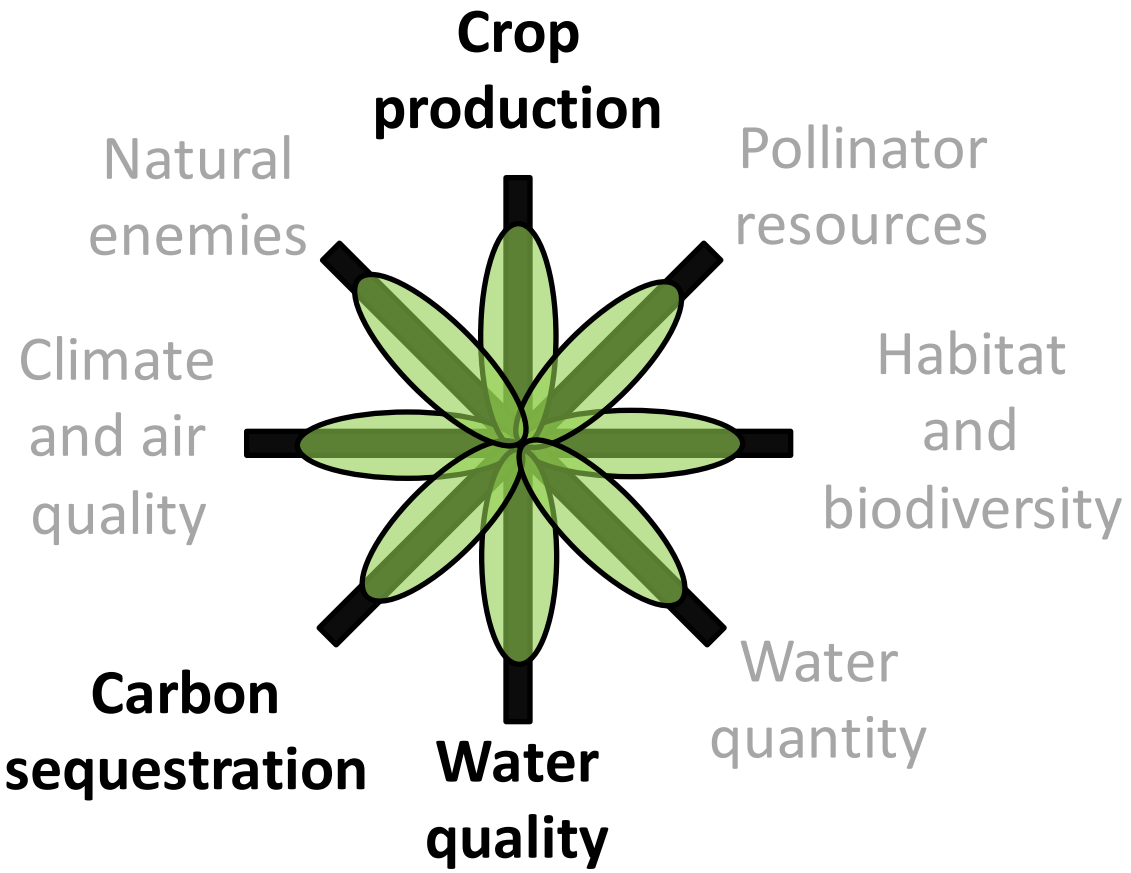
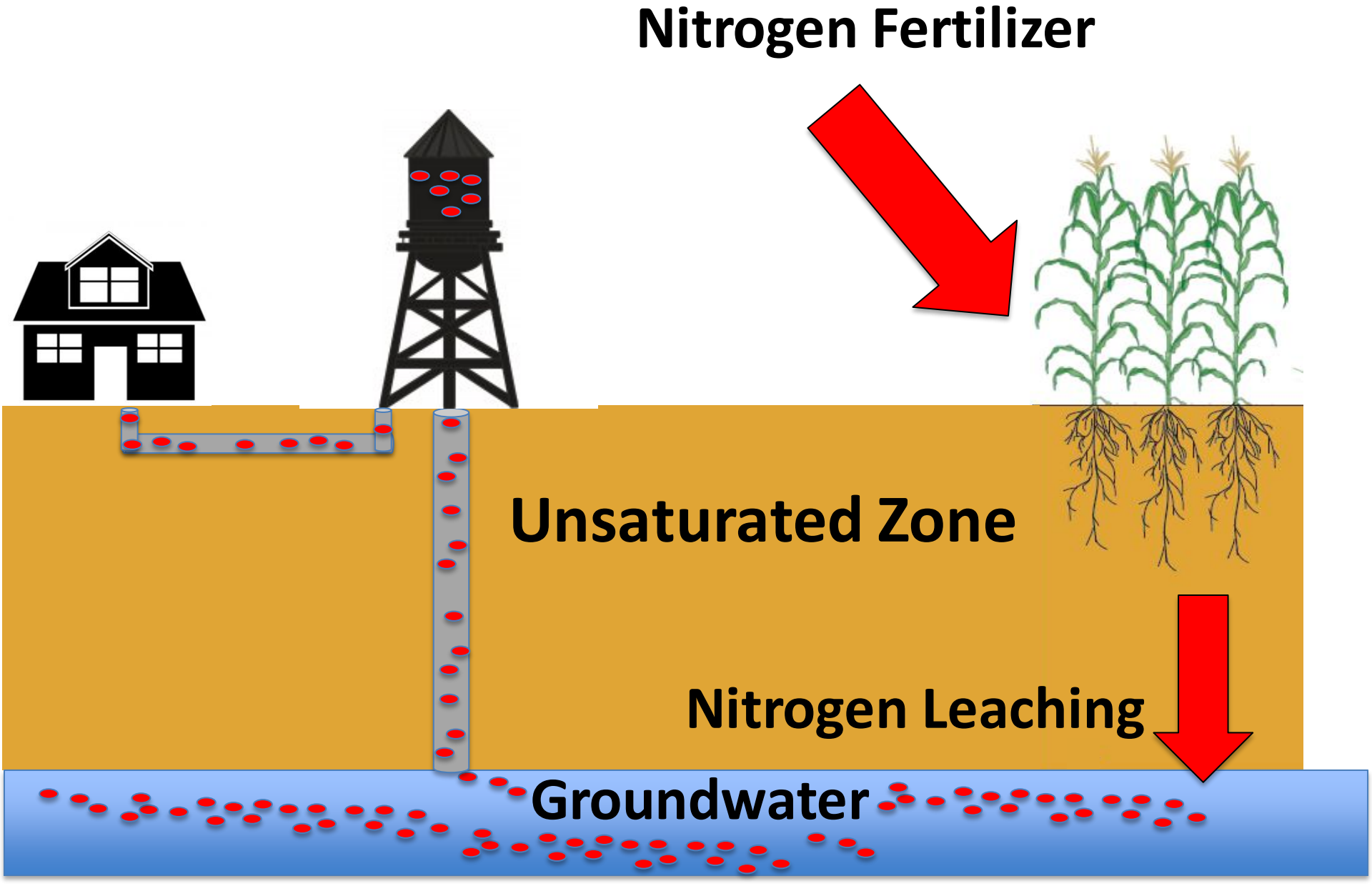
Environmental impacts of cropping systems

Perennial Crop

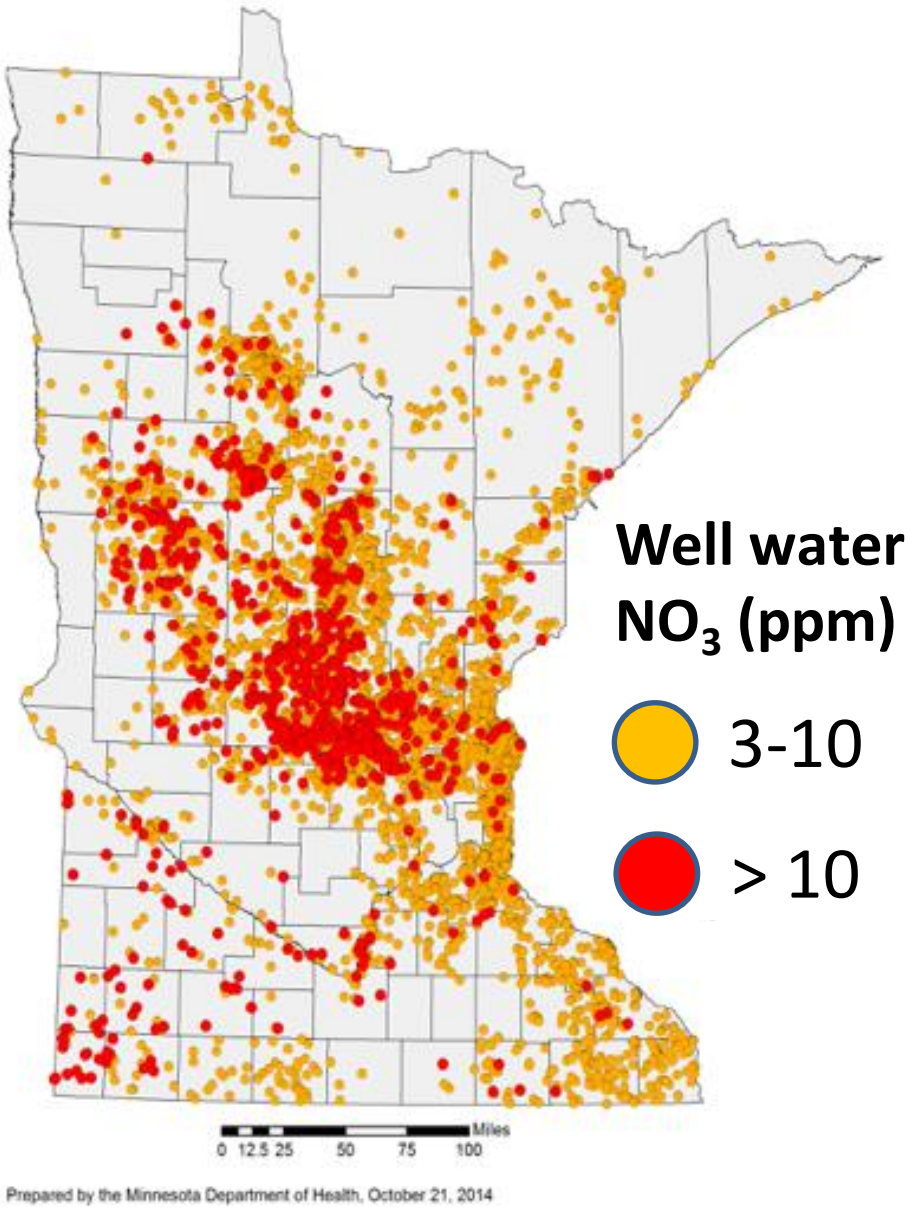


after Foley et al., 2005

Nitrate Leaching and Groundwater



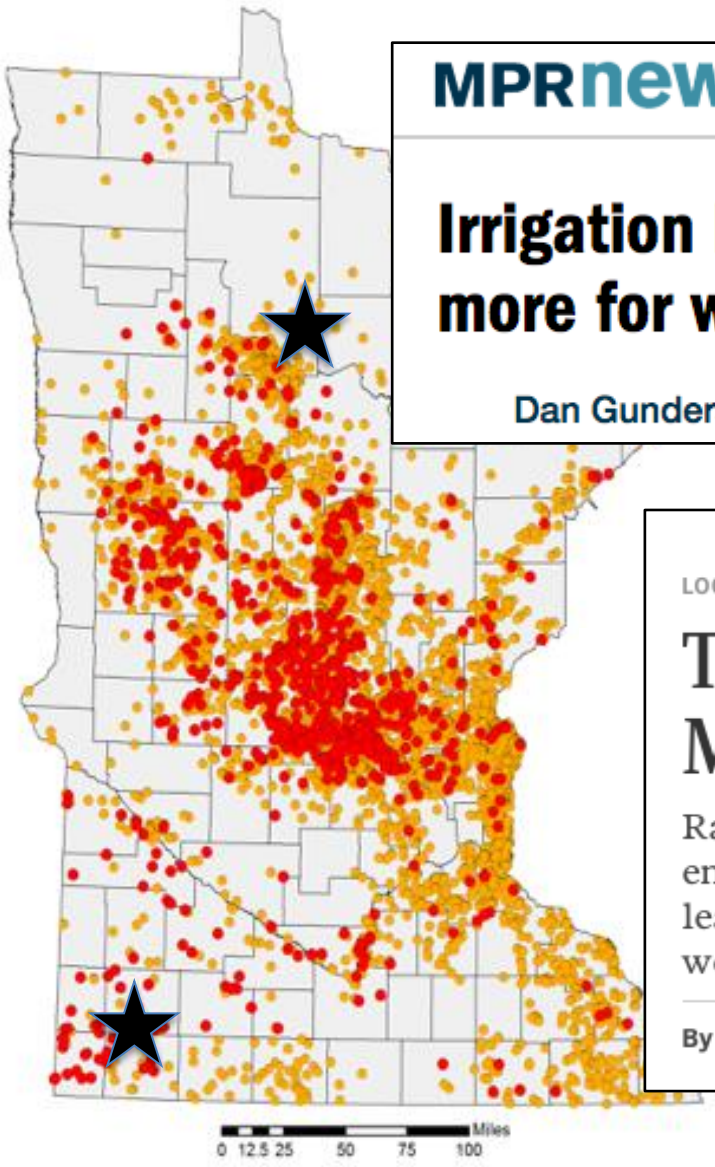
Nitrate Leaching and Groundwater



Minnesota Nitrate Issues

- 13% of wells exceeded safe drinking limit statewide
- 30% in central sand plains

Nitrate Leaching and Groundwater



Prepared by the Minnesota Department of Health, October 21, 2014

MPRnews Sections Members More

Irrigation boosts potatoes, but Park Rapids pays more for water

Dan Gunderson · Park Rapids, Minn. · Feb 13, 2014 Busin

StarTribune

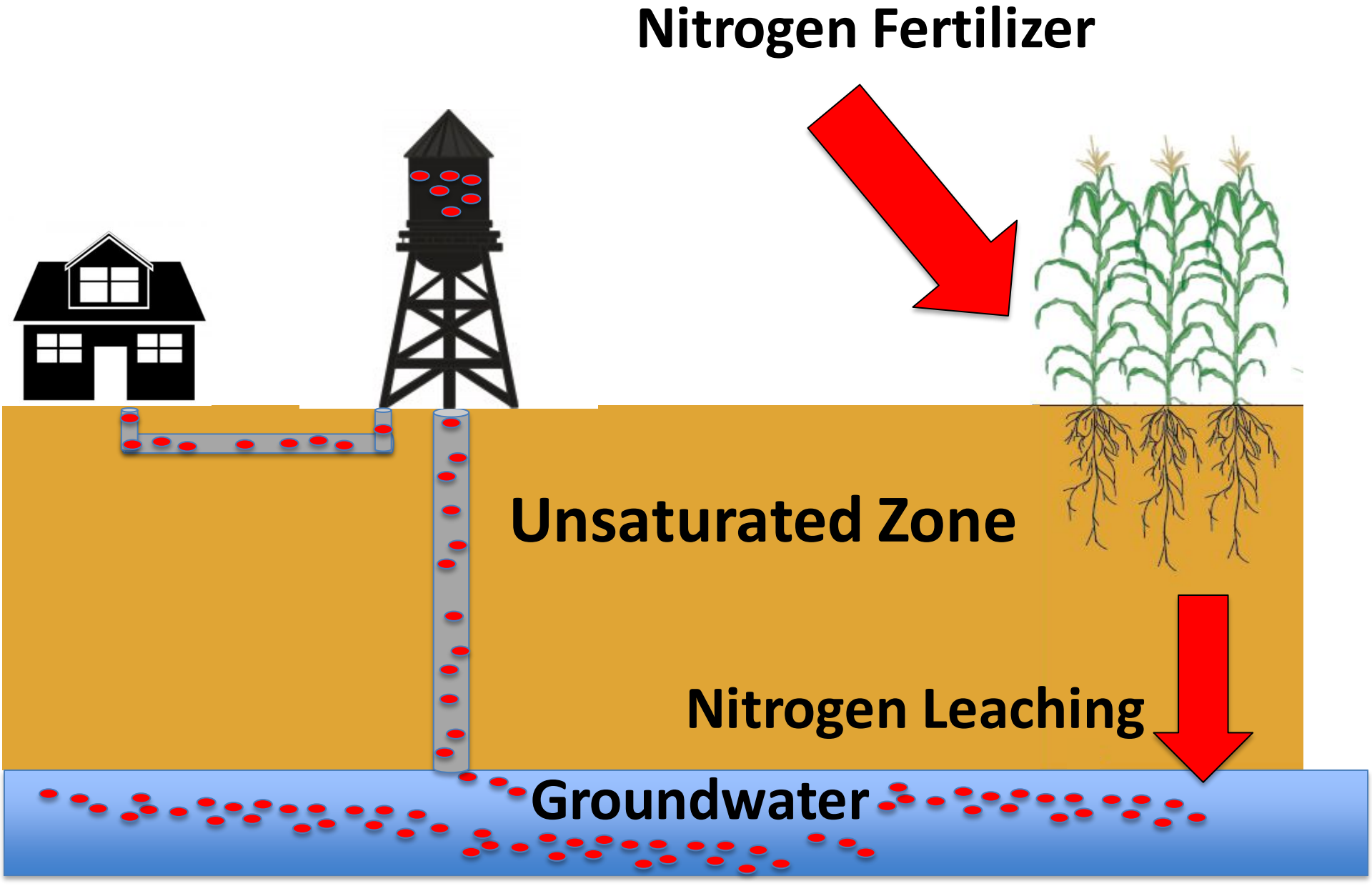
LOCAL

Tainted drinking water is costing Minnesota taxpayers millions

Randall's water emergency is the latest sign of an environmental problem in Minnesota. Nitrogen fertilizer is leaching into groundwater from farm fields, contaminating wells and costing taxpayers millions of dollars a year.

By Tony Kennedy Star Tribune | APRIL 29, 2015 — 12:24PM

Nitrate Leaching and Groundwater



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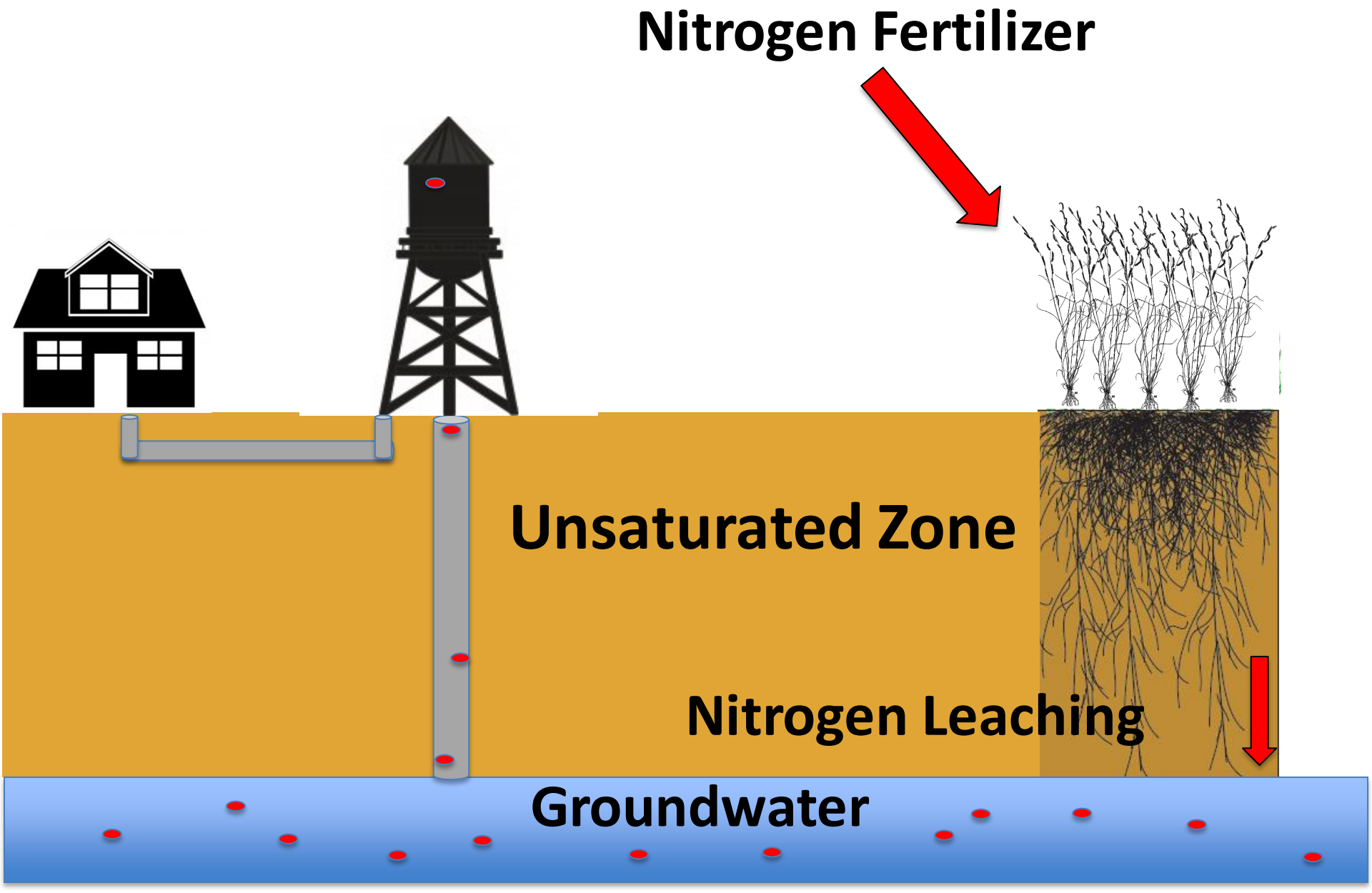
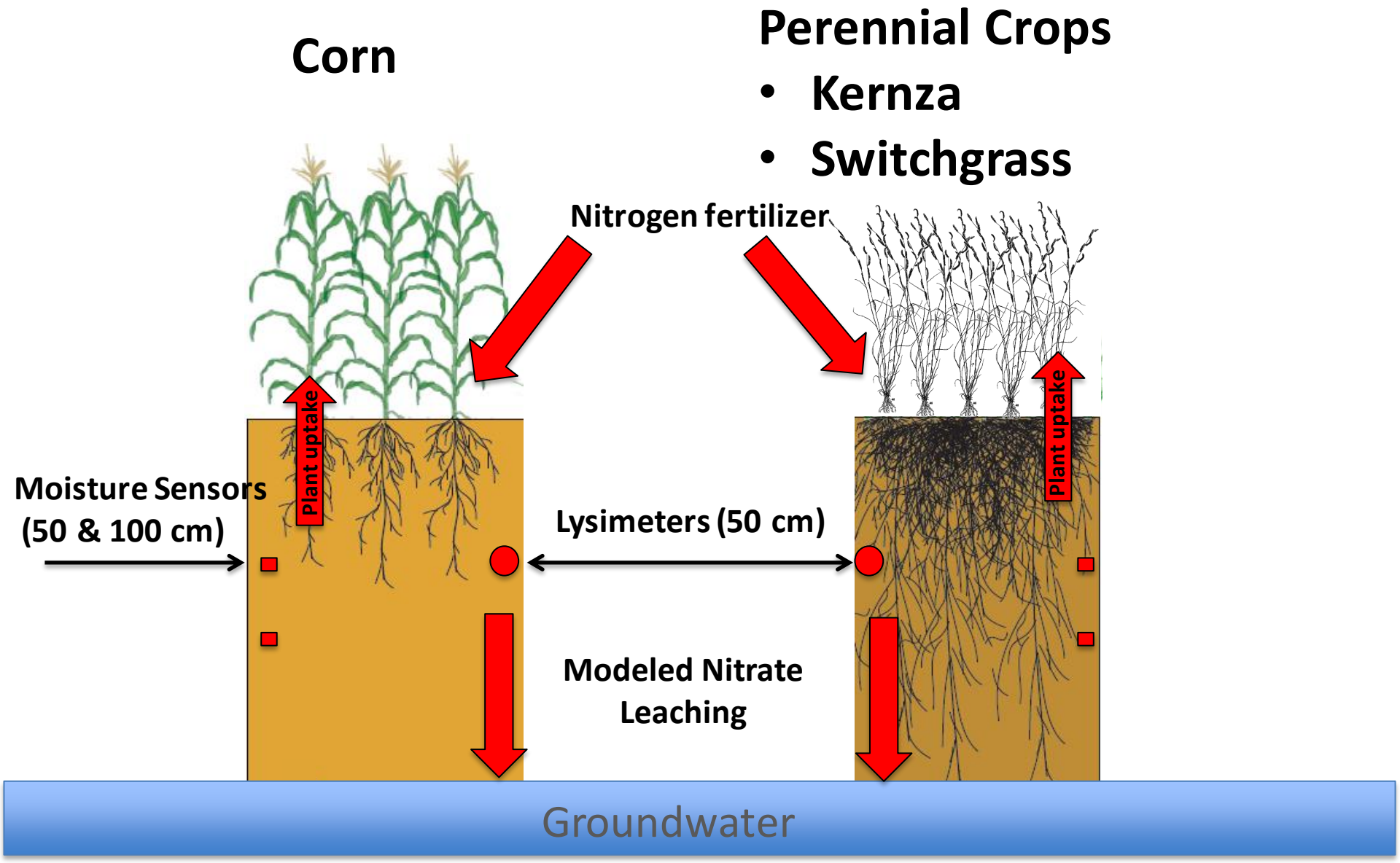
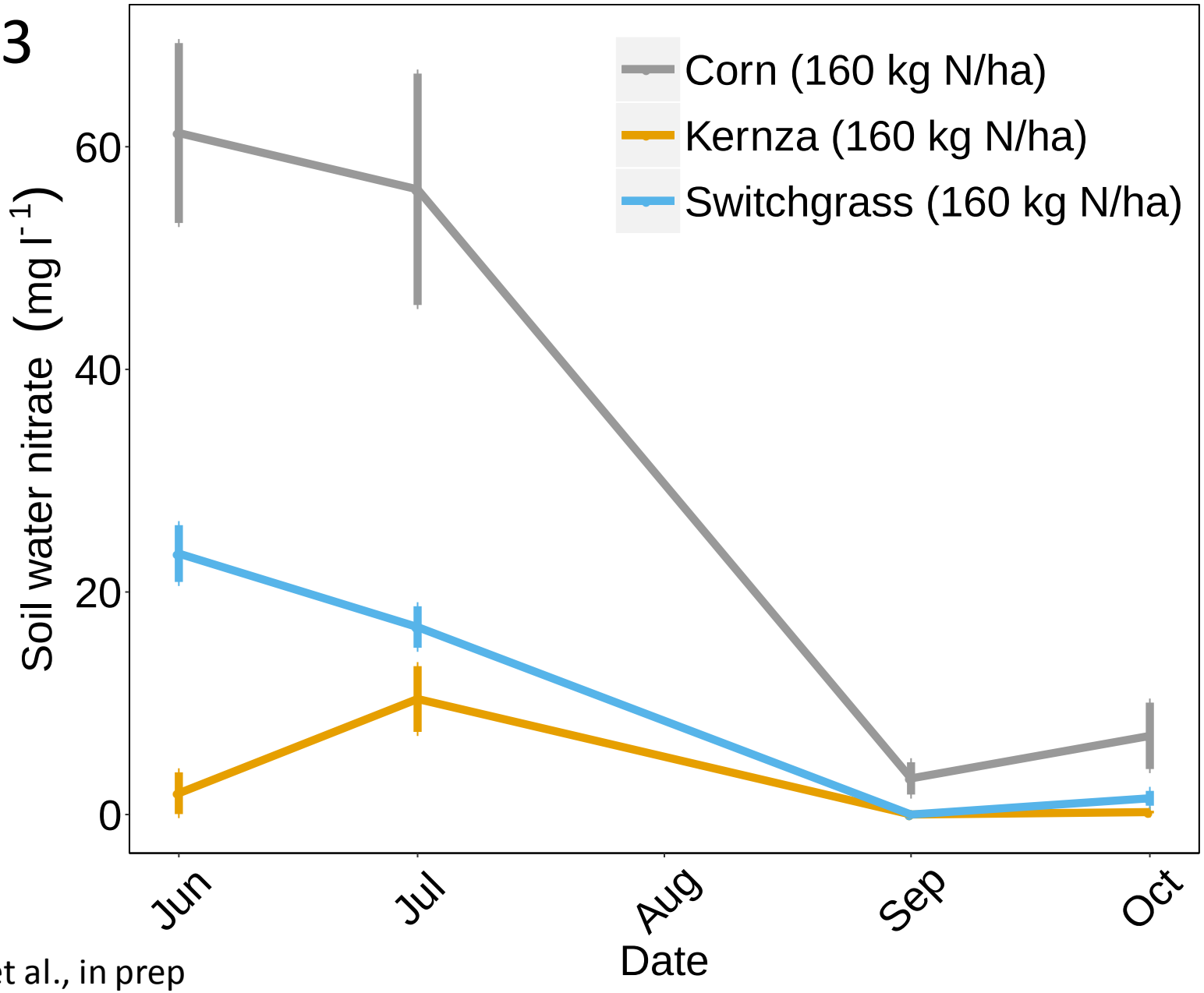


Nitrate Leaching and Groundwater



Kernza and water quality

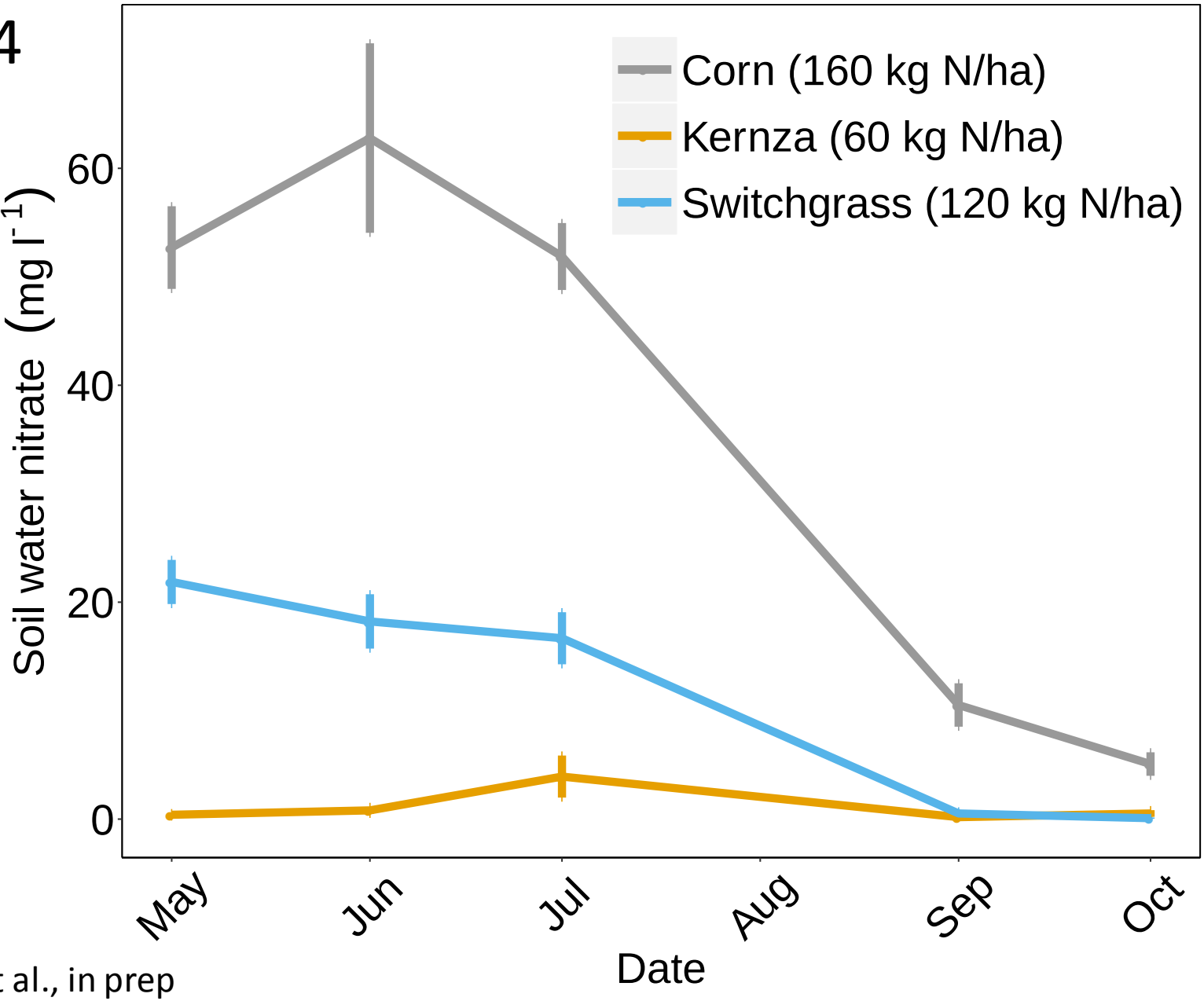
2013



Jungers et al., in prep

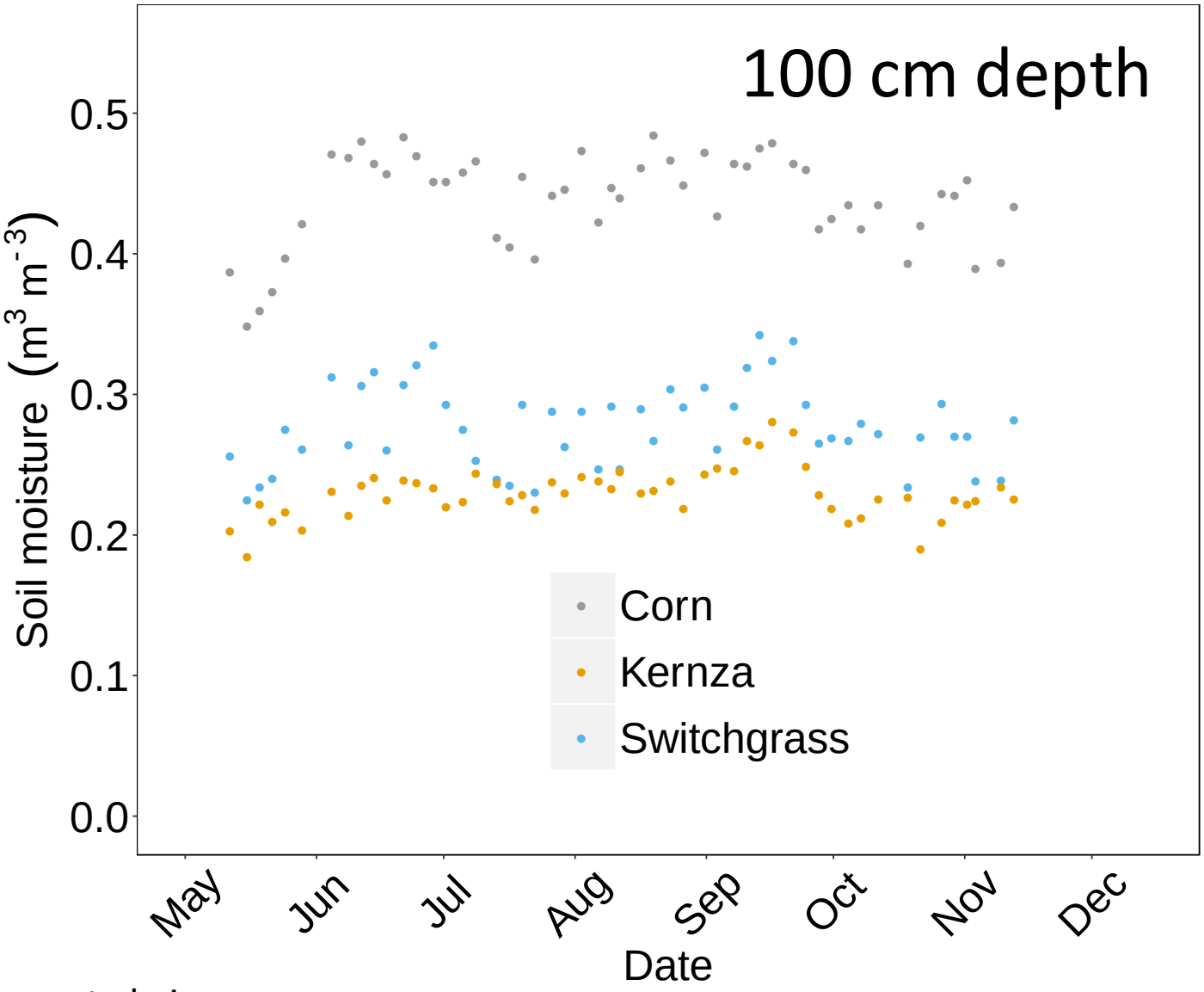
Kernza and water quality

2014



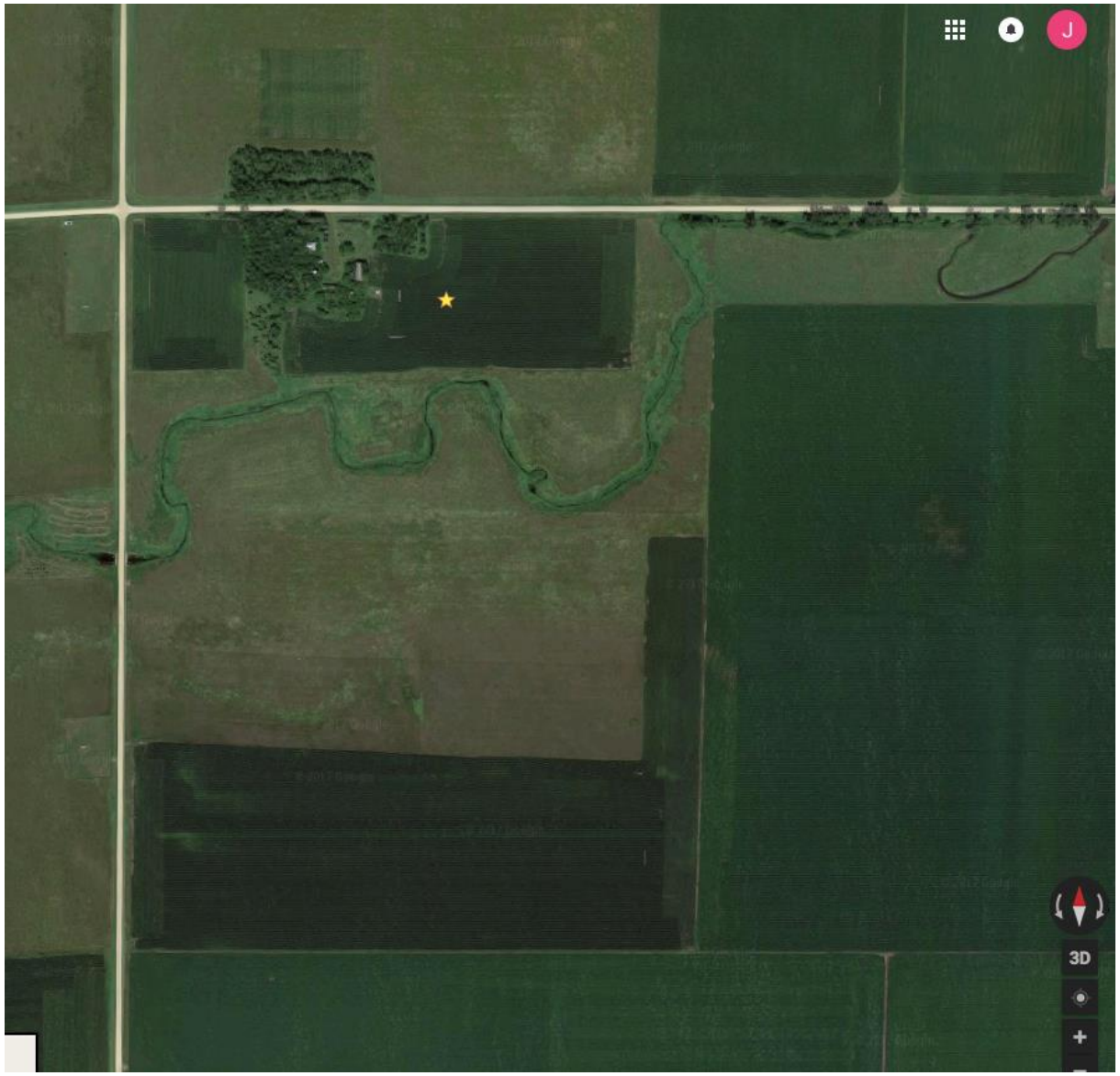
Jungers et al., in prep

Kernza and water quality



Jungers et al., in prep

Kernza and water quality



40 acre Kernza planting in an instrumented wellhead protection area. Land owned by Lincoln-Pipestone Rural Water Supply and was previously farmed in corn and soybean.

Kernza and GHG mitigation

Objective: Determine the GHG footprint of Kernza

Experiments

- Stand maintenance: inter-row cultivation/disturbance
- Grazing
- Legume intercropping and N fertilization

Kernza and GHG mitigation

Measurements

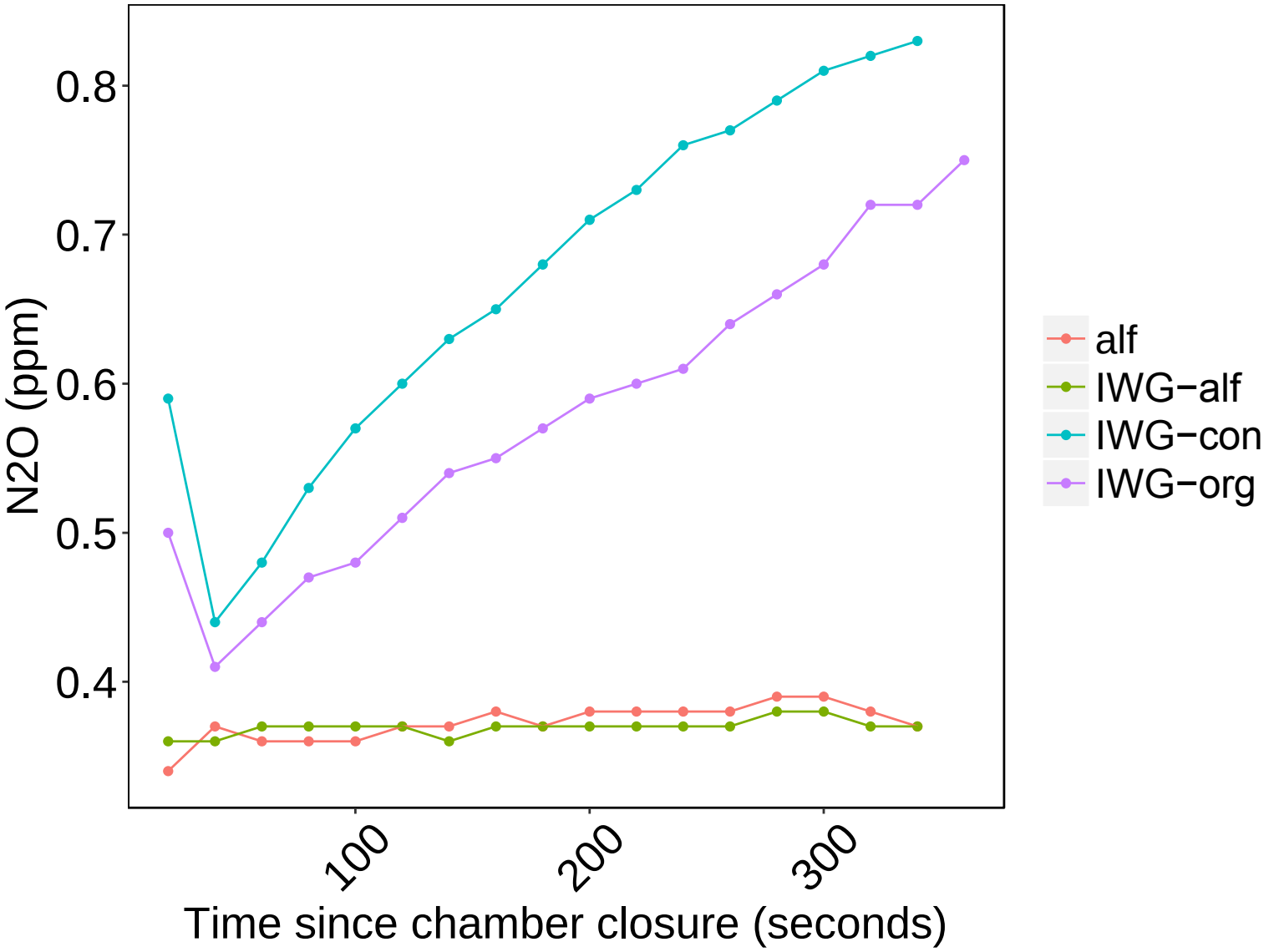
- Crop yield & growth parameters
- Belowground biomass
- Labile C pool
- Microbial activity

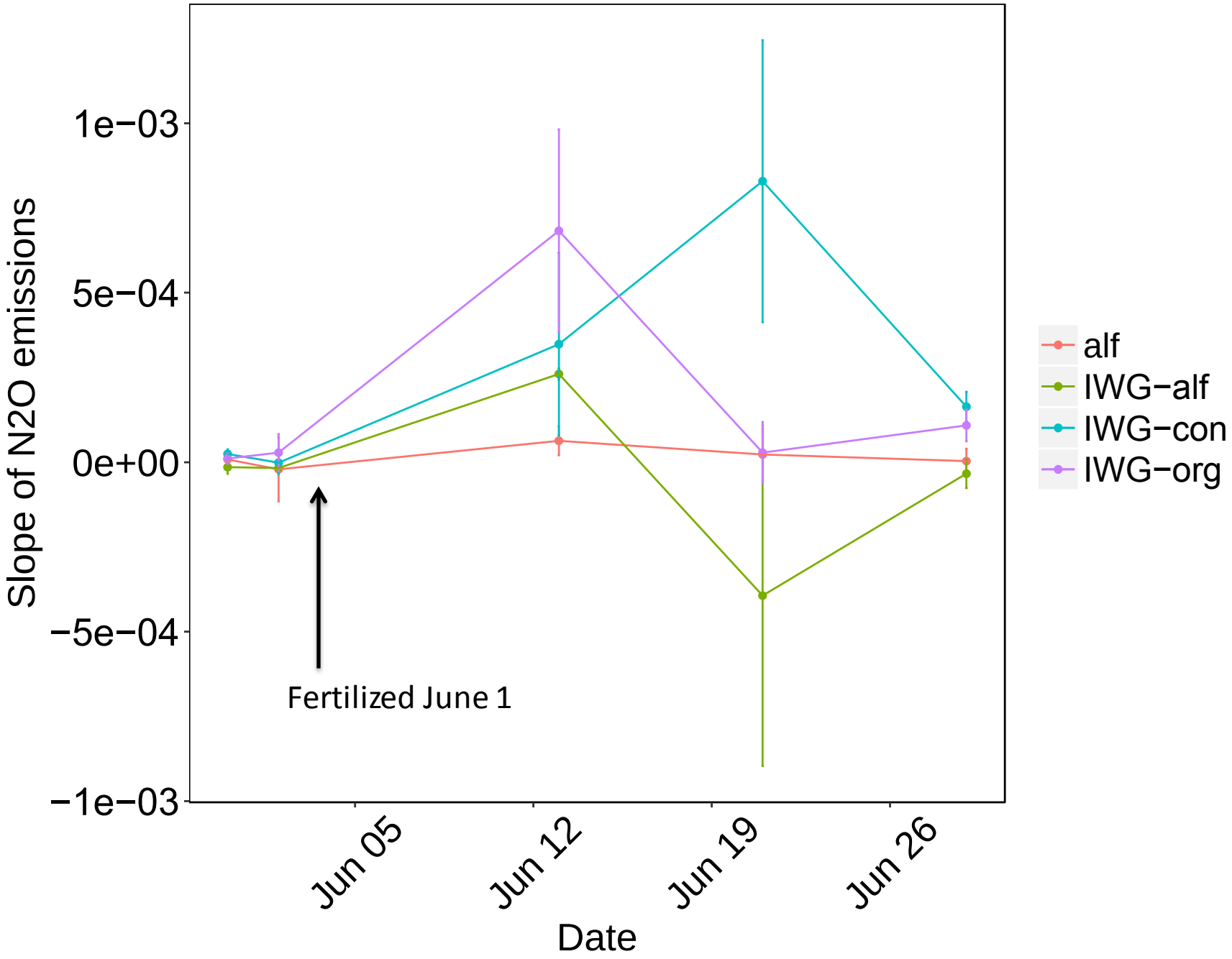
Kernza and GHG mitigation

Measurements

- Soil GHG emissions

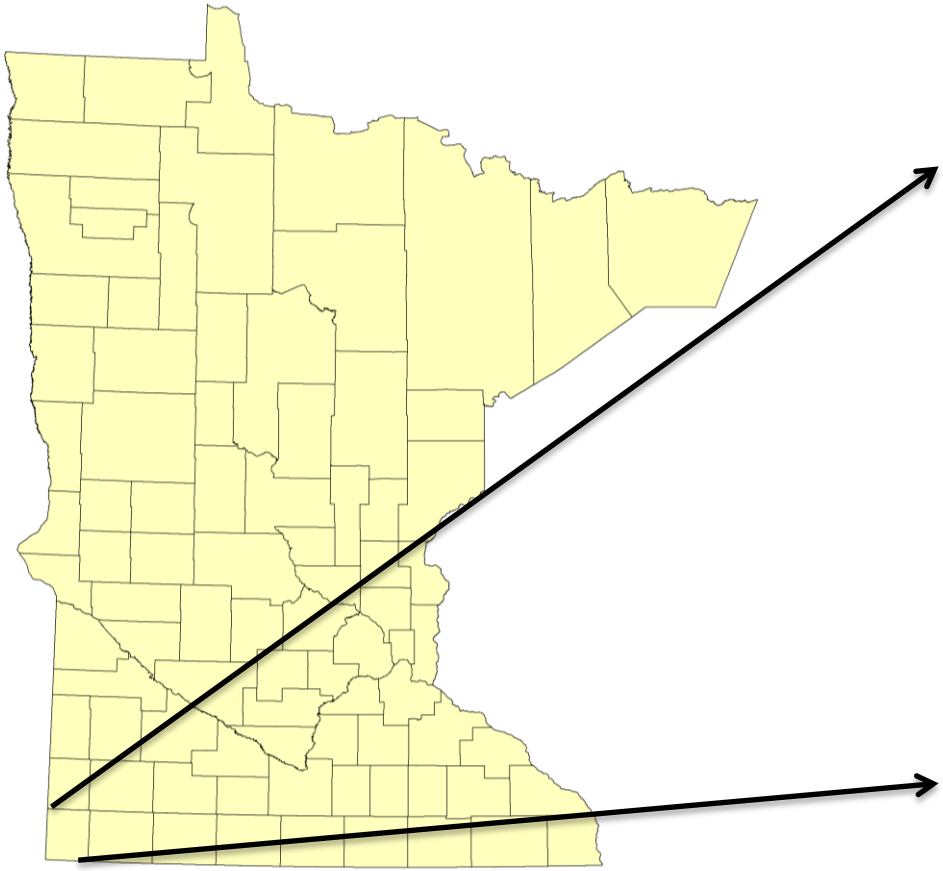
Kernza and GHG mitigation




Slope of N2O emissions
1e−03
5e−04
0e+00
−5e−04
−1e−03
Fertilized June 1
Jun 05
Jun 12
Jun 19
Jun 26
Date
alf
IWG−alf
IWG−con
IWG−org

Kernza production and GHG mitigation

Objectives: Use ‘DayCent’ to simulate Kernza yield and C dynanics

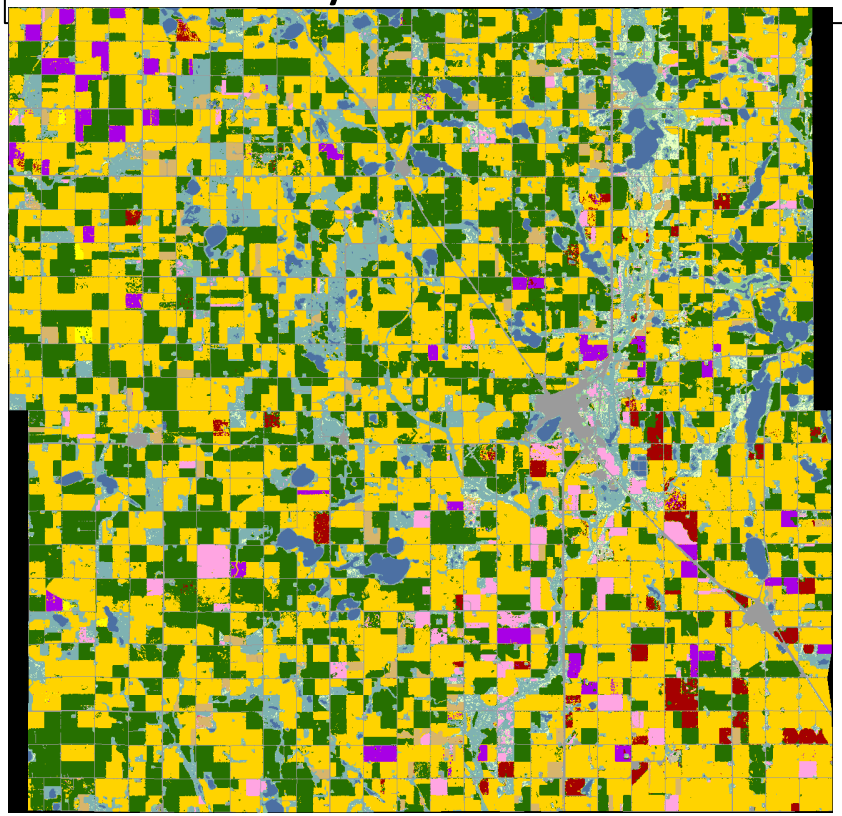


Data inputs

Land cover: CDL

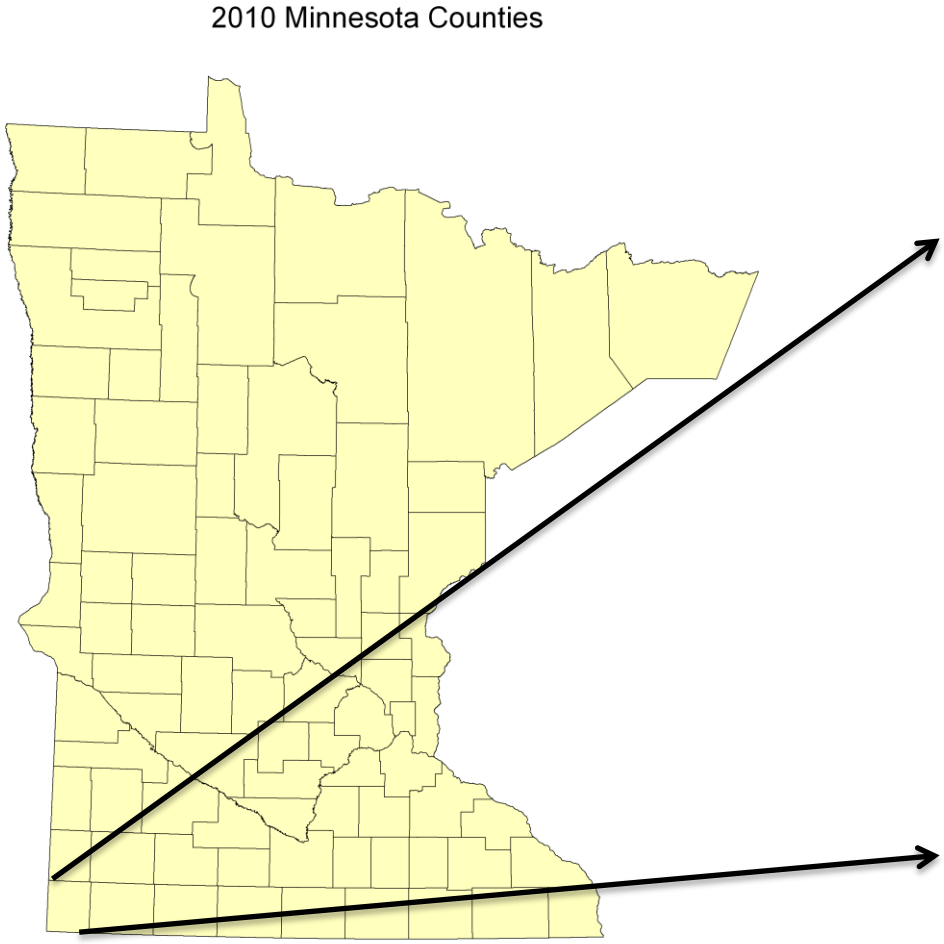
Soil: SSURGO

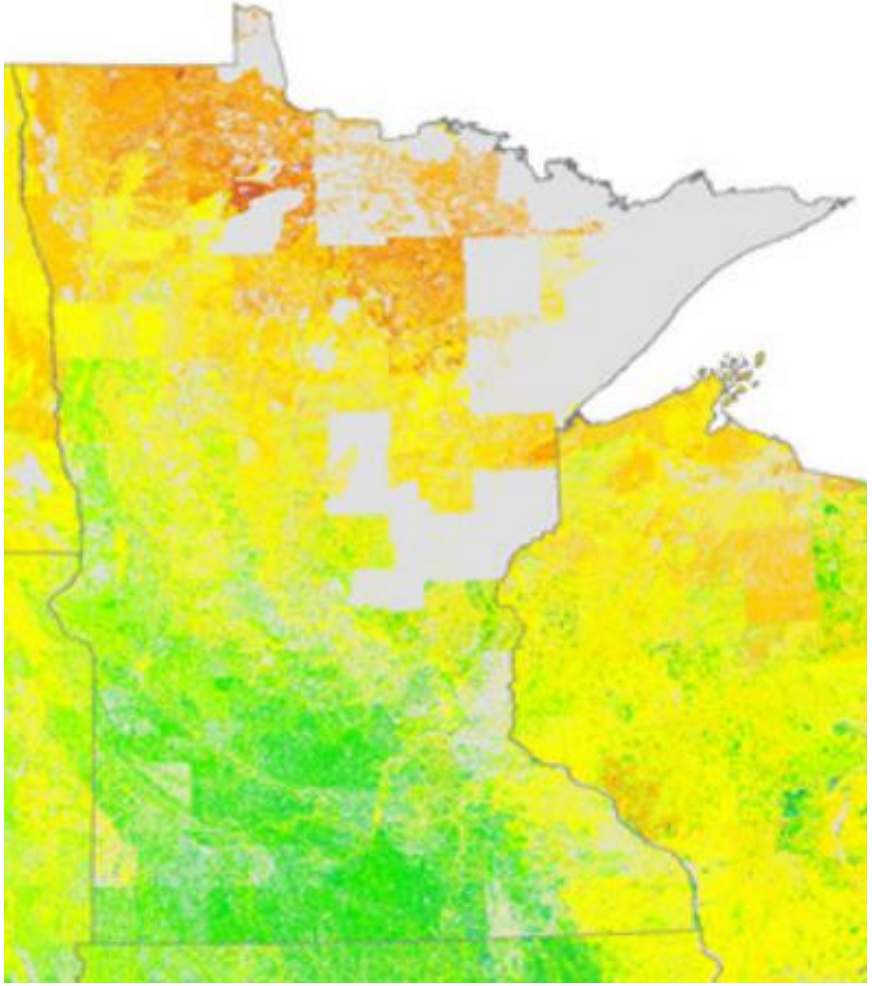
Climate: DayMet



Kernza production and GHG mitigation

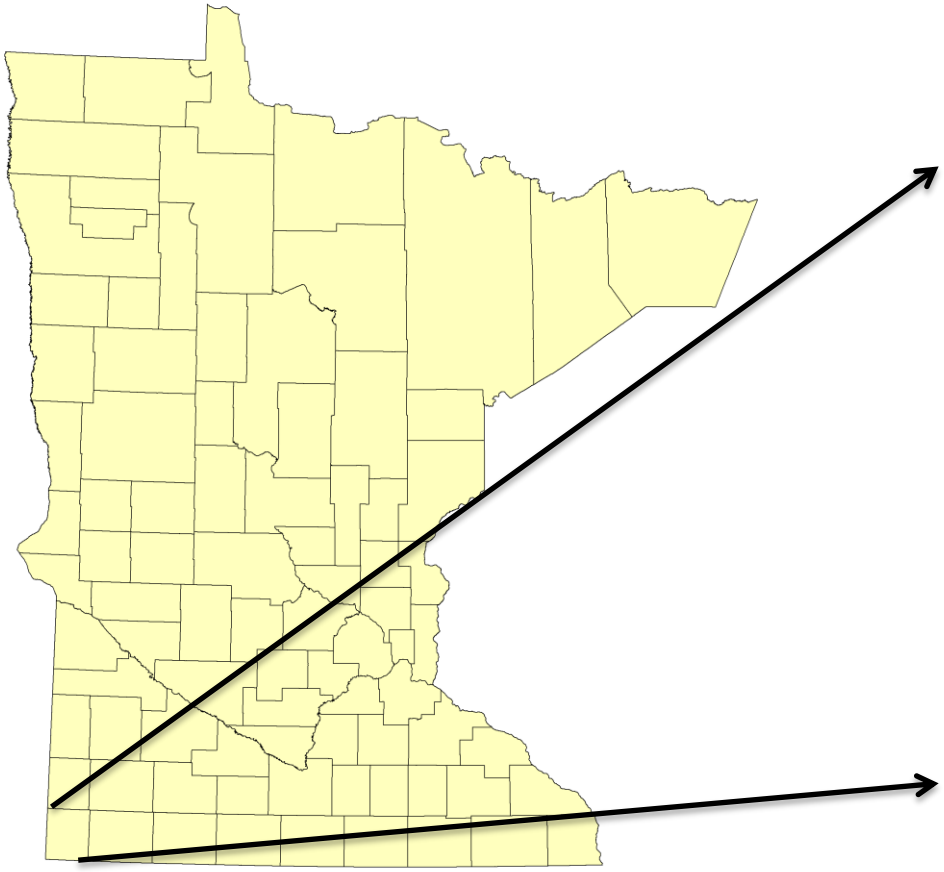
Simulate annual row crop production and GHG emissions

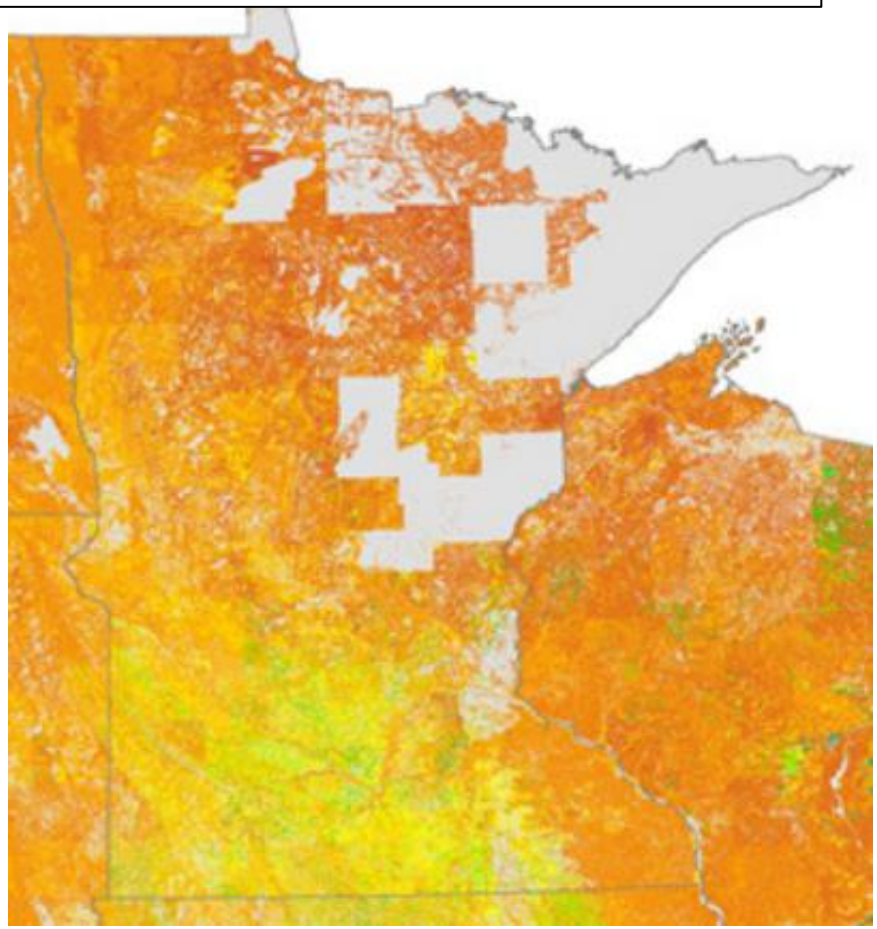




Kernza production and GHG mitigation

Simulate Kernza production and GHG emissions where annual crops are underyielding





Kernza production and GHG mitigation

Scenario	Area Affected	Total Kernza Production	Difference in Annual Crop Production	Difference in Economic Value	Difference in GHG mitigation
Replace all annual crop land that yields 10% less than county average					
Replace all annual crop land grown within 100 meters of surface waters					
Replace all annual crop land in wellhead protection areas					

Questions

Acknowledgments

Mentors and Collaborators

- Craig Sheaffer, Nicole Tautges, Lee DeHaan, Nancy Ehlke, Don Wyse

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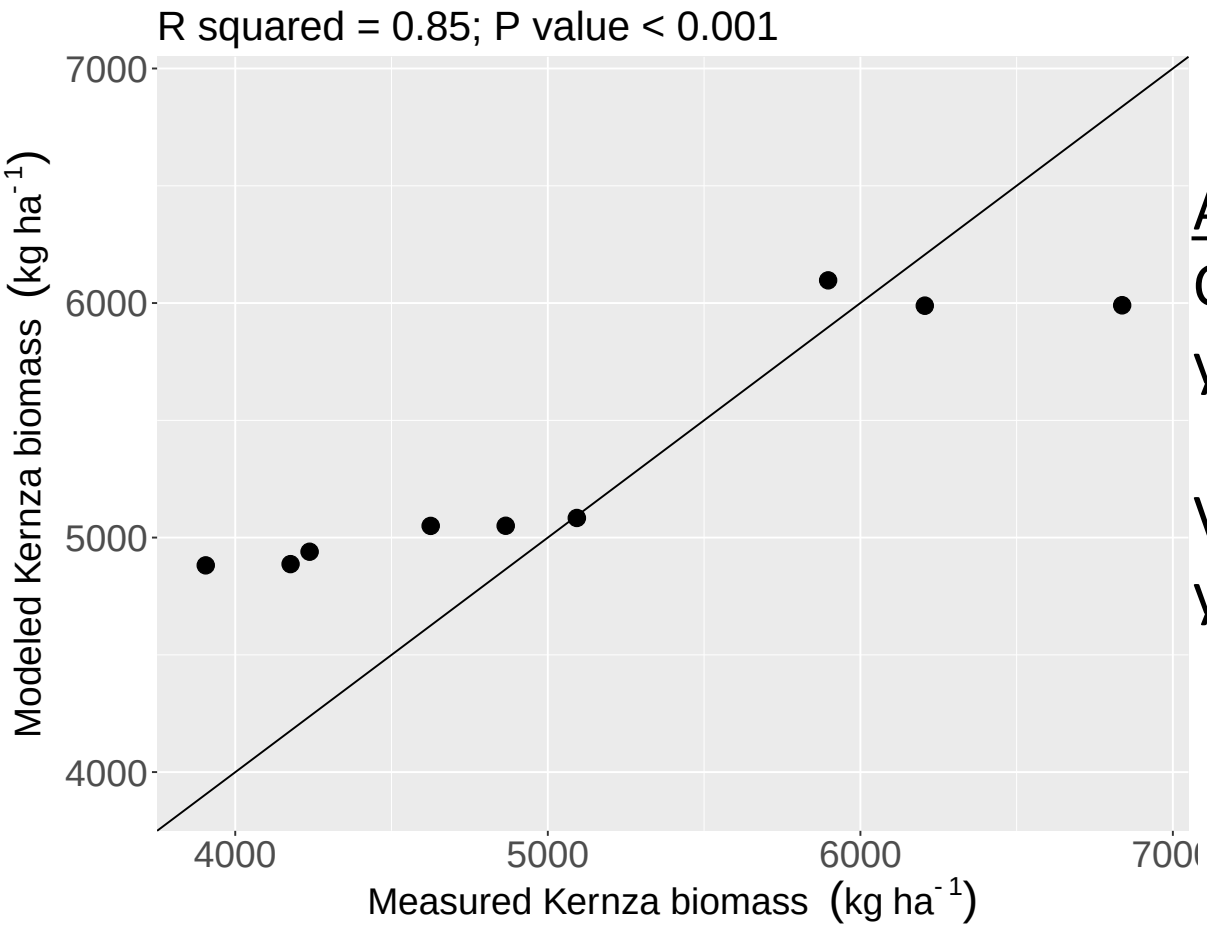
- The Land Institute and Malone Family Foundation
- USDA-AFRI
- The University of Minnesota Forever Green Initiative
- SARE
- Ceres Trust Fund

Modeling Kernza GHG mitigation

Objectives: Parameterize ‘DayCent’ crop and carbon simulation model



<u>Aboveground Biomass</u>

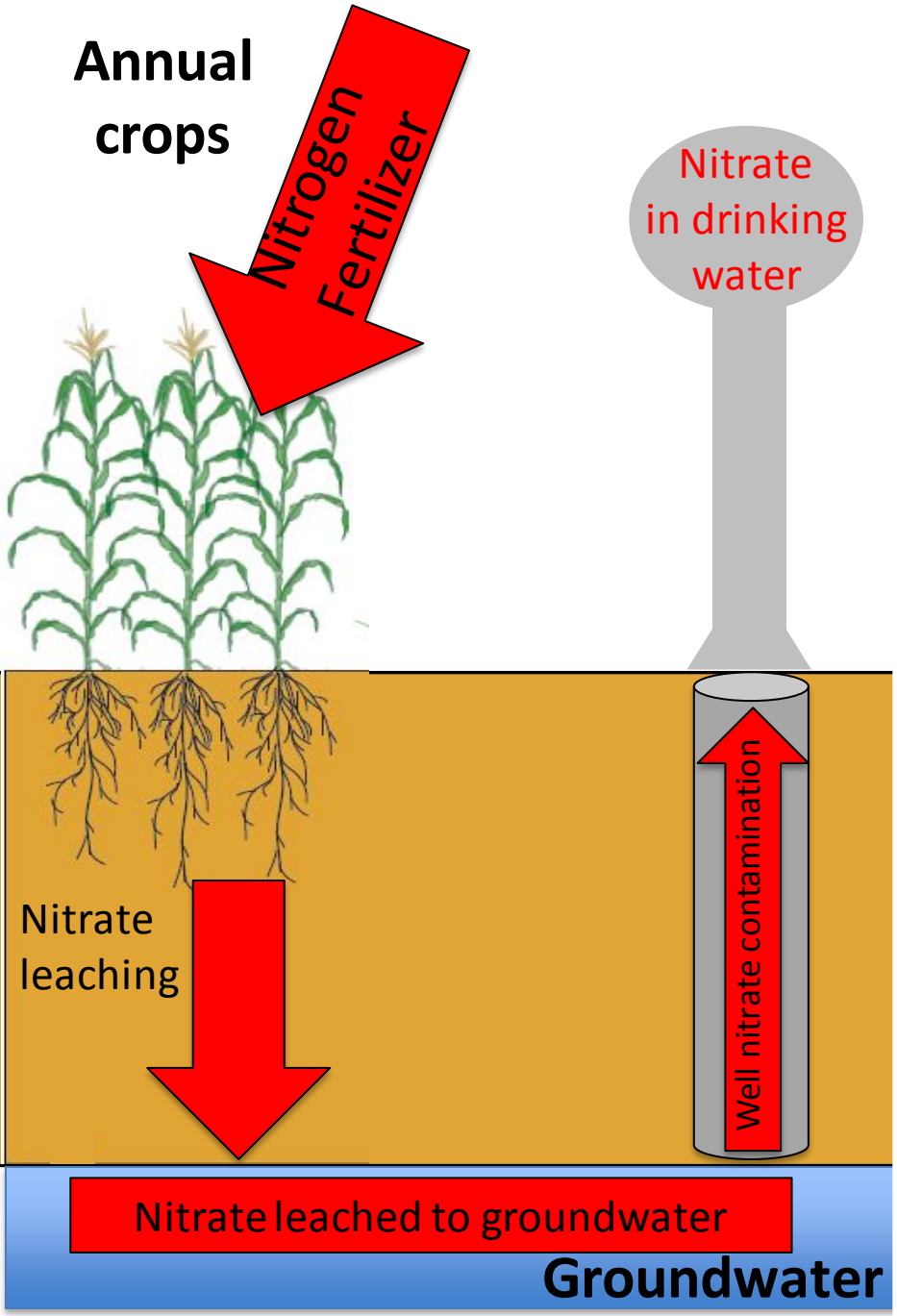
Calibration using 9 site-years of data.

Validation using 21 site-years of data.

Modeling Kernza GHG mitigation

Objectives: Parameterize ‘DayCent’ crop and carbon simulation model

- Aboveground biomass
- Belowground biomass
- Soil moisture
- Soil C dynamics


Annual crops
Nitrogen Fertilizer
Nitrate in drinking water
Nitrate leaching
Well nitrate contamination
Nitrate leached to groundwater
Groundwater