

Quantifying the Environmental Benefits of Kernza

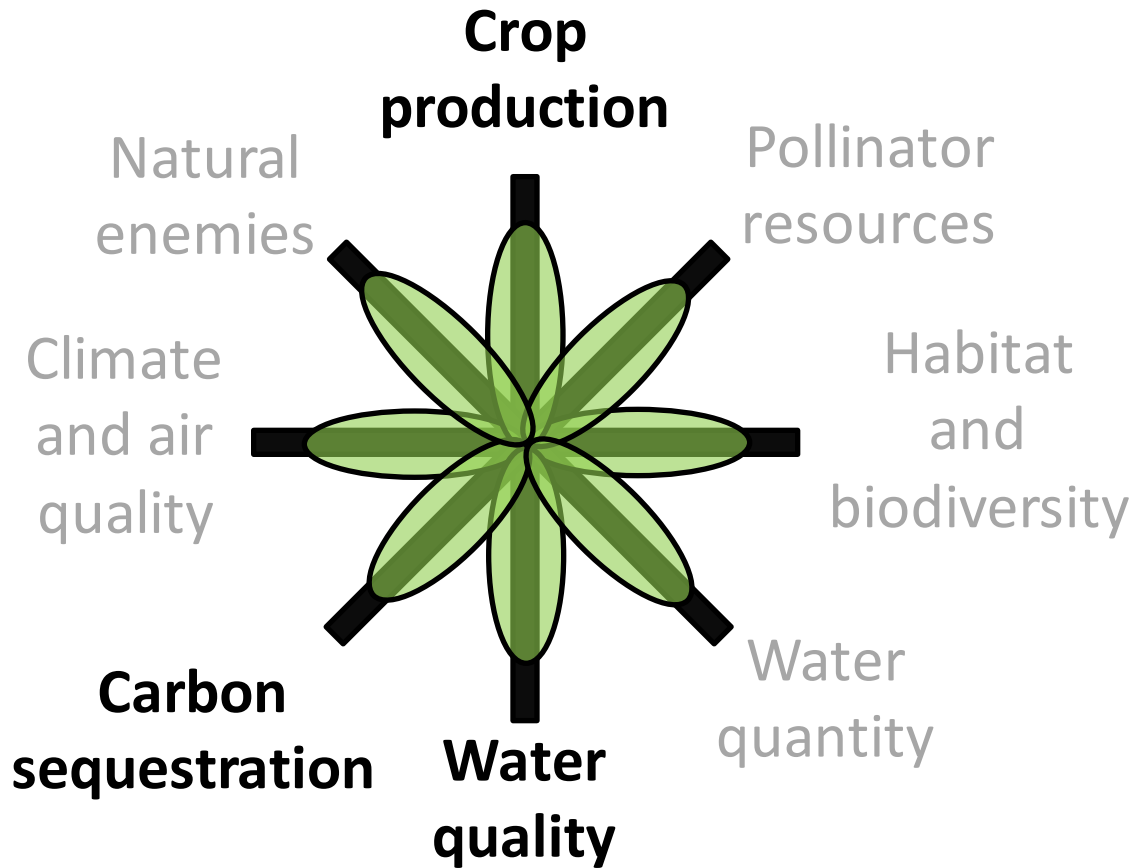
Jacob Jungers

Research Assistant Professor, Dept. of Agronomy and Plant Genetics, UMN



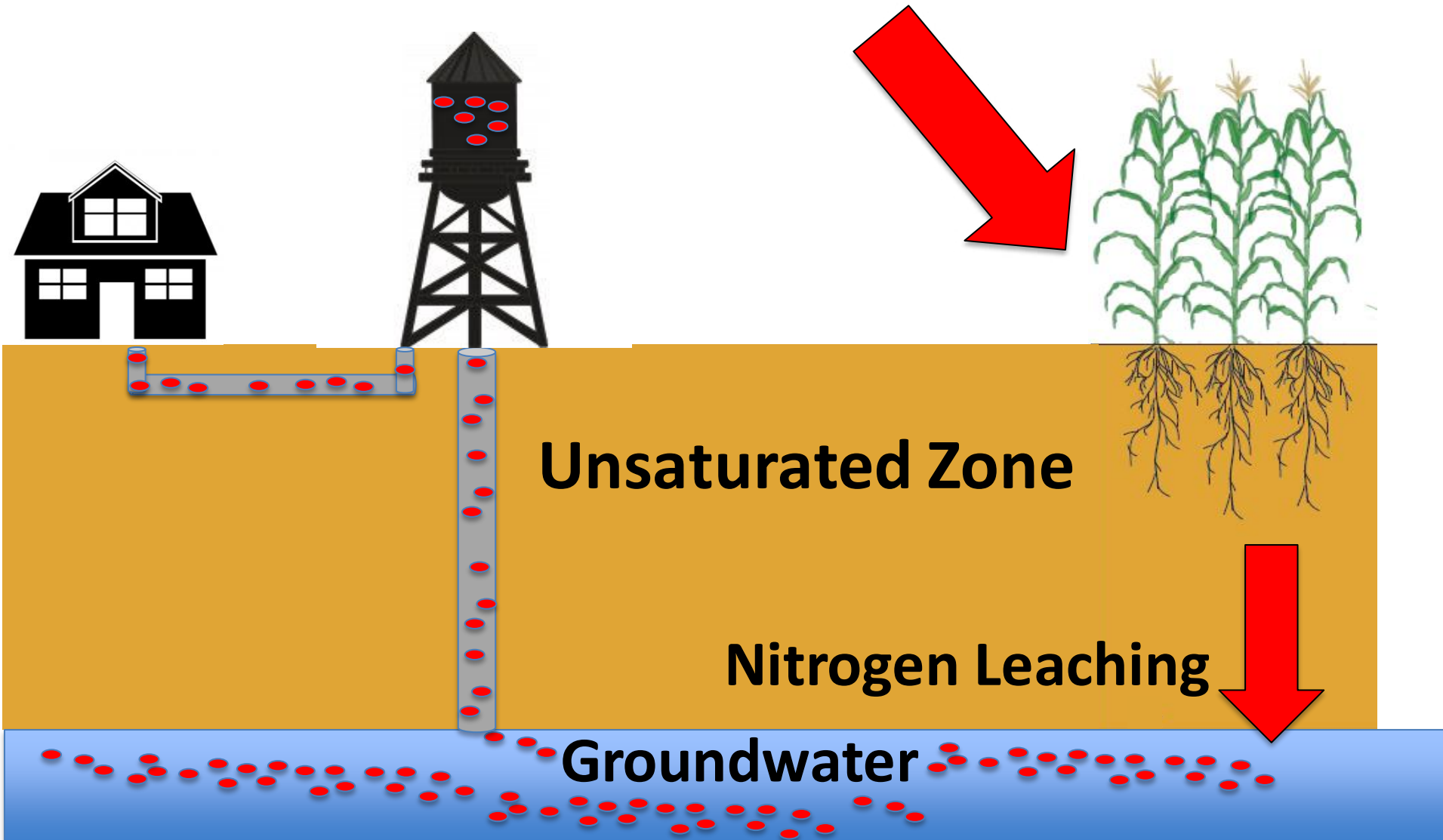
Environmental impacts of cropping systems

Perennial Crop

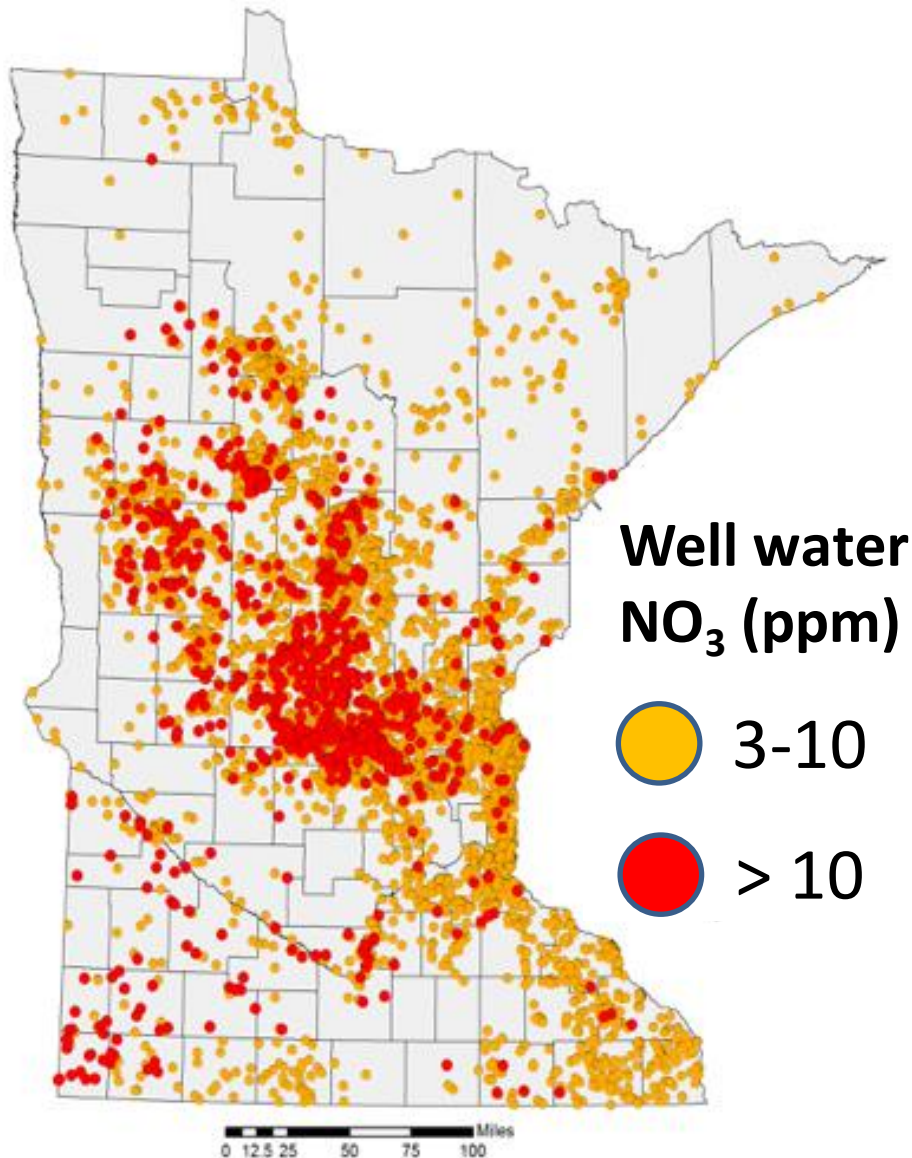


Nitrate Leaching and Groundwater

Nitrogen Fertilizer



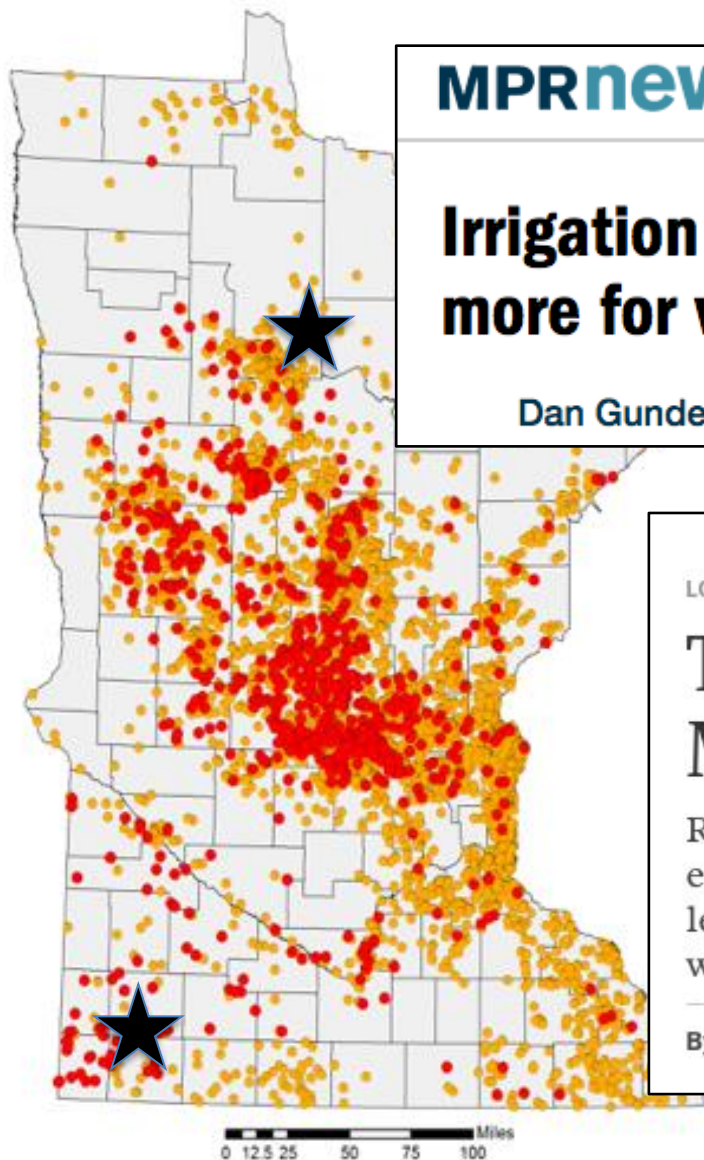
Nitrate Leaching and Groundwater



Minnesota Nitrate Issues

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

Nitrate Leaching and Groundwater



MPRnews

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Irrigation boosts potatoes, but Park Rapids pays more for water

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

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 **StarTribune**

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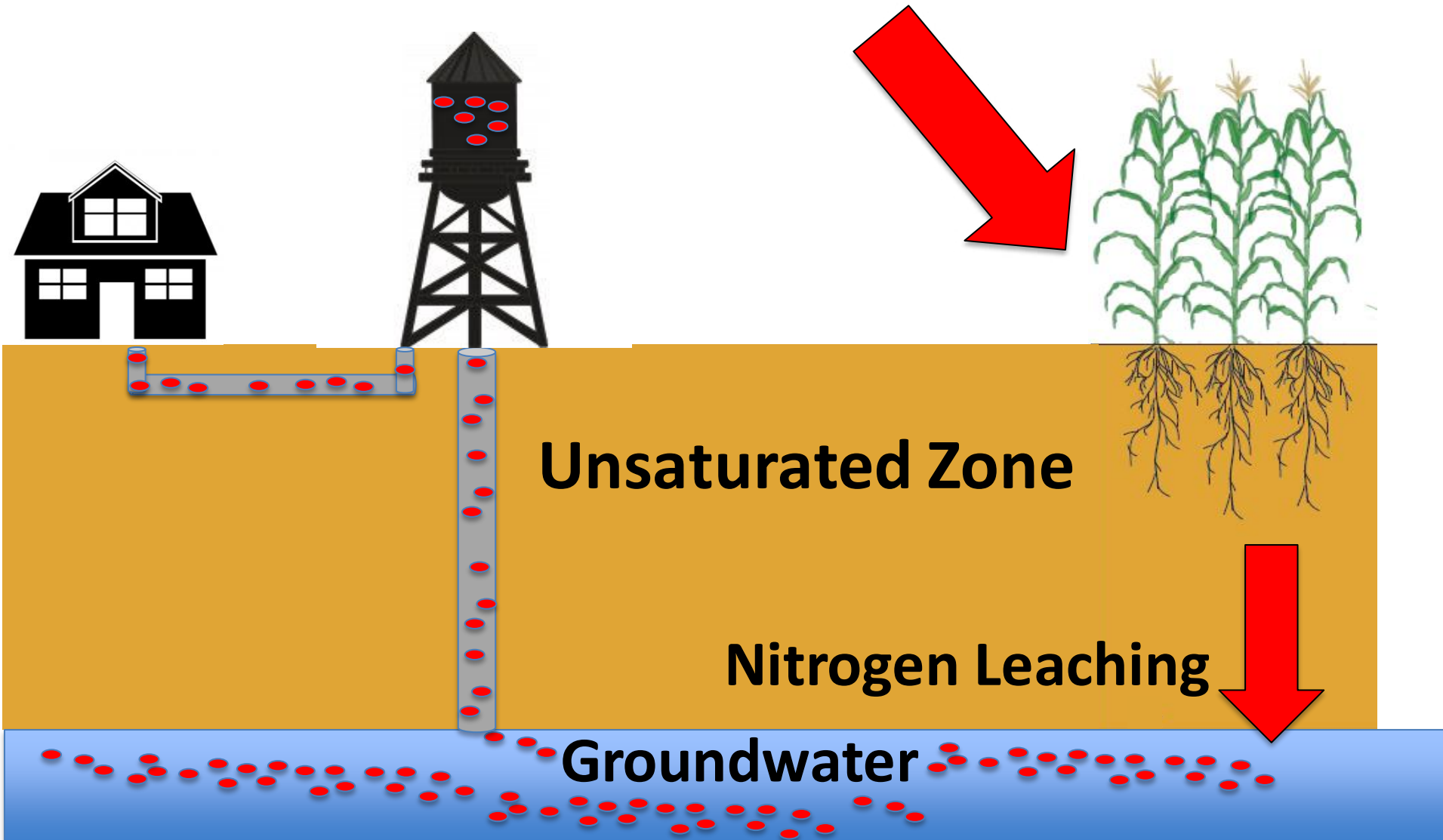
Tainted drinking water is costing Minnesota taxpayers millions

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

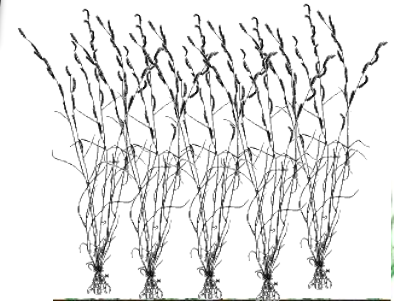
Nitrate Leaching and Groundwater

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Nitrate Leaching and Groundwater

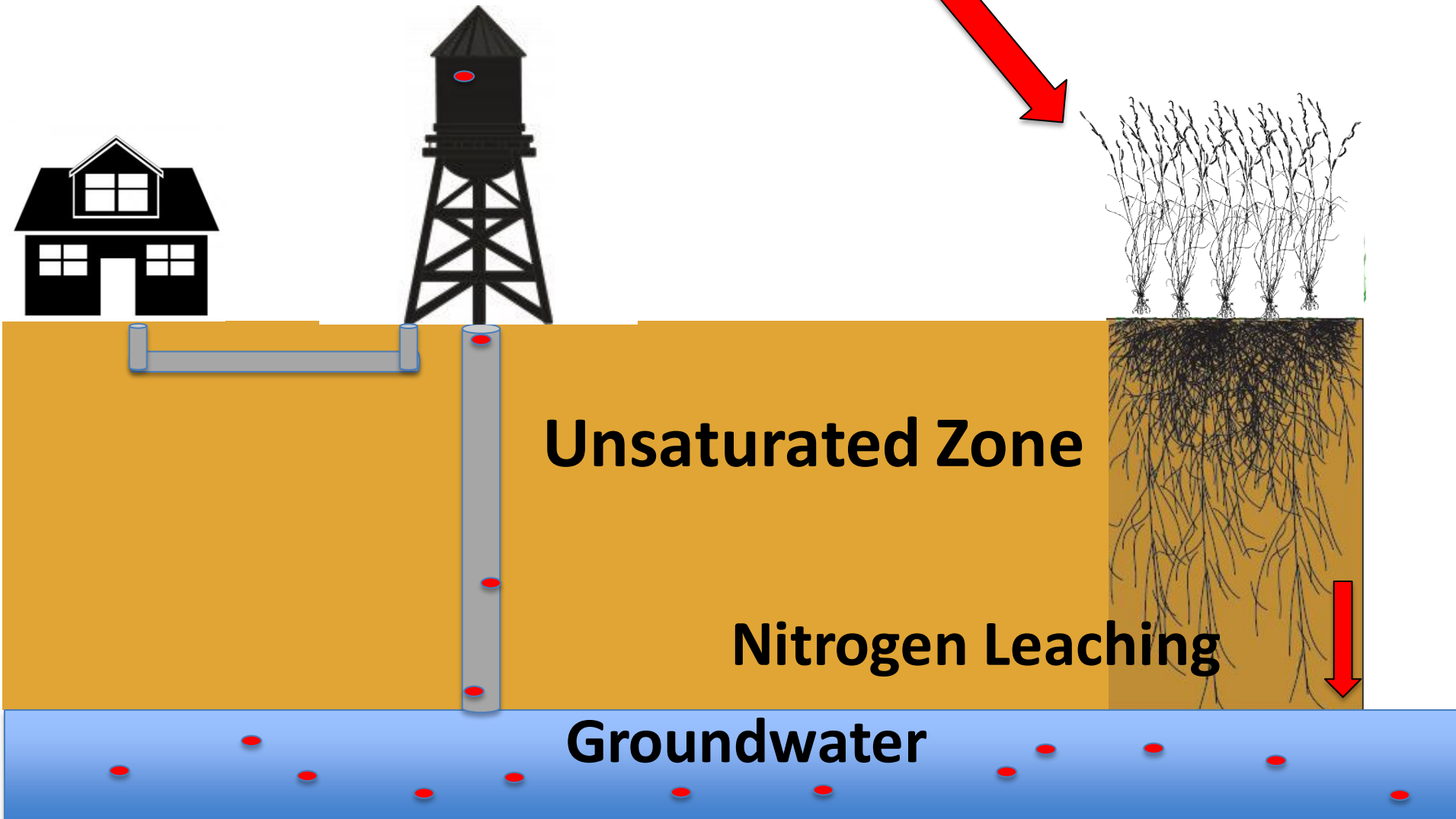
Nitrogen Fertilizer



Unsaturated Zone

Nitrogen Leaching

Groundwater

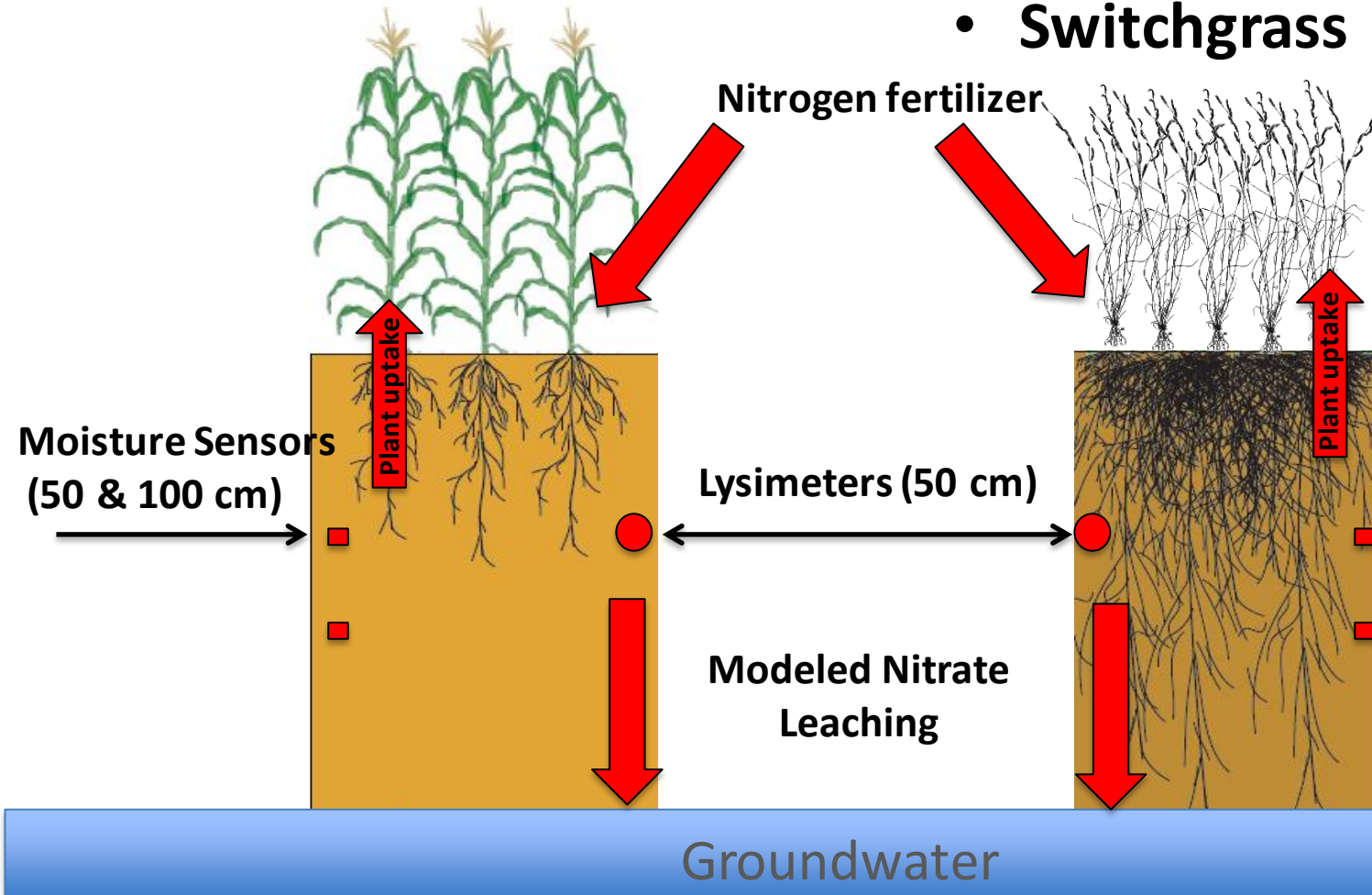


Nitrate Leaching and Groundwater

Corn

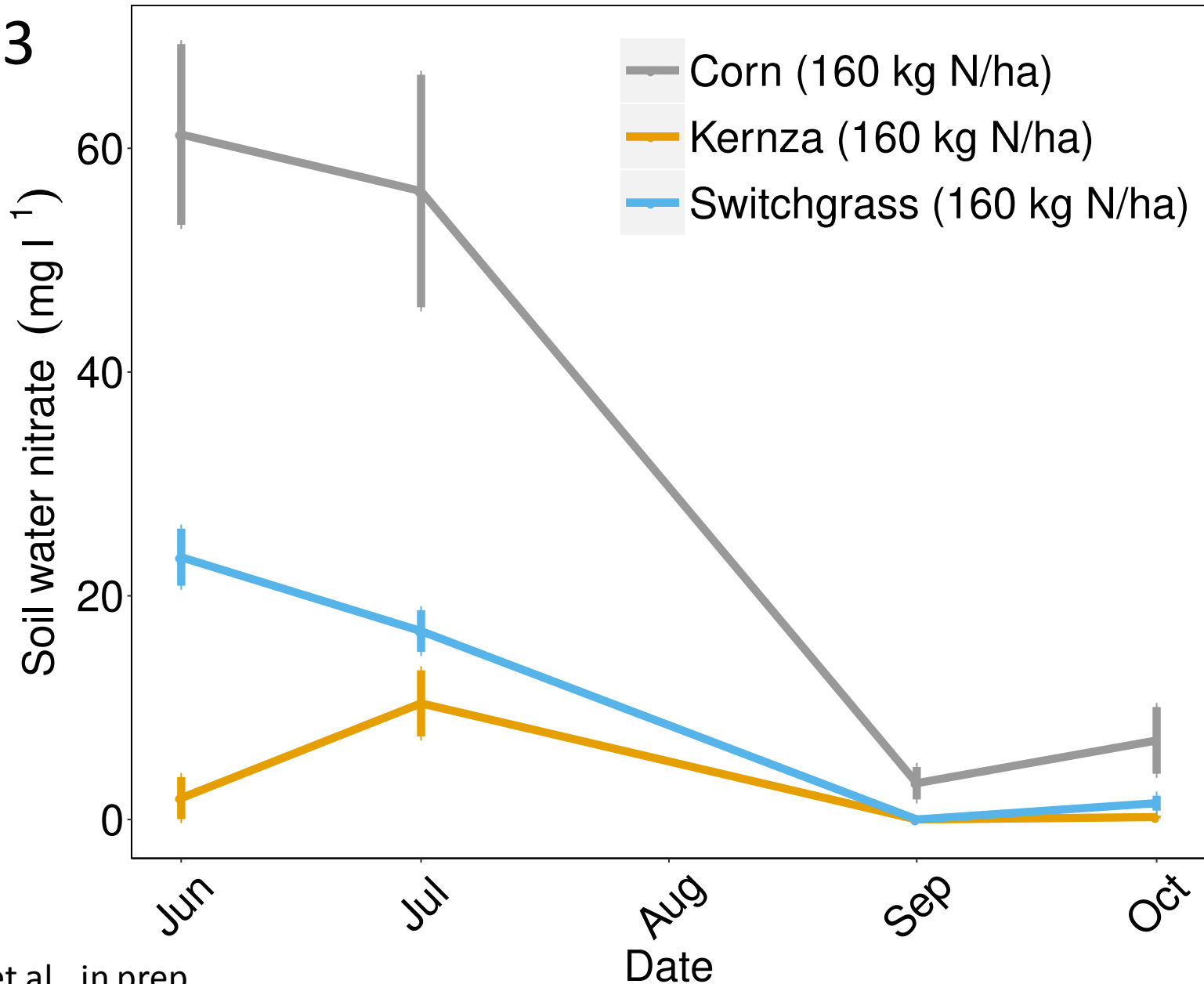
Perennial Crops

- Kernza
- Switchgrass



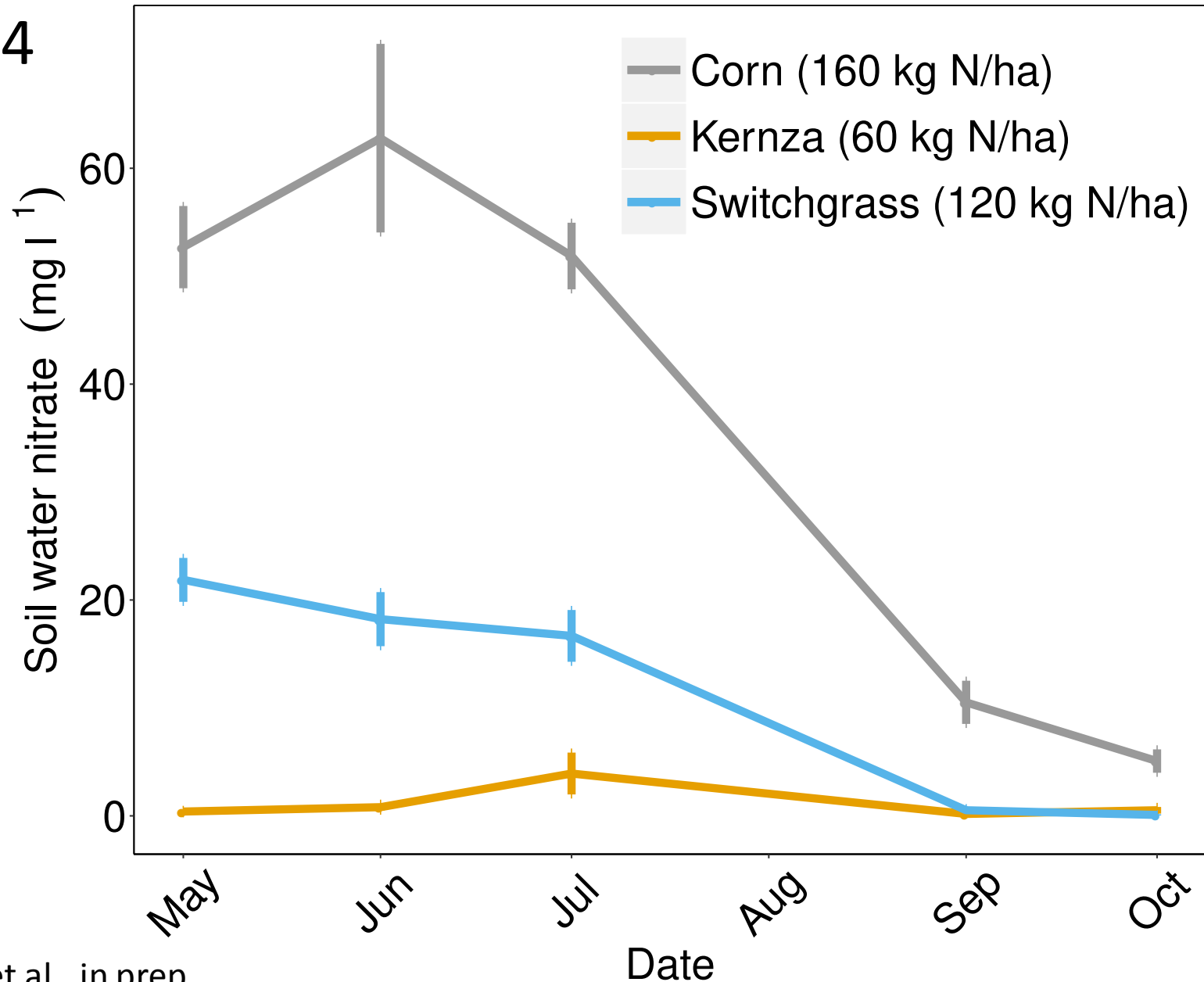
Kernza and water quality

2013

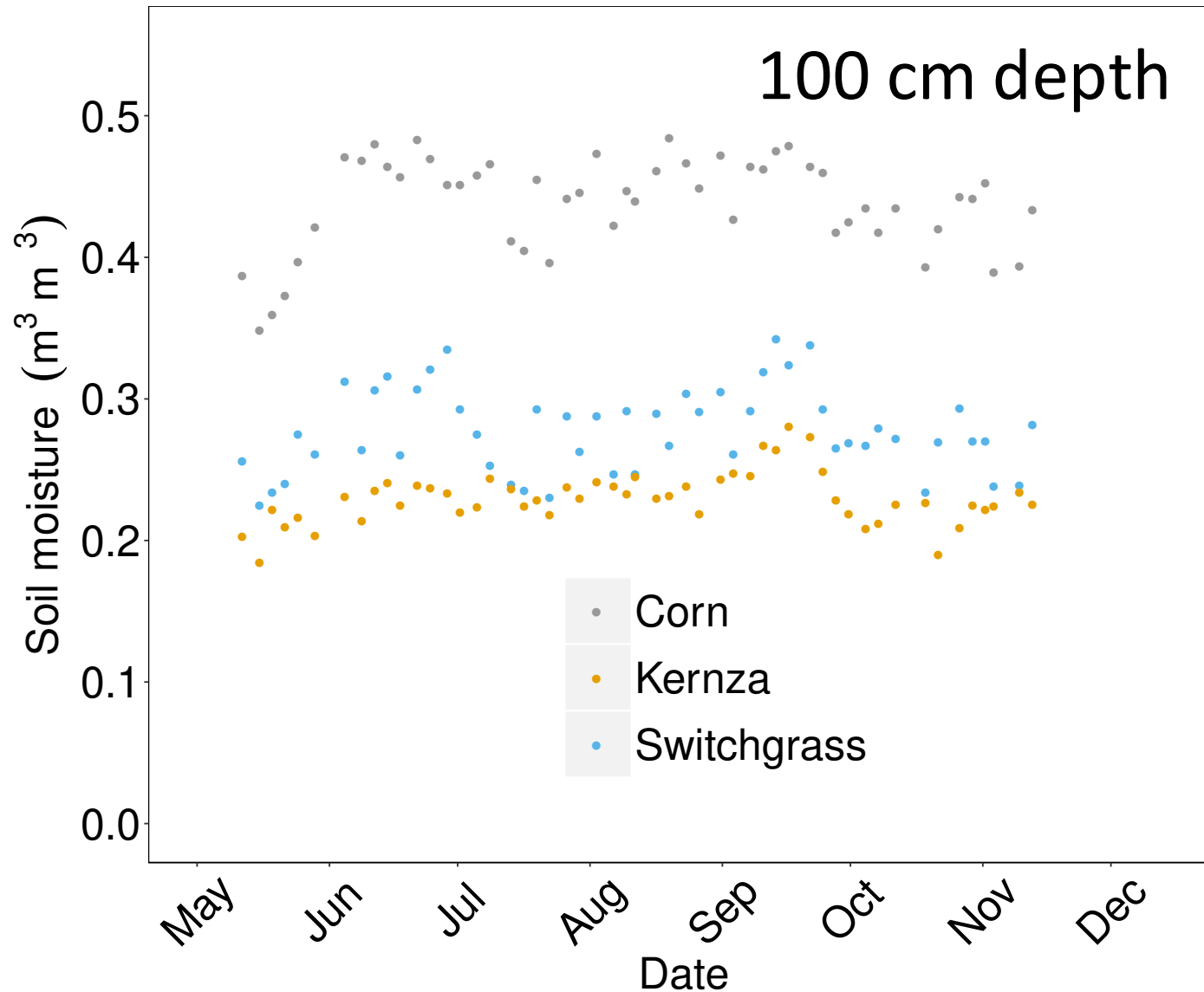


Kernza and water quality

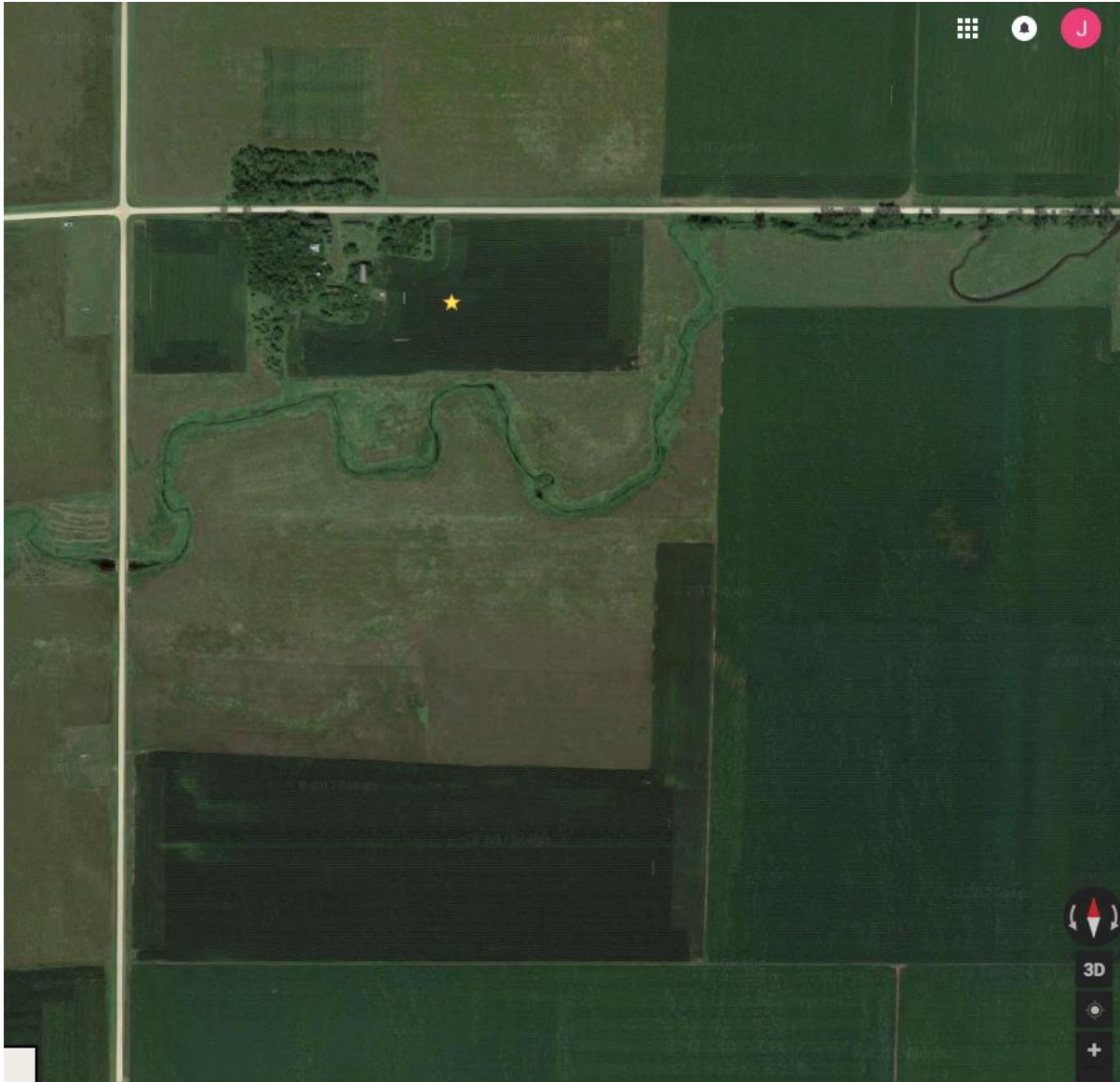
2014



Kernza and water quality



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



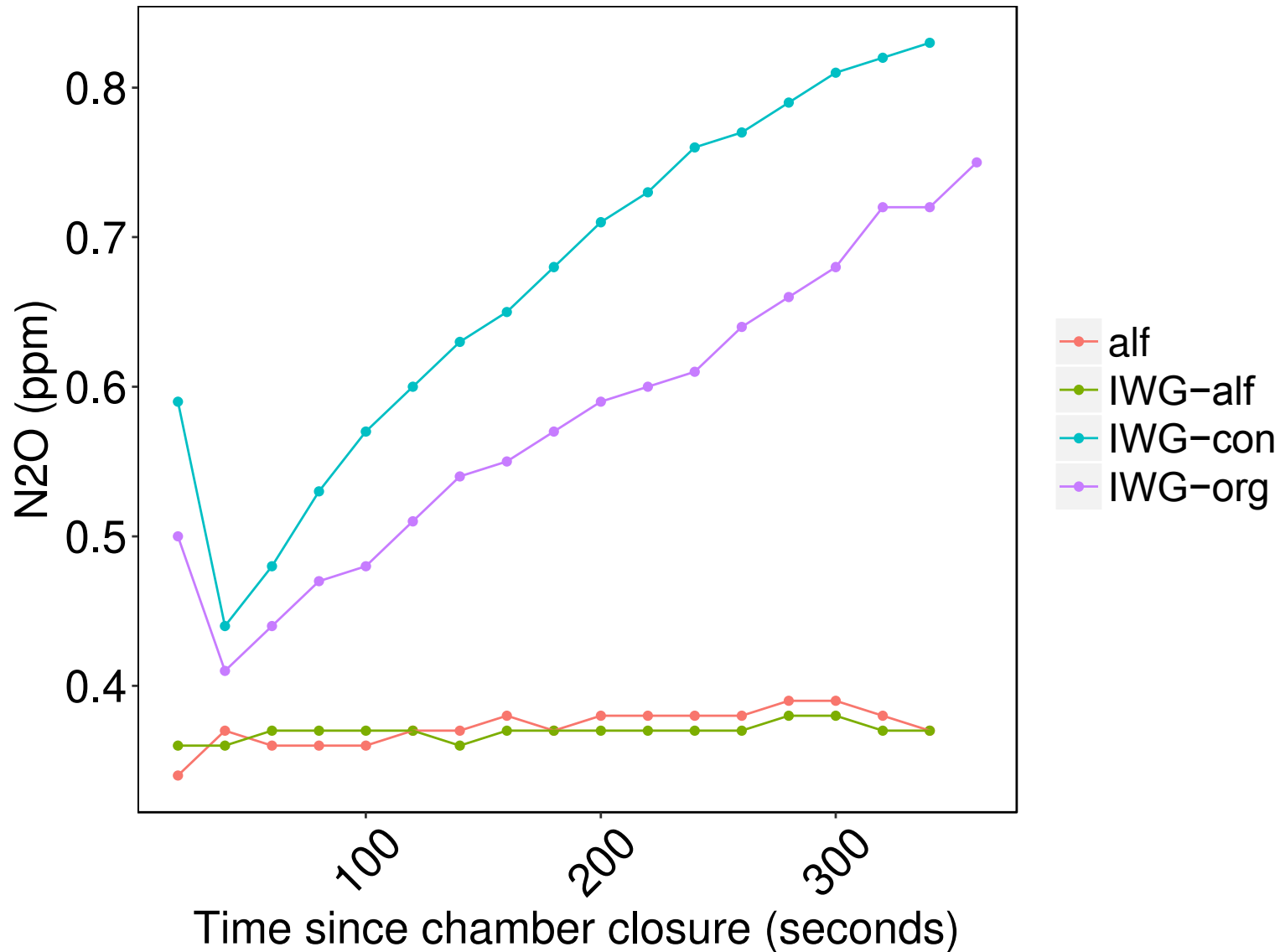
Kernza and GHG mitigation

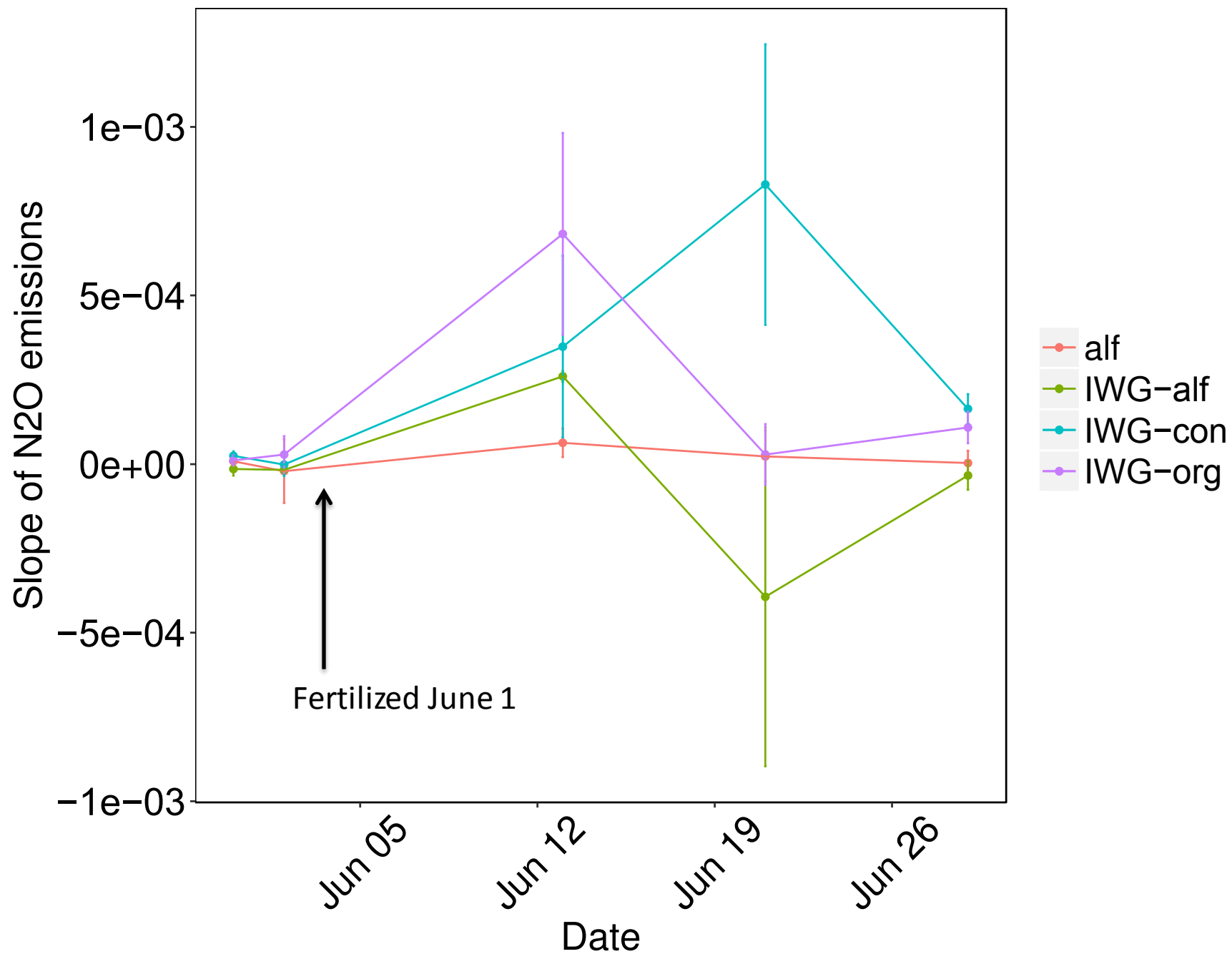
Measurements

- Soil GHG emissions



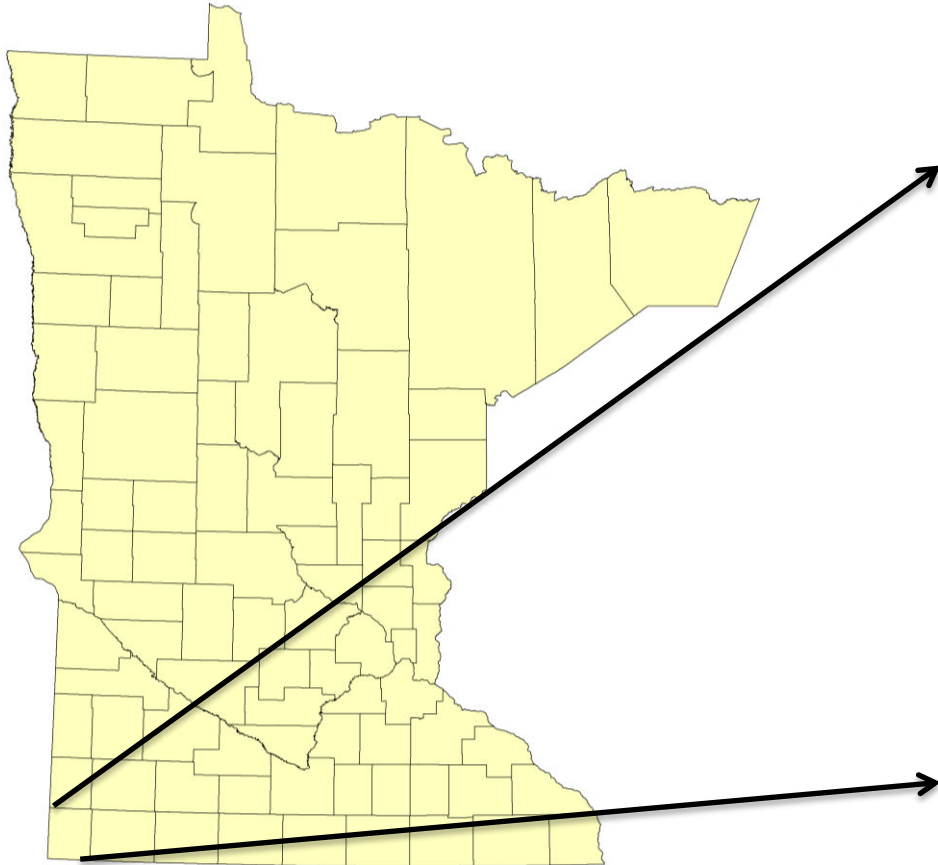
Kernza and GHG mitigation





Kernza production and GHG mitigation

Objectives: Use 'DayCent' to simulate Kernza yield and C dynamics

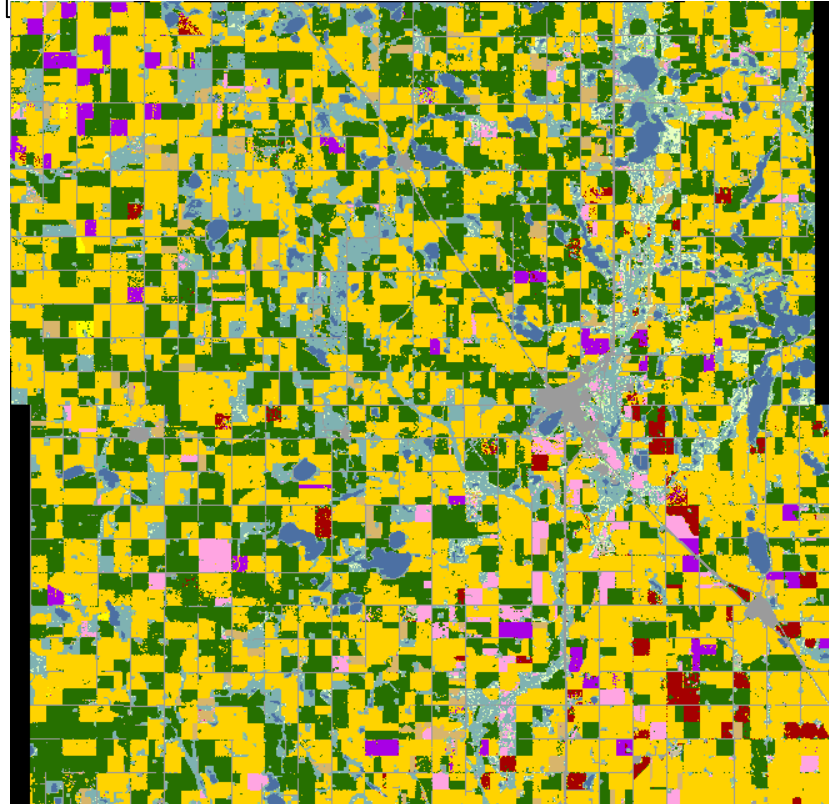


Data inputs

Land cover: CDL

Soil: SSURGO

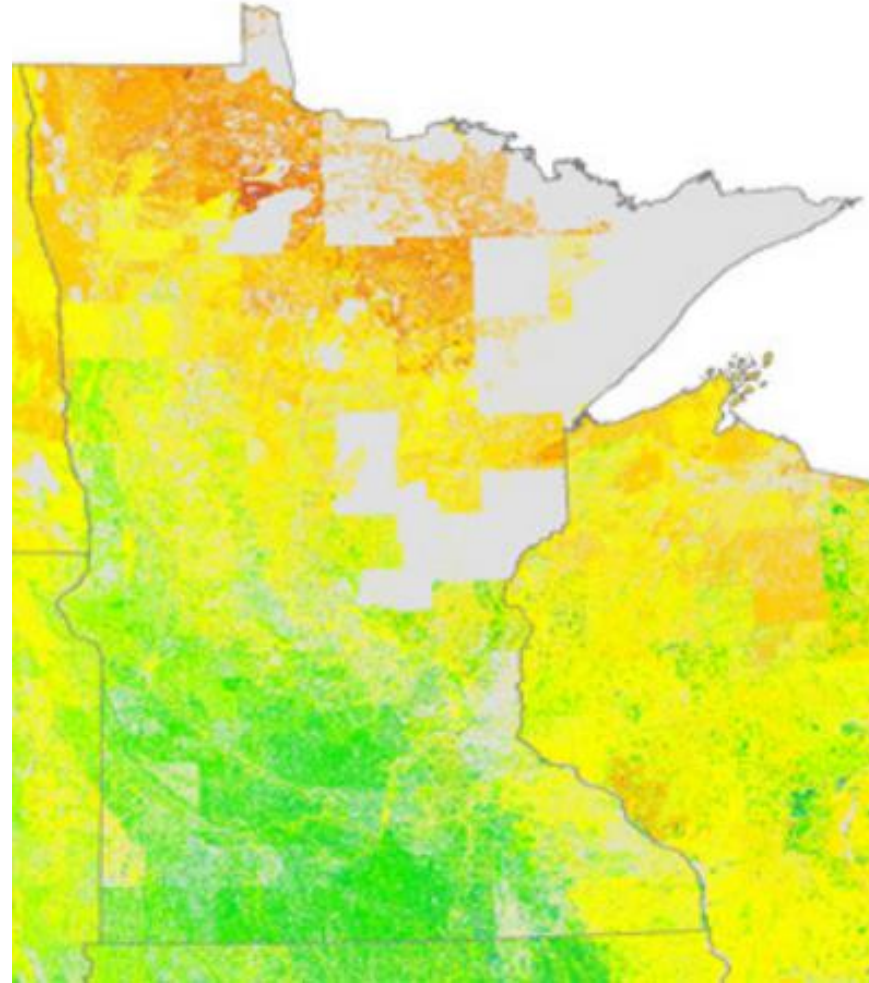
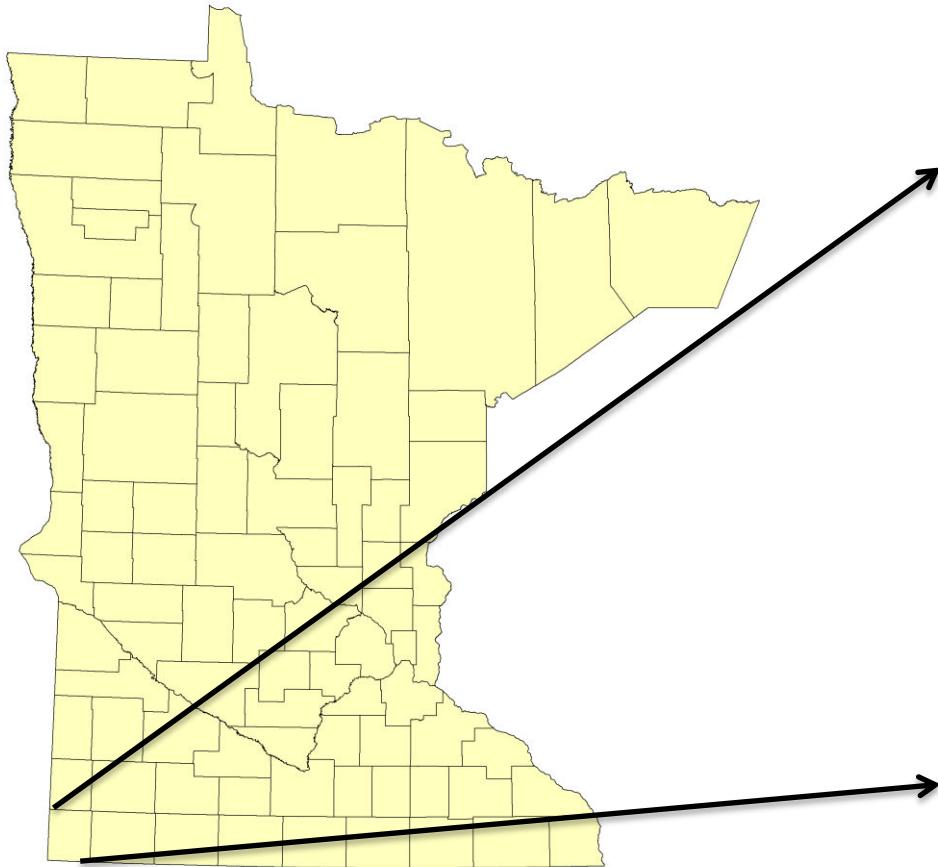
Climate: DayMet



Kernza production and GHG mitigation

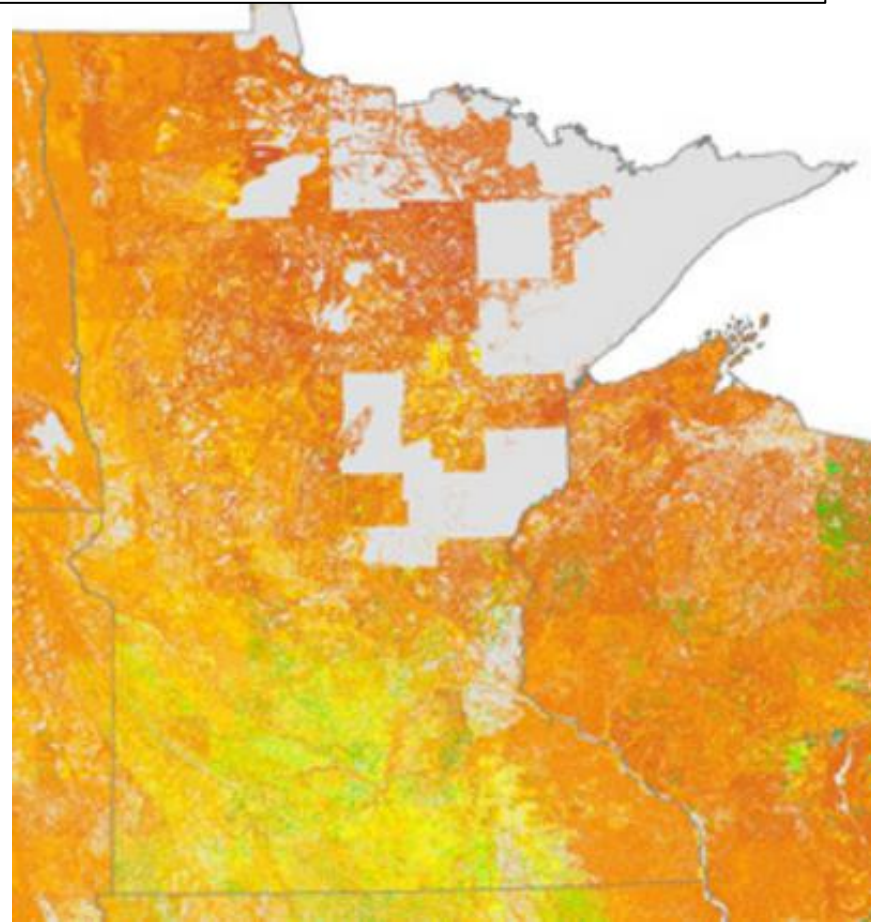
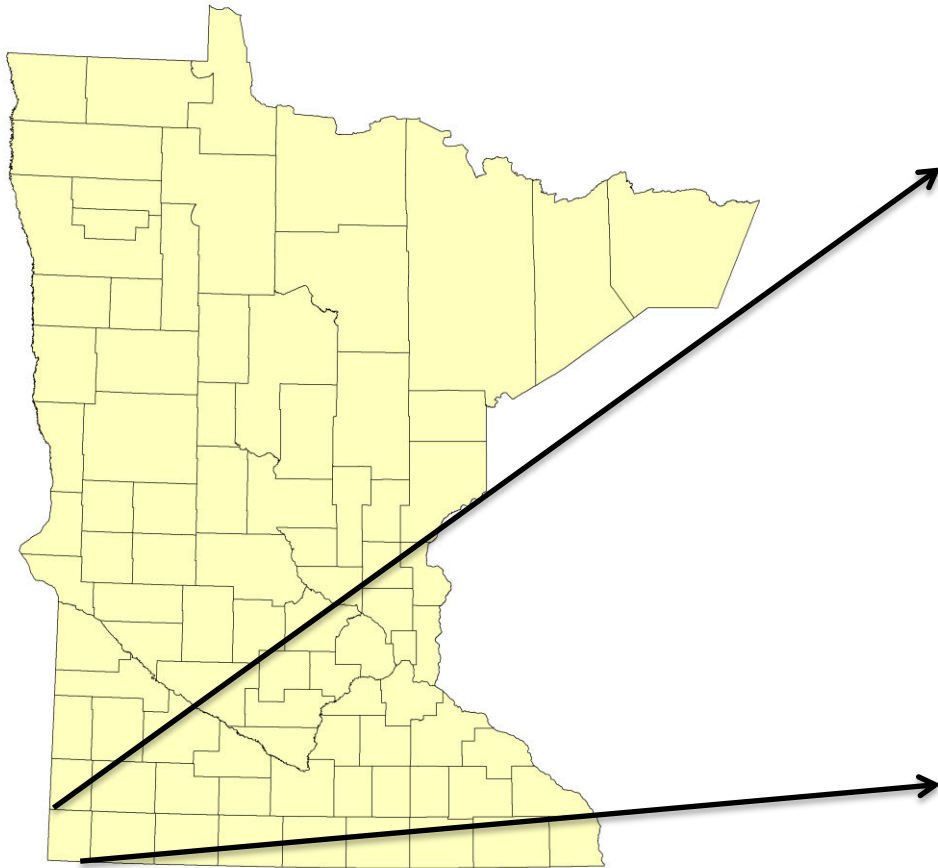
Simulate annual row crop production and GHG emissions

2010 Minnesota Counties



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

Technicians and Graduate Students

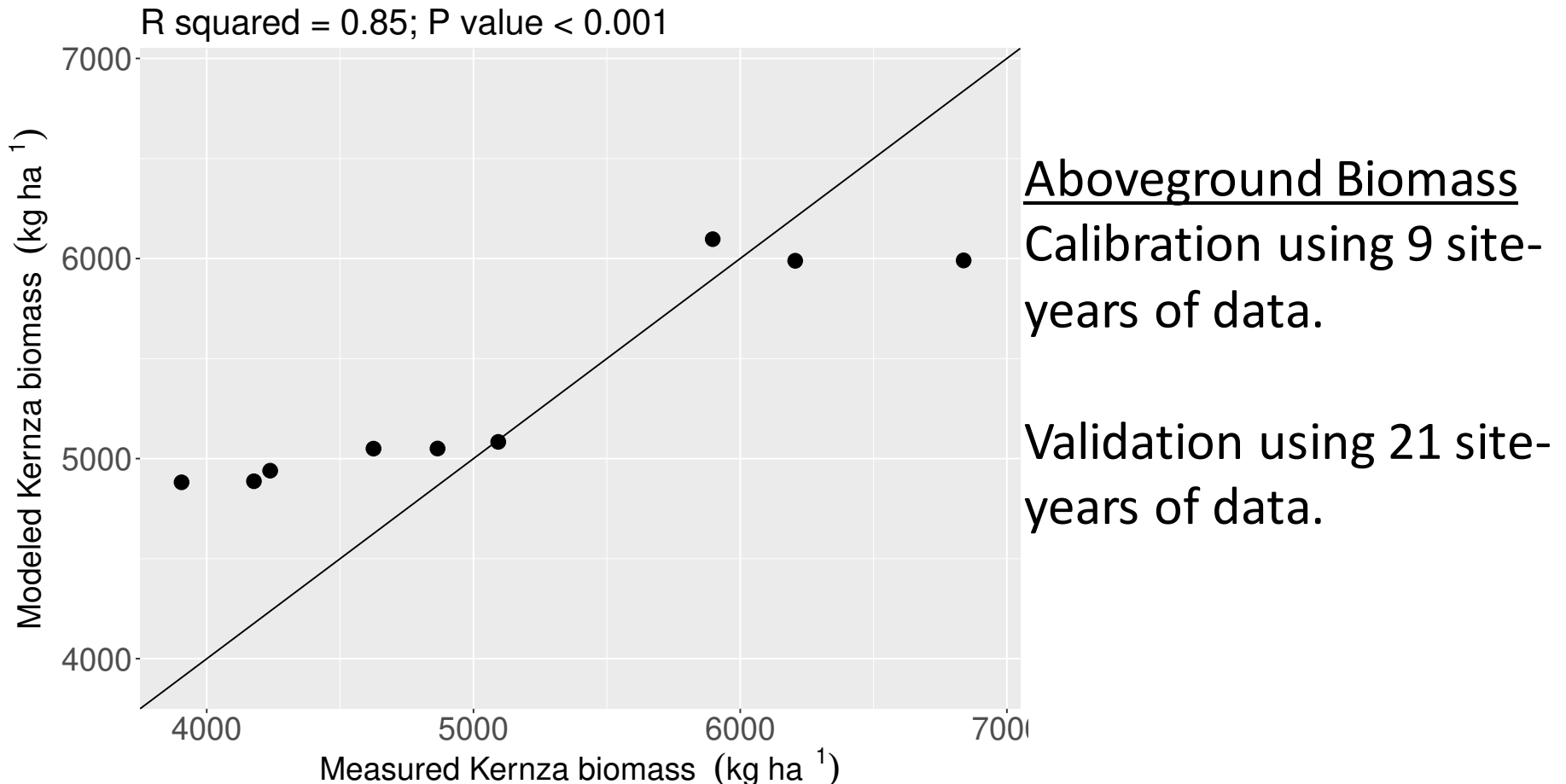
- Brett Heim, Lindsay Wilson, Kevin Betts, Charlie Frahm

Funding

- Minnesota Department of Agriculture
- 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



Modeling Kernza GHG mitigation

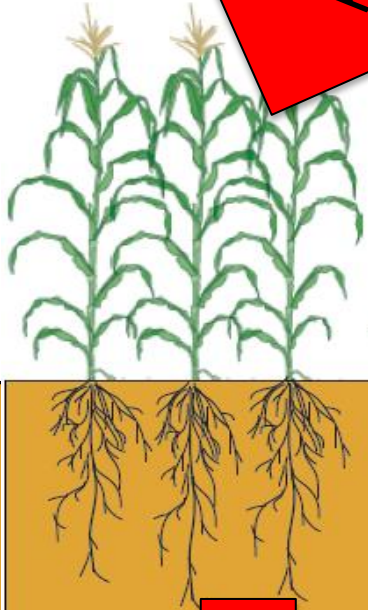
Objectives: Parameterize 'DayCent' crop and carbon simulation model

- 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