Conceptual to Quantitative Frameworks for Evaluating Irrigation Groundwater Pumping Impacts in the Northern Lake States

Mallika Nocco

M.S. Soil Science

Research Assistant

The Center for Sustainability and the Global Environment

Mack Naber

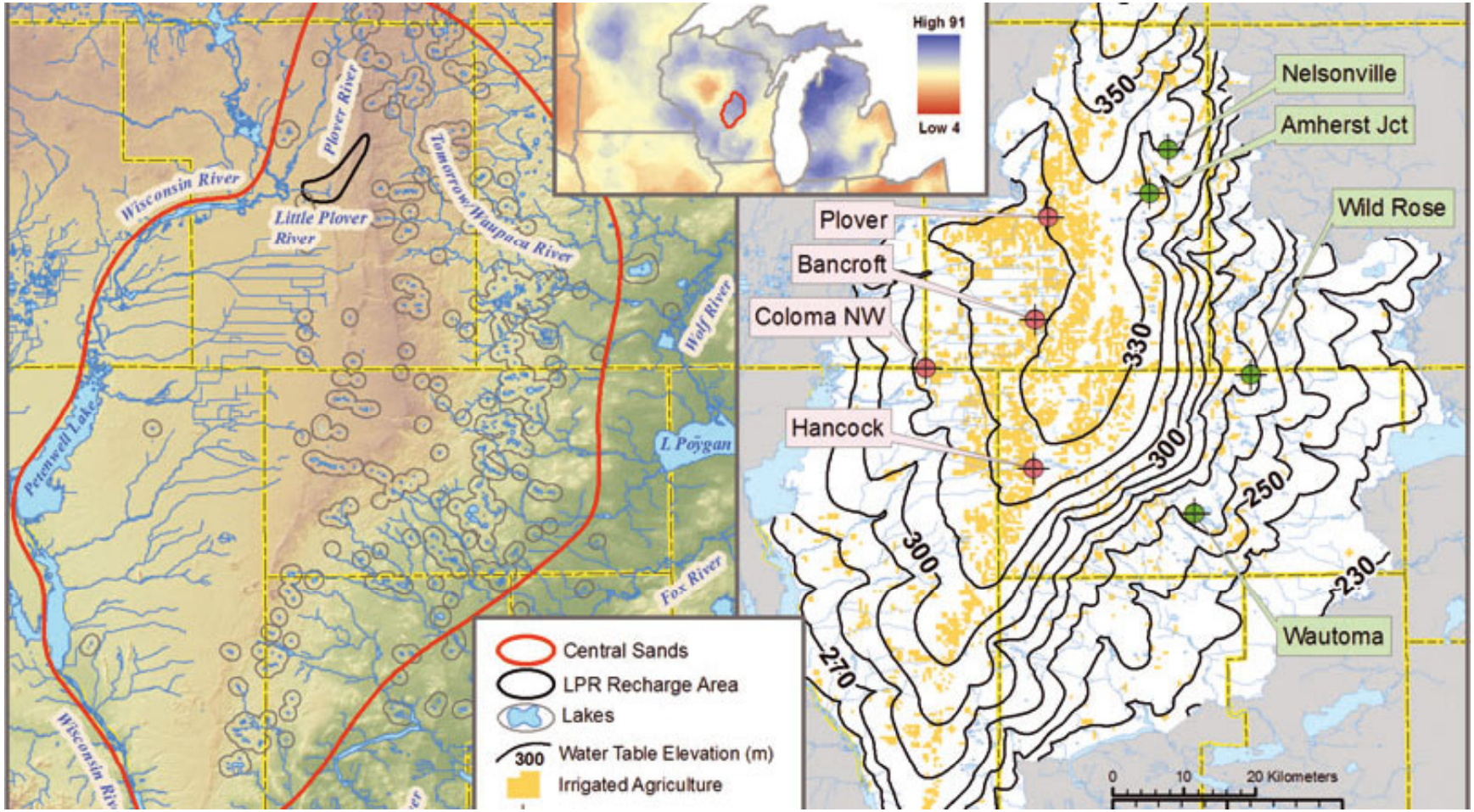
M.S. Soil Science

Research Technician

Nutrient Cycling and Agroecosystems Laboratory

The University of Wisconsin-Madison

Irrigated Agriculture in the Northern Lake States



Kraft et al. 2012

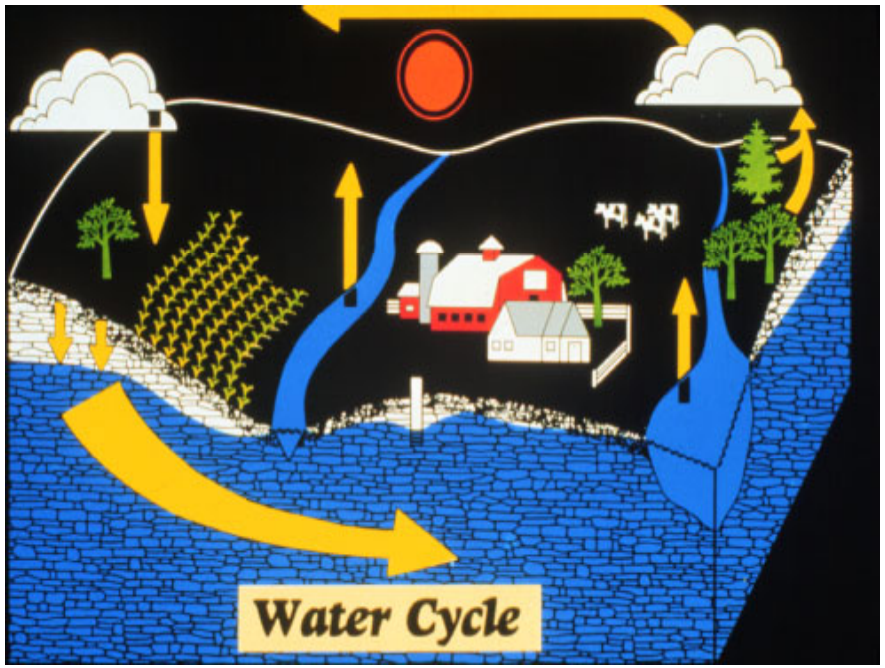
Precipitation - **ET** - Runoff

Rise / fall of the water table (also lakes and wetlands)

Water In – Water Out = ± Storage

Discharge to streams

Pumping



Irrigated Agriculture: A Dual Pump Ecosystem

ET Pumping

Primary Crops
Cover Crops
Residue
Seasonality
Interannual Climate

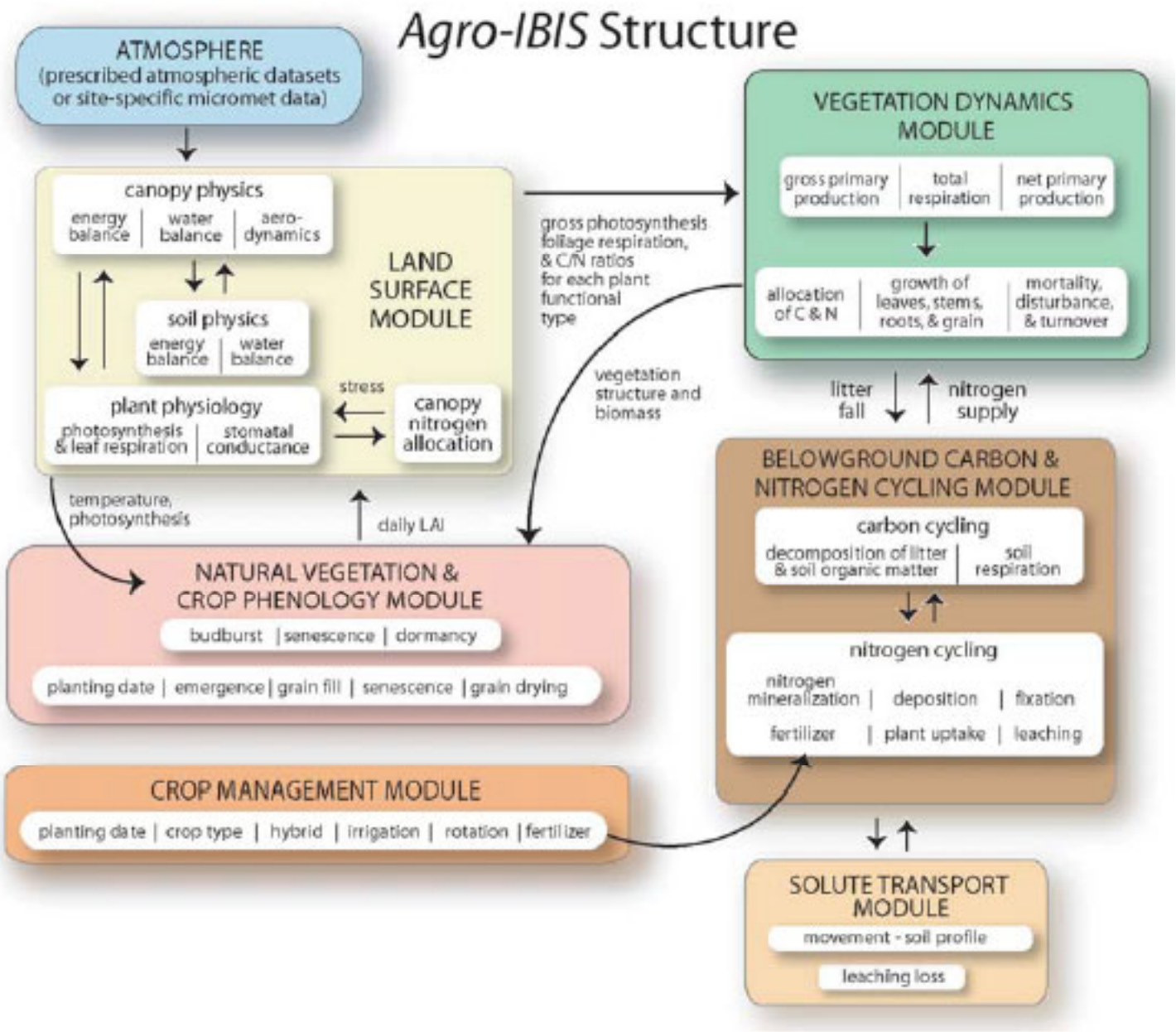
Groundwater Pumping

Frequency
Spatial Extent
Volume

Climatic and Cultural Drivers of Recharge

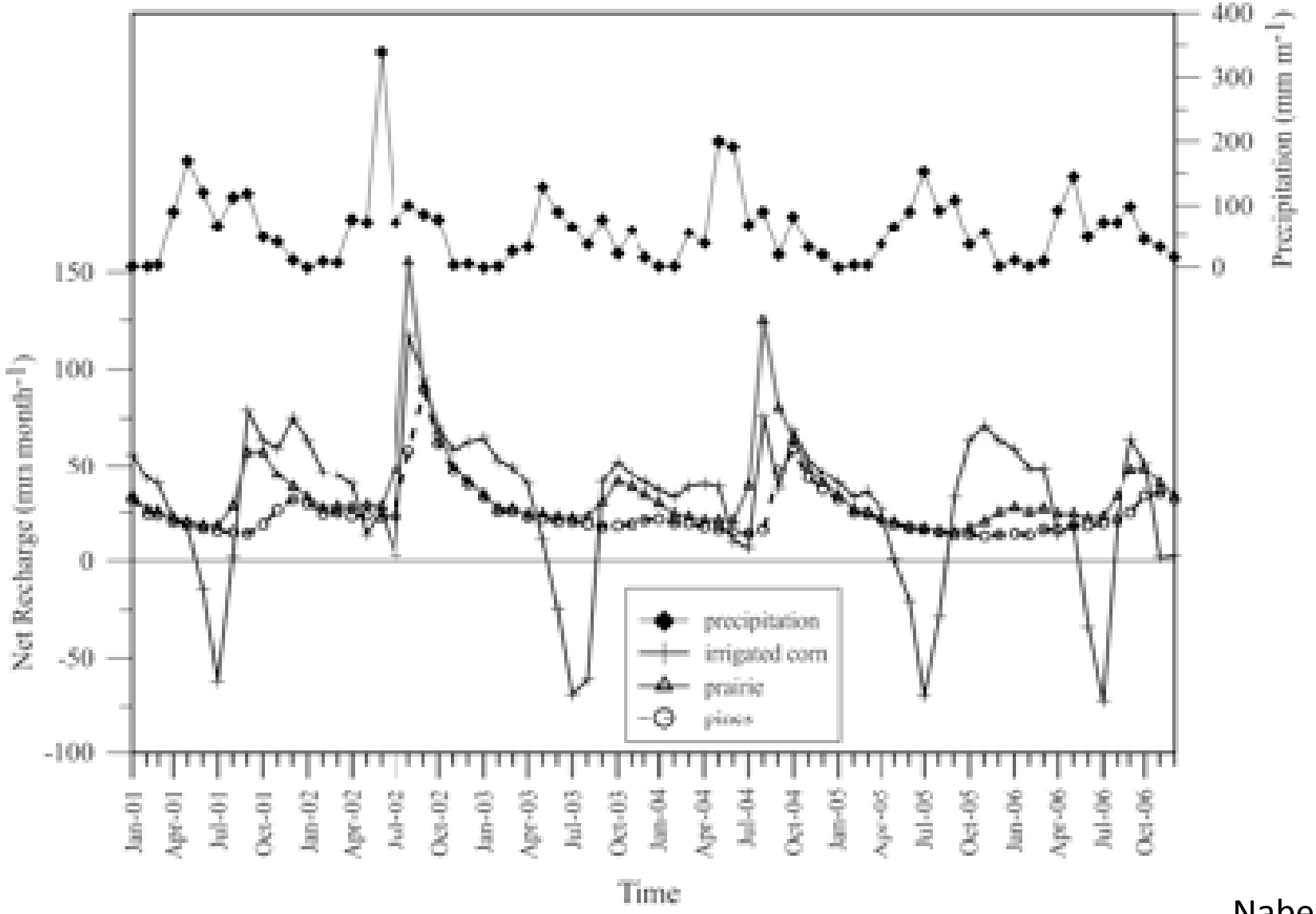
Climatic or Cultural Driver	Groundwater Recharge	Rationale
↑Total Annual Precip	↑	Increased water into the system
↑Temperature	↓	PET increases
↑Frost during Thaw	↓	Frost encourages runoff
↑Irrigated Land	↓	Greater LAI for more of the year
↑Crop Cover	↓	Greater AET for more of the year
↓Tillage during Shoulders	↓	Greater residue/standing crop canopy evaporation from surface

Adapted from WICCI, 2011



Kucharik, 2003

Conundrum of the Shoulder Season



Naber, 2011

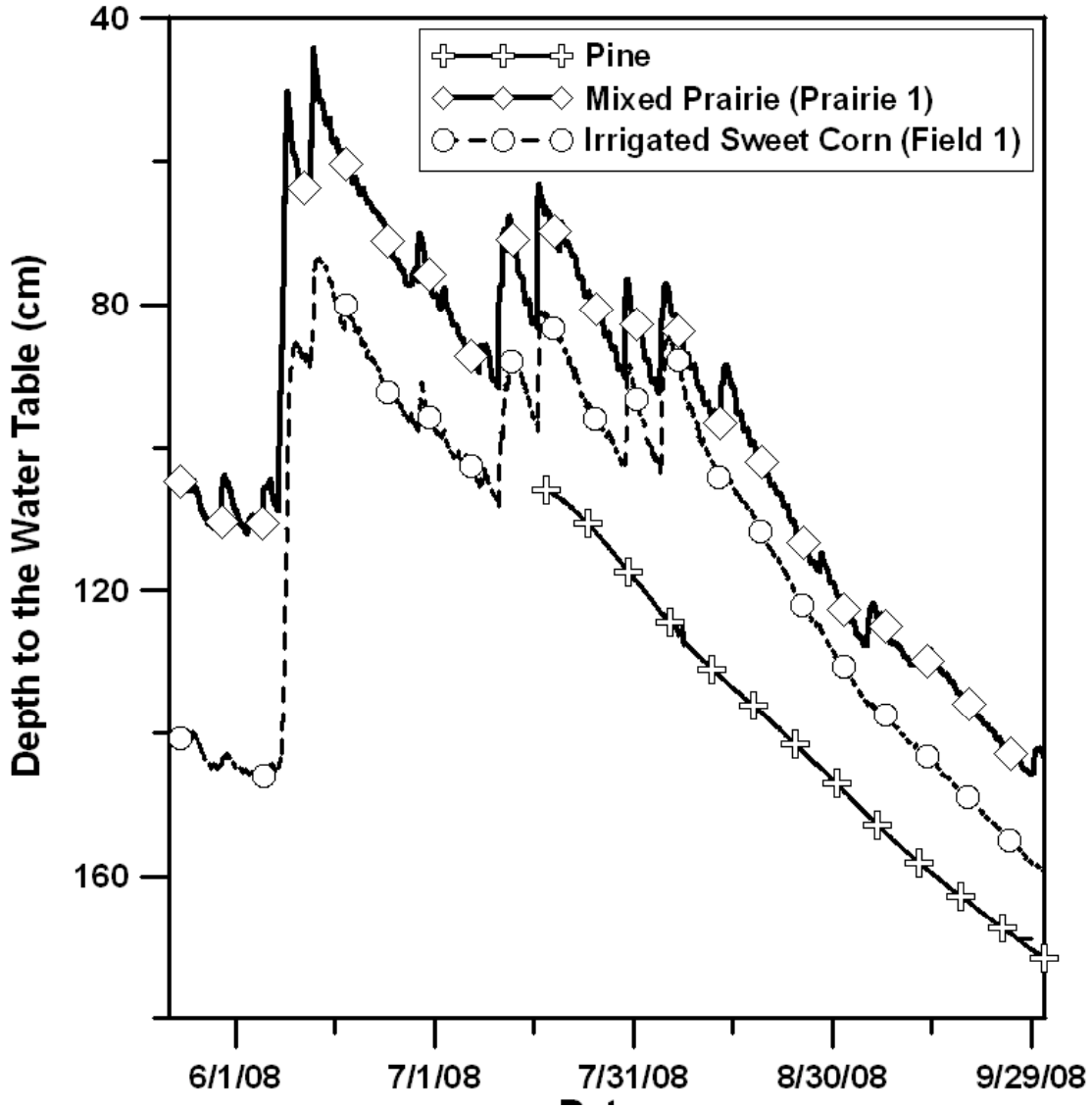
Portage County, WI Fall 2012

Wheat in Waupaca, WI Fall 2012

Winter Wheat Fall 2010

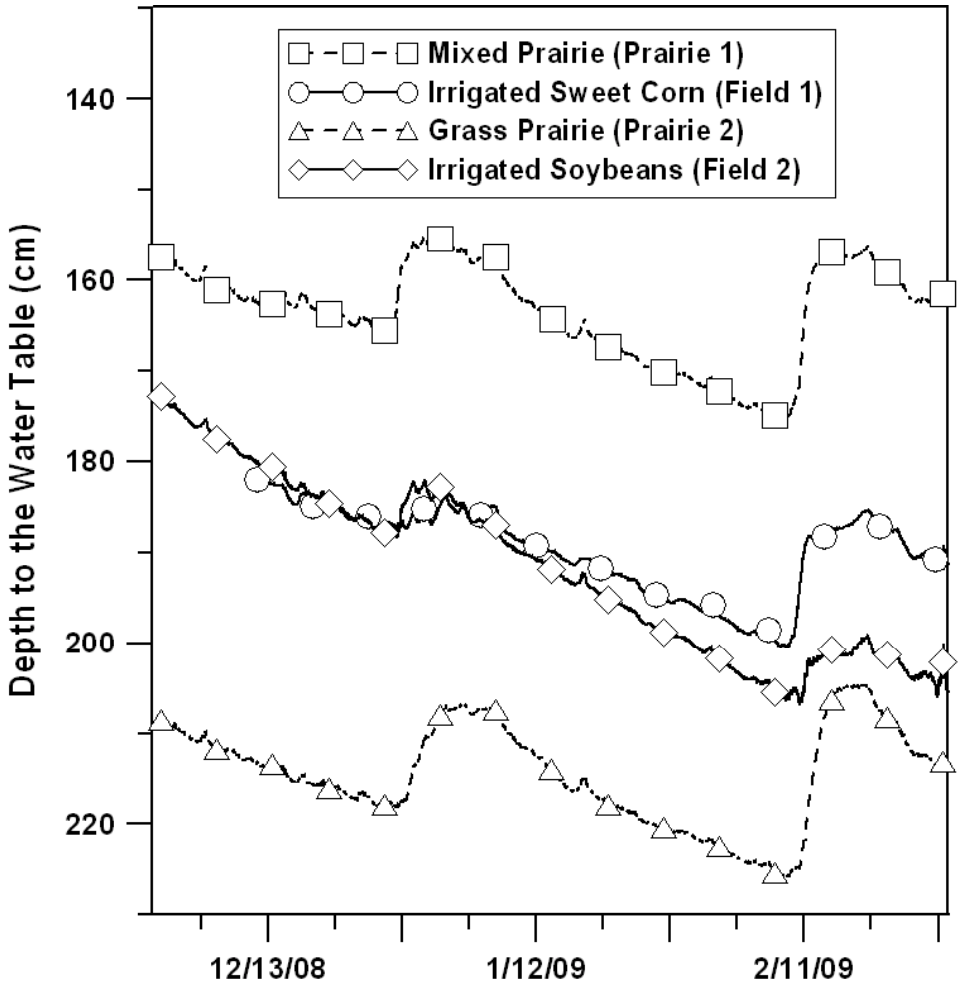
Potato Field with Winter Wheat Fall 2010

Summer Field Data (Spring?)



Weisenberger, 2009

Winter Field Data (Fall?)



Weisenberger, 2009

Future Work: Field Studies

Cropping System	**Irrigation**	**Fall tillage**	**Spring**	**Summer**	**Fall**	**Winter**
Bare soil	Rainfed	N/A	Bare soil	Bare soil	Bare soil	Bare soil
Continuous maize	Rainfed	Conventional	Maize	Maize	Maize	Bare soil
Continuous maize	Irrigated	Conventional	Maize	Maize	Maize	Bare soil
Continuous maize	Rainfed	No-tillage	Maize	Maize	Maize	Maize residue
Continuous maize	Irrigated	No-tillage	Maize	Maize	Maize	Maize residue
Potato-oats (cover crop)	Irrigated	Conventional	Potato	Potato	Bare soil	Bare soil
Potato-oats (cover crop)	Irrigated	Cover Crop	Potato	Potato	Oats	Oats

Future Work: Modeling

Sim	Tillage/residue/cover	Crop Type	Irrigation
1.	N/A	Potential Vegetation	Rainfed
2.	Conventional	Corn	Rainfed
3.	No-till/100% residue cover	Corn	Rainfed
4.	Conventional	Corn	Irrigated
5.	No-till/100% residue cover	Corn	Irrigated
6.	Conventional/bare soil	Potato	Irrigated
7.	No-till/fall cover crop	Potato	Irrigated

Acknowledgements

- Professor Chris Kucharik, UW-Madison
- Professor George Kraft, UW-Stevens Point
- WI-DNR
- University of Wisconsin Consortium

Questions?