

Perennial Grass, Corn and Soybean Effects on Soil Moisture and Inorganic Nitrogen Leaching in Central Illinois

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October 9, 2008

Context of our study

- Council on Food and Agricultural Research (C-FAR) Strategic Research Initiative 2003-2008 on biomass crops for energy, comparing switchgrass, *Miscanthus giganteus* and corn-soybean for energy production, economics and environmental impacts.
- <http://miscanthus.uiuc.edu/>

switchgrass



Miscanthus giganteus

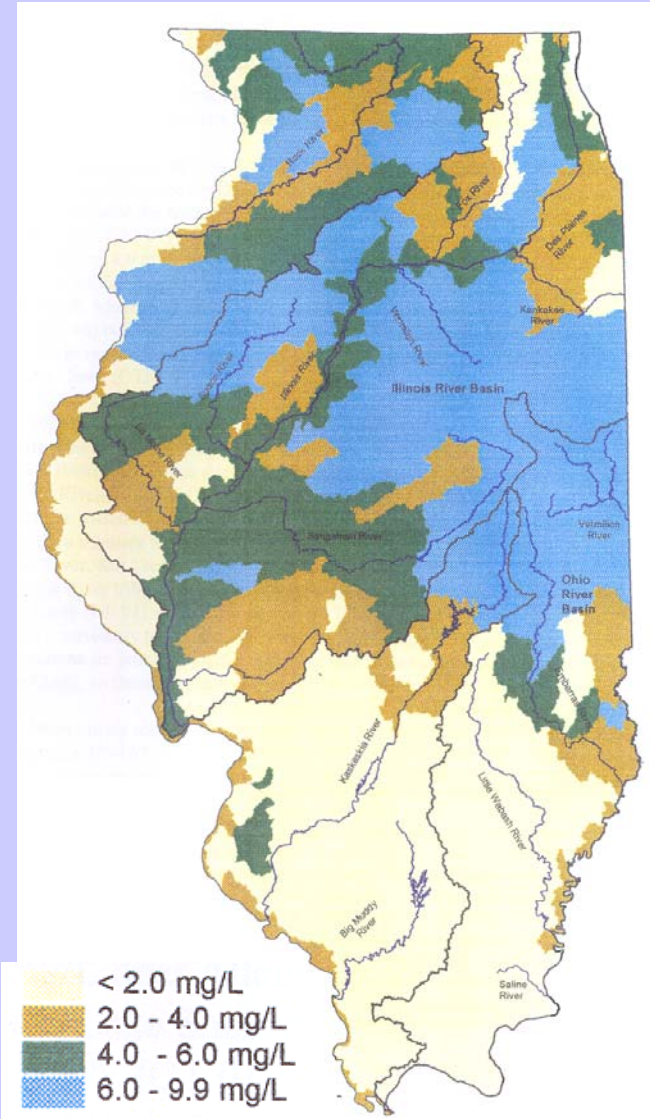


Our sub-project focus

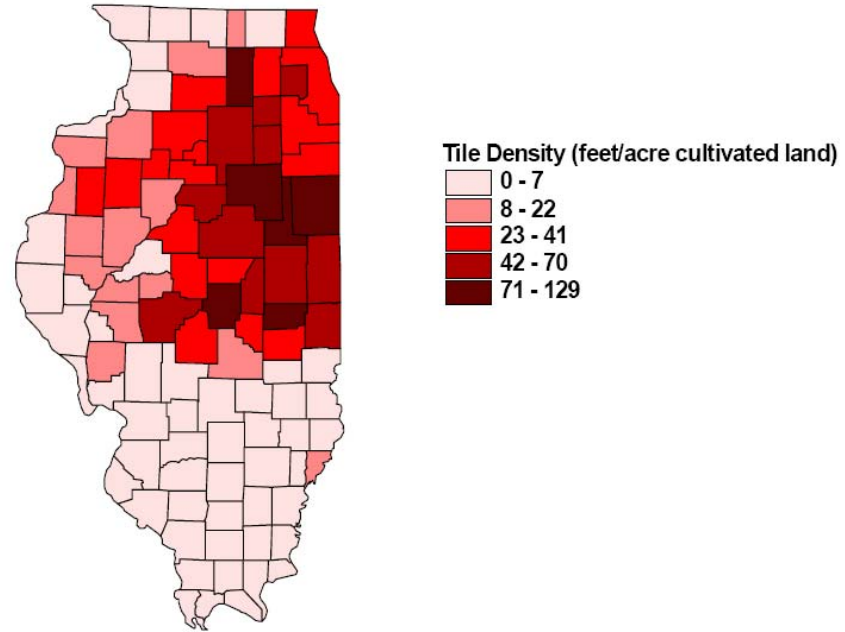
evaluation of impacts on water resources by focusing on water use by and nitrogen leaching from biomass crops compared to a conventional corn and soybean rotation

- intensive soil moisture measurements to estimate evapotranspiration in experimental plots on the UIUC South Farms
- resin lysimeters to quantify nitrogen leaching

Illinois EPA Average Concentrations of Nitrate + Nitrite-N in streams 1980-1996

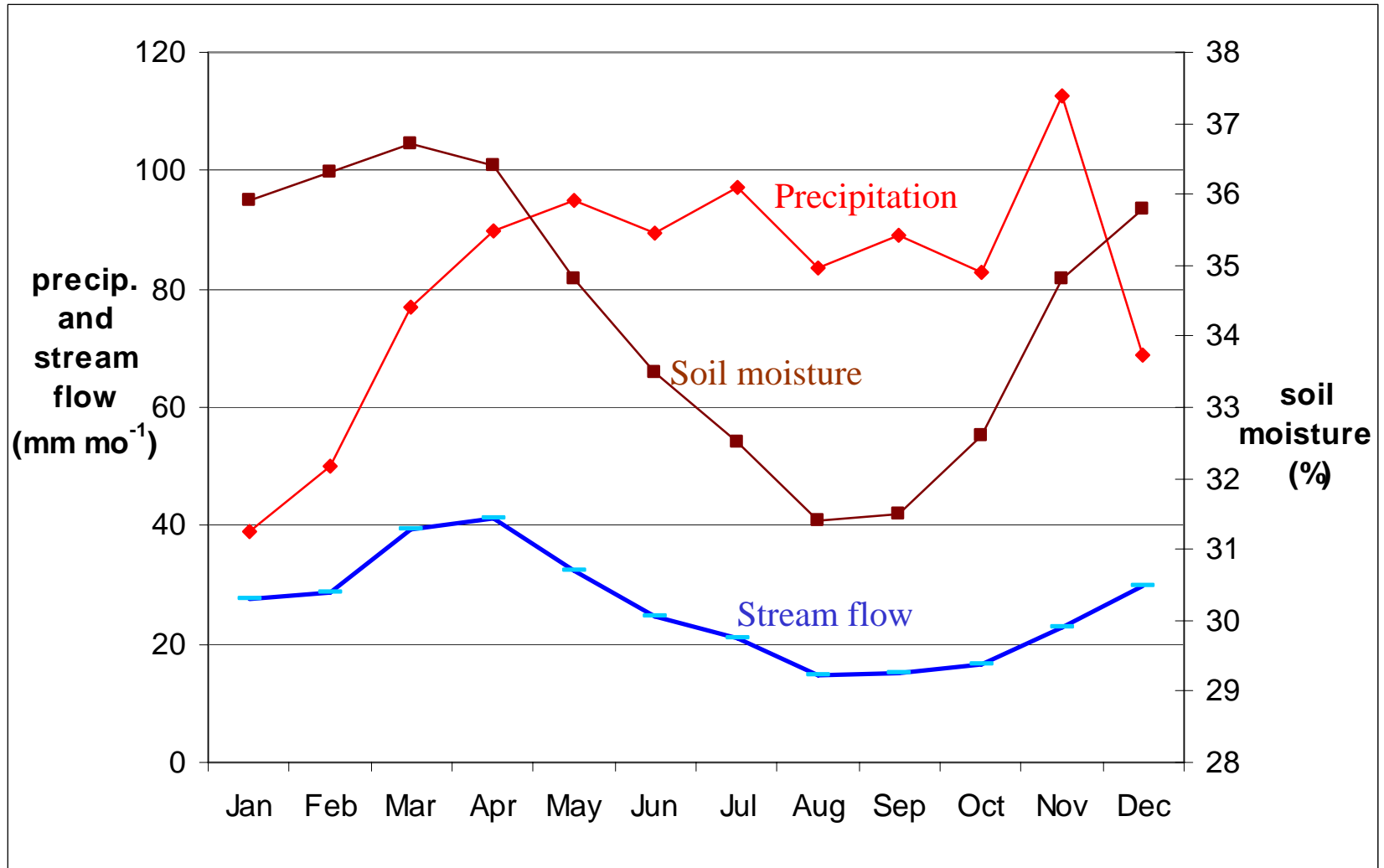


Status of Tile Drainage in 1909



Source: Davison, 1915

Components of the Illinois Hydrologic Cycle



1983-94 average data from Illinois Climate Network and US Geological Survey taken from Yeh et al. (1998)

Soil Moisture Measurements

Diviner2000 Portable Water Monitoring Device

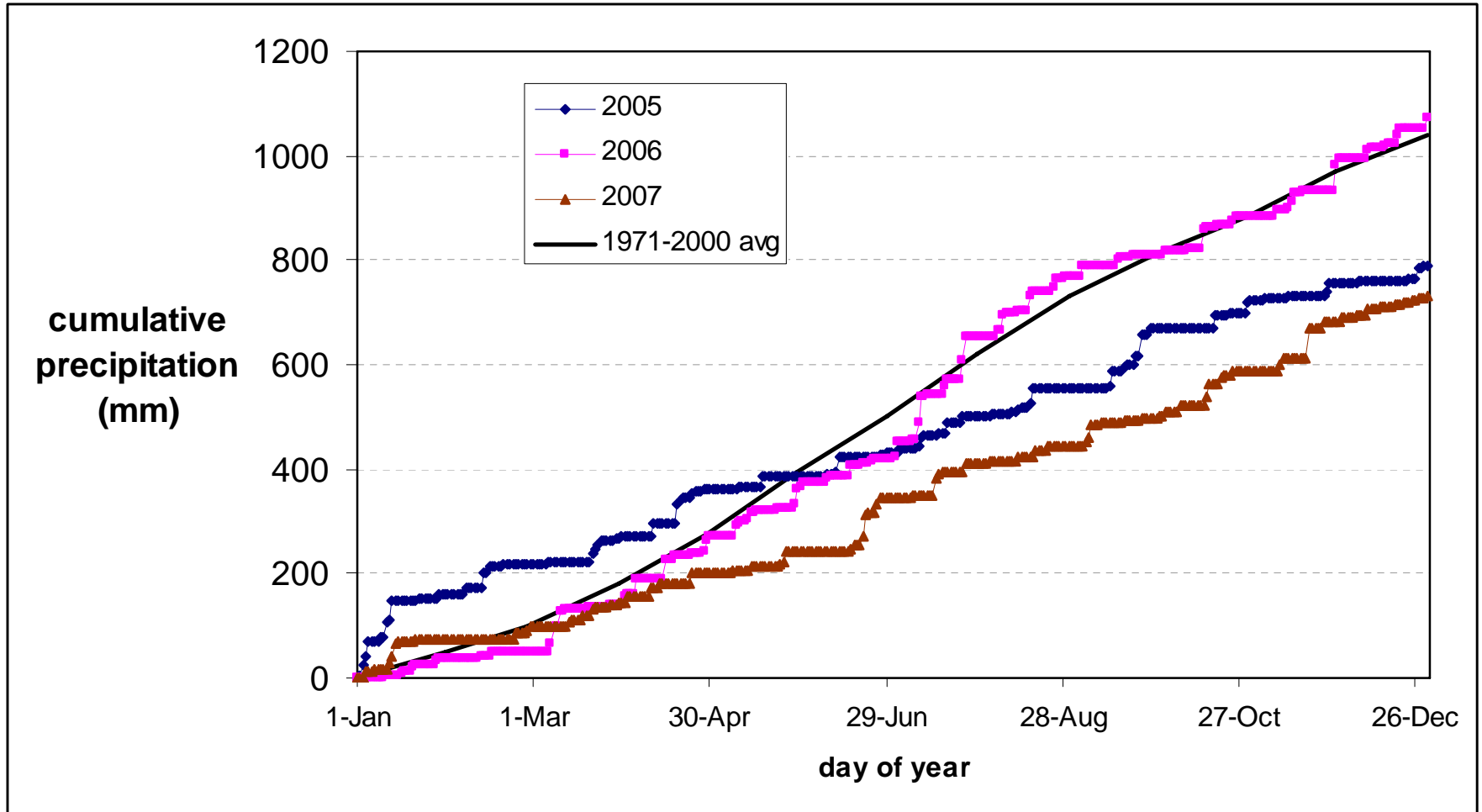
Utilizes Frequency Domain Reflectometry (FDR) to measure soil water content every 10 cm down a 90 cm tube



Soil Moisture Measurements

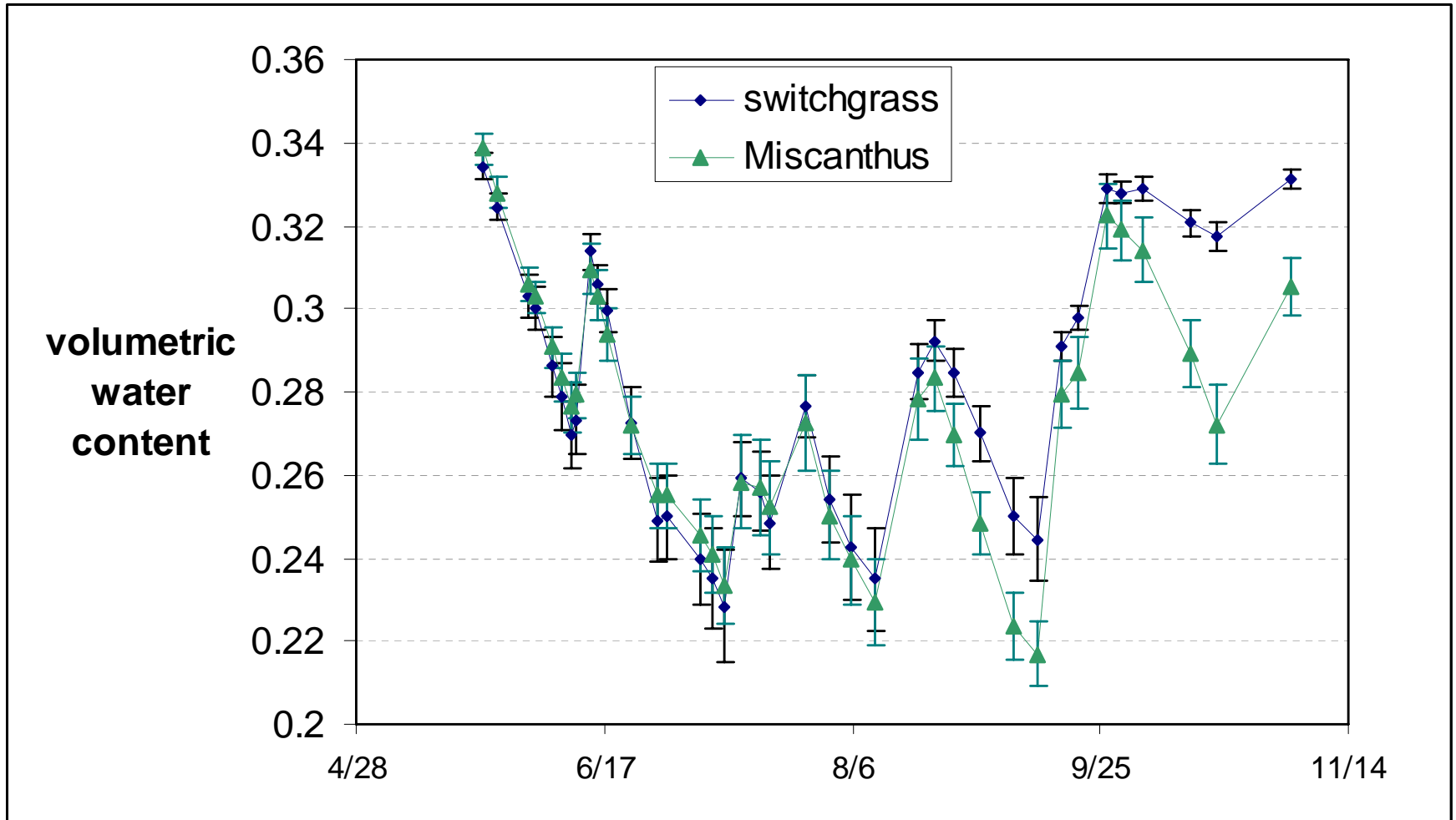
- total of 94 tubes
 - generally 4 tubes per plot
 - about 16 to 24 replicate tubes per treatment
 - Measured approximately every 3 to 4 days during growing season
- data collected in 2005 through present

Cumulative precipitation at Urbana and South Farms



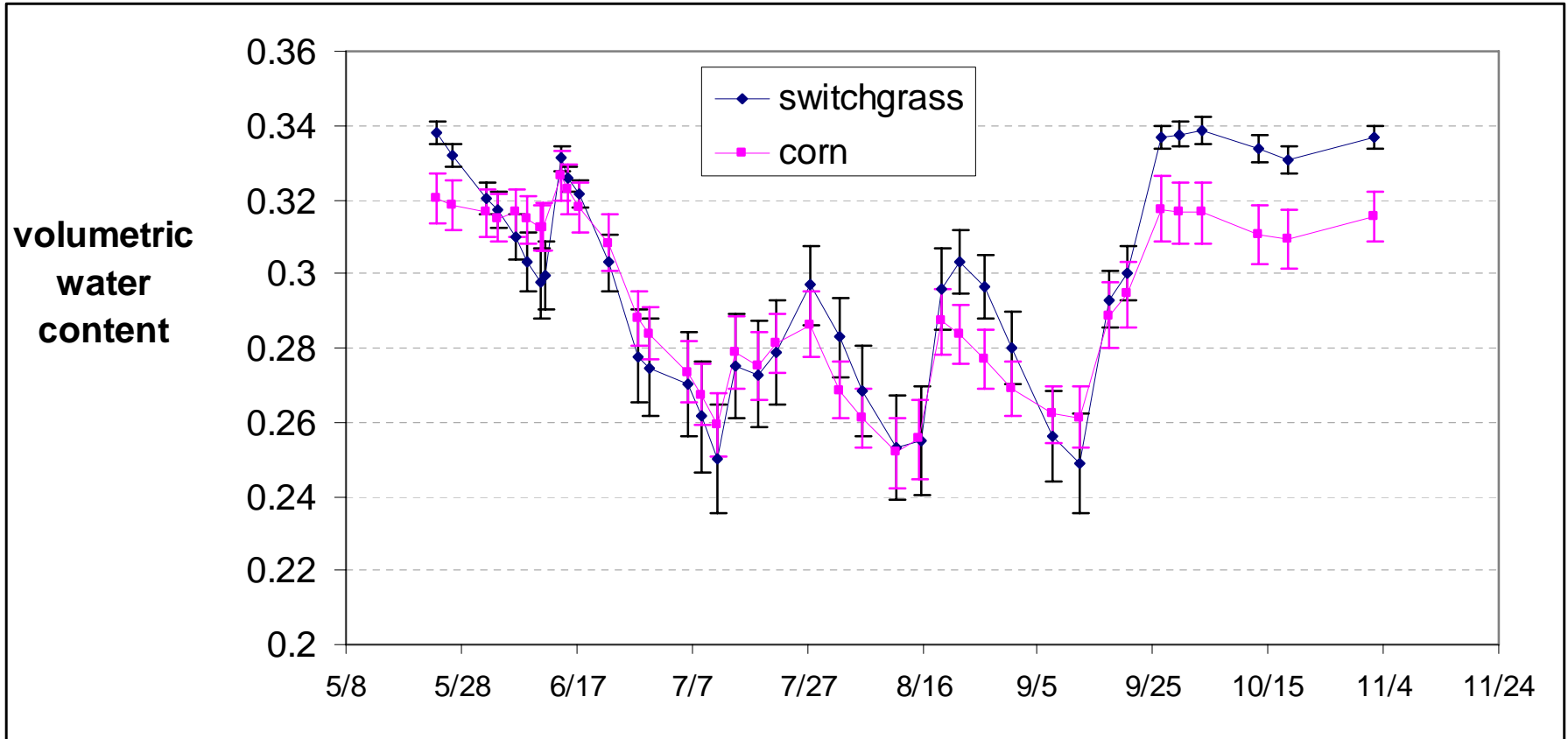
Soil Moisture 2005 (0 to 90 cm)

(small plots)



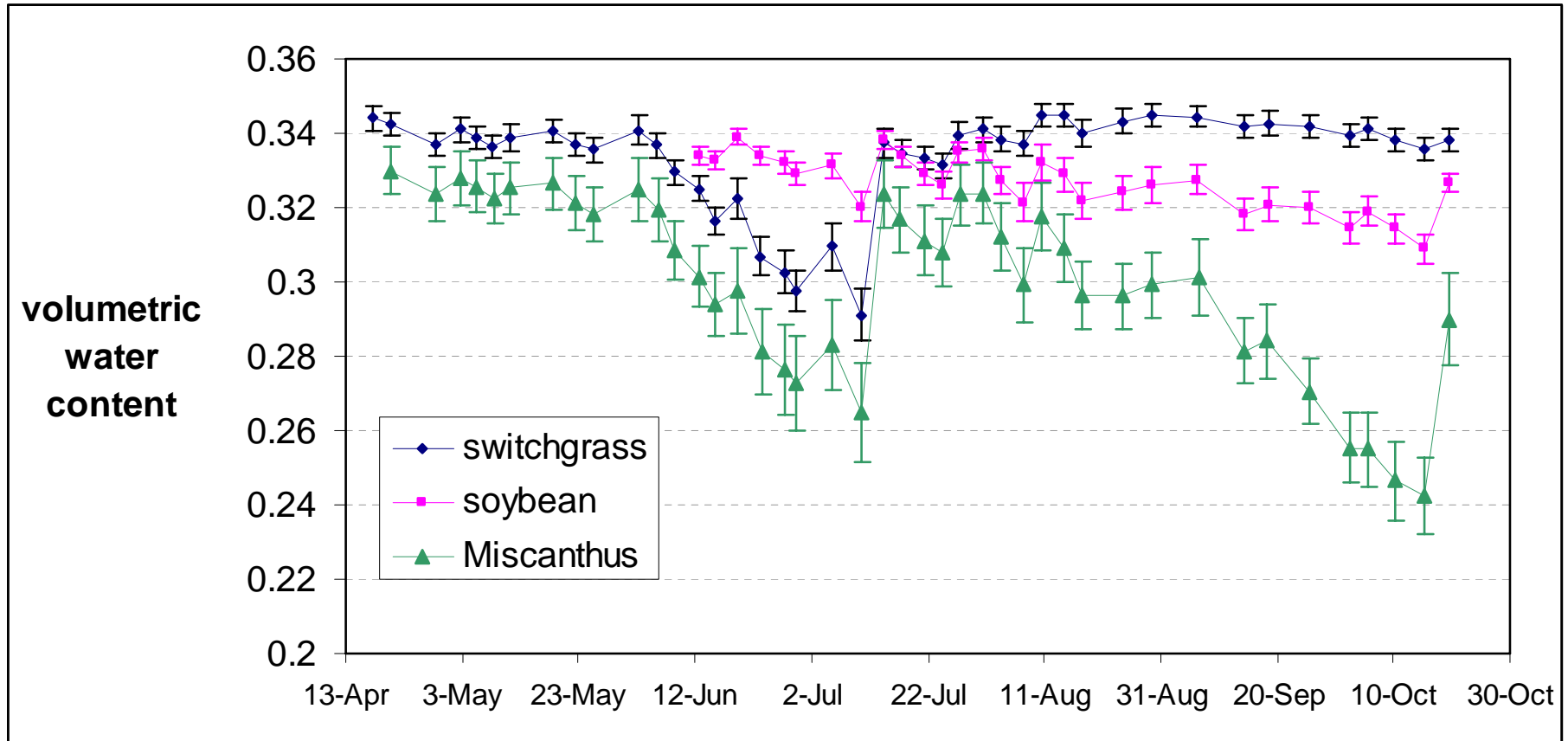
Soil Moisture 2005 (0 to 90 cm)

(large plots)



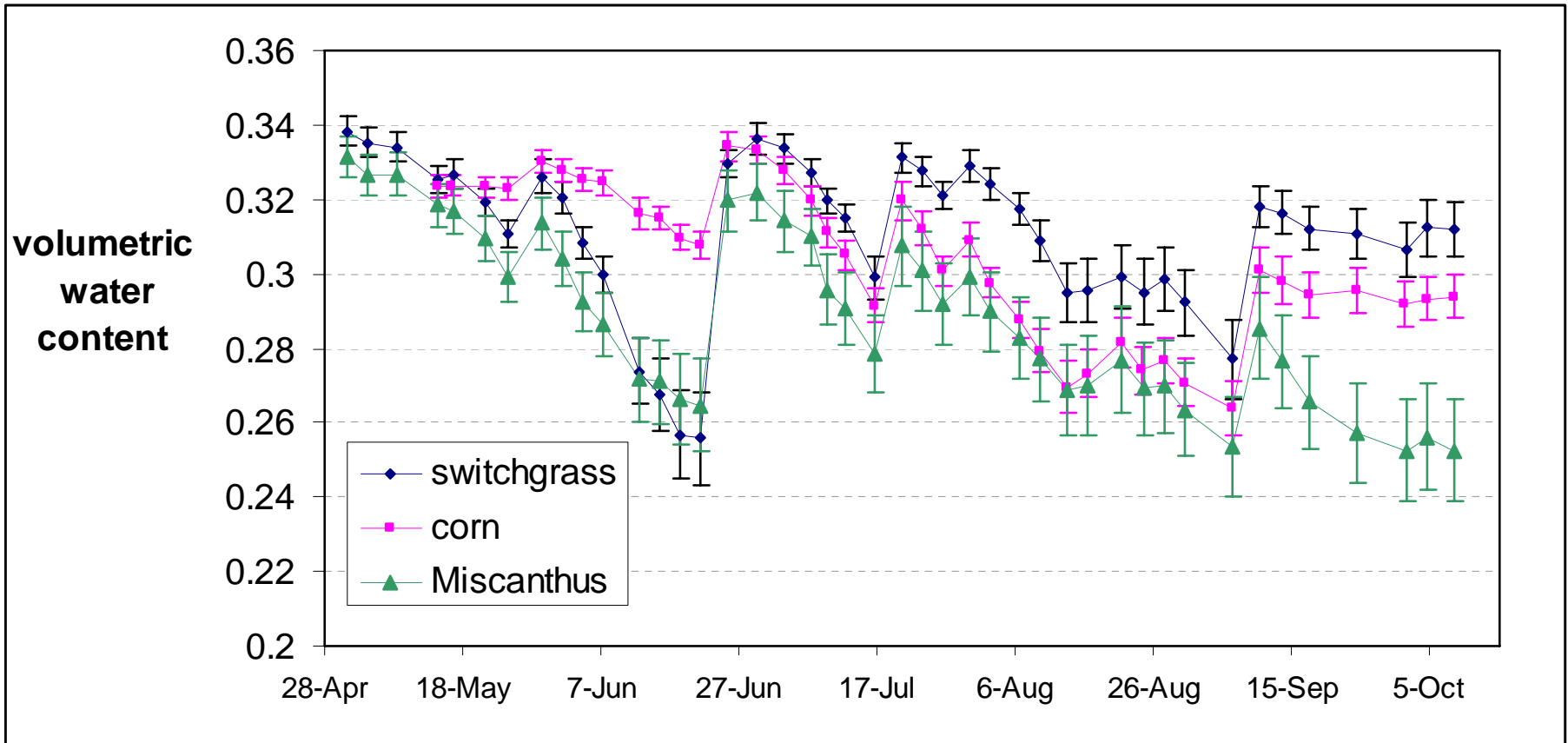
Soil Moisture 2006 (0 to 90 cm)

(large plots)



Soil Moisture 2007 (0 to 90 cm)

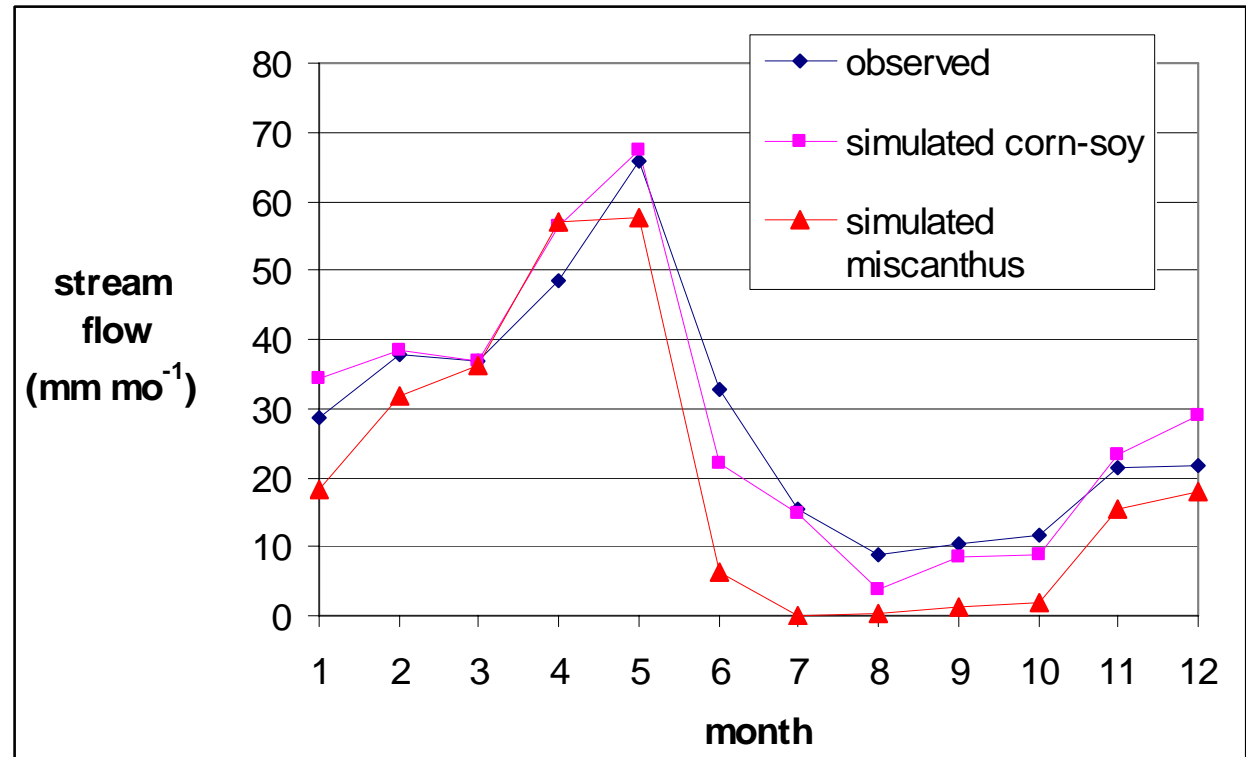
(large plots)



Soil Moisture

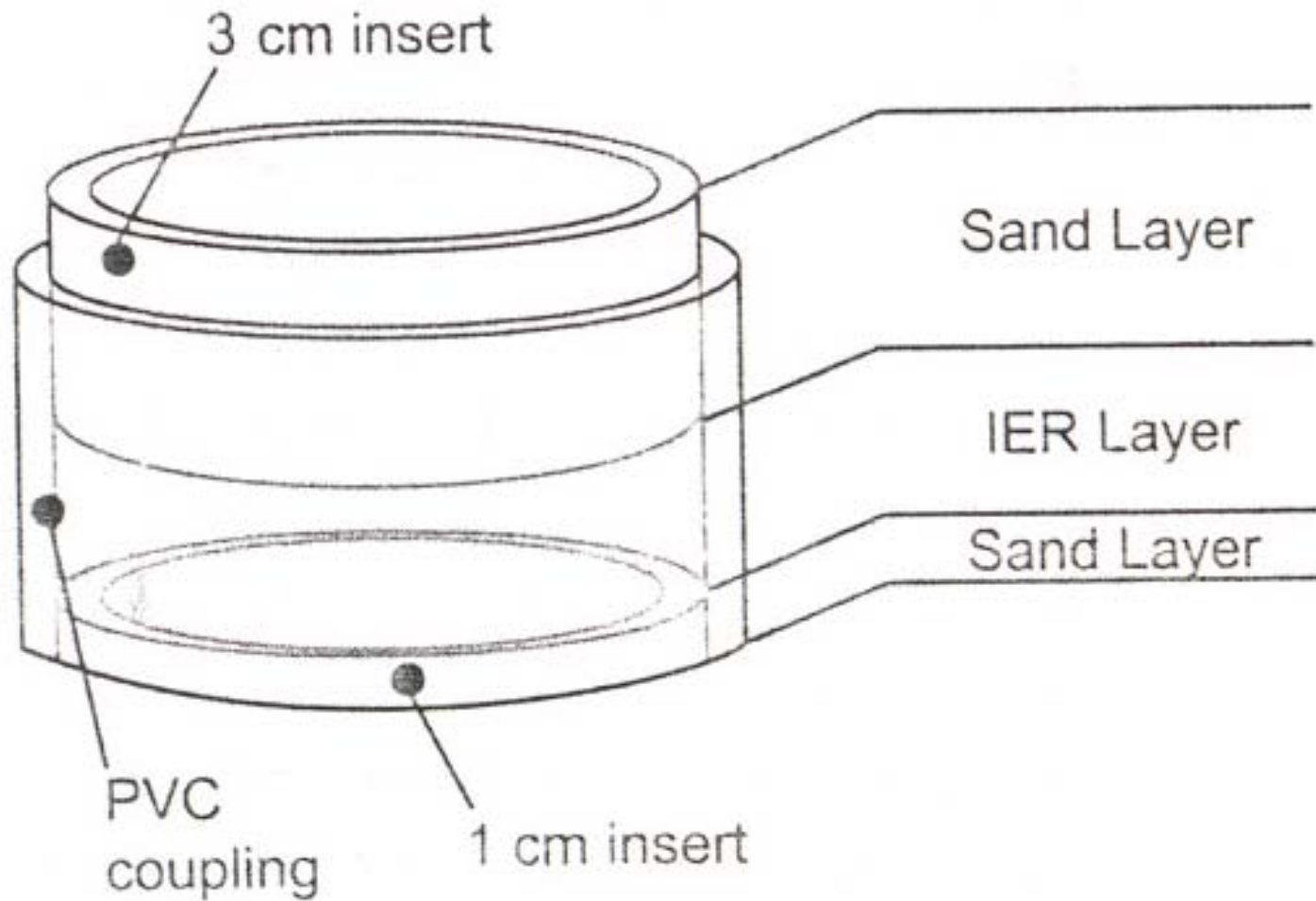
- data analysis still underway:
- Calibration of a crop evapotranspiration model for estimating longer term and larger scale impacts on stream flows

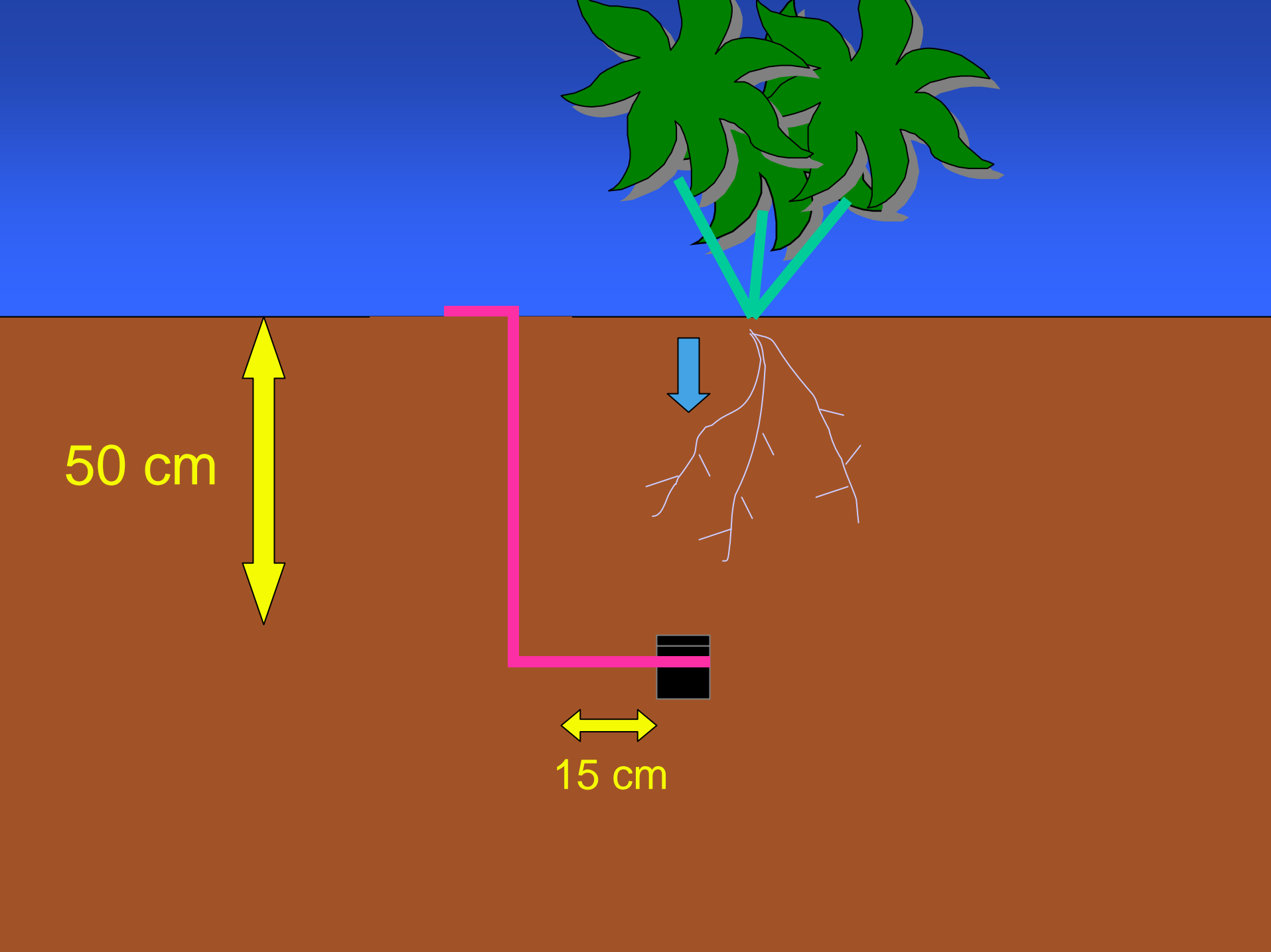
Preliminary modeling result
Simulating the Embarras watershed at Camargo 1989-2003, all corn-soybean vs. all Miscanthus. Additional model refinement needed.



Assessing N Leaching

Ion Exchange Resin (IER) Lysimeters

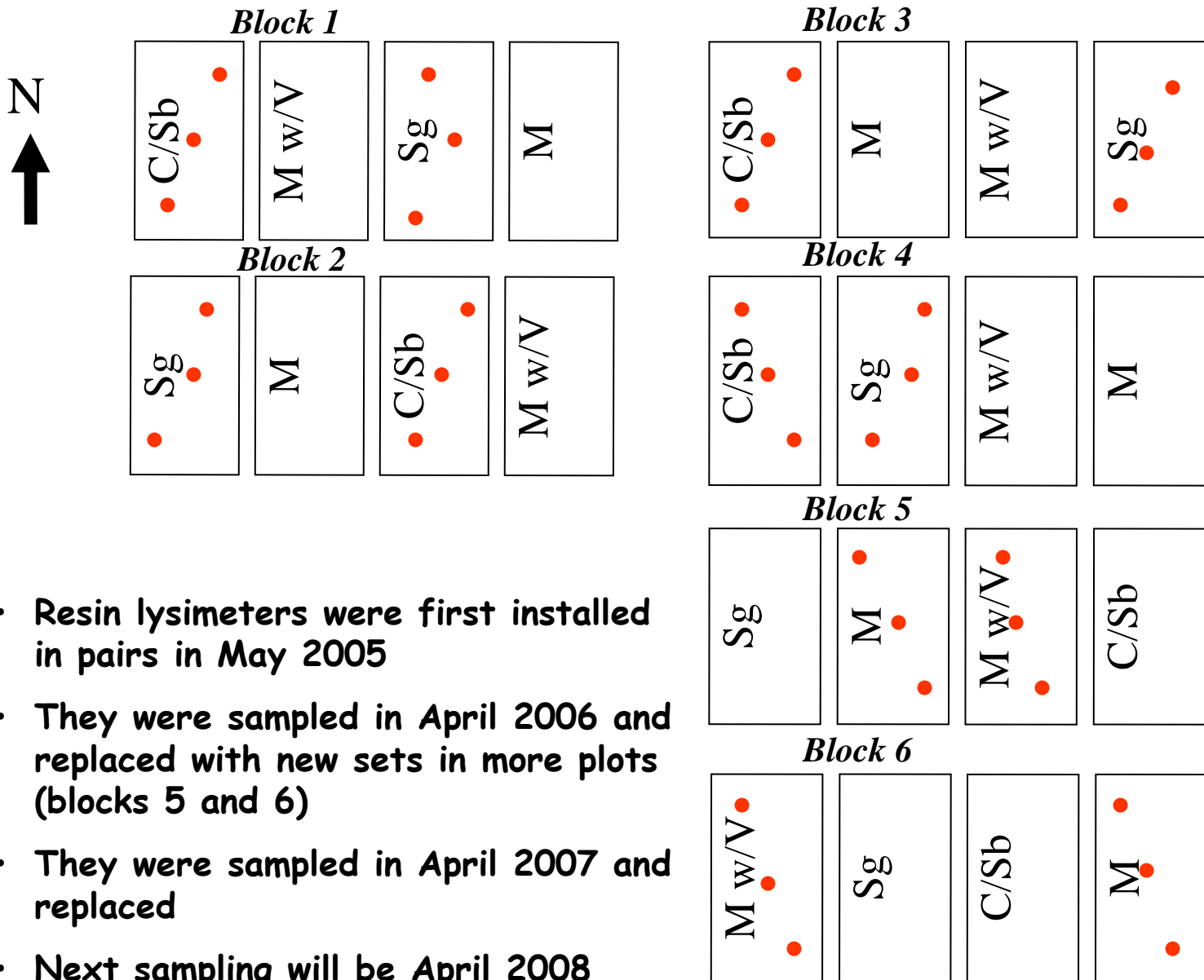




50 cm

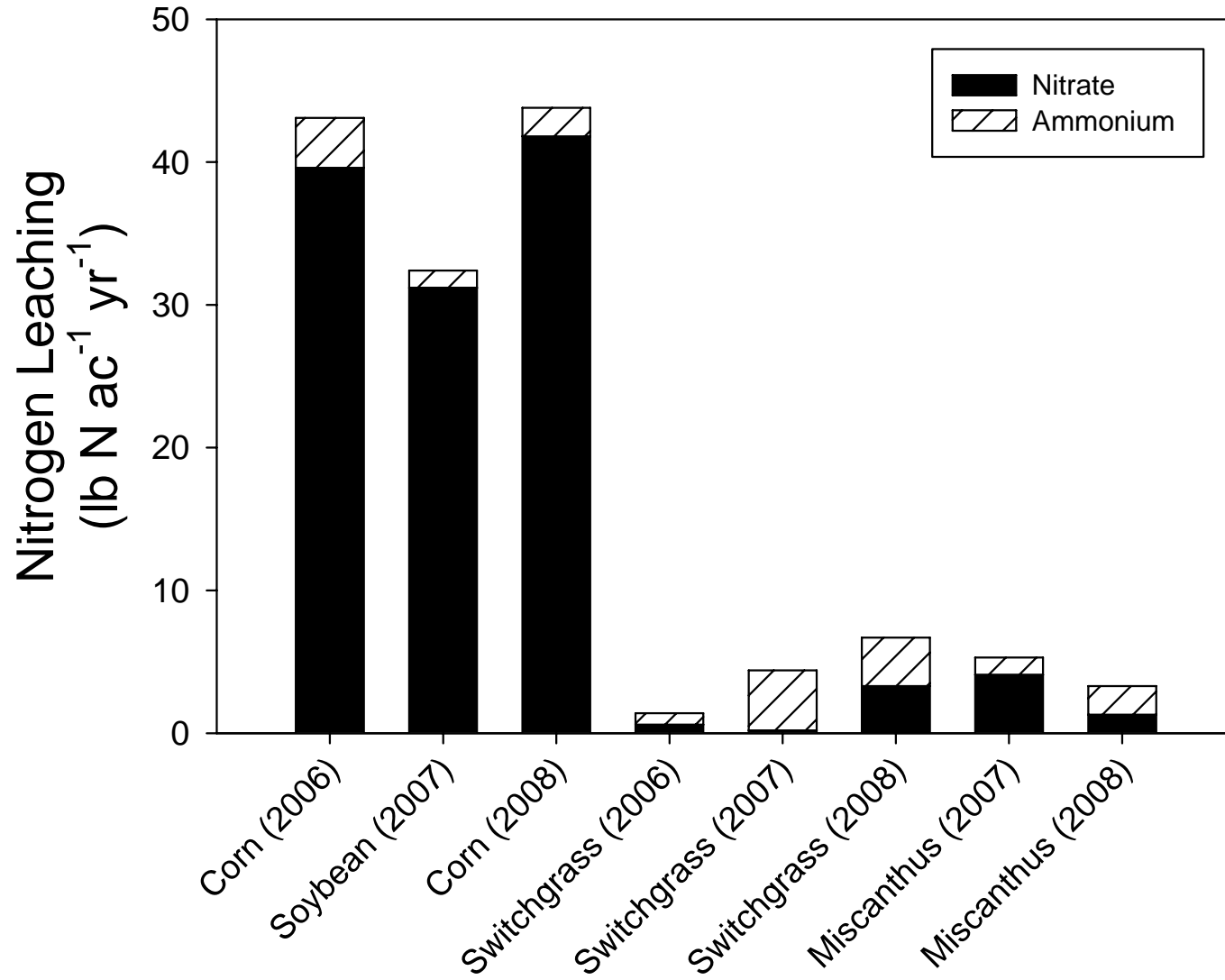
15 cm

Resin Lysimeters



- Resin lysimeters were first installed in pairs in May 2005
- They were sampled in April 2006 and replaced with new sets in more plots (blocks 5 and 6)
- They were sampled in April 2007 and replaced
- Next sampling will be April 2008

Inorganic N Leaching below 50 cm



Working Conclusions

- biomass crops (switchgrass and *Miscanthus*) greatly reduced inorganic N leaching compared to corn and soybean
- soil moisture early in the growing season was reduced in biomass crops compared to corn and soybean
- end of the growing season soil moisture was significantly lower under *Miscanthus* than other crops examined
- widespread adoption of switchgrass or *Miscanthus* has some potential to reduce flood flows during spring
- *Miscanthus* also has some potential to extend and intensify low stream flow periods of late summer and early fall

Thank you