# Untangling the Influences of Shallow Groundwater and Soil Texture on Corn Yield Variability

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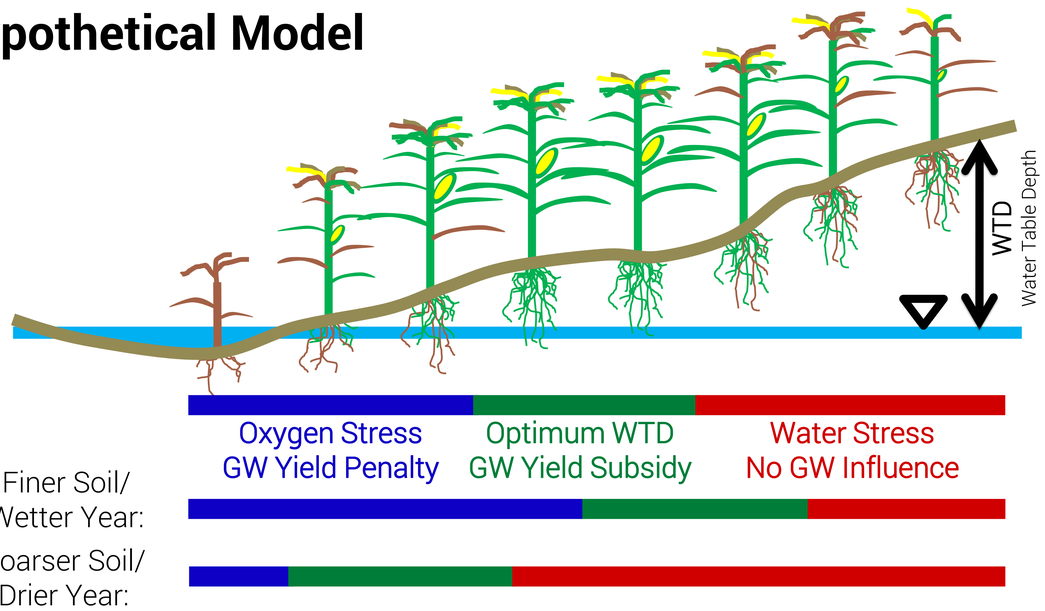
## Research Questions

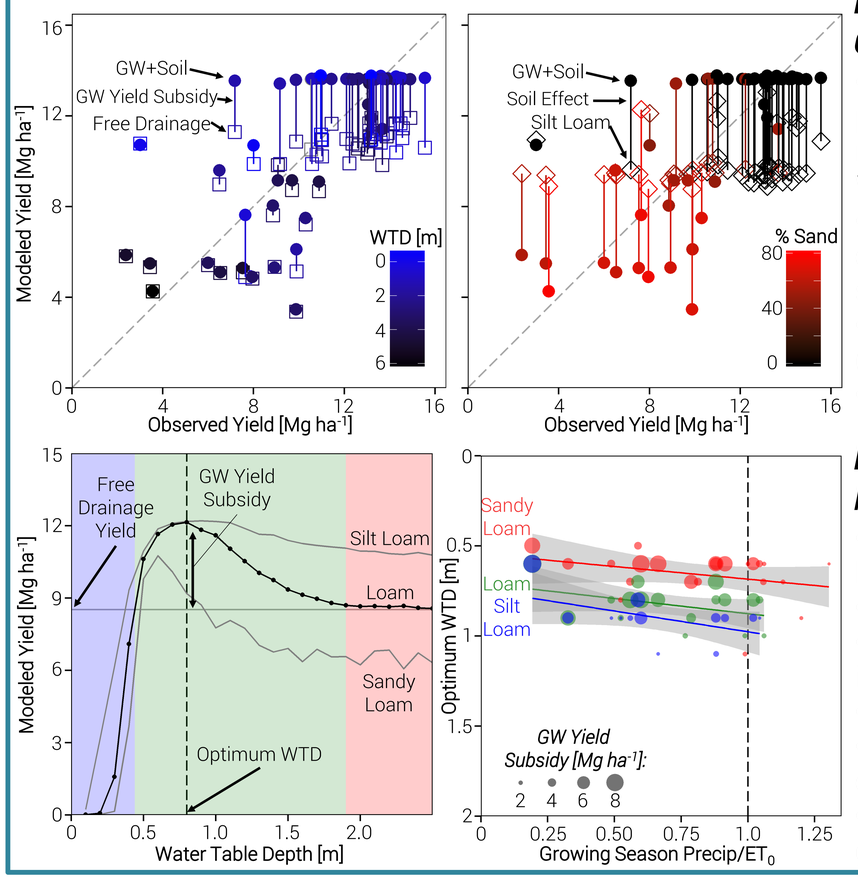
(1) Under what conditions can a shallow water table provide a groundwater yield subsidy and/or penalty to corn production?

(2) How do soil texture and growing season weather conditions influence the relationship between WTD and corn yield?

## Hypothetical Model




## Biophysical Modeling: AgroIBIS-VSF



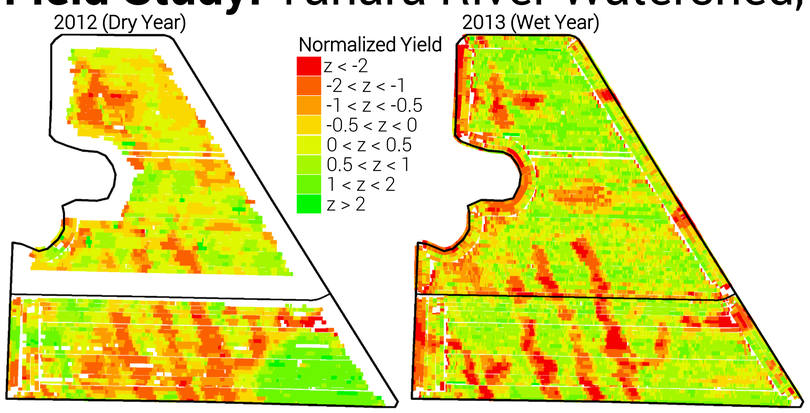

### *Experiment 1: Study Site Validation & Groundwater/Soil Separation*

- Simulations at 61 points using Rosetta pedotransfer function for soil water retention characteristics and interpolated WTD (GW+Soil points on graph)
- Additional simulations with free drainage conditions (squares, left plot) and silt loam soils (diamonds, right plot)
- GW yield subsidy: -0.68 to +3.76 Mg ha$^{-1}$ (mean = +1.86 Mg ha$^{-1}$)
- Soil texture effect: -4.57 to +5.31 Mg ha$^{-1}$

### *Experiment 2: Factorial WTD/Soil Impacts*

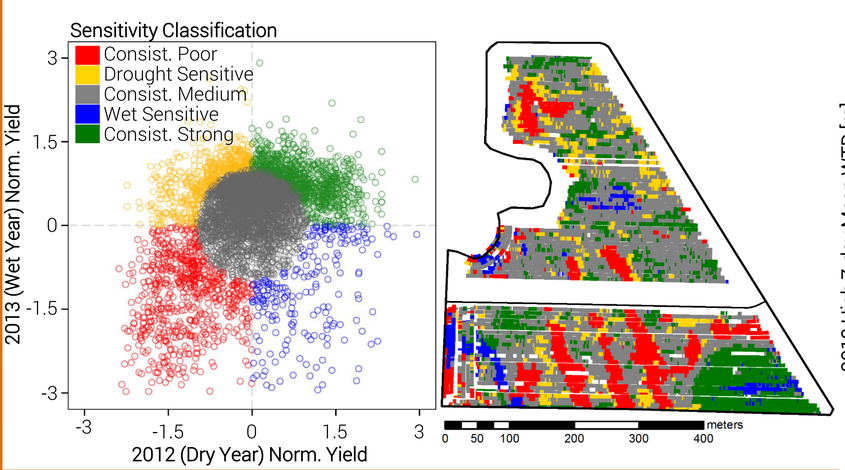
- Simulated 1986-2013 growing seasons, holding WTD constant at 0.1 to 4.75 m
- Single growing season shown in left plot
- Years when GW yield subsidy > 10% shown in right plot
- Optimum WTD is shallower in finer soils
- Groundwater yield subsidy is more common and larger in coarser soils
- Different soil types respond to changes in growing season weather conditions similarly

## Field Study: Yahara River Watershed, South-Central Wisconsin

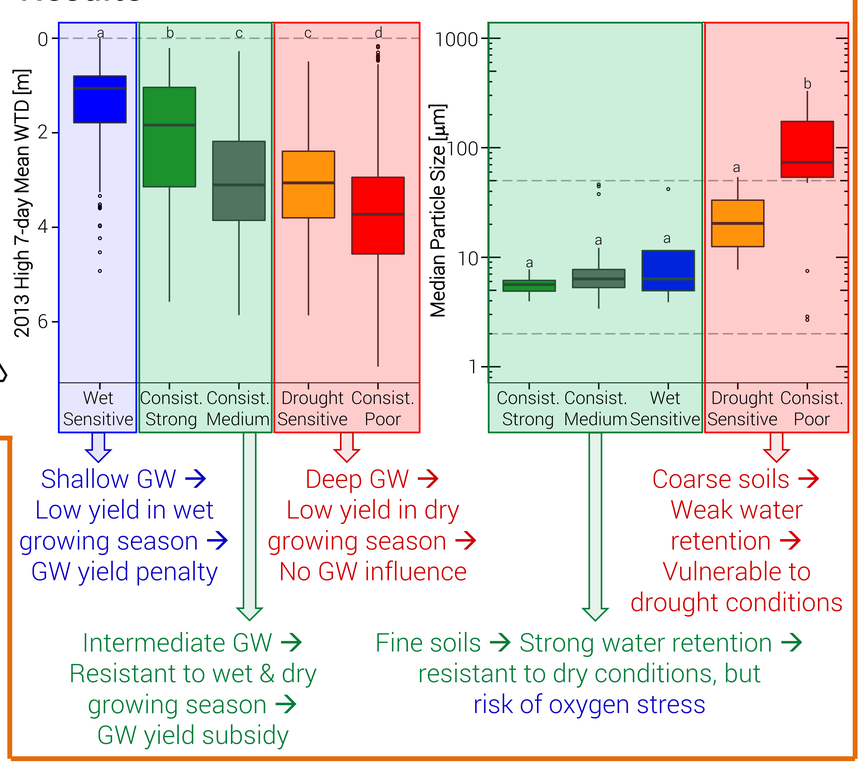



### *Site Description & Methods*

- Dane County, south-central Wisconsin
- 50 acre commercial cornfield with ~8 m of topographic relief.
- Soil primarily silt loam, with loam & sandy loam at higher elevations.
- Yield data collected using GPS-equipped combine.
- GW data interpolated between monitoring wells in/surrounding field (not shown) at 3-hr resolution.
- Soil texture sampled at 61 random points within field, particle size distribution calculated using Beckman-Coulter LS230.




### *Results*




## Conclusions

- Areas with shallow groundwater experience a groundwater yield penalty during wet years
- Areas with intermediate groundwater experience a groundwater yield subsidy during dry years and are more drought resistant
- Regions with no groundwater influence experience yield losses during both years
- Optimum WTD is a function of soil type and growing season weather conditions
- Coarser soil increases the probability of receiving a groundwater yield subsidy
- Closing yield gaps requires understanding interactions between WTD, soil texture, and weather

## Work is published:

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