Impacts of environmental factors on corn yield-fertilizer rate response: observation and model simulation

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1. Introduction

- Nitrogen(N) is an important nutrient in food, livestock feed and fiber production. It's urgent to improve the Nitrogen Use Efficiency to mitigate the challenge of world population increasing, arable area limitation and N pollution.
- We use both field experiment data and *Ecosys* model to explore the impacts of environment factors on crop yield-fertilizer response.

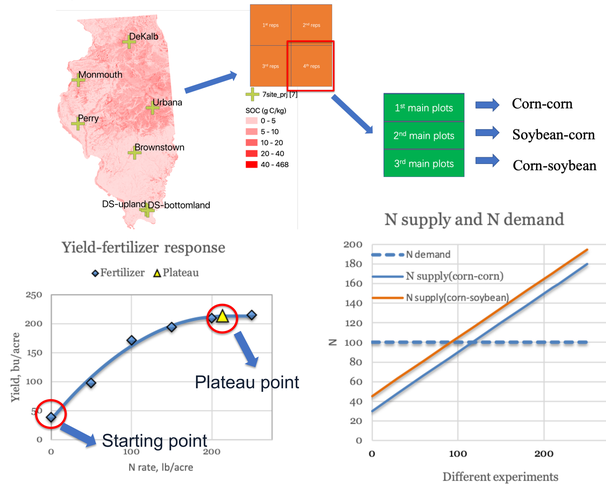
Scientific questions:

- Which environment factors control the starting yield/plateau yield/plateau nitrogen of the fertilizer-yield response curve?
- What is the influence of different rotations (corn-corn and corn-soybean) to the yield-fertilizer response?

2. Method and data

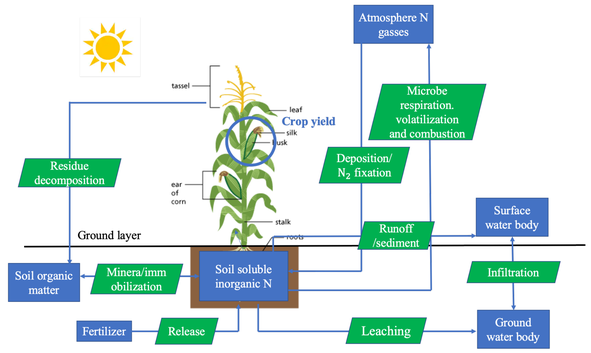
(1) Field experiment

We used the field experiment data(1999-2008) from 7 sites across the Illinois states. All these sites collect 10-year corn yield with different fertilizer rate (0, 45, 90, 135, 180 and 225 lb/acre) for different crop rotations (corn-corn and corn-soybean).



(2) *Ecosys* model

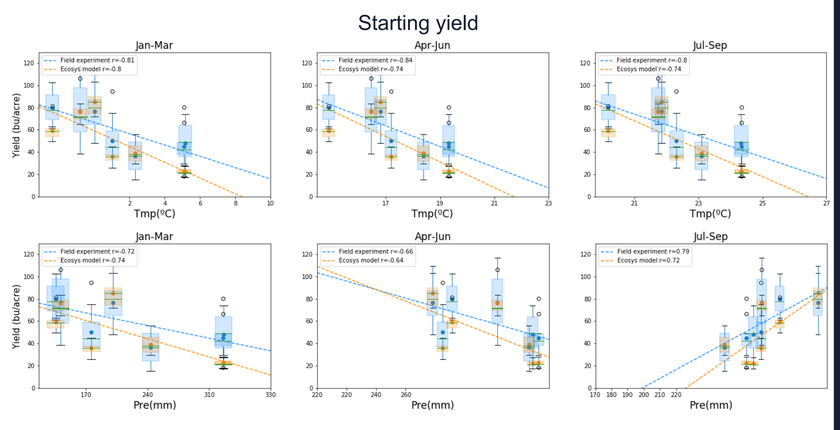
Ecosys is a mechanistically-based ecosystem model which could simulate both nutrient and water cycling in different ecosystems (agriculture, forests, savannah, grassland, tundra and desert). It could simulate the behavior under different environment conditions (soils, climates and managements).



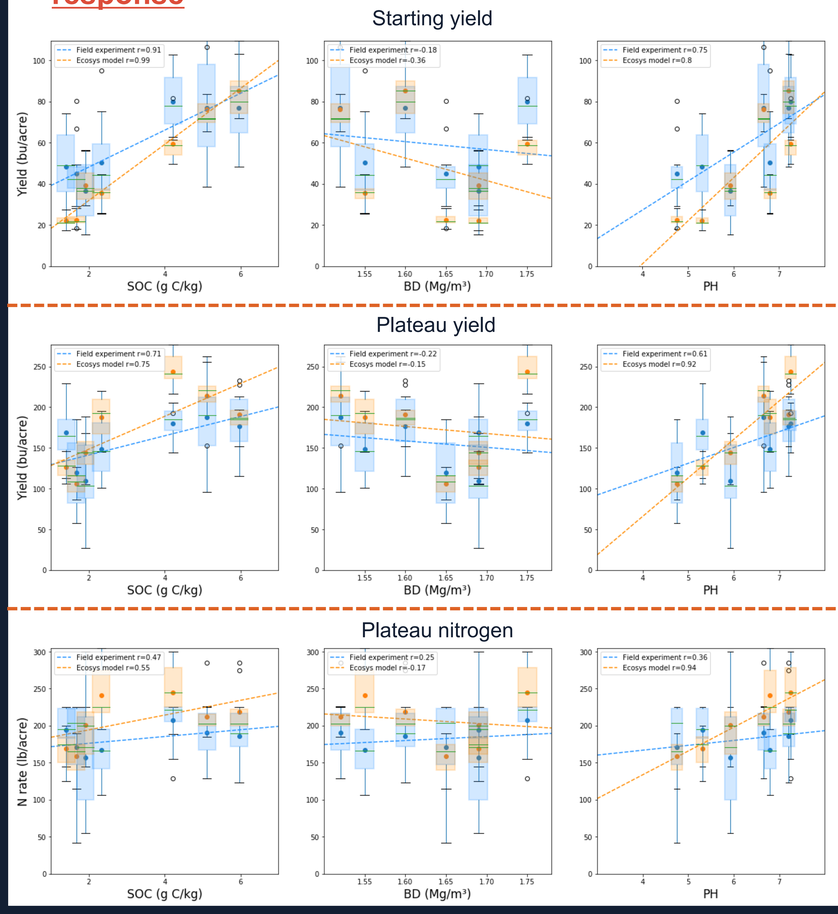
(3) Datasets

For data-driven analyses and *Ecosys* modeling, we used:
Climate Data: Parameter-elevation Regressions on Independent Slopes Model **(PRISM)** monthly product (Data-driven analyses)/ North American Land Data Assimilation System **(NLDAS-2)** forcing data (*Ecosys* model)
Soil Data: USDA Gridded Soil Survey Geographic Database **(gSSURGO)**
Fertilizer, Plant and Harvest time: Field experiment date collection

3. Impacts of climate on the yield-fertilizer rate response



4. Impacts of soil properties on the yield-fertilizer rate response



5. Conclusion

In this research, we analyzed the influence of soil and climate variables on the non-fertilizer yields based on the field experiment data collected from 7 sites across the Illinois State, and the *Ecosys* model are also tested to simulate the fertilizer-yield response on these sites:

(1) Climate during June-July has large impact on the starting and plateau yield, especially for the precipitation, which positively affects both two representative yields.
(2) Soil organic matter and PH strongly influence the starting and plateau yields.
(3) Corn-soybean rotation generates relatively large starting yield, small plateau nitrogen and similar plateau yield compared with the corn-corn rotation, which may be caused by more residue added to the soil organic matter pool.
(4) The *Ecosys* model performs well in yield-fertilizer rate response for capturing most of the effects from soil and climate variables.

6. References and Acknowledgement

Grant, R. F. "Simulation of carbon assimilation and partitioning in maize." Agronomy Journal 81.4 (1989): 563-571.

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