
Student Scholarship

Spring 4-29-2024

CRADLE Explorer: CASFER Interactive Platform for Data and Model Visualization

Olatunde D. Akanbi

Case Western Reserve University, oda10@case.edu

Vibha S. Mandayam

Case Western Reserve University, vsm21@case.edu

Haiping Ai

Case Western Reserve University, hxa269@case.edu

Arafath Nihar

Case Western Reserve University, axn392@case.edu

Erika I. Barcelos

Case Western Reserve University, eib14@case.edu

See next page for additional authors. <https://commons.case.edu/studentworks>



Part of the [Agriculture Commons](#), [Animal Sciences Commons](#), [Data Science Commons](#), [Earth Sciences Commons](#), [Environmental Sciences Commons](#), and the [Food Science Commons](#)

Recommended Citation

Akanbi, Olatunde D.; Mandayam, Vibha S.; Ai, Haiping; Nihar, Arafath; Barcelos, Erika I.; Bruckman, Laura S.; Yarus, Jeffrey; Wu, Yinghui; Zhang, Huichun (Judy); and French, Roger H., "CRADLE Explorer: CASFER Interactive Platform for Data and Model Visualization" (2024). *Student Scholarship*. 15.

<https://commons.case.edu/studentworks/15>

This Poster is brought to you for free and open access by Scholarly Commons @ Case Western Reserve University. It has been accepted for inclusion in Student Scholarship by an authorized administrator of Scholarly Commons @ Case Western Reserve University. For more information, please contact digitalcommons@case.edu.

CWRU authors have made this work freely available. [Please tell us](#) how this access has benefited or impacted you!

Authors

Olatunde D. Akanbi, Vibha S. Mandayam, Haiping Ai, Arafath Nihar, Erika I. Barcelos, Laura S. Bruckman, Jeffrey Yarus, Yinghui Wu, Huichun (Judy) Zhang, and Roger H. French

CRADLE Explorer: CASFER Interactive Platform for Data and Model Visualization



An NSF Engineering Research Center



Olatunde D. Akanbi^{1,2,5}, Vibha Mandayam^{1,3,5}, Haiping Ai^{1,4,5}, Arafath Nihar^{1,3}, Erika I. Barcelos^{1,2,5}, Laura S. Bruckman^{1,2,5}, Jeffrey M. Yarus^{1,2,5}, Yinghui Wu^{1,3,5}, Huichun (Judy) Zhang^{4,5}, Roger H. French^{1,2,3,5}

¹SDLE, Department of Material Science and Engineering, Case Western Reserve University, Cleveland OH, USA

²Department of Material Science and Engineering, Case Western Reserve University, Cleveland OH, USA

³Department of Computer and Data Science, Case Western Reserve University, Cleveland OH, USA

⁴Department of Civil and Environmental Engineering, Case Western Reserve University, Cleveland OH, USA

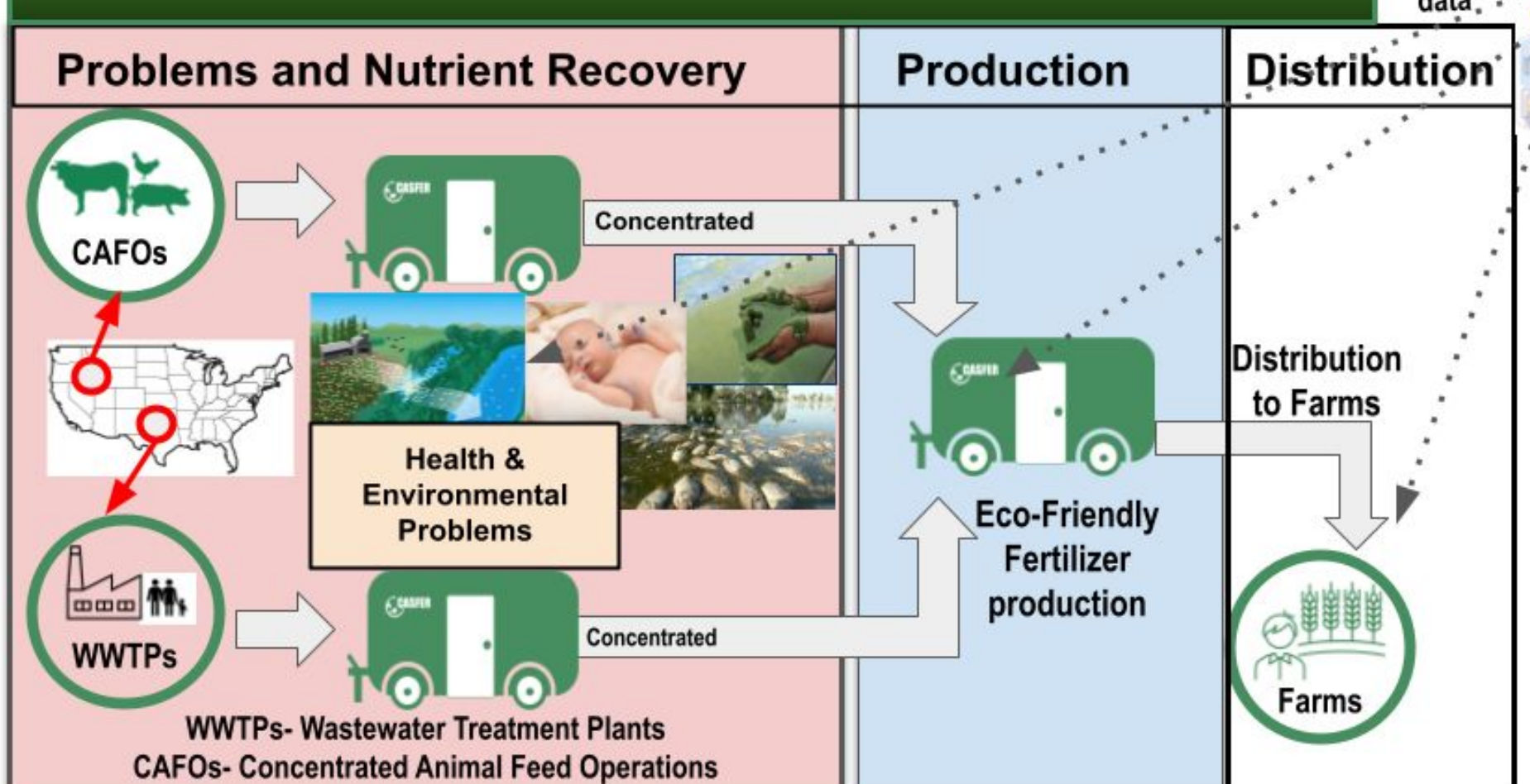
⁵Center for Advancing sustainable and Distributed Fertilizer Production (CASFER)

Corresponding Author: Roger French, roger.french@case.edu



The Problem and the Objectives

We Need a Unified Platform for All



Objectives

- A unified and interactive platform for CASFER reserchers
- Enable Farmers to monitor crops and enhance fertilizer application
- Enable stakeholders to view the outputs of the project
- Researchers can input their data to test and build models

Graphical User Interface

The screenshot shows the CRADLE Data Explorer interface. It includes a sidebar with 'Shared Apps' and a main area with various controls for data visualization, such as 'Select Date', 'Select County', and 'Show Legend'. The main area displays several maps, including 'Methane Emission with WWTP Locations' and 'Methane emission with CAFOs centers'.

Highlights

- Several Interactive features to enhance smooth running and navigation by users (Vast data streams integrated)
- Data and model visualization with Spinner and loader to monitor map rendering

- Application Launch from Open OnDemand
- Secured access but can be launched publicly

Soil Nitrogen Modeling

The screenshots show soil nitrogen modeling results. The top row displays two maps of Ohio and Texas, labeled 'Nitrogen - Cond. Simulation 932'. The bottom row shows a map of Florida, also labeled 'Nitrogen - Cond. Simulation 932'. The maps use a color scale to represent nitrogen concentration (g/kg).

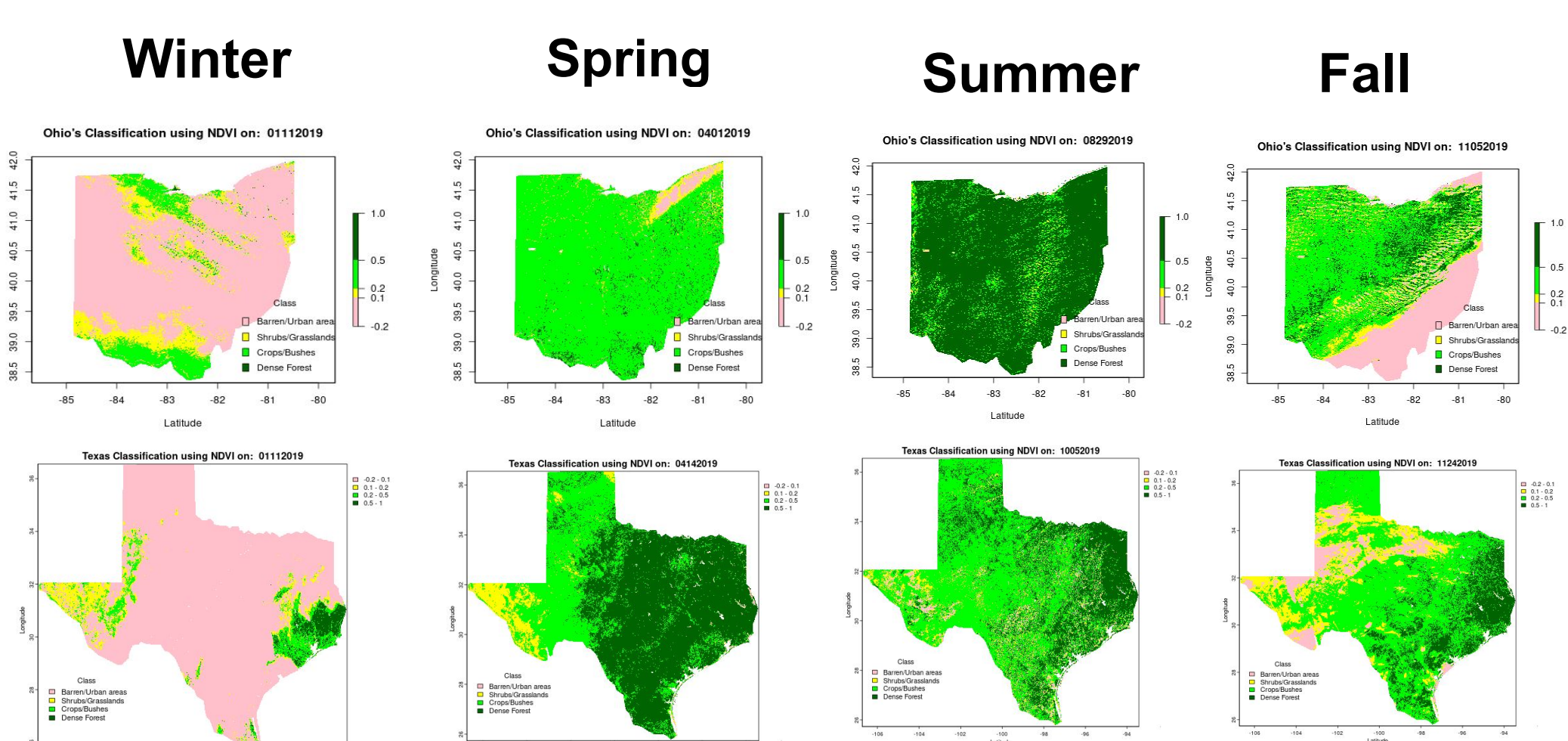
Highlights

- Conditional simulation results with 1000 realizations
- Animations of Soil Nitrogen Simulation
- Results show high nitrogen accumulation close to rivers and farmlands

Takeaways

- **Farmers' Guidance**
 - Plant crops based on soil suitability
 - Recommend best soil types for planting
- **Monitoring for Nitrogen Economy**
 - Track metrics for efficient nitrogen use
 - Identify nitrogen accumulation areas for CASFER trailer placement
 - Researchers/users can input their data to visualize
- **Optimizing Soil Nutrients**
 - Determine optimal times for land application
 - Align crop choice with suitable soil and timing
 - Recognize soil properties influencing nutrient distribution
- **Next Steps**
 - Integrate weather, CAFOS, precipitation data for spatiotemporal Graphical Neural Networks

Initial Results- Land Use



Crop Growth, Elevation, and Hydrological Dynamics

The screenshot shows the CRADLE Data Explorer interface with various data visualization options. It includes a sidebar with 'Shared Apps' and a main area with controls for 'Select Date', 'Select County', and 'Show Legend'. The main area displays several maps, including 'Methane Emission with WWTP Locations' and 'Methane emission with CAFOs centers'.

Functions

- Time series visualization (Daily)
- County level visualization for better look
- Clicks to display the value at a point (e.g Nitrate plus Nitrite)
- Users can import image to overlay and write what the legend would be

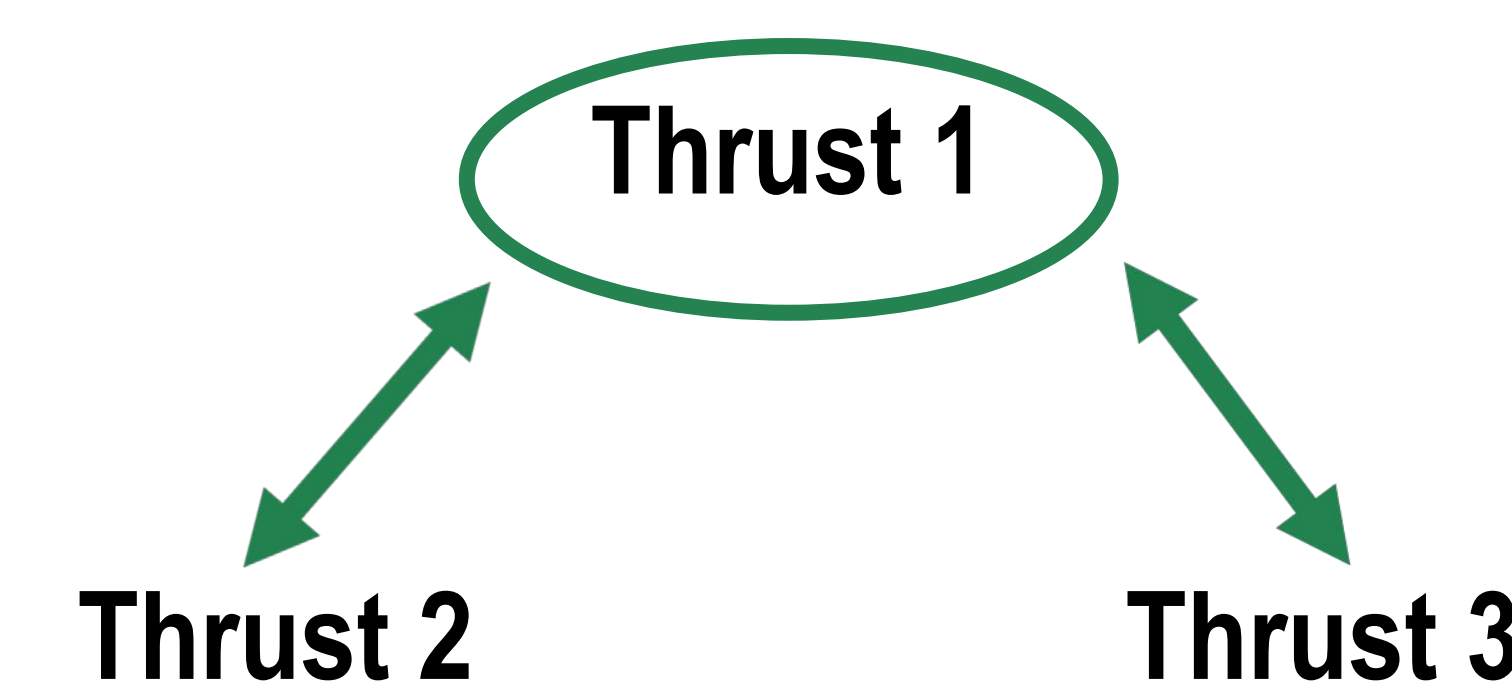
Acknowledgement

- This material is based upon work supported by the National Science Foundation under Grant No. 2133576.
- Hendrik Hamann and IBM Environmental Intelligence Suite acknowledged
- This work made use of the High Performance Computing Resource in the Core Facility for Advanced Research Computing at Case Western Reserve University.

References

- Akanbi, O.D., Bhuvanagiri, D.C., Barcelos, E.I. et al. Integrating Multiscale Geospatial Analysis for Monitoring Crop Growth, Nutrient Distribution, and Hydrological Dynamics in Large-Scale Agricultural Systems. *J geovis spat anal* 8, 9 (2024). <https://doi.org/10.1007/s41651-023-00164-y>

Thrust Interactions



Animations

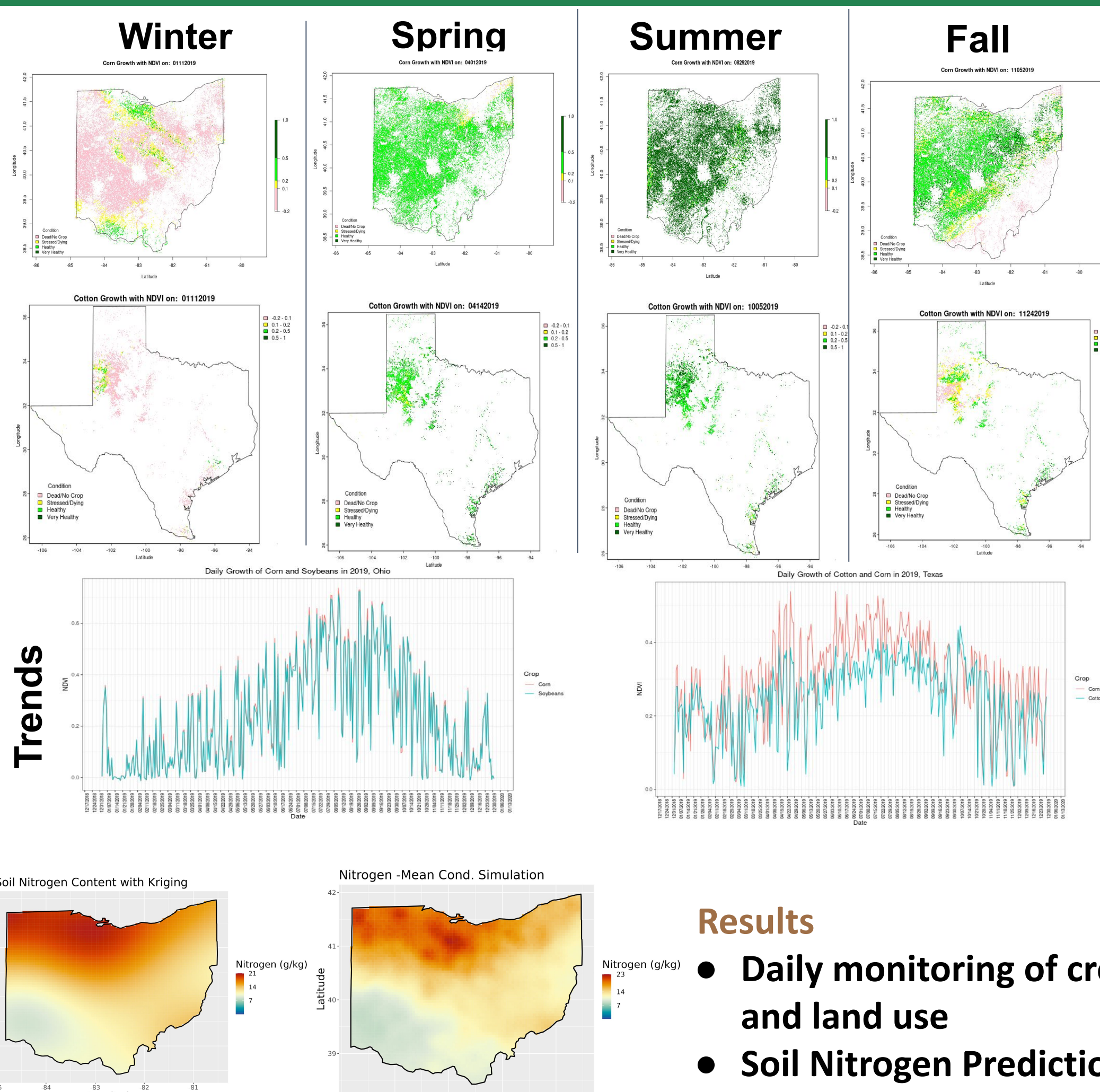
Vegetation, Crop Growth & Correlations



Conditional Simulations



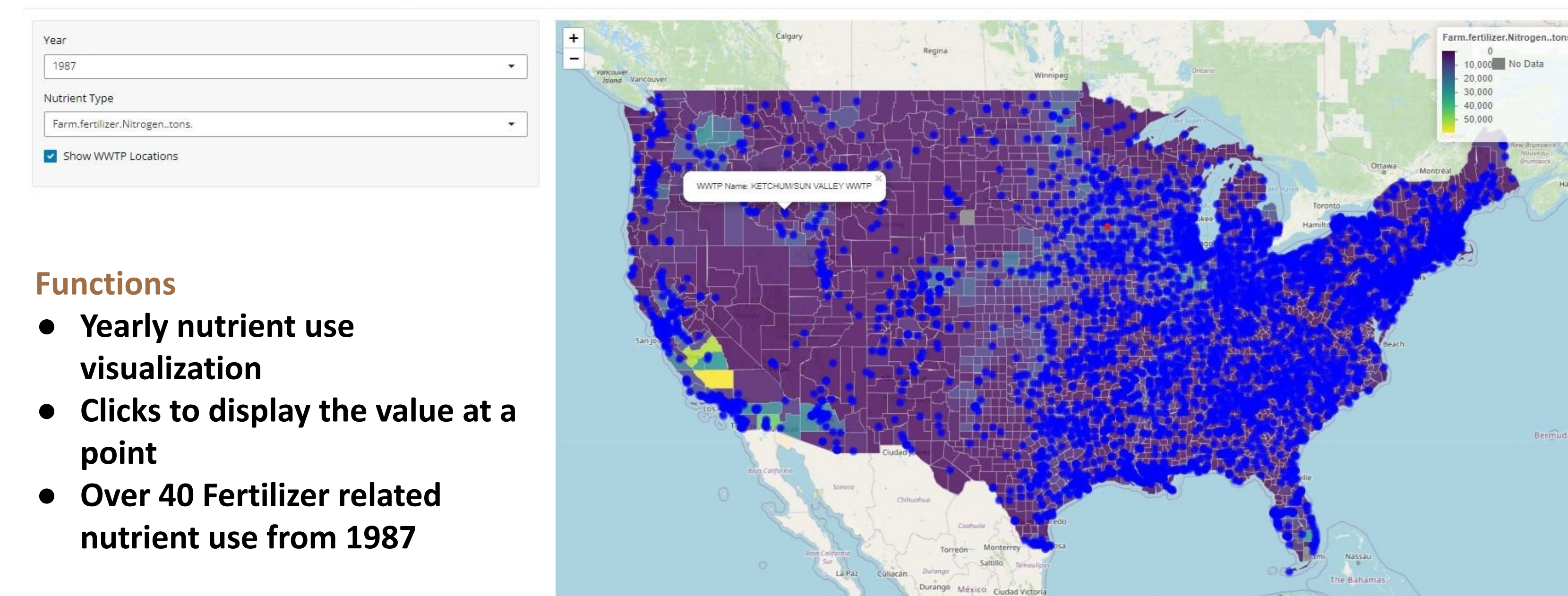
Initial results- Crop Growth & Modeling



Results

- Daily monitoring of crop and land use
- Soil Nitrogen Prediction

Nutrient Use per County



Functions

- Yearly nutrient use visualization
- Clicks to display the value at a point
- Over 40 Fertilizer related nutrient use from 1987
- These results from multimodal data visualization will aid to monitor our vast data streams
- Take decisions on precision agriculture and nutrient management
- See down into what happens at county level

How can we see all these results without GIS softwares, make our inputs, take decisions and build a nitrogen circular economy without coding experience?