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## CRADLE Explorer: CASFER Interactive Platform for Data and Model Visualization

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## Authors

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# CRADLE Explorer: CASFER Interactive Platform for Data and Model Visualization



An NSF Engineering Research Center



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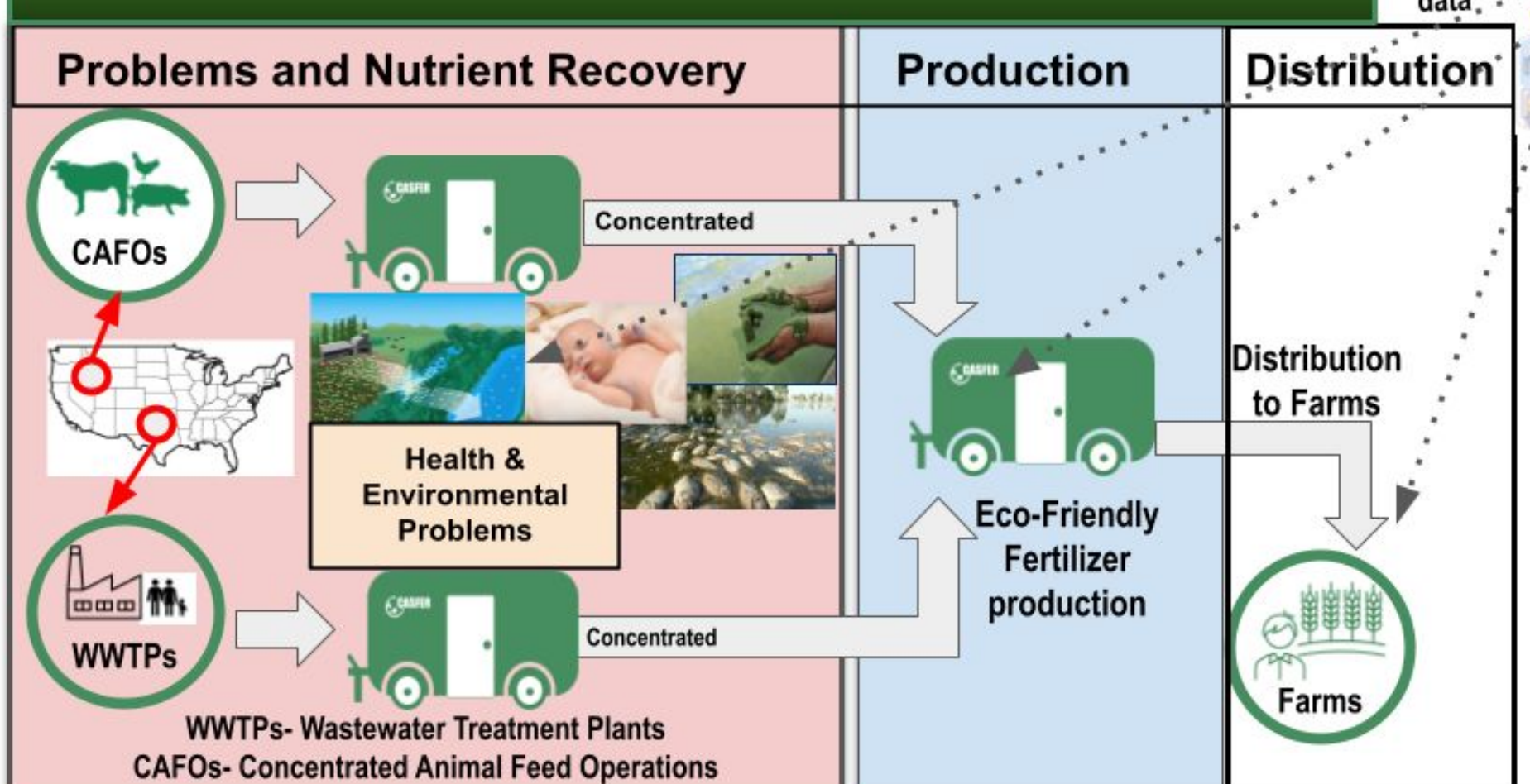
<sup>5</sup>Center for Advancing sustainable and Distributed Fertilizer Production (CASFER)

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## The Problem and the Objectives

### We Need a Unified Platform for All



### Objectives

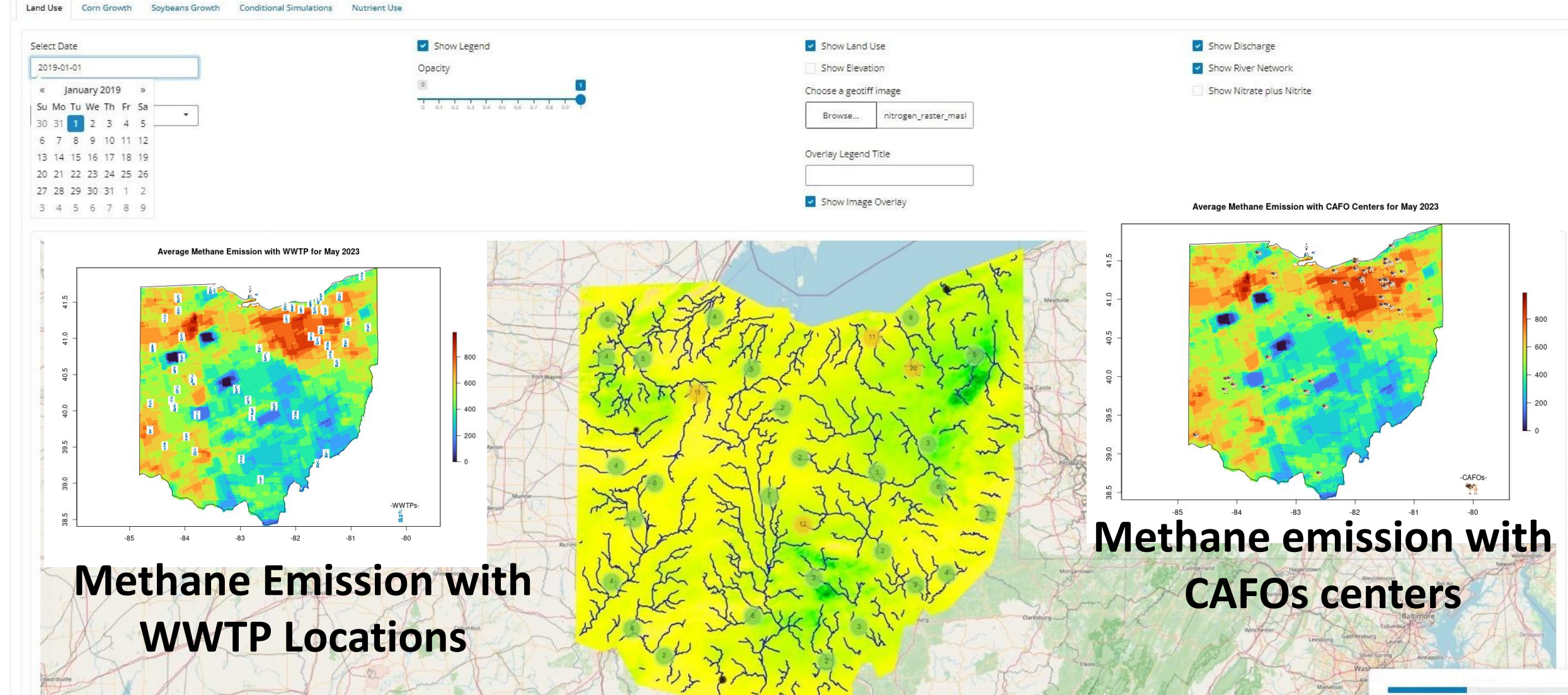
- A unified and interactive platform for CASFER reserchers
- Enable Farmers to monitor crops and enhance fertilizer application
- Enable stakeholders to view the outputs of the project
- Researchers can input their data to test and build models

## Graphical User Interface

The screenshot shows the CRADLE Data Explorer web interface. It includes a sidebar with 'Shared Apps' and a main content area with various settings and data visualization options. The interface is designed for interactive data exploration and visualization.

### 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



## Soil Nitrogen Modeling

Two screenshots of soil nitrogen simulation results. The top screenshot shows 'Nitrogen - Cond. Simulation 932' for Ohio, and the bottom screenshot shows the same simulation for Texas. Both maps use color gradients to represent nitrogen levels.

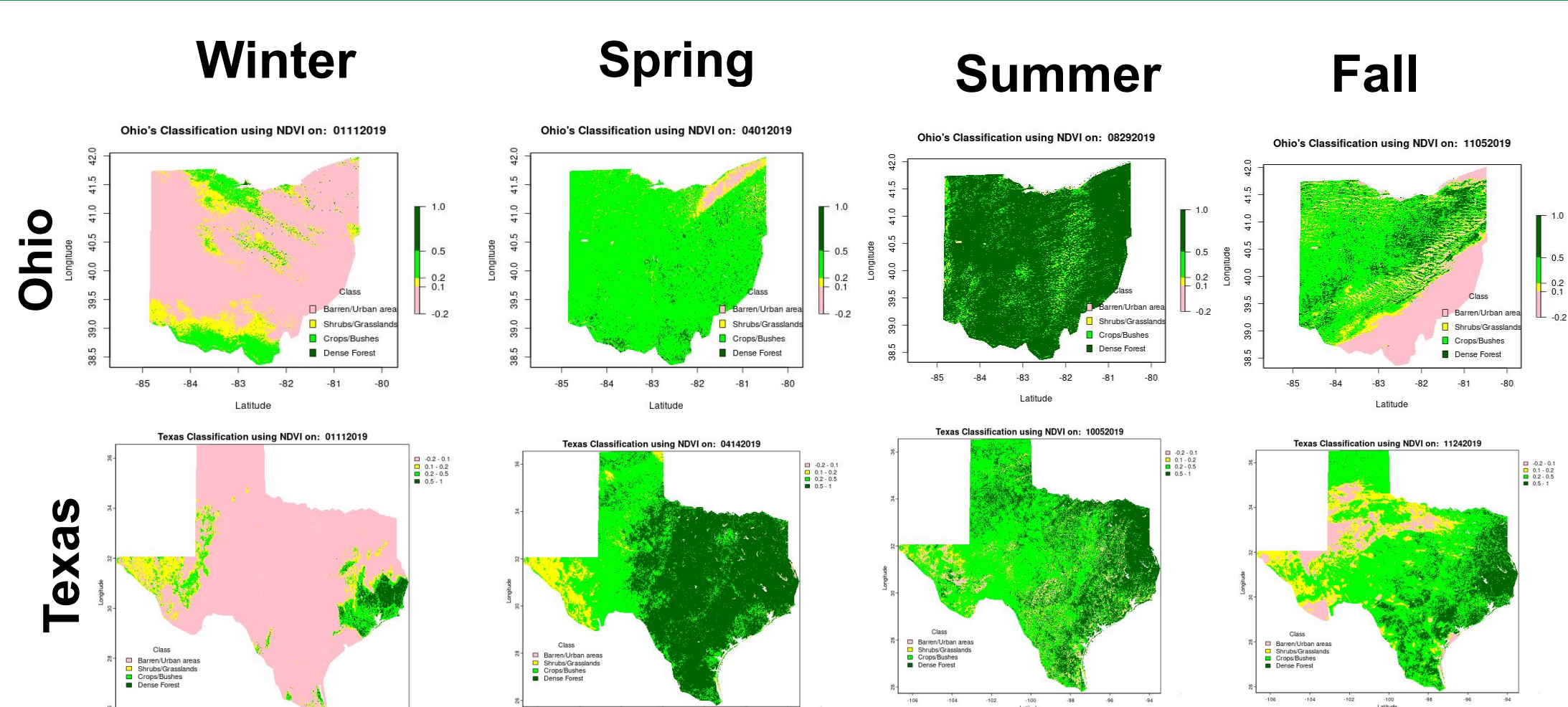
### Highlights

- 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 content area with various settings and data visualization options. The interface is designed for interactive data exploration and visualization.

### 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

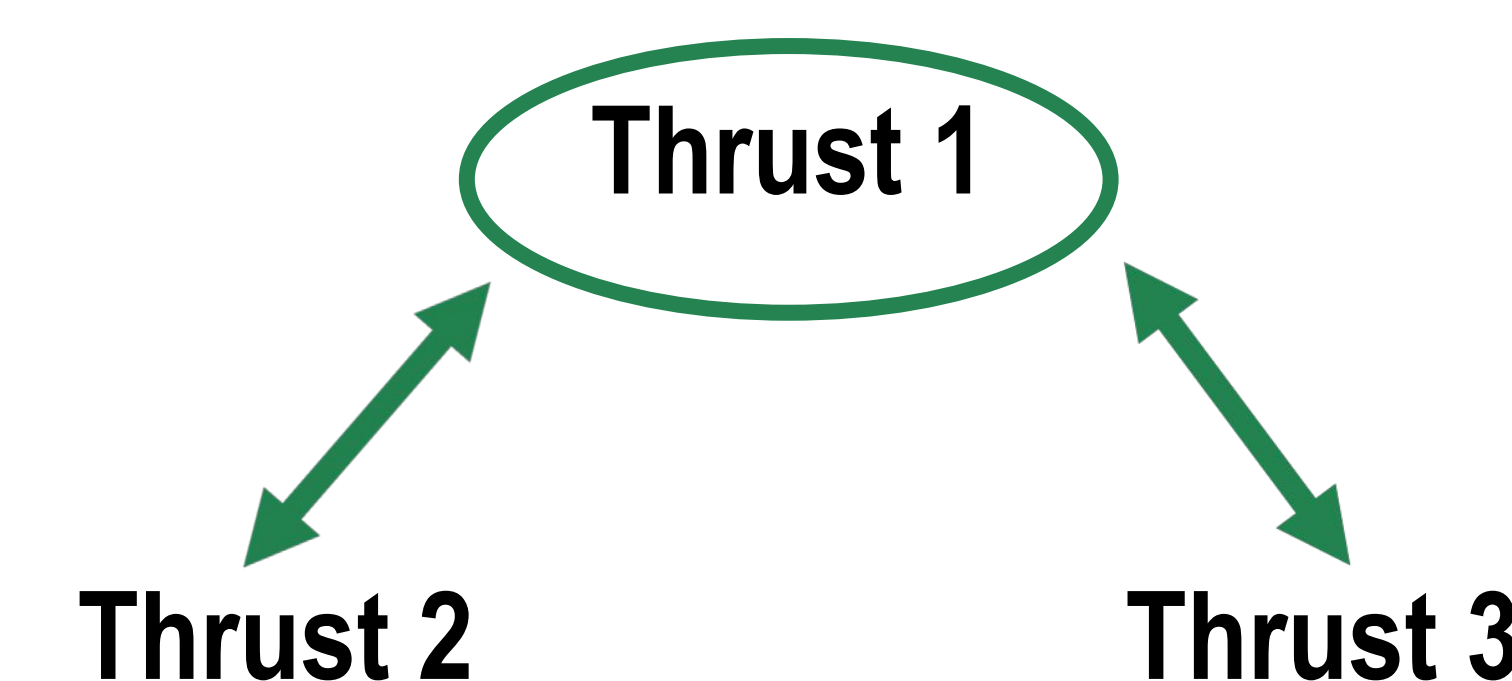
## Acknowledgement

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- 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



## Nutrient Use per County

A map of the United States showing nutrient use per county. The map is color-coded by county, with a legend indicating the amount of nutrient use. The map is titled '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

### Results

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

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