

# Beyond the Green: Decoding Iowa's 2020 NDVI Spike and its Environmental Drivers

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## Project Overview

This study used satellite data from the Google Earth Engine data catalog to investigate a significant increase in NDVI across the state of Iowa in the summer of 2020. Results showed a significant correlation between black carbon and NDVI, indicating a strong relationship while other factors showed a weaker connection. As NDVI has been shown to have a strong correlation to yield in the past, this introduces a potentially significant connection in agriculture.

## Background & Objectives

NDVI (Normalized Difference Vegetation Index):

- A widely used indicator of plant health, calculated using satellite data that compares red and near-infrared light.

Why NDVI Matters:

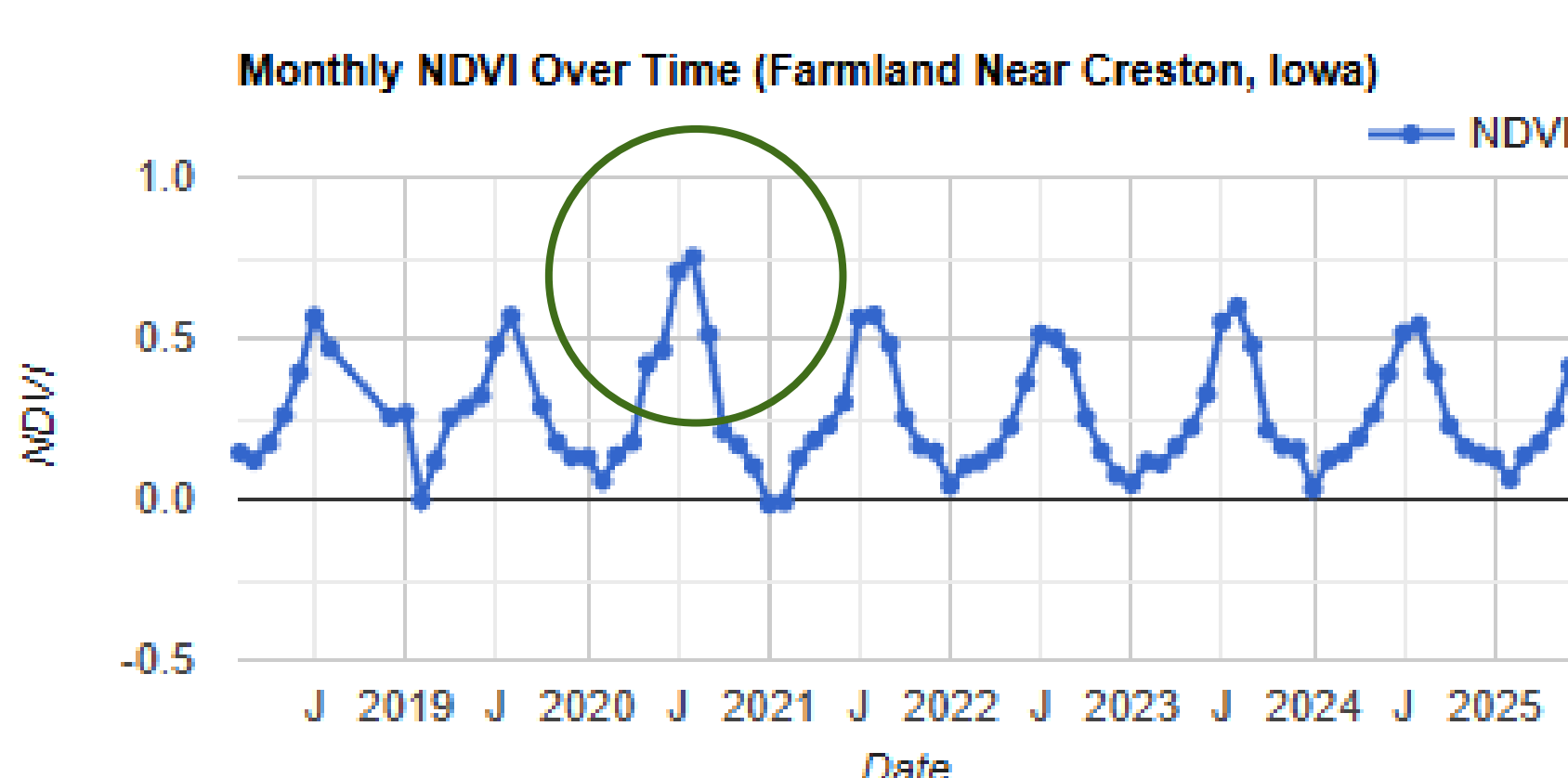
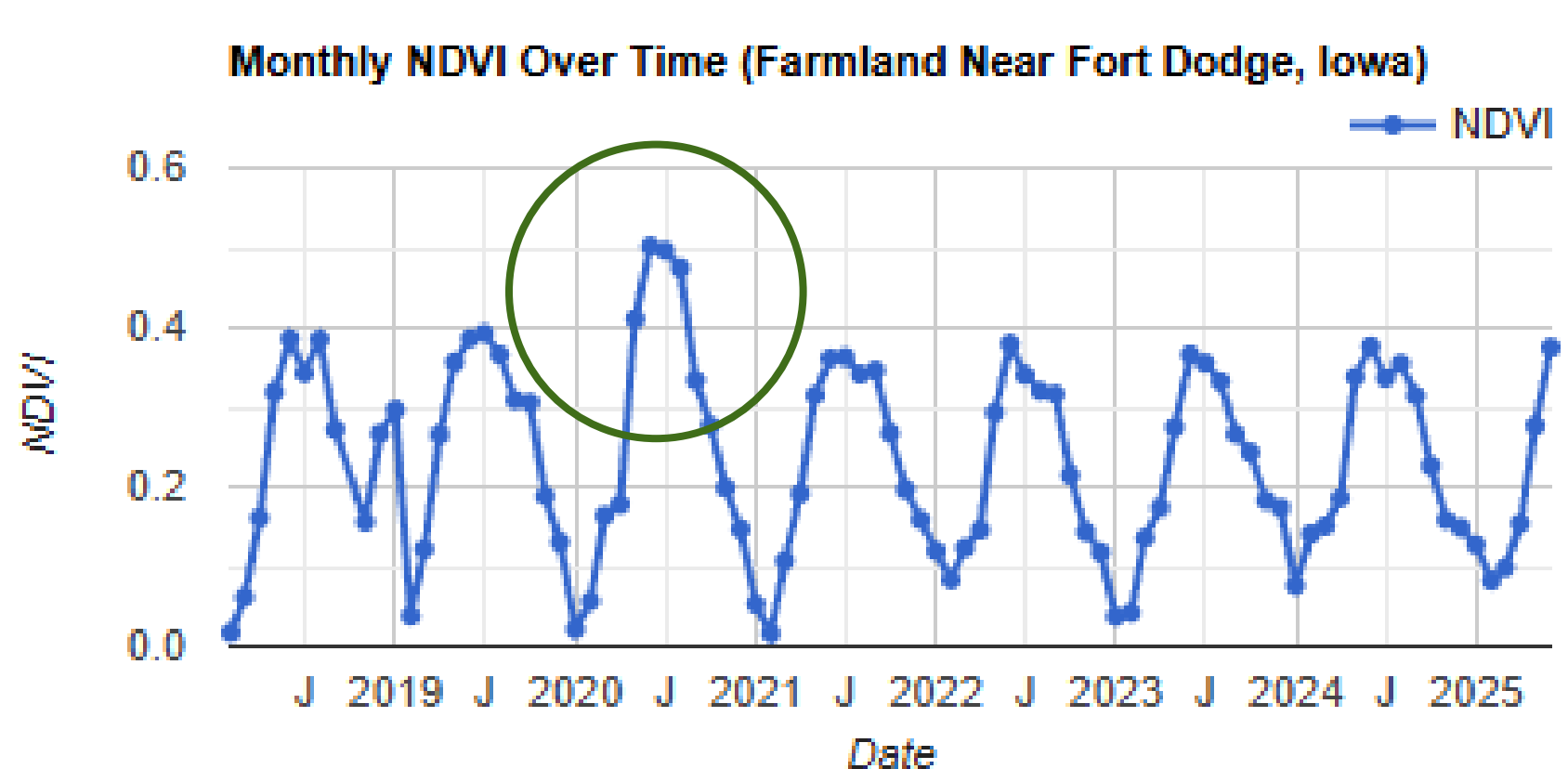
- Prior research links NDVI to crop yield (Shane, 2021), making it a valuable tool in agricultural monitoring.

Key Observation:

- A notable spike in NDVI occurred across Iowa farmland in the summer of 2020.

Research Question:

What caused this spike – and could the factors behind it be replicated to help boost yield in future growing seasons?



## Methods

Research Approach

- Tool Used: Google Earth Engine
- Study Period: 2018–2022
- Focus Area: Iowa farmland
- Goal: Identify environmental factors that may explain the NDVI spike in 2020
- Methodology:
  - Compared NDVI trends with multiple environmental variables, including:

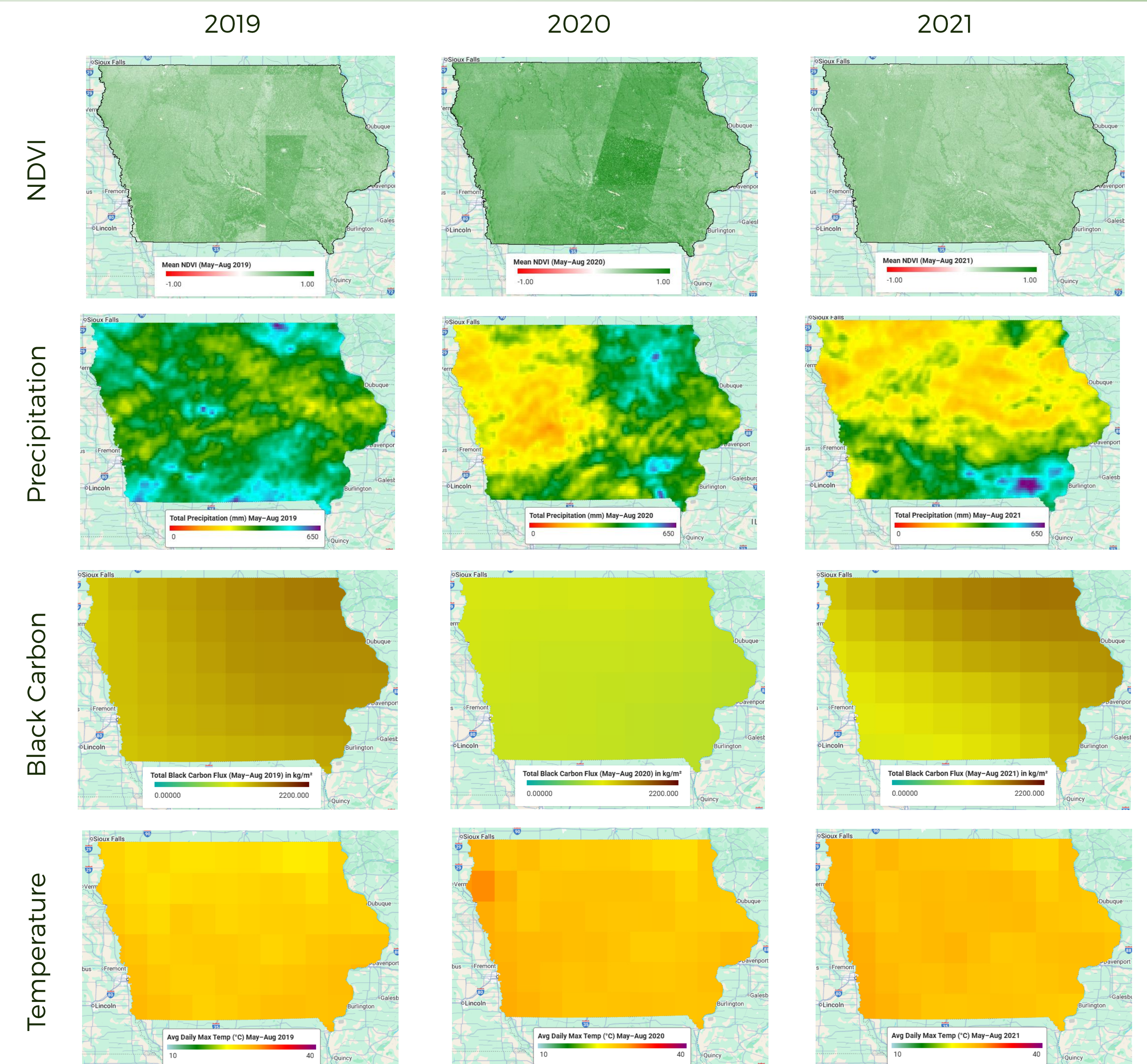
- Black carbon
- Precipitation
- Temperature
- Soil moisture
- Cloud cover
- Aerosols and atmospheric effects

Key Observations:

- Black carbon dropped sharply in summer 2020
- Precipitation gradually declined from 2019 to 2022

Analysis:

- Data from 10 randomized farmland locations across Iowa
- Used scatterplots and correlation/regression analysis to evaluate relationships between NDVI and environmental factors



## Results & Conclusion

Key Findings:

Data Source: 10 randomized farmland locations across Iowa (2018–2022)

NDVI vs. Black Carbon:

- Moderately strong negative correlation ( $r = -0.71$ )
- Indicates higher NDVI is associated with lower black carbon levels

NDVI vs. Precipitation: Minimal correlation ( $r = -0.15$ )

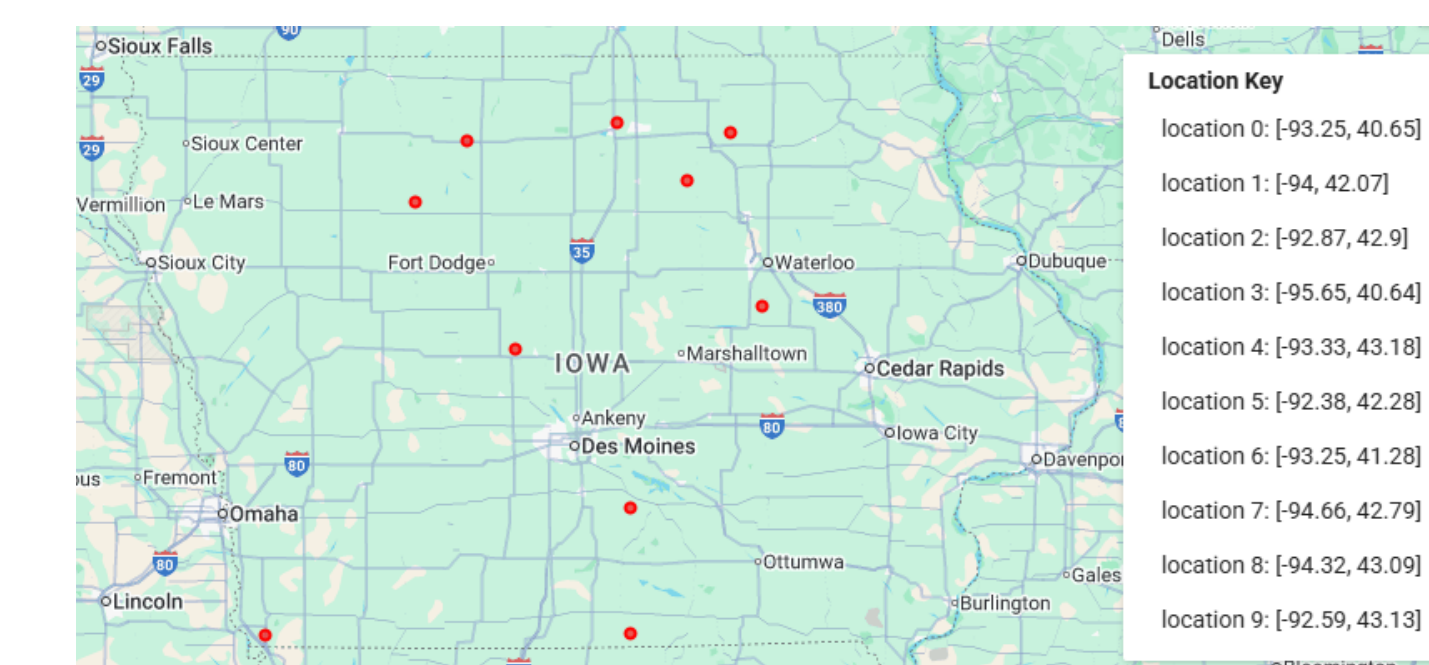
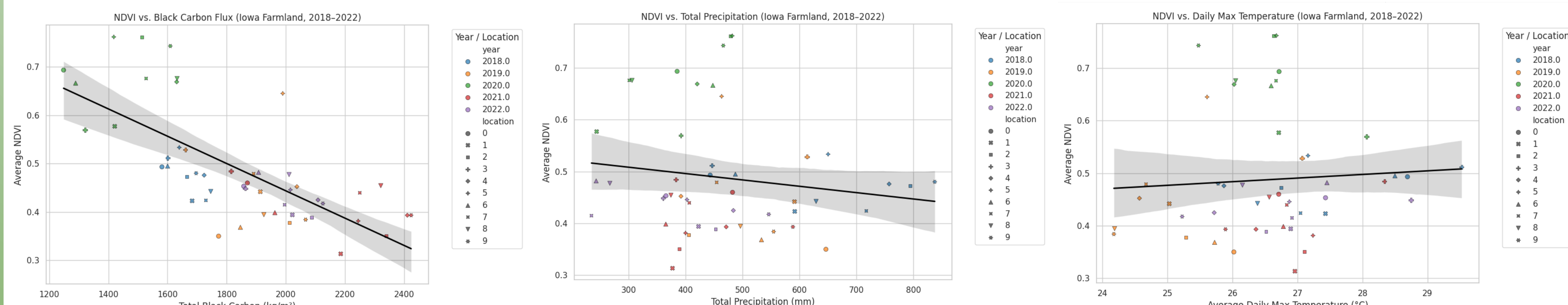
NDVI vs. Temperature: No significant relationship ( $r = 0.07$ )

Regression analysis:

- Predicting NDVI from black carbon showed a strong relationship ( $r^2 = 0.51$ )
- Suggests black carbon is a key environmental factor impacting vegetation health

Notable Insight:

- The 2020 NDVI spike appears more closely tied to reduced black carbon, likely influenced by pandemic-related changes
- Emphasizes the link between air quality and plant vitality



Next Steps:

Future research can explore sustainable methods to reduce black carbon, such as:

- Alternatives to open-air burning
- Policy impacts on emissions

Verify relationship to yield and investigate how these reductions influence NDVI and agricultural yield over time.

## Classroom Applications

Introductory Probability & Statistics: This course emphasizes *statistical thinking* and *data literacy*. NDVI-based research offers an engaging entry point through a “notice and wonder” activity using initial NDVI graphs. This helps students see how curiosity drives questions – showing that math is dynamic, not static.

Dual-Credit Statistics:

This course prioritizes *student-driven investigations*. Students can work with similar NDVI or satellite datasets to:

- Formulate their own research questions
- Explore real-world data
- Conduct semester-long investigations using statistical methods learned throughout the course

This approach encourages authentic, inquiry-based learning while reinforcing core statistical concepts.

## Future Collaborations

We plan to continue working together to support high school students in building spatial thinking and data literacy using Google Earth Engine. This collaboration may expand through a National Geographic Society education grant, allowing us to develop classroom resources and student-led geospatial investigations.

## References

Shane, A. R. (2021). High-Resolution Crop Yield Predictions from Satellite-Generated NDVI Images (Order No. 28262113). Available from Dissertations & Theses @ Iowa State University; ProQuest Dissertations & Theses Global. (2553840501). <https://www.proquest.com/dissertations-theses/high-resolution-crop-yield-predictions-satellite/docview/2553840501/se-2>

## Acknowledgements

