

Massachusetts Trends in NDVI & AOD and Their Relationship, 2001-2020

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I. Background & Overarching Questions

The causes and drivers of climate change have wide-ranging impacts on many things, including vegetation productivity and air quality. The individual trends in these variables and their relationship has been explored in the literature in the context of public health and urbanization (Emberson et al., 2001; Kashyap & Patel, 2023; Khan et al., 2022; Setälä et al., 2013), but not often in the context of climate.

Our study seeks to explore how these variables have changed individually and together over time, and what the magnitude and direction of that trend is

II. Data & Methods

Variables: vegetation productivity/normalized difference vegetation index (NDVI) and air quality/aerosol optical depth (AOD)

Data: Moderate Resolution Imaging Spectroradiometer (MODIS): terra and aqua blue band (0.47 μm) for AOD, terra red and near infrared bands for NDVI. AOD temporal resolution is 1 day, NDVI is 16 days

Google Earth Engine (GEE) was used to extract yearly, pixel level trends (Mann-Kendall Tau and Theil-Sen Median) for both variables in 2001-2020,

A case study of trends at 10 points in Massachusetts (Figure 1) was performed to see how the variables related to each other over time.

III. Results



Story Map!

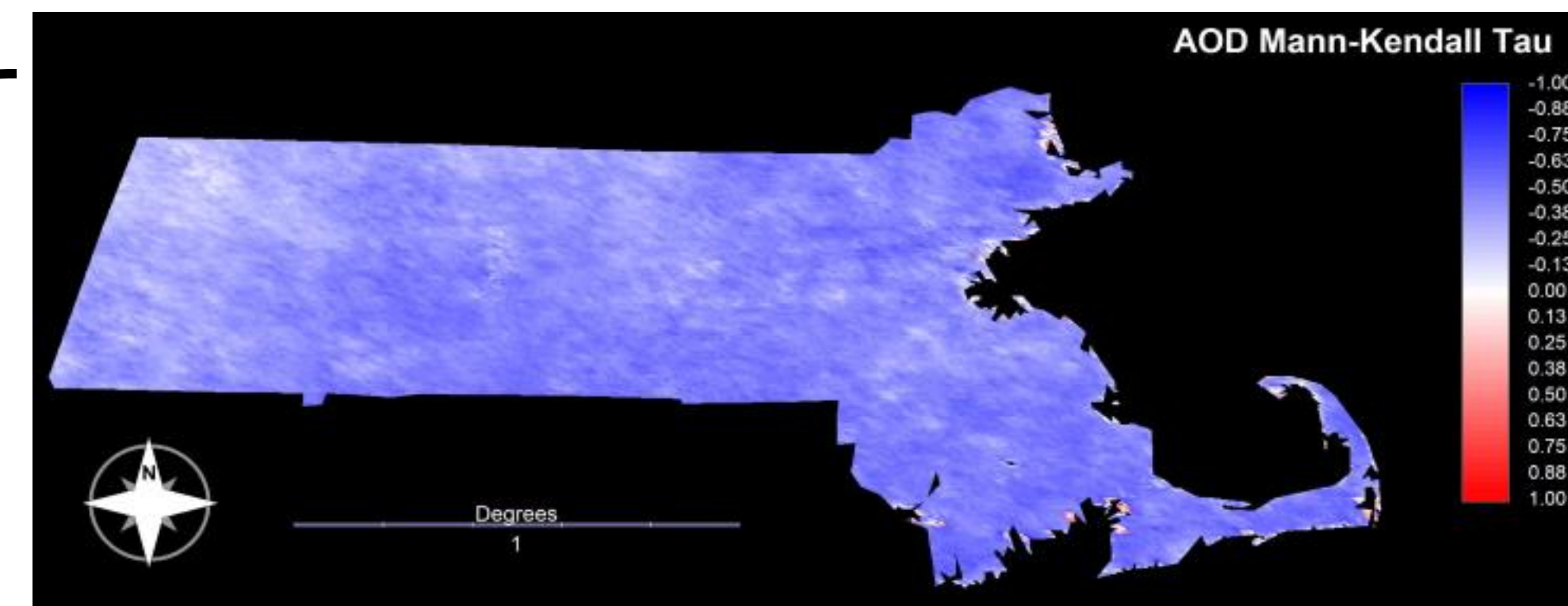


Figure 2. AOD Mann-Kendall Tau Results

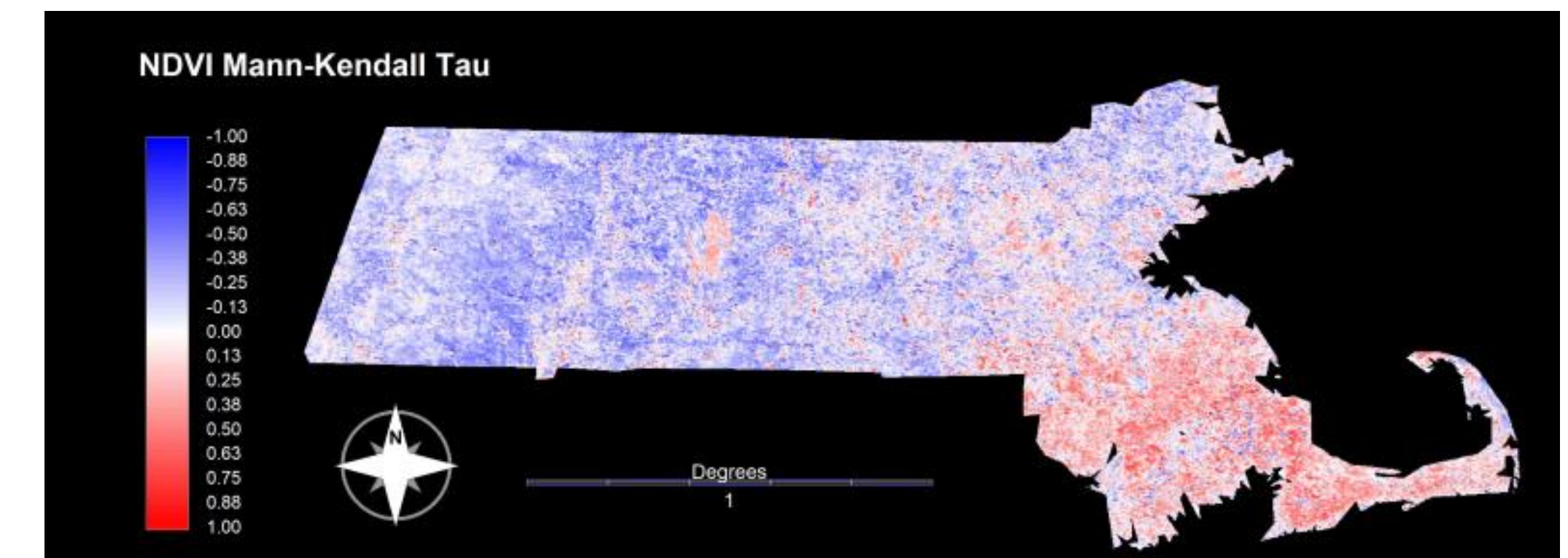


Figure 3. NDVI Mann-Kendall Tau Results



Figure 4. AOD Theil-Sen Median Results

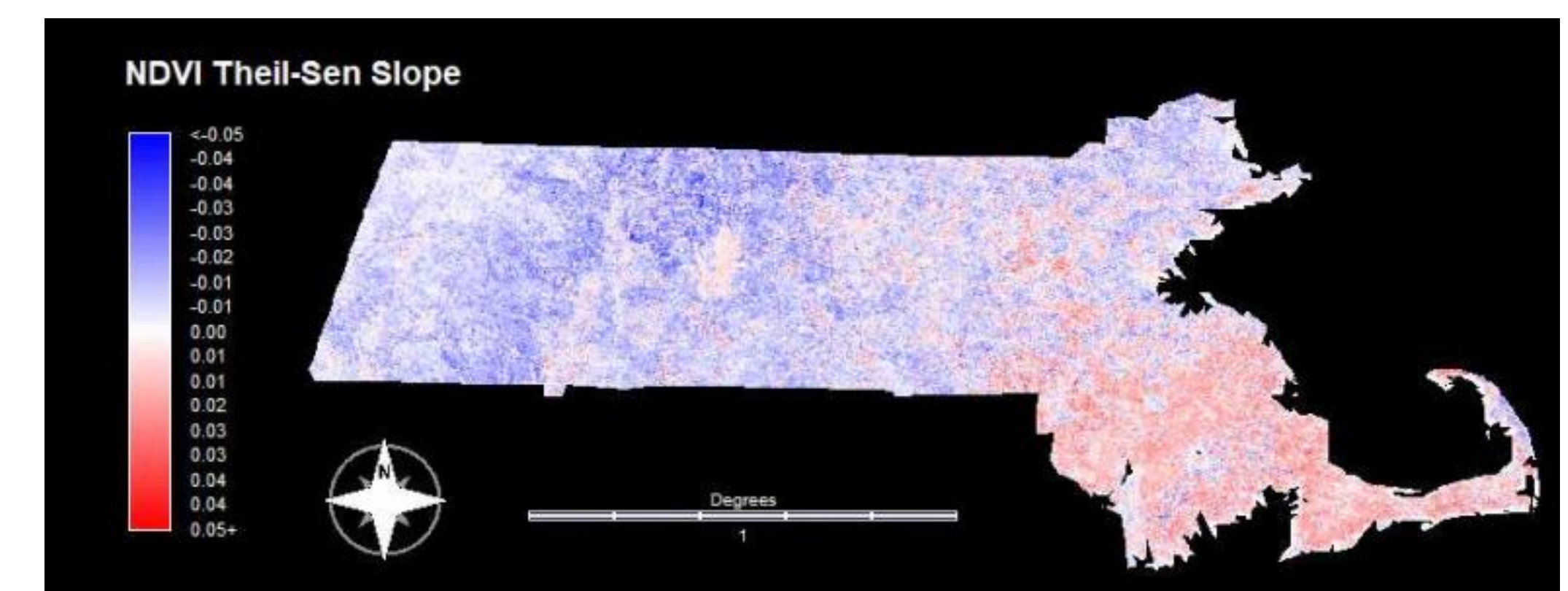


Figure 5. NDVI Theil-Sen Median Results

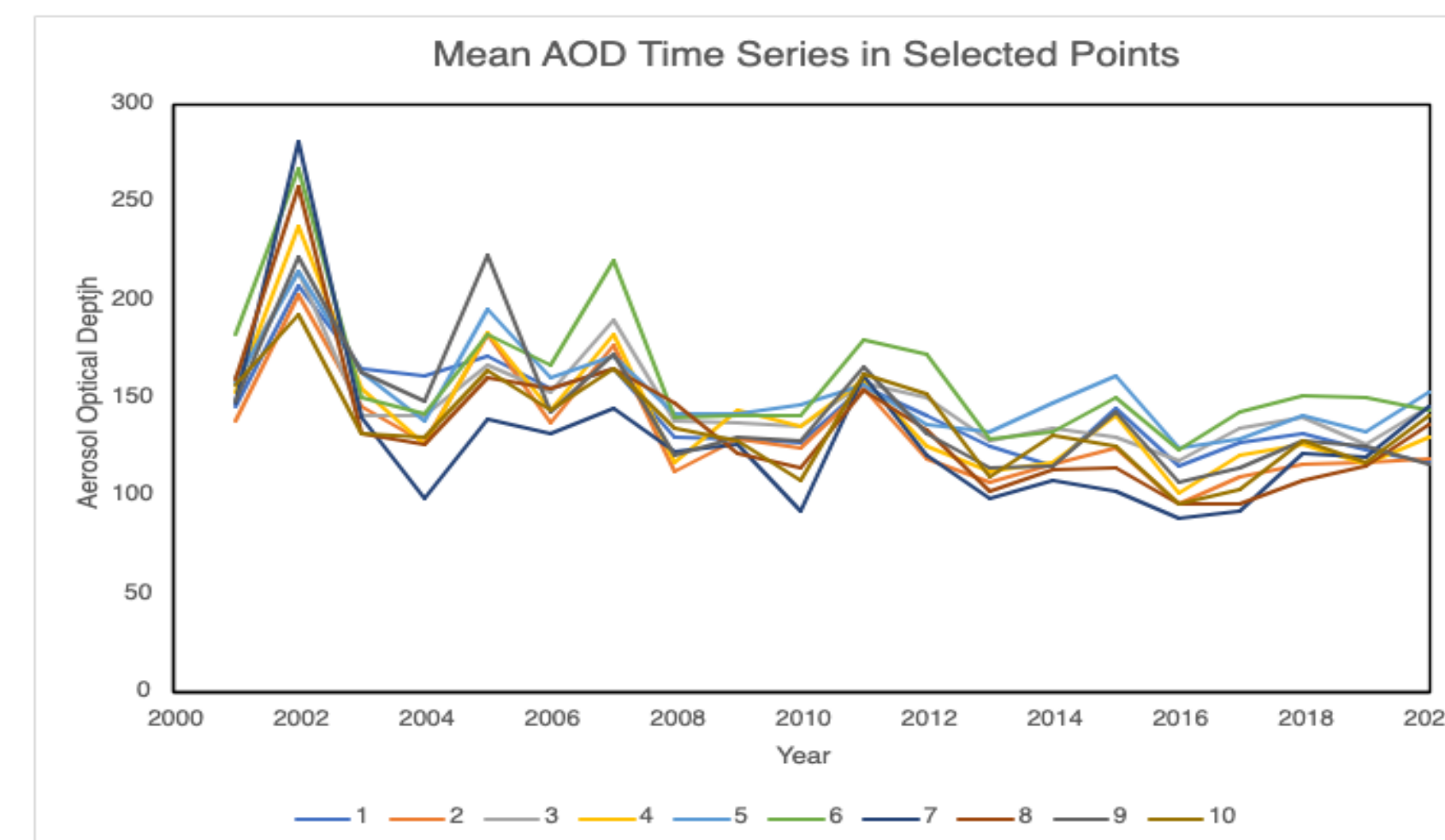
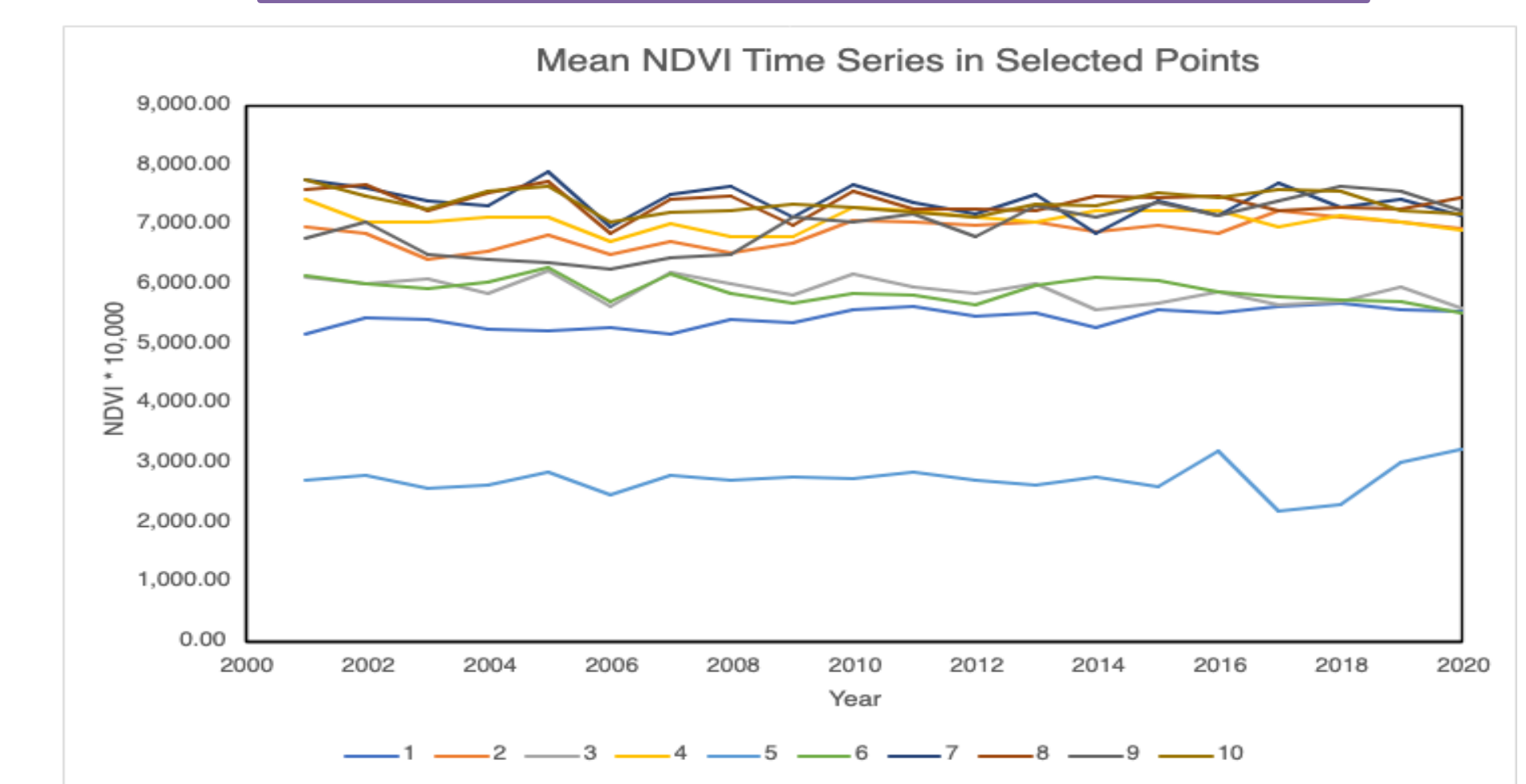


Figure 6. Case Study Results



IV. Discussion & Conclusion

- While air pollution is slightly increasing over time in a fairly uniform manner (Figures 2 & 5), NDVI is spatially variable, with positive trends in the Southeast and negative trends across the majority of the rest of the state.
- Doing a case study on 10 points with different land uses and geographic locations across the state, we found that there are not significant relationship between the two variables using both Theil-sen and linear regression, which possible due to lack of number of temporal variables (20 years yearly data). The implications of this are the relationship between them cannot be not determined with confidence. NDVI, and to some extent AOD, are spatially variable across the state, and thus their relationship is as well, which has implications for how we manage the impacts of anthropogenic change in the future
- Future directions for this project include expanding our temporal and spatial study area, testing the relationship of other variables with NDVI; and examining a finer temporal resolution to get at questions of seasonality and phenology. Using two different satellites for our data could also improve results.

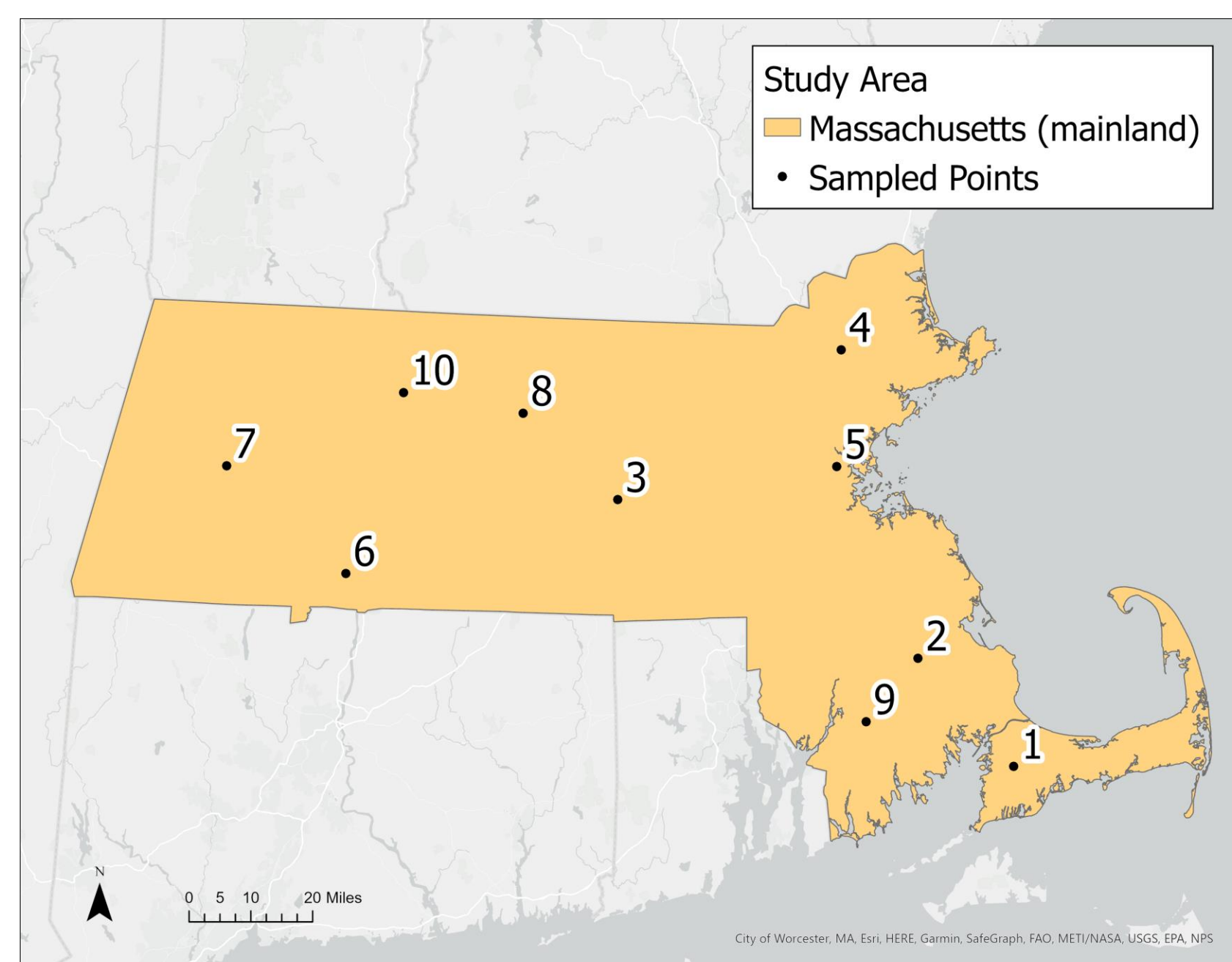


Figure 1. Study area map with case study points

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- Kashyap, R., Kuttippurath, J., & Patel, V. k. (2023). Improved air quality leads to enhanced vegetation growth during the COVID-19 lockdown in India. *Applied Geography*, 151, N.PAG-N.PAG. <https://doi.org/10.1016/j.apgeog.2022.102869>
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