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The Effect of Temperature on Algal Blooms in New York State



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Background

Water shapes all flora and fauna. Urbanization, industrialization, and other human activities have negatively affected this important source.⁶ For example, algal blooms arise due to a combination of sunlight, warm temperatures, and excessive nutrient runoff. The nutrients are a result of fertilizer runoff which enters aquatic systems and cause algal blooms (Fig 1). Increased air temperatures cause increased water temperatures which creates ideal conditions for cyanobacteria growth which are responsible for blooms.^{3,4} Algal blooms affect the entire ecosystem by decreasing sunlight availability in the water. Decreased sunlight contributes to low oxygen dead-zones which negatively affect drinking water reservoirs.^{4,6}

I examined the relationship between mean annual mean temperature and the number of algal blooms in New York counties between 2012-2018. This project serves to evaluate and analyze the interaction of temperature in Fahrenheit and its impact on the number of algal blooms in counties across New York State.



Fig 1. Algal blooms across New York (a) Madison, Oneida counties (b) Lake Neatahwanta in Fulton (c) blue green algae at South end Skaneateles Lake

Methodology

Algal Bloom Data

Algal bloom surveillance was conducted by external programs with trained citizens in a visual or sample report. Visual surveillance through a field report described the algal bloom with a photograph. If a bloom could not be visually determined, a water sample was taken and tested for the quantitative phytoplankton count, pigment/chlorophyll concentration, or toxin concentration.⁸

Temperature Data

The annual mean °F temperature data was collected in New York counties between 2012-2018 by the National Center for Environmental Information.⁷

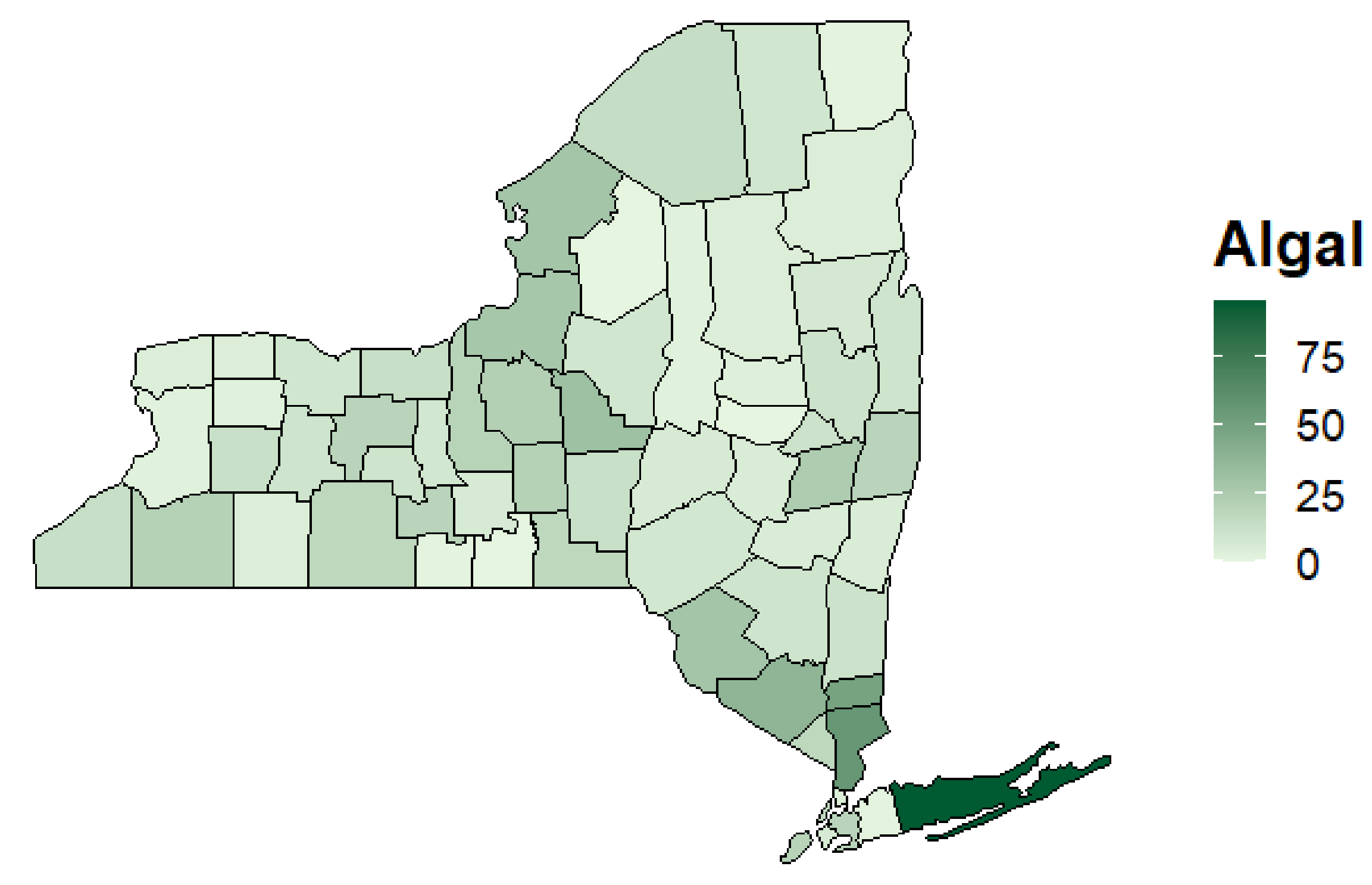


Fig 2. Choropleth map based off the number of algal blooms by county in New York state between 2012-2018

Results and Analysis

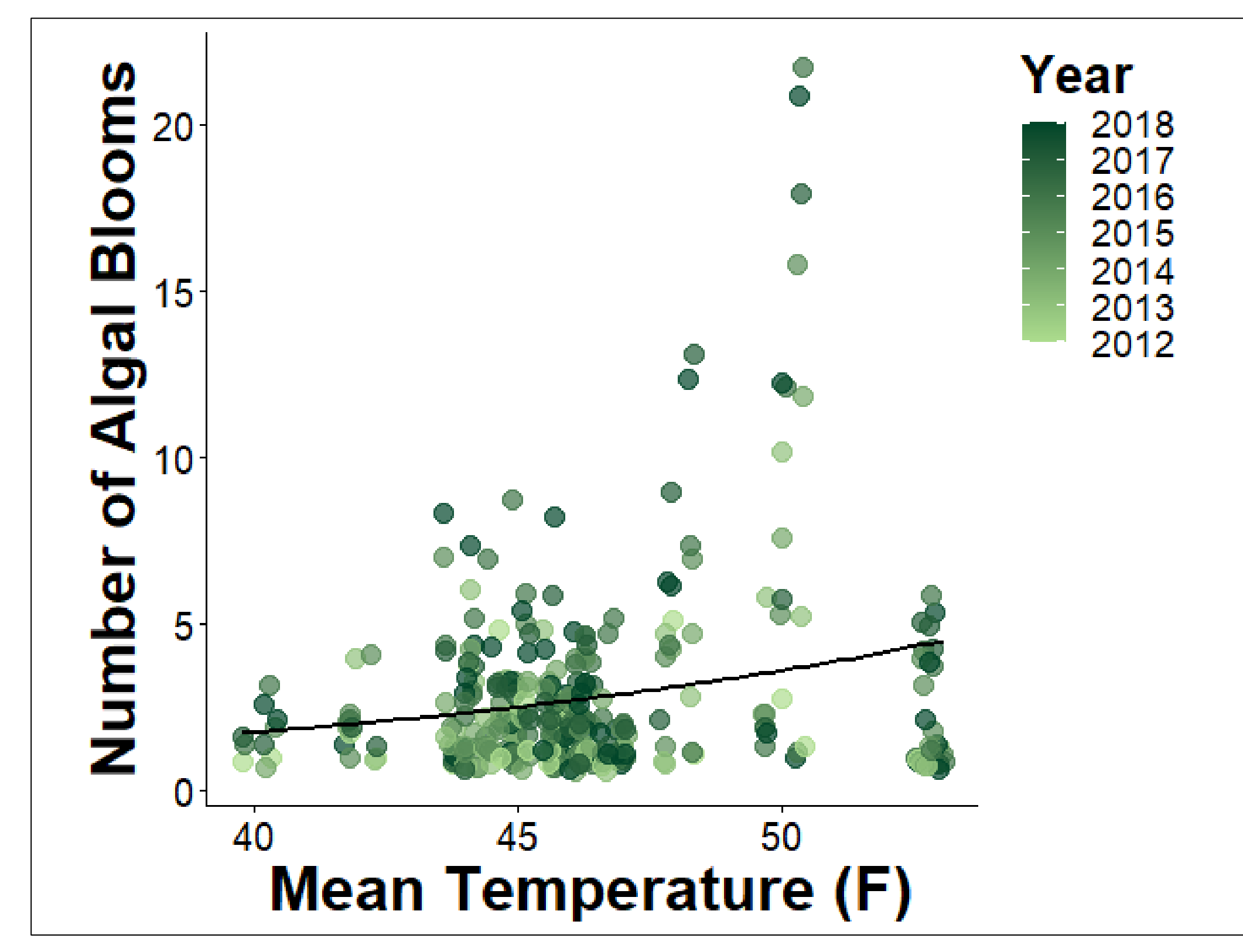


Fig 3. (a) The number of algal blooms for the annual mean temperature in °F by New York county

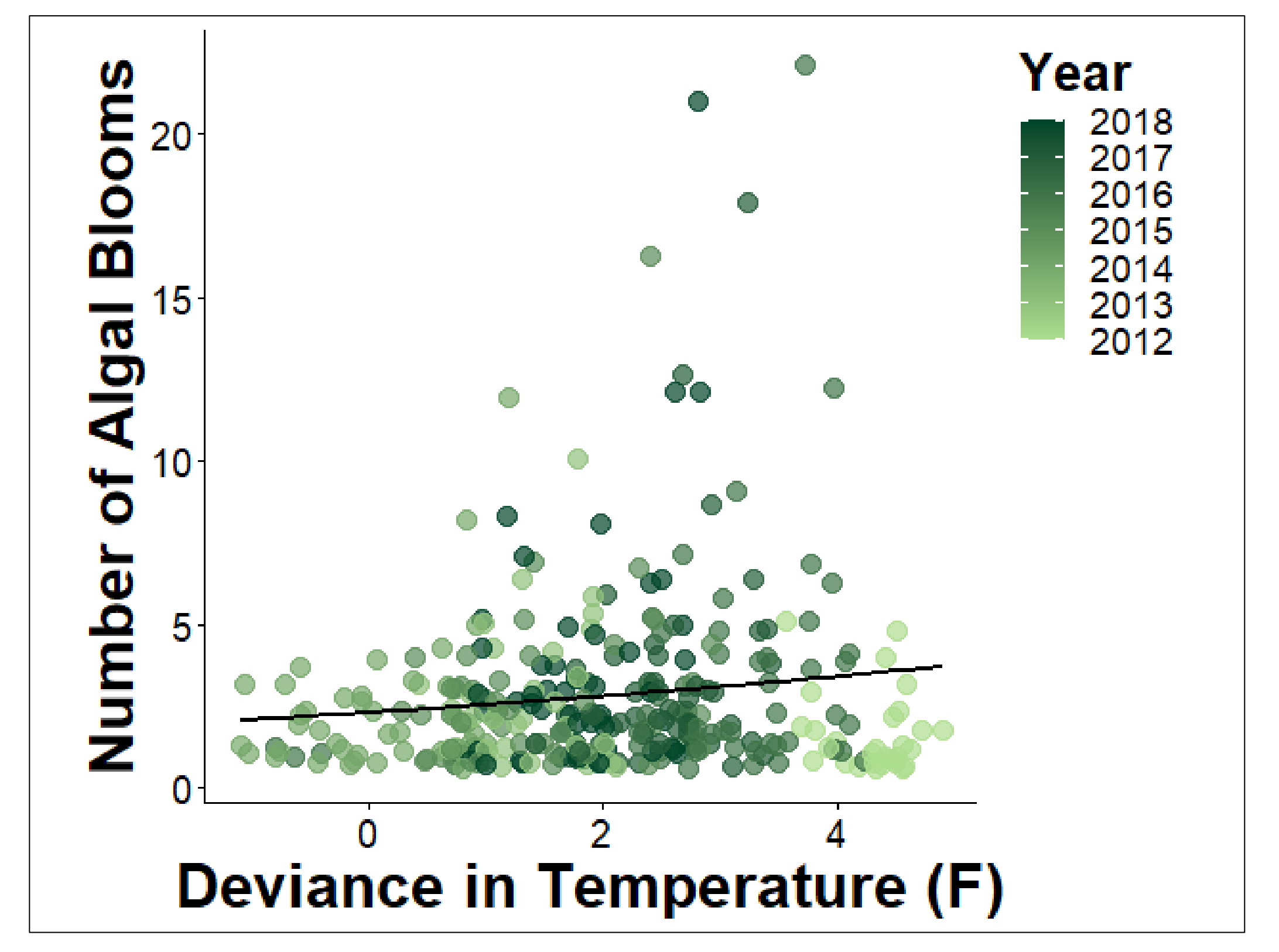


Fig 3. (b) The number of algal blooms for the annual anomalies (deviance from the average temperature) in °F by New York county

The annual mean temperature had positive significant effect on the number of algal blooms in New York state counties (Poisson GLMM, $x_2 = 40.783$, $df = 1$, $p\text{-value} < 0.001$). The trendline of Fig 3a. demonstrated a positive slope since there was an increase of algal blooms per one degree °F. The temperature anomalies which are a deviation from the average also had a positive significant effect on the number of algal blooms (Poisson GLMM, $x_2 = 44.617$, $df = 1$, $p\text{-value} < 0.001$). The trendline of Fig 3b. demonstrated a positive slope increase of 1.440 algal blooms per one degree of °F increase.

Conclusion

Temperature positively correlated with the number of algal blooms in New York state. This is because warmer temperatures prevent mixing and circulation in lakes and other bodies of water.⁶ The lack of circulation causes the algae layers to grow thicker and faster causing more algal blooms that are larger in size. When the annual mean temperature increases, the viscosity of the water decreases. The decreased viscosity of water increases the ability of small organisms to migrate vertically which pushes cyanobacteria towards the surface which causes an increase in algal blooms.¹¹

Acknowledgements

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