Nitrate in Iowa Watersheds

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Abstract

Using mathematical modeling and statistical analysis, our research aims to discover if the amount of precipitation within a given time and location causes an increase of nitrate in the surrounding watersheds. The watersheds that we analyzed were all within the vicinity of farmland. Nitrate is a highly soluble poly-atomic ion that is a key compound in many fertilizers. Its high solubility coupled with proximity to watersheds means that they are all highly susceptible to fertilizer runoff. We are able to investigate this relationship by gathering and analyzing data from the Iowa Department of Public Health and the Coe College Department of Chemistry.

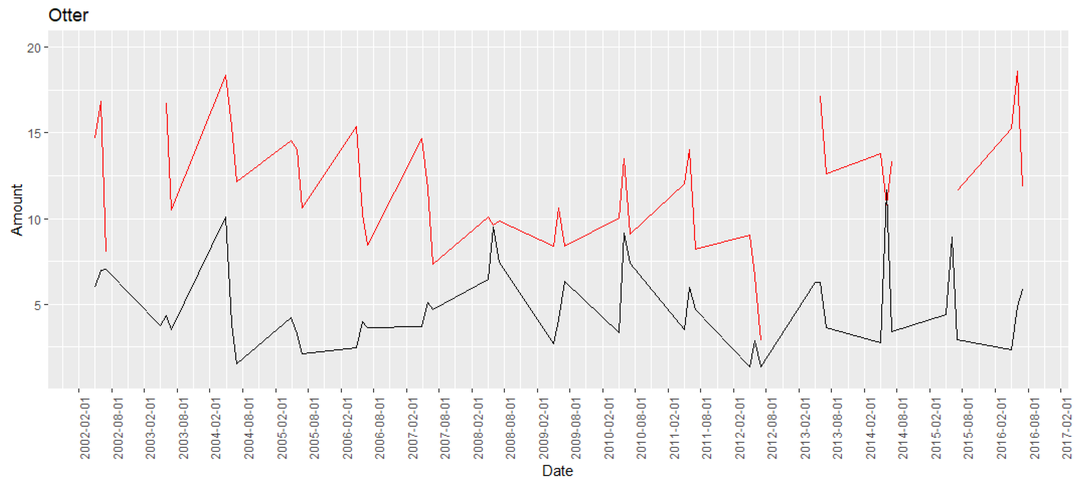
Background

Nitrate levels have been steadily increasing within watersheds across the nation. A watershed is an area of land that filters water on top of and under the ground to nearby bodies of water. Increasing levels of nitrate in the surface waters of the Mississippi River basin have become a major concern for environmental agencies in the United States.

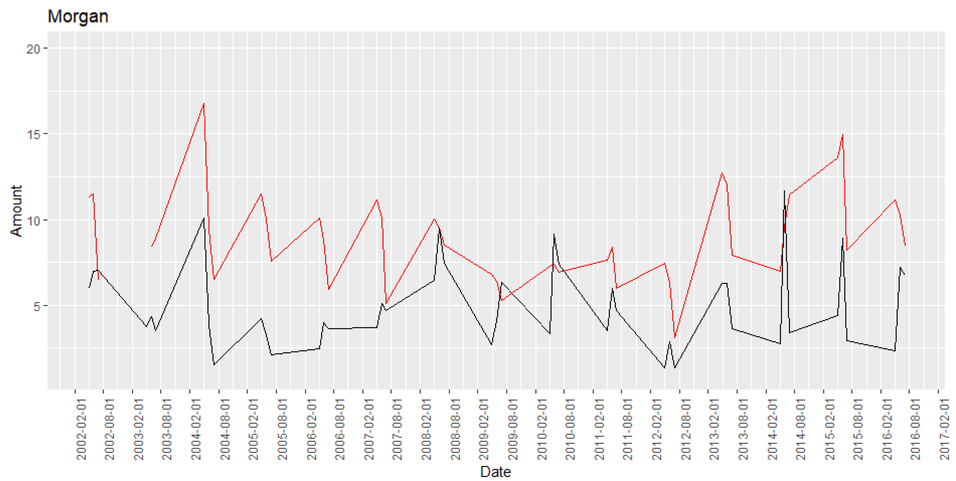
Nitrate in large amounts can be extremely harmful to marine animal habitats and can cause excessive growth in algae and plant life. It is a common belief that a major contributor to the increased nitrate levels is the tile drainage from agricultural farmland. Nitrate is a key component in agricultural fertilizer, and water runoff from row crops can transfer nitrate into local bodies of water. There are many factors that impact the amount of nitrate in the tile drainage from farmlands. Our objective is to discover, using mathematical modeling, how much of a factor localized precipitation is in contributing to the nitrate runoff from farmlands.

Mathematical Model and Strategy

Using county-specific precipitation and individual watershed nitrate data, we analyze and create several models that represent the relationship between nitrate and precipitation from May-August in 2002-2017. Also included are the correlation values generated from the models. The red lines represent nitrate levels and the black lines represent precipitation amounts.



Otter watershed is located in Linn County Iowa.
Correlation Values:
Nitrate vs. Precipitation: .4719
Nitrate vs. Temperature (not graphed): -.523



Morgan watershed is located in Linn County Iowa.
Correlation Values:
Nitrate vs. Precipitation: .397
Nitrate vs. Temperature (not graphed): -.476

Conclusion & Future Work

The research that we conducted over the summer of 2019 investigated possible causes of increased nitrate levels in watersheds near farmland in Buchanan and Linn counties in Iowa. The watersheds we investigated were all near the vicinity of farmland. We believed that the close proximity of these watersheds to farmland would cause increased nitrate levels to be present, most noticeably after rainfall. Our research shows that there is a positive correlation between precipitation and nitrate. Our correlation values are lower than expected, meaning that there are more factors affecting nitrate levels in watersheds other than precipitation. Towards the end of our research, we looked into other factors that could have an impact. For example, temperature and nitrate have a negative correlation. In the future, factors such as soil temperature, climate, and type of fertilizer could be investigated and analyzed to understand more relationships that affect nitrate levels in watersheds.

References

[1] For precipitation data: National Oceanic and Atmospheric Administration

[2] For Nitrate data: Coe College Chemistry Department

[3] For temperature and localized precipitation data: Iowa Department of Public Health

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