Anticipating Wastewater Emergencies in Alabama Using a Predictive Maintenance Machine Learning Model

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The UN recently reported on its global effort to improve access to clean and affordable drinking water, an issue made worse by changing climate patterns and poor wastewater infrastructure. One of the most damaging effects of this poor infrastructure is sanitary sewage overflows (SSOs), which result in thousands of gallons of sewage spilling into local waterways each year, causing adverse human health and ecological impacts while also disproportionately impacting low-income and minority communities. Knowing when an SSO may occur is crucial for minimizing its impact on surrounding communities, providing a chance for preventative measures to be made. This project takes a predictive maintenance machine learning approach to SSOs. I collected precipitation data from a NOAA station near the Tuscaloosa, AL, airport and Black Warrior River, an area prone to SSOs, and asked an environmental nonprofit for its data on SSOs from 2017 to 2023. Using a threshold of a predicted probability of 50% to classify predicted SSOs, the model predicts failures with a 90-95% accuracy over the testing dataset. This model can define a relationship between precipitation and SSOs and can be used to warn of a possible risk of water contamination for recreation and drinking. After having a proof-of-concept model for the county, I wanted to improve the specificity of the model's predictions using GIS software. I retrained the model on data organized by U.S. Census Block Groups and had between 95% and 98% accuracy when run on a testing dataset. Finally, I created a two-week SSO risk map to provide an example of how the model could be implemented to benefit at-risk communities, translating the model's predictions into an easily understandable format to raise awareness of water contamination.

Awards Won: