Atmospheric Quality vs. Corn Quality Over Time

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Data Set Information

Our analysis will consist of synthesizing and analyzing two distinct, yet inherently related datasets which span years 1987-2020: one from the E.P.A., tracking hourly atmospheric gas concentrations and weather data (~400,000 obs./site, 48 vars.); and one from the U.S.D.A., which contains weekly surveys of corn crop quality, each containing multiple samples from around the U.S. (79,389 obs., 13 vars.). The E.P.A. data from CASTNET includes atmospheric concentrations for SO4, NO3, NH4, SO2, HNO3, CO, Ozone, and other trace gasses, along with standard weather data (temperature, humidity, wind speed, etc.). The U.S.D.A. data from the National Agricultural Statistics Service records the percentage of each corn sample falling into each of 5 distinct crop condition/quality levels.

Background and Motivation

In recent decades, the Ozone layer has shrunk and rebounded significantly, largely due to human activity. The Ozone layer is vitally important to life on Earth, and has therefore been monitored closely, along with many other gasses and pollutants in the atmosphere. In this project, we aim to explore how the health of the atmosphere—as reflected by these gasses—is affected by human activity as well as natural causes. In order to accomplish this, we will examine historical data from around the U.S. to identify natural and man-made trends of gas concentrations in the atmosphere (including certain pollutants and ozone). In turn, this information will be compared against the quality of corn grown in the U.S. to explore possible correlations between the health of our atmosphere and the health of our crops. Corn is the most produced feed grain in the U.S., according to the U.S.D.A., which makes its health a powerful barometer for environmental analysis. Taking these project elements together, we hope to develop a statistical analysis which highlights humans' impact on the environment, along with the direct consequences of that impact (as reflected by crop health).

Multiple Potential Interconnected Questions

1. During what years did the greatest increases/decreases in air pollution occur, and how do these changes correlate with specific U.S. events that may have created such fluctuations? (ex. Oil Embargo, NAFTA development, Clean Air Act, etc.)
2. Which states have held the greatest/least air pollution per capita?
3. How do elevation level and other geographic factors affect the level of air pollution, if at all?
4. How do natural events and weather/climate patterns affect gas concentrations (including certain pollutants and ozone)?
5. How did change in various human activities over time (such as agricultural activity, urban development, industrialization) affect gas concentration levels?
6. Do changes in concentrations of these pollutants correlate with changes in ozone concentration?
    a. If so, is there a chemical reason why they contribute to the breakdown of ozone?
7. Are there significant differences in the average quality of corn produced by each state?
    a. If so, which states produce the highest quality corn? Why is this the case?
8. How has the mean national corn quality changed over time, as new technologies emerge?
    a. Have gaps in corn quality between states expanded or contracted over time?
    b. If they have expanded/contracted, what could have caused this?
9. Is there a correlation between changes in states' corn quality over time and changes in particulate/gas concentrations over time?
    a. If so, how much of these changes in state corn quality can be attributed to national technology improvements versus local atmospheric conditions?