

Lightning and Wildfire Correlations, and their Implications for Human Health in Florida



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Abstract

This project is aiming to depict the correlation between fires initiated by lightning, and how these fires may impact the sustainability of human health. The state of Florida is the area of interest. The research will be assessed with two correlations: 1) to evaluate if cloud-to-ground lightning is connected to wildfires that occur in the same area of the strikes; and 2) to determine if the fires, lightning-initiated or not, match with poor health conditions of people living in the same vicinity. Health data include mortality rate caused by asthma, chronic lower respiratory disease, lung disease, and heart disease, and these health hazards were picked due to their common association with fire and smoke. All the data- lightning, fire, and health- contains daily outputs for the years 2009 up to 2012, and the results are represented by Florida's counties. The preliminary results demonstrate that lightning and fire correlations generally do not show a consistent relationship for each county; some have up to a 0.97 R-value while others are as low as -0.67. The results for fire and health correlations will be further investigated.

Methodology

Lightning Data

NLDN provided daily lightning satellite data for the entire U.S. was plotted in ArcGIS, then clipped to include only the state of Florida. The remaining data was then compiled a total sum of annual cloud-to-ground strikes for each Florida county.

Fire Data

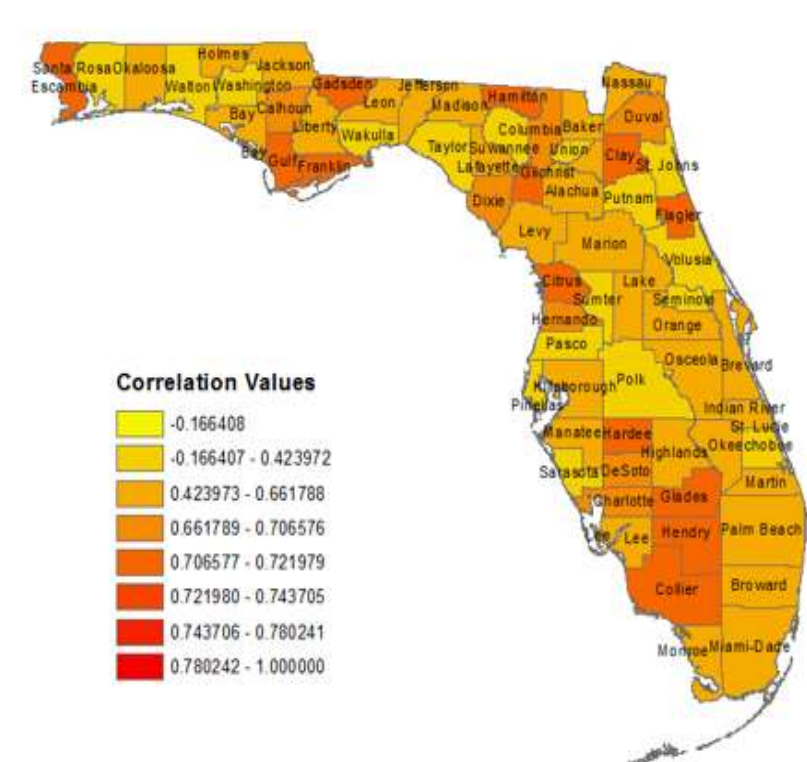
Wildfire data for Florida came from a compilation of MODIS AQUA and Terra satellites, and it was plotted in ArcGIS as 1 km. The total amount of fires for each county was compared to the frequency of lightning that occurred in that same county.

Health Data

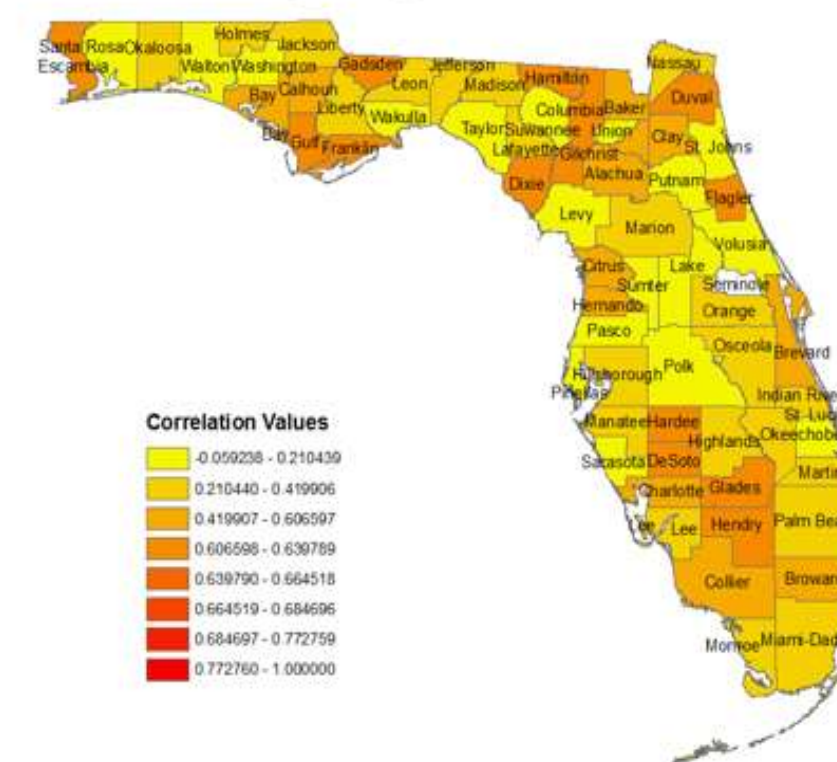
Asthma, chronic lower respiratory disease (CLRD), heart disease, and lung disease was plotted with fires to test annual correlations for each county. This came from Florida health charts data online.

Lightning and Fire Data Analysis and Results

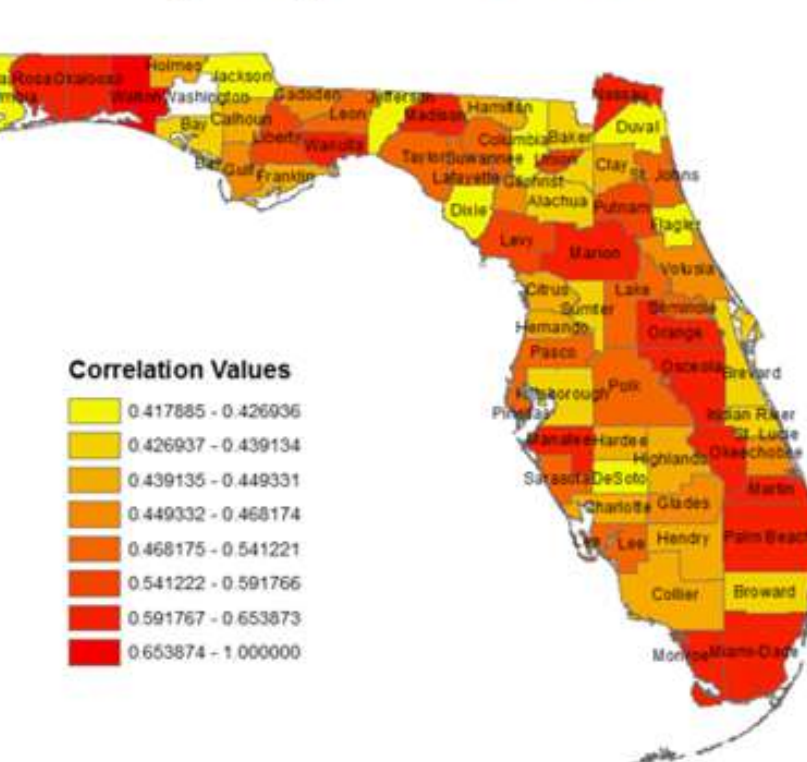
2009 Florida Lightning and Fire Correlations



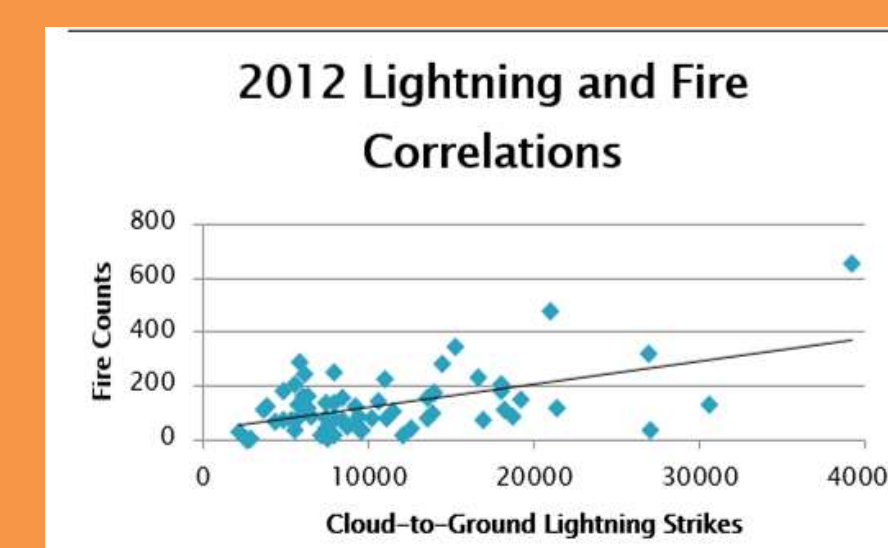
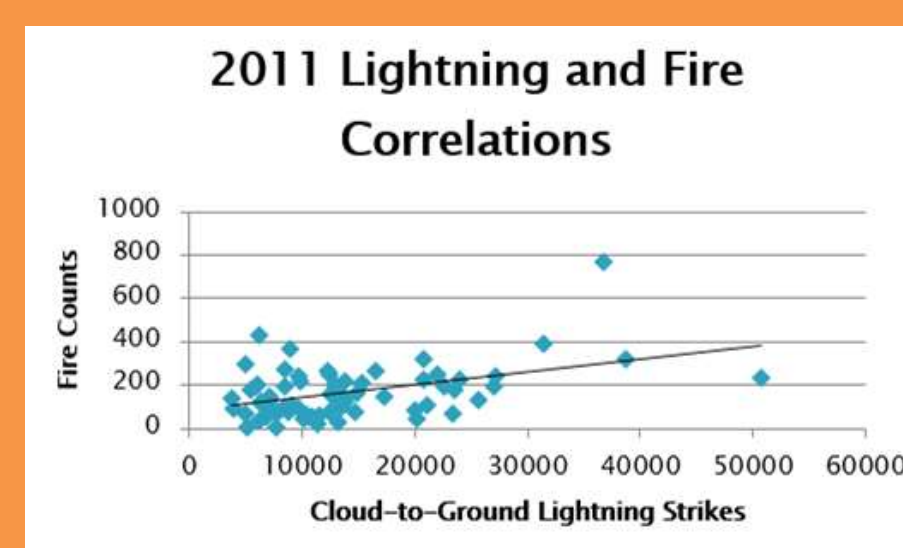
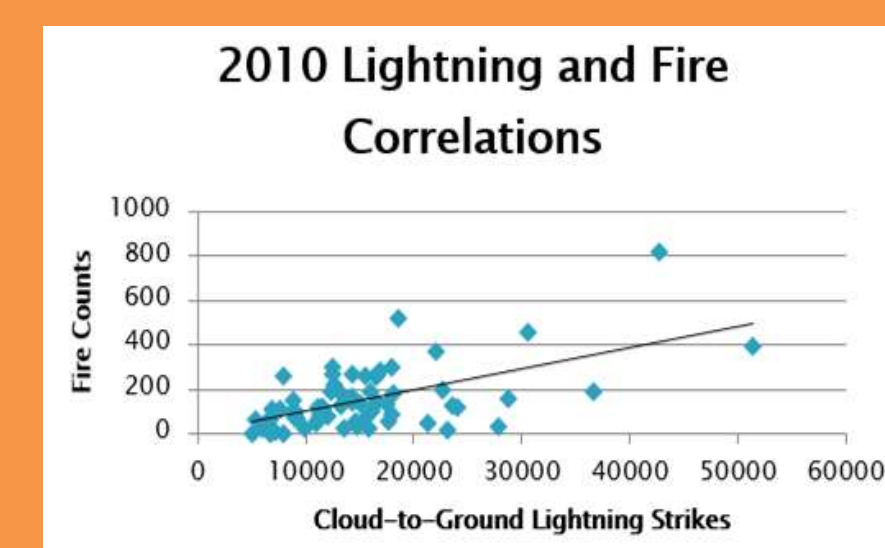
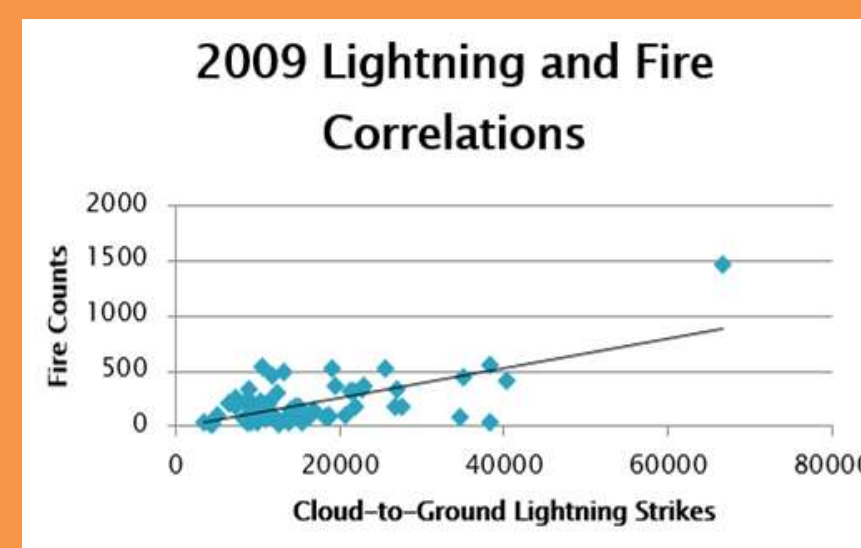
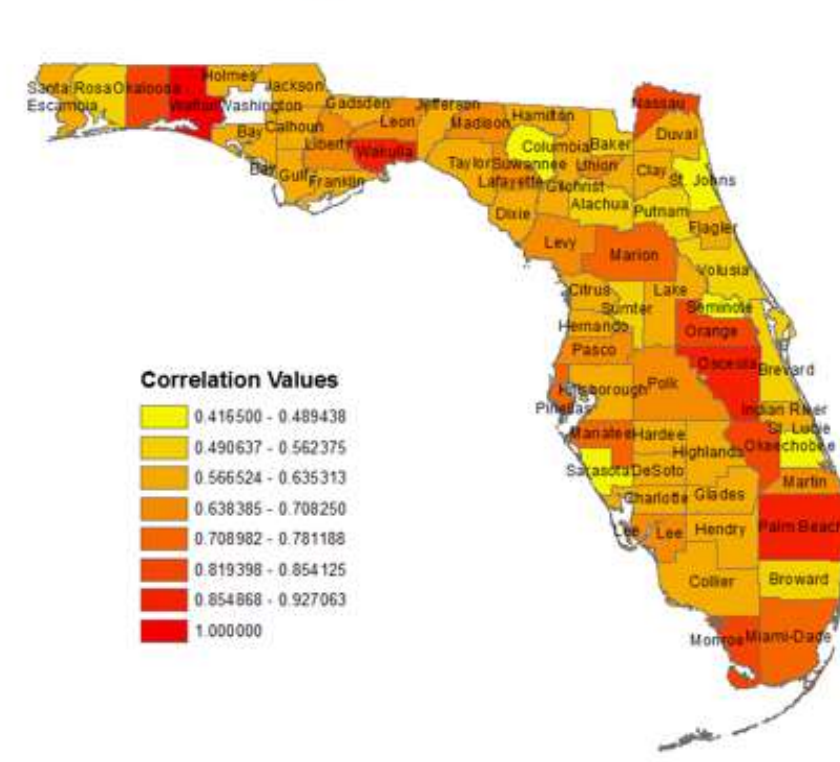
2010 Florida Lightning and Fire Correlations



2011 Lightning and Fire Correlations



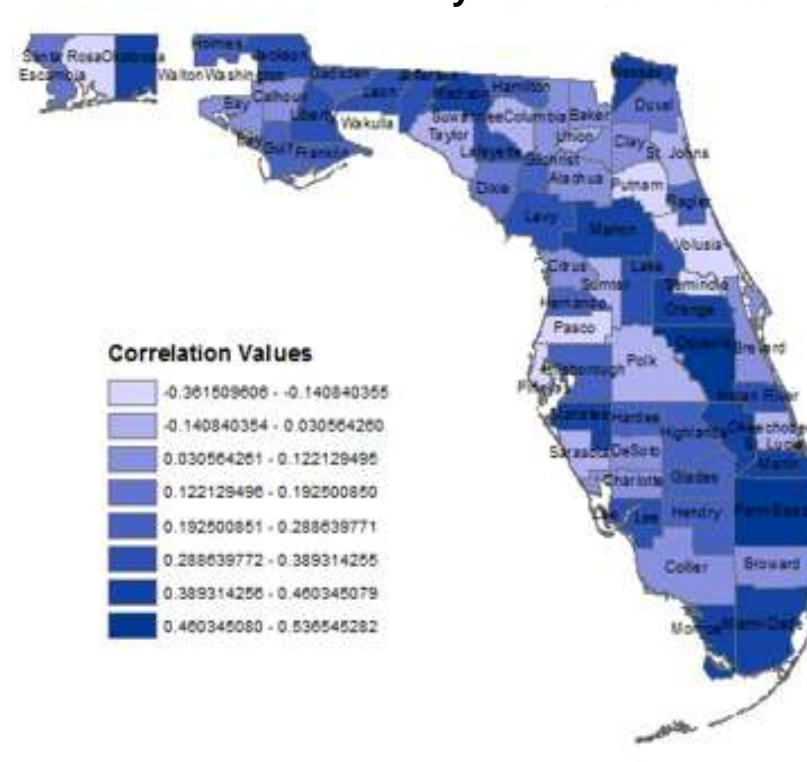
2012 Florida Lightning and Fire Correlations



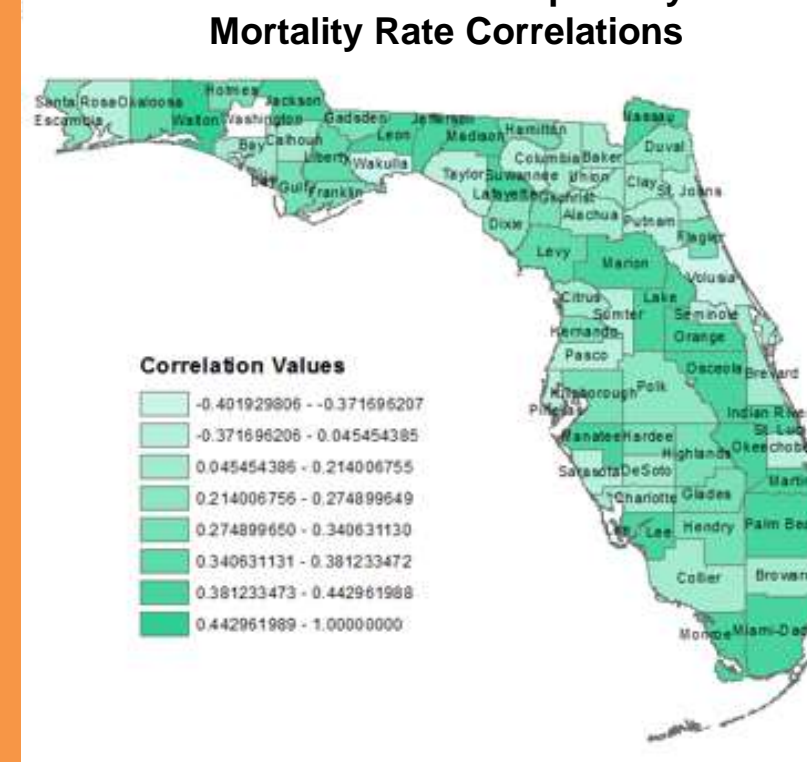
- **2009:** A good portion of the lightning-to-fire correlations did appear to be positive for this year. Location does not seem consistent; counties in all regions of Florida had low and high overall correlations
- **2010:** This year had lower total correlations than 2009, however the 2010 scatterplot still shows a positive linear trend. Compared to 2009, the individual counties that have consistently high correlations are Glades, Hendry (Southwest), Flagler (Northeast), and Escambia (Northwest)
- **2011:** There were several counties with high lightning-fire correlations this year; the total wildfires that occurred was the second highest of all 4 years. Interestingly, the highest correlation values occur in central Florida, unlike the other 2 years where this occurs most on the outskirts
- **2012:** There are not as many counties with extremely high correlations as 2011, but there still are a few mainly in central Florida. This year had an even higher amount of fires than 2011

Fire and Health Analysis and Results

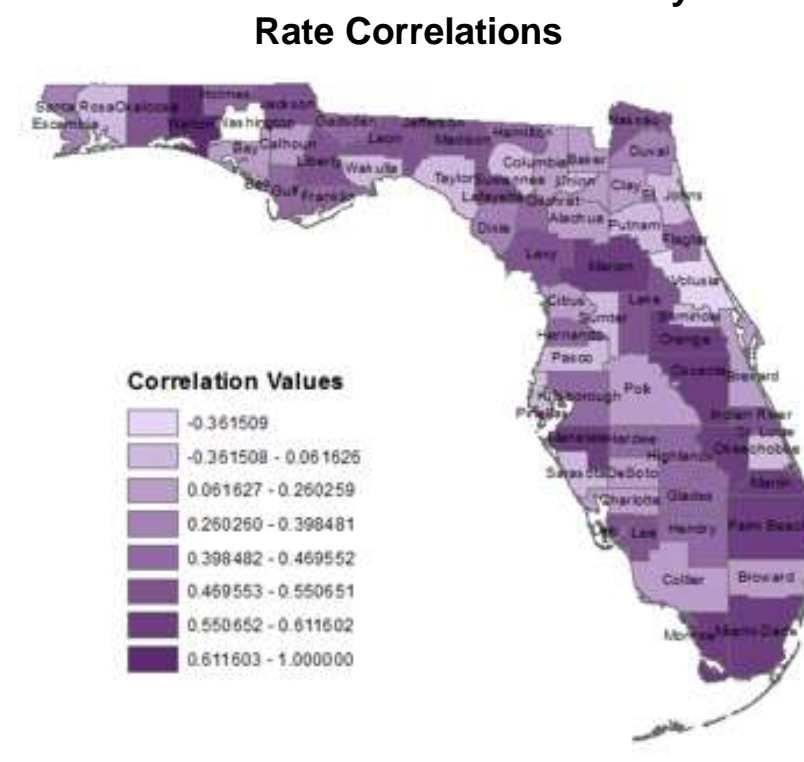
Fire and Asthma Mortality Rate Correlations



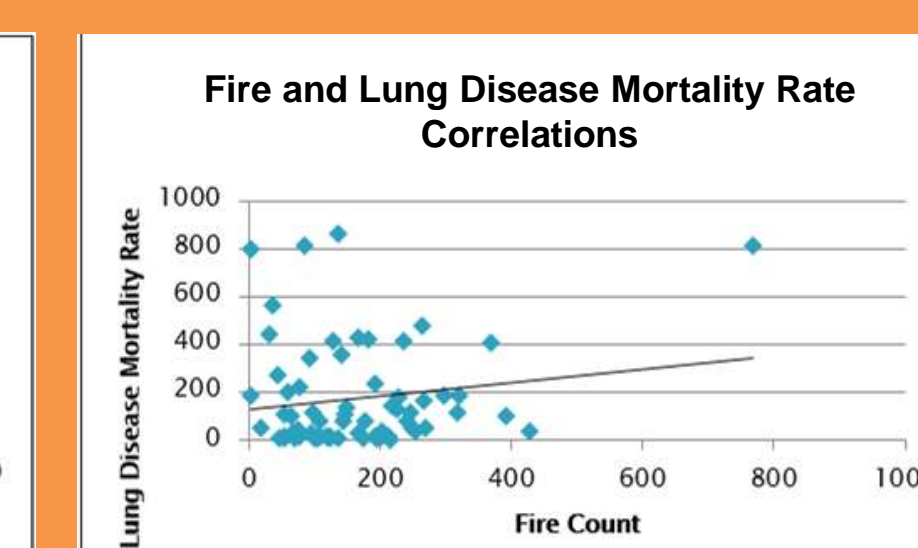
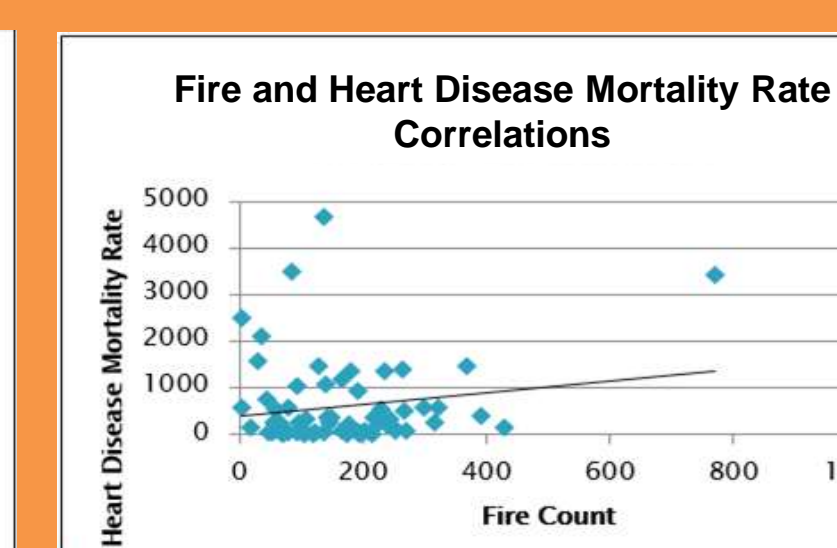
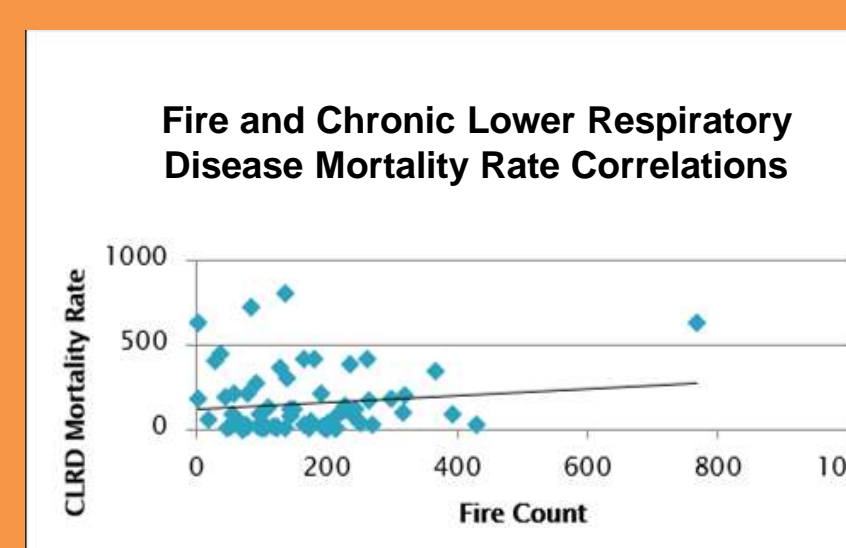
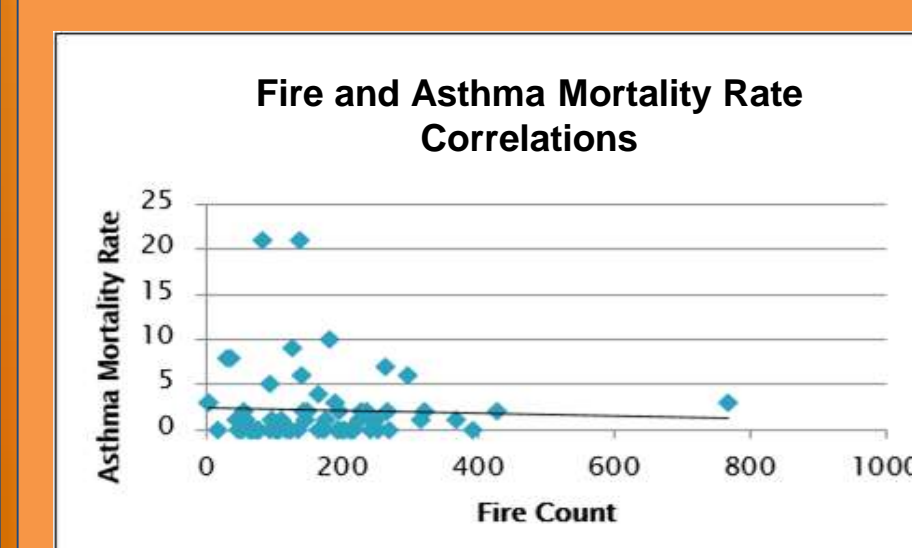
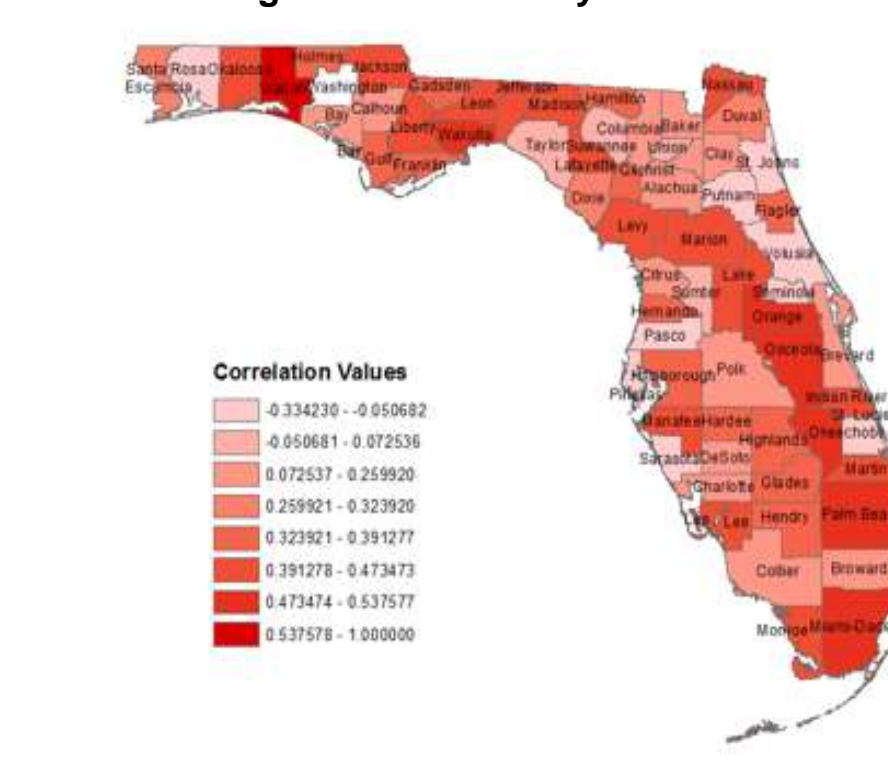
Fire and Chronic Lower Respiratory Disease Mortality Rate Correlations



Fire and Heart Disease Mortality Rate Correlations



Fire and Lung Disease Mortality Rate Correlations



- **Asthma:** The highest correlation value did not exceed 0.54, however there were quite a few counties along central Florida that reached this range. Still, the scatterplot shows a slight negative linear trend, suggesting that fire is not very connected to asthma mortality
- **Chronic Lower Respiratory Disease:** CLRD also had a low overall range when correlated with fires for each county. Though this scatterplot shows a more positive trend, but many instances when the fires count increases the CLRD mortality rate does not
- **Heart Disease:** Again, central Florida seems to be the hotspot for the highest fire-to-health correlations, and this includes heart disease. One notable county is Walton in the Northwest, which is not central but receives a high correlation for all 4 health conditions
- **Lung Disease:** Central Florida has the highest correlations. Upon further research it seems the highest populations in Florida are located in the Palm Beach, Broward, and Miami-Dade regions in the Southeast, meaning population does not pose much of a factor

Conclusion

- When the lightning, fire, and health data is all observed together, it seems central Florida poses an interesting trend of having higher correlation values. This makes sense with lightning-fire correlations because the majority of lightning in Florida thunderstorms occurs in the central belt of the state. Fire-health correlations do not seem to be as population driven as expected, since the majority of population is in Southeast Florida. Therefore, this could be due people have more than one health condition (some who have asthma may also have CLRD)
- Asthma and fire is the only scatterplot with a negative linear trend. This could be because, though it represents poor health conditions, it is not a long-term disease like lung disease, for example
- 2011 had the year with the highest lightning-fire correlations, while 2010 had the lowest. This shows there can be a high amount of various even when the years are back-to-back.

Future Work

- Use obtained lightning data to check if polarity or multiplicity of the lightning strike influences the correlation value with fires
- Use Florida hospitalization health data instead of mortality rates
- Redo data for Walton and Washington counties to check why there's no data evident
- Test lightning and health correlations; though not much of a correlation is expected it may explain the exceptionally high R-values in central Florida

Acknowledgment

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