Report of Climate Change in Alabama

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Abstract
Community advocates gaspgroup.org in 2020 are initiating a climate report specifically for topics affecting our citizens. We hope to connect with as many people as possible, and we feel that the availability of local information is currently small and diffuse. The report will be hosted by and updated on the gaspgroup.org website.
Alabama population is closing in on five million persons, and it boasts 668,000 acres of public forest land (*National Forests in Alabama - Districts*, n.d.). The Environmental Protection Agency (EPA) currently calculates a rise from ~60 now, to ~150 incredibly hot days per annum, in southern states by 2080. Alabama contains several large lakes, the waterways feed directly into the Gulf of Mexico, and by proxy, the Atlantic Ocean (Elmer et al., 2020). We are anxious to know how we may be thus affecting, or effected by sea level rise. Sea level rise in Mobile is a potential peril, half the mud flats, shoals and salt marsh in neighboring Florida may be lost this century. Nitrogen (N) pollution to air and water is another distinct issue with accelerated effects being observed in the Gulf Coast as red tides, also known as algal bloom (Hallegraeff, 2010). Some Alabama localities, mostly urban, have serious air quality issues to address (Murdoch & Thayer, 1988), and we evaluate the role of these in terms of Alabama climate outcomes and carbon monoxide equivalent (CO2e) emissions (Carlson et al., 2017).
Key Words: Data Science, climate, geospatial, ArcGIS, environment, pollution

1. Design

Upon consultation with Internationalcomparisons.org we've acquired public data from sources listed below, and hence developed procedures for geospatial presentation. We believe this method is informal and powerful. Thus these data are being prepared for the public in report and in blog format, which we consider neither disconcerting nor obtuse to Alabama demographics.

1.1 Preliminary Questions

Much of Alabama is cropland, so what is the contribution of farms to carbon pollution/ remediation, with respect to municipality contribution?

The presence of numerous associated water bodies make this question essential to Alabama climate impact: how does nitrogen fertilizer application affect water, in relation to climate change and sea level rise?

Describe areas of Alabama most vulnerable to flooding as risk increase and sea levels rise.

1.2 Data Sources

CO2e data is thanks to EarthStat (Carlson et al., 2017) circa 2000.
Nitrogen data is public, EPA EnviroAtlas sourced data circa 2006.
Hydrology floodplain data is from National Ocean & Atmospheric Administration (NOAA) (Youngman et al., 2011).
Bathymetry data courtesy of NOAA Coastal Services Center (Stoker et al., 2009).

2. Early Results

2.1 Farming

Greenhouse gas emission from croplands are considerably low overall, there are particular USA regions with moderate levels, but Alabama is not a problematic area (1B). In fact, croplands have a great potential for sequestering carbon and restoring balance to climates. Programs to reward farmers for realizing this incredible opportunity are being developed as aggressive business and legislative action underway (*New Bill Would Help Farmers Participate in Carbon Markets*, n.d.). Closely observing Figure B: clearly areas with increased CO2e from croplands coincide with water bodies, in particular Mobile Bay and the Tennessee River.

2.1.1 Comparing Figures A, B, and C: Base map, CO2e, and Nitrogen fertilizer

Our analysis suggests that CO2e from croplands correlate with N application in Alabama, especially near Mobile Bay and across the Tennessee River. This CO2 equivalent is predominately NO2 gas, a product of N fertilizer application. Alarmingly, this effect is heightened close to waterbodies. It's likely that fertilizer run-off is increased in these areas, which tend to be on sloped land.

N pollution is a contributor to climate change, but perhaps understated in importance (Houlton et al., 2019). Excess N fertilizer to crops flows into waterways, creating algal blooms with accelerated growth (1C). These blooms trap heat from the sun in water, ultimately heating oceans and causing polar ice to melt. This effect is being seen as N accumulates within Mobile Bay and along the Gulf of Mexico coastline.

2.2 Hydrology and Bathymetry

Flood zones throughout the state indicate high risk of flooding occurs in valleys and localize within major cities across the state (1D). Some large zones can be seen in in Tuscaloosa and Montgomery (Youngman et al., 2011). 2019 bore the highest levels of January/February rainfall since 1895 according to the National Weather Service, Birmingham office. I can attest to a startling incidence of flooding in Northern Alabama this year. Also included is a model of Mobile County, from a separate dataset (Stoker et al., 2009), which predicts that if hit by a Hurricane Katrina type storm, half of the county is in serious danger of flooding (1D). Neighboring Baldwin County and all other Alabama counties are not included in this DEM storm model.

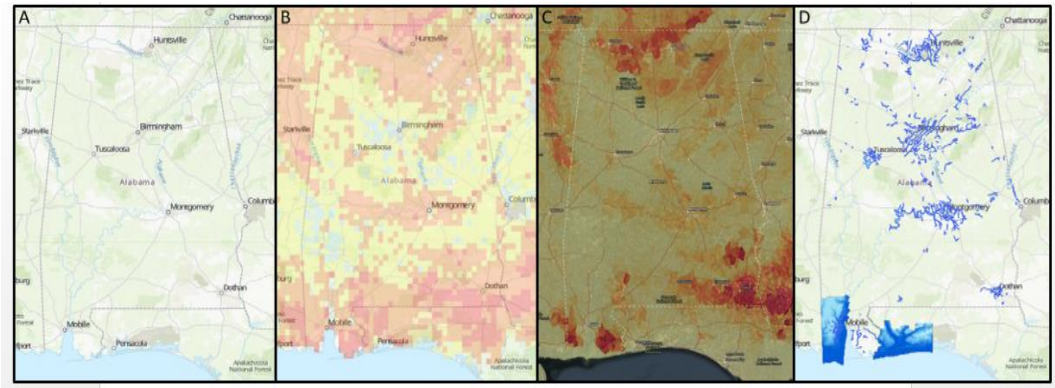

Figure 1: (A) Alabama map showing the location of major cities and water bodies. (B) Carbon equivalent (CO2e) emissions from cropland. (C) Nitrogen applied to soil (synthetic and manure based). (D) Predicted flood risk map.

Further Discussion

Croplands carry a huge potential for sequestering carbon and stalling climate change. By far, the most emissions are produced in cities, traffic, and by industry. Industry often buys raw materials from cropland, so why not buy carbon credits and make business sustainable? This solution gives business incentives for clean practices, and it also offers farmers incentive to produce more carbon credits (*Arva Intelligence Corp.* | *Arpa-e.Energy.Gov*, n.d.; *International Emissions Trading* | *UNFCCC*, n.d.).

Nitrogen fertilizer incentives are another option to explore, and important to not only climate, but to public health and many large industries such as fishing. Modest gains in yield are insufficient incentive for farmers to switch from organic fertilizer, which a farmer often has free access to. Networks need development and funding, to encourage optimal usage, participation, and fair treatment (Fa & Ma, 2014; Robertson et al., 2013).

People living in cities tend to be concerned with a disparate set of issues. Fires often affect large communities, and Alabama is certainly at risk in years to come. Mosquito borne illness is spreading from tropical to more sub-tropical regions as climate temperatures rise (*Mosquito-Borne Diseases* | *Alabama Department of Public Health (ADPH)*, n.d.). Sea level rise in Mobile bay has been slightly greater than that in Miami(*Sea Level Trends - NOAA Tides & Currents*, n.d.).

On a positive note there are signs that funding to climate science is increasing. In Alabama, the EPA EnviroAtlas project has mapped Birmingham with high resolution, providing virtual cornucopias of road to data mining. Mobile Bay has reef restoration projects underway to protect the shorelines (Lai et al., 2020). We want energy high and focus on our common crisis: climate.

This work is ongoing and in very early stages, so please stay tuned. In the near future we plan to add indicators of air quality, analysis of storms/ rainfall, and health/ mental effects of air pollution exposure. We also supply accessible climate advocacy/advice for farmers and consumers!

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