Members

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Research Question

How did California's pandemic response impact the level of greenhouse gases (GHGs) emissions in California? Specifically, how has the resulting decrease in air-travel and motor vehicle usage affected the emission of CO_2 and N_2O?

Background & Prior Work

Global warming is increasingly becoming an urgent issue, but sadly many people think that individuals are effortless to change this. Additionally, Earth's natural resources are dwindling at an unsustainable rate, and its pollution tolerance is steadily decreasing. While humans have resumed their lives with a sense of complacency in the face of such global issues, COVID-19 pandemic has provided us a rare opportunity to show people that global warming is not something we aren't able to change. In this study, we are expecting to see the positive effects on the environment as a result of the decreased human activity enforced by government regulations. GHG emissions and global warming are detrimental to sustainability of life on Earth, upending the delicate balance of ecosystems on Earth, such as stimulating the growth of harmful cyanobacteria ("How rising CO_2 and global warming may stimulate harmful cyanobacterial blooms").
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In this study, a focus will be placed on CO_2, NO_2 and N_2O emissions from airplanes and motor vehicles, which accounted for 88% of all GHGs emitted in 2018 ("Overview of Greenhouse Gases"). Specifically for our state California, transportation has established itself as the leading contributor for greenhouse gas pollution, clipping at 40% of the state's emissions alone ("*Transportation and Climate Change*"). According to the WHO:

Human activities that are major sources of outdoor air pollution, include:
- Fuel combustion from motor vehicles (e.g. cars and heavy duty vehicles)
- Heat and power generation (e.g. oil and coal power plants and boilers)
- Industrial facilities (e.g. manufacturing factories, mines, and oil refineries)
- Municipal and agricultural waste sites and waste incineration/burning
- Residential cooking, heating, and lighting with polluting fuels

("Ambient air pollution: Pollutants")

Researchers from the Nasa Earth Observatory have shown that airborne nitrogen dioxide emissions, which are a major contributor to air pollution, have plummeted over China ("Airboned Nitrogen Dioxide Plummets over China") as a result of the COVID-19 lockdown measures implemented in early 2020. It shows that as soon as human activity related to motor vehicles decreases, there is a dramatic change in the amount of GHG emissions.

Some articles for further research:
How the current pandemic crisis can lead to a permanent decrease in transportation demand
https://www.iea.org/articles/changes-in-transport-behaviour-during-the-covid-19-crisis

"In California transportation is the leading source of greenhouse gas pollution, accounting for about 40% of the state's emissions."
https://www.biologicaldiversity.org/programs/climate_law_institute/transportation_and_global_warming/index.html

Analysis: Coronavirus temporarily reduced China's CO2 emissions by a quarter
https://www.carbonbrief.org/analysis-coronavirus-has-temporarily-reduced-chinas-co2-emissions-by-a-quarter

Hypothesis

Due to widespread economic shutdown and the stay-at-home order in California during the COVID-19 pandemic, there is a reduction in people's outdoor activities and travel plans. As a result, the usage of motor vehicles and airplanes has decreased dramatically. Since motor vehicles and airplanes are two of the major contributors to greenhouse gas (GHG) emissions, there will also be a dramatic decrease in greenhouse gas emissions, specifically CO_2 and N_2O emissions. Even though the stay-at-home order would also lead to increased indoor activities that might release greenhouse gases, the effects are not impactful enough to skew the data significantly.

Data
    To answer the question of how California's pandemic response affected the levels of GHG emissions in California, we will need to consider several key variables such as CO_2 and N_2O emissions (levels) in California at different times (mainly splitting between pre COVID-19 and during). Other variables that we will need to consider is the number of flights going in and from California as well as traffic counts. Furthermore, regarding traffic counts, it is important to also distinguish the types of vehicle.
    In order to obtain the necessary data for the study, we will be using APIs to gather data from government reported websites. Web scraped data will be uploaded into a database repository. Depending on the data, the data will be stored either as a CSV document or, if the platform allows us to use API, as a much more organized data set which can be directly stored in a MYSQL database. We will preferably need one observation per day starting from the earliest date of pandemic response in California to September 2020. The observations should include CO_2, N_2O, NO_2 levels for that given day. Along with these observations, we will also include

what type of vehicle the emissions come from and observe trends relating to transportation. From our current knowledge the data will be collected from API's and public repositories that have been published by credible sources. The datasets that are needed will vary from the period of pandemic response in California and corresponding datasets from the same time period in 2018 and 2019 for comparison. As for collecting data for our datasets, we will need to be mindful of different locations across California (population density). Also other potential factors that may influence the data include the rise of rideshare companies such as Lyft and Uber and the usage of electric vehicles (including cars, scooters, and bicycles).

Ethics & Privacy

Most datasets measuring quantities and impacts of CO_2 and N_2O emissions (such as in air quality) in proximity to motor vehicle usage that will be used are published in the public domain, such as data accumulated in NASA's EarthData website for tracking CO_2 and N_2O emissions. So those datasets should find permission usage-wise for this project. As a result, it does not seem like there will be any privacy concerns that limit the open sourceness of the data collected nor will there be any additional terms and conditions that need to be complied with. There may be some info unpublished in open source, like specific individuals that compiled the findings, but details like that should not impede the data gathering phase.

In relation to ethics, concerns arise in the forms of usage of data for personal gains, often cherry-picked, and the limitations involved in collecting data from various sources. Concerns regarding the misuse of findings about GHG emissions include: findings and data are used to spread misinformation, and they may be politicized. Cherry-picked data is a common occurrence involving misinterpretations or misuse of data for personal gains. As a result, there is room for bias within these involved sources that can skew expected/actual trends synthesized from more objective findings. To combat the spread of misinformation and misuse of information, measures employed can include: filing a complaint in case of misuse, requesting a clarification in case of misuse, and most importantly, make the findings of this study as irrefutable as possible.

Moreover, platform availability is a big concern as well for organizations or researchers who have worked hard to collect accurate CO_2 emission data, but experience limitations when it comes to sharing the data with the world. Additionally, data may not be compiled equitably around the world considering how cities differ in population and geographically speaking (i.e. urbanized, rural, suburban). We can work around the discrepancies brought upon between city differences by focusing on comparing cities between times rather than comparing the cities themselves. Furthermore, data sets are expected to vary dramatically month by month, which is expected before and during the pandemic.

After a thorough analysis of the current systems, our mission is to collect data from credible platforms, whether from government or privately funded, to create a clear demonstration of CO_2 & N_2O pollutants being emitted into the atmosphere as a product of motor vehicle usage. Since the beginning of the pandemic that has played a hand in the minimal usage in motor vehicles, we will be able to gather data before and during the shutdown. As we compare those gatherings accumulated through the three-month period, we anticipate being in a prime position to pinpoint how California's shutdown response to the COVID-19 pandemic has proven to be opportune as reductions in motor vehicle usage tempers down greenhouse gas emissions.

Team Expectations
- Everyone should be up to date on the progress of the topic
- Each member should try to contribute with their respective skills and expertise
- If you have any questions, ask away!
- Communication is key to a successful project

Project Timeline

Meeting Date	Meeting Time	Completed Before Meeting	Discuss at Meeting
10/19 M	5-6pm	COGS 108 project brainstorm	Project's question brainstorm Get familiar with our topic. Set date and to-do list for next meeting
10/20 T	8-10pm	Research question brainstorm	Formulate research question; Discuss background, hypothesis, and ethics concerns, and do the first draft on these parts.Discuss datasets and variables. Set date and to-do list for next meeting
10/21 W	4-6pm		Elaborate on background and hypothesis parts, make the research question more specific.
10/22 T	6pm	Research Question specifics, Background information section	Data, Ethics & Privacy Section, finalize hypothesis
Week 4	TBD	Project Proposal & Finding links	Where & how to get the data
Week 5	TBD	Collected all needed data sets	Discuss how to clean up data if needed, data wrangling, formatting datasets
Week 6	TBD	Formatting dataset	Analyze the data
Week 7	TBD	Analyze data & attain clear data usability	Discuss data viz, style choices, presentation choice
Week 8	TBD	data visualization	Formulate data in diagram format and attach detailed information for audience to capture results

Week 9	TBD	Final check, make sure the project is complete	Discuss potential concerns and suggestions for how the report is formatted & create rough final project draft
Week 10	TBD	Finalize project report	Submit project

Works Cited

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