The Year Earth Changed

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Introduction

- People were required to **stay at home** during COVID-19 lockdown period.
- **The Year Earth Changed documentary** reveals that **air quality** and **global emission of greenhouse gas** have **fallen** due to COVID-19 lockdown. The moment we paused, the earth was able to breath again.

Fig. 1 The Himalayas before and after lockdown in Jalandhar, India(source: https://www.heraldscotland.com/news/19283486.lorraine-kelly-show-probed-photoshopping-himalayas-row-involving-david-attenborough-bbc-documentary/)

Introduction

- Our study has two parts: firstly we analyzed **air quality in India and California**, secondly we studied **carbon dioxide emissions in China, United States and India**.
- Preliminary evaluations: we found **drops** of both the air pollution and carbon dioxide emission during the COVID-19 lockdown period.
- Importance of our study: provide insights regarding health and control of air pollution and greenhouse gas emissions.

Methodology

---Air Quality Analysis

India:

- 2015 to 2022
- PM2.5, PM10, NO, NO2, NOx, NH3, CO, SO2, O3, Benzene, Toluene, Xylene, AQI and AQI_Bucket
- Lockdown period: 2020.03.25 - 2020.06.06
- Data wrangling: missing data

Methodology

---Air Quality Analysis

	Missing Values	% of Total Values
Xylene	18109	61.300000
PM10	11140	37.700000
NH3	10328	35.000000
Toluene	8041	27.200000
Benzene	5623	19.000000
AQI	4681	15.900000
AQI_Bucket	4681	15.900000
PM2.5	4598	15.600000
NOx	4185	14.200000
O3	4022	13.600000
SO2	3854	13.100000
NO2	3585	12.100000
NO	3582	12.100000
CO	2059	7.000000

Methodology

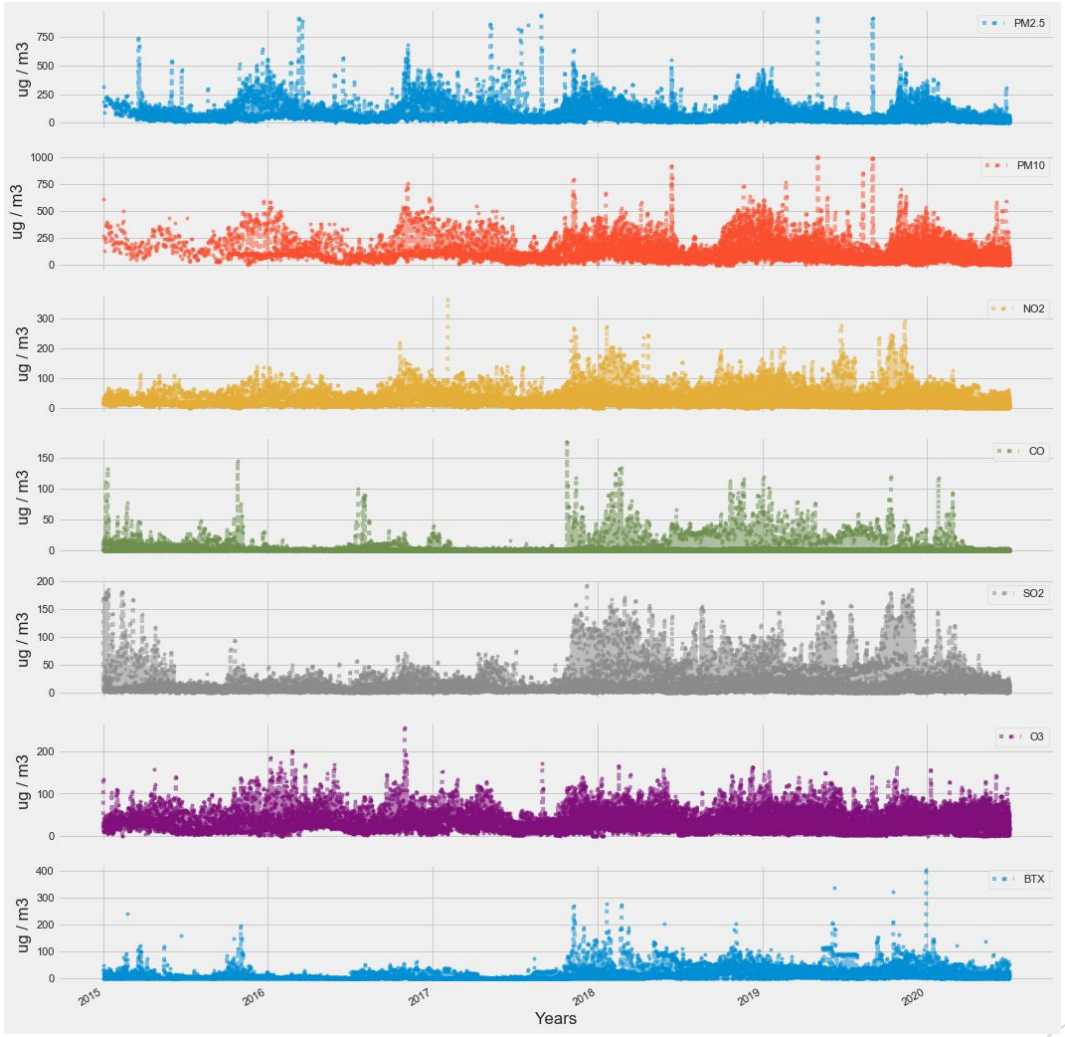
---Air Quality Analysis

India:

- City select: Ahmedabad, Bengaluru, Chennai, Delhi, Hyderabad and Mumbai
- Factors that might affect the air quality of India.

Methodology

---Air Quality Analysis



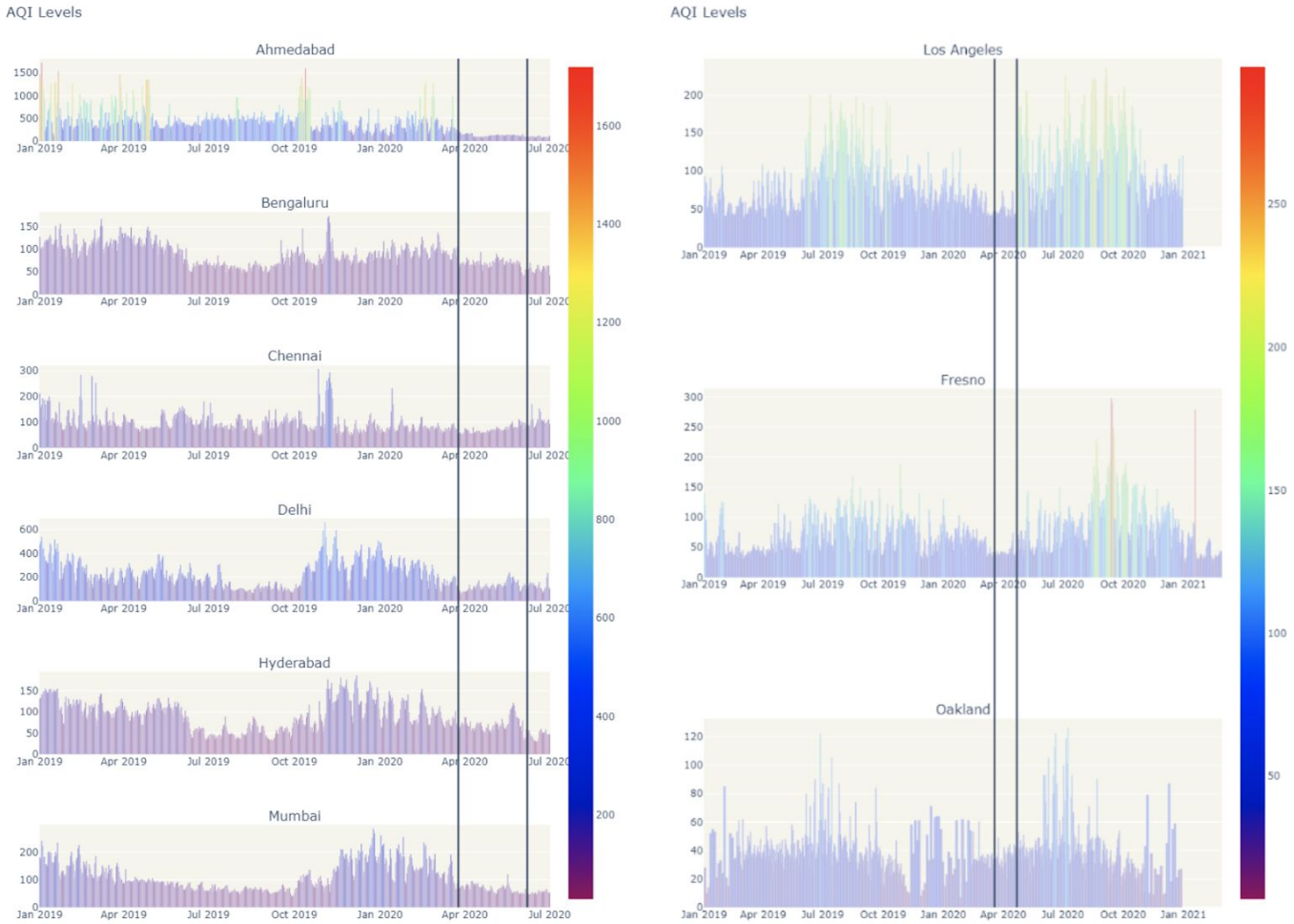
Methodology

---Air Quality Analysis

- Compare the level of AQI before and after the lockdown period
- Compare the impact of lockdown period between India and California

Methodology

---Air Quality Analysis



Result

---Air Quality Analysis

- As AQI levels have a significant drop after the lockdown policy was posted, we concluded that the lockdown policy has a very positive impact on air pollution in both India and California.
- Except for all those experiments, we also calculate the average AQL value of all those cities before and after the lockdown policy. The AQI value dropped 66.8% in Ahmedabad, 29.2% in Bengaluru, 22.5% in Chennai, 52.8% in Delhi, 29.8% in Hyderabad, and 50.3% in Mumbai. In California, the AQI value dropped 39.1% in Fresno, 50.3% in Los Angeles, and 7.7% in Oakland.

Methodology & Results
Carbon Dioxide Emission Analysis

- Representative countries: **China**, the **U.S** and **India**

- Dataset: acquired from Carbon Monitor [1]; contains emissions data from **Jan 1 2019** to **Dec 30 2020**; measured from electrical power generation, industrial production, **ground transportation**, residential activity, and domestic and international **aviation**.

Methodology & Results
Carbon Dioxide Emission Analysis

- lockdown period of each country:

Country	Lockdown Period
India	Mar 25 2020 - May 31 2020
United States (New York State)	Mar 19 2020 - June 18 2020
China (Wuhan)	Jan 23 2020 - Mar 25 2020

(Investigated from [2][3][4][5])

Methodology & Results
Carbon Dioxide Emission Analysis

- Fig 2. CO2 during **pre-lockdown** period in 2019 and 2020

Country (before lockdown)	Mean in 2019	Mean in 2020	Difference in Means of 2019 and 2020
China (Jan.1 - Jan.23)	0.92	0.83	-0.09 (**-10%**)
India (Jan.1 - Mar.25)	0.29	0.26	-0.03 (**-10%**)
U.S (Jan.1 - Mar.19)	1.70	1.61	-0.09 (**-5%**)

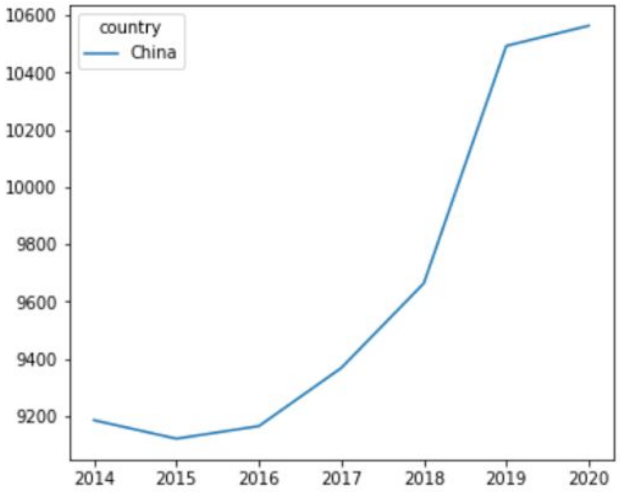
Methodology & Results
Carbon Dioxide Emission Analysis

- Fig 3. CO2 during **lockdown** period in 2019 and 2020

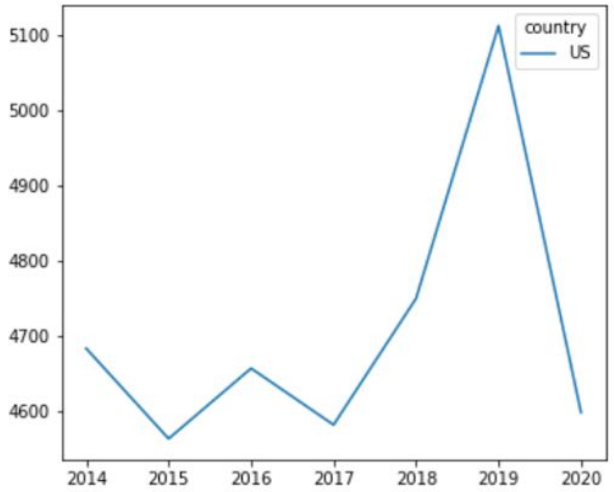
Country (during lockdown)	Mean in 2019	Mean in 2020	Difference in Means of 2019 and 2020
China (Jan.23 - Mar.25)	0.93	0.61	-0.32 (**-34%**)
India (Mar.25 - May.31)	0.29	0.18	-0.11 (**-38%**)
U.S (Mar.19 - June.18)	1.75	1.36	-0.39 (**-22%**)

Methodology & Results
Carbon Dioxide Emission Analysis

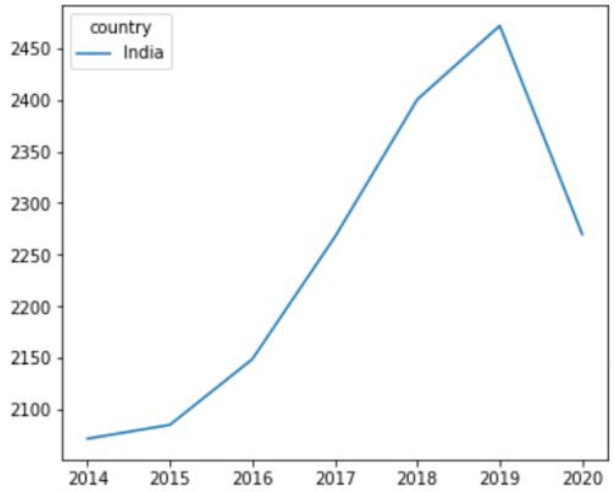
- Yearly Co2 from 2014 - 2020
  - Obtained historical data from Climate Watch [6]
  - Computed the sum of daily emissions in 2019-20
  - Fig 5. In 2019-2020, growth in **China** is much **slower** than previous years and **significant drops** in **India** and **U.S**



yearly co2 in **China**



yearly co2 in **U.S**



yearly co2 in **India**

Discussion

- Our findings present evidence that, during the COVID-19 pandemic, air pollution has declined across India and California in the U.S and CO2 emission has declined in China, U.S, and India. Decreases in CO2 are likely associated with reduced ground transportation and aviation as people working remotely and travels were limited.
- **Pro**:
  - Real-time CO2 emission measurements provide ground based quantification of pollution change
  - Our research is also geographically broad, including 3 countries across the world
- **Con**:
  - Only studied correlation rather than causation of pollution and COVID-19
  - Lacks the consideration of weather and large-scale events that could potentially impact the pollution level.

Conclusion

- Studied the impact of **COVID-19 lockdown** on **environmental changes**
- Analyzed the **air pollution** in India and California and showed a decrease of AQI level in both areas during COVID-19 lockdown period
- Analyzed the **CO2** emissions in China, the U.S and India and found a decrease in average emission during COVID-19 lockdown period and reductions of yearly emissions in the U.S and India. The increase of yearly emission in China was slower.
- Protect the public health and the planet earth
- Future Work: study the causation of COVID-19 lockdown and environmental changes and the impact of weather and large-scale events

Reference

- [1]“Carbon monitor.” [Online]. Available: https://carbonmonitor.org/
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- [6]. [Online]. Available: https://www.climatewatchdata.org/

Thanks for listening!