

High Resolution Predictors for Fine-Grained Air Quality Modeling: A Case Study over Delhi, India

Author Name
Affiliation
email@example.com

Abstract

Air pollution kills 7 million people every year. Nations have deployed high quality air quality sensors but they are costly. Air quality modeling and source apportionment studies have been conducted in the past, but i) physics-driven models do not take sensor readings into account and thus exhibit high bias and ii) machine learning models focus mainly on modeling and less on actionable insights/what-ifs. Global coverage of pollution sources is available from NASA but it is coarse-grained in space (0.25 deg resolution) and thus unsuitable for city level modeling. In this paper, we present a fine-grained curated dataset for machine learning based air quality modeling with focus on PM_{2.5}. We describe the proxies we retrieved for sources of air pollution including but not limited to SO₂, NO₂ and CO. With a machine learning model, we show the impact of including such proxies on the modeling performance and thus make a case for their impact based on its importance for the model.

1 Introduction

Air pollution takes 7 million lives a year and 9 out of 10 people breathe air that violates WHO standards [?].

considered, by the United Nations, one of the major environmental risk to health worldwide. Accordingly, it is addressed for mitigation in multiple United Nations Sustainable Development Goals, such as the 3.9 and 11.6 [?].

Nipun's comment:

2 placeholder for some points

1. Physical models interpretable but often exhibit high bias ..
2. ML models may be able to accurately spatio-temporal interpolation but offer little actionable insights/what-ifs
3. PM like pollutants created from primary pollutants over several days
4. Different sources contribute different kinds of pollutants: waste burning primarily ..
5. Atmosphere exhibits inertia (how to model?)
6. mixing height varies over space and time

7. proxies for different sources: fire count + intensity for fires, traffic intensity (fine-grained), road network (coarse grained plus static) for number of vehicle,
8. Ghazipur land fill case
9. Anand Vihar case
10. low pollution case
11. what-if: if we reduce the thermal produce by half then what is the effect?

3 Related Work

4 A Primer on Air pollution

Abbreviation	Full Name
Su	Sulfates
Ni	Nitrates
OC	Organic Carbon
SOA	Secondary Organic Aerosols
BC	Black Carbon
Du	Dust
SS	Sea Salt

Table 1: Constituents of PM_{2.5} [?]

5 Dataset

Delhi, the capital of India is one of the highly polluted cities in the world. In this section, we discuss large scale proxy data for sources of air pollution i.e. NO₂, SO₂ and CO over Delhi. We would like to emphasize that most of the mentioned sources can be acquired for other cities/regions from global sources or the regional government/research portals.

5.1 Carbon Monoxide (CO)

Carbon Monoxide is formed due to incomplete combustion. It can lead to release of Organic Carbon (OC) and Black Carbon (BC) (see Table ??) in the air.

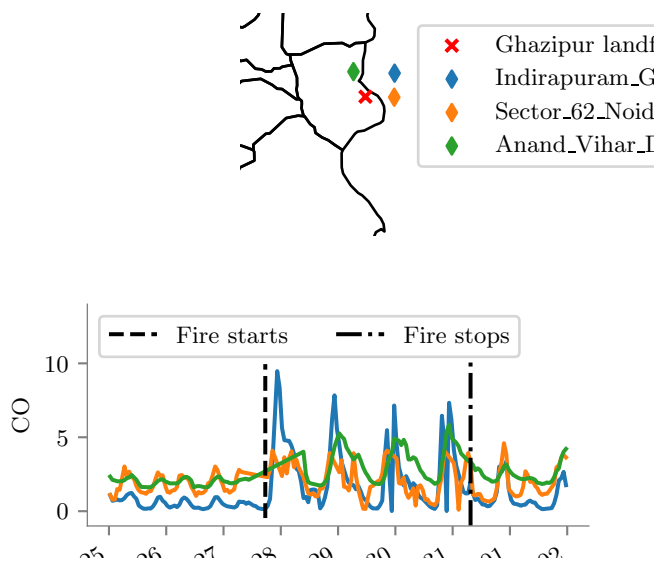


Figure 1: Caption

The Trash Mountain of Delhi: Ghazipur landfill

Ghazipur landfill in Delhi is around 29 hectares sized landfill area of East Delhi. It is used to dump around 2200 MT of municipal solid waste daily [?]. It is contributing heavily to the health [?], water quality [?] and air quality [?]. It releases toxic gases in air including methane which is flammable and can lead to open fire [?].

On 28th March, 2022, Ghazipur landfill caught an open fire which lasted over 48 hours and was reported by multiple media houses [?; ?; ?].243.91125pt

Proxy: Fire counts

Zeel's comment: <https://www.hindustantimes.com/cities/delhi-news/ghazipur-landfill-burns-for-3rd-time-in-a-month-101650492209448.html> 3 times burning during Apr. Another one <https://www.thehindu.com/news/cities/Delhi/fire-breaks-out-at-ghazipur-landfill-site-mcd-says-60-70-doused/article66962224.ece>

6 Discussion

7 Limitations & Future work

8 Conclusion

References

- [Agarwal *et al.*, 2024] Dhruv Agarwal, Srinivasan Iyengar, and Pankaj Kumar. Pollutionmapper: Identifying global air pollution sources. *ACM Journal on Computing and Sustainable Societies*, 2(1):1–23, 2024.
- [Babbar *et al.*, 2017] Puneet Babbar, Swatantra Verma, and Gauhar Mehmood. Groundwater contamination from non-sanitary landfill sites—a case study on the ghazipur landfill site, delhi (india). *International Journal of Applied Environmental Sciences*, 12(11):1969–1991, 2017.

- [Guttikunda and Calori, 2013] Sarath K Guttikunda and Giuseppe Calori. A gis based emissions inventory at 1 km × 1 km spatial resolution for air pollution analysis in delhi, india. *Atmospheric Environment*, 67:101–111, 2013.
- [HindustanTimes, 2022] HindustanTimes. High-lights: Ghazipur landfill fire in Delhi continues to rage after 10 hours — hindustantimes.com. <https://www.hindustantimes.com/india-news/breaking-news-today-march-28-2022-101648429099578.html>, 2022. [Accessed 22-02-2024].
- [IndiaToday, 2022] IndiaToday. Massive blaze breaks out at Delhi’s Ghazipur landfill site; fire tenders rushed to spot — indiastoday.in. <https://www.indiatoday.in/cities/delhi/story/delhi-ghazipur-garbage-landfill-site-fire-pictures-video-1930495-2022-03-28>, 2022. [Accessed 22-02-2024].
- [NDTV, 2022] NDTV. 48 Hours On, Fire At Delhi’s Ghazipur Landfill Still Not Under Control — ndtv.com. <https://www.ndtv.com/india-news/delhi-ghazipur-fire-48-hours-on-fire-at-delhis-ghazipur-landfill-still-not-under-control-1.6484290>, 2022. [Accessed 22-02-2024].
- [Rafaj *et al.*, 2018] Peter Rafaj, Gregor Kiesewetter, Timur Gül, Wolfgang Schöpp, Janusz Cofala, Zbigniew Klimont, Pallav Purohit, Chris Heyes, Markus Amann, Jens Borken-Kleefeld, et al. Outlook for clean air in the context of sustainable development goals. *Global Environmental Change*, 53:1–11, 2018.
- [Ranjan *et al.*, 2014] Manju Rawat Ranjan, AL Ramanathan, Ashutosh Tripathi, and Pawan Kumar Jha. Landfill mining: a case study from ghazipur landfill area of delhi. *International Journal of Environmental Sciences*, 4(5):919–925, 2014.
- [WHO, 2024] WHO. Air pollution — who.int. https://www.who.int/health-topics/air-pollution#tab=tab_2, 2024. [Accessed 22-02-2024].
- [Yadav and Negi, 2023] Shilpi Yadav and Mahabir S Negi. The impacts on environment and health of residents: A case study of ghazipur dumpsite (landfill), east delhi. In *Population, Sanitation and Health: A Geographical Study Towards Sustainability*, pages 125–135. Springer, 2023.