Proceedings of the 15th International Conference on Environmental Pollution and Remediation (ICEPR 2025)
Paris, France – August, 2025
Paper No. ICEPR 192
DOI: 10.11159/icepr25.192

Impact of Power Plants on Ambient $PM_{2.5}$ in West Bengal, India

Chen Luo[1], Sayantan Sarkar[2], Joyanto Routh[1*]
[1]Linköping University
SE-581 83, Linköping, Sweden
[2]School of Civil and Environmental Engineering, Indian Institute of Technology Mandi
175005, Kamand, Himachal Pradesh, India
[*]Joyanto.routh@liu.se

Extended Abstract

The Indo-Gangetic Plain (IGP) is one of the most polluted regions in the world in terms of ambient $PM_{2.5}$ levels and is highly vulnerable to the increasing trend of air pollution and its impact on exposed population [1]. Coal-fired thermal power plants (TPP) are among the major contributors to this burden [2]. The Farakka Thermal Power Plant (2100 MW) is located in West Bengal in the lower IGP, which is known to receive long-range transported pollutants from the Middle and Upper IGP [3-5]. This is then mixed with local emissions from TPP, among other contributors to atmospheric pollutants, and poses significant challenges to the control and mitigation of air pollution as a whole. To address this issue, we conducted a year-round sampling of $PM_{2.5}$ at a downwind rural site (as case) and an upwind suburban site (as control). We report the annual and seasonal levels of inorganic species (water-soluble ions, heavy metals), organic carbon (OC) and elemental carbon (EC), and levoglucosan, and apportion the sources with PMF (Positive Matrix Factorization). This is coupled with the application of the HYSPLIT model (Hybrid Single-Particle Lagrangian Integrated Trajectory) to compute backward air trajectories and concentration-weighted trajectories, in order to highlight the potential emission sources.

Preliminary source apportionment results are as follows for the downwind and the upwind sites, respectively (1) secondary inorganic aerosols contributed to 21% and 26% of the total sum of variables, (2) 22% and 34% from coal combustion, (3) 5% and 3% from open waste burning, (4) 7% and 4% from crustal sources, (5) 12% and 19% from vehicular exhaust, and (6) 25% and 13% from biomass burning. Additionally, at the upwind site, construction activity contributed to 8%, and a metal-rich source contributed to 15% at the downwind site.

Our observations indicate that besides the Farakka TPP, the Sagardighi TPP located south of the sampling site contributed substantially to the pollutant levels in summer (ca. 79% of annual emissions at the upwind site and 59% at the downwind site), when prevailing winds blew northward. While these figures may be overestimated due to the underrecognized yet locally prevalent practice of biomass burning for cooking, which significantly contributes to SO_4^{2-} and Cl^- concentrations, the findings are nonetheless worrisome. The fact that the Sagardighi power plant with only 76% of Farakka's power generation capacity exerted a disproportionately large influence on receptor sites suggests that it may pose an even greater health risks than the nearby Farakka TPP in the region. This underscores the need for large-scale efforts in research, dispersion modelling and implementing pollution control practices to reduce air pollution in India.

References

[1] IQAir, "2023 World Air Quality Report," 2023. Available: https://www.iqair.com/newsroom/waqr-2023-pr?srsltid=AfmBOorpTMr471LeWX905flePFx01an0juN1tYfekS464CAyBNXLG5oA

[2] S. Guttikunda and N. KA, "Evolution of India's PM 2.5 pollution between 1998 and 2020 using global reanalysis fields coupled with satellite observations and fuel consumption patterns," *Environmental Science: Atmospheres*, vol. 2, no. 6, pp. 1502–1515, 2022, doi: 10.1039/D2EA00027J.

[3] R. R. Behera, D. R. Satapathy, A. Majhi, and C. R. Panda, "Spatiotemporal variation of atmospheric pollution and its plausible sources in an industrial populated city, Bay of Bengal, Paradip, India," *Urban Clim*, vol. 37, p. 100860, May 2021, doi: 10.1016/J.UCLIM.2021.100860.

[4] S. Bikkina, M. M. Sarin, and V. Chinni, "Atmospheric 210Pb and anthropogenic trace metals in the continental outflow to the Bay of Bengal," *Atmos Environ*, vol. 122, pp. 737–747, Dec. 2015, doi: 10.1016/J.ATMOSENV.2015.10.044.

[5] A. Kumar, M. M. Sarin, and B. Srinivas, “Aerosol iron solubility over Bay of Bengal: Role of anthropogenic sources and chemical processing,” *Mar Chem*, vol. 121, no. 1–4, pp. 167–175, Aug. 2010, doi: 10.1016/J.MARCHEM.2010.04.005.