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Sensitivity Analysis of PM2.5 Concentrations to the Emission Sources in the Megacity of Tehran



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Introduction

- Tehran:
 - Population: 13,260,000 (2017)
 - Metropolitan area: 2,235 km²
 - Urban area: 1,200 km²





Introduction



Air Quality in Tehran (March 2019 – March 2020)



Reference: Tehran Air Quality and Noise Report, Period of March 2019-March 2020, QM99/03/01(U)/1

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PM2.5: the criteria pollutant in Tehran







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Introduction



PM2.5: the criteria pollutant in Tehran



2019-March 2020, QM99/03/01(U)/1



- Approaches for identification of the share of emission sources in an
 - observed pollution:
 - Emission Inventory
 - Source Apportionment
 - Sensitivity Analysis of the
 - validated modeled concentration
- There is high inconsistency among results of the above approaches.





• There is high inconsistency among results of the above approaches.







- Drawbacks of Sensitivity Analysis Approach
 - Dependent on emission inventory input to the dispersion model
 - Dependent on the assumptions in concentration distribution modeling (boundary and background concentrations, emission sources, and mass fluxes, ...)
 - Inaccuracy in the validation of the simulation results
 - Costly access to compatible dispersion simulation models and gathering model inputs





- Advantages of Sensitivity Analysis Approach
 - Possibility of consideration of secondary pollutant formation
 - Possibility of long-term and short-term estimates
 - Easy to conduct at relatively low cost
 - Possibility of assessing the effects of different emission sources and mitigation scenarios
- Yet, no Sensitivity Analysis of observed concentration to the emission sources is conducted in Tehran.



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- Emission Inventory of Tehran
 - Input to the PM2.5 dispersion model.
 - Based on activity data (e.g., energy consumption in sectors) and
 - Based on Emission Factors developed under GAINS model of IIASA
- ADMS-Urban: the implemented pollutant dispersion model
 - Gaussian dispersion model developed by Cambridge Environmental Research Consultants (CERC)
 - predicts the boundary layer structure by Monin–Obukhov length
 - Interpolate hourly meteorological data
 - Various emission source types
 - Consideration of secondary pollution formation in the atmosphere
 - Linkage to output visualizers

• Emission Inventory of Tehran in 2013 (Primary PM2.5 Emissions)





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• Validation of the dispersion modeling results with measured data in a

sampling station at Sharif University of Technology, Western Tehran





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- Sensitivity Analysis of the modeled concentration to the emission sources:
 - One-by-one dispersion models considering specific emission source
 - Normalized to offset the overestimation



Mobile Sources

Agriculture

- Residential and Commercial
- Industrial burning

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Industry



Discussion

- In environmental management, what matters is the reason for the pollution
- The share of sources in total emissions, is not necessarily their share in causing pollution.
- Rather, several factors must be considered in environmental analysis:
 - Meteorological conditions,
 - Topography,
 - Secondary formation of the PM,
 - Closeness of the emission sources to the location under study (residential area)





Conclusion

- Sensitivity Analysis can better reflect the share of emission sources in pollution. However, this needs development of a validated pollutant dispersion model.
- Sensitivity Analysis, is necessary for air pollution management in megacities, at least as a complement for emission inventory results.
- Pollution control policies must be evaluated by analyzing the sensitivity of the observed concentration to the mitigation measure.
- More accurate and updated sensitivity analysis inputs are necessary for future studies.





Thank you for your attention!

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