IASTA National Aerosol Conference 2024

December 17-20, 2024
Doon University, Dehradun

Conference
Proceedings of IASTA - 2024

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PREFACE

Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital and Doon University, Dehradun, is hosting the National Aerosol Conference 2024, from 17-20 December 2024, under the flagship of the Indian Aerosol Science and Technology Association (IASTA). IASTA-2024 focuses on broad topics covering aerosol/air pollution climate effects, indoor air quality and human health impact, cloud-aerosol interactions, aerosol/air quality modeling, nuclear and radioactive aerosols, aerosols for medical applications, bioaerosols, air quality control, clean energy, and sustainability development, aerosol instruments. The aim of IASTA-2024 is to provide an excellent platform for young researchers, technocrats, and policymakers to exchange their knowledge/ideas. IASTA-2024 will allow participants to interact, collaborate, and contribute toward the growth of aerosol science and technology. The conference will also provide an opportunity for the industries to showcase their technologies, different products, and innovations in the field of aerosol and air pollution. The scientific and technical program of the IASTA-2024 conference includes keynote addresses, Plenary Lectures, Invited Talks, contributed papers, and posters (108 platforms, 48 lightning, and 150 posters), along with a technical exhibition of different products and systems related to aerosol research and technology and allied areas. The conference also includes panel discussions on the topic "Air Quality in Uttarakhand" and popular lectures.

On behalf of the IASTA, the technical program committee thanks all the invited speakers, panelists, authors of the contributed papers, and sponsors who have supported in finalising the scientific and technical programmes. The committee thank all the persons involved in bringing out the proceedings, well in time for IASTA 2024. We take this opportunity to wish all the delegates interactive and fruitful discussions during the conference.

(Technical Programme Committee)
IASTA 2024

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SPATIAL HETEROGENEITY IN AEROSOL CHEMICAL COMPOSITION AND MORPHOLOGY OVER EASTERN HIMALAYAN REGION

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KEYWORDS: TSP, SEM, EDX, Biogenic, Geogenic, Anthropogenic.

INTRODUCTION

Northeast India (NEI) is influenced by natural aerosols, especially biological aerosols (Pathak et al., 2022), as well as is altered by remote aerosols from Indo Gangetic Plain (IGP) and West Asia. The complex topography makes the region vulnerable to resuspension of all kinds of aerosols, mainly in the post-harvesting period when crop residue burning, and favourable meteorological conditions lead to the increase in the concentration of anthropogenic fine-mode particles. In the aerosol type discrimination, most aerosols could not be identified and remained as mixed types, which were supplemented by the identified biological aerosols like culturable microbial populations, pollens, animal debris, and fungal spores in different seasons. However, a quantitative study on aerosols' chemical composition or morphological properties over the location has not been addressed so far and thus this study aims to explore the same.

METHODS

The study was conducted over seven locations based on the nature of the site in the NEI over the North bank of Brahmaputra Valley comprising from the easternmost location (EL) (Sadiya) to the westernmost location (WL) (Dhubri). A high-volume sampler (STAPLEX, TSP-2) was used to sample TSP on glass filter paper (8×10 inch) at a 1 m3/min flow rate from Oct-Nov 2023 during fair weather conditions. 3 samples were collected from each location. Morphological and elemental analysis has been carried out using a Scanning Electron Microscope (SEM) (JEOL JSM 6390 LV), an Energy Dispersive X-ray Spectrometer (EDX), and an INCAx Sight microanalysis system (Oxford Instruments, Model 7582). The categorization of the biogenic aerosols is done by the following clustering rule (Coz et al., 2010) based on the constituent element's weight percentage: (C+O) > 75% and 1% < P; K; Cl < 10%.

RESULTS & DISCUSSIONS

The weight percentage (wt.%) of different elements has been evaluated by using EDX. The wt.% of major elements such as C, O, and Si is in the range of 20-45% in all the locations along with minor elements: Na, Mg, Al, P, S, Cl, Ca, K, Fe, Cu, Zn, Sb and Ba have also been observed (wt.% < 10%). High Carbon content in Sadiya (32%) and Dhubri (30%), followed by Guwahati and Itanagar, which reflects the dominance of carbonaceous aerosols emitted primarily from biomass burning and fossil fuel combustion. Based on the single compound analysis, Majuli has the highest contribution of biogenic aerosols (70%), followed by Dibrugarh (35%). This region has an abundance of vegetation and is surrounded by the almighty Brahmaputra River making the region less vulnerable to remote aerosols. Further, biogenic were classified based on their microstructural features. The highest percentage

contribution of pollens/fungal/animal debris has been seen over Dibrugarh/Majuli /Bongaigaon. Moreover, the contribution of geogenic aerosols is significant in all locations except River Island Majuli. The highest percentage contribution is found in Guwahati (68%) followed by Itanagar (50%). Being a hilly region, it often has exposed rock surfaces and is subject to weathering and erosion processes that release particulate matter into the atmosphere. These regions have less vegetation cover, which can lead to increased soil erosion and dust generation which leads to the abundance of geogenic aerosols. Apart from that, Anthropogenic aerosols with high Carbon content in Sadiya (32%) and Dhubri (30%) have been observed (Figure 1).

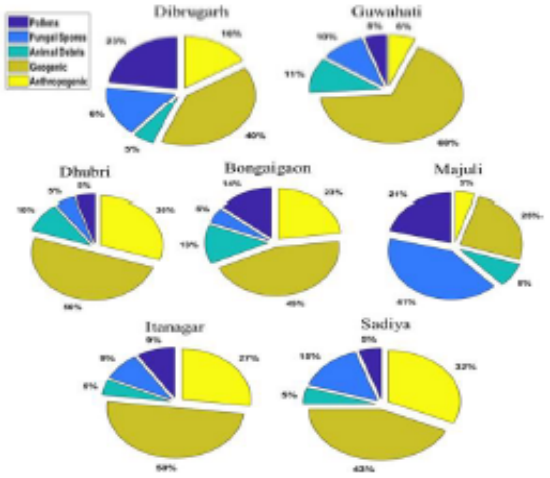

Figure 1. Percentage contribution of different groups: Biogenic (Pollens. Fungal, Plant/animal debris), Geogenic, and Anthropogenic in the total PM during different locations.

Enrichment Factor analysis confirms that C, Al, Cl, Cu, Zn, Sb, and Ba are non-crustal (EF >10) in all the locations. A Strong correlation between Ca, Mg, Si, and K, exists in EL (Sadiya, Dibrugarh, etc) derived from soil or resuspension of road dust. The same between Cu, Zn, Al and Ba exists over WL (Dhubri, Bongaigaon, etc) indicating vehicular emissions, and industrial activity. Principal Component Analysis reveals that Dibrugarh, Majuli, and Sadiya have a mixed source of crustal and industrial origin, whereas Itanagar, Bongaigaon, and Dhubri are from industrial and vehicular emissions.

CONCLUSIONS

The study highlights that Total Suspended Particles (TSP) have a wide distribution of aerosol chemical composition leading to variability in types, that can be well evaluated based on single particle spectrum analysis along with morphological features. A dominance of anthropogenic aerosols, particularly carbon-rich particles in Sadiya and Dhubri, while Majuli and Dibrugarh have significant biogenic contributions. Based on Source apportionment we can conclude that biomass-burning/fossil fuel-generated aerosols dominate eastern locations/western locations.

ACKNOWLEDGEMENTS

The ISRO-GBP-ARFI project supports this work. B.D. is grateful to SERB WEA Project: WEA/2021/000013, Department of Science and Technology, Govt. of India for the fellowship.

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