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On variability of $PM_{2.5}$ and Heat Index for two locations in India during El Niño

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Abstract

The present study deals with the diurnal variability of $PM_{2.5}$ and Heat Index for two locations in India, i.e., Delhi and Jodhpur during post-monsoon spanning the El Niño periods. The highest levels of $PM_{2.5}$ are observed during the stable night time conditions; while Heat Index is found to be higher during the afternoons. The correlation analysis between the two variables have also been carried out.

1. Introduction

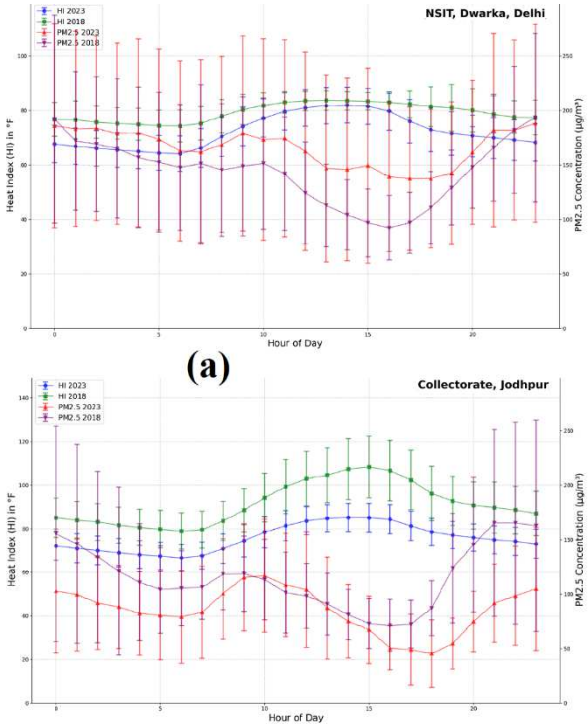
Aerosols play a critical role in the energy balance of the Earth and are important for atmospheric chemistry, climate and human health [1]. Climate change is anticipated to result in more frequent hot days and nights, prolong the duration of the hot season, and increase the occurrence of heat waves in numerous urban areas across Asia [2, 3]. In fact, last some years have seen serious repercussions of climate change combined with the El Niño effects on the rising temperatures in Asia-Pacific region [4]. Previous studies have reported the association of $PM_{2.5}$ with the meteorological conditions like relative humidity (RH) and temperature [5].

2. Data and methods

The present study investigates the diurnal variability of fine particulate matter, particularly, $PM_{2.5}$ along with the Heat Index (HI) for two urban locations in India. The choice of HI is based on the fact that it combines the RH with air temperature and provides important consideration for the thermal comfort. The time duration of the study spans over the post-monsoon (POM) season (October-November) during the El Niño periods of different strengths; i.e., POM 2018 and POM 2023 with Oceanic Niño Index (ONI) of 0.9 (moderate) and 1.9 (strong) respectively (https://ggweather.com/enso/oni.htm). Both the cities lie in Indo-Gangetic Plains. Delhi is one of the major aerosol hotspots owing to rapid increasing population and associated anthropogenic activities but is also affected by agricultural biomass burning in the adjoining North-West region during POM. Jodhpur is a desert dust dominated area but is also affected severely by anthropogenic activities. Data has been obtained from Central Pollution Control Board (CPCB) for two locations, i.e., Delhi and Jodhpur (https://cpcb.nic.in/real-time-air-qulity-data/).

3. Results

We first observe the diurnal variability of $PM_{2.5}$ and Heat Index (HI) for the two regions (Figure 1(a)). It is found that the highest levels of $PM_{2.5}$ are found during the mid-night and the lowest levels during the afternoons. On the other hand, HI is maximum during the afternoons. We further observed the histograms of the two variables in four time intervals, i.e., 6 am – 12 pm (noon), 12 pm to 6 pm, 6 pm - 12 am (midnight) (Figure 1(b)). Lastly, the correlation between $PM_{2.5}$ and HI is also investigated for the four time intervals.



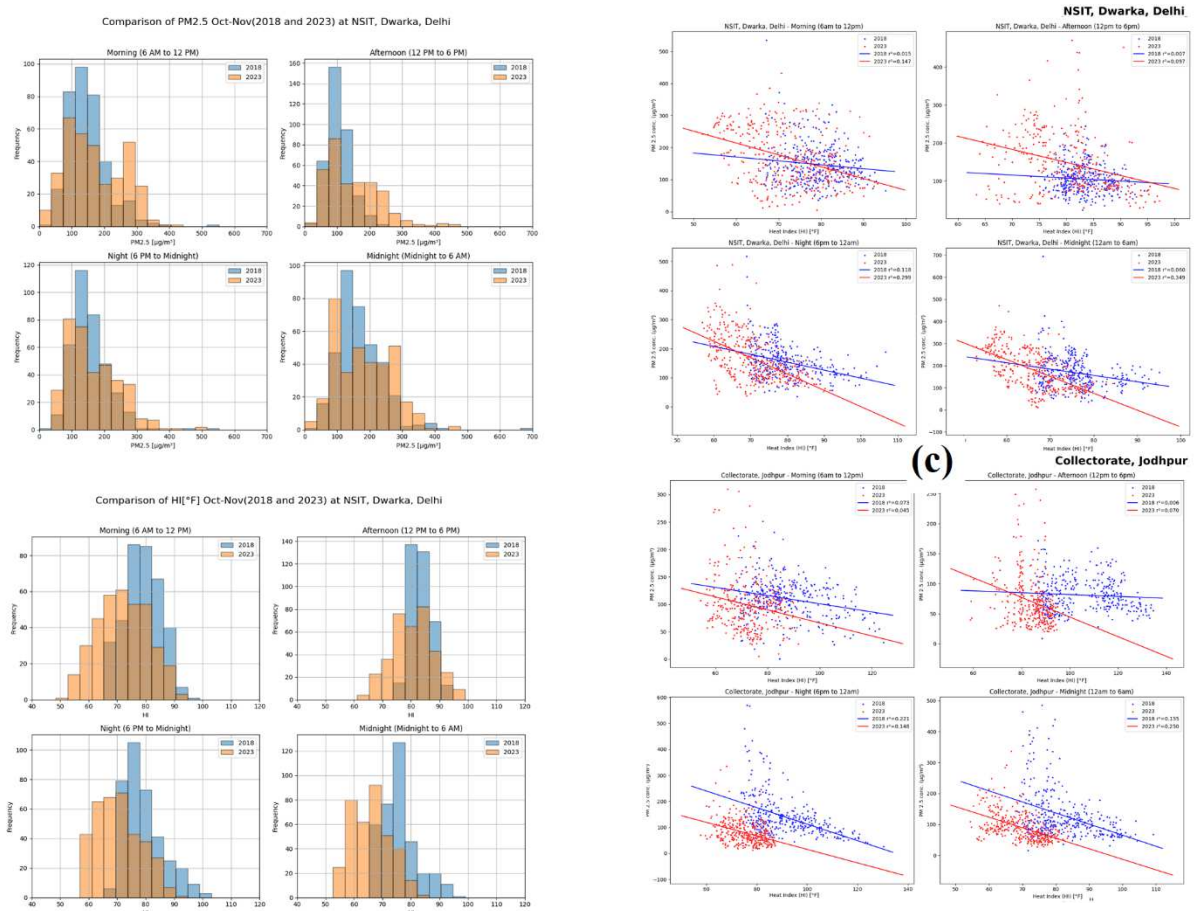


Figure 1 (a) Diurnal curves and; (b) Histograms and (c) Correlation plots during different time intervals for $PM_{2.5}$ and HI (POM 2018 and 2023) over Delhi and Jodhpur

We found that in general, there was a negative correlation between the two variables for all the time intervals in both the cities, especially during the stable night conditions of 6 pm to 12 pm and 12 pm to 6 am. The findings are indicative of further examination of the association of fine particulate matter with the heat index, especially, during the night-time stable atmospheric conditions.

4. Acknowledgements

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5. References

1. U. Pöschl, "Atmospheric aerosols: composition, transformation, climate and health effects," *Angewandte Chemie International Edition*, **44(46)**, 2005, pp. 7520-7540, https://doi.org/10.1002/anie.200501122

2. V. Mishra, A. R. Ganguly, B. Nijssen, and D. P. Lettenmaier, "Changes in observed climate

extremes in global urban areas," *Environmental Research Letters*, **10(2)**, (2015), 024005, https://iopscience.iop.org/article/10.1088/1748-9326/10/2/024005

3. C. B. Field, V. Barros, T. F. Stocker, and Q. Dahe (Eds.), "Managing the risks of extreme events and disasters to advance climate change adaptation: special report of the intergovernmental panel on climate change," IPCC 2012, Cambridge University Press. 582 pp.

4. J. Eggeling, C. Gao, D. An, et al., "Spatiotemporal link between El Niño Southern Oscillation (ENSO), extreme heat, and thermal stress in the Asia–Pacific region," *Scientific Reports*, **14**, 2024, 7448, https://doi.org/10.1038/s41598-024-58288-0

5. Vaishali, G. Verma, and R. M. Das, "Influence of Temperature and Relative Humidity on PM2.5 Concentration over Delhi," *MAPAN*, **38**, 2023, pp. 759–769, https://doi.org/10.1007/s12647-023-00656-8