Deciphering challenges in the marble dust dominated ecosystem of Kishangarh through atmospheric composition measurements

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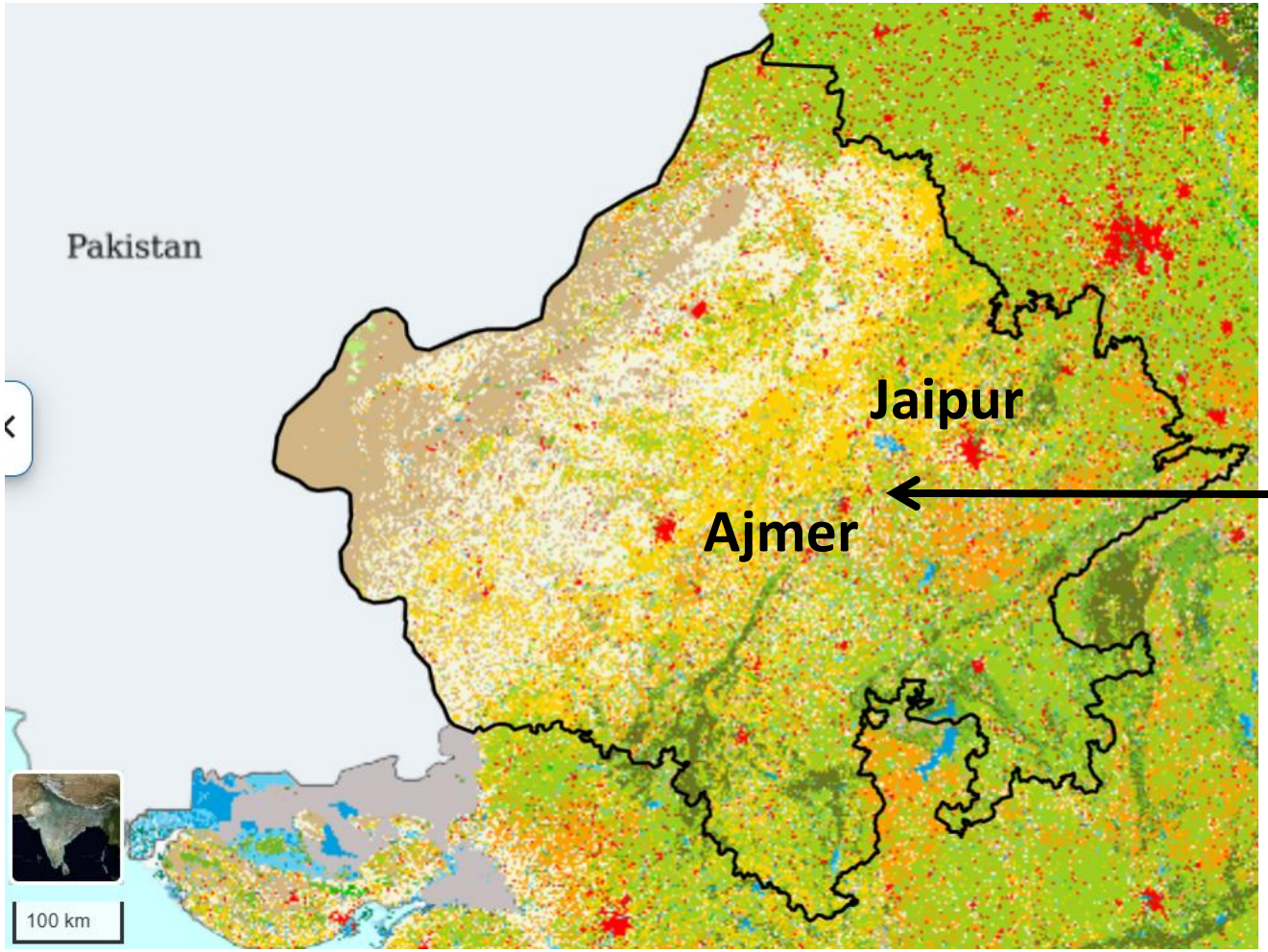
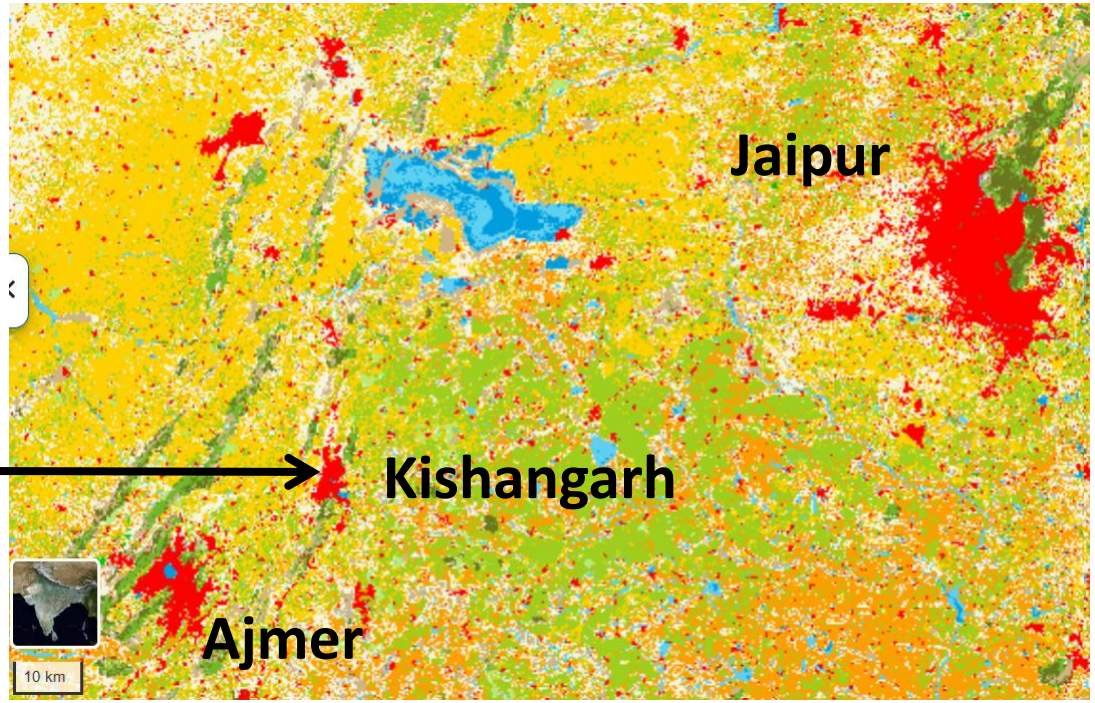
Kishangrah: India‘s Marble capital

***Jaipur*: Capital of Rajasthan**
***Ajmer*: Historic capital**
***Kishangarh*: New town**
(with Marble processing industries)





Marble Slurry Crisis: Kishangarh is home to one of Asia's largest slurry disposal sites. In January 2026, the National Green Tribunal (NGT) noted that over **1,200 marble processing units** in Kishangarh dump approximately **5,500 metric tonnes** of slurry daily. This has led to high levels of fugitive dust pollution, a primary cause of respiratory diseases like silicosis.

https://bhuvan.nrsc.gov.in/ngmaps/thematic

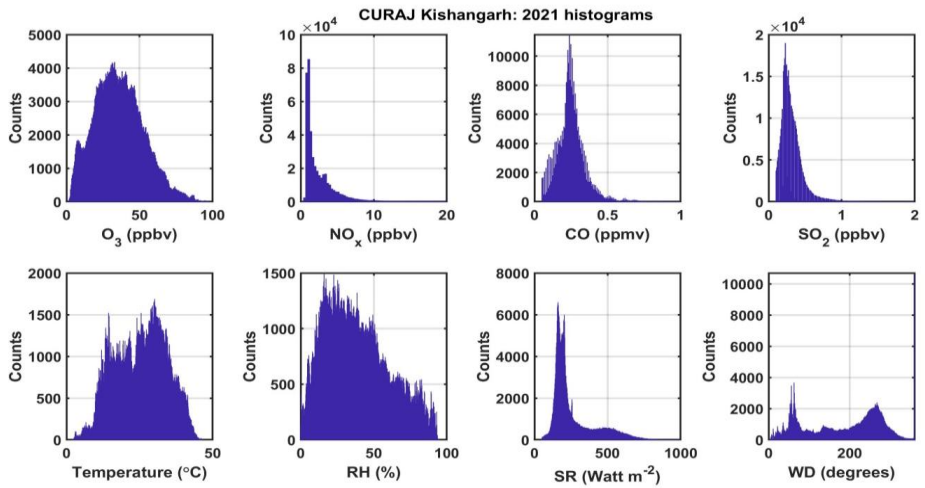
Kishangarh: Marble dust dynamics and Meteorolgy

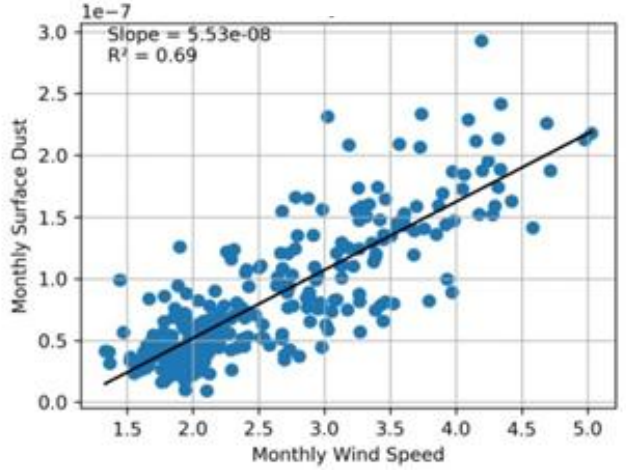
Marble processing industries and marble slurry:

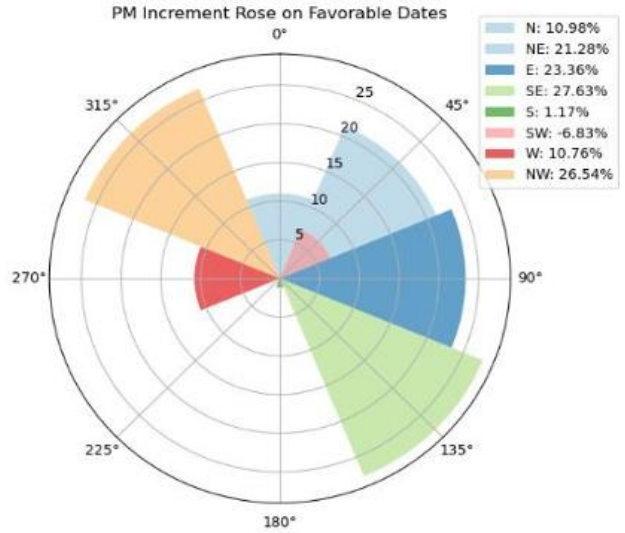
Quartz and Feldspar mining workers. A research highlighted that high-grade silica (11%–14% potassium content in feldspar) in the region puts thousands of workers at risk (source: https://socialresearchfoundation.com/new/publish-journal.php?editID=5741)

Meteorology and dust dynamics:

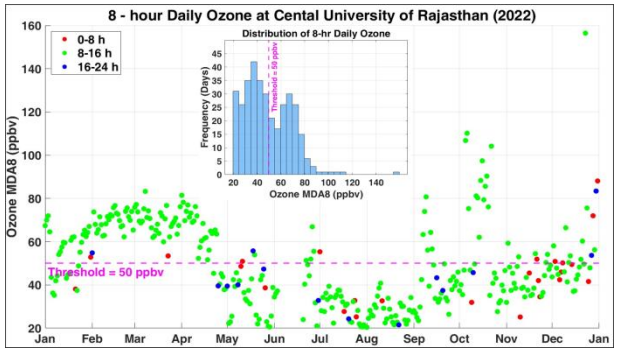
Wind speed, elevated temperature (reaching 49°C in summer), moisture flux particularly soil moisture play important role in upliftment of dust. (Acknowledgements: Alfred, Devnandan)

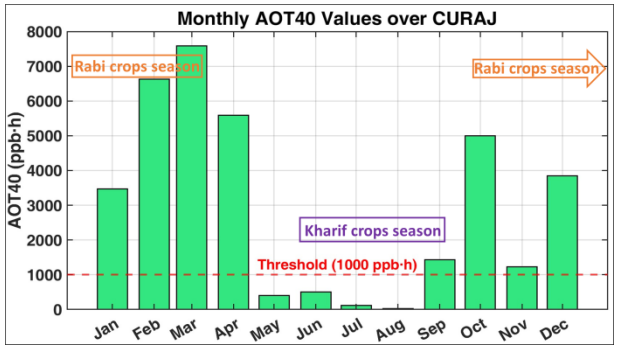


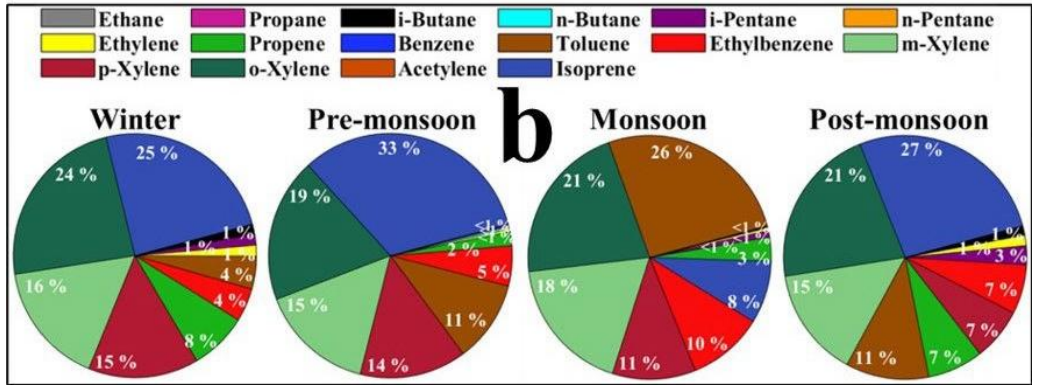




Kishangarh: Atmospheric & Biogeochemical Impacts







Effect of Ozone on Human Health.

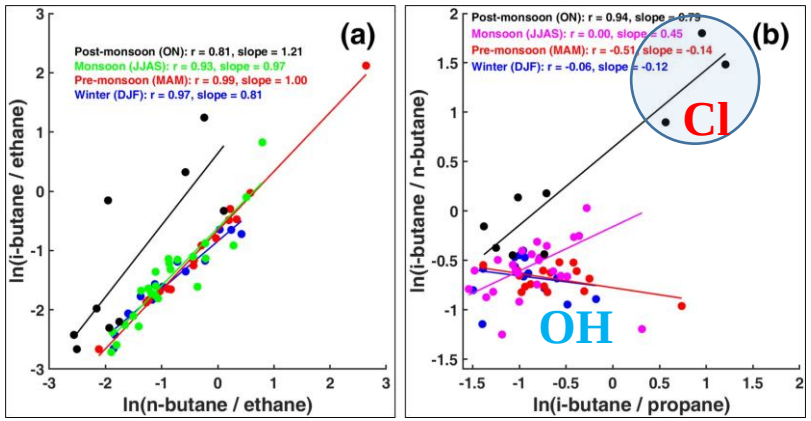
43% >Threshold 50 ppbv

Effect of Ozone on Vegetation.

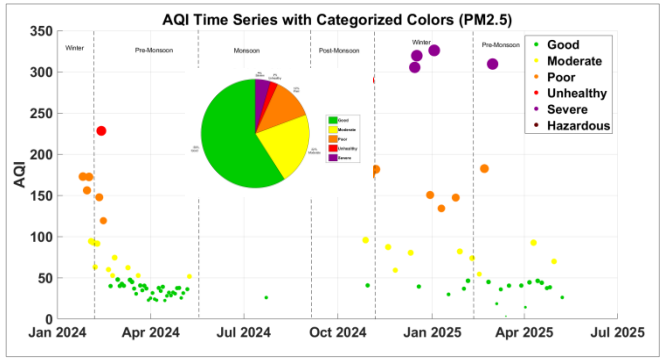
Total AOT40 value is 35829 ppbv.hr

Isoprene is a major **PEC** contributor.

With 25% in winter & 33% in summer

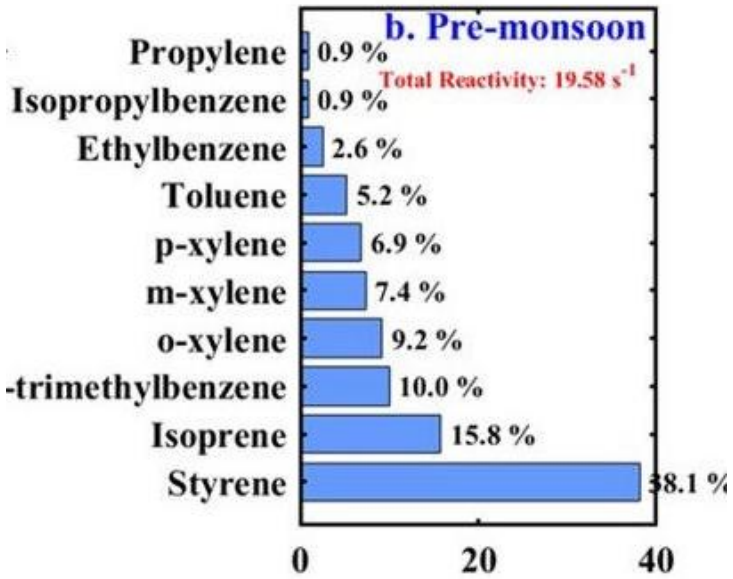


Butane-ethane: 0.91±10%



Air Quality Index.

17% data above moderate



OH: Propane 1.1×10^{-12} n-Butane 2.4×10^{-12} i-Butane 2.2×10^{-12}

Cl: Propane 1.1×10^{-10} n-Butane 2.2×10^{-10} i-Butane 2.5×10^{-10}

Acknowledgements

Varsha Ganguly, Alfred and Devnandan for work on PM

Soniya Yadav for work on Ozone and hydrocarbons

Dr. Manish Naja, Dr. Mahendra Rajwar for work on hydrocarbons

Central Univeristy of Rajasthan for research platform and infrastructures

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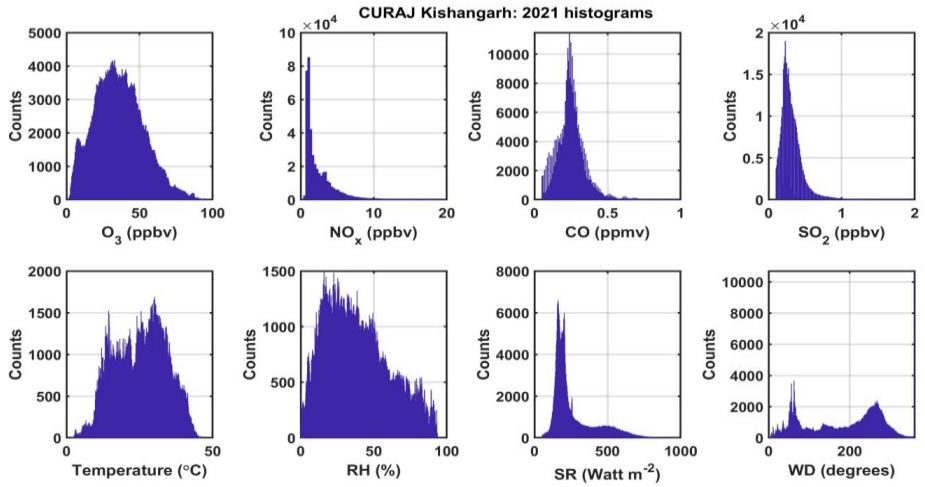
Pallavi Saxena, Session Convener for EGU platform in BG session

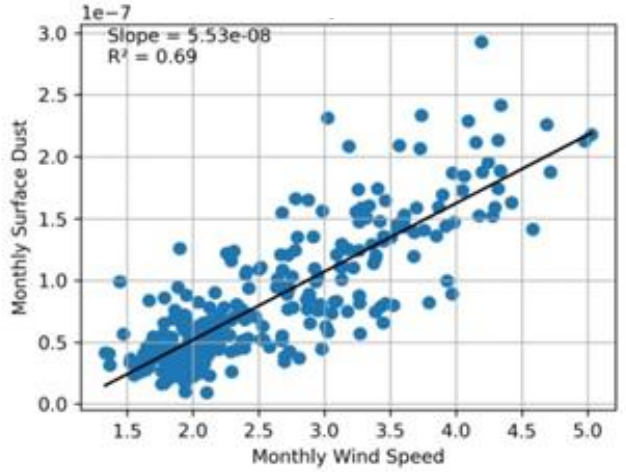
END OF PICO PRESENTATION

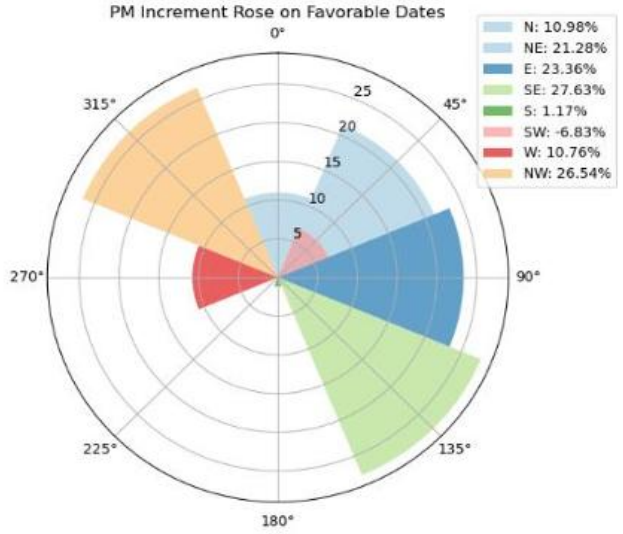
Thank you very much for your kind attention

Kishangarh: The hub of Marble Dust

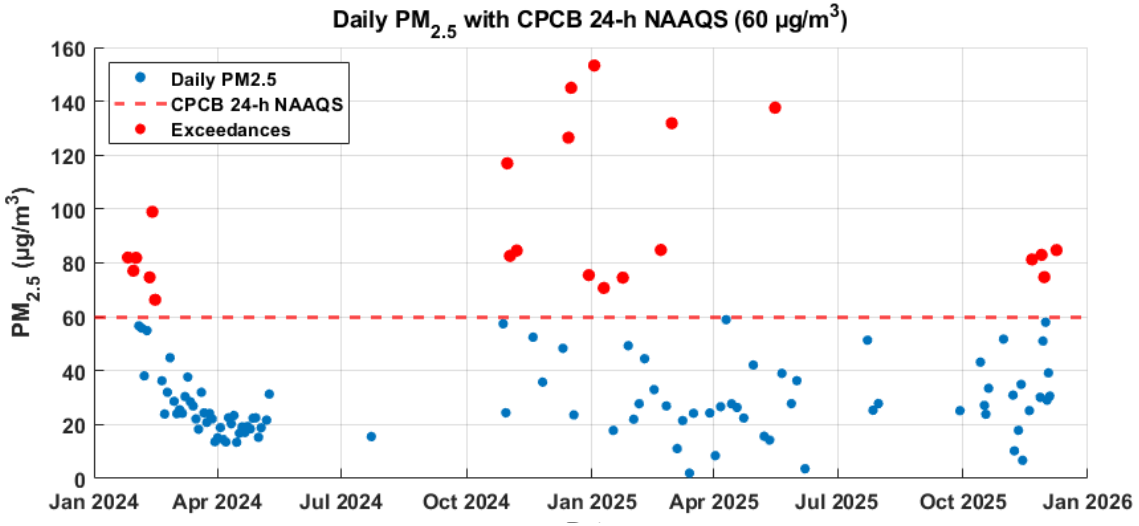
- Kishangarh is a small town in Rajasthan, on the eastern side of the Aravallis with a population of 0.23 million (projection from 2011 census).
- In January 2026, the National Green Tribunal (NGT) noted that over 1,200 marble processing units in Kishangarh dump approximately 5,500 metric tonnes of slurry daily.
- This dust is subject to meteorological impacts, particularly winds and soil moisture, leading to uplift when subjected to a threshold wind speed of 7 m/s.
- The dust concentrations are highest in pre-monsoon, particularly in the month of May, with over 15 dust days per year.

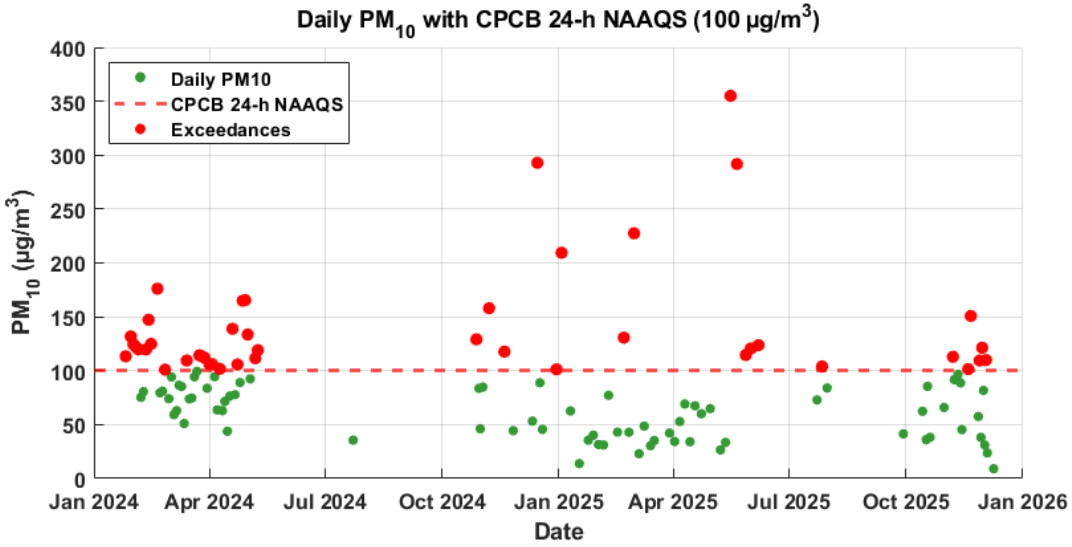


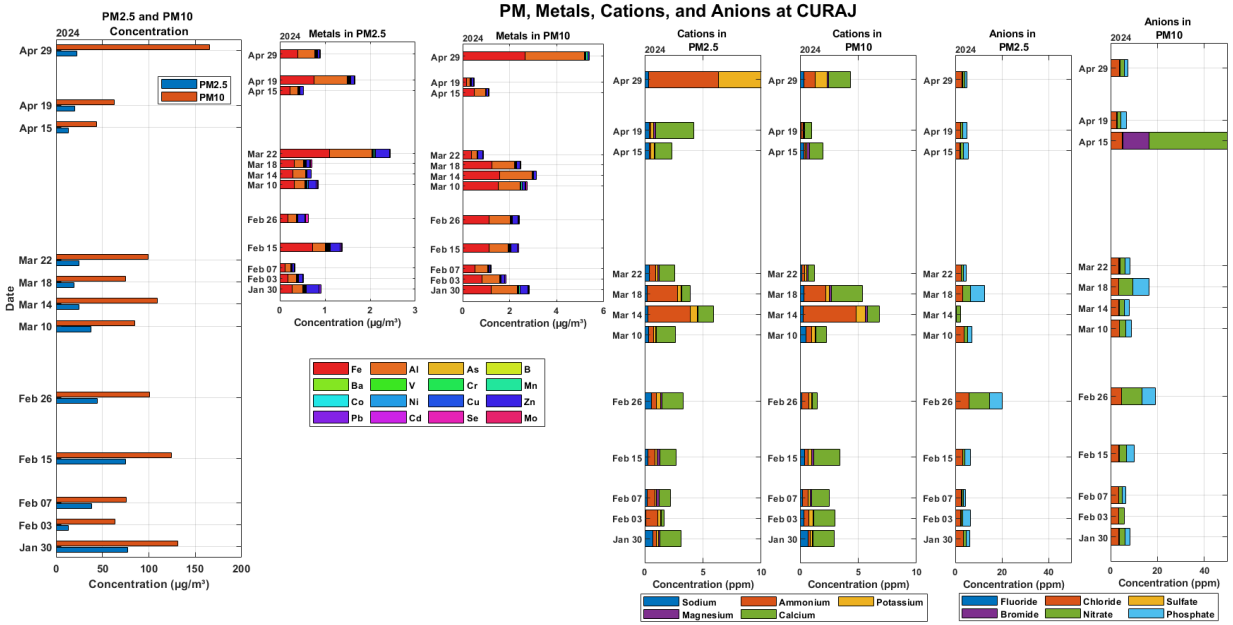


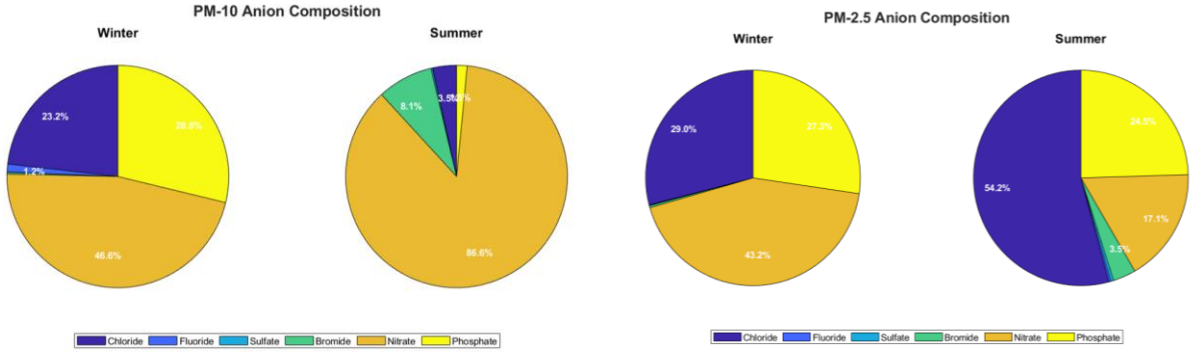


Kishangarh: PM levels and composition



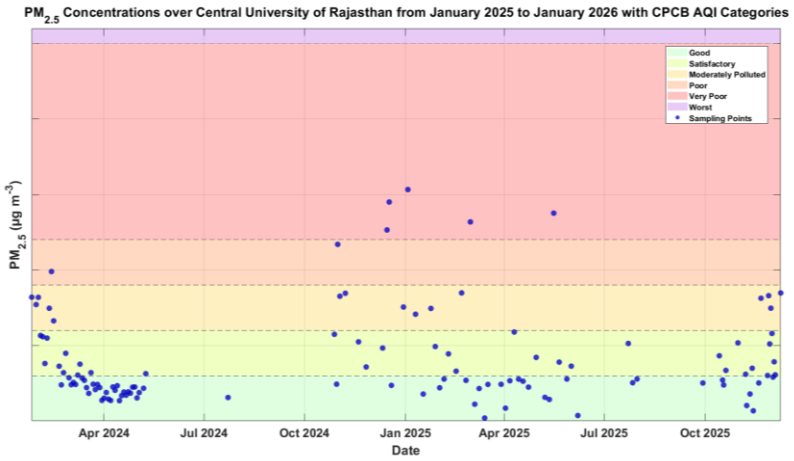






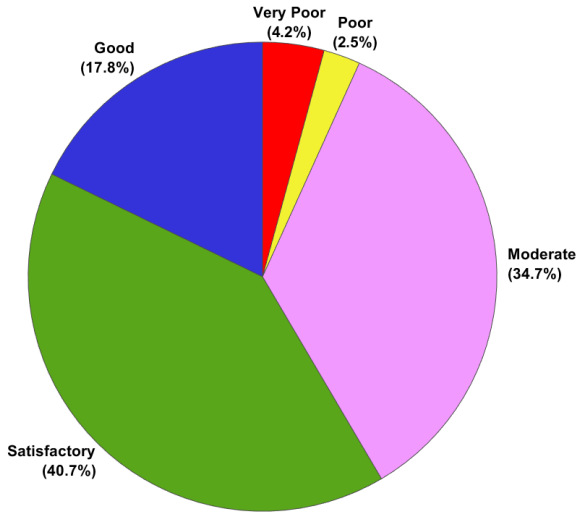
Metals: Fe, Al: Fossil Fuel & Crustal
Cations: Ca^{2+}, NH^{4+}: new particle formation
Anions: NO_3^-, Cl^{-1}: metals, meteorological links

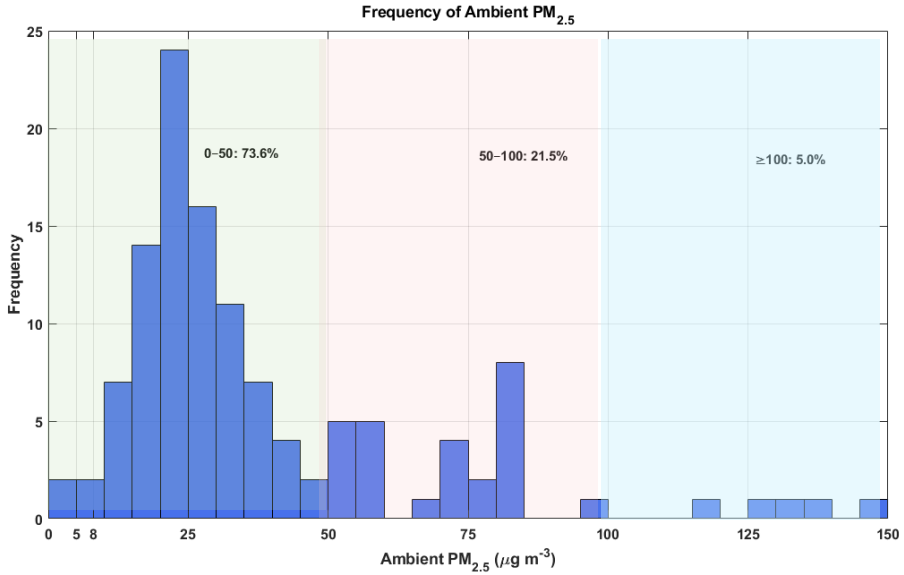
Kishangarh: PM impact on air quality



Air Quality Index.

41.5% below satisfactory

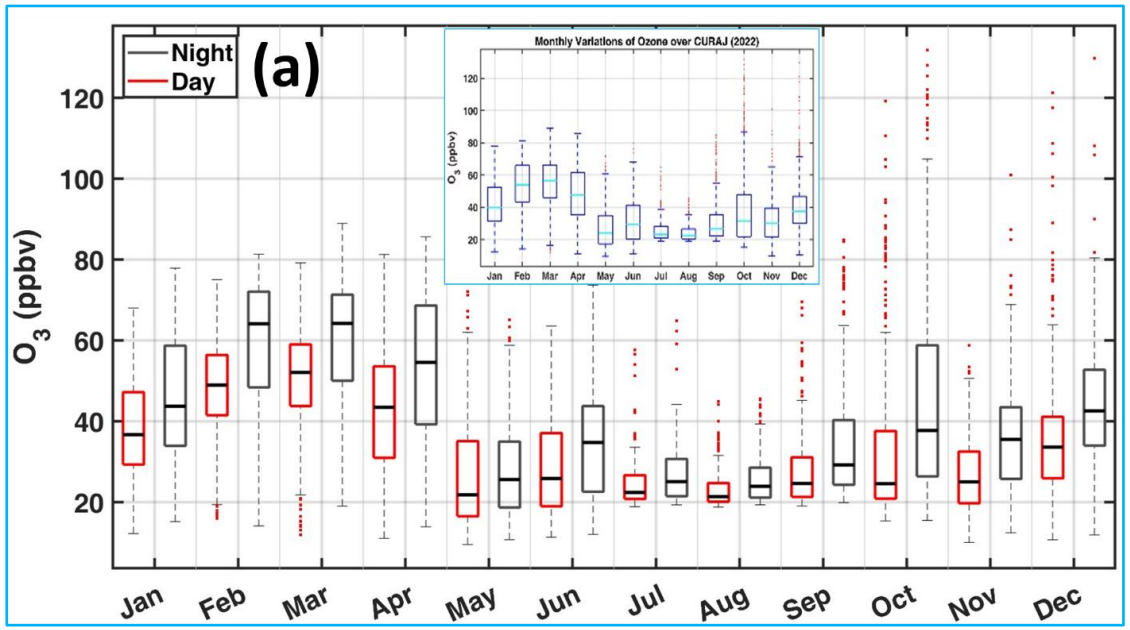


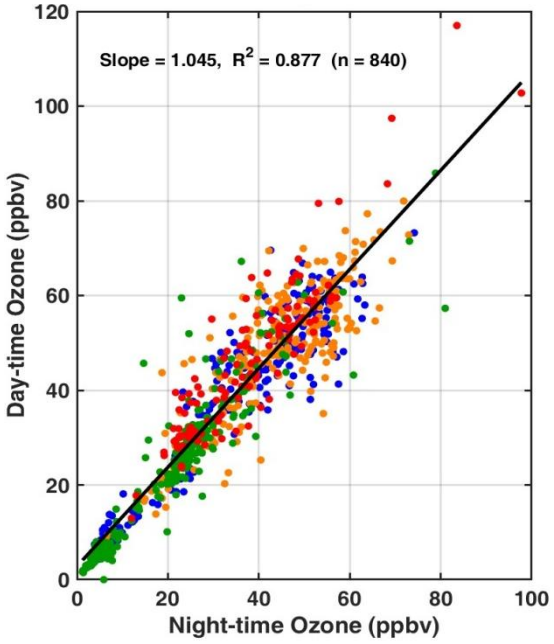


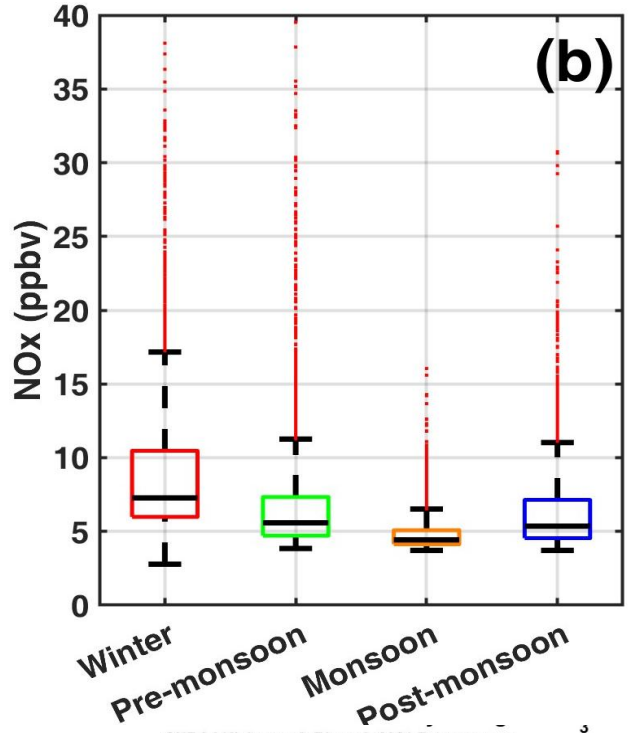
Our measurements of PM in a reference site in Kishangarh (35 kms away in north-east from the marble manufacturing areas) indicate significant potential of PM on human health including COPD, Ischemic Heart Diseases, respiratory Infections.

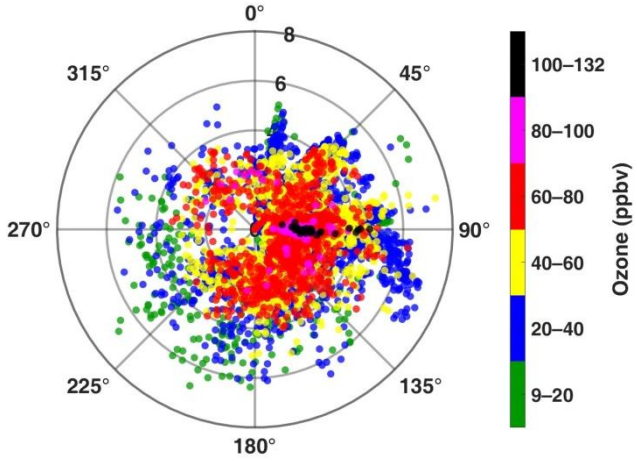
(Source for Attributable PM levels based on Apte, Joshua Schulz et al. (2015) "Addressing Global Mortality from Ambient PM2.5." *Environ. Sci. & Tech)*

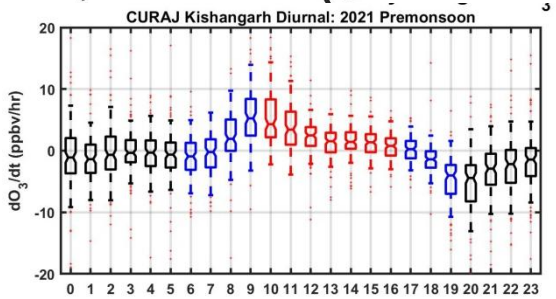
Kishangarh: Trace Gases

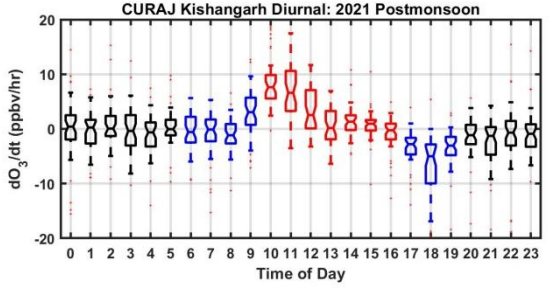








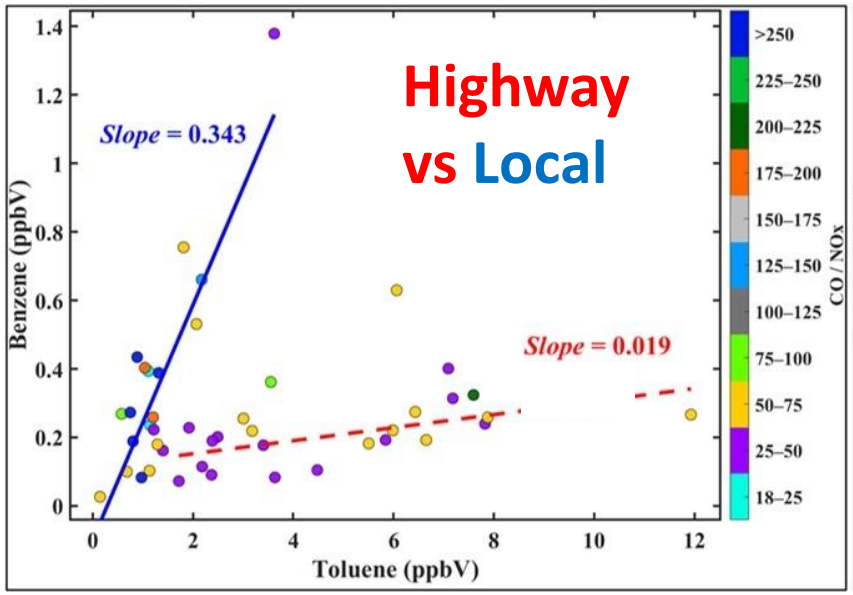


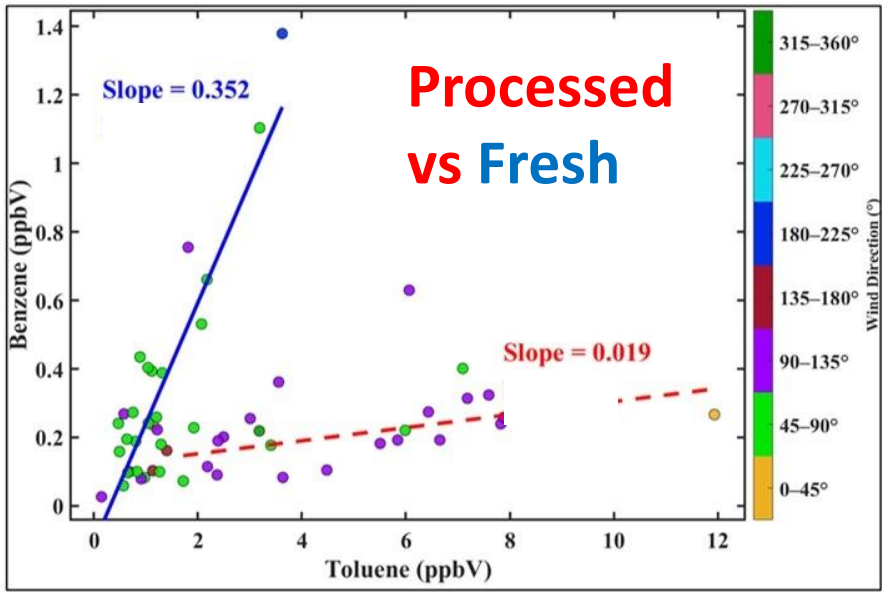


Ozone (ppbv)

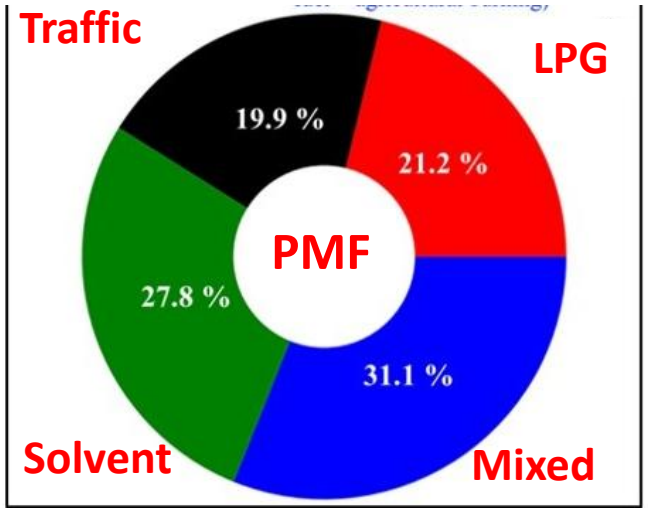
- **Higher night-time ozone across most months highlights that atmospheric transport dominates over solar-driven processes (low photochemical buildup).**
- **O_3 levels associated with wind direction, higher levels on east and lower on the dust dominated west direction**
- **Lowest daytime O_3 during dust dominated May**

Kishangarh: hydrocarbons & emissions

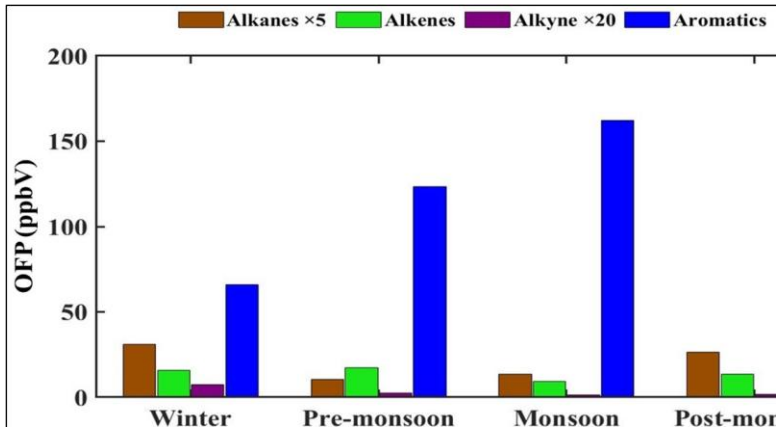




PMF analysis



- Evaporative emissions found to be a major source of carcinogenic hydrocarbons
- Air Masses are segregated using two fold criteria: Benzene/Toluene and CO/NOx
- Segregated air masses related to different sources: local evaporative vs transported emissions (highway)
- Evaporative emissions found to be a major source of carcinogenic hydrocarbons
- Aromatics dominate in contribution to Ozone Formation Potential
- Isoprene is a significant contributor to OH reactivity apart from xylene, styrene & toluene



S. Yadav, C. Mallik et al. (J. Env. Sc., 2026): https://www.sciencedirect.com/science/article/abs/pii/S1001074226002950

Wrap Up

- High PM levels (both coarse and fine) related to impacts from dust
- $PM_{2.5}$ levels high enough to cause respiratory impacts
- Impact of Chlorine chemistry observed through both PM chemical composition analysis & hydrocarbon ratios
- High dust during May coincides with low O_3 levels despite high levels of solar radiation
- Ozone formation potential is modulated by carcinogenic VOCs.
- Hydrocarbons indicate solvent evaporation as a major source, characteristic of semi-arid regions
- Isoprene, biogenic VOC, contributes significantly to OH reactivity
- AOT40 above threshold during Rabi cropping season, the major agricultural production in North-West India

Acknowledgements

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