

A sensor network to map air quality across the rural-to-urban spectrum in North India

SAUMYA SINGH¹

Mark J. Campmier¹, D. Sairam³, Adeel Khan³, Sofiya Rao², Tanushree Ganguly³, Adithi Upadhyaya⁵,
Harshraj Mishra⁴, Ravikant Pathak⁴, Karthik Ganesan³, Sagnik Dey², Joshua S. Apte¹

¹University of California Berkeley

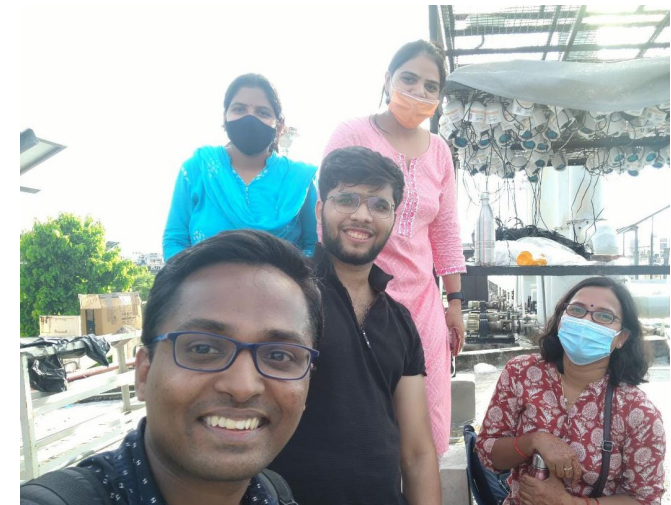
²Indian Institute of Technology, Delhi

³Council on Energy, Environment and Water

⁴IGPCARE

⁵ILK

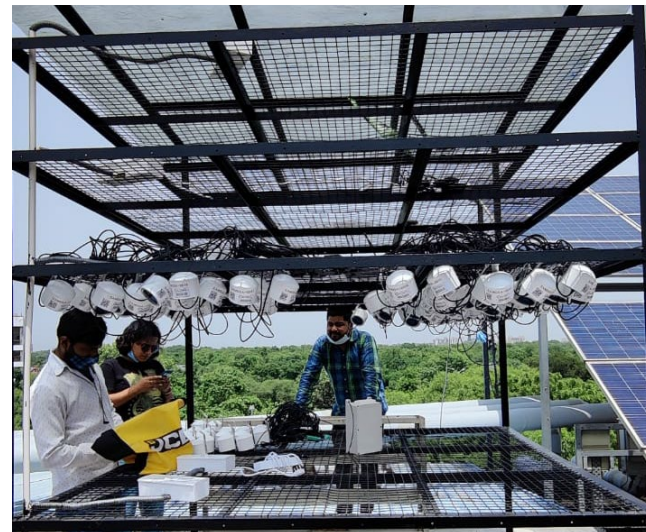
Acknowledgements: Our collaborative team



UC Berkeley Team

IIT Delhi Team

CEEW Team:
Council on Energy,
Environment & Water



IGPCARE

ILK Labs
Bangalore

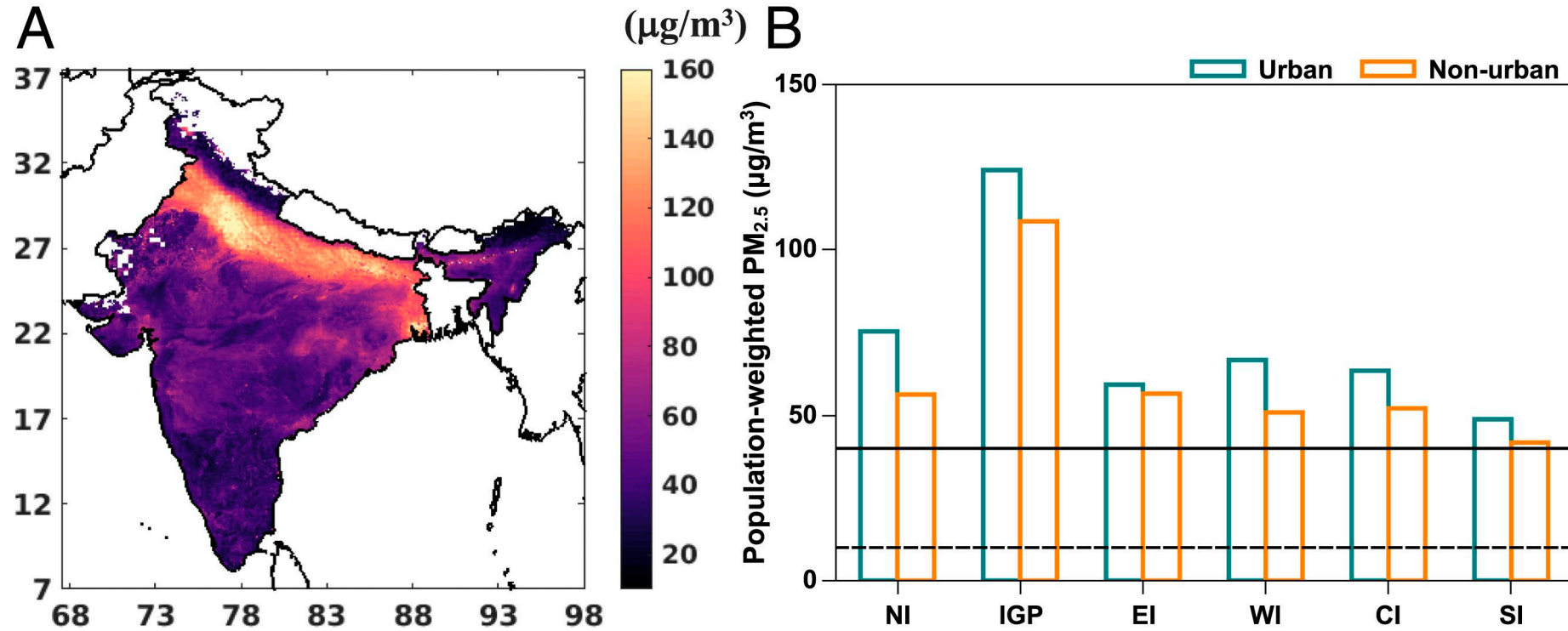
CSTEP Bangalore

Field assistants

Sensor hosts

IGP & urban-rural disparity

- **Indo-Gangetic Plain (IGP)** is an air pollution hotspot.
- >65% rural population but limited measurements.
- **Rural-to-urban gradient** is poorly understood



SAMOSA Goal:
understand linkages of rural and urban air quality in IGP

(L) Satellite-derived annual mean surface PM_{2.5}
(R) Variation in population-weighted PM_{2.5} over urban and nonurban locations in six regions

Multiple colocation sites in India

Minimize sensor-to-sensor variability.
Develop long-term, seasonally-resolved calibration.

Purple Air sensor

Reference monitor (BAM)



IGPCARE, Hamirpur

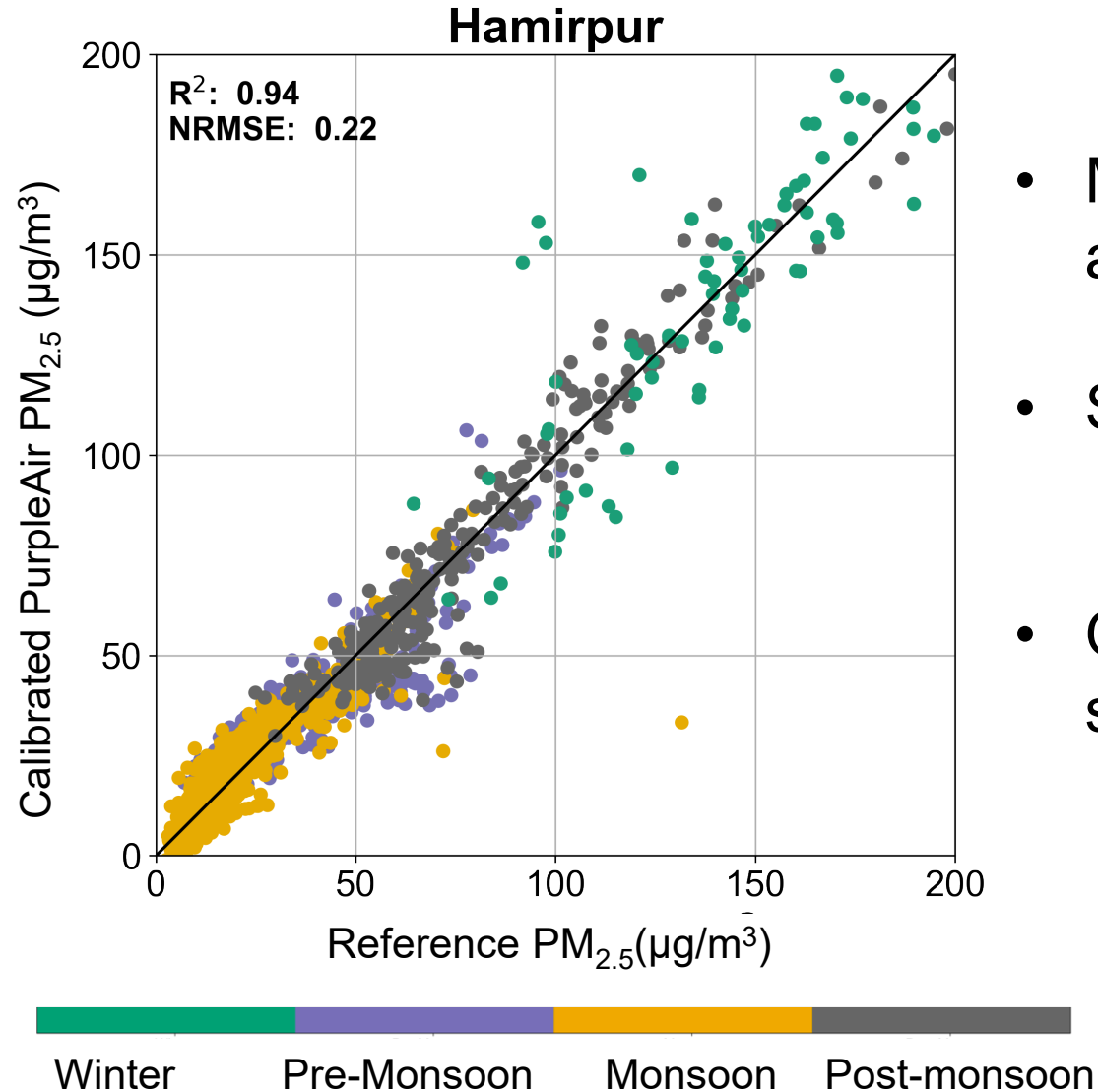


IIT Delhi



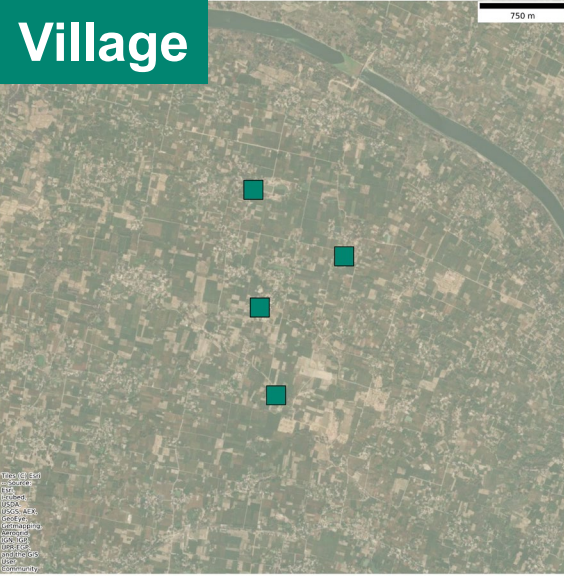
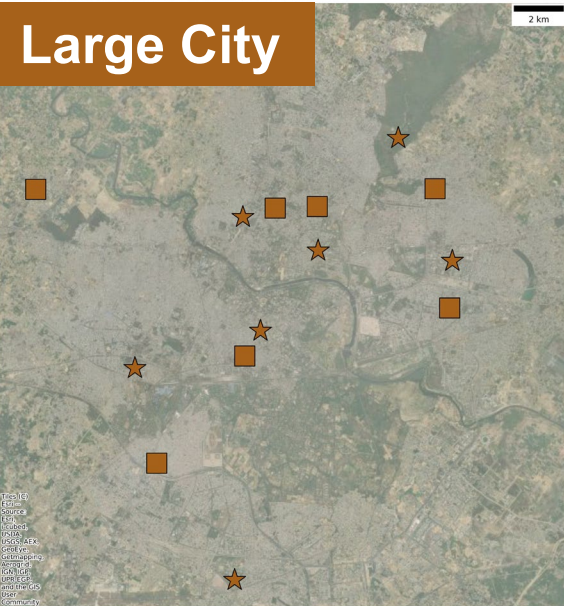
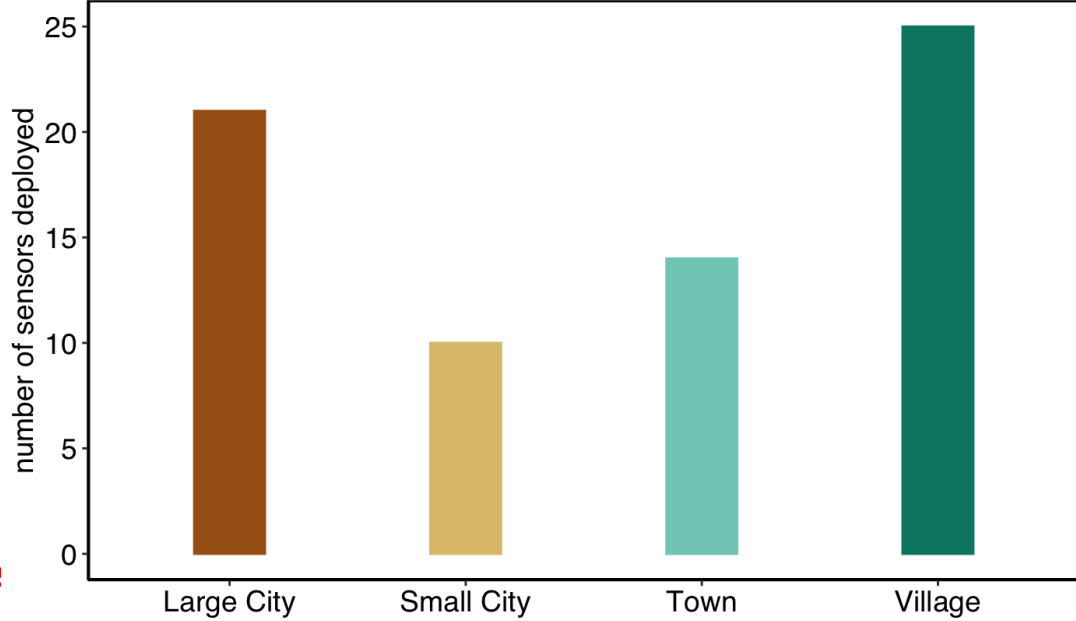
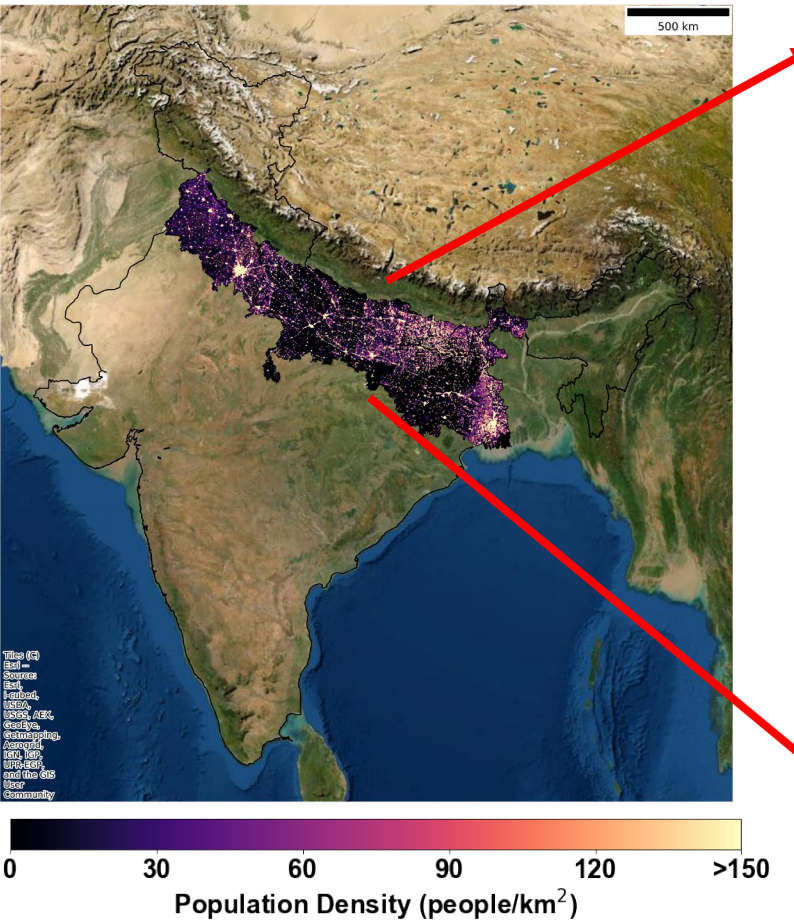
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Results from long-term calibration



- Multilinear regression using PurpleAir ATM PM_{2.5} and PurpleAir RH.
- Seasonally Weighted Model
Corrected PM_{2.5} = $0.774 \cdot \text{ATM} - 0.30 \cdot \text{RH} + 17.0$
- Our relatively simple model greatly reduces systemic bias and error.

Study Region: Indo-Gangetic Plain



Goal: Characterize rural-to-urban PM_{2.5} gradient in IGP

Rural sites

From field to variety of houses in villages



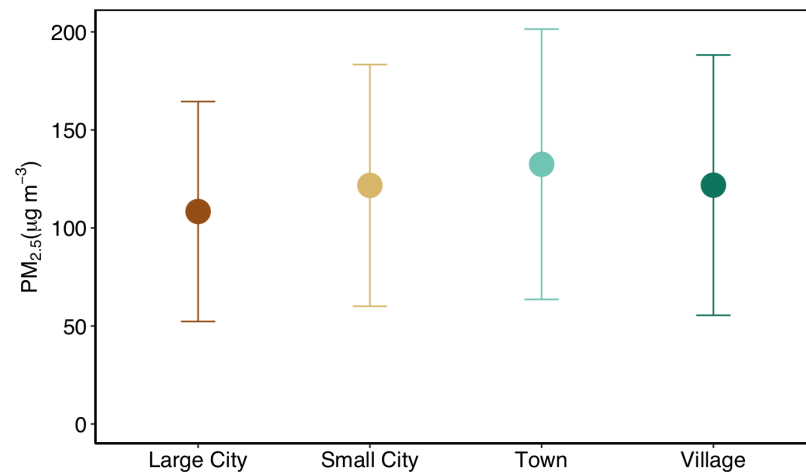
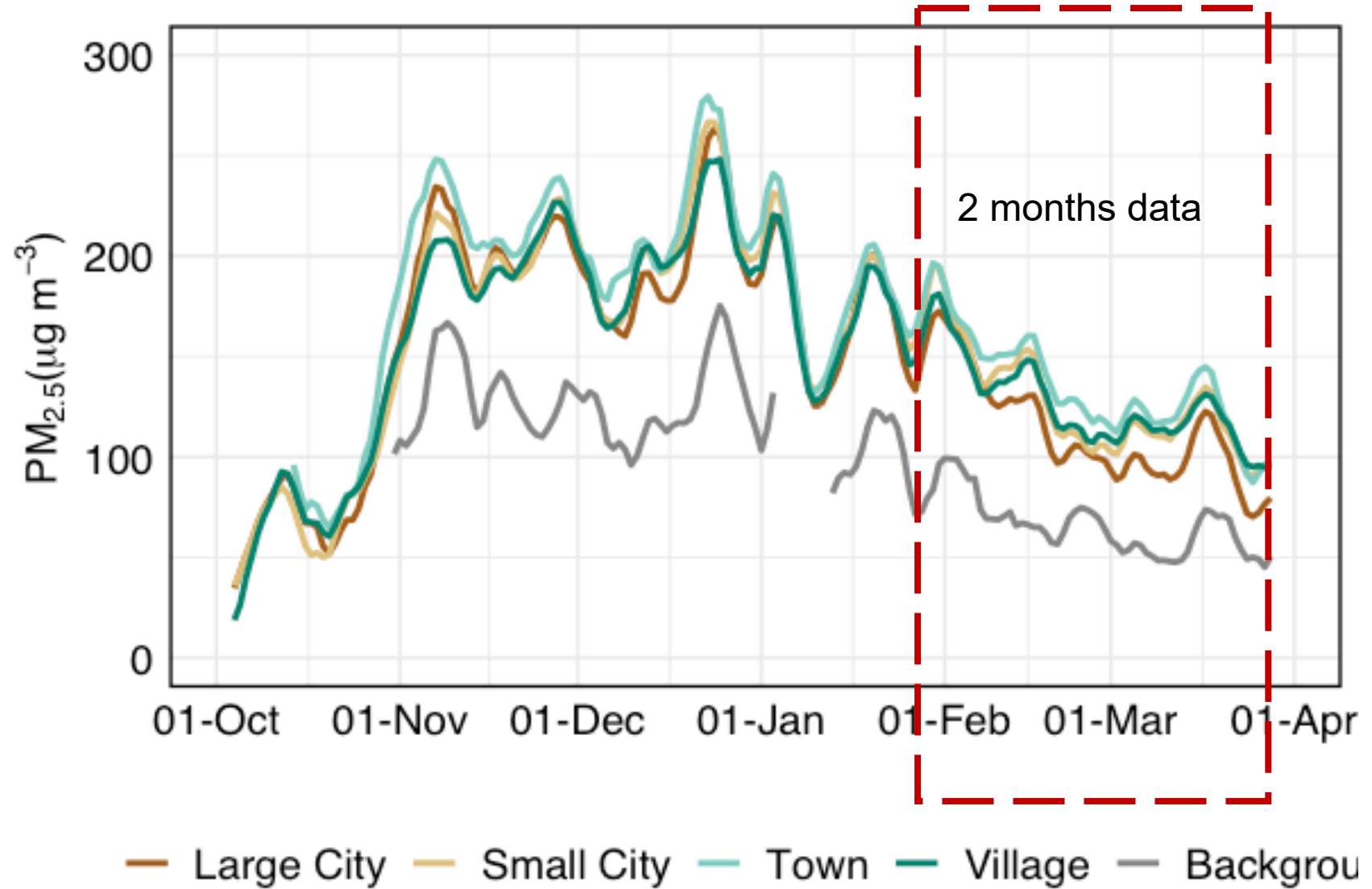
Urban sites



Most cities are not like Delhi!

PM_{2.5} levels in 4 types of settlement

- Daily PM_{2.5} levels > 100 µg/m³ in all settlements
- Background site is the cleanest among all.

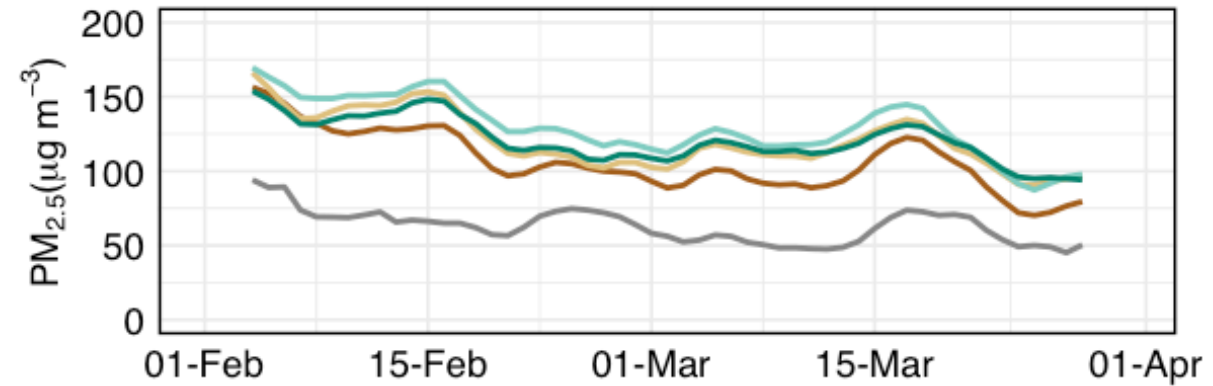


PM_{2.5} gradient: Town > Village > City

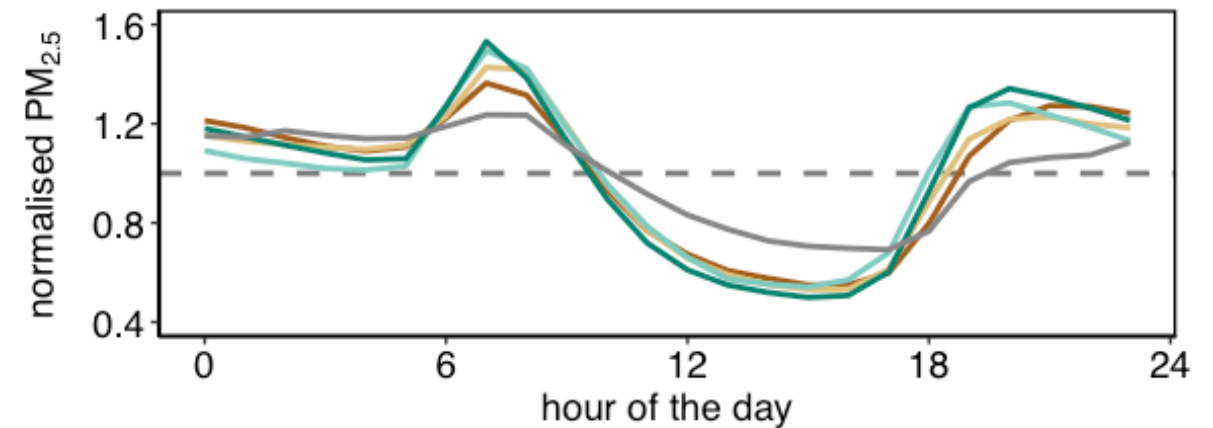
Temporal variability

- Consistent rank-order pattern:
Town > Village > Sm. City > Lg. City
- Diurnal range is sharpest in the towns and villages.

Diurnal pattern: largely regional sources with stronger local influences during morning and evening time.

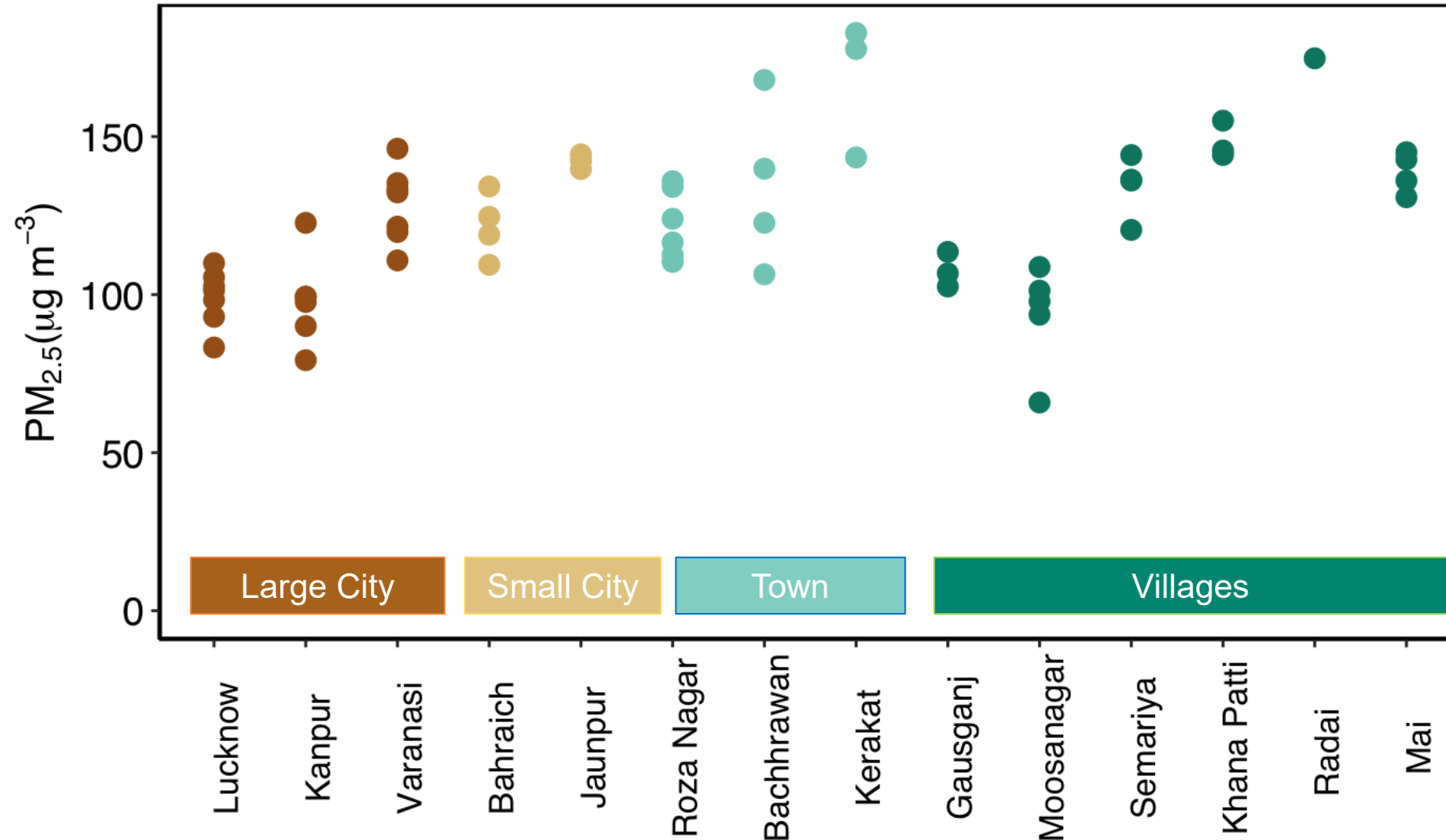


— Large City — Small City — Town — Village — Background



— Large City — Small City — Town — Village — Background

Variation within and among settlements



Large variability at inter-settlement and intra settlement level indicate the heterogeneity of air pollution in IGP region.

Site average concentration, Feb-March 2022

Summary

- For $PM_{2.5}$, cities may be the best-case scenario: towns and villages are often more polluted.
- Diurnal variability shows strong regional influence with local signals during morning and evening.
- To support large networks, build a great team & focus on standardized, scalable procedures.



Thank You!

Dr. Saumya Singh
saumya_singh@berkeley.edu