


The challenge of creating seamless, healthy breathing spaces in India : Role of Satellite based-$PM_{2.5}$ for health effects research and air quality management

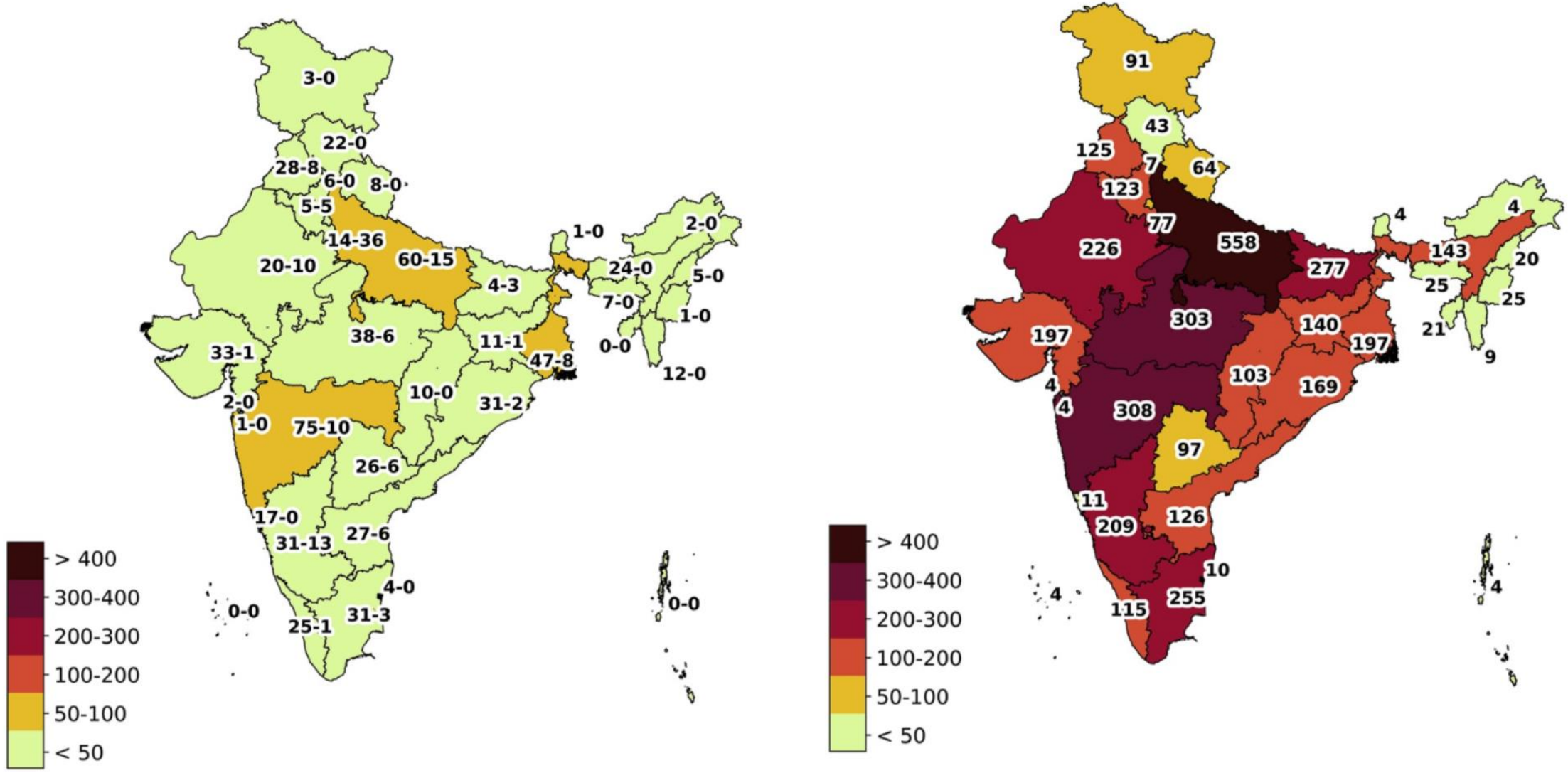
Dr. Kalpana Balakrishnan
Dean (Research)
Professor and Director
SRU-ICMR Center for Advanced Research
Air Quality, Climate and Health
Sri Ramachandra Institute for Higher Education and Research (SRIHER) Chennai, India

Prepared In Collaboration with
Dr. Sagnik Dey
Institute Chair Professor, Centre for Atmospheric Sciences
IIT Delhi

HEI-East Africa Workshop 2023




Ambient Air Quality Monitoring Network in India

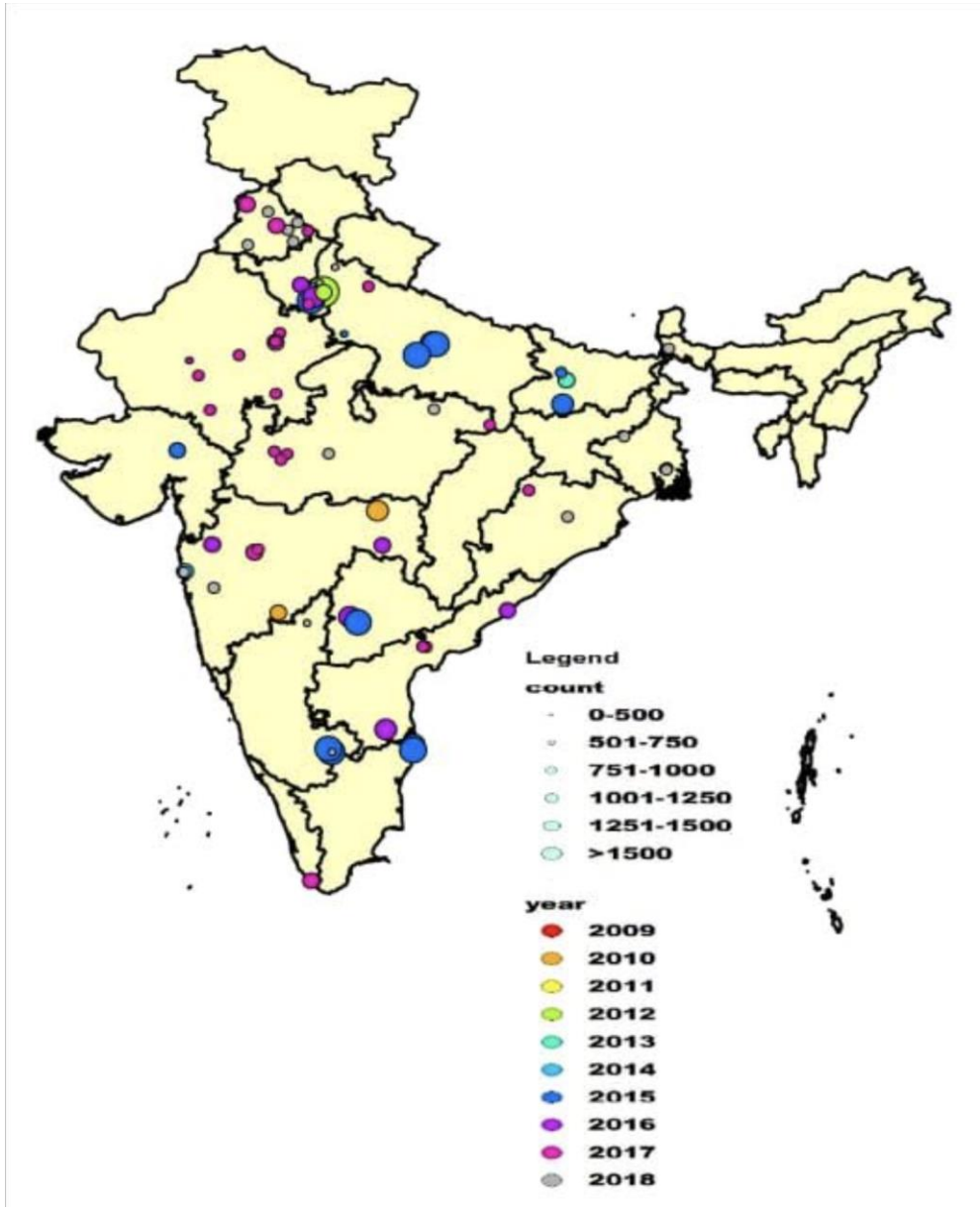


Current

Planned

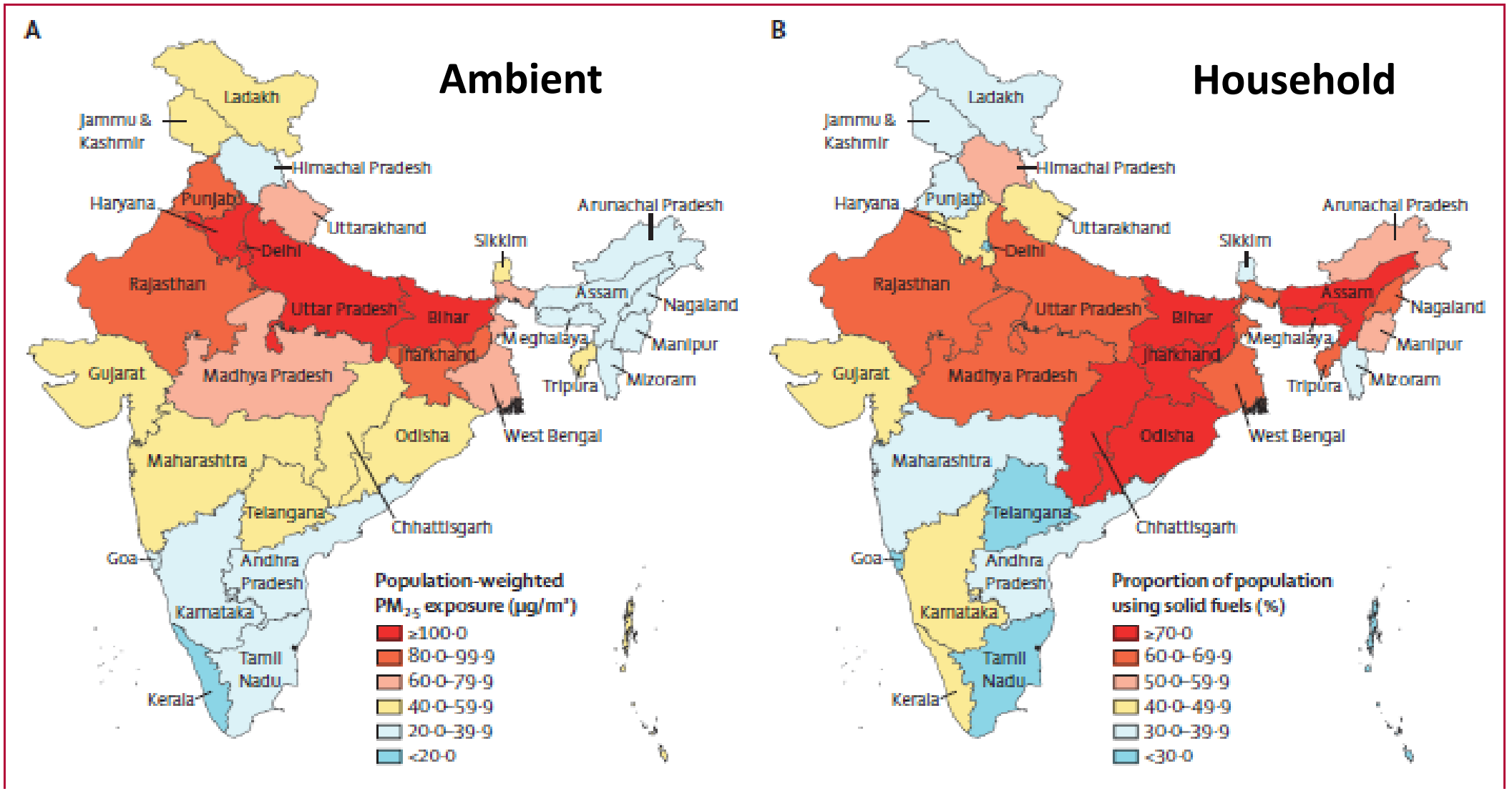
Brauer et al 2019

Why do we need satellite-$PM_{2.5}$ in India?



- Disproportionately distributed ground (reference-grade) monitors [Martin et al., 2019]
  - 804 manual monitors
  - 342 CAAQMS
  - All urban sites
- Mean distance to the nearest monitor = 80 km
- 1 Billion USD is required to create an adequate network [Brauer et al., 2019]

State level exposures for ambient and household air pollution (GBD 2019)



India SLDBI Collaborators ***Lancet 2021***, Balakrishnan et al. ***Lancet Planetary Health*** 2019

Deaths Attributable to Air Pollution in India, 2019

17.5% of all deaths in India were attributed to air pollution

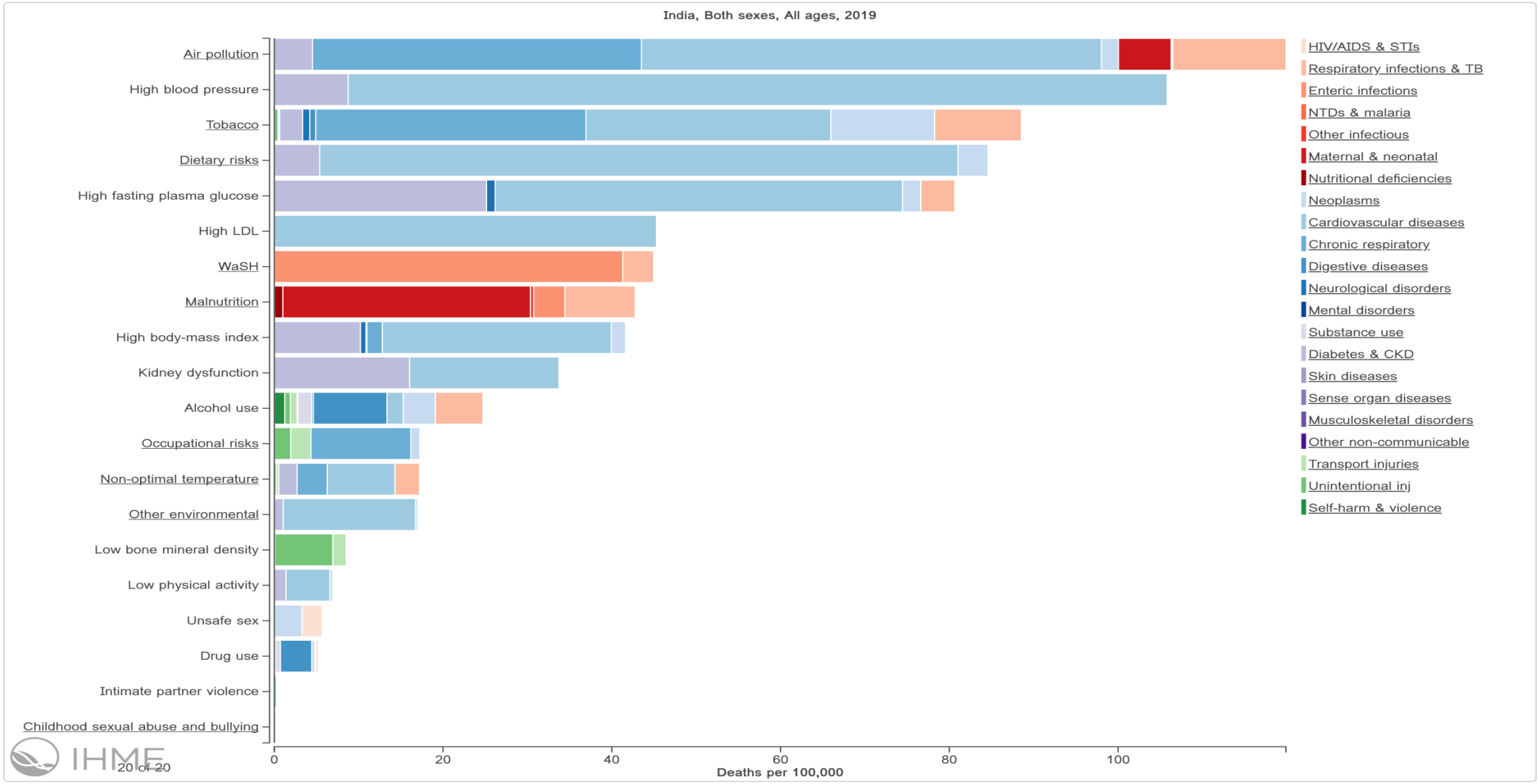
Total deaths attributable to air pollution: 1.67 million (95% UI 1.42 to 1.92million)
0.98 million [95% UI 0.77-1.19] from ambient particulate air pollution **(AAP)**
0.61 million[95% UI 0.39-0.86] due to household air pollution **(HAP)**

	Number of deaths, millions*	Percentage of total deaths†	Number of DALYs, millions*	Percentage of total DALYs†
Air pollution	1·67 (1·42–1·92)	17·8% (15·8–19·5)	53·5 (46·6–60·9)	11·5% (10·2–12·8)
Ambient particulate matter pollution	0·98 (0·77–1·19)	10·4% (8·4–12·3)	31·1 (24·6–37·5)	6·7% (5·3–8·0)
Household air pollution	0·61 (0·39–0·86)	6·5% (4·3–9·0)	20·9 (14·1–28·7)	4·5% (3·0–6·1)
Ambient ozone pollution	0·17 (0·08–0·26)	1·8% (0·9–2·7)	3·06 (1·51–4·83)	0·7% (0·3–1·0)

Data are point estimate (95% UI). DALYs=disability-adjusted life-years. *The sums of deaths and DALYs attributable to each component of air pollution are more than the estimates for overall air pollution because the population attributable fractions from component risk factors can add up to more than the population attributable fraction for the parent risk factor, even if the components are independent. †In 2019, 9·39 million total deaths and 467·8 million total DALYs were estimated for India.[42]

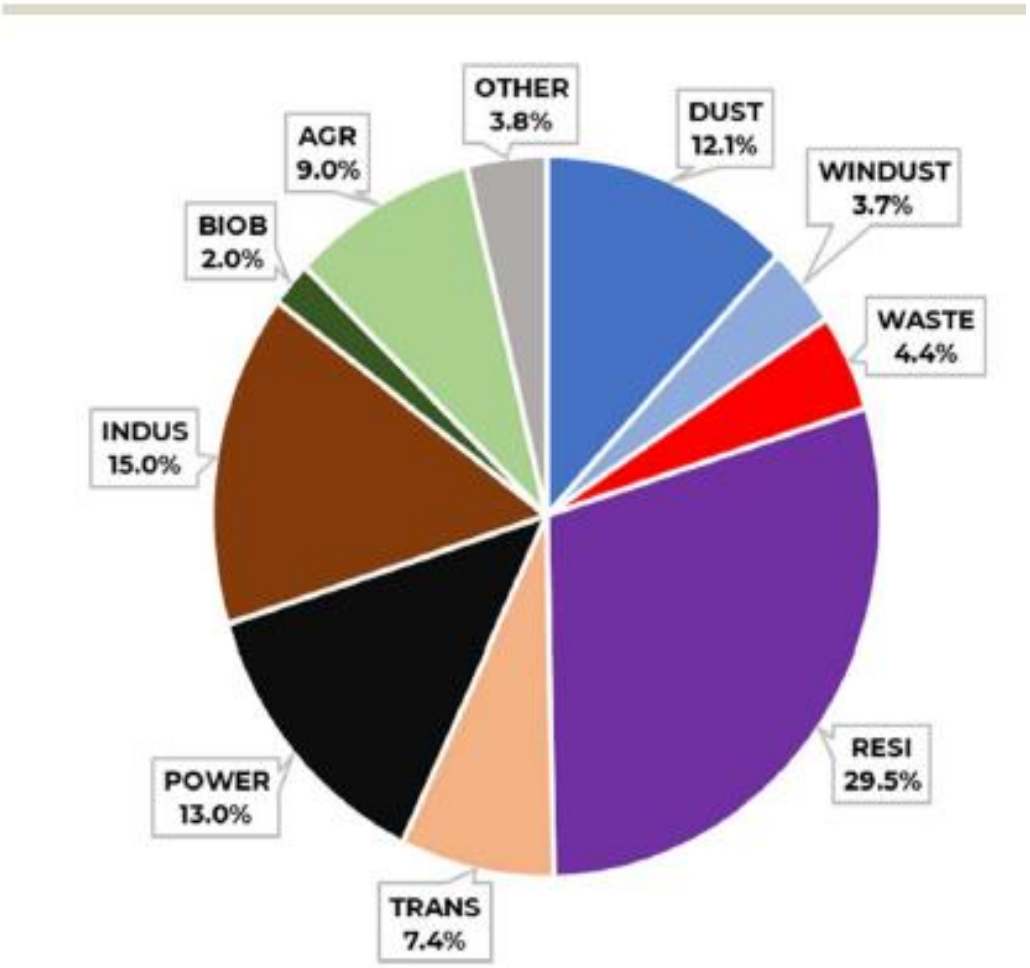
India SLDBI Collaborators, **Lancet** 2021; Balakrishnan et al. ***Lancet Planetary Health*** 2019

Air pollution – *the new villain for health policy*

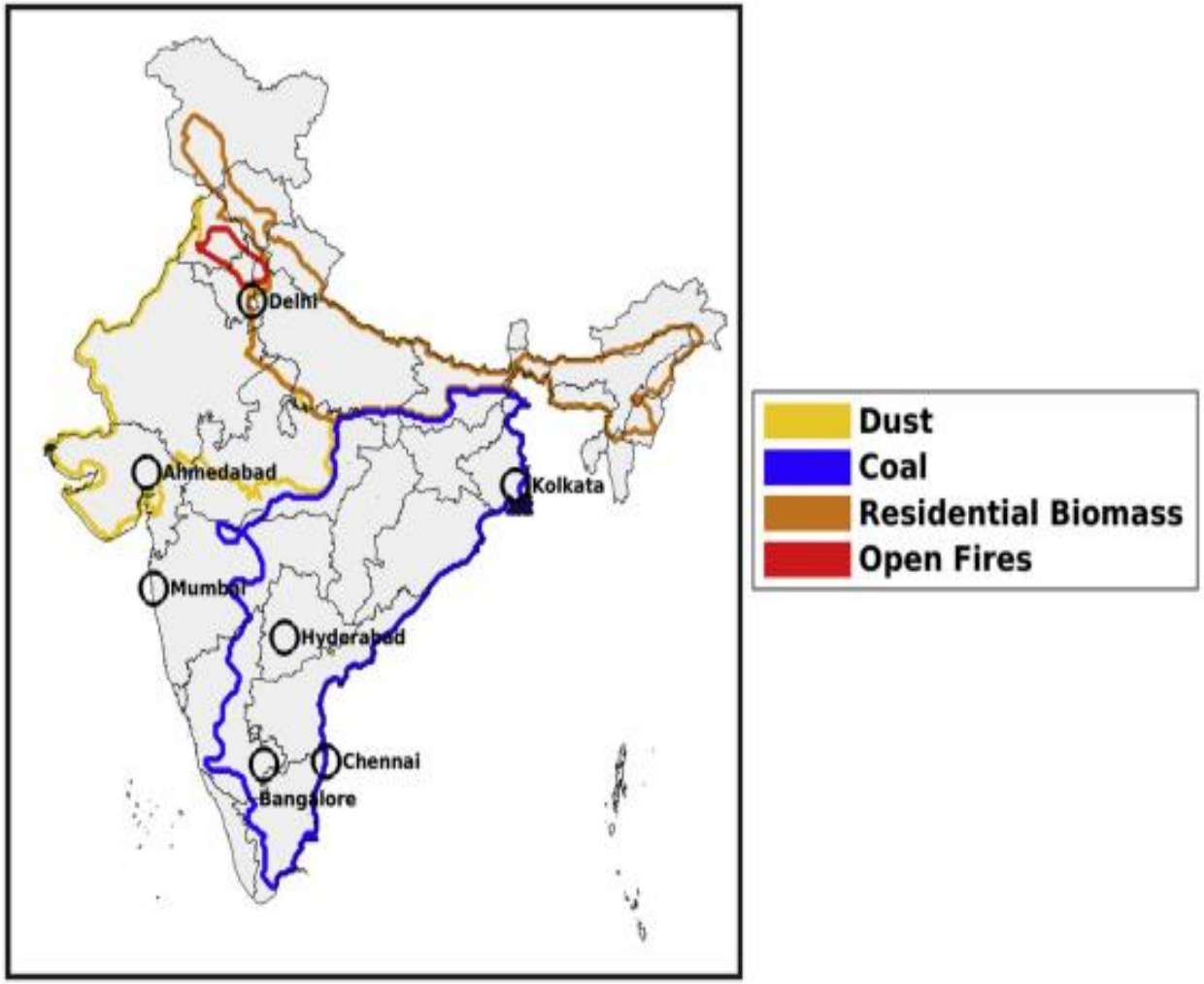


GBD 2019

Sources and Source Weighted Air-sheds in India



Guttikunda et al 2022



Brauer , Dey et al 2019

NCAP
NATIONAL CLEAN AIR PROGRAMME

Key Sectoral Interventions under NCAP

National $PM_{2.5}$ Database for India

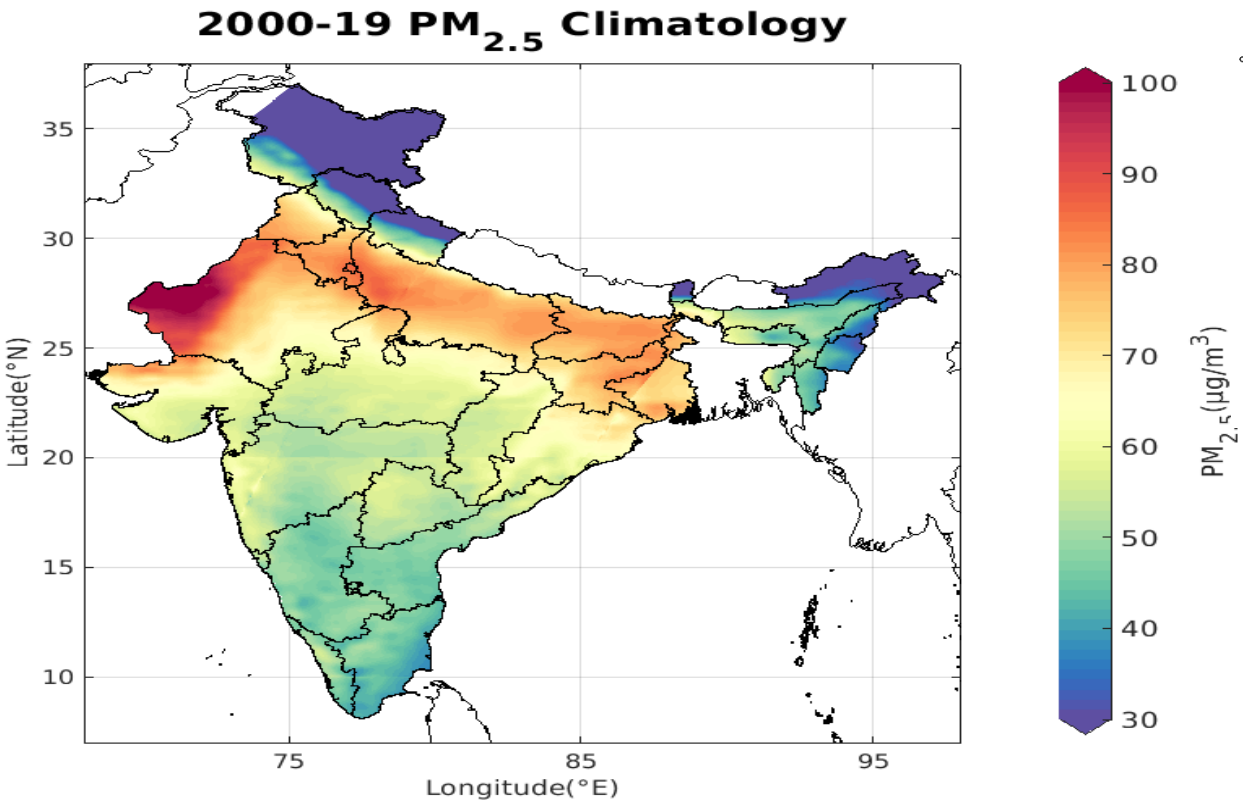
remote sensing

MDPI

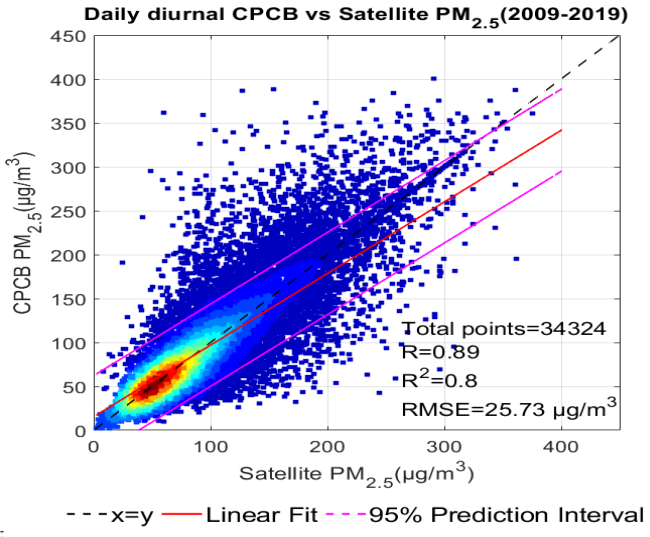
Article

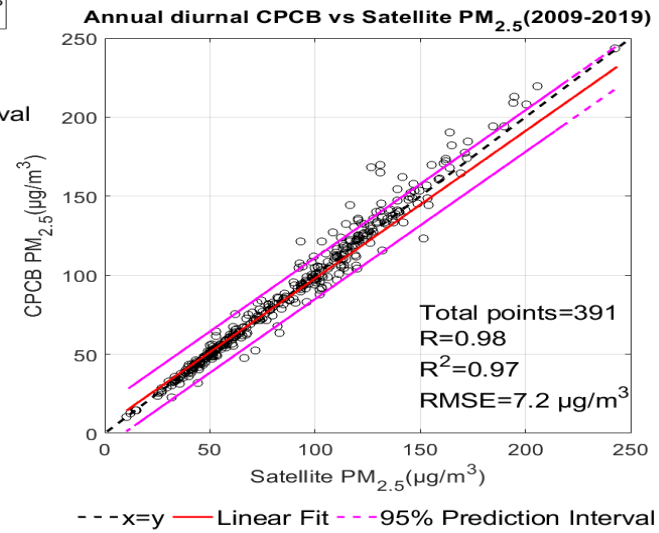
A Satellite-Based High-Resolution (1-km) Ambient $PM_{2.5}$ Database for India over Two Decades (2000–2019): Applications for Air Quality Management

Sagnik Dey [1,2,*], Bhavesh Purohit [1], Palak Balyan [1], Kuldeep Dixit [1], Kunal Bali [1], Alok Kumar [1], Fahad Imam [1], Sourangsu Chowdhury [3], Dilip Ganguly [1], Prashant Gargava [4] and V. K. Shukla [4]

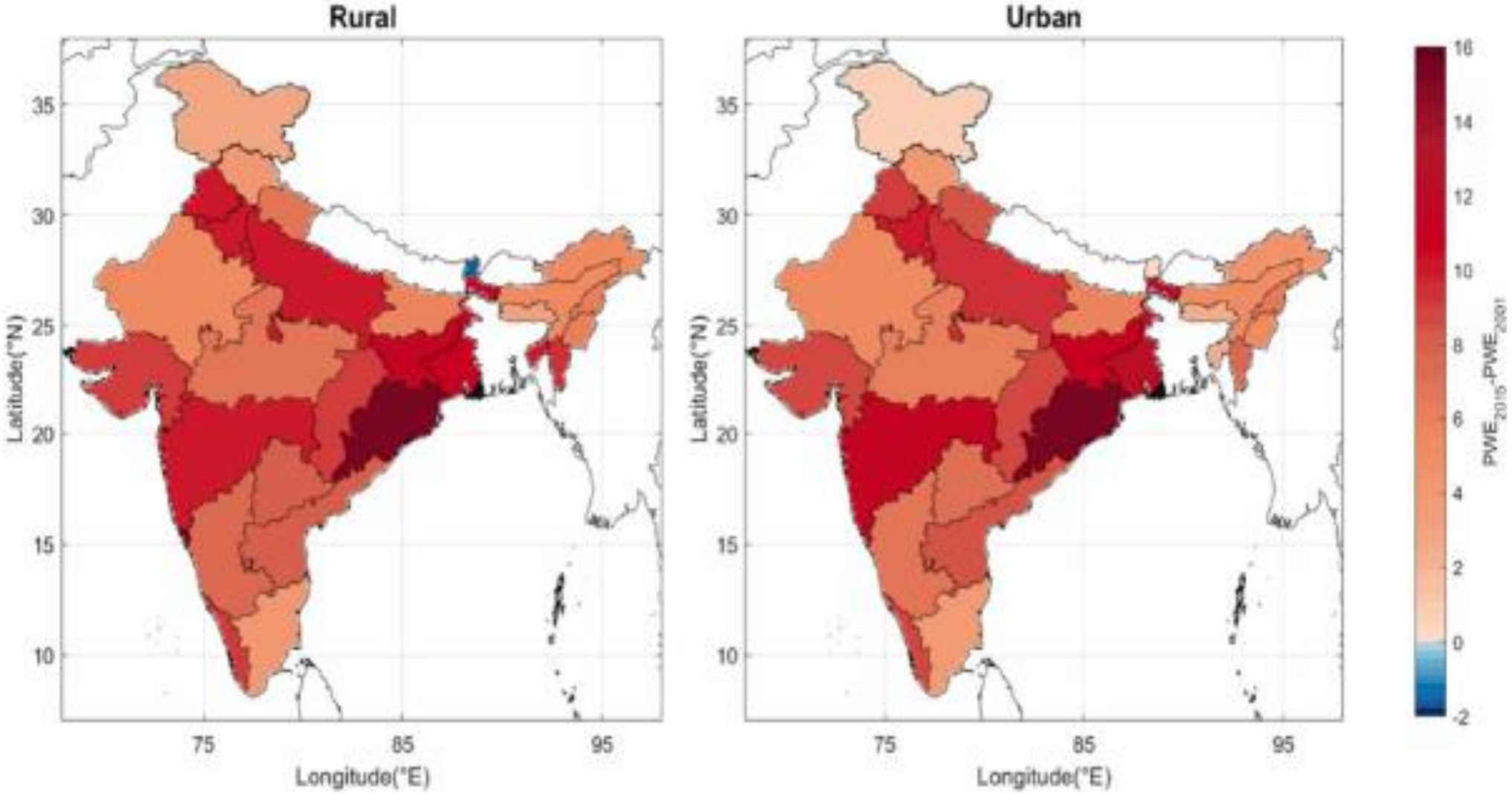


- Daily & annual $PM_{2.5}$ data from 2000 onwards (21+ years) – V1
- Data will be hosted by the CPCB and disseminated through a portal



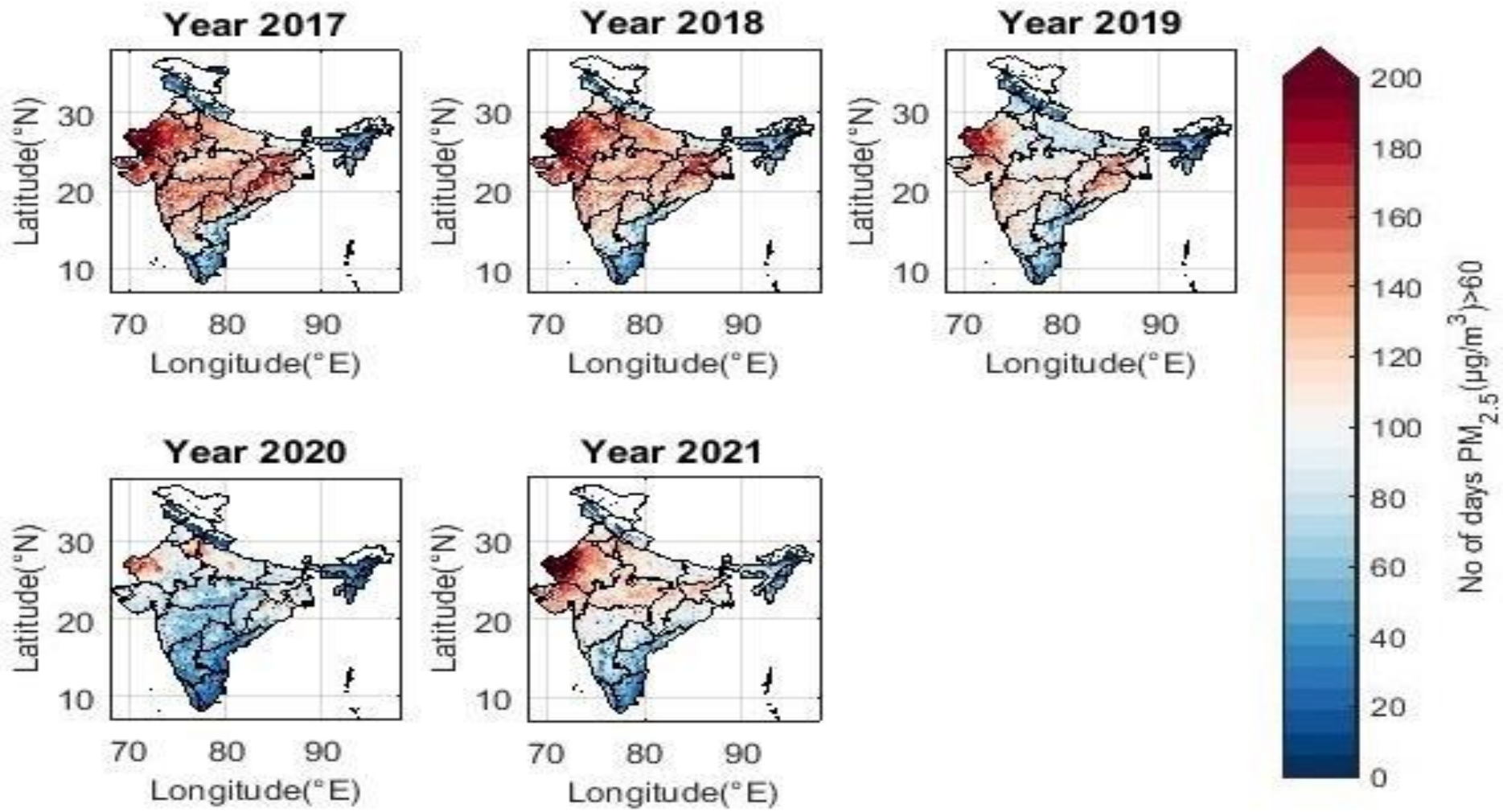


Exposure Surveillance: Limited Gains in Exposure Across Cities and Villages



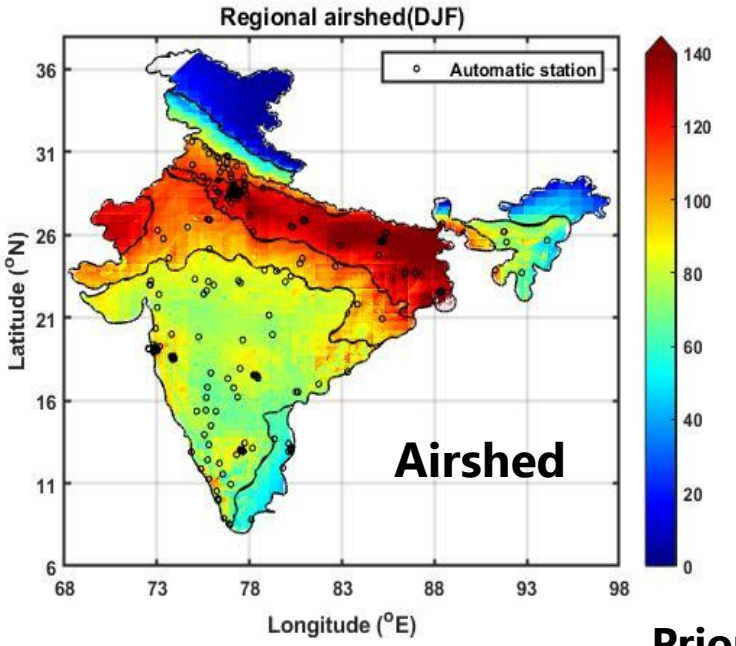
Dey et al ***Remote Sensing 2020***

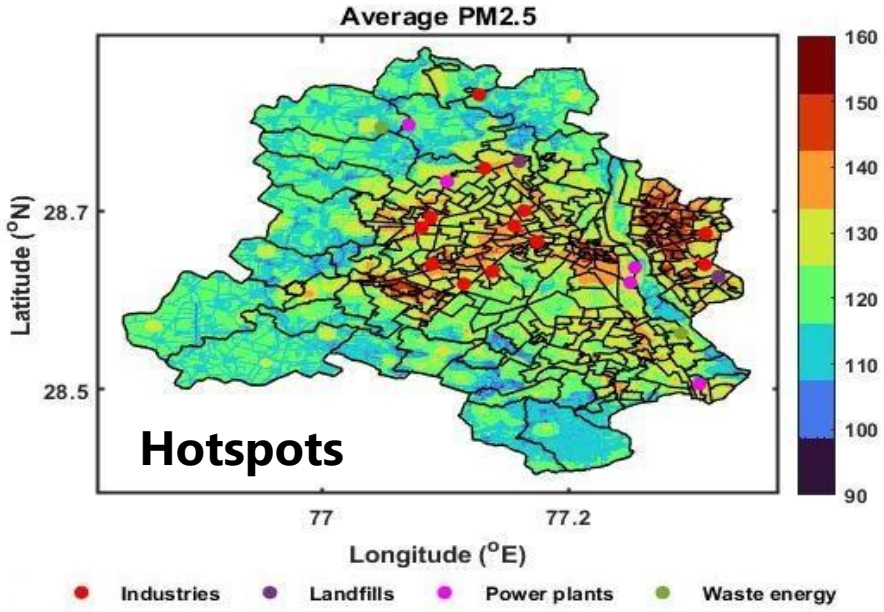
Daily exceedance (in the NCAP era)



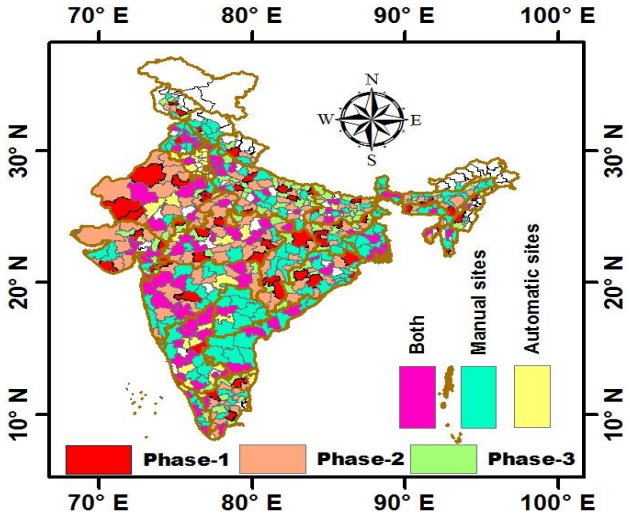
- Daily $PM_{2.5}$ exceeded the national standard in lesser number of days in recent years

Air quality management applications

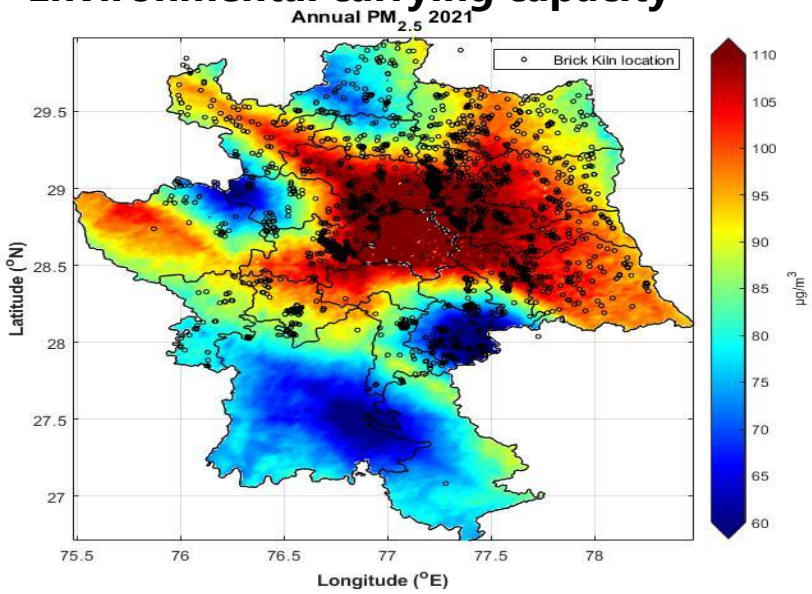




Prioritizing network expansion



Environmental carrying capacity



Health Studies

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Robust relationship between ambient air pollution and infant mortality in India

Priyanka N. deSouza [a,*], Sagnik Dey [b,c], Kevin M. Mwenda [d,e], Rockli Kim [f,g,h], S.V. Subramanian [h,i], Patrick L. Kinney [j]

Research

A Section 508–conformant HTML version of this article is available at https://doi.org/10.1289/EHP8910.

Child Survival and Early Lifetime Exposures to Ambient Fine Particulate Matter in India: A Retrospective Cohort Study

Jiawen Liao,[1,2] Yang Liu,[1] Kyle Steenland,[1] Ajay Pillarisetti,[1,3] Lisa M. Thompson,[4] Sagnik Dey,[5,6] Kalpana Balakrishnan,[7] and Thomas Clasen[1]

Contents lists available at ScienceDirect

SSM - Population Health

journal homepage: http://www.elsevier.com/locate/ssmph

Crop Fires and Cardiovascular Health – A Study from North India

Prachi Singh [a,d,*], Ambuj Roy [b], Dinkar Bhasin [c], Mudit Kapoor [d], Shamika Ravi [e], Sagnik Dey [f]

Spears *et al. Environmental Health* (2019) 18:62
https://doi.org/10.1186/s12940-019-0501-7

Environmental Health

RESEARCH Open Access

The association of early-life exposure to ambient $PM_{2.5}$ and later-childhood height-for-age in India: an observational study

Dean Spears[1,2*], Sagnik Dey[3,4], Sourangsu Chowdhury[3], Noah Scovronick[5], Sangita Vyas[1] and Joshua Apte[6]

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

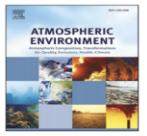
Ambient air pollution and acute respiratory infection in children aged under 5 years living in 35 developing countries

Daniel B. Odo [a,b,*], Ian A. Yang [c,d], Sagnik Dey [e,f], Melanie S. Hammer [g], Aaron van Donkelaar [g], Randall V. Martin [g], Guang-Hui Dong [h], Bo-Yi Yang [h], Perry Hystad [i], Luke D. Knibbs [a,j]

Contents lists available at ScienceDirect

Atmospheric Environment

journal homepage: www.elsevier.com/locate/atmosenv



Impact of acute exposure to ambient $PM_{2.5}$ on non-trauma all-cause mortality in the megacity Delhi

Pallavi Joshi [a], Santu Ghosh [b], Sagnik Dey [a,c,d,*], Kuldeep Dixit [a], Rohit Kumar Choudhary [a], Harshal Ramesh Salve [e], Kalpana Balakrishnan [f]

Original Research Article

ISEE ENVIRONMENTAL EPIDEMIOLOGY

OPEN

The Association Between Ambient $PM_{2.5}$ Exposure and Anemia Outcomes Among Children Under Five Years of Age in India

Unnati Mehta[a,b], Sagnik Dey[a,c,d,*], Sourangsu Chowdhury[a], Santu Ghosh[f], Jaime E Hart[b,g], Anura Kurpad[f]

LETTER

The association of in-utero exposure to ambient fine particulate air pollution with low birth weight in India

Nihit Goyal[1,*] and David Canning[2]

RECENT PROGRESS IN EXPOSURE/EXPOSURE-RESPONSE ASSESSMENTS

Developing, Validating and deploying field instrumentation to capture exposure heterogeneity in rural and urban micro-environments

PC- XR8
Active PM Sampler

Casella
Active PM Sampler

Air-check Touch
Active PM Sampler

Air-check XR 5000
Active PM Sampler

PATS+
Passive PM Sampler

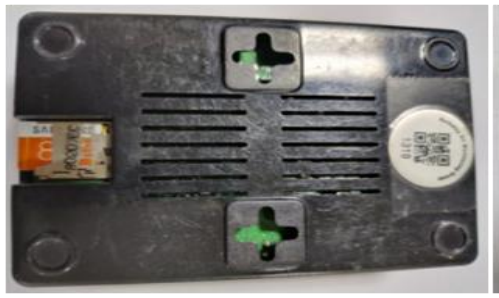
UPAS
Active PM Sampler

ECM
Active PM Sampler

Purple Air
Passive PM Sampler

Drager
Passive CO Sampler

LASCAR
Passive CO Sampler



Beacon Logger
Time Location monitor

Beacon Unit
Time Location monitor

I button & Dots
Stove use monitors

From carrying to wearing PEM devices…

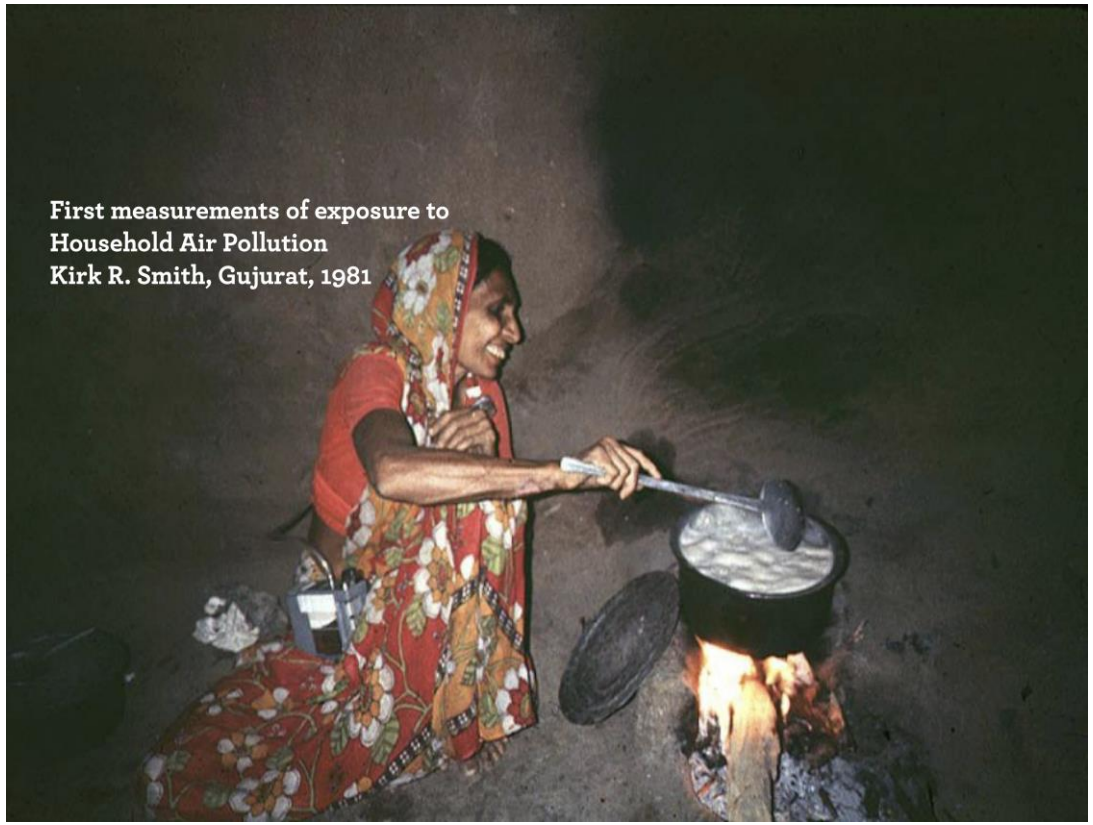
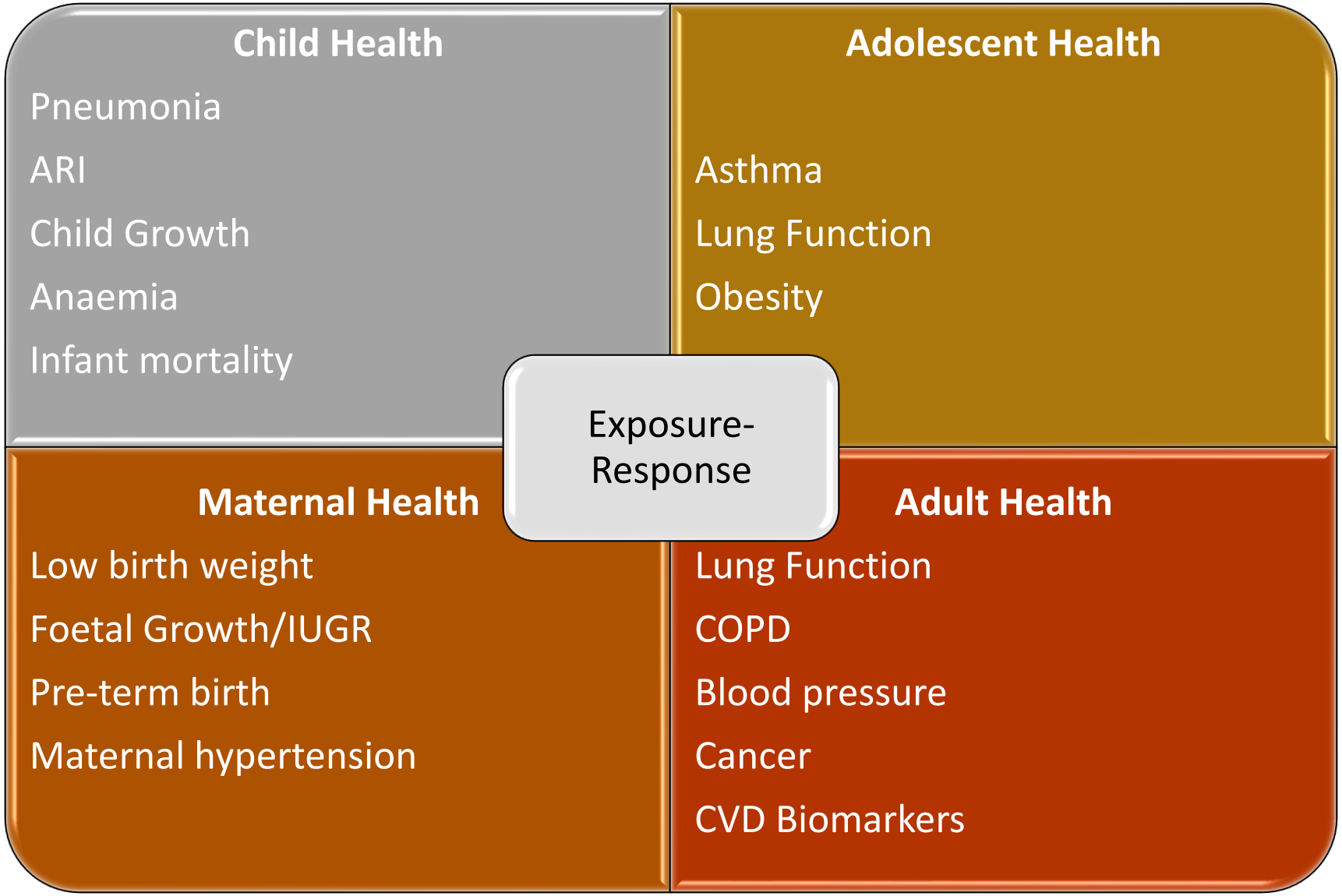


Photo Credit: SRIHER, UC Berkeley

From short-term to long-term monitoring….

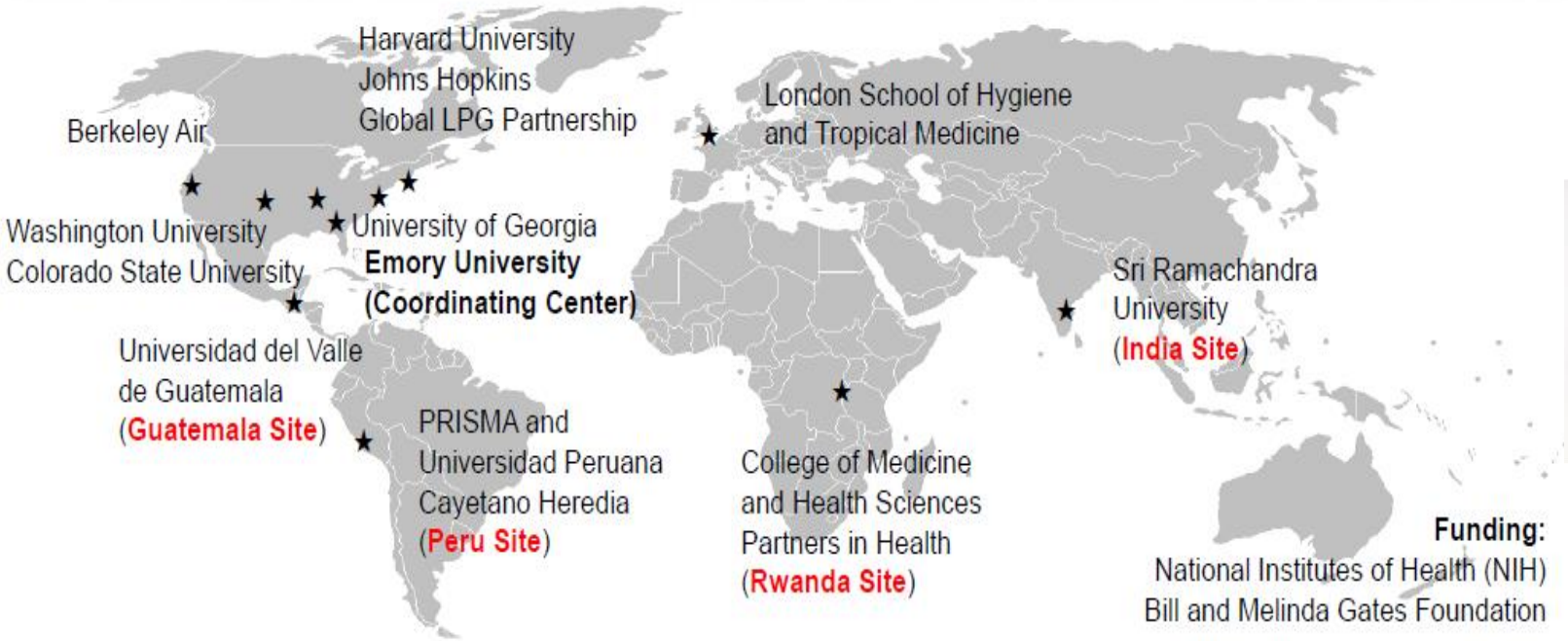
Photo Credit: SRIHER, AIIMS,IIT-D, C-STEP

Addressing health impacts of national relevance in rural-urban cohorts



HAPIN: Scaling multi-pollutant, longitudinal HAP and stove-use monitoring within multi-country RCTs

The Household Air Pollution Intervention Network (HAPIN)



Funding:
National Institutes of Health (NIH)
Bill and Melinda Gates Foundation

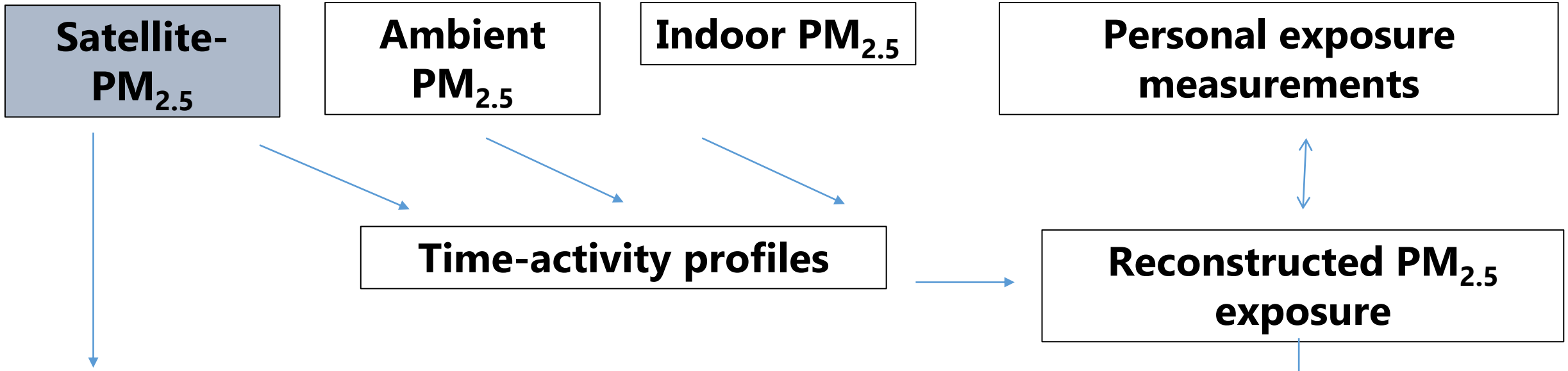
LPG intervention → Birth weight; Child severe pneumonia; Child linear growth/stunting; Adult blood pressure

Ambient PM:
E-Sampler
and Purple
Air monitors

Low-cost (???)Sensor application in India

The way forward

Future applications in health studies



On-Going Studies:

TAPHE (Maternal and Child Health): Rural-Urban-Southern India
DAPHNE (Maternal, Child, Adolescent Health): Urban-NCR
CARRS (Adult CVD): Urban-Southern India and NCR
APCAPS-CHAI (Adult CVD): Rural-Peri-Urban-Southern India
MUDHRA (Adult CRD): Rural-Southern India
HAPIN (Maternal and Child Health, Adult CVD)- Rural-Southern India

Integrating Satellite based $PM_{2.5}$ with planned actions in NCAP

- Setting up long-term local surveillance for exposure, health and bio-monitoring for select NCAP actions at strategic sites
- Creating capacities at local institutions via existing Centres of Excellence
- Populating information in public dashboards on a annual basis

Creating Seamless Healthy Breathing Spaces

Thank you from SRIHER!