

# Source Apportionment of PM<sub>2.5</sub> in India

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Health Effects Institute

July 18, 2019



*Trusted Science • Cleaner Air • Better Health*

# What is the Health Effects Institute?

An independent non-profit institute providing trusted science on the health effects of air pollution for nearly 40 years

*Over 350 scientific studies, reviews, re-analyses conducted around the world, including increasingly in Asia*

Balanced Core Support – a public-private partnership

Partnerships- international agencies, donors, non-profits, academic institutions etc.

Independent Board and Expert Science Committees

# HEI's work in India

Public Health and Air  
Pollution in Asia

GBD-MAPS India

State of Global Air



<https://www.healtheffects.org/system/files/SR18AsianLitReview.pdf> ; <https://www.healtheffects.org/publication/public-health-and-air-pollution-asia-papa-coordinated-studies-short-term-exposure-air>  
<https://www.healtheffects.org/publication/gbd-air-pollution-india>  
[www.stateofglobalair.org](http://www.stateofglobalair.org)

# Approaches for source apportionment



Bottom-up

Emissions inventories, chemical transport models

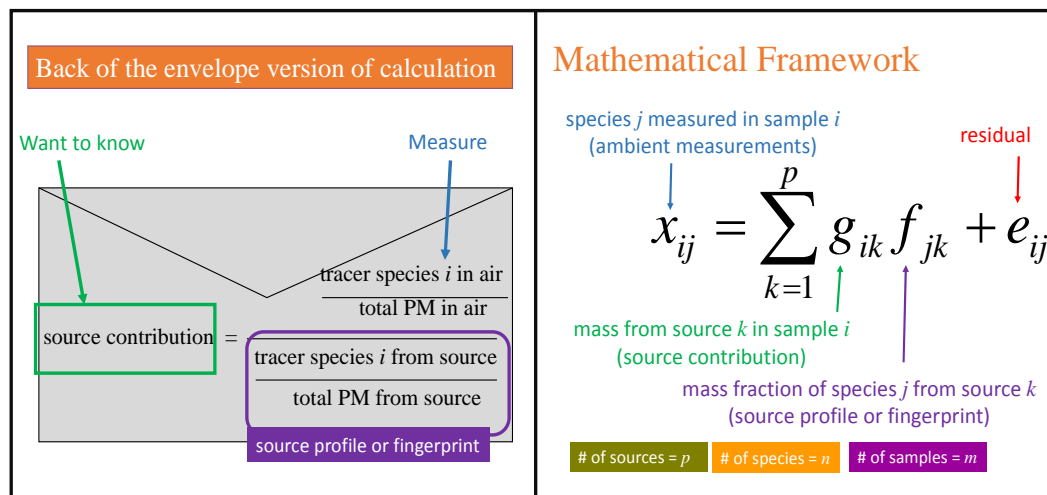


Top-down

Ambient air quality measurements, source *fingerprints*

# Source Apportionment using top-down approaches

## Top-Down Source Apportionment Math



Credit: Dr. Mike Hannigan

Chemical Mass Balance (CMB)

Positive Matrix Factorization (PMF)

Other multivariate methods

Six City Source Apportionment Study

Real-time source apportionment

# GBD-MAPS India

## **An international collaboration**

Indian leads: Dr. Chandra Venkataraman, IIT-Bombay; Kalpana Balakrishnan, Sri Ramachandran University

HEI in collaboration with IIT-Mumbai, Tsinghua University, University of British Columbia and IHME; others

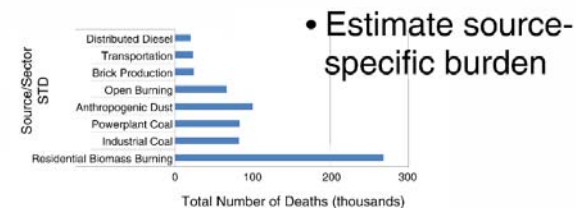
## **Goals**

Identify what sources contribute the most to poor air quality and health

Evaluate the implications of alternative control policies on future impacts

Provide a baseline against which to measure future progress

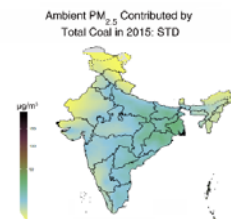
# GBD-MAPS approach



- Estimate source-specific burden

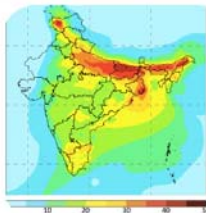
Apply GBD exposure response functions

- Estimate the GBD 2015 population exposure to each source



Link to gridded population data

- Simulate the fraction of ambient PM<sub>2.5</sub> due to each major source



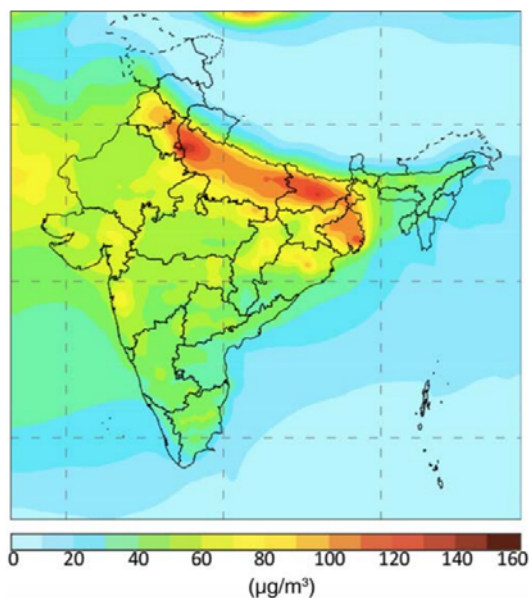
Simulate using atmospheric, chemical transport models (GEOS-CHEM, nested-south Asia version); scaled to satellite data

- Develop current and future emissions inventories

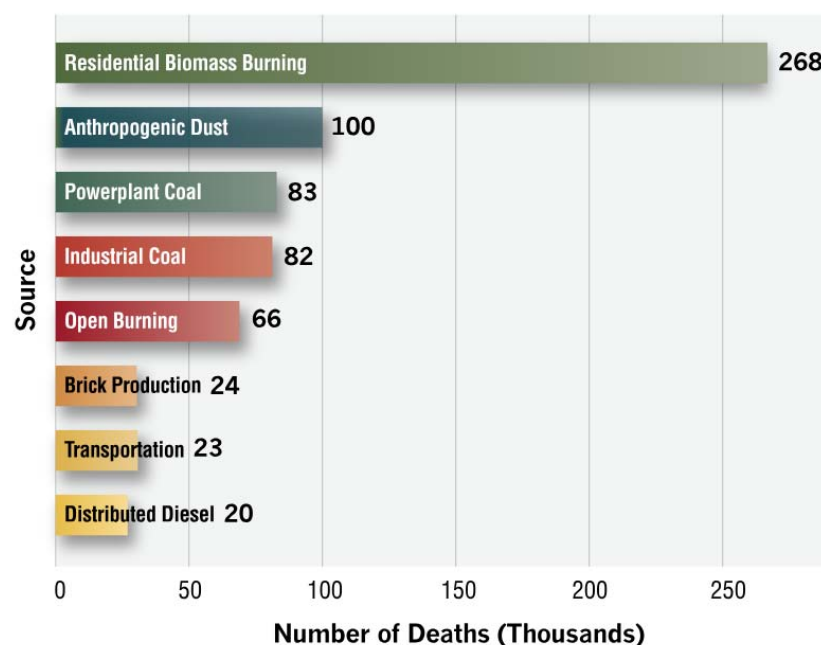


Emissions inventories, current and projected under alternative scenarios for 2030 and 2050

## Major source contributors to baseline PM<sub>2.5</sub> levels and health burden at the national level



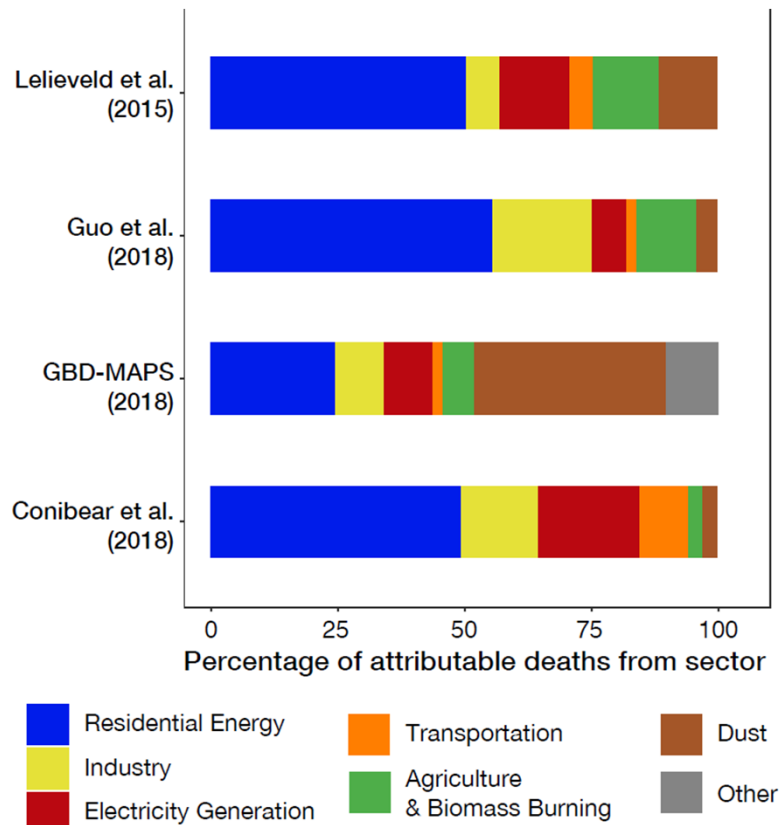
2015



**Residential biomass burning (24.4%)** is the largest individual contributor to the burden of disease in India, followed by **coal combustion (15.5%)** and **open burning of agricultural residue**.



But this isn't the only study-- how do the different estimates compare?



National estimates: bottom-up modelling

City-level estimates: bottom-up/top-down

Apte JS and Pant P. (2019) Towards Cleaner Air for a Billion Indians. PNAS, doi: <https://doi.org/10.1073/pnas.1905458116><sup>9</sup>

No single sector - silver bullet that will solve our air pollution problem

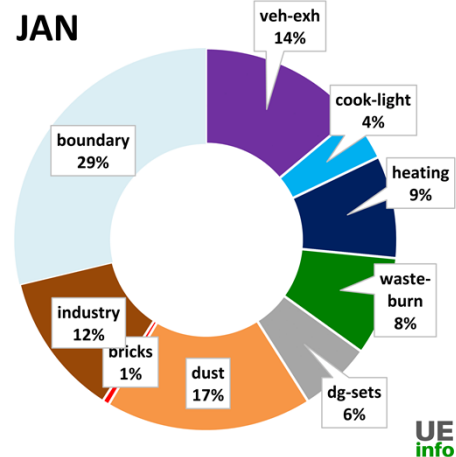
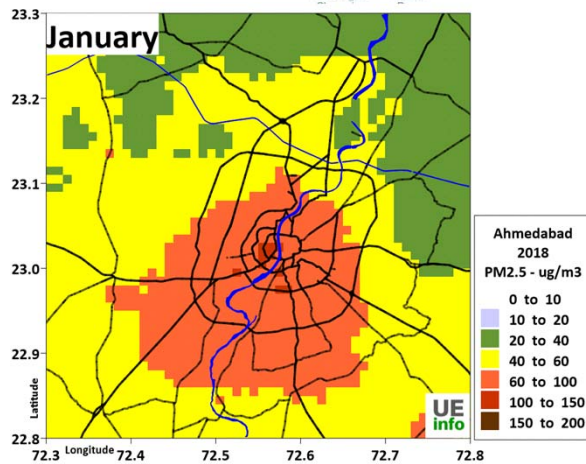
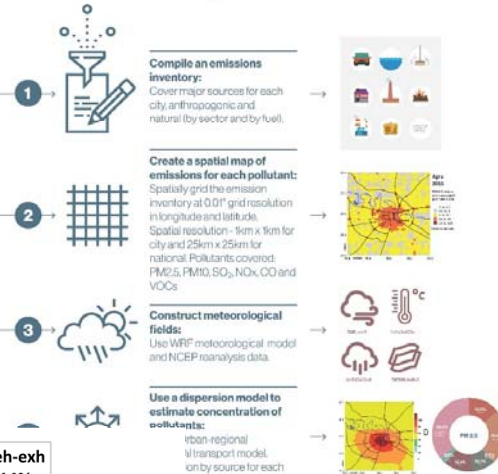
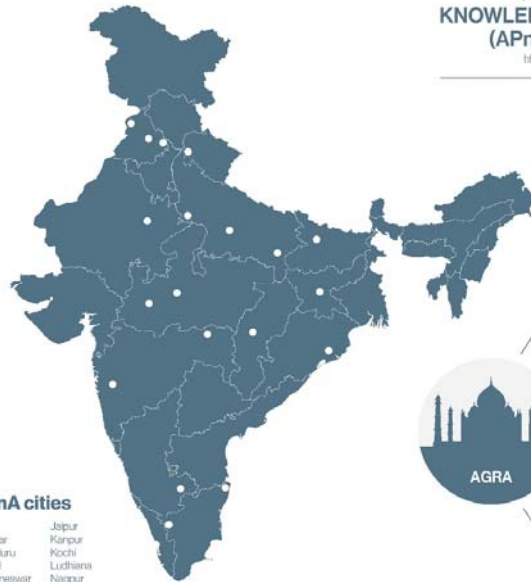
Need coordinated multi-sectoral regional action, as well as the city-level action as mandated by NCAP

Improved data access as well as data transparency

Ongoing assessment – convergence of results from various approaches

# CLEARING THE AIR WITH DATA

Supporting long-term policy making by  
establishing baselines for air pollution  
in a city.



50 cities

## Questions for discussion

Per NCAP, cities will be required to conduct source apportionment analysis.

Are there common protocols/methodologies to be used?

How will source apportionment analyses be used?

Who will do this? How?

Standard Operating Procedures  
QA/QC Processes

Prioritize sources to control?  
Seasonal contributions?  
Measurement of progress?

Thank you!

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