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Air Pollution knowledge Assessments (APnA) City Program Open Data Sources and Applications

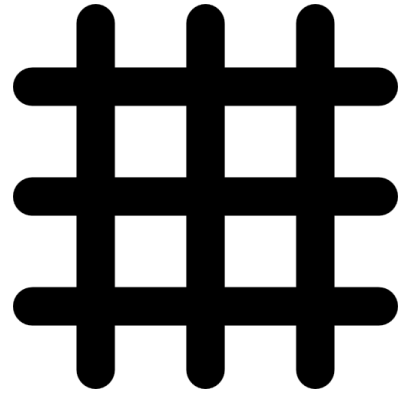
**Dr Sarath Guttikunda
UrbanEmissions.Info, India**

**Data-Driven Decision-Making for Clean Air
Better Air Quality Conference, Manila, Philippines
November 15th, 2023**

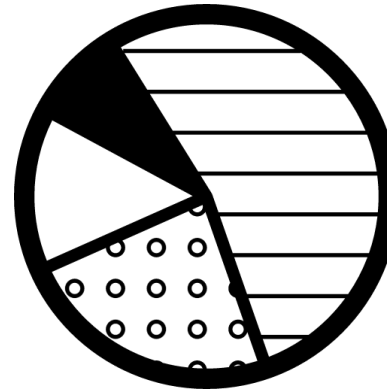
APnA City Program



City airshed landscape,
geography, and
meteorology



Baseline
inventory of total
& gridded
emissions



Modelled pollution
totals & source
contributions



Knowledge
sharing

Information baselines for 50 Indian airsheds

APnA City Program

As of December 2022

India's NCAP cities (131)

Punjab (9)

Amritsar, Dera Bassi, Gobindgarh, Jalandhar, Khanna, Ludhiana, Naya Nangal, Pathankot/Dera Baba, Patiala

Haryana (1)

Faridabad

Chandigarh (1)

Chandigarh

Delhi (1)

Delhi

Rajasthan (5)

Alwar, Jaipur, Jodhpur, Kota, Udaipur

Gujarat (4)

Ahmedabad, Rajkot, Surat, Vadodara

Maharashtra (19)

Akola, Amravati, Aurangabad, Badlapur, Chandrapur, Jalgaon, Jalna, Kolhapur, Latur, Mumbai, Nagpur, Nashik, Navi Mumbai, Pune, Sangli, Solapur, Thane, Ulhasnagar, Vasai Virar

Karnataka (4)

Bengaluru, Devanagere, Gulburga, Hubli-Dharwad

Jammu & Kashmir (2)

Jammu, Srinagar

Himachal Pradesh (7)

Baddi, Damtal, Kala Amb, Nalagarh, Paonta Sahib, Parwanoo, Sunder Nagar

Uttarakhand (3)

Dehradun, Kashipur, Rishikesh

Odisha (7)

Angul, Balasore, Bhubneshwar, Cuttack, Kalinga Nagar, Rourkela, Talcher

Telangana (4)

Hyderabad, Nalgonda, Patancheru, Sangareddy

Andhra Pradesh (13)

Anantapur, Chittoor, Eluru, Guntur, Kadapa, Kurnool, Nellore, Ongole, Rajahmundry, Srikakulam, Vijayawada, Vishakhapatnam, Vizianagaram

Assam (5)

Guwahati, Nagaon, Nalbari, Sibsagar, Silchar

Meghalaya (1)

Byrnihat

Nagaland (2)

Dimapur, Kohima

Uttar Pradesh (17)

Agra, Prayagraj (Allahabad), Anpara, Bareilly, Firozabad, Gajraula, Ghaziabad, Gorakhpur, Jhansi, Kanpur, Khurja, Lucknow, Meerut, Moradabad, Noida, Raebareilly, Varanasi

Bihar (3)

Gaya, Muzaffarpur, Patna

Tamil Nadu (4)

Chennai, Madurai, Thoothukudi (Tuticorin), Tiruchirappally (Trichy)

Madhya Pradesh (7)

Bhopal, Dewas, Gwalior, Indore, Jabalpur, Sagor, Ujjain

Chhattisgarh (3)

Bilhal, Korba, Raipur

West Bengal (6)

Asansol-Kanigunj, Barrackpore, Durgapur, Haldia, Howrah, Kolkata

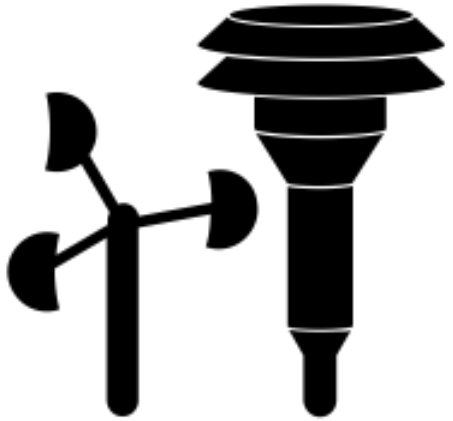
Jharkhand (3)

Dhanbad, Jamshedpur, Ranchi

Other cities

(Africa) Addis Ababa, Kampala, Nairobi, Accra, **(Eastern Europe and Central Asia)** Tashkent, Bishkek, Skopje, Sarajevo, Belgrade, **(Asia)** Bangkok, Hanoi, Dhaka, Kathmandu, and Jakarta

1



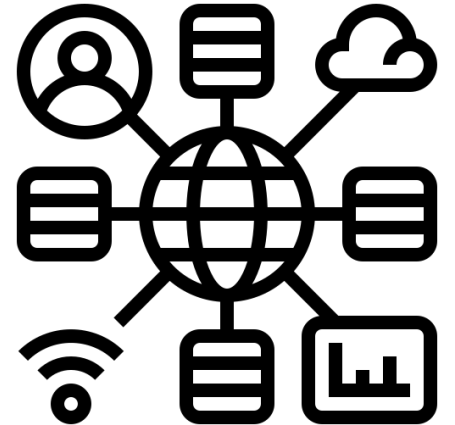
Monitoring

2



Modeling

3

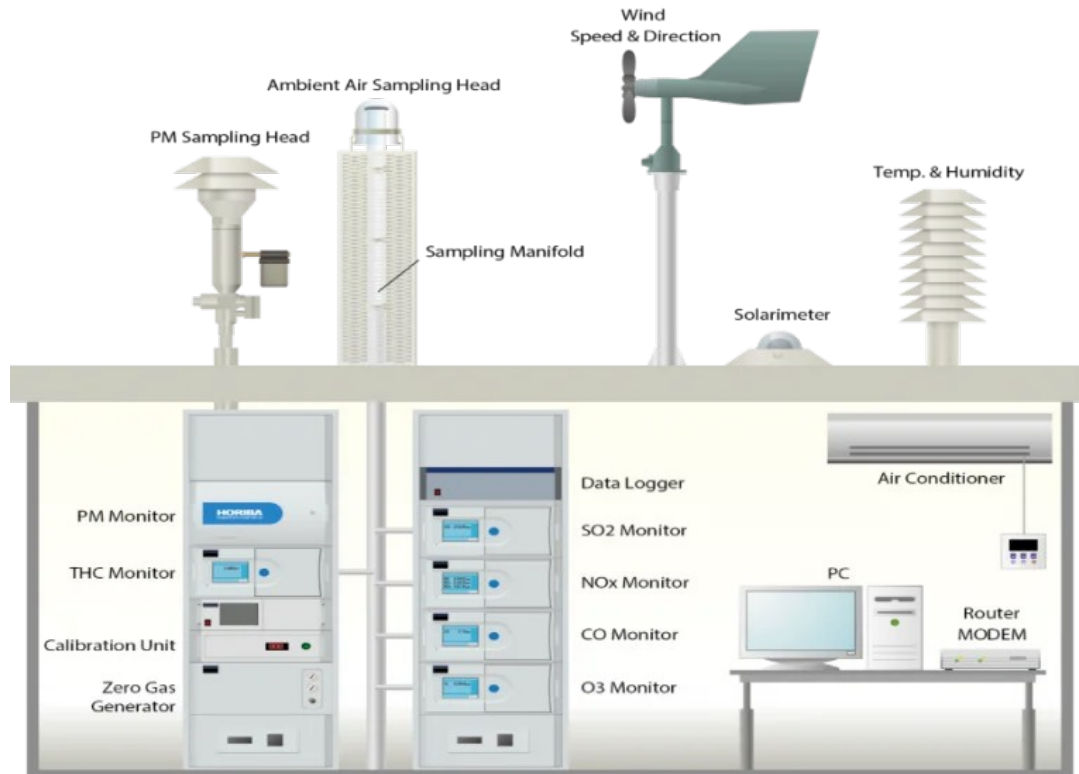


Applications

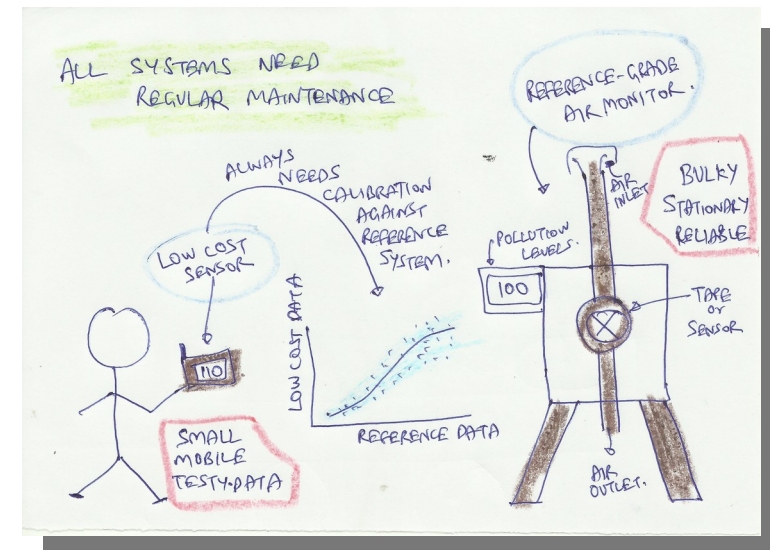
1

Air Quality Monitoring

Traditional

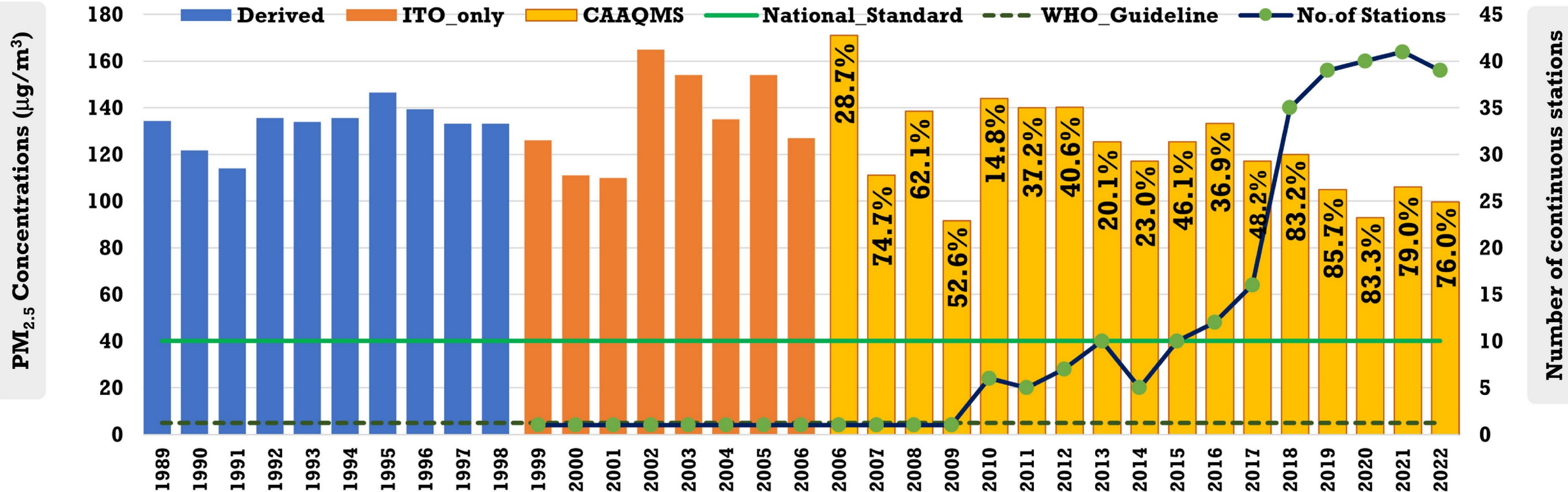


Emerging



WHAT IS POLLUTING DELHI'S AIR? REVIEW FROM 1990 to 2022

% value = % 15-minute data points available in that year



1989 to 1998 data is converted from PM10 concentrations from manual stations. Number of continuous stations measuring PM_{2.5} in Delhi increased from 1 in 1999 to 2006 to 41 in 2021. Within 100km of NCR Delhi there are 70+ stations. Data availability every 15-min in 2019 is 85% -- more than double the average of 2013-17. Post-2018, data availability has been consistently above 80%

Detailed paper is published @ MDPI Sustainability: <https://www.mdpi.com/2071-1050/15/5/4209>
 Data sourced from <https://app.cpcbcr.com/ccr/#/caaqm-dashboard-all/caaqm-landing>

1

Satellite retrievals

Delhi: COVID19 lockdowns

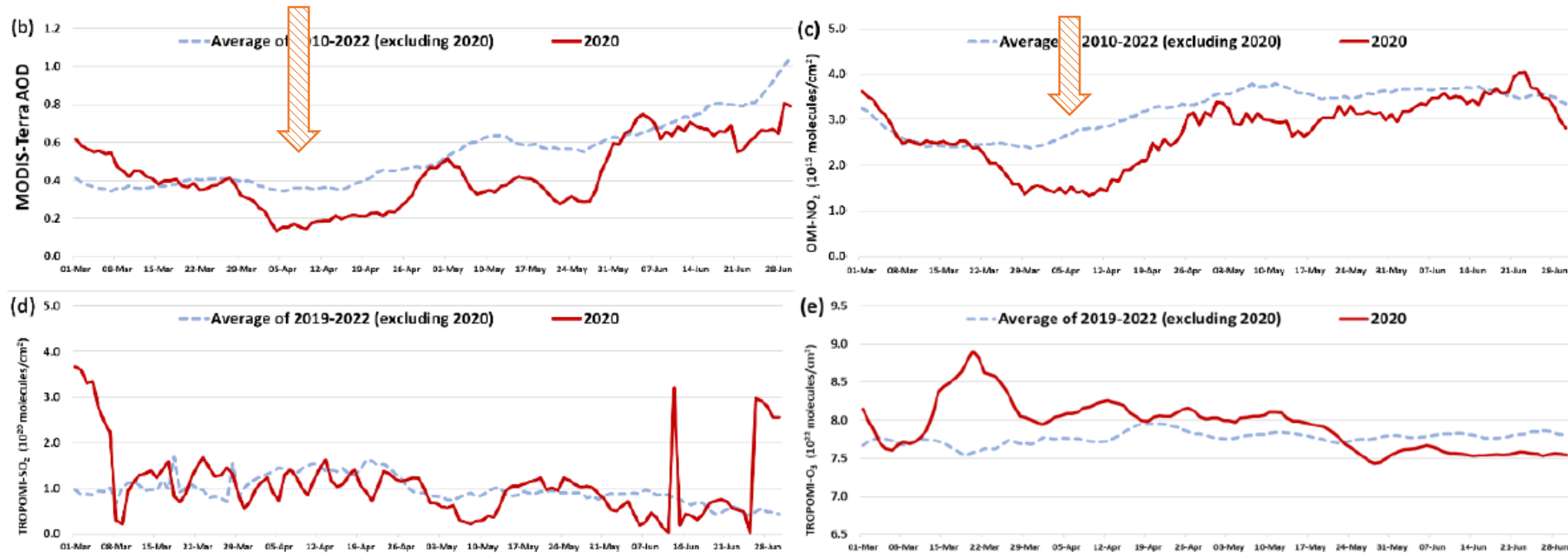


Figure 4. Summary of satellite data retrievals as an 8-day running mean of the area covering Delhi's airshed. (a) NASA MODIS-Terra AOD for all years and all days to illustrate long-term trends. For the period of 1 March to 30 June in specific, (b) NASA MODIS-Terra AOD, (c) NASA OMI NO₂, (d) ESA TROPOMI SO₂, and (e) ESA TROPOMI ozone, illustrating changes during 2020's COVID-19 lockdowns. MODIS and OMI data were extracted from NASA's Giovanni open-access database and TROPOMI from Google Earth Engine database.

Mar 2020

Data access (example)



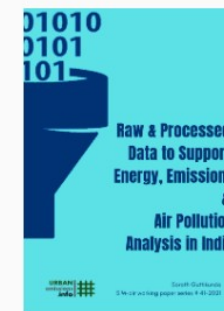
Resource Links for Energy, Emissions & Air Pollution Analysis in India

There is weak institutional capacity to address air pollution in an integrated manner, because there is little in the way of an organized knowledge base that may help support pollution control planning

Here we present a repository of resource links with information directly relevant for energy, emissions, and pollution analysis in India covering

1. Official national and state level portals; guidelines, acts, and rules documents
2. Ambient air quality monitoring
3. Satellite retrievals and tools
4. Global and regional health impact analysis and tools
5. Compiled statistics, maps, and other geospatial databases
6. Compiled databases on energy, emissions, meteorology, and reanalysis fields
7. Compiled statistics on Indian energy sectors

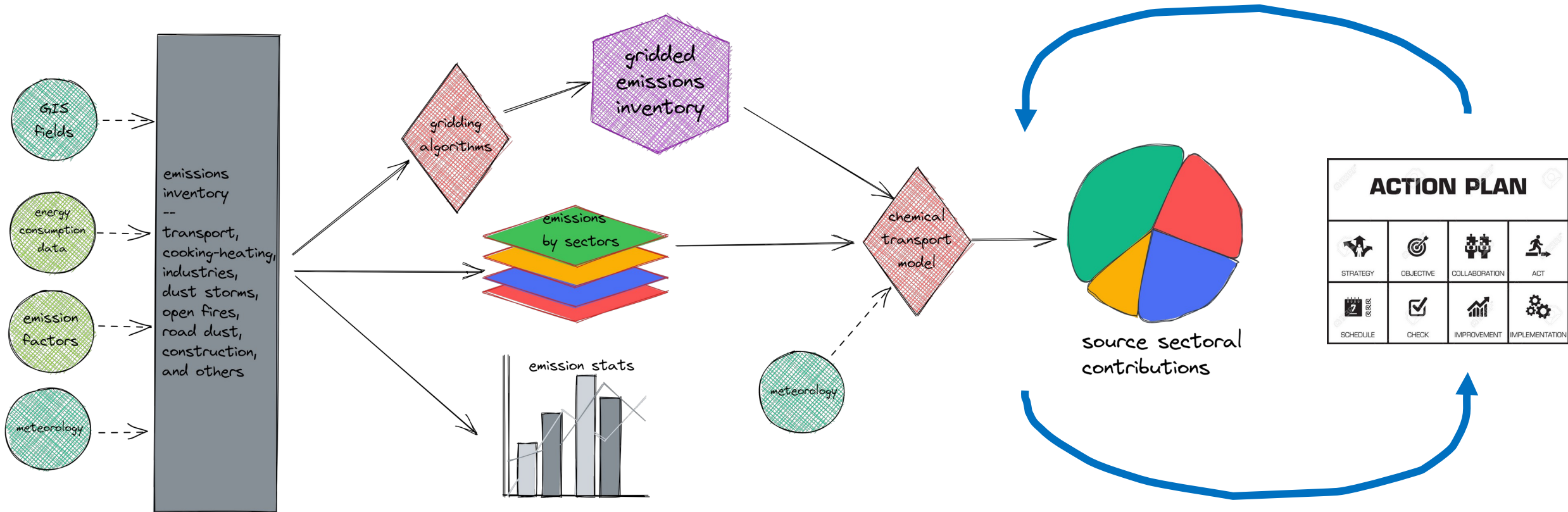
This list was last updated in January 2021. Click on the image to download all the links as a PDF working paper.



Challenges – make it simple to access and use

2

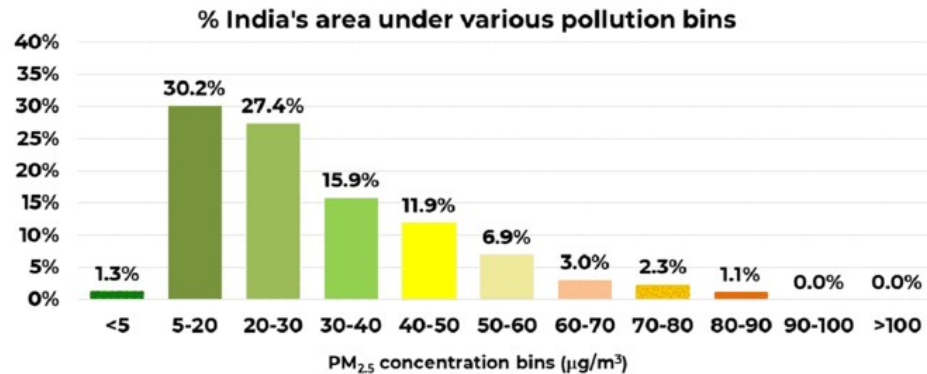
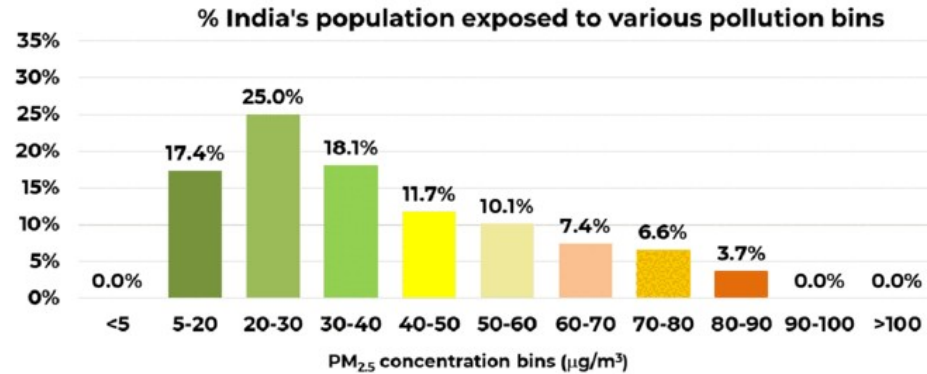
Air Quality Modeling



Challenges – computational & personnel capacity (biggest) and data access

Global Reanalysis Fields

India Air Quality Information - Reanalyzed PM_{2.5} Concentrations Year 1998



India Annual Standard = 40 µg/m³
WHO Annual Guideline = 5 µg/m³

* Map represents states and union territories from 2011 census and bifurcation of Andhra Pradesh. Map of Jammu & Kashmir includes Ladakh.
** Global historical reanalysis data as annual and monthly averages is accessible @ <https://sites.wustl.edu/acag/datasets/surface-pm2-5>

2

Urban-centric APnA program



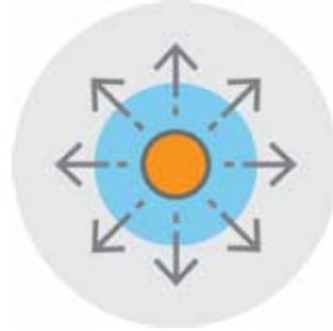
Compile an emissions inventory covering major sources for each city



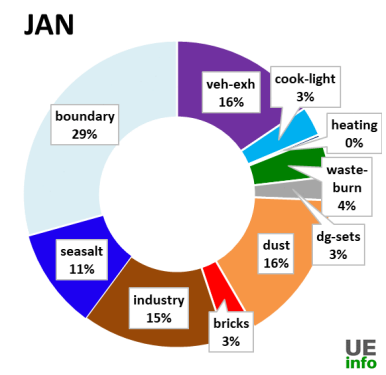
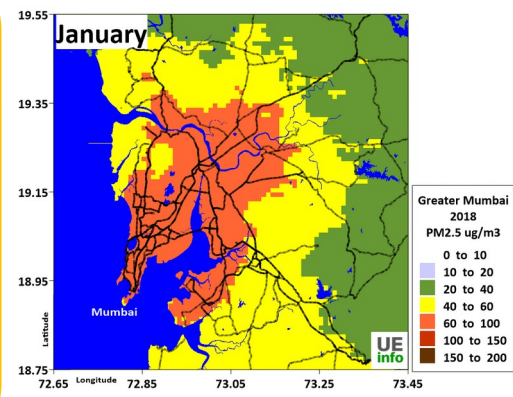
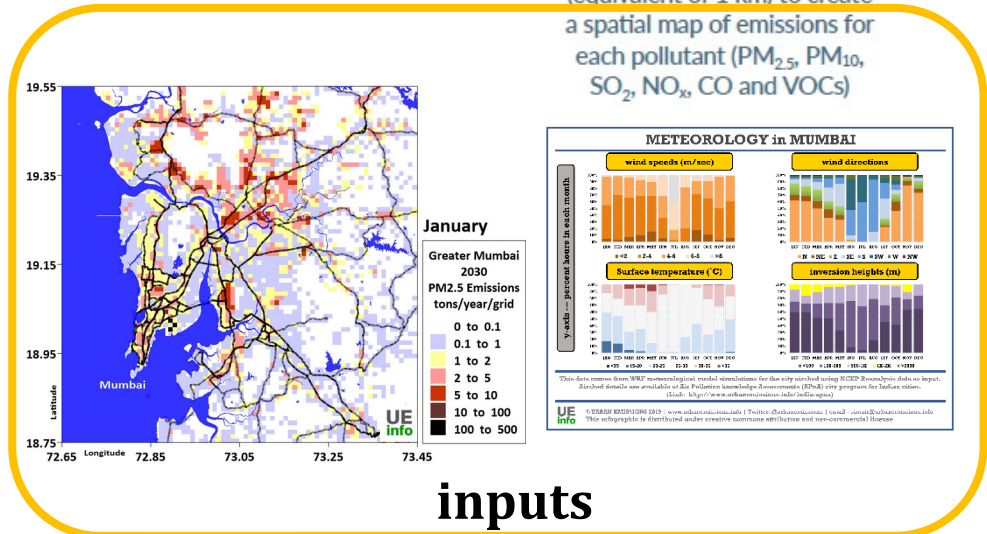
Spatially grid the emission inventory at a 0.01° grid resolution in longitude and latitude (equivalent of 1 km) to create a spatial map of emissions for each pollutant (PM_{2.5}, PM₁₀, SO₂, NO_x, CO and VOCs)

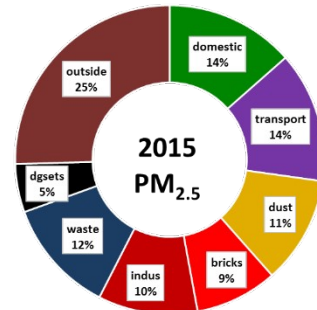
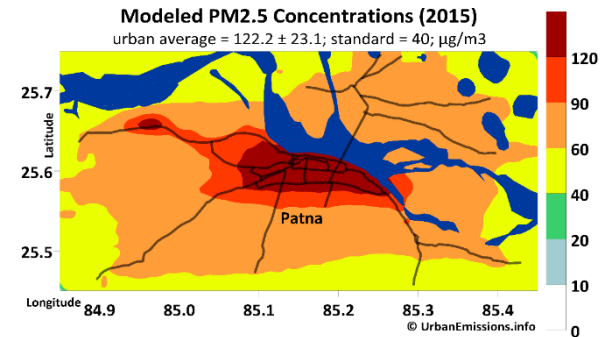


Use WRF meteorological model to construct meteorological fields



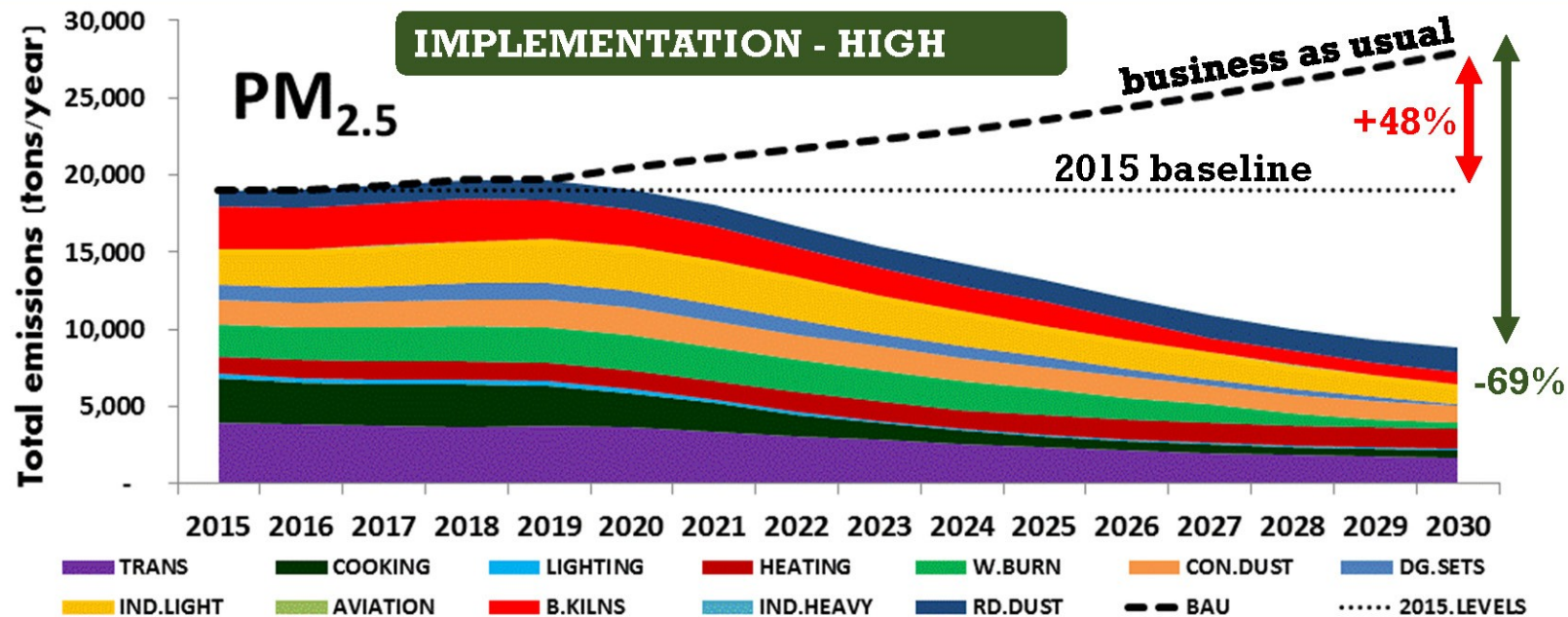
Use a dispersion model to estimate concentration of pollutants by source for each city



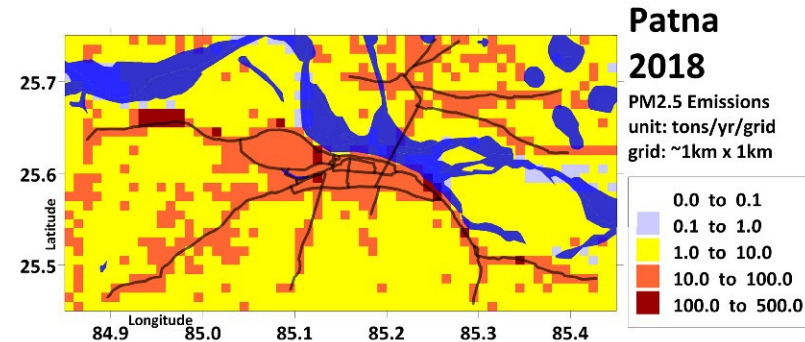


- Domain size – 60km x 30km
- Meteorology at fine resolution from WRF (driven by NCEP fields)
- Dispersion modeling via CAMx chemical transport model
- “Outside” is the influence of boundary conditions driven by the dispersion results based on national emissions inventory (<http://www.urbanemissions.info>)

WHAT-IF EMISSIONS ANALYSIS for PATNA

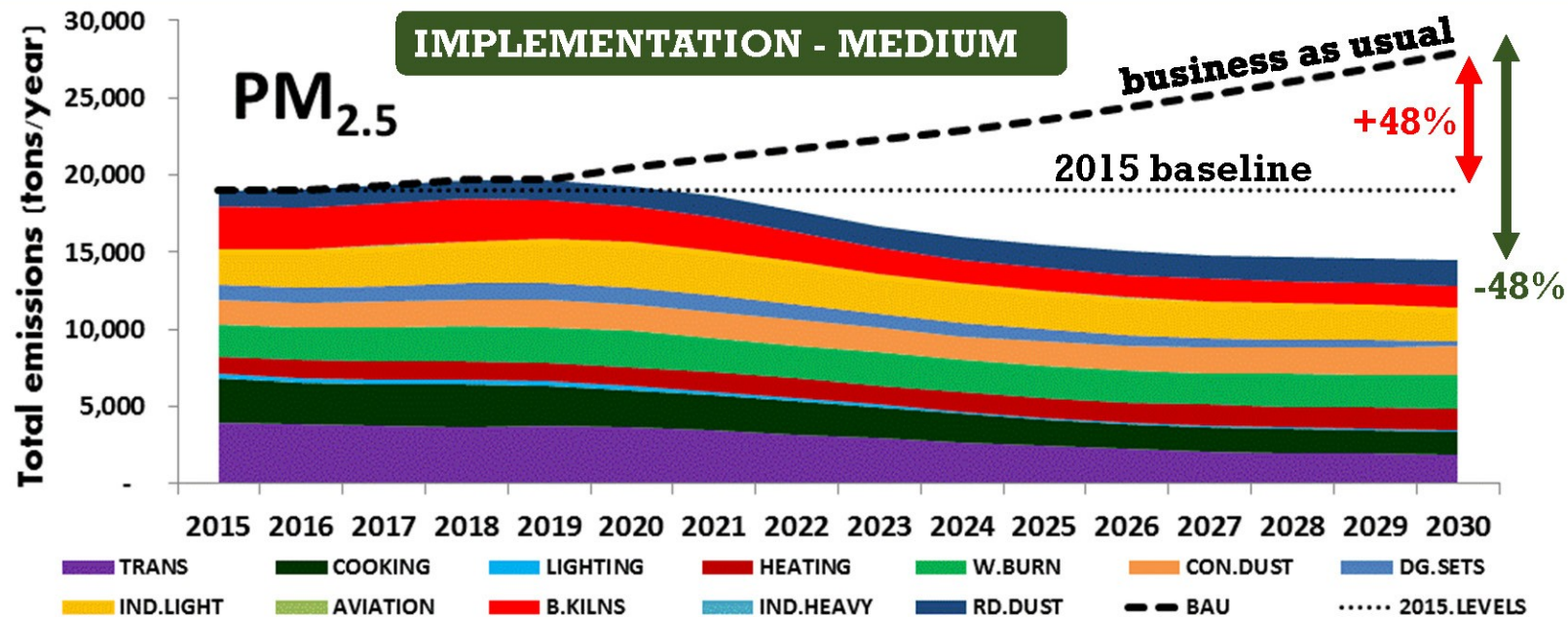


control options analyzed -- Introduction of BS6 in 2020 ** CNG/EV for private/bus/3W ** 10% reduction in private VKT ** DPF retrofit for HDV/LDV ** PUC enforcement; Control on-road silt loading ** Control construction site dust ** Gas/Electricity for industries ** Zig-zag for all brick kilns ** Promotion of alternate bricks ** Control open-waste burning ** LPG/clean-chulas for cooking ** Clean heating for winters ** No kerosene/low Gen-Sets

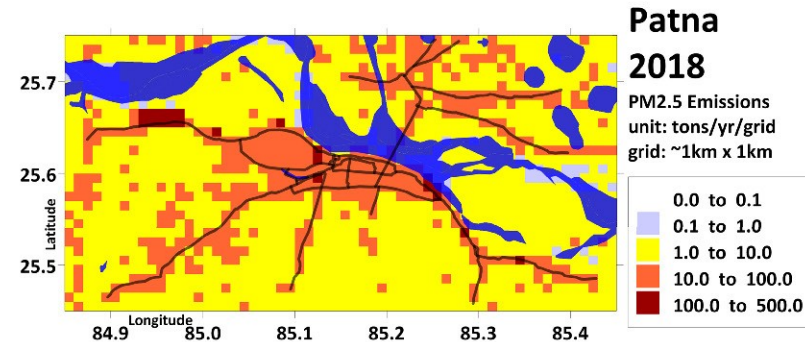


visit <http://www.urbanemissions.info> for emission inventory methodologies & data resources

WHAT-IF EMISSIONS ANALYSIS for PATNA

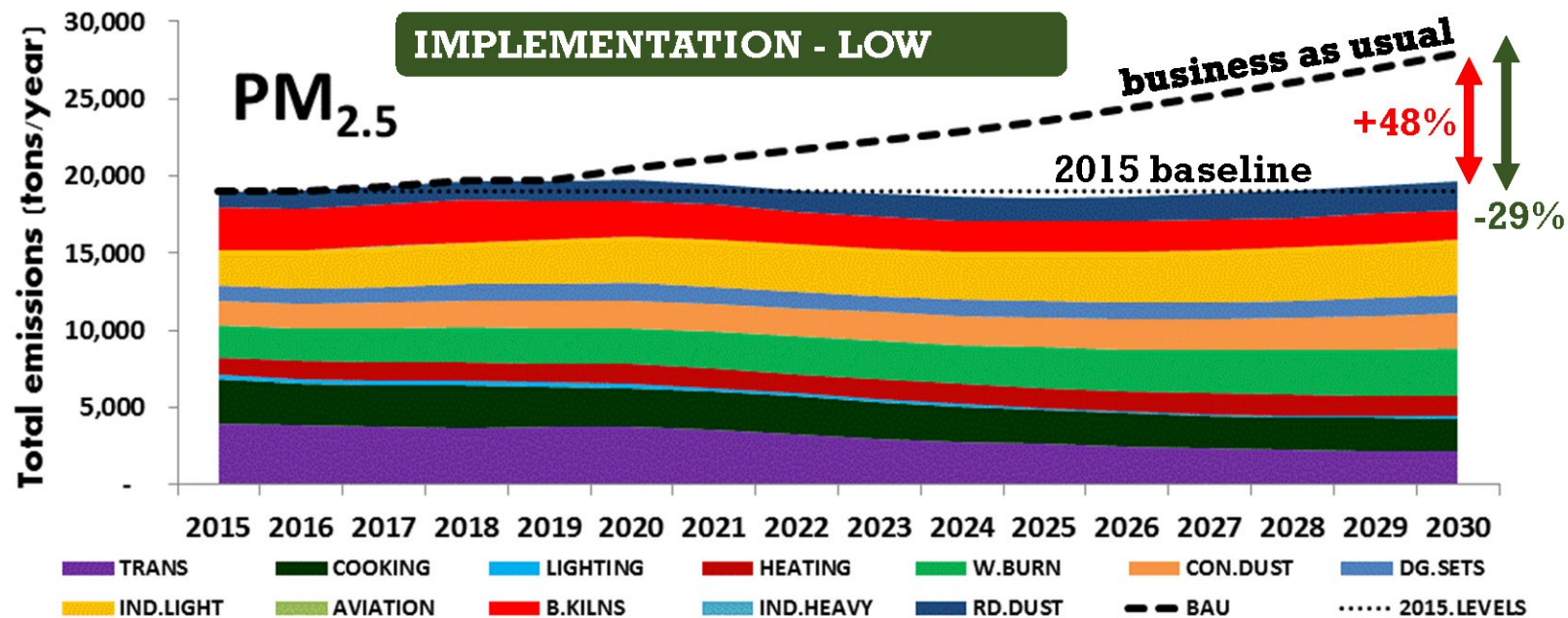


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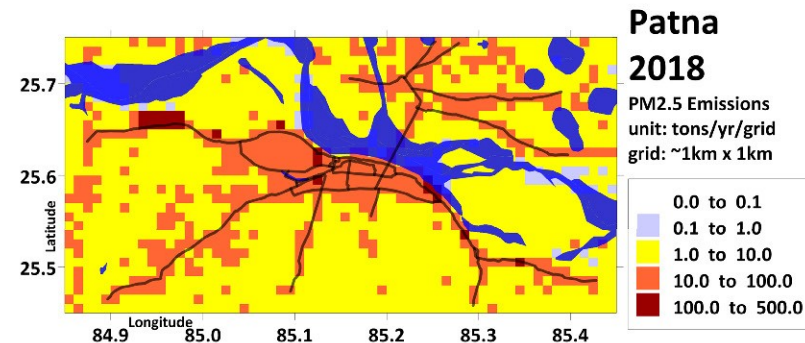


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visit <http://www.urbanemissions.info> for emission inventory methodologies & data resources

COAL KILLS

An Assessment of Death and Disease caused by India's Dirtiest Energy Source



[Printer friendly Page](#)



[Email this page](#)

Ministry of Health and Family Welfare 13-August, 2013 14:59 IST

Health Hazards from Emission in Coal-Fired Power Plants

Government is aware of the report titled "Coal kills- An assessment of death and disease caused by India's dirtiest energy source" which was jointly published by Conservation Action Trust (a non-profit organization), Urban emission (air pollution research firm) and Greenpeace India in Dec 2012. The report shows that in 2011-2012, emission from Indian coal plants resulted in 80,000 to 1,15,000 premature deaths and more than 20 million asthma cases from exposure to air pollution. The study quantified additional health impacts such as large number of cases of heart attacks, emergency room visits, hospital admission and lost workdays caused by coal based emissions. The study estimates that monetary cost associated with these health impacts exceeds Rs. 16,000 to 23,000 crores per year.

Central Electricity Authority (CEA) has informed that Ministry of Power has constituted a Standing Committee on occupational health and safety of workers of thermal power plants. The committee has members from various stake holders.

new standards ratified in December 2015
deadline for compliance December 2017

Supreme Court seeks govt's reply on toddlers' cracker ban plea

A bench headed by chief justice HL Dattu issued notices to the Delhi government, Delhi Pollution Control Board and the Centre seeking their response by October 16.



Harish V Nair | Posted by Arunava Chatterjee
New Delhi, October 9, 2015 | UPDATED 13:28 IST

A +



Diwali cracker ban plea

Arjun Gopal, Aarav Bhandari and Zoya Rao Bhasin, all aged between 6 and 14 months, w
knocked the doors of the Supreme Court seeking immediate steps to curb Delhi's fatal a

Capital's children in harm's way



7.7 mn

No. of vehicles in Delhi until 2012-13 against Beijing which has 5.2 million vehicles

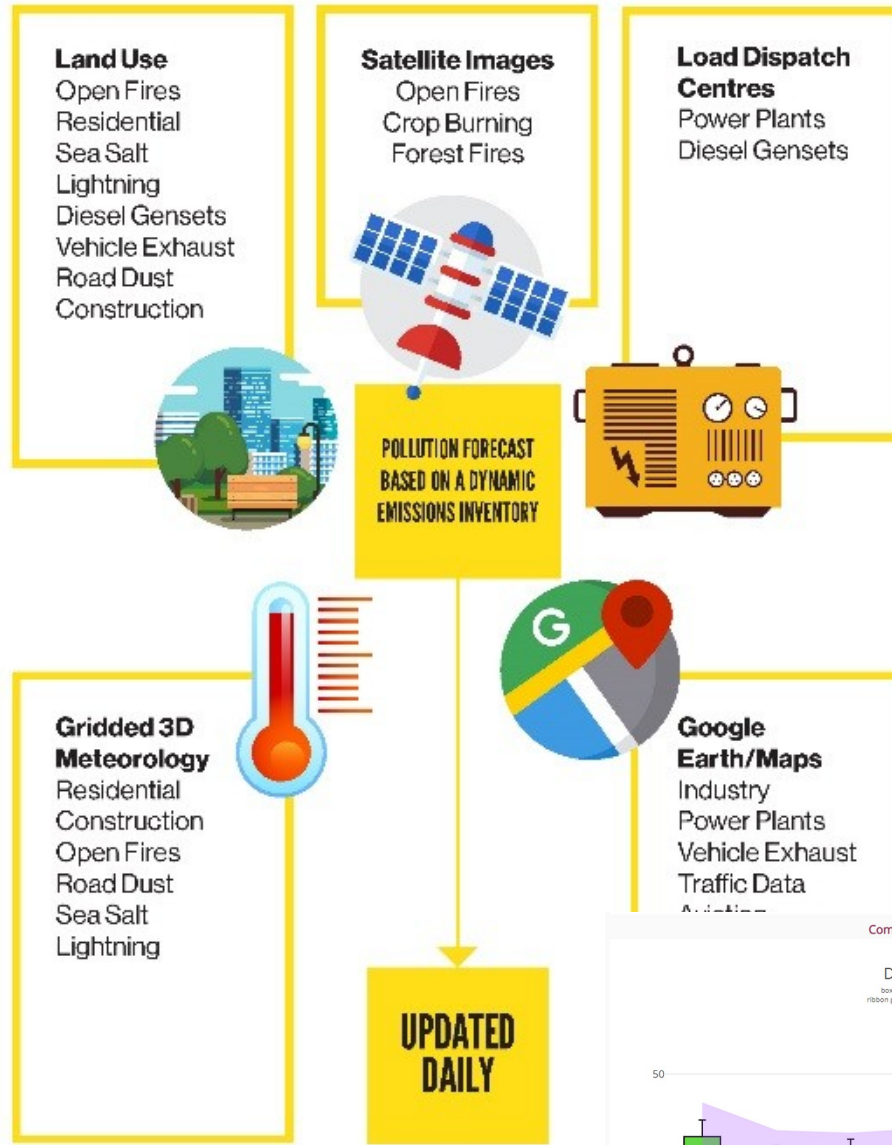
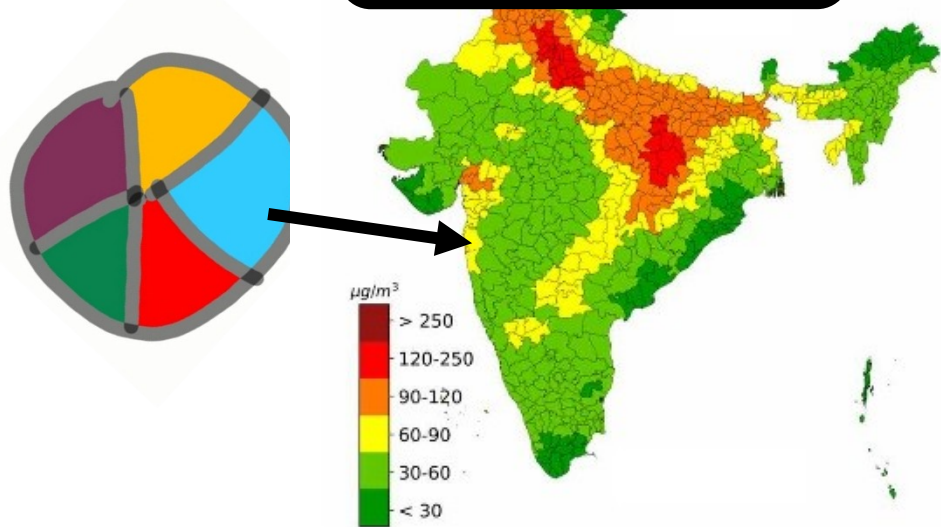
985 $\mu\text{g}/\text{m}^3$

Was the level of PM 2.5 in Delhi on December 16, 2013. Beijing's daily PM 2.5 level for 2013 never exceeded 400 $\mu\text{g}/\text{m}^3$ and averaged around 250 $\mu\text{g}/\text{m}^3$. In Delhi however, it averages around 500 $\mu\text{g}/\text{m}^3$

TOMORROW'S AIR QUALITY INFORMATION. TODAY.

www.indiaairquality.info

Since 2016



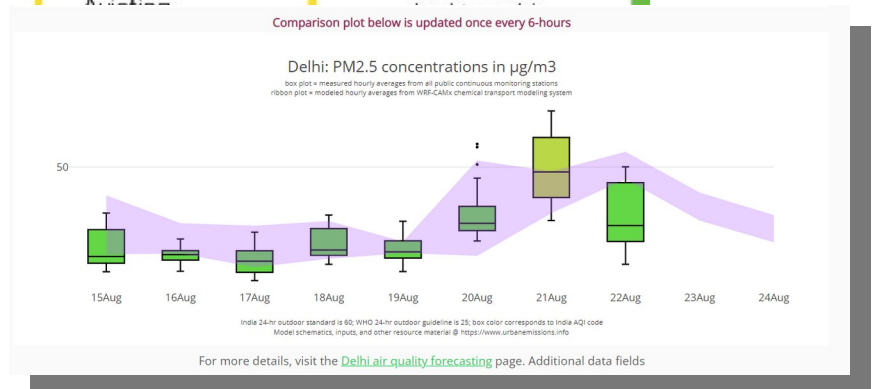
URBAN emissions.info

Coverage
640 districts in India

Forecast period
next 3 days

Criteria pollutants
PM2.5, PM10, SO₂, NO_x, CO, Ozone

Dispersion model
CAMx with full



India National Clean Air Programme (NCAP)

23 states – 122 cities – 92 action plans – 4711 action points

2020

Summary of action points by theme



All transport modes

38%



All industry, including power

15%



Waste management

11%



Household cooking

2%



Road dust management

13%



Construction debris management

8%



Ambient monitoring & public awareness

6%



Others

7%

Summary by type



Institutional

74%



Physical

24%



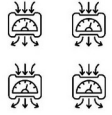
Economic

2%

Access date : 2019-Nov-25

ESTABLISHING AN AIRSHED'S AIR QUALITY BASELINE

TOP-DOWN APPROACH



Network of reliable and continuous monitoring stations with a representative mix of locations across the airshed.



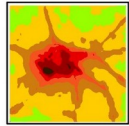
Data management center for processing, QA/QC, archiving and dissemination for open release.



A
Q
I



URBAN
emissions
.info



Concentrations of all criteria pollutants at required spatial and temporal resolutions.



Chemical transport and meteorological models (require large server, storage, and processing capacity).



Emission inventories (including natural sources) and meteorological data at required spatial and temporal resolutions.



Activity data and emission factors of all known sources burning coal, diesel, petrol, gas, biomass, and waste and dust.



BOTTOM-UP APPROACH

Thank you..

Visit us @ Booth#2