Addressing Climate and Air Quality in India and the United States

NRDC

Vijay Limaye
Senior Scientist, NRDC

Health Effects Institute Annual Conference
2 May 2023

This work was supported by the Wellcome Trust [#216093/Z/19/Z]

Climate-Linked Threats to Health in India

- Indian cities face serious and intensifying health risks from climate change, extreme heat & air pollution

- National policy responses to address these threats are underway:
  - **Climate change targets**
  - **Heat Action Plans and cool roofs**
  - **India Cooling Action Plan**
  - **National Clean Air Programme**

India to update climate commitment with 50% renewable power mix pl

Heatwave Pangs: Why Heat Action Plans Are Need Of The Hour In India

The first Heat Action Plan (HAP) was designed and implemented
experiencing severe and prolonged heatwave conditions this year
implementation of HAPs have become essential.

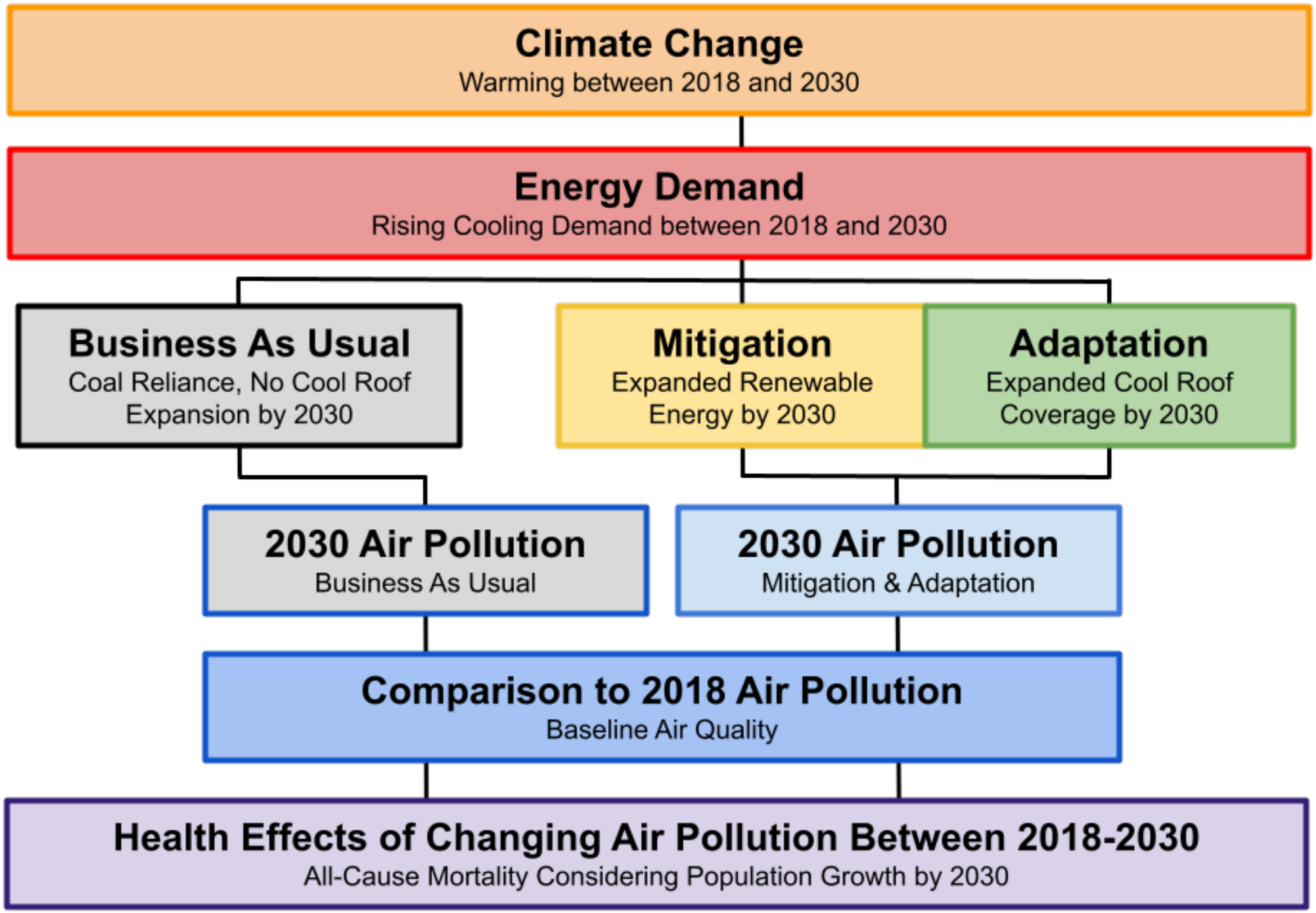
Ministry of Environment, Forest and Climate Change

India Cooling Action Plan Launched

National Clean Air Programme: Centre aims at 40% reduction in particulate matter by 2026

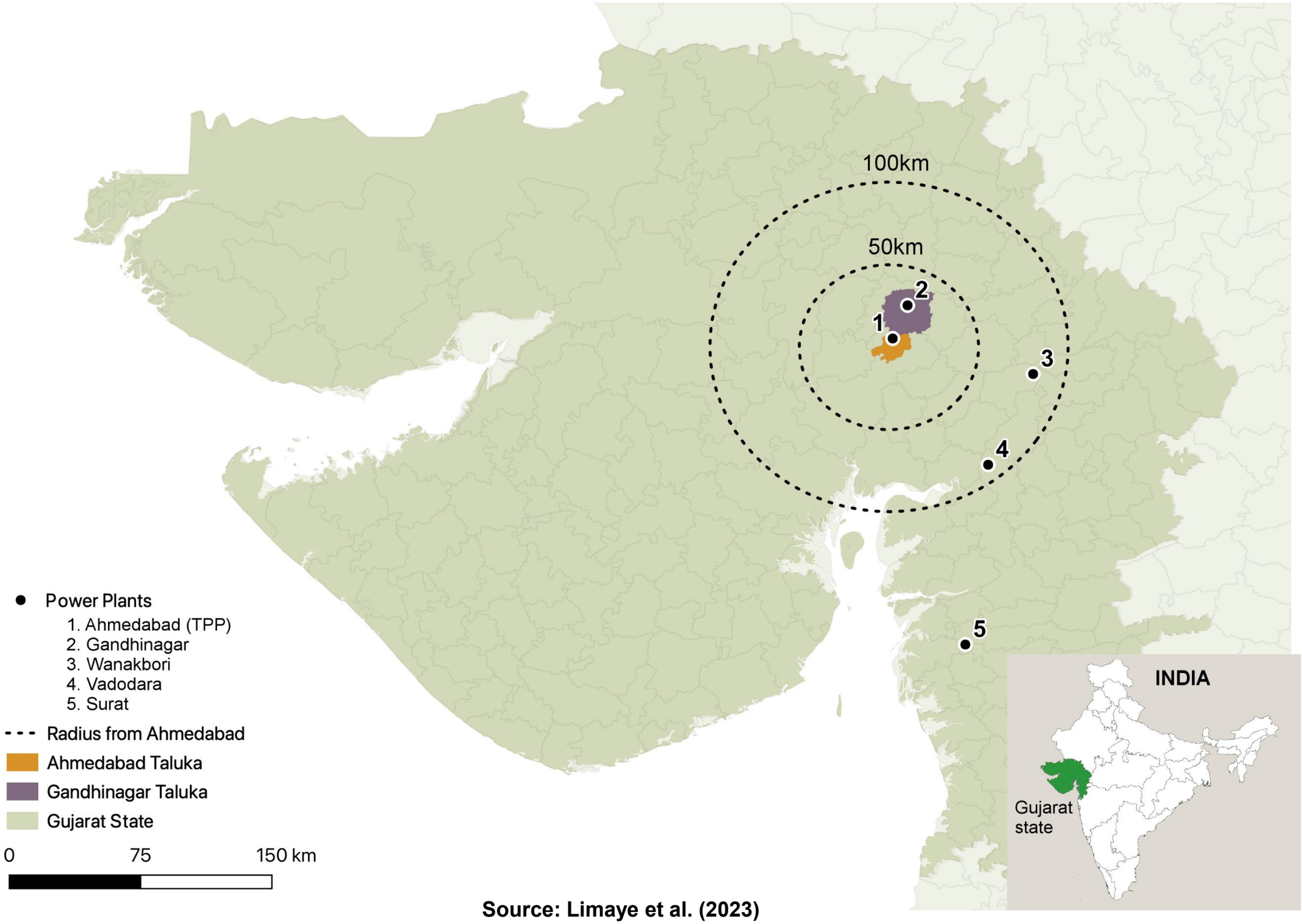
What are the local benefits of mitigation and adaptation actions for air quality and health?

Approach



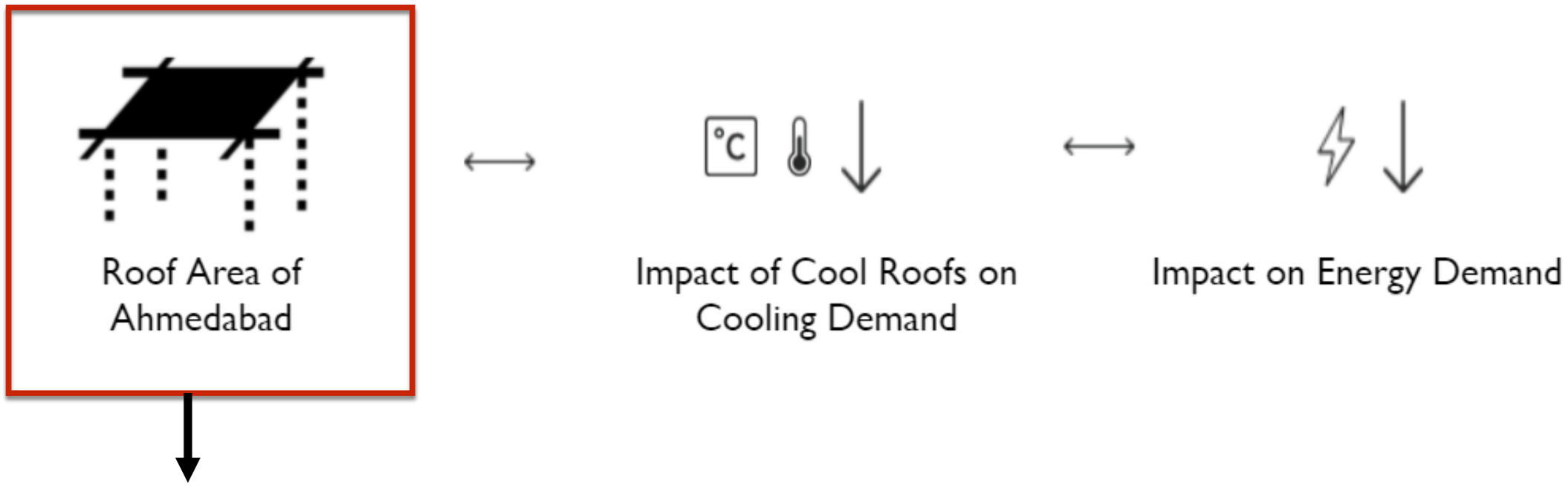
Source: Limaye et al. (2023)

Study Area



Source: Limaye et al. (2023)

Climate Change & Energy Demand: Methods



Plot Area - 1,32,320 square meter

Roof Area - 52,916.2 square meter

Source: Joshi et al. (2022)

Climate Change & Energy Demand: Results

	2018 Baseline	2030 BAU	2030 M&A
Average Temperature (°C)	27.58	28.39	28.39
Wind Speed at 10m (m/s)	3.58	3.38	3.38
Relative Humidity at 2m (%)	55.13	53.10	53.10
Additional Cool Roof Area Coverage from 2018 (km^2)	-	0	20.60
Torrent Power Plant (TPP) Power Supply (TWh)	1.70	2.10	0
Renewable Energy Supply to Ahmedabad (TWh)	0.73	6.63	8.73
Ahmedabad Cooling Electricity Demand (TWh)	1.46	4.22	4.01

Under BAU, coal energy supply increases slightly. With mitigation, renewables can make up for energy supplied to city.

Source: Limaye et al. (2023)

Climate Change & Energy Demand: Results

	2018 Baseline	2030 BAU	2030 M&A
Average Temperature (°C)	27.58	28.39	28.39
Wind Speed at 10m (m/s)	3.58	3.38	3.38
Relative Humidity at 2m (%)	55.13	53.10	53.10
Additional Cool Roof Area Coverage from 2018 (km^2)	-	0	20.60
Torrent Power Plant (TPP) Power Supply (TWh)	1.70	2.10	0
Renewable Energy Supply to Ahmedabad (TWh)	0.73	6.63	8.73
Ahmedabad Cooling Electricity Demand (TWh)	1.46	4.22	4.01

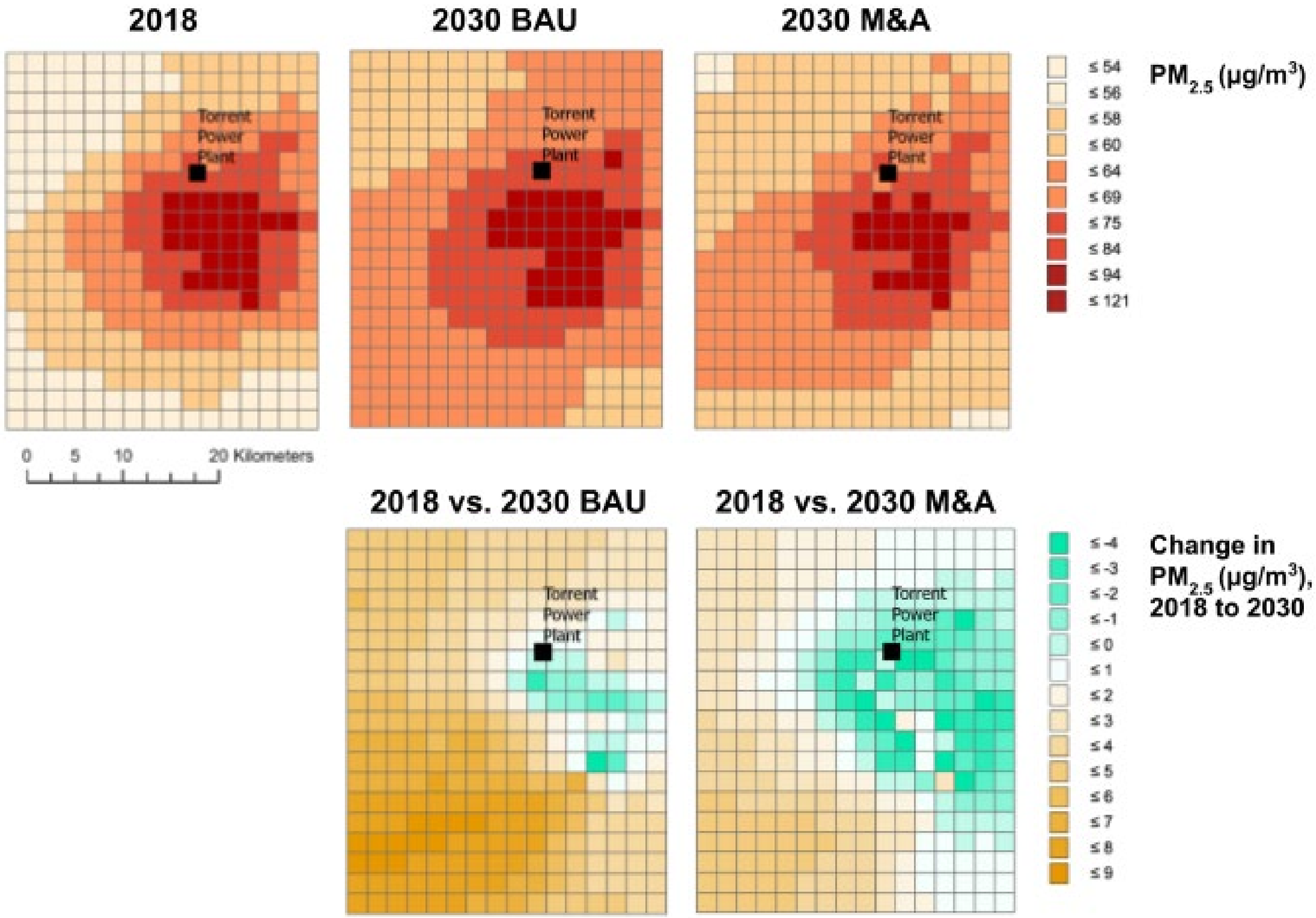
Under BAU, cooling energy demand increases by a factor of 2.9. With cool roof adaptation, cooling energy demand reduced by 0.21 TWh

Source: Limaye et al. (2023)

Air Quality Modeling: Methods

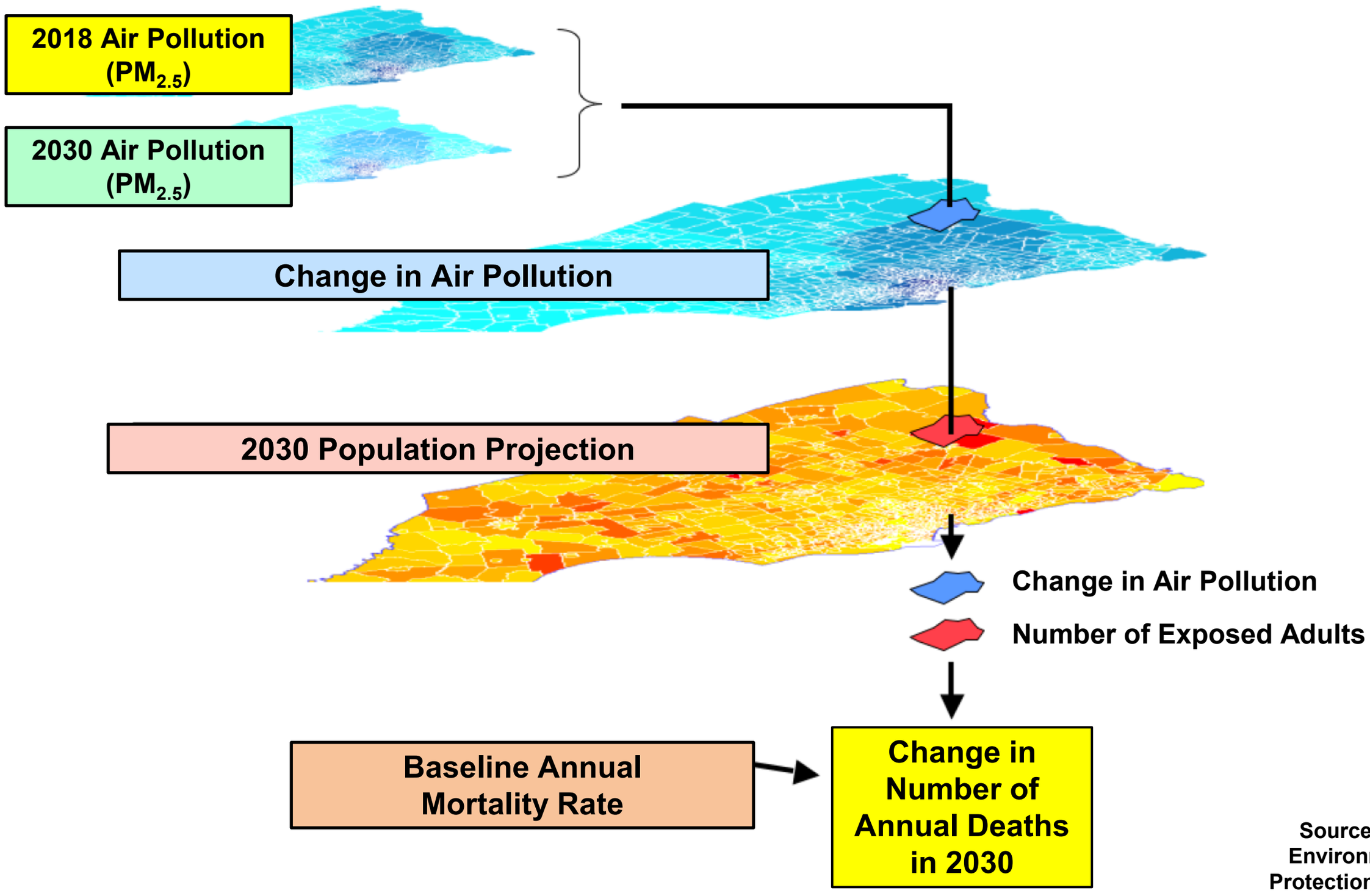
Scenario	Energy Sector Emissions (Mitigation)	Cool Roofs (Adaptation)
2018 Baseline	• Direct estimate of TPP emissions in 2018 • Apply 2018 meteorology and boundary conditions	• Estimate current cooling energy demand from buildings, consistent with 5% cool roof area coverage
2030 Business-As-Usual (BAU)	• Climate change affects ambient temperatures and cooling energy demand • 2030 meteorology and boundary conditions • **Adjust coal power plant emissions to reflect slight growth relative to 2018**	• Estimate current cooling energy demand from buildings, consistent with 5% cool roof area coverage
2030 Mitigation and Adaptation (M&A)	• Climate change affects ambient temperatures and cooling energy demand • 2030 meteorology and boundary conditions • **Eliminate coal power plant pollution emissions and assume additional Ahmedabad city power demand met by renewable energy sources**	• **Assume total of 20% cool roof area coverage (15% beyond the 5% baseline in 2018) leads to reduction in cooling energy demand from buildings**

Air Quality Modeling: Results



Source: Limaye et al. (2023)

BenMAP Health Impact Estimates: Methods



Source: U.S. Environmental Protection Agency

BenMAP Health Impact Estimates: Methods

	2018 Baseline	2030 BAU	2030 M&A
BenMAP-CE Inputs			
Population (age 0-99)	**8.46 million**	**9.31 million**	**9.31 million**
Annual Daily Average $PM_{2.5}$ ($\mu g/m^3$, manually weighted)	**63.40**	**65.50**	**64.90**
Annual Daily Average $PM_{2.5}$ ($\mu g/m^3$, population weighted)	**71.04**	**75.18**	**70.93**
Change in $PM_{2.5}$ (% change) from 2030 to 2018 ($\mu g/m^3$, population weighted annual average)	-	**+4.13** (+5.81%)	**-0.11** (-0.15%)
Pope et al. 2015 All-cause mortality, age 30-99 (95% CI)	-	**+1,389** (1,092, 1,681)	**-25** (-22, -28)
Turner et al. 2016 All-cause mortality, age 30-99 (95% CI)	-	**+1,193** (793, 1,585)	**-23** (-18, -27)
Burnett et al. 2018 Non-accidental mortality, age 25-99 (95% CI)	-	**+870** (648, 1,088)	**-52** (-38, -66)

Mitigation & Adaptation actions result in 922-1,414 fewer deaths in 2030 compared to a Business-As-Usual 2030 scenario.

Source: Limaye et al. (2023)

Policy Recommendations

- Substituting renewable energy for highly polluting fossil fuels benefits health

- Indian cities can quantify adaptation benefits

- Decisionmakers in India should consider air quality and health effects of climate and energy policies

- Interdisciplinary approaches can identify ways to reduce climate threats to health

Policy Applications and the U.S. Experience

Health as the focus of air pollution policy

PREMIUM

Health must be turned into a feature and eventually a function of air pollution policy

November 16, 2022 12:15 am | Updated 11:50 am IST

BHARGAV KRISHNA, SAGNIK DEY

COMMENTS SHARE READ LATER

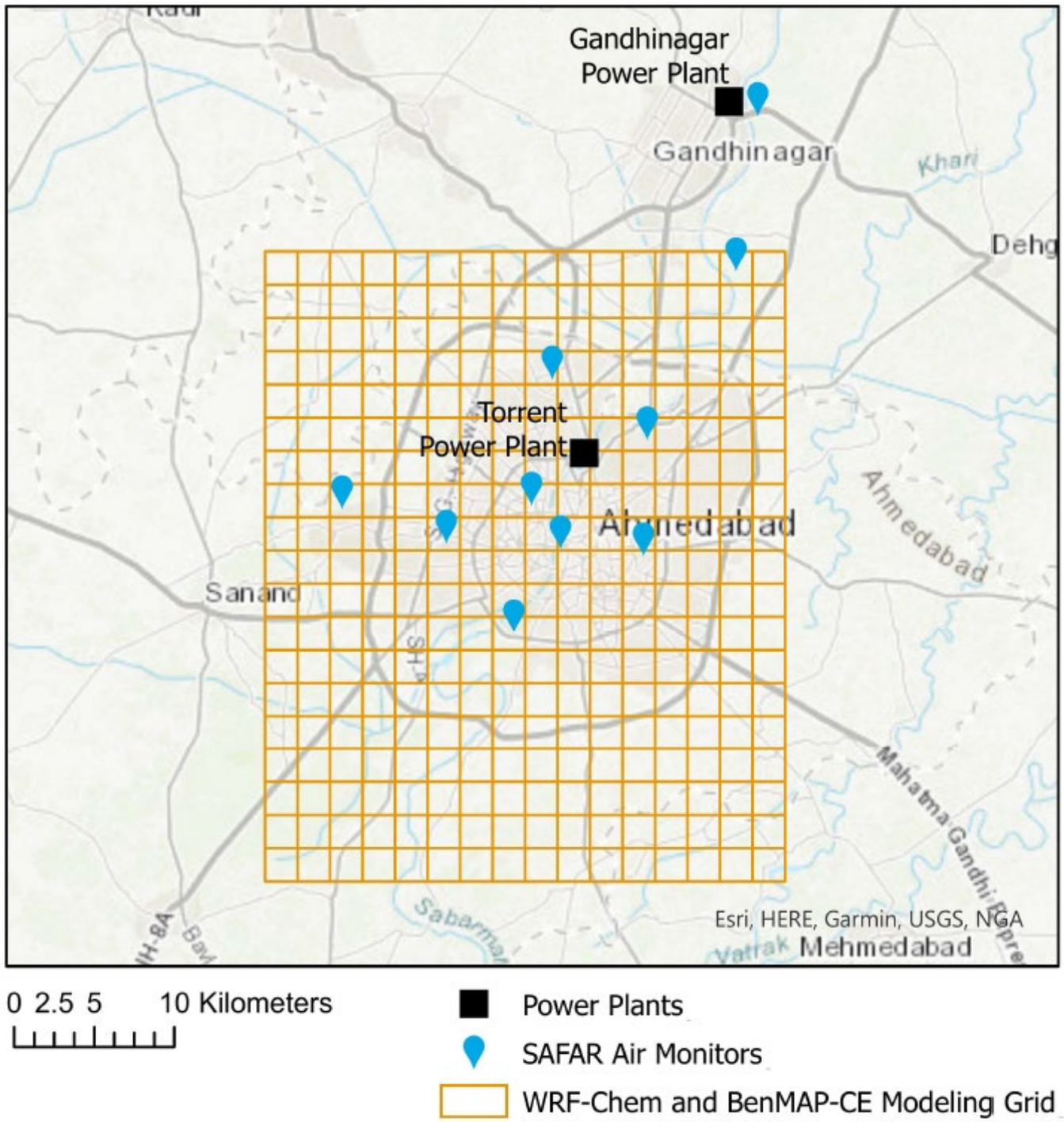
https://www.thehindu.com/opinion/op-ed/making-health-the-focus-of-air-pollution-policy/article66140242.ece

Additional Health Impact Analyses

	2018 Baseline	2030 NCAP	2030 NAAQS	2030 WHO AQG
BenMAP-CE Inputs				
Population (All ages)	**8.46 million**	**9.31 million**		
Annual Daily Average $PM_{2.5}$ ($\mu g/m^3$, population weighted)	**71.04**	**49.73**	**40.00**	**5.00**
$PM_{2.5}$ Change from 2030 to 2018 ($\mu g/m^3$, population weighted annual average)	-	**-21.31**	**-31.04**	**-66.04**
Excess Annual Mortality (95% CI), relative to 2018 Baseline				
Pope et al. 2015 (All-cause, age 30-99)	-	**-6,510** (-5,223, -7,735)	**-9,047** (-7,329, -10,659)	**-17,369** (-14,372, -20,086)
Turner et al. 2016 (All-cause, age 30-99)	-	**-5,655** (-3,870, -7,339)	**-7,904** (-5,485, -10,143)	**-15,364** (-10,986, -19,235)
Burnett et al. 2018 (Non-accidental, age 25-99)	-	**-4,459** (-3,372, -5,500)	**-6,550** (-4,993, -8,023)	**-15,979** (-12,525, -19,111)

Source: Limaye et al. (2023)

Air Monitoring and Modeling Data



Source: Limaye et al. (2023)

India's National Clean Air Programme

For More Information

Journal Articles:

Limaye VS, Magal A, Joshi J, Maji S, Dutta P, Rajput P, et al. Air quality and health co-benefits of climate change mitigation and adaptation actions by 2030: an interdisciplinary modeling study in Ahmedabad, India. *Environmental Research: Health*. 2023. https://doi.org/10.1088/2752-5309/aca7d8

Joshi J, Magal A, Limaye VS, Madan P, Jaiswal A, Mavalankar D, et al. Climate Change and 2030 Cooling Demand in Ahmedabad, India: Opportunities for Expansion of Renewable Energy and Cool Roofs. *Mitigation and Adaptation Strategies for Global Change*. 2022. https://doi.org/10.1007/s11027-022-10019-4

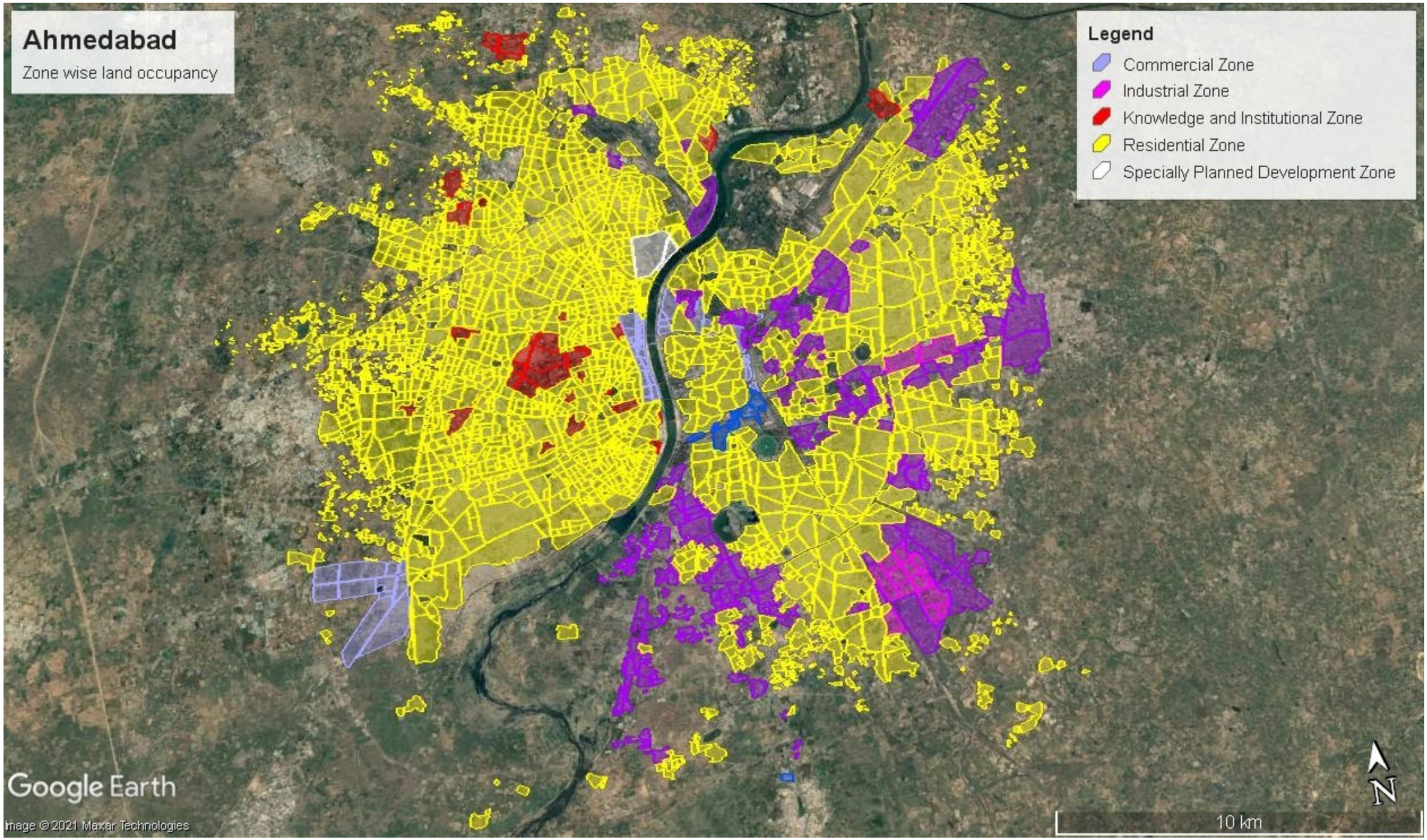
Vijay Limaye
Senior Scientist, NRDC
vlimaye@nrdc.org
nrdc.org/bio/vijay-limaye
@vlimaye

INDIAN INSTITUTE OF PUBLIC HEALTH GANDHINAGAR

GERMI GUJARAT ENERGY RESEARCH AND MANAGEMENT INSTITUTE

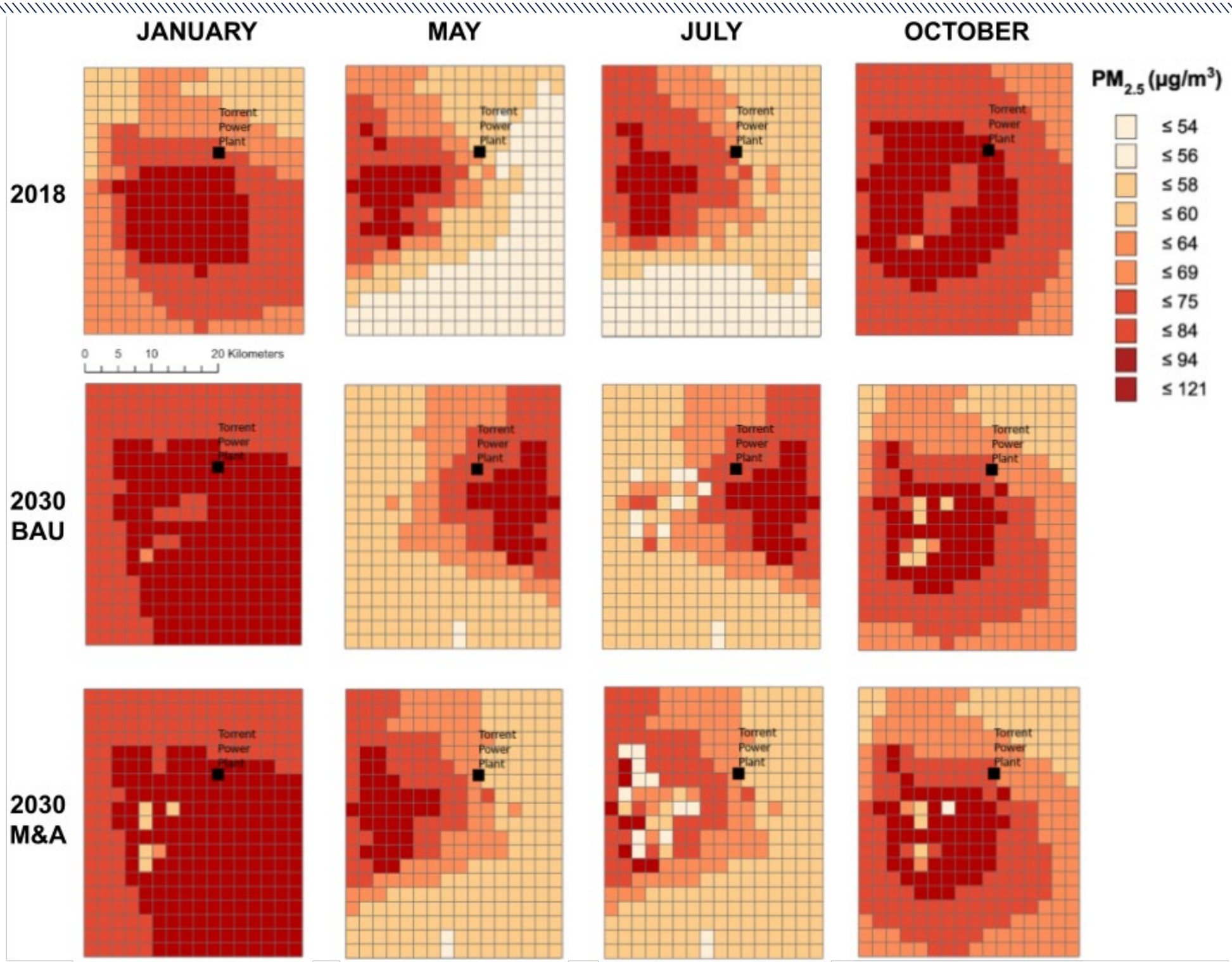
NRDC

Aim 1 Results



Source: Joshi et al. (2022)

Monthly Air Pollution Results



Source: Limaye et al. (2022), in press