



## Calidad de Aire | Air Quality

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Nishka Sharma - Gerente de Investigación y  
Políticas en AQLI

How much longer would you live if you  
breathed clean air?

Discover the Answer



# Air Quality Life Index (AQLI)

A tool for policymakers to  
determine the impacts of air  
pollution on life expectancy

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Energy Policy Institute at the University of Chicago*

Visit: <https://aqli.epic.uchicago.edu/>



## PRESENTATION ROADMAP

### Air Pollution 101

- What is Air Pollution
- Health Effects of Air pollution

### Trends in Central America

### Solutions

- What are some solutions
- Air Quality Management

### AQLI

- What is AQLI
- Background on AQLI

### Spotlight on Guatemala

### Summary



# Air Pollution

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## SOURCES OF AIR POLLUTION ARE A GLOBAL CHALLENGE WE MUST TACKLE TOGETHER



WHO Air Quality Guidelines set goals to protect millions of lives from air pollution.

CLEAN AIR FOR HEALTH

#AirPollution



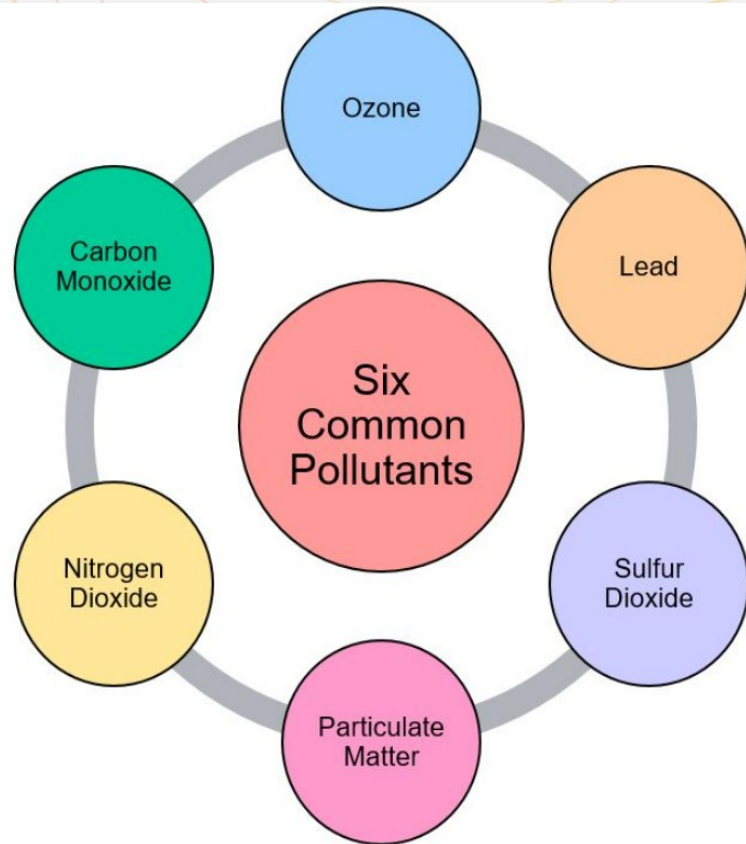
World Health Organization

What is air pollution? Where does it come from?

Pollutants from various sources interact in the atmosphere and have direct and indirect effect on the environment



## What are the main classes of pollutants?



### Six Common Pollutants

The Clean Air Act requires EPA to set national ambient air quality standards (NAAQS) for specific pollutants to safeguard human health and the environment. These standards define the levels of air quality that EPA determines are necessary to protect against the adverse impacts of air pollution based on scientific evidence. EPA has established standards for six common air pollutants, which are referred to as "criteria" pollutants.

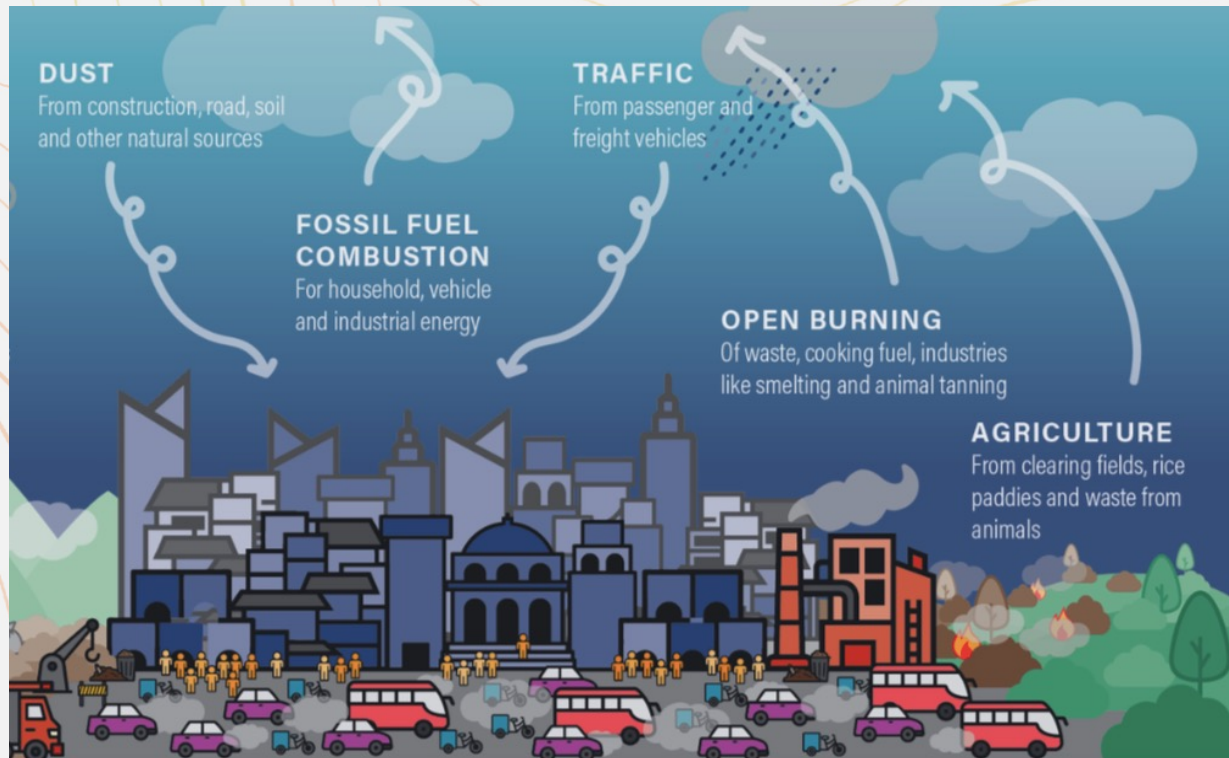
- Carbon monoxide (CO)
- Lead (Pb)
- Nitrogen dioxide (NO<sub>2</sub>)
- Ozone (O<sub>3</sub>)
- Particulate matter (PM), and
- Sulfur dioxide (SO<sub>2</sub>)



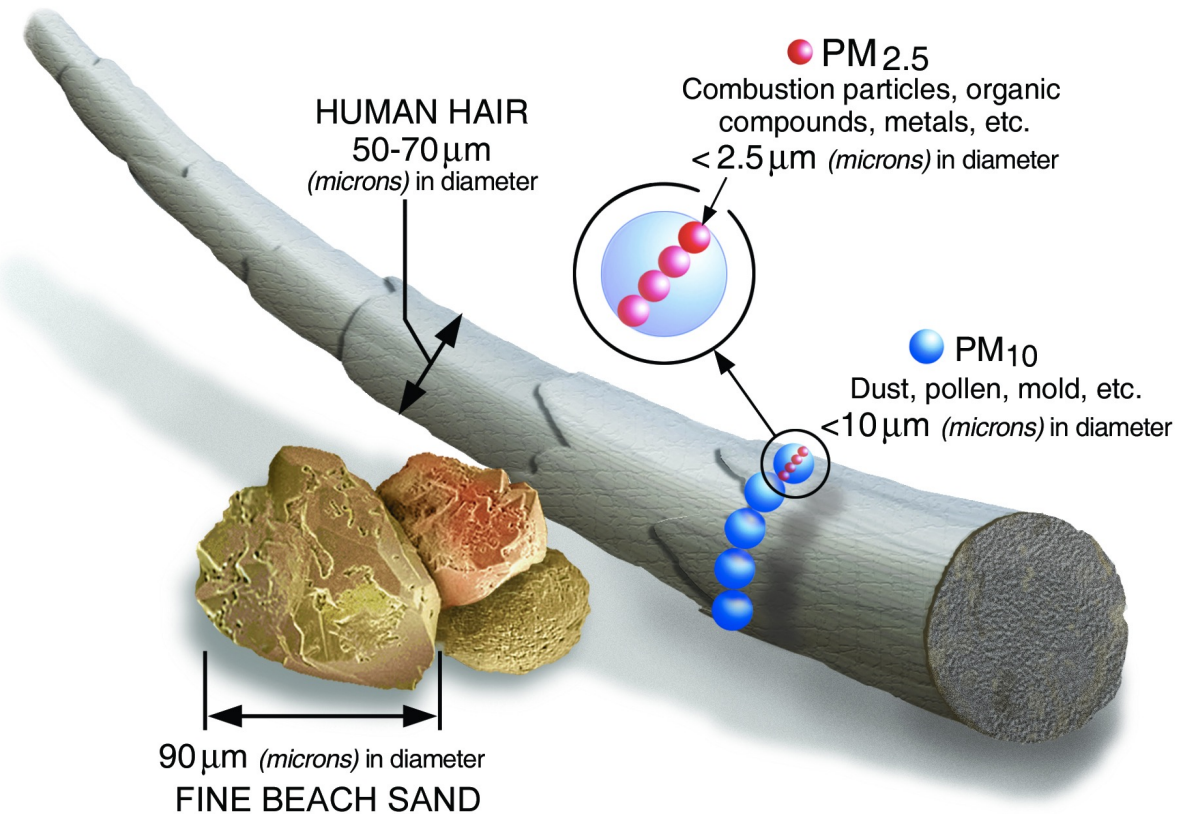
Image Credit: My NASA Data



## What is PM? Where does it come from?



Credit: World Resources Institute



To learn more, visit: <https://aqli.epic.uchicago.edu>



## THE WHO AIR QUALITY GUIDELINES (AQGs) SET GOALS TO REDUCE AIR POLLUTION

They set out to achieve this by:

1

INTERIM TARGETS  
HELP COUNTRIES TO  
CONTINUOUSLY  
IMPROVE AIR QUALITY

2

RECOMMENDING AQG  
LEVELS TO PROTECT  
PEOPLE FROM AIR  
POLLUTION

CURRENT  
LEVELS

INTERIM  
TARGETS

RECOMMENDED  
AQG LEVELS

CLEAN AIR FOR HEALTH

#AirPollution



What is the international community doing to fight air pollution?

World Health Organisation (WHO) has guidelines for air pollution. After 15 years, WHO proposed updated guidelines in 2021. The updated standard is stricter than the previous standard set in 2005





## What is the international community doing to fight air pollution?

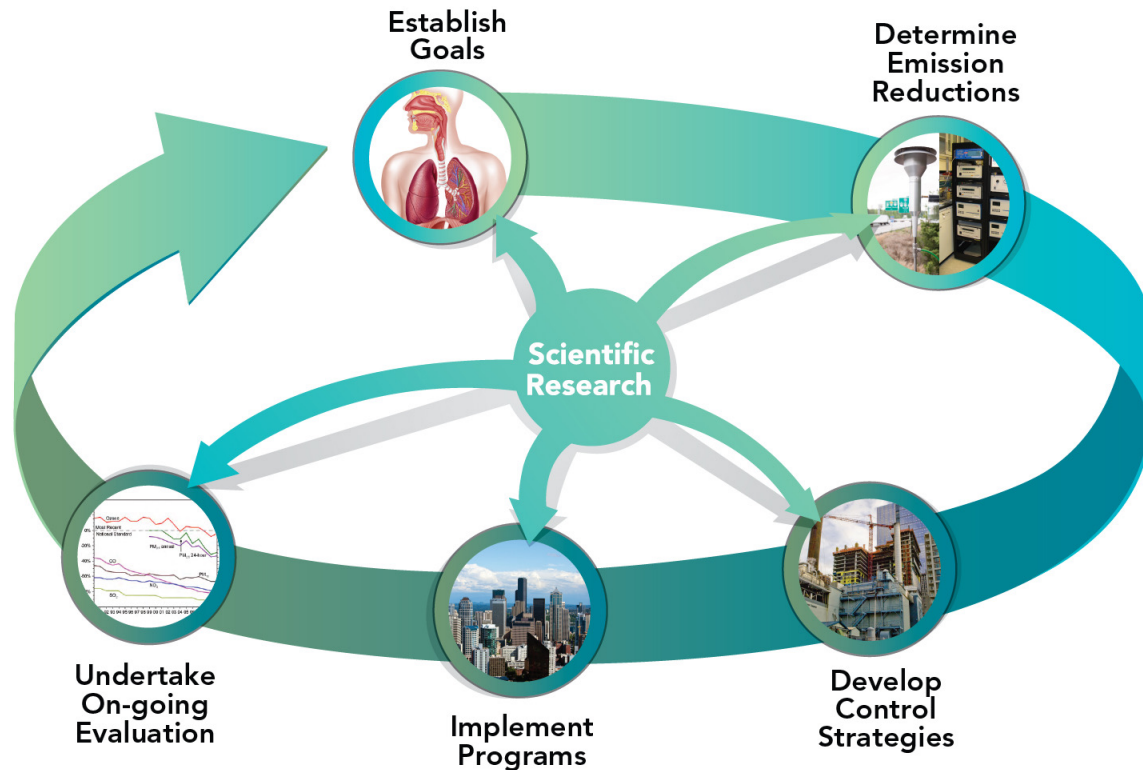
Air Quality Management Programs eg United States Environmental Protection Agency's Clean Air Act of 1970.



Figure from 2022 AQLI Annual Update

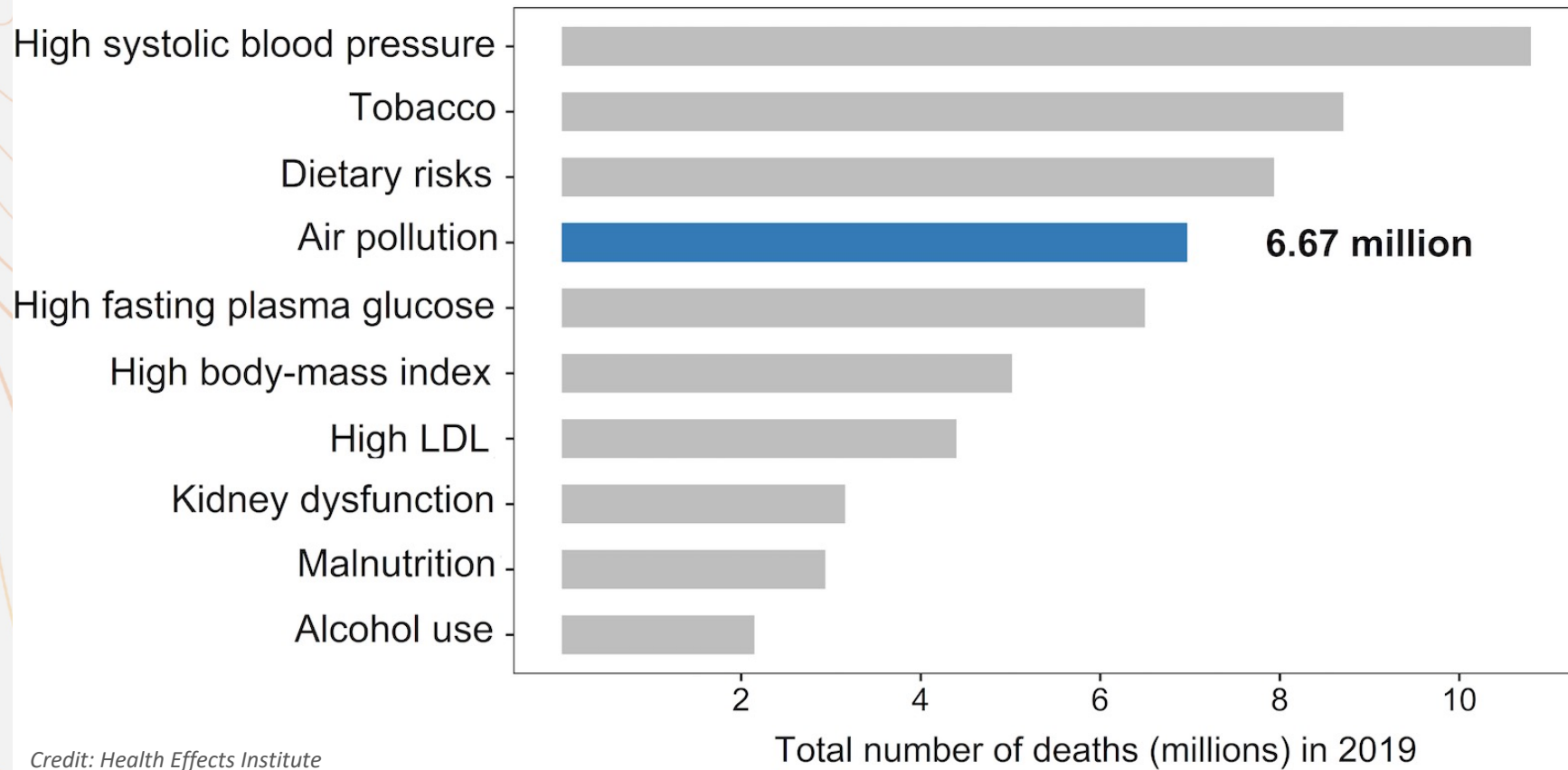


## AIR QUALITY MANAGEMENT CYCLE



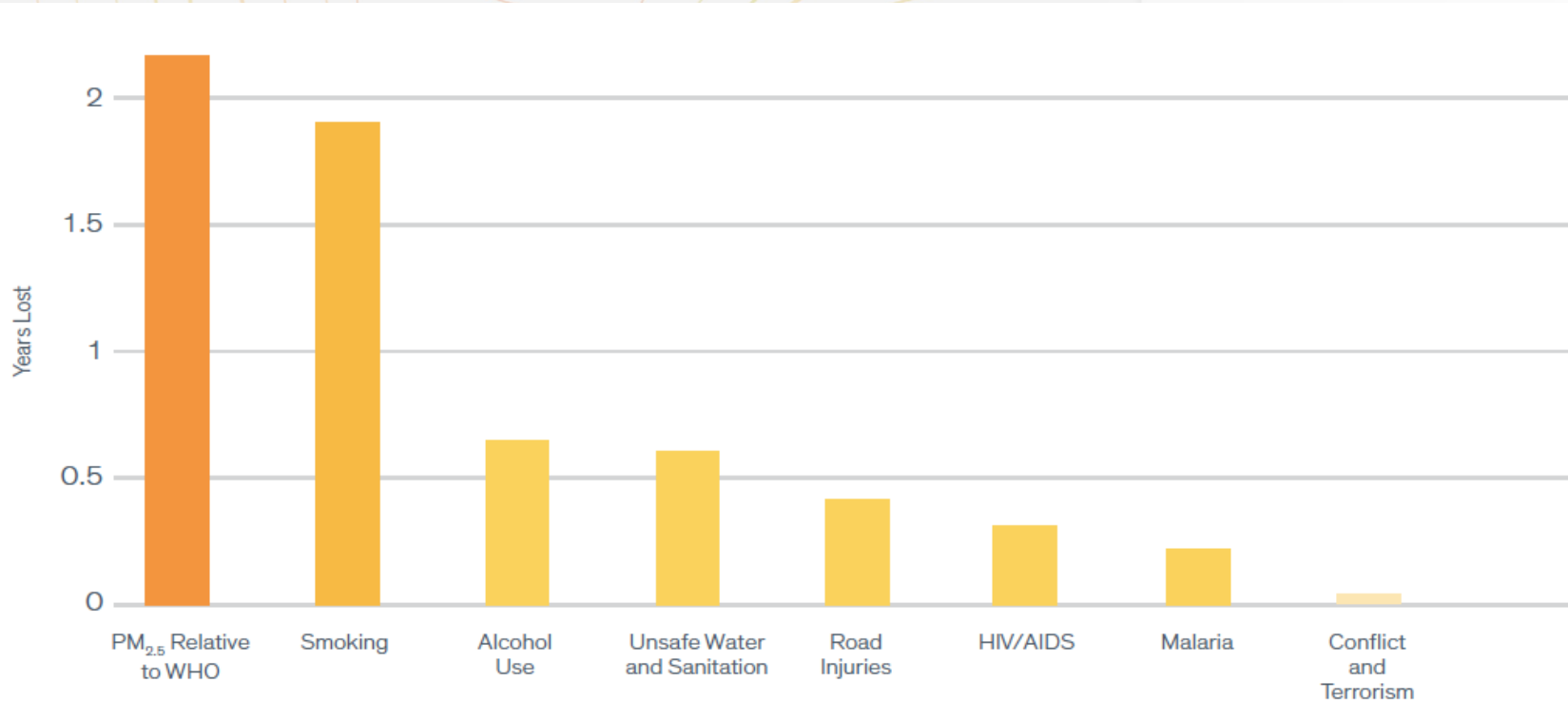
What is the international community doing to fight air pollution?

Some countries have air quality management programs



Why are these steps being taken?

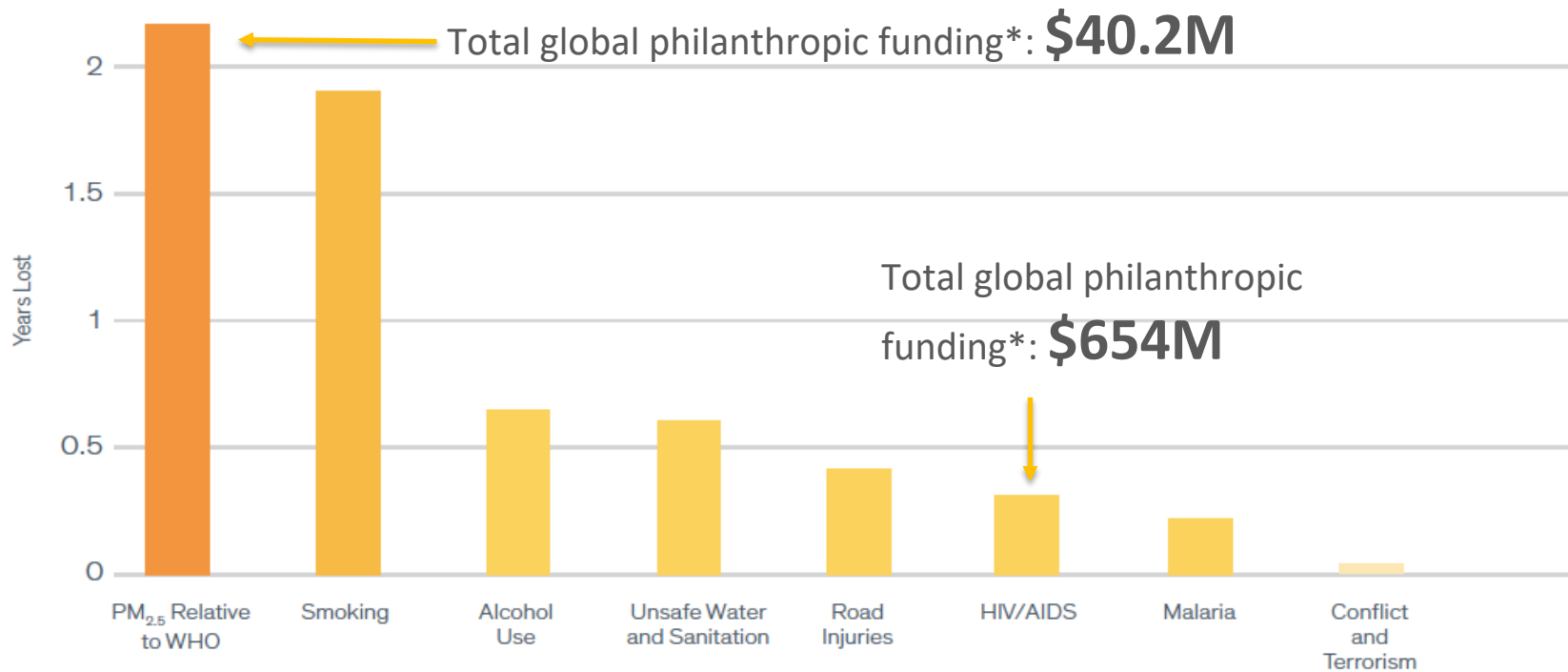
Air Pollution is the fourth leading risk factor for deaths globally



## Life Expectancy Impact of PM<sub>2.5</sub> vs Other Causes/Risks of Death, Global

Particulate pollution is one of the largest public health threats of our time

Figure from 2022 AQLI Annual Update



## Life Expectancy Impact of PM<sub>2.5</sub> vs Other Causes/Risks of Death, Global

Particulate pollution is one of the largest public health threats of our time

Figure from 2022 AQLI Annual Update

\*Source: 2021 Clean Air Fund Report on the State of Global Air Quality Funding

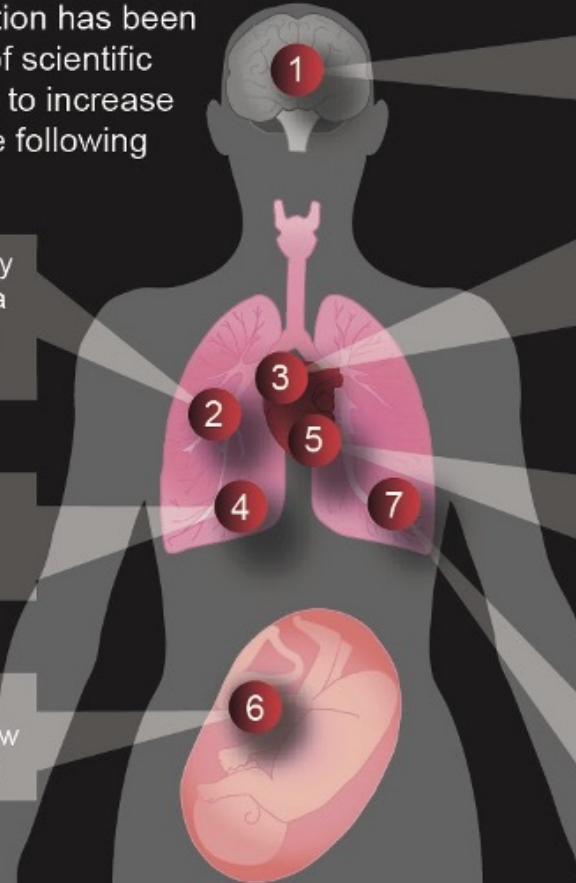


Particulate matter air pollution has been shown (through a branch of scientific study called epidemiology) to increase our risk of experiencing the following health problems:

Chronic obstructive pulmonary disease, or COPD, meaning a reduction in the amount of air going in and out of the lungs

Lower respiratory infections, including pneumonia, some types of flu, and bronchitis

Problems during pregnancy, including pre-term delivery, low birth weight, and other issues



Stroke, a reduction in blood flow to the brain, which can be fatal if not treated right away

Heart disease, meaning a reduction in blood flow to the heart, which increases the risk of heart attack and stroke

Heart attack, a very dangerous condition where part or all of the heart muscle is deprived of oxygen

Lung cancer, one of the most common and deadly forms of cancer

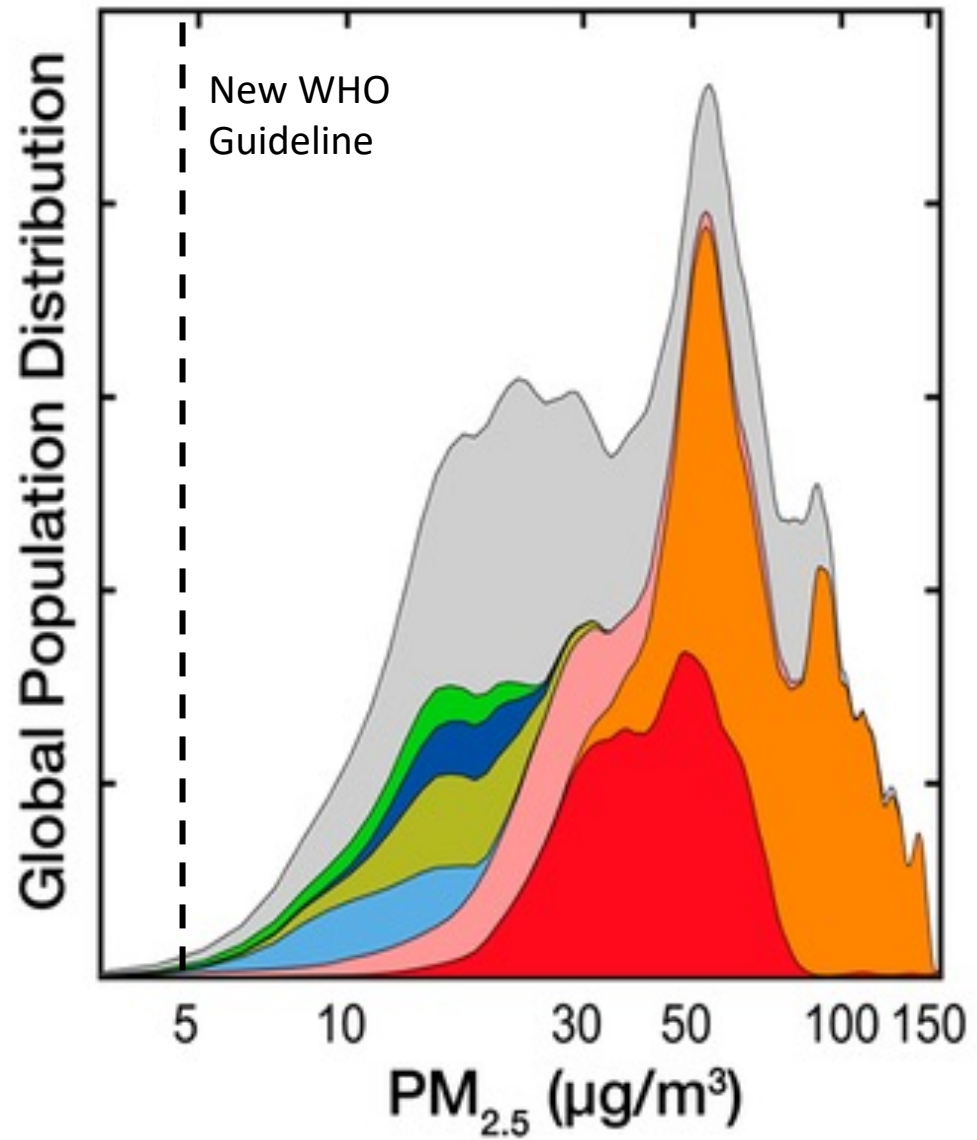
How can PM affect our health?



# Nearly everyone on earth breathes air more polluted than the new WHO PM<sub>2.5</sub> air quality guideline

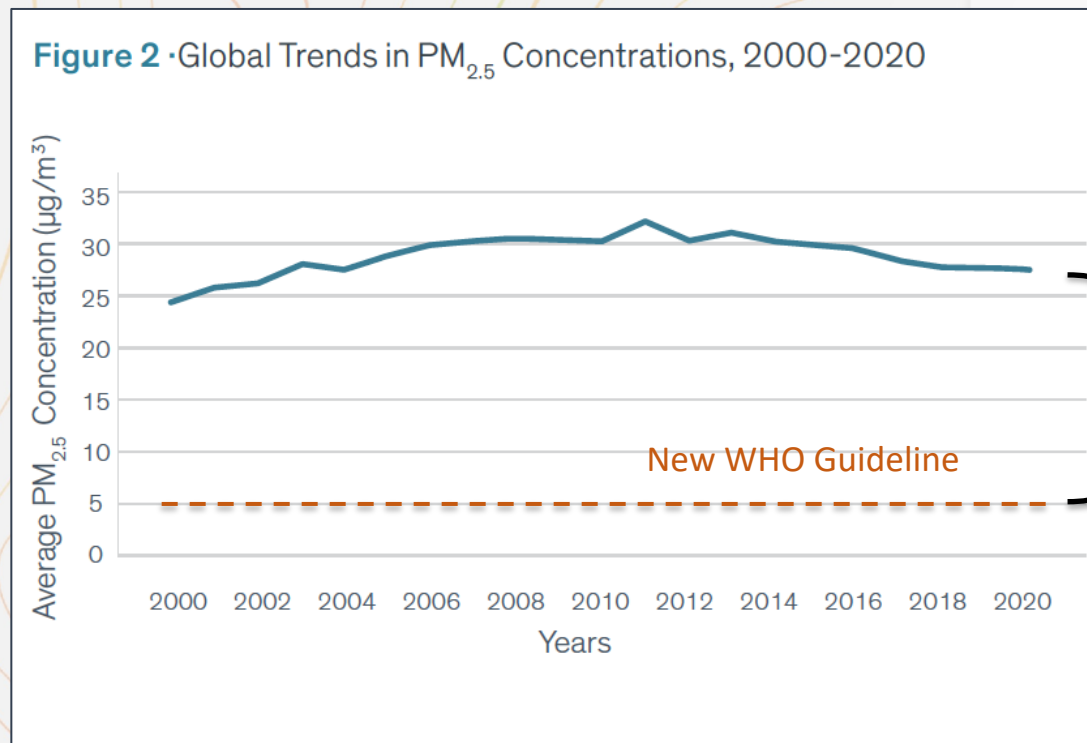
- China
- India
- Southeast Asia
- North America
- Western Europe
- Eastern Europe
- Tropical South America
- Rest of World

Data: Hammer et al ES&T 2020





## The global toll of air pollution on life expectancy remains high in 2020



This year's analysis reveals that permanently reducing global air pollution to meet the World Health Organization's (WHO) guideline would add **2.2 years** onto global average life expectancy

Figure from 2022 AQLI Annual Update





# Introducing AQLI

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# The Air Quality Life Index (AQLI)

**AQLI** Air Quality Life Index®

The Index About Pollution Facts Policy Impacts Reports News

ENG | 中文 | हिन्दी

How much longer would you live if you breathed clean air?

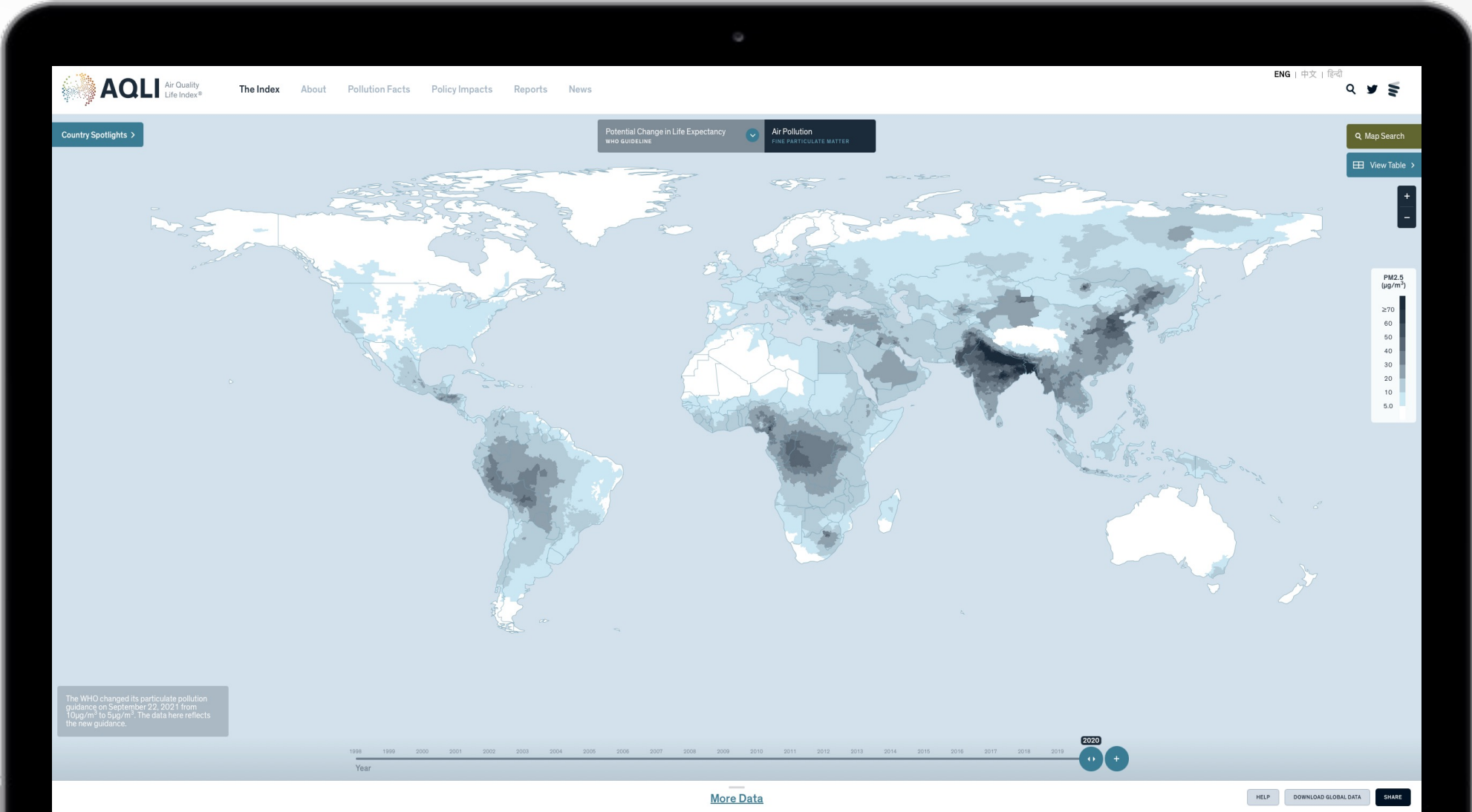
Find Out

**In the News** April 11, 2023  
Air pollution affects children physically, mentally, causes diseases  
via [Jago News](#)

**In the News** March 31, 2023  
The Human And Health Cost Of



# The Air Quality Life Index (AQLI)

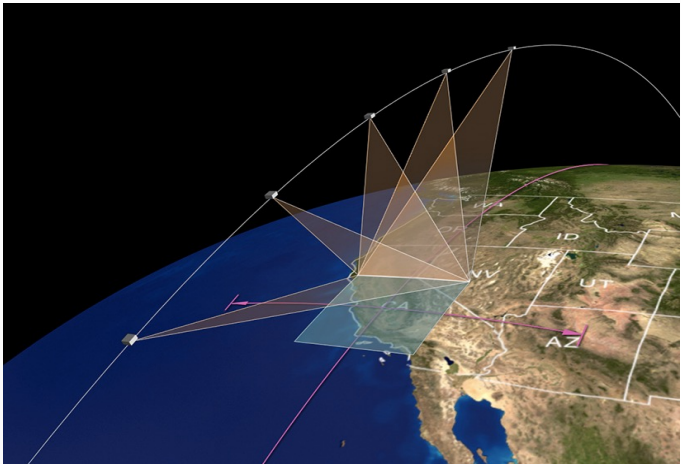




# How does AQLI get high resolution PM data?



Satellite raw data from NASA MODIS, MISR, and SeaWIFS



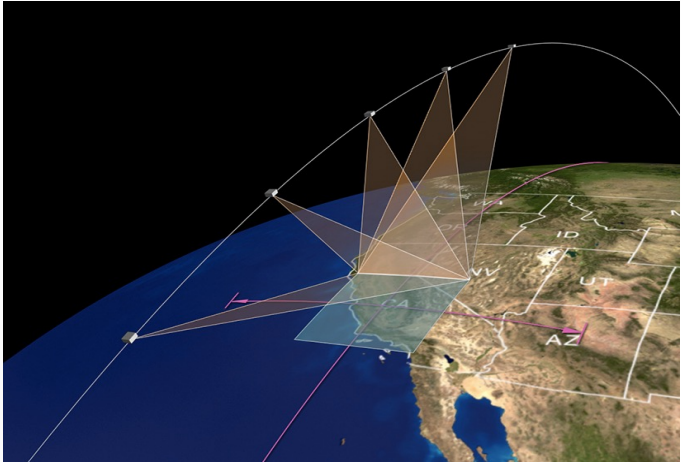
Credit: NASA/JPL-Caltech



# How does AQLI get high resolution PM data?



Satellite raw data from NASA MODIS, MISR, and SeaWIFS



Credit: NASA/JPL-Caltech

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3D model of global atmospheric chemistry

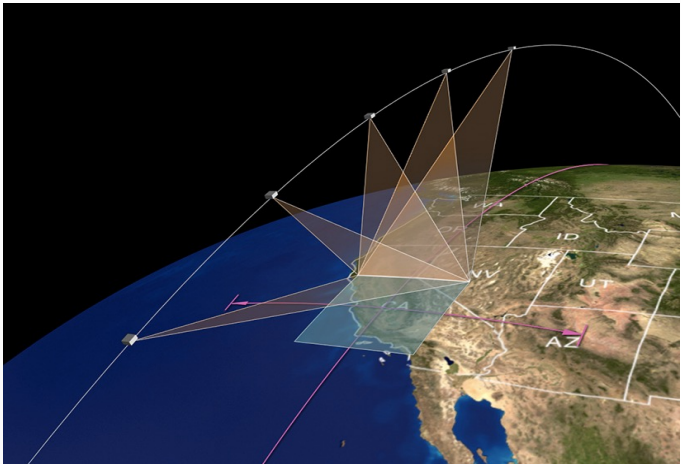




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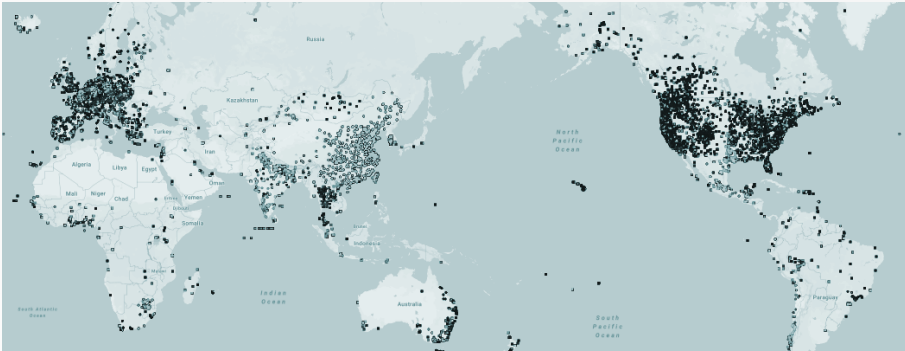
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3D model of global atmospheric chemistry



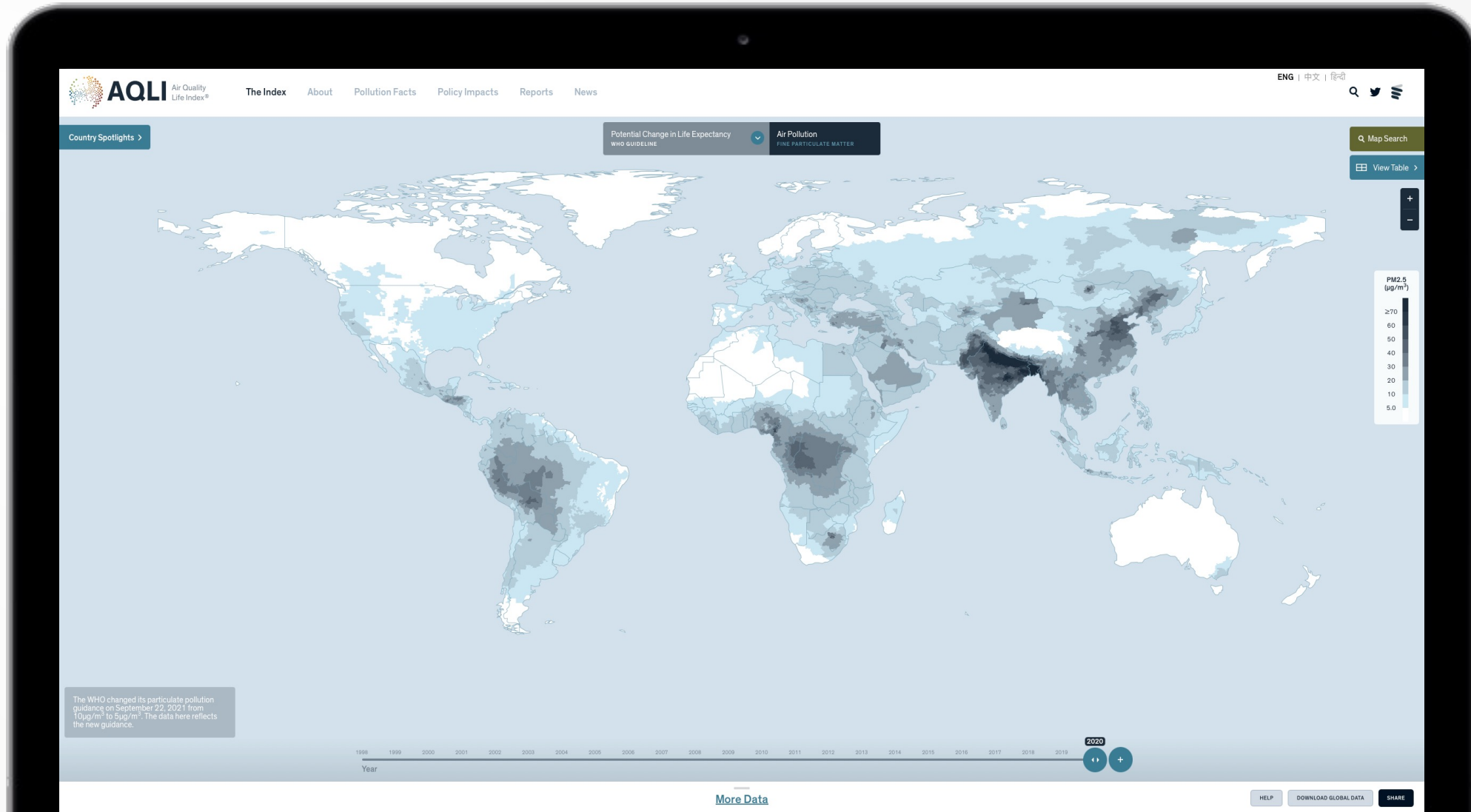
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Open air quality data from governments' monitoring networks



Credit : OpenAQ

# The AQLI provides high resolution data for the entire world



The data can be viewed at multiple levels globally, including national and sub-national

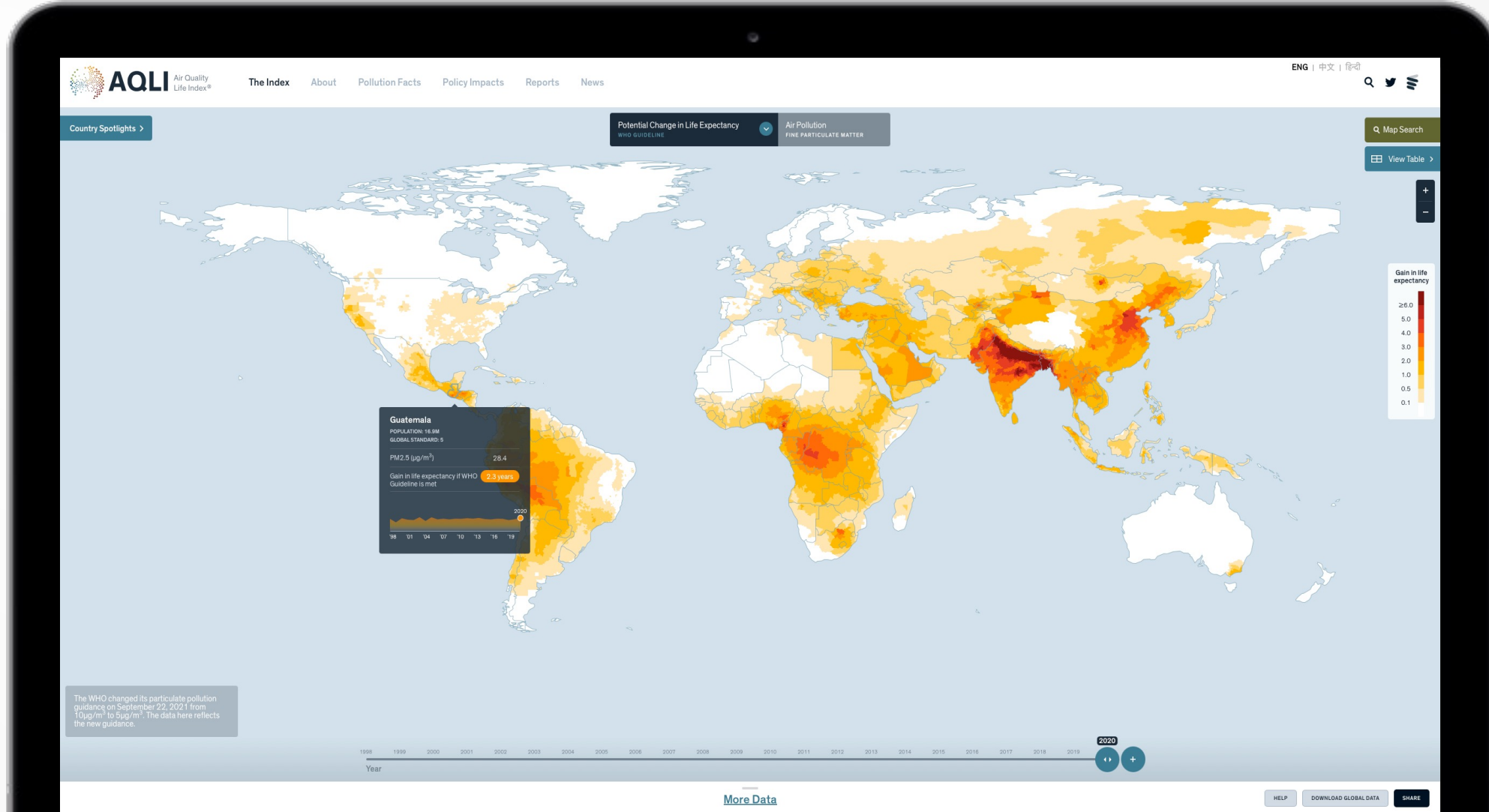




# Availability of data from 1998 lets users view trends over time



Combined, the satellite data and AQLI's life expectancy calculation allow for unprecedented view of impact of pollution on life expectancy around the world





"According to our study, these high pollution levels translate into more than 2 years of life lost to the average life expectancy across the globe": Christa Hasenkopf (@sciencereally), director, AQLI, on the fresh Air Quality Life Index report



10:12 AM · Jun 14, 2022



### 'China's financial, public commitment helped turn tide on air pollution'

Air pollution levels in India have continued to increase, according to the Energy Policy Institute at the University of Chicago (EPIC)'s Air Quality Life Index (AQLI) released on Tuesday

THE AIR WE BREATHE | DELHI WORST-AFFECTED

### Bad air biggest health risk in India, cuts 5 yrs in life expectancy: Study

**The toll from air pollution**  
Bad air takes 2.2 yrs off global life expectancy. The worst-hit countries:  
Bangladesh 4.8 years  
India 5 years  
Nepal 4.3 years  
Pakistan 3.8 years  
DRC 2.8 years

**Jayashree Nandi**  
NEW DELHI: Air pollution is the greatest threat to human health in India, reducing life expectancy by five years, according to a new study by the Energy Policy Institute at the University of Chicago (EPIC)'s Air Quality Life Index (AQLI) released on Tuesday. In contrast, child and maternal mortality rates reduces average life expectancy in India by about 1.8 years and smoking by about 1.5 years, it added.

The study also said that residents in Delhi, India's most polluted region, would gain 8 years life expectancy on average if annual average PM 2.5 levels did not exceed five micrograms per cubic metre, the threshold identified as optimum by the World Health Organisation's (WHO) revised air quality guideline released in September last year. Delhi was the most polluted state with around 9.7 years life expectancy lost on average as per AQLI's analysis last year, based on WHO's earlier target of 10 micrograms per cubic metre (µg/m<sup>3</sup>) for PM2.5 levels.

## AQLI in local, national and international media (2022)

Since its inception, the AQLI tool has been used in **211 countries** by **over 200,000 users**



### NHRC notice to environment ministry on air pollution impacting life expectancy

In a statement, the NHRC said it has taken motu cognizance of media reports quoting a survey that air pollution is a great threat to human health in India, reducing overall life expectancy by five years and 9.7 years for the people in Delhi.

In the News July 11, 2022 via [The New York Times](#)

## Air Pollution Kills 10 Million People a Year. Why Do We Accept That as Normal?

### मास्कर Research • सिकागो यूनिवर्सिटी की स्टडी : देश में लोगों की औसतन 5 साल उम्र कम हो रही, प्रदूषण में कमी आई तो बढ़ेगी 7.9 साल उम्र वायु प्रदूषण के कारण करीब 8 साल कम हो रही बिहार के लोगों की उम्र

विश्व में अदर केवल से सबसे अधिक फैल रहा वायु प्रदूषण

प्रदूषण के स्तर में सुधार हुआ तो औसत उम्र बढ़नी बढ़ेगी

विश्व स्तरित 4 राज्यों में हम में सुम सबसे की मोडुटनी 80 से ऊपर

देश	वर्षों में उम्र
भारत	5.8
नेपाल	4.3
पाकिस्तान	3.8
दक्षिण अफ्रीका	2.8

विश्व स्तरित 4 राज्यों में हम में सुम सबसे की मोडुटनी 80 से ऊपर

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In the Parliament of India, policymakers are using the AQLI to justify policy action

*Indian Member of Parliament, Ms. Vandana Chavan used the AQLI findings to demand a change to the India Air Act, 1981 during a 2019 Rajya Sabha session*



# Background

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**PNAS**

Proceedings of the  
National Academy of Sciences  
of the United States of America

RESEARCH ARTICLE | ENVIRONMENTAL SCIENCES | OPEN ACCESS

# New evidence on the impact of sustained exposure to air pollution on life expectancy from China's Huai River Policy

Avraham Ebenstein, Maoyong Fan, Michael Greenstone , , and Maigeng Zhou [Authors Info & Affiliations](#)

September 11, 2017 | 114 (39) 10384-10389 | <https://doi.org/10.1073/pnas.1616784114>

Key Result:  $\frac{0.98 \text{ years}}{10 \mu\text{g}/\text{m}^3 \text{ PM}_{2.5}}$



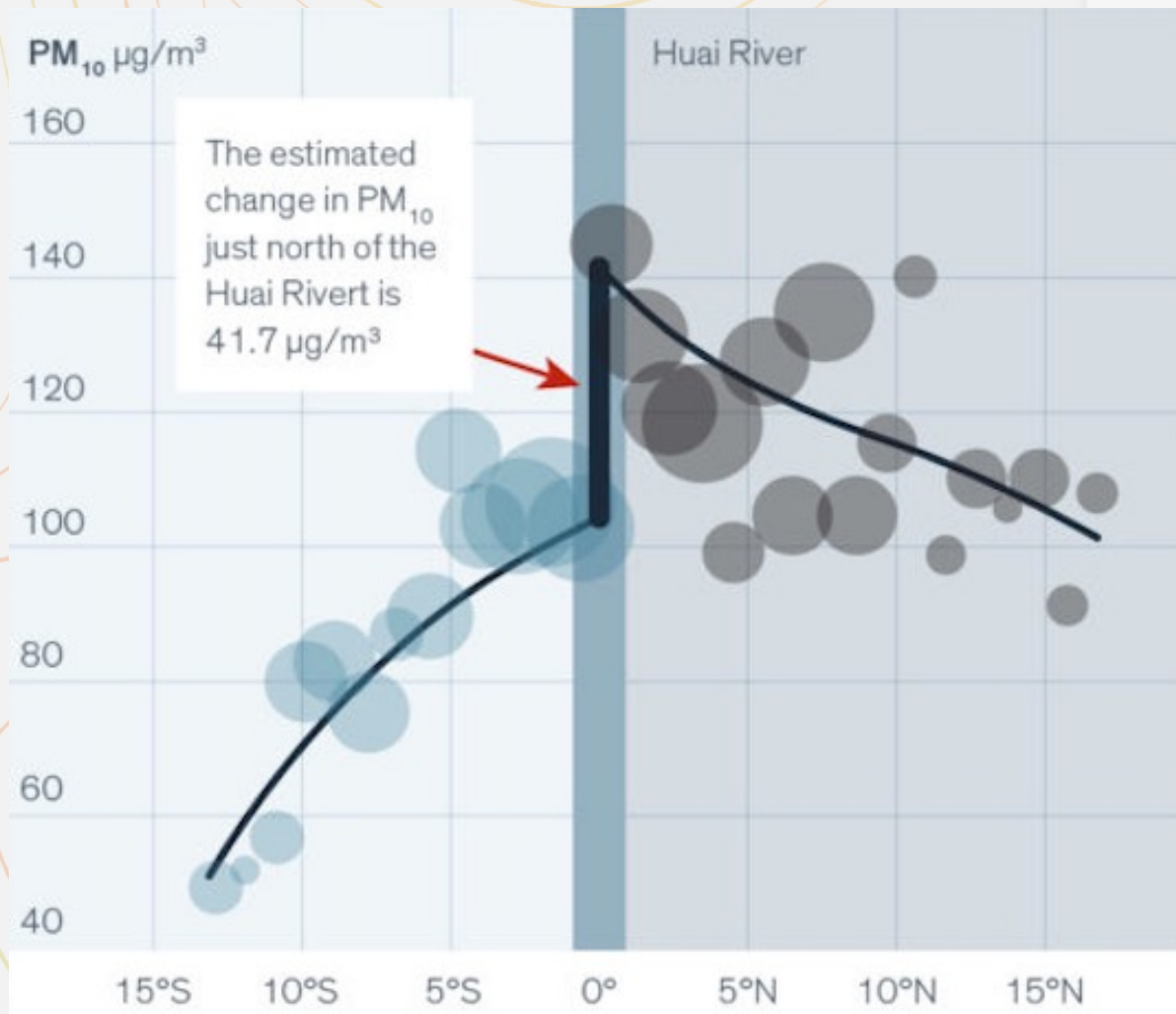
# China's Huai River winter heating policy: A tale of two skies



**Key Result**



$$\frac{0.98 \text{ years}}{10 \mu\text{g}/\text{m}^3 \text{ PM}_{2.5}}$$



Source: Ebenstein et al. (2017)

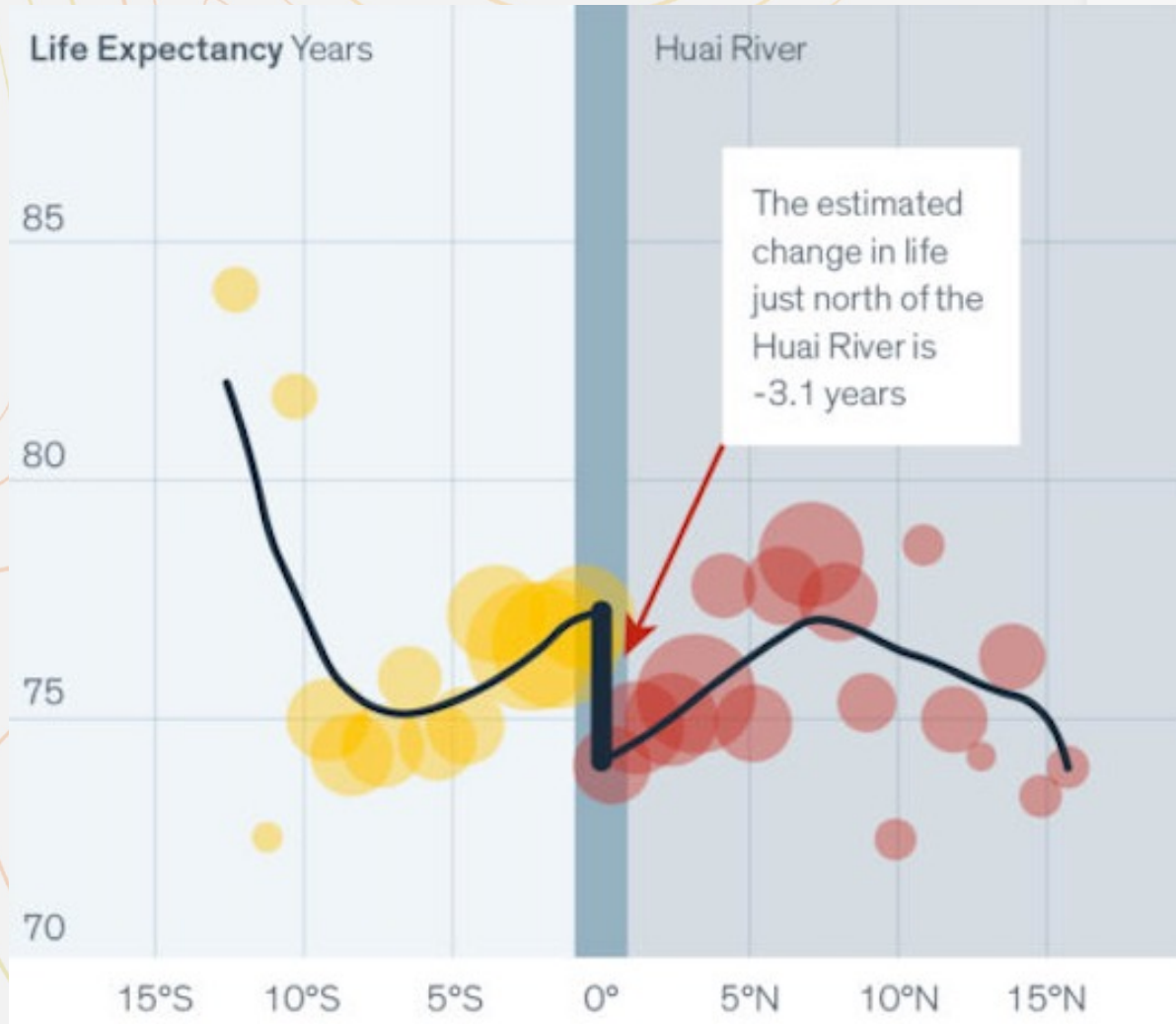
Pollution is 50% higher north of the river

### $PM_{10}$ Emissions North and South of the Huai River

  $PM_{10}$  in South

  $PM_{10}$  in North





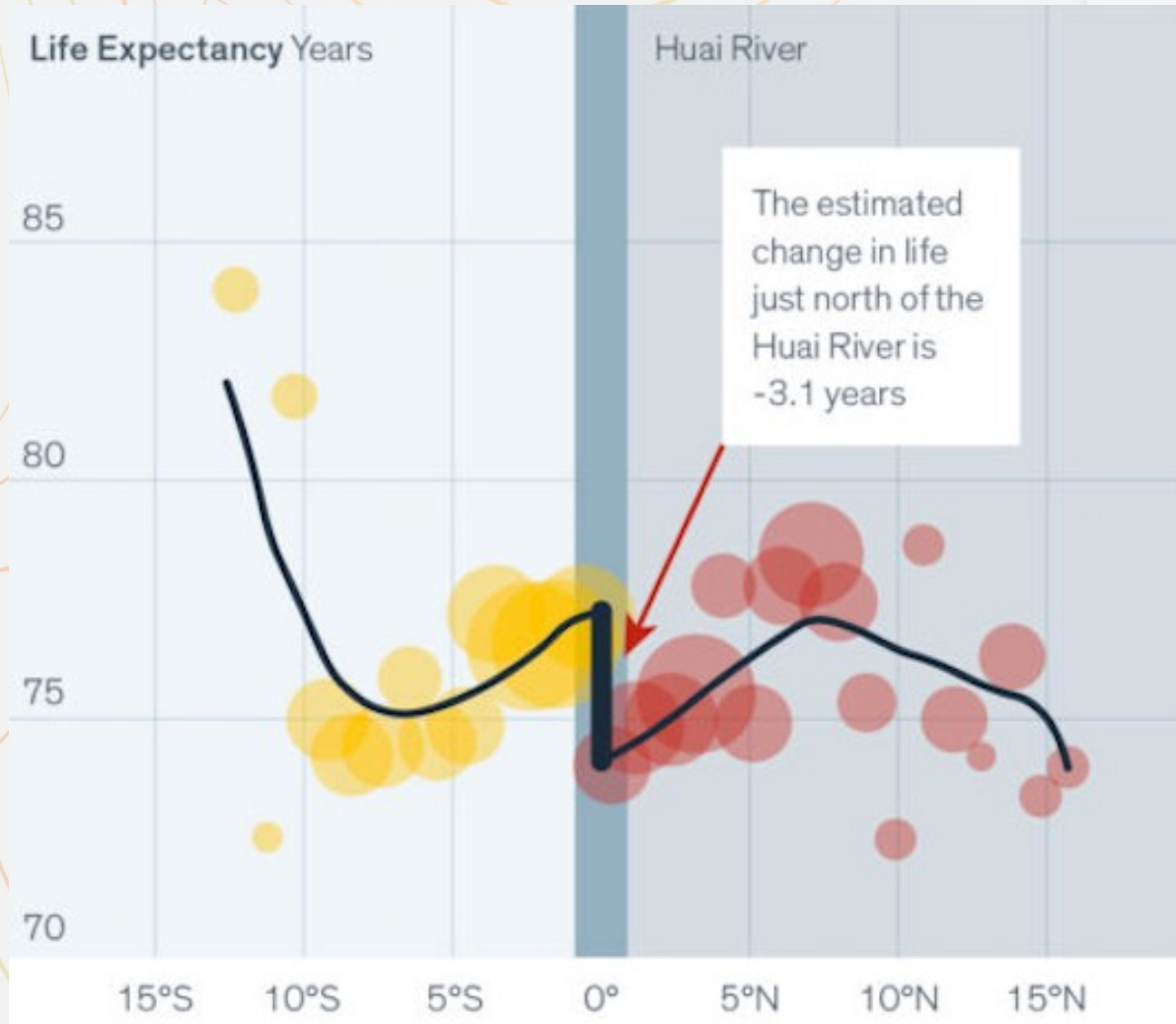
Source: Ebenstein et al. (2017)

Life expectancy is about 3 years lower

### Life Expectancy in North and South of the Huai River

● L.E. in South

● L.E. In North



Source: Ebenstein et al. (2017)

Life expectancy is about 3 years lower

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**Life Expectancy in North and South of the Huai River**

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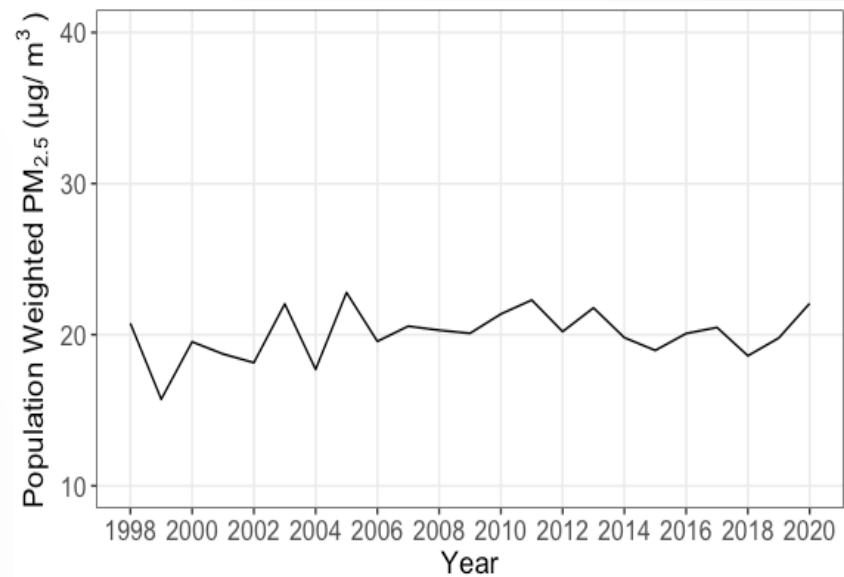
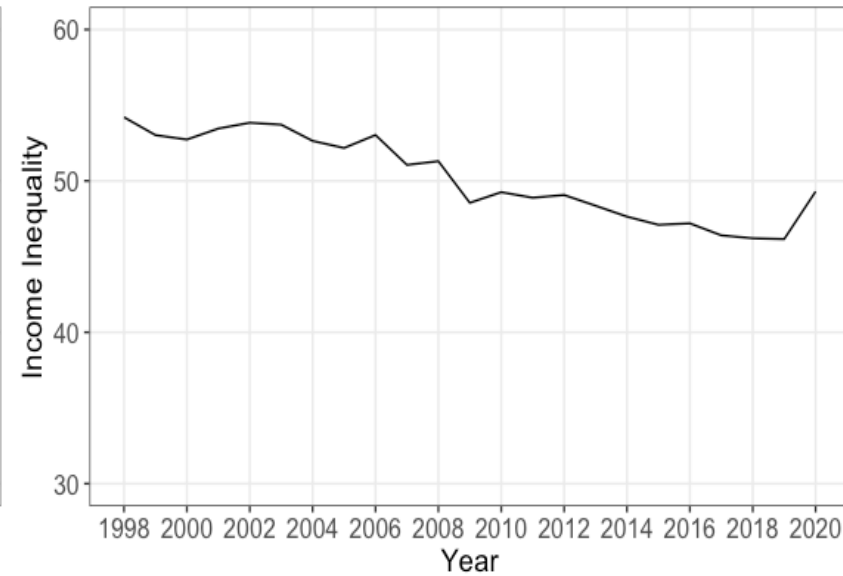
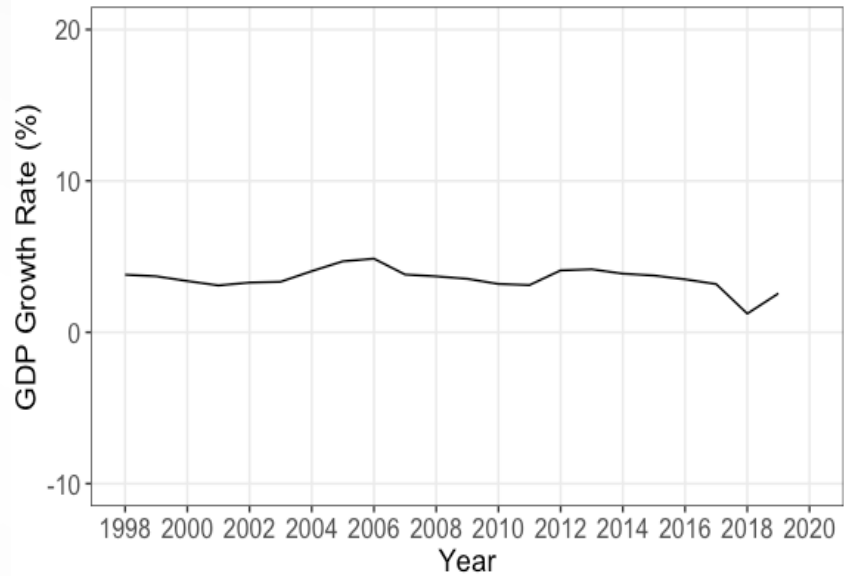


# Trends in Central America

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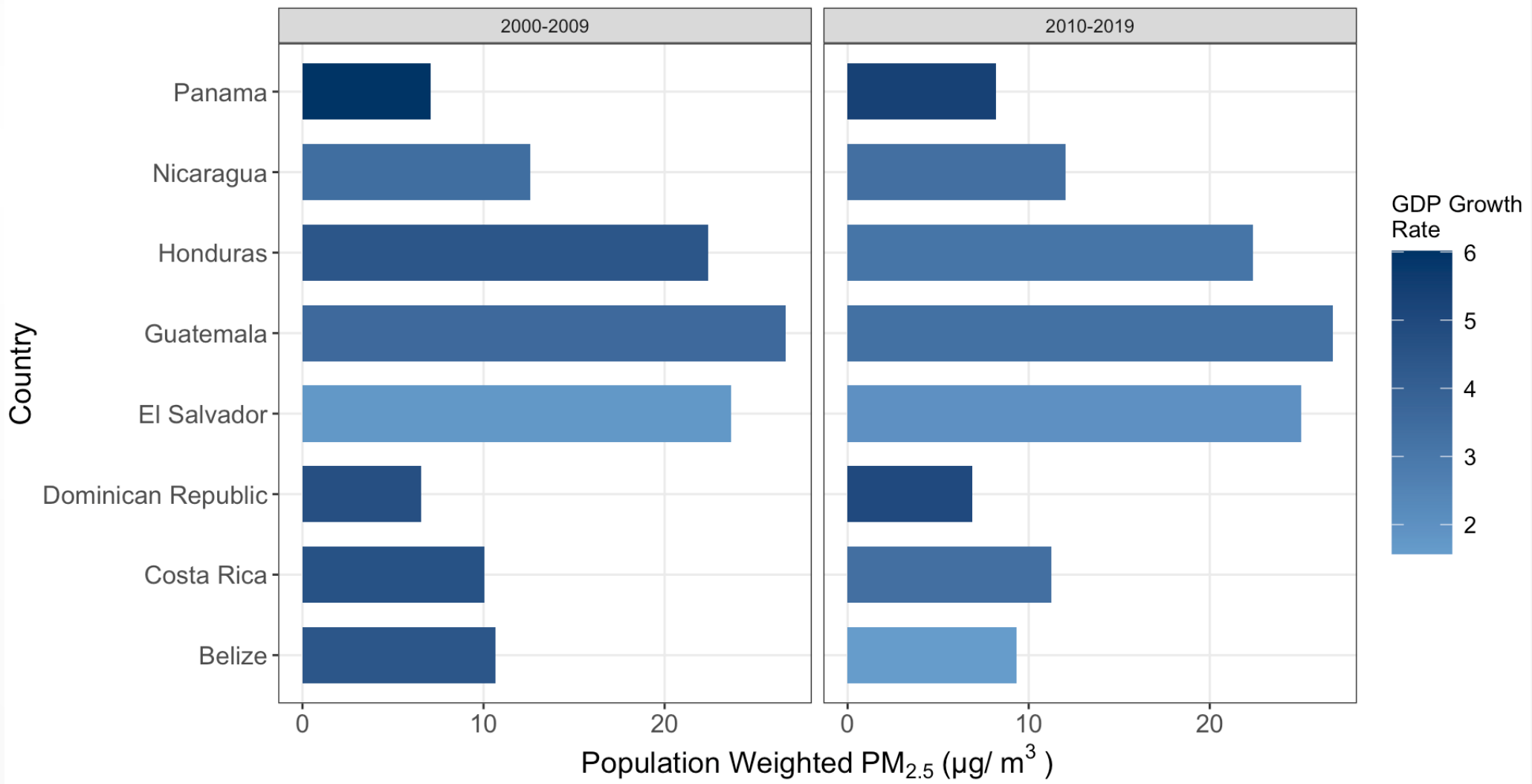


# Pollution remains persistent despite favorable trends in GDP growth and income inequality

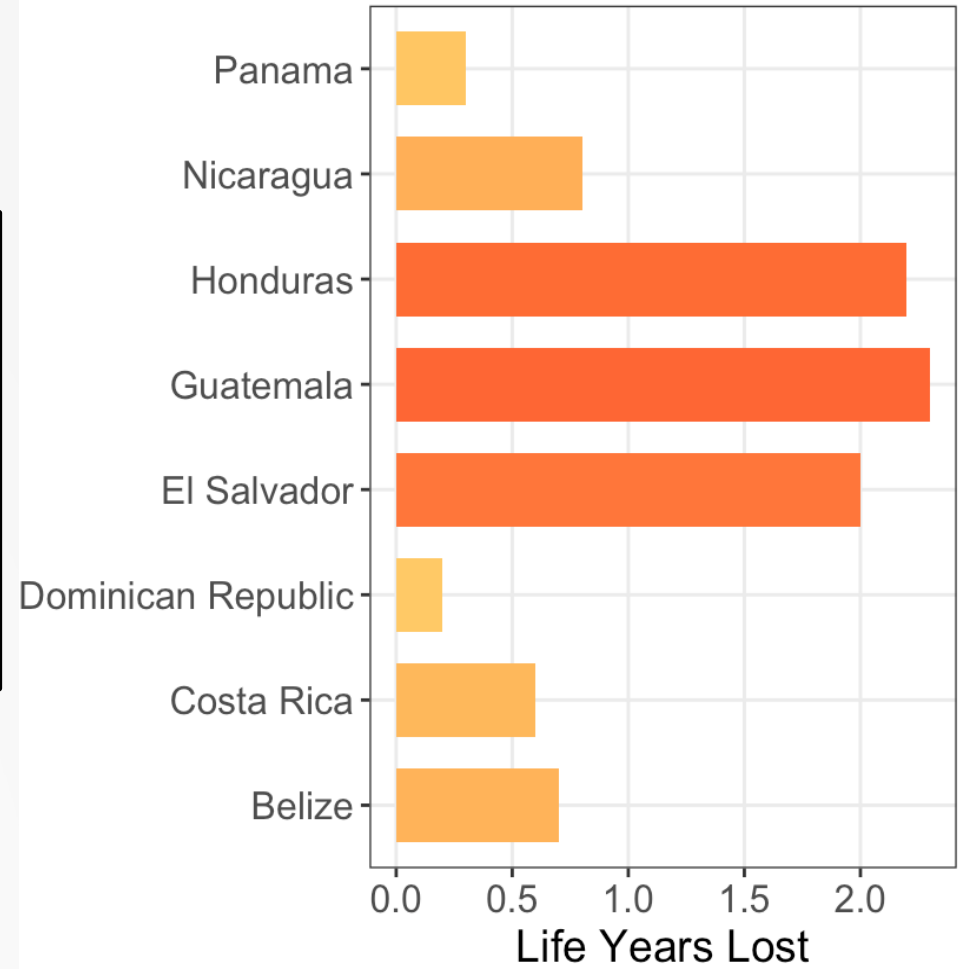
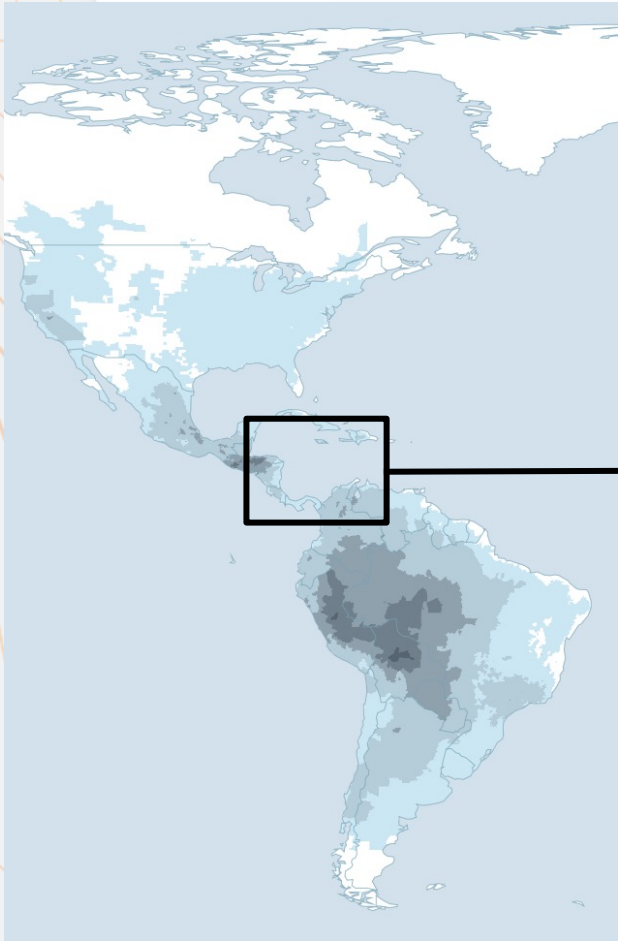


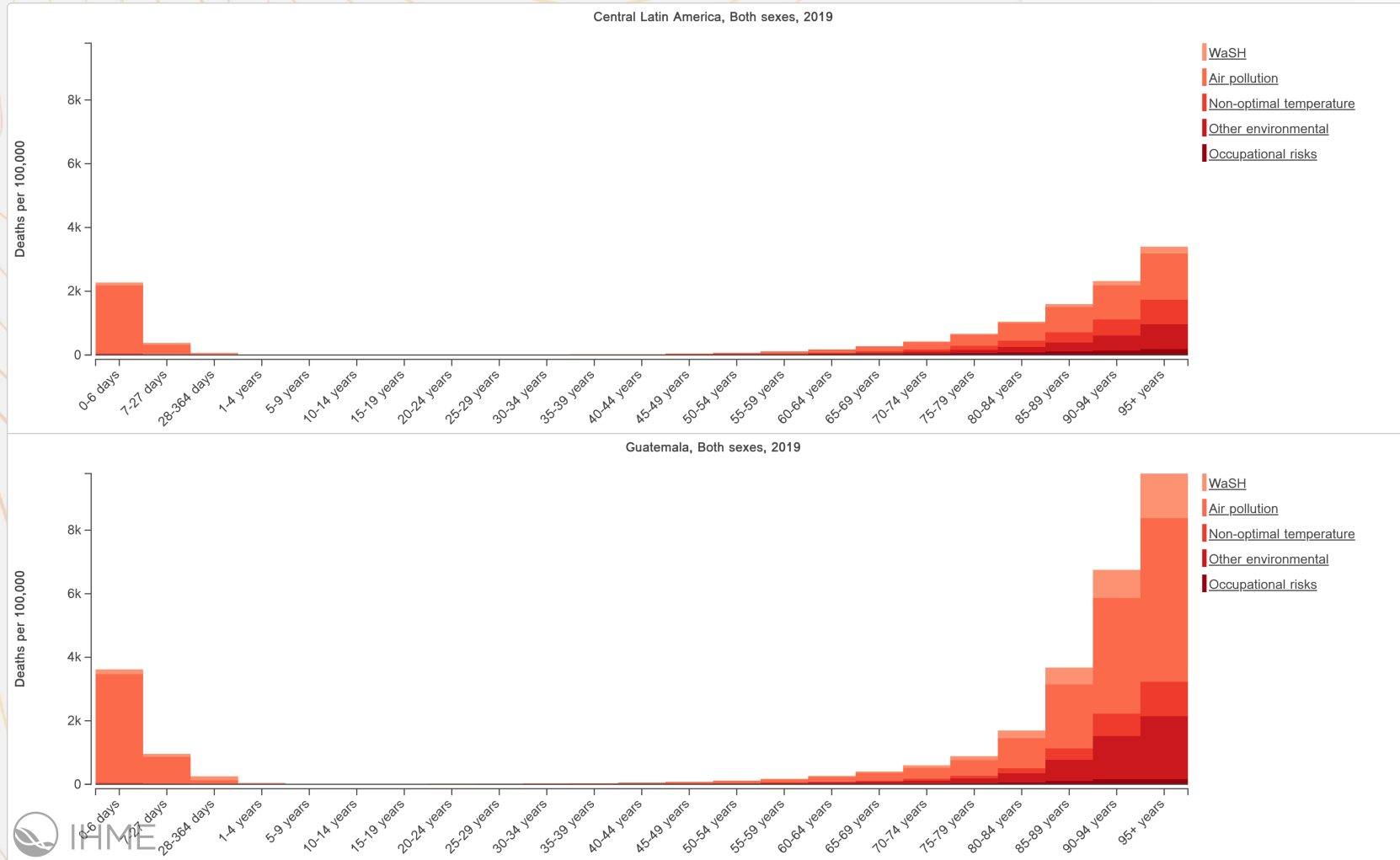


# GDP growth rate and PM2.5 by country



# Applying AQLI in Central America





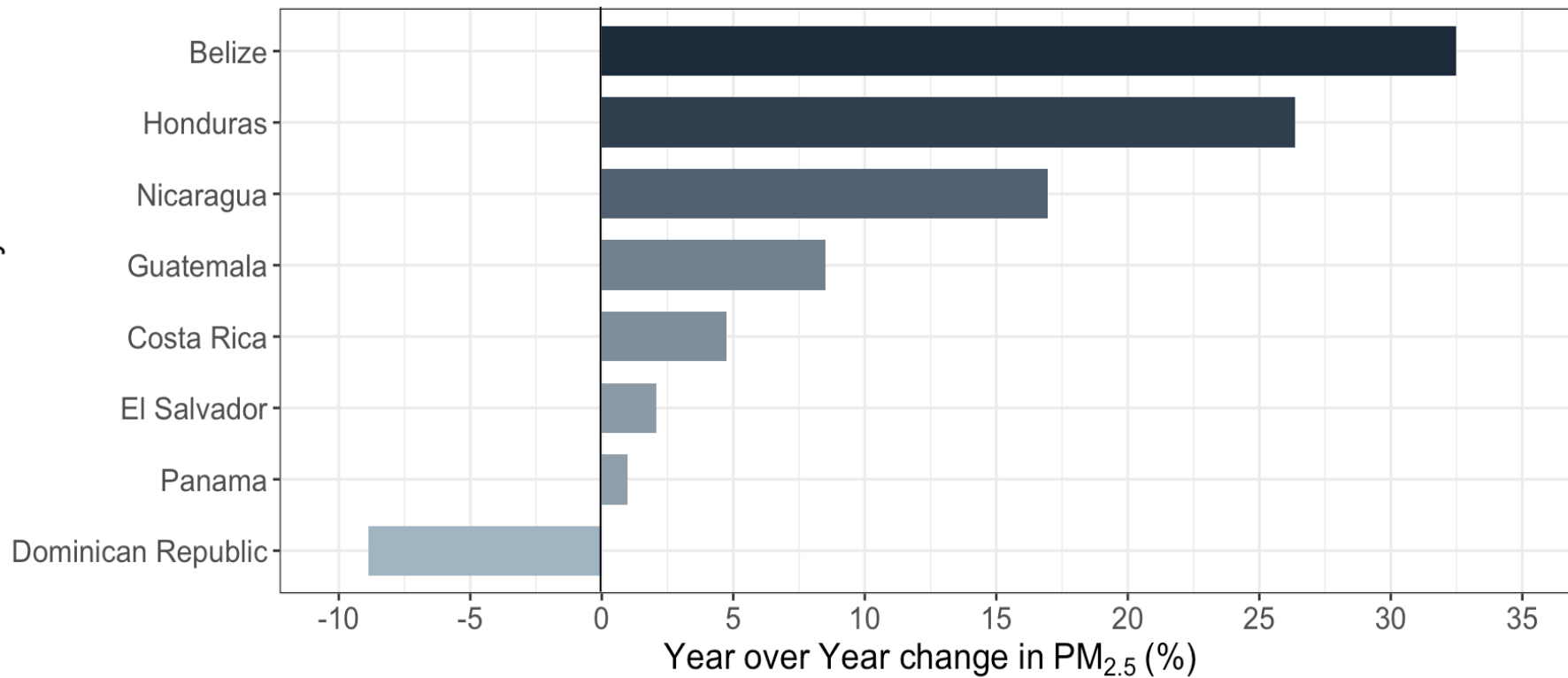
## Death rate by risk factor

Compared to the rest of Central America, Guatemala faces a higher health burden due to air pollution



## Year over Year change in PM<sub>2.5</sub> pollution in Central American Countries

(2019 to 2020)



Year over year  
change in PM<sub>2.5</sub>  
concentration

But not all is bad. Guatemala did not see the maximum rise in particulate pollution from 2019 to 2020



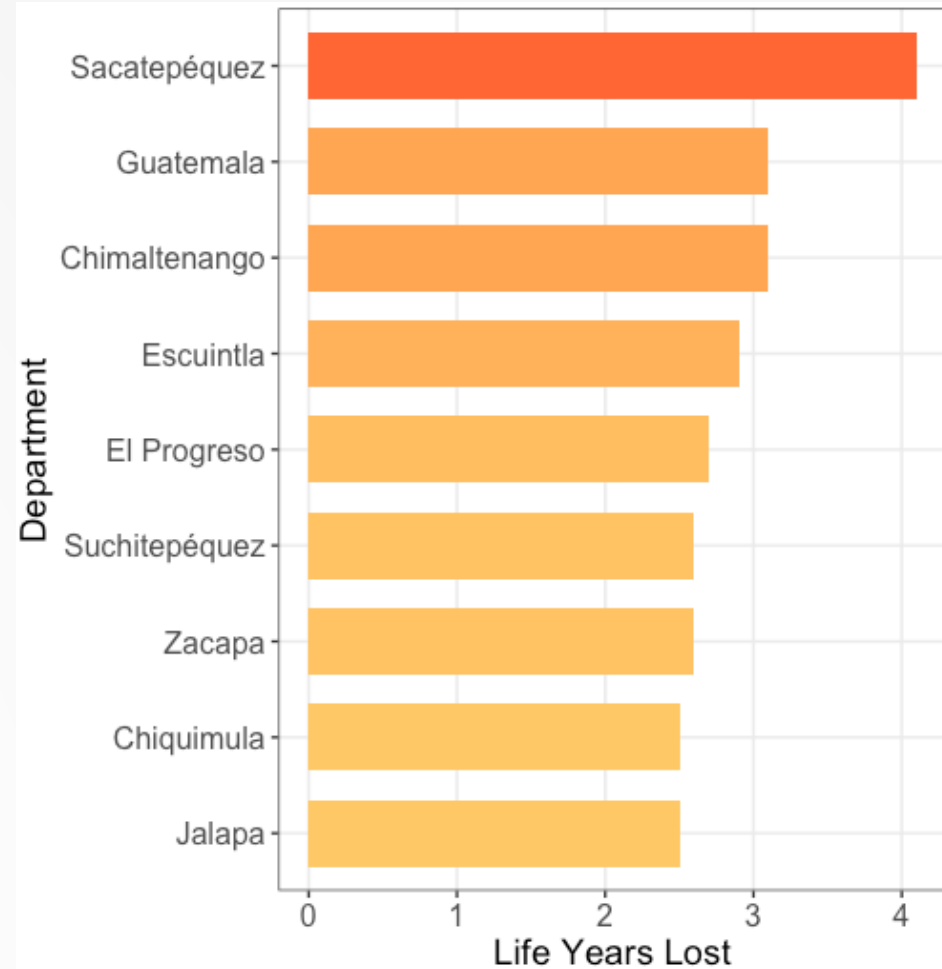
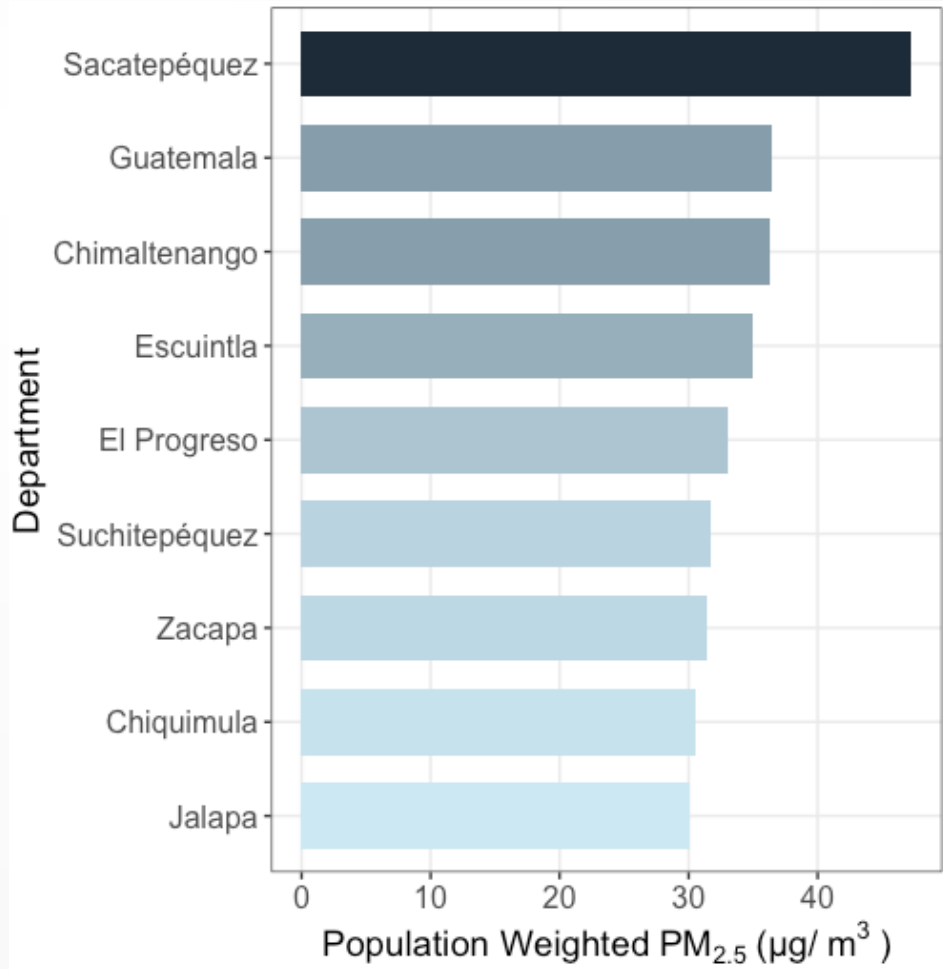


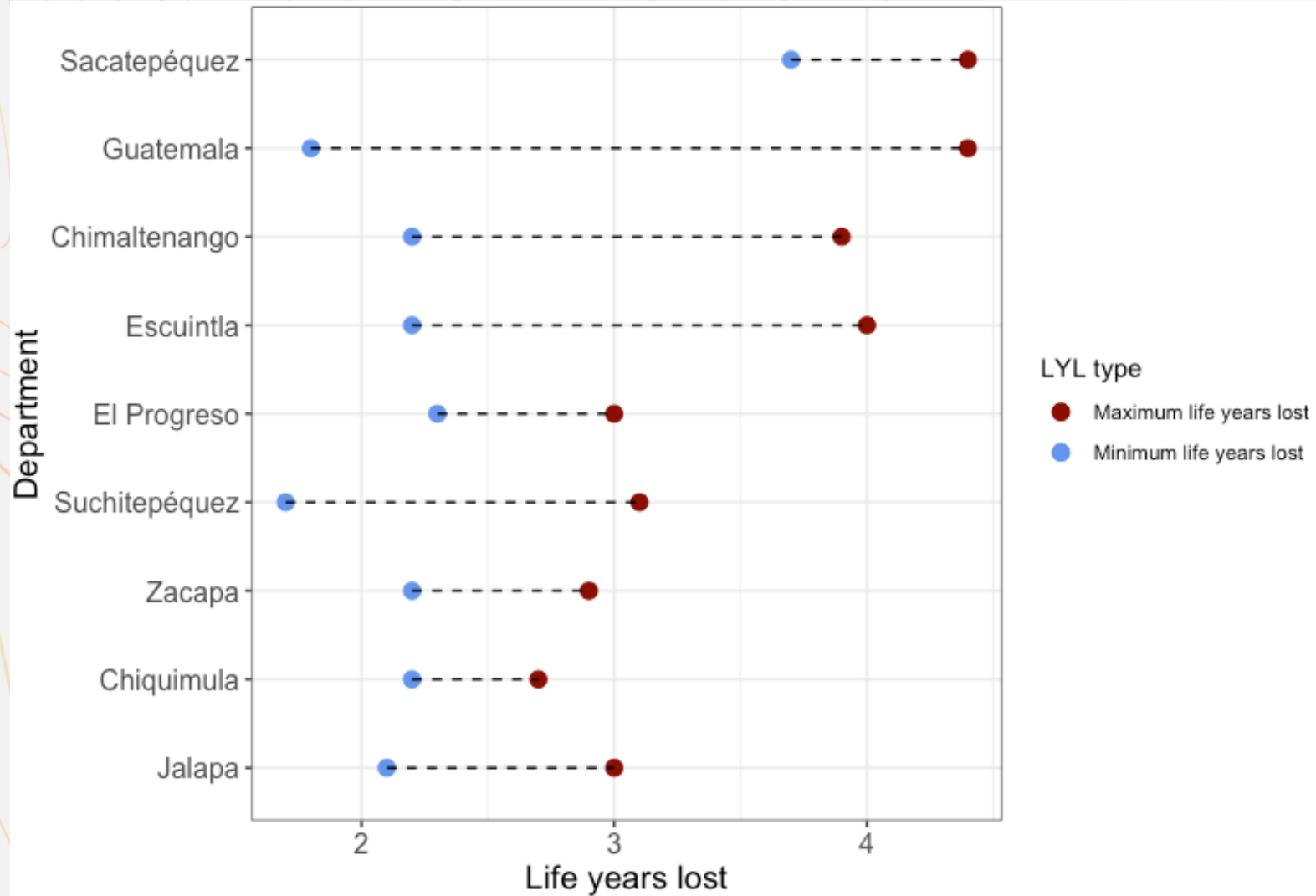
# Zooming in on Guatemala





# PM2.5 concentration and Life Years Lost in Top 10 Most Polluted Departments in Guatemala





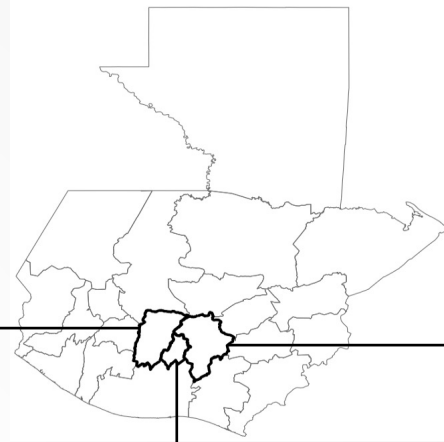
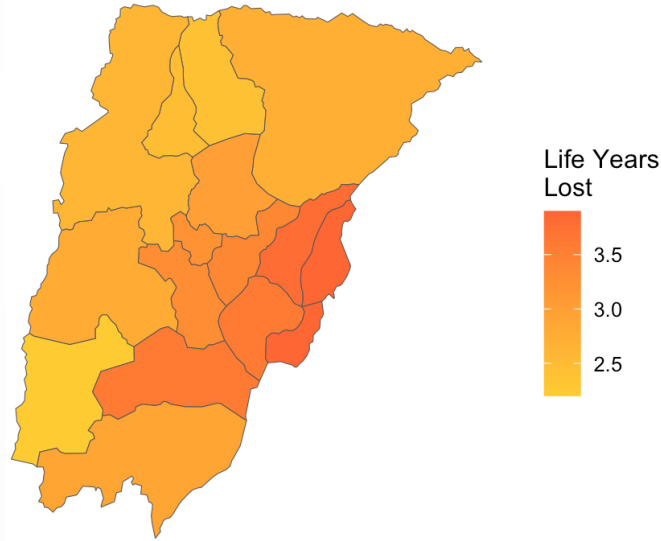
## Range of life years lost in the top 10 most polluted departments in Guatemala

The least polluted municipality in Sacatépéquez is more polluted than the most polluted municipalities in most other states in this list

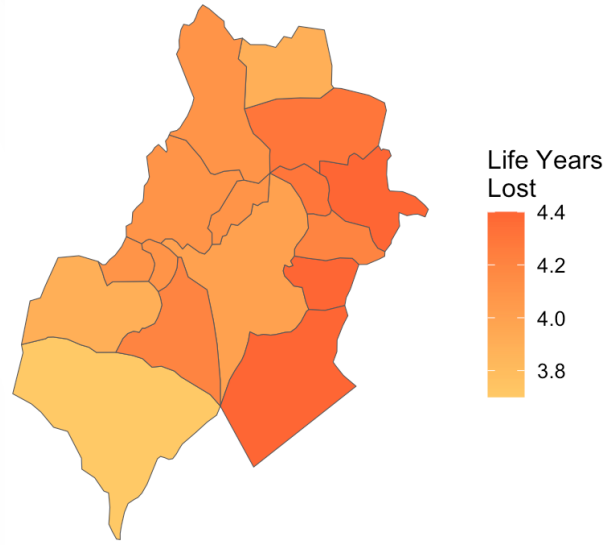


# Spatial distribution of life year lost in 2021 in the top 3 most polluted departments in Guatemala

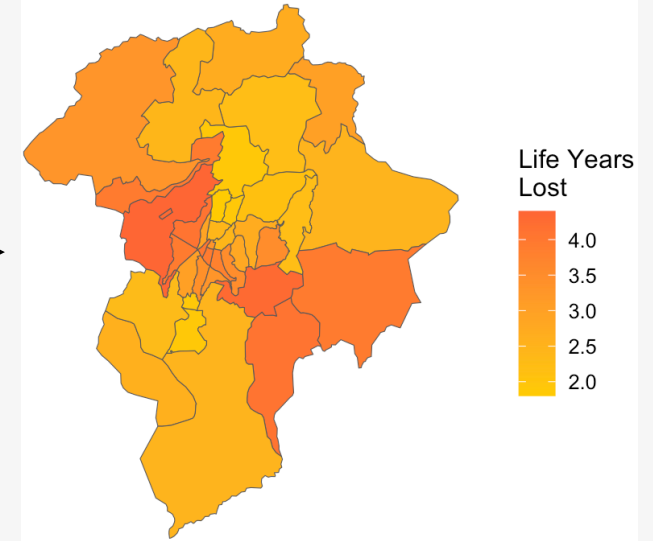
Chimaltenango Department



Sacatepéquez Department



Guatemala Department





Recommendation	PM2.5 ( $\mu\text{g}/\text{m}^3$ )	Life Years Lost
Interim target 1	35	2.94
Interim target 2	25	1.96
Interim target 3	15	0.98
Interim target 4	10	0.49
<b>AQG level</b>	<b>5</b>	<b>0</b>

Table: WHO recommended Air Quality Guideline (AQG) with interim targets and their corresponding Life Years Lost

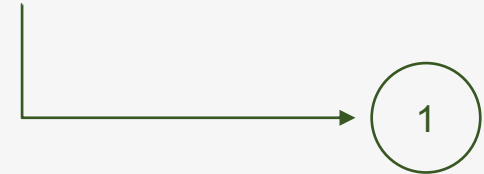
Monetary benefit of achieving WHO target level of particulate pollution

In addition to health benefits, there are monetary benefits to reducing air pollution.

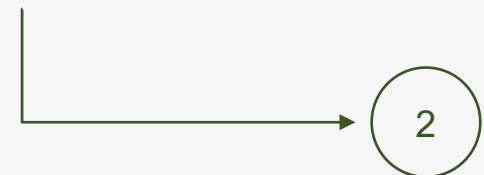
# Monetary benefit of achieving WHO target level of particulate pollution



*Monetary Benefit = Affected Population × Average Gain in Life Expectancy × VSLY*



$$\text{Guatemala VSLY} = \frac{\text{US VSL} \times \left(\frac{\text{Guatemala GNI}}{\text{US GNI}}\right)}{\text{Expected Life Years Remaining for Median Age Individual}}$$





# Proposed Solutions

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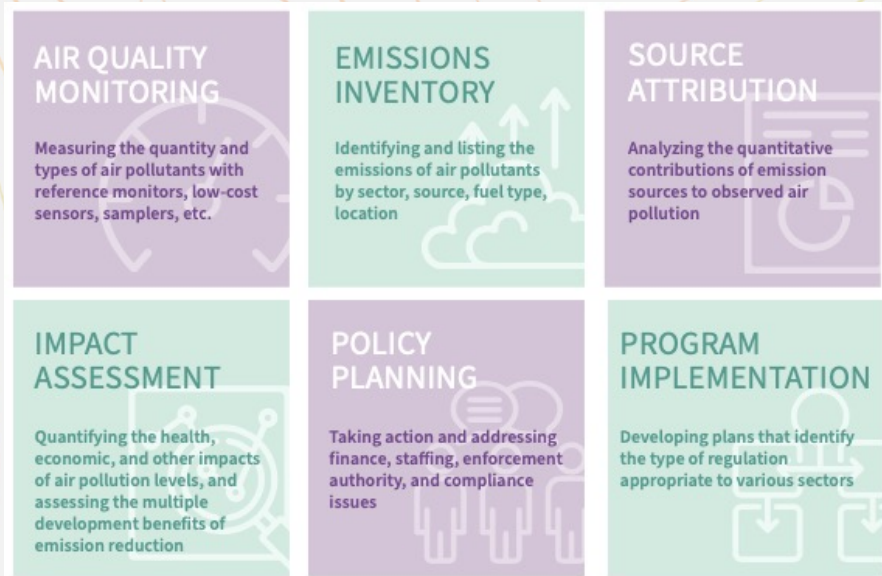


## What are some solutions to the air pollution problem

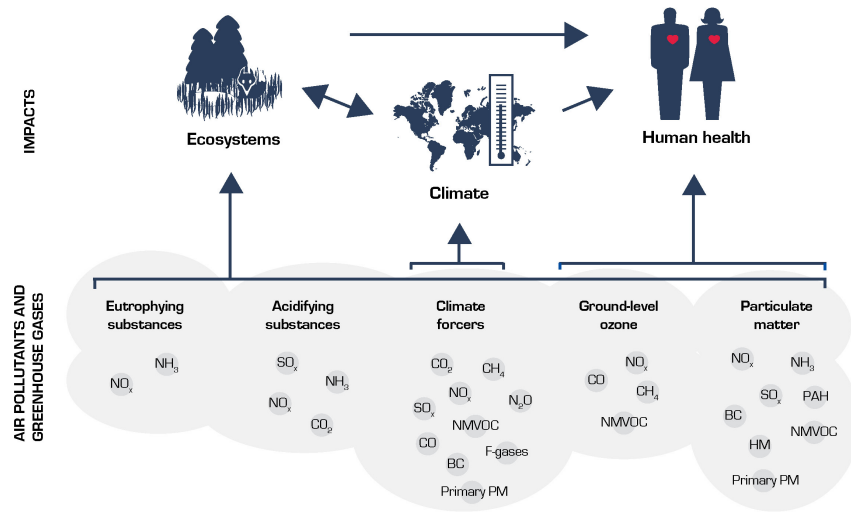
Small scale/local solutions e.g., Mexico City's ProAire program

Some helpful resources that talk about good air quality management practices:

1. [Open Air Quality Data: The Global Landscape](#) report by OpenAQ, 2022
2. [Strengthening Air Quality Management Guidance](#) report by Clean Air Fund and UNEP, 2022
3. Urban Emissions Air Quality Monitoring 101 <https://urbanemissions.info/blog-pieces/air-monitoring-101/>







EEA Report No 9/2013: Air quality in Europe - 2013



Satellite raw data from NASA MODIS, MISR, and SeaWiFS



Credit: NASA/JPL-Caltech

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3D model of global atmospheric chemistry  
**GEOS-Chem**

+

Open air quality data from governments' monitoring networks



Credit: OpenAQ

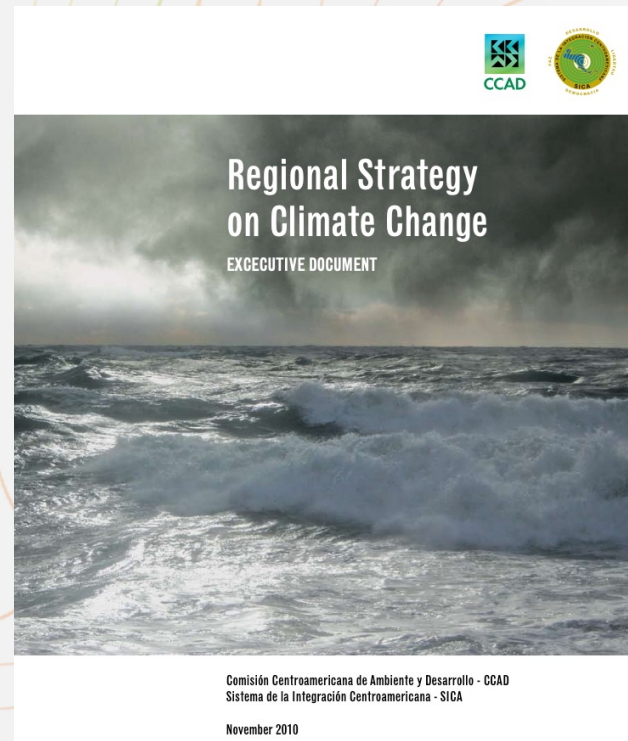
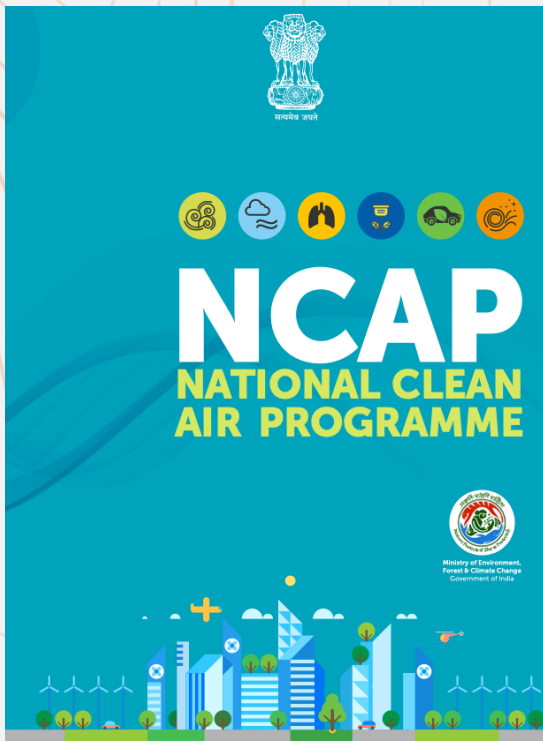
## Why is air quality management important?

- Air Quality affects human health through direct and indirect pathways
- National Ambient Air Quality Standards (NAAQS) and data help in presenting an accurate status of local air



## Examples of air quality management programs

- In 1992, Mexico City administration initiated the ProAire Programme
- In 2015, Mexico introduced a nationwide National Air Quality Strategy (ENCA)
- India launched its National Clean Air Programme in 2019 with the goal of reducing PM concentrations
- Central American Integration System's (SICA) Regional Strategy on Climate Change





# To Summmarize...

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# Air Pollution is one of the most pressing problems



## DEATHS LINKED TO OUTDOOR AND HOUSEHOLD AIR POLLUTION

**7 million** people die prematurely every year from air pollution – both household and outdoor.  
Among these deaths:

- 21%** are due to pneumonia
- 20%** from stroke
- 34%** from ischaemic heart disease
- 19%** from chronic obstructive pulmonary disease (COPD)
- 7%** from lung cancer

**CLEAN AIR FOR HEALTH** #AirPollution World Health Organization

## REDUCING AIR POLLUTION AND MITIGATING CLIMATE CHANGE, TOGETHER HELP TO PROTECT OUR HEALTH

**WHO Air Quality Guidelines set goals to protect millions of lives from air pollution.**

**CLEAN AIR FOR HEALTH** #AirPollution World Health Organization



## AQLI is built to help **everyone** tackle air pollution

**Directly connects** air pollution information to health

Can be used by **both policymakers and public alike**

Life expectancy lost, an **easily understandable** underlying health **metric**

**Interactive** platform with full and **open access**

**Hyperlocal and Global**

Comparison **across regions and time**



Air quality management practices are an important tool in the fight against air pollution



# Thank you

Have Questions? Write to me at: [nishkasharma@uchicago.edu](mailto:nishkasharma@uchicago.edu)

To learn more, visit: <https://aqli.epic.uchicago.edu/>