Environmental Pollution and Human Health Impact in sub-Sharan Africa

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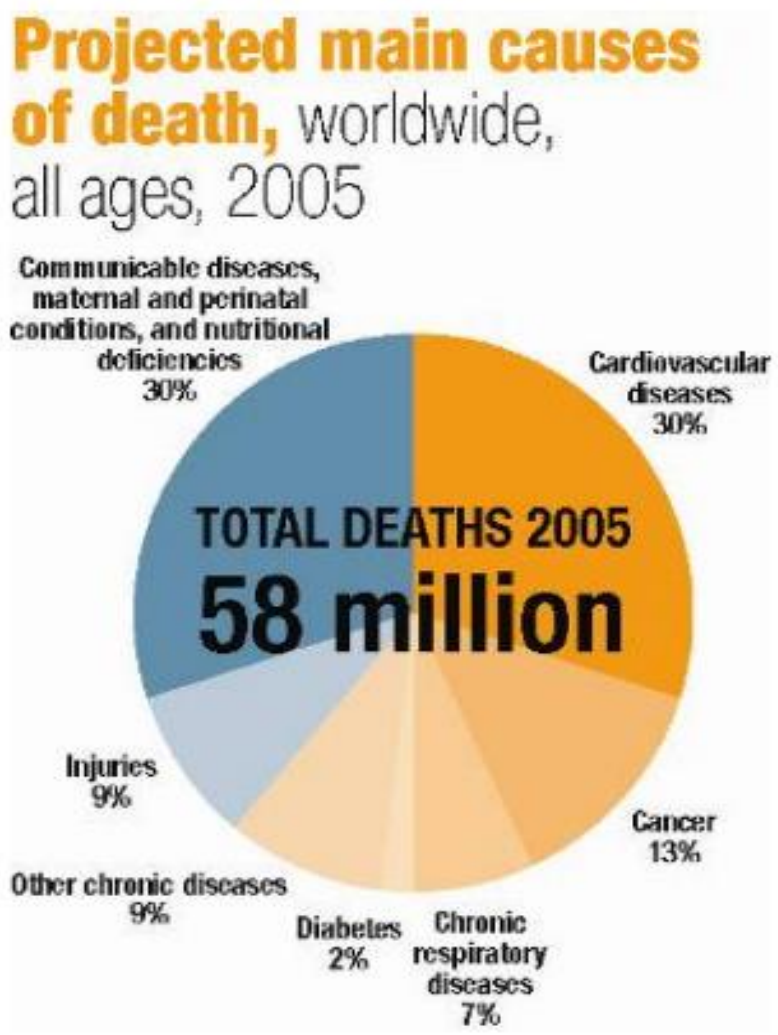
Developing countries and emerging economies
Noncommunicable Diseases (NCD) and diseases of poverty



2 in 3 death are from NCDs – 80% of burden is in low-and middle-income countries

- Cardiovascular disease-heart stroke,
- Chronic respiratory diseases
- Diabetes
- Cancer
- Injuries

Diseases of poverty:

- TB
- malaria
- COVID-19

INADEQUATE / UNSAFE WATER
Sanitation and Hygiene

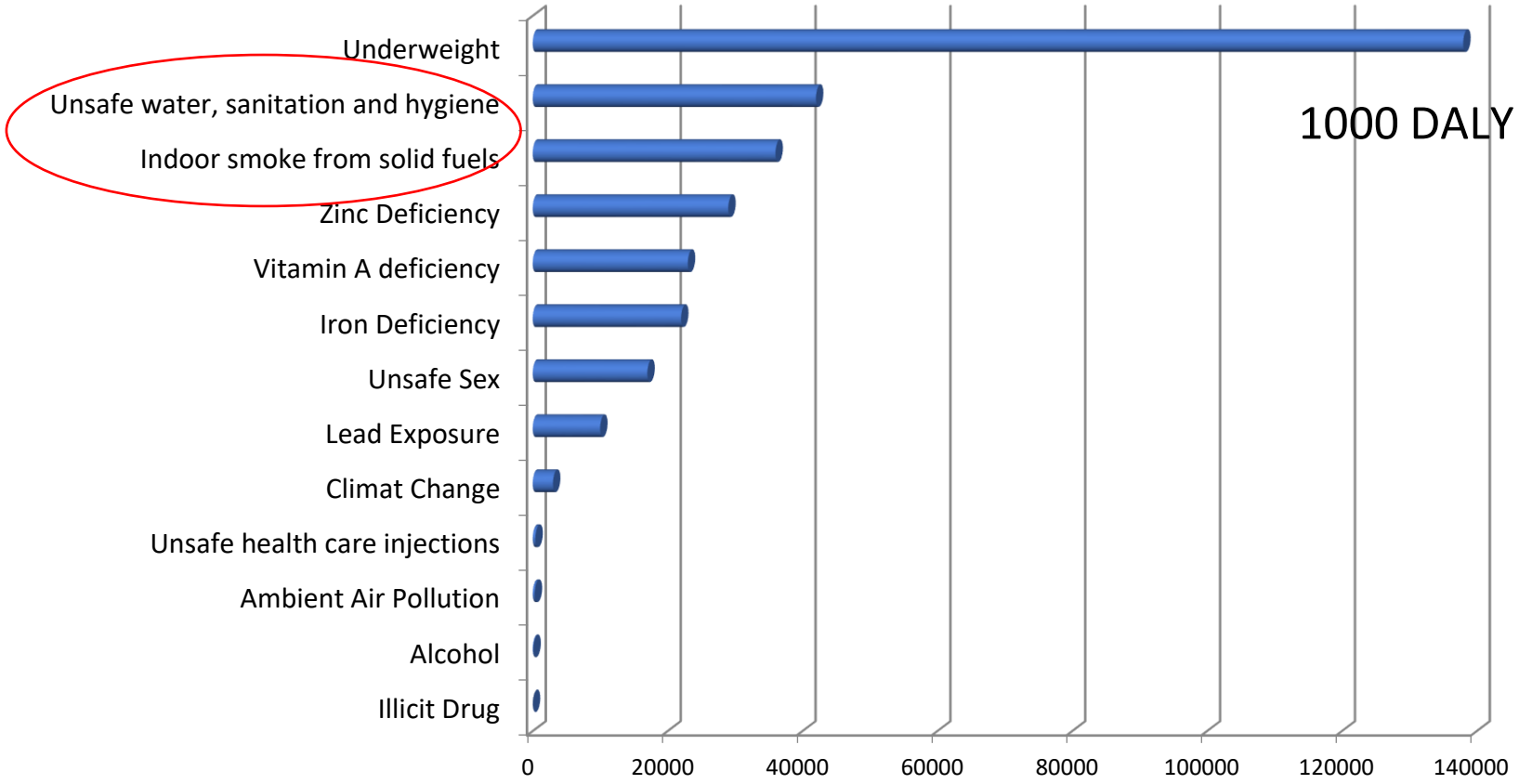
Climate change and health impacts– greater in Africa

Cumulative emissions of greenhouse gases, to2002

Estimate of *Per capita* mortality from climate change

https://drjustinthacker.wordpress.com/tag/global-warming/

Childhood Disease and the Environment



Lack of clean water and in-door air pollution are 2nd and 3rd most important contributor to poor health in the world's children

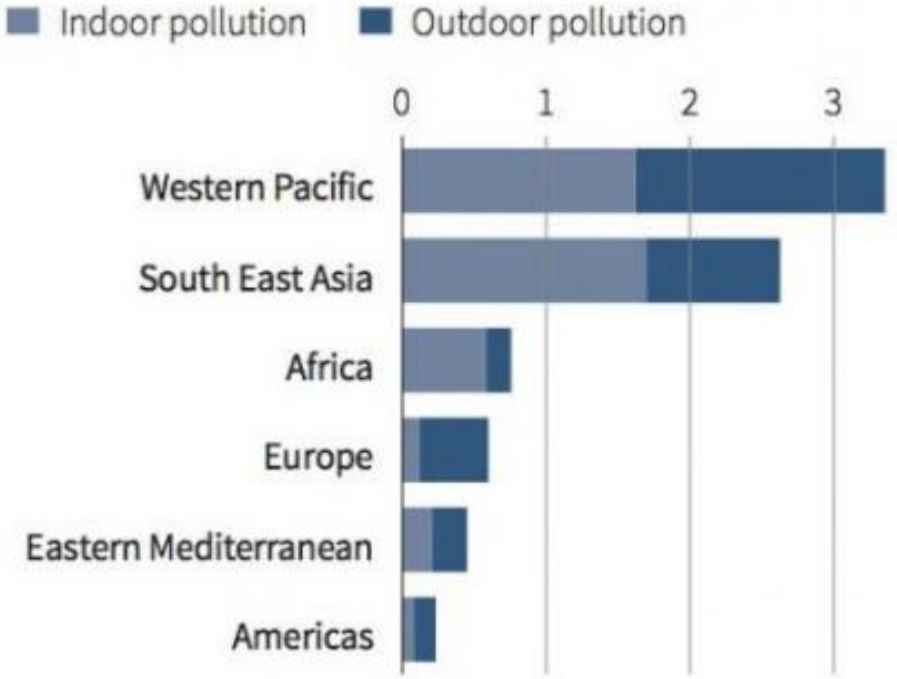
WHO, 2002, www.who.int/whr/2002/en/

Health effects of air pollution

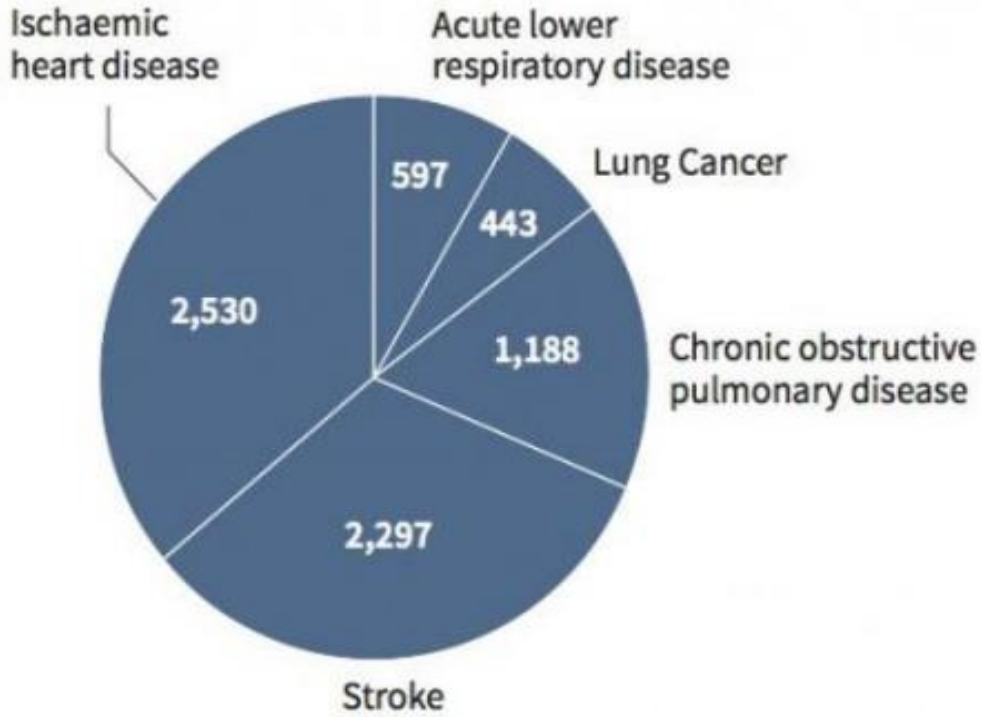
Deadly air pollution

Air pollution killed around 7 million people worldwide in 2012 according to WHO's latest report.

Air pollution-linked deaths by region
in millions



Air pollution-linked deaths by disease
in thousands



Indoor pollution is mostly caused by cooking over coal, wood and biomass stoves.
Outdoor pollution is mostly caused by transport, power generation, industrial and agricultural emissions, and residential heating and cooking.

Source: World Health Organization

Sources of air pollution

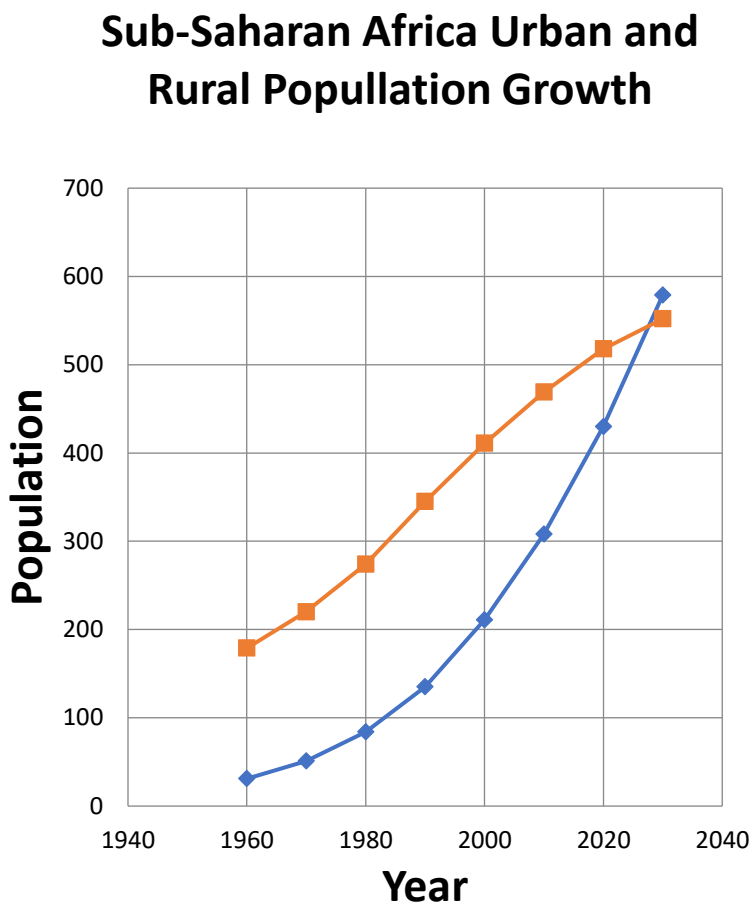
Air pollution is a mixture of gases, particulate matter and biological entities which can individually or collectively affect human health.

Out-door pollution

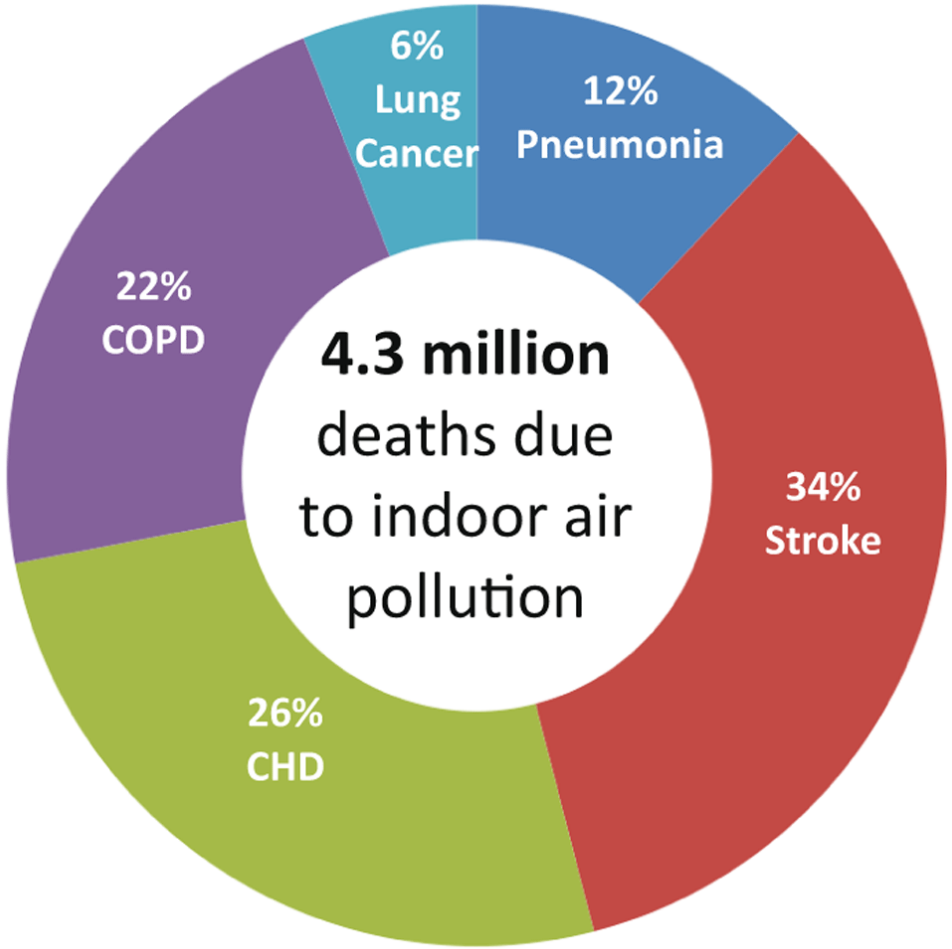
In-door Pollution

Trends and challenges Air Pollution

- **Fast urban growth in low-and middle-income cities** – Urban population of sub-Saharan African countries is growing at rate that is twice the national average.
- By 2030 the urban population of sub-Saharan Africa countries would surpass the rural population. Most urban population lives in slums where air pollution is high- 40% is slums
- Biofuel is used by for household cooking by 50% the worldwide and in sub-Saharan countries the 80-90%. Many stoves and cooking area are not well vented and cooking stove emitter air borne pollutants such as PM, CO, PAHs and toxic hydrocarbons, and NOx, and SOx
- Children peak and mean exposure to a combined “neighborhood” and in house pollution exceed WHO guidelines for safe standards.

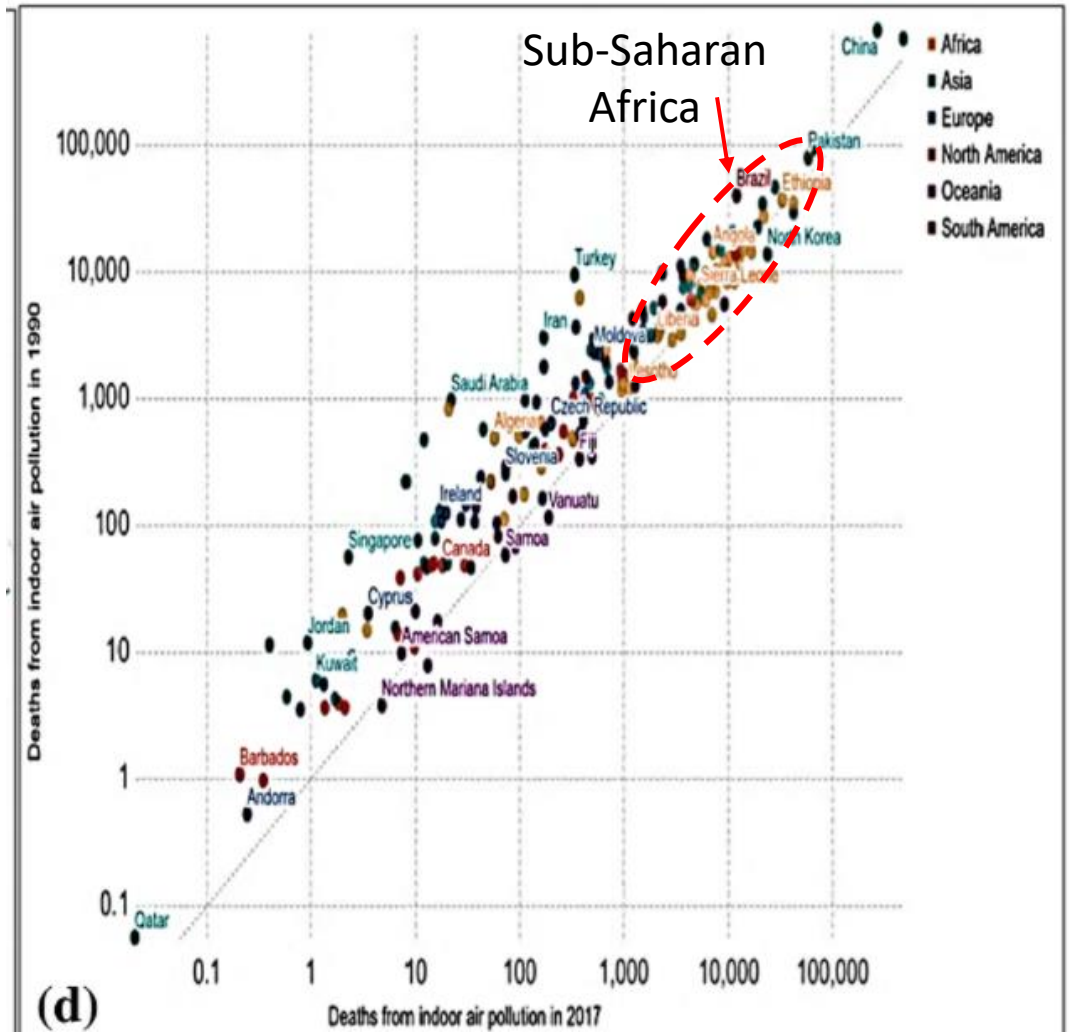


Deaths related to indoor air pollution.

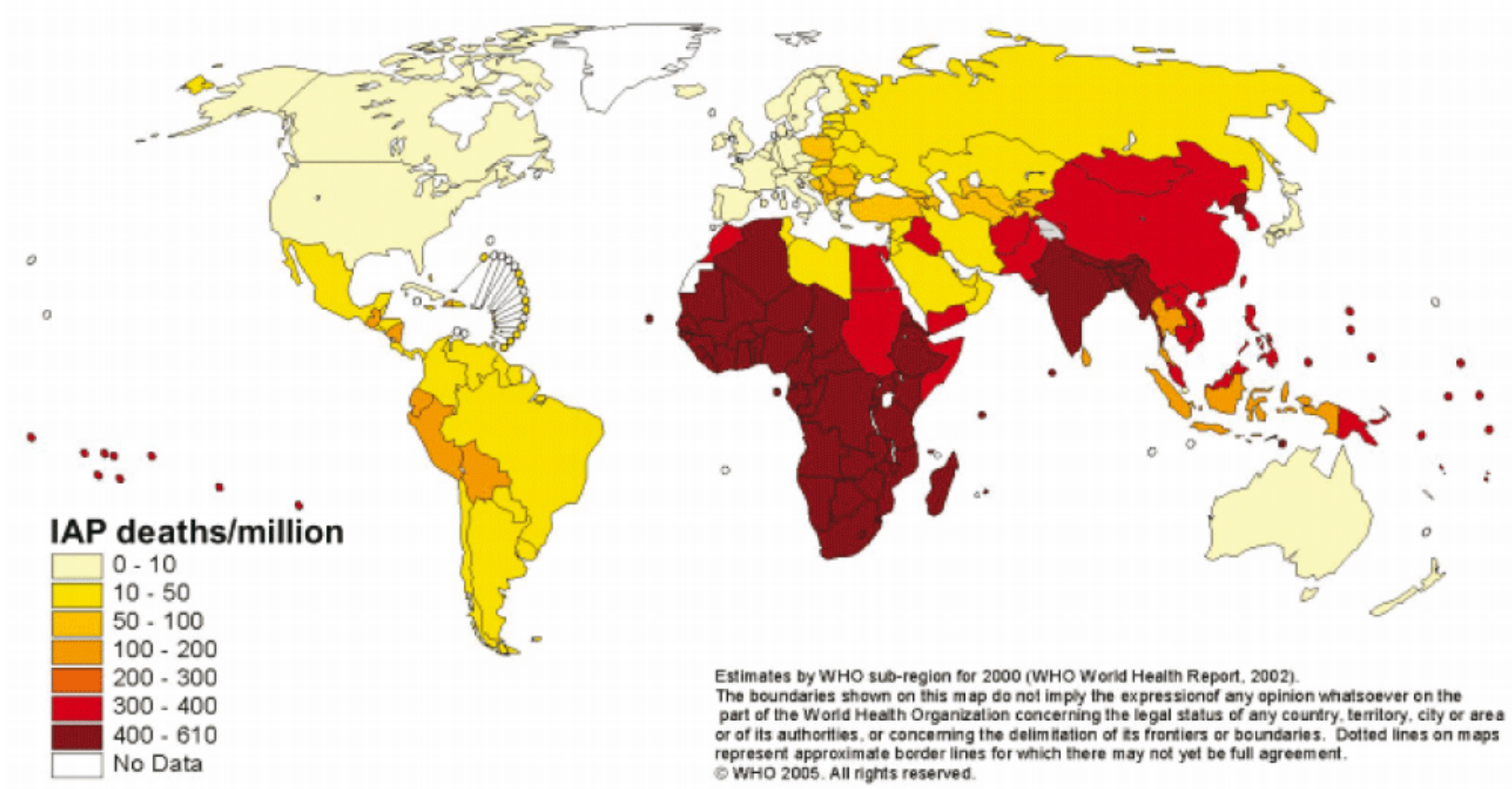


Apte K and Salvi S. Household air pollution and its effects on health [version 1]. F1000Research 2016, 5:2593 (doi: 10.12688/f1000research.7552.1)

Number of deaths by in-door air pollution in 1990 versus 2017

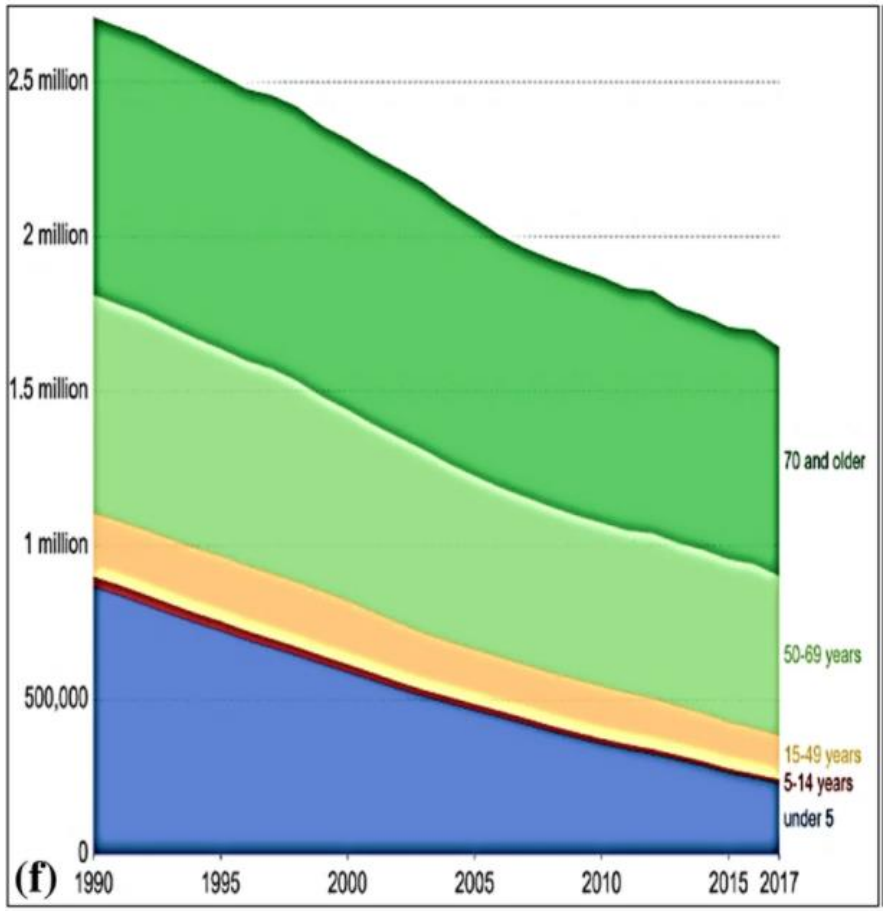


Global in-door air pollution (IAP) mortality per million population.



Apte K and Salvi S. Household air pollution and its effects on health [version 1]. F1000Research 2016, 5:2593 (doi: 10.12688/f1000research.7552.1)

In-door air pollution rate per 100,000 people in 1990 versus 2017 as a function of age. Old age people above 69 year are more prone for indoor air pollution risk



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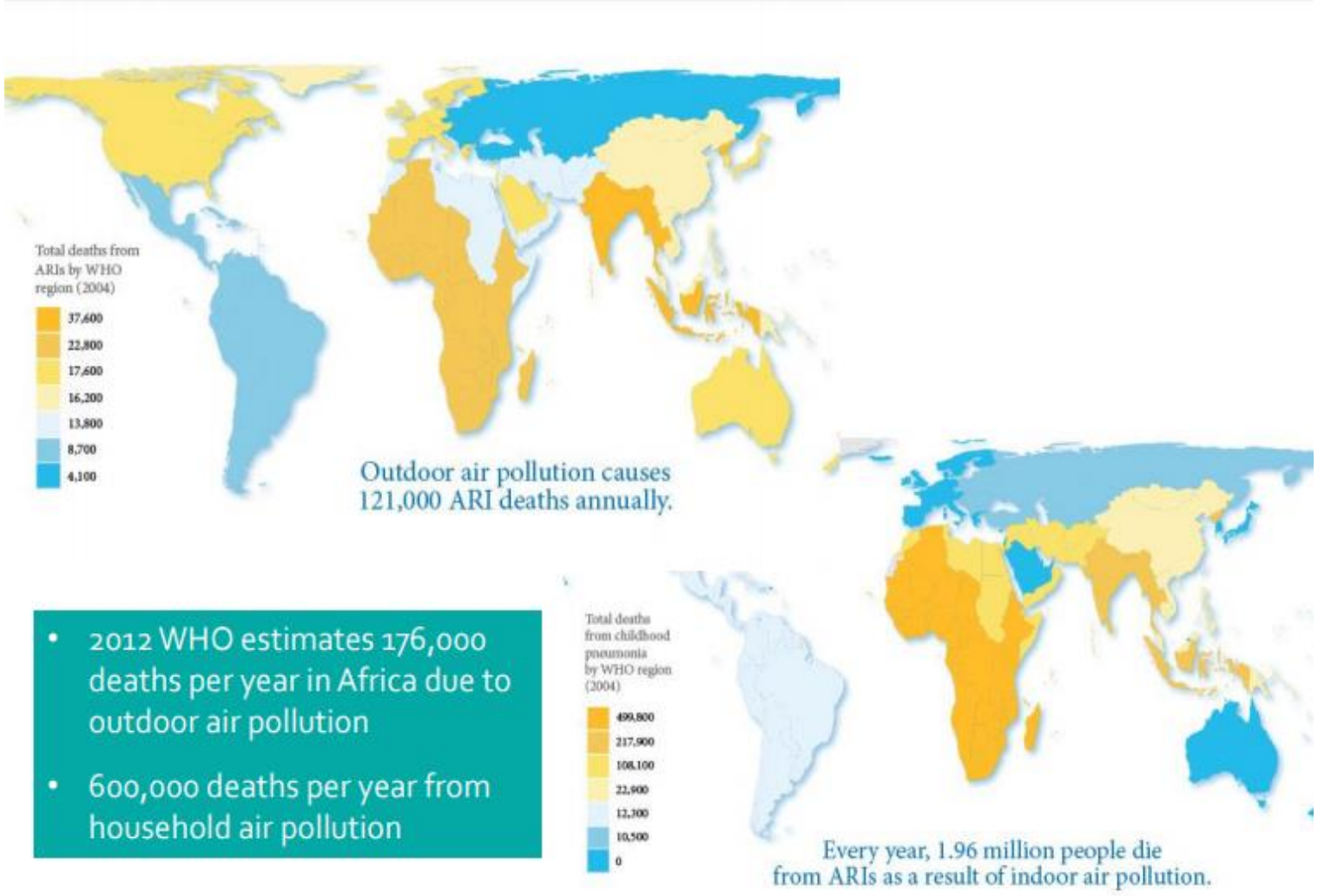
High levels of out-door and in-door pollution in Sub-Saharan Africa



- 2012 WHO estimates 176,000 deaths per year in Africa due to outdoor air pollution
- 600,000 deaths per year from household air pollution

Source: The Acute Respiratory Infections Atlas: First Edition

Case studies in collaboration with Addis Ababa University: Out-door and in-door air pollution in Ethiopia

Measurement Plan - 1

Ambient – measurements (PM, CO, VOCs) at selected urban sites Based on point-source, vicinity to traffic,

Measurement

In door – measurement for PM, CO, VOCs

Cooking methods,

Socio economic factors

Meteorological measurements – Temp, humidity, wind Affecting pollutant dispersion (out side source

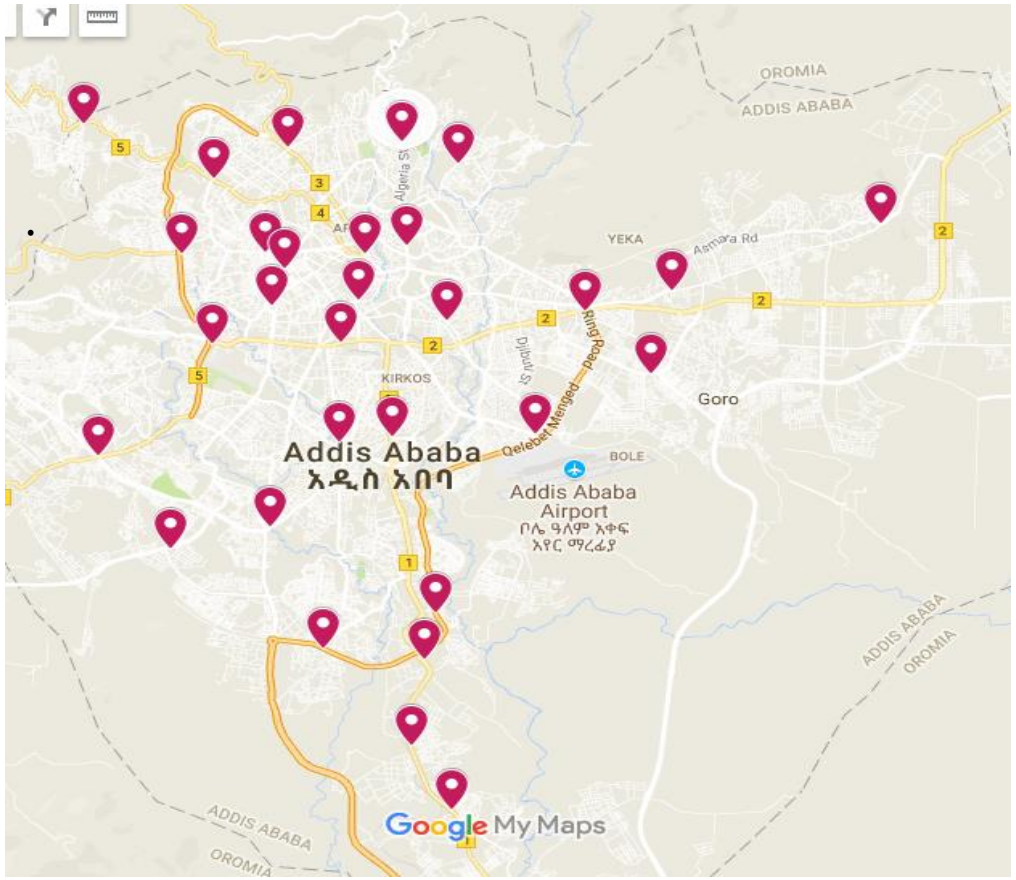
Conventional

iOS

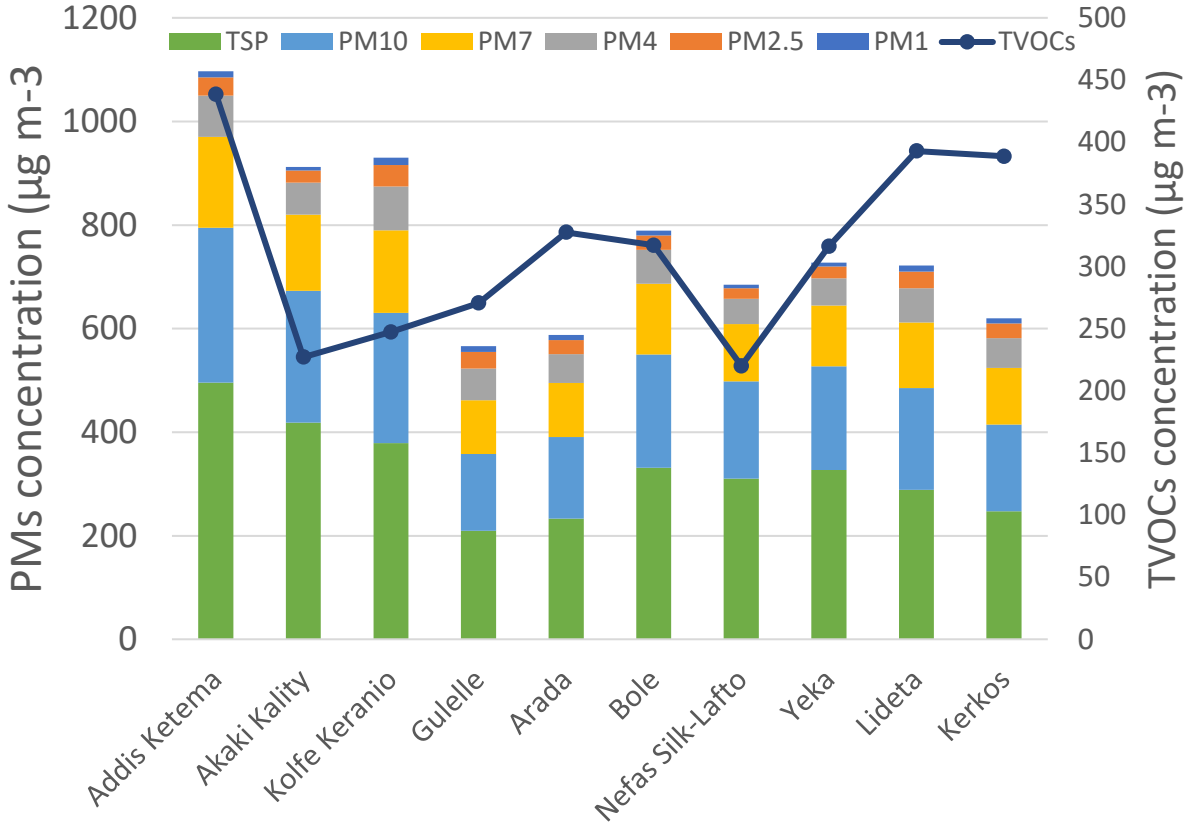
Personal sensors

New approach

The spatial variation of PMs and TVOCs at different sub-cities in Addis Ababa.



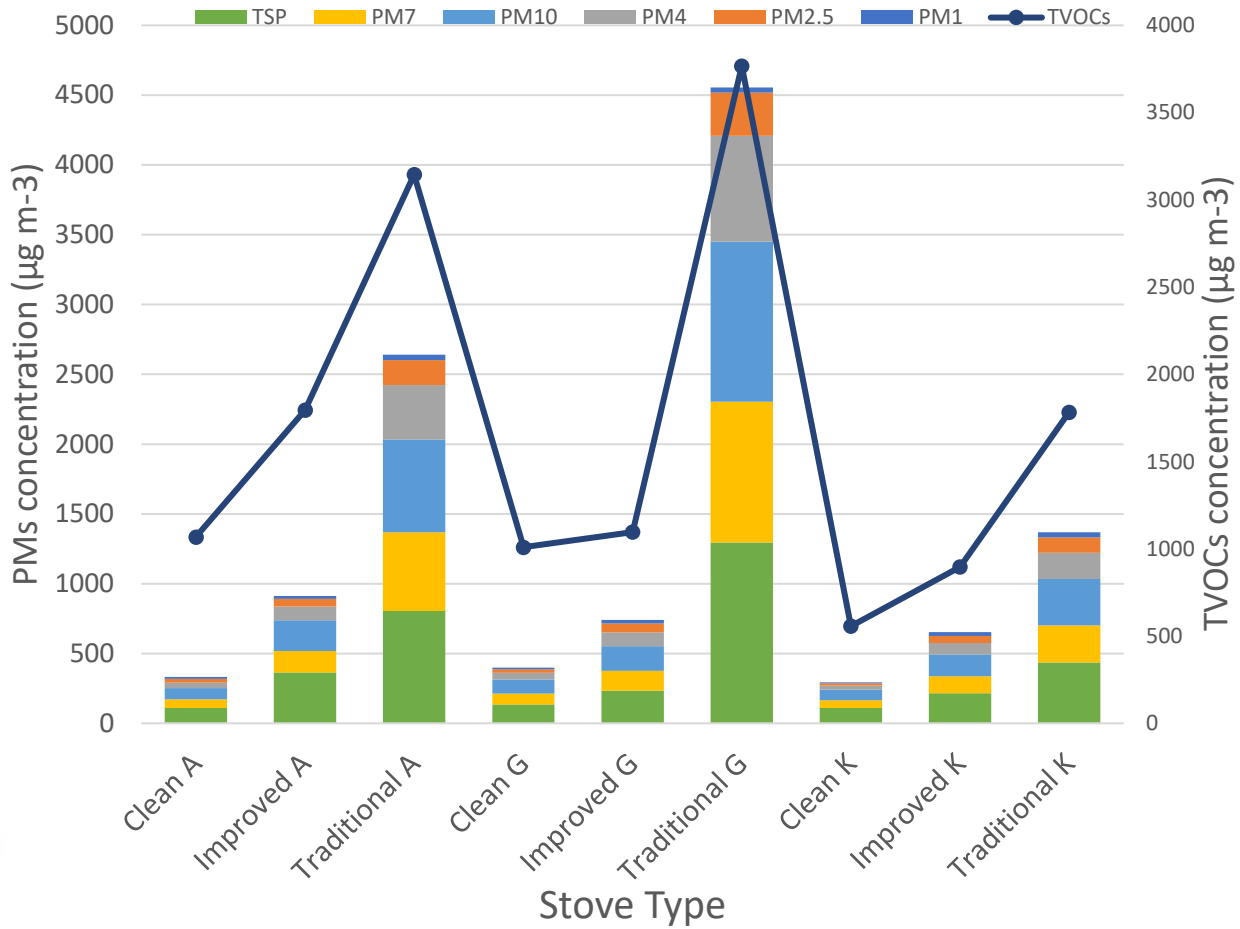
Air Sampling points in Addis



Embiale, Zewge, Chandravanshi, Sahle-Demessie, *Environmental Monitoring and Assessment* 191 (6), 397, 2019; *International Journal of Environmental Science and Technology*, 16: 4761, 2019

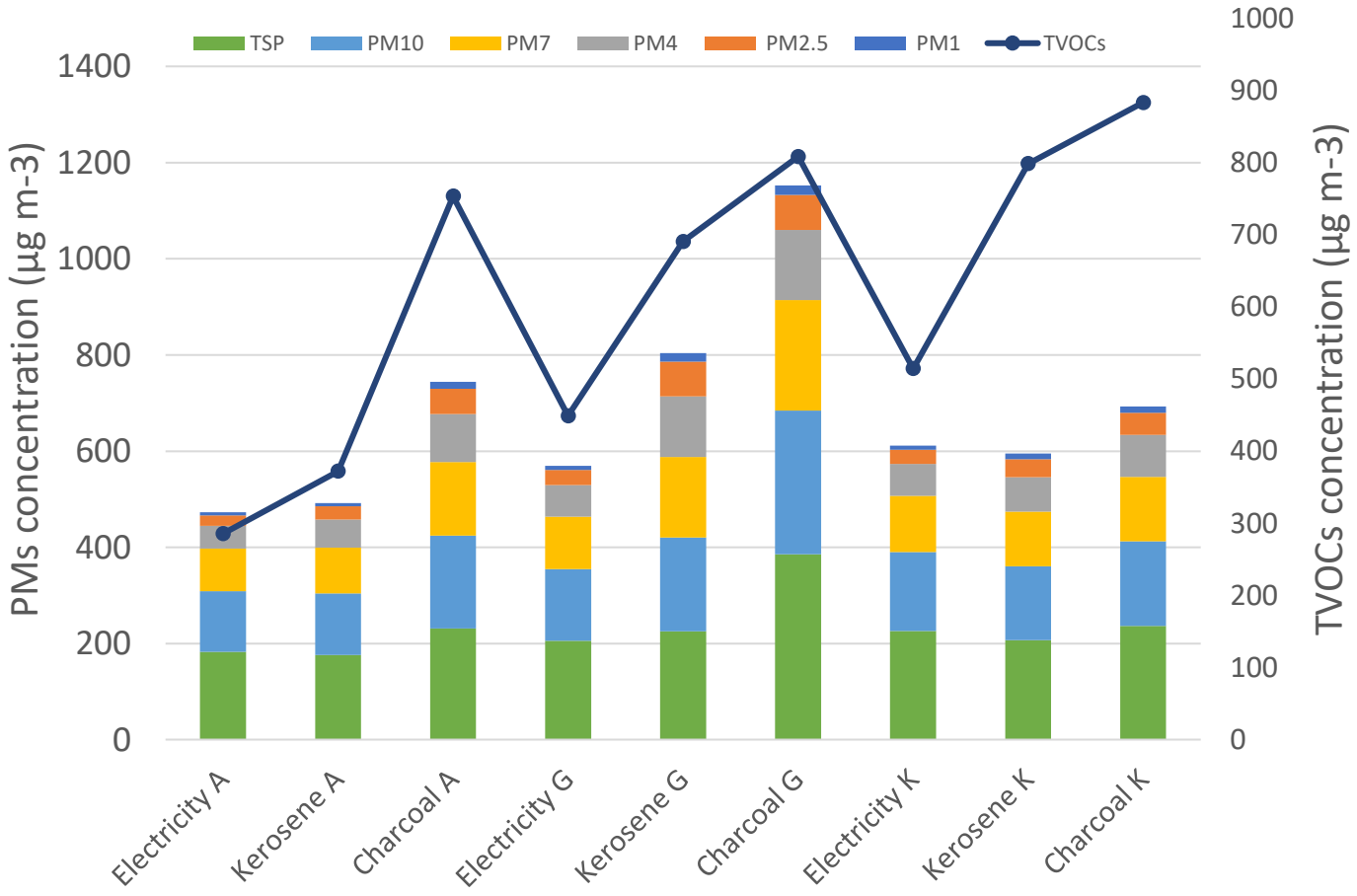
Traditional cooking stove – major source of pollution

ure 1. (a) The pictures of three types of cook stove used for baking the *Injera*. (b) The sketch of three types of cook stove ed for baking the *Injera*.

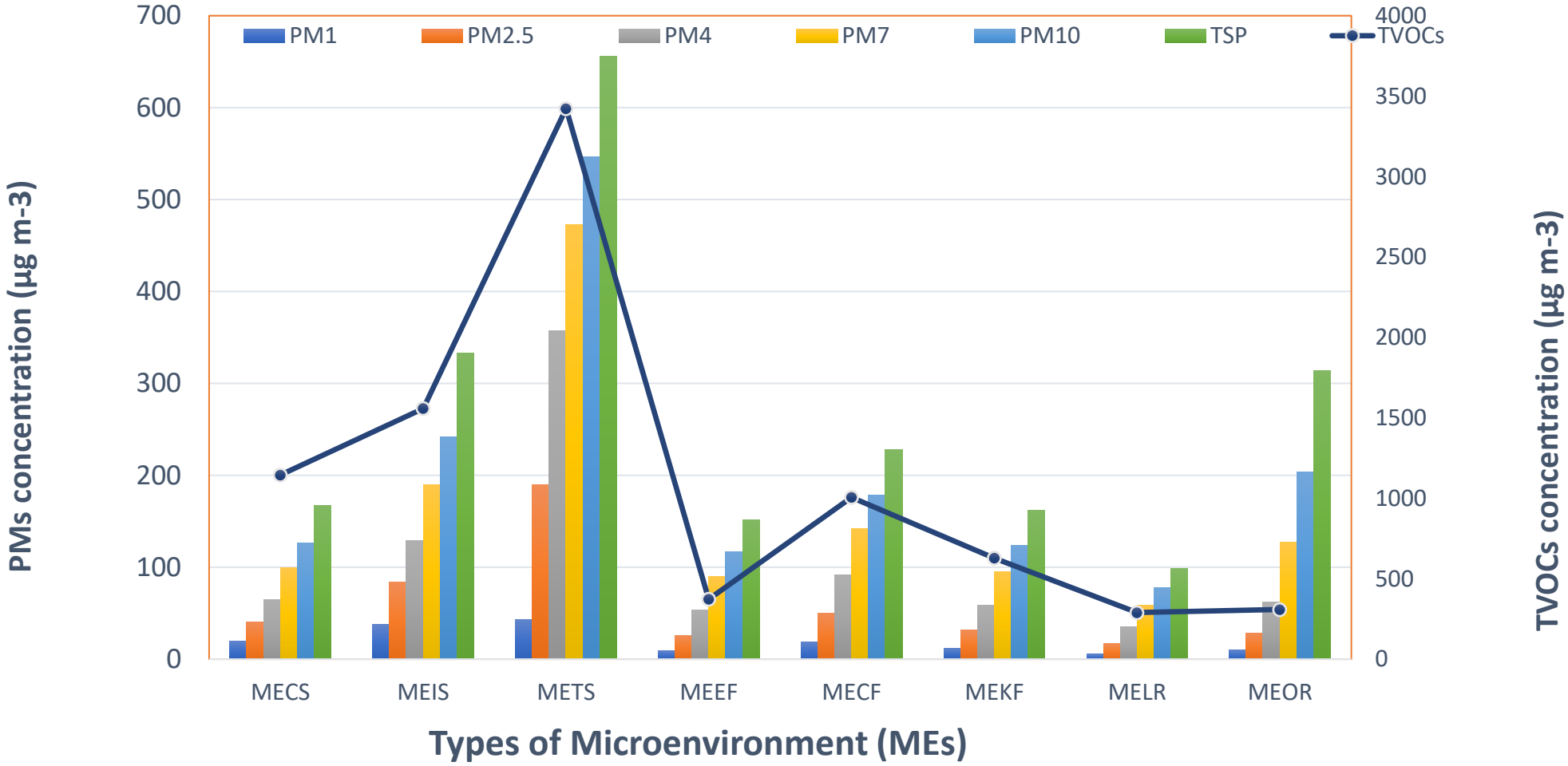


Embiale, Zewge, Chandravanshi, Sahle-Demessie, *Indoor and Built Environment*, 2019, Vol. 28(8) 1140–1154.

The level of PMs and TVOCs during preparation of Wot during dry season at different sites using different types of fuel type



Embiale, Zewge, Chandravanshi, Sahle-Demessie *Toxicological & Environmental Chemistry, , 1*02, 1-4, 151-169; *International Journal of Environmental Analytical Chemistry, 20*20.



Embiale, Zewge, Chandravanshi, Sahle-Demessie *Environmental Monitoring and Assessment,* Volume191, Issue6, Pages1-18

Article

Health risk assessment of total volatile organic compounds, particulate matters and trace elements in PM_{10} in typical living rooms in Addis Ababa, Ethiopia

Asamene Embiale, Bhagwan Singh Chandravanshi, Feleke Zewge & Endalkachew Sahle-Demessie

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ABSTRACT

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Nowadays, particulate matter and total volatile organic compounds in the air are the primary environmental concern of the world due to their health impact. Therefore, the present work was focused on the assessment of short-term exposure to particulate matter (PMs) in the air samples of different particle size (PM1, PM2.5, PM4, PM7, PM10) and total suspended particles (TSP), total volatile organic compounds (TVOCs)

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Published: 24 May 2019

Levels of trace elements in PM_{10} collected at roadsi of Addis Ababa, Ethiopia, and exposure risk assess

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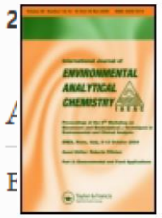
Environmental Monitoring and Assessment 191, Article number: 397 (2019) | Cite this article



Taylor & Francis

International Journal of Environmental Analytical Chemistry

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/geac20

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Archives of Environmental & Occupational Health

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/vaeh20

Indoor air pollution from cook-stoves during *Injera* baking in Ethiopia, exposure, and health risk assessment

Asamene Embiale , Bhagwan Singh Chandravanshi , Feleke Zewge & Endalkachew Sahle-Demessie

To cite this article: Asamene Embiale , Bhagwan Singh Chandravans Endalkachew Sahle-Demessie (2021) Indoor air pollution from cook-st Ethiopia, exposure, and health risk assessment, Archives of Environm 76:2, 103-115, DOI: 10.1080/19338244.2020.1787317

Eco/Toxicology

Health risk assessment of trace elements through exposure of particulate matter-10 during the cooking of Ethiopian traditional dish sauces

Asamene Embiale, Bhagwan Singh Chandravanshi, Feleke Zewge & Endalkachew Sahle-Demessie

Pages 151-169 | Received 20 Apr 2020, Accepted 10 May 2020, Accepted author version posted online: 18 May 2020, Published online: 09 Jun 2020

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Abstract

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This study was aimed to analyze trace elements in the particulate matter-10 and evaluate their health risks during the cooking of the most widely consumed Ethiopian traditional dish sauces (*Wots*) using charcoal, kerosene and electricity stoves. The trace elements (iron, cadmium, arsenic, chromium, lead, boron, nickel, cobalt, tin, copper and zinc) in the particulate matter-10 were found in the range 0.001–0.175 μg m^{-3}. The human health risk assessment has done based on the United States Environmental Protection Agency prescription. The hazard quotient and hazard index values using charcoal, kerosene and electricity stoves were found below 1. This result showed that the inhabitants stay at any of these three microenvironments has no likelihood to have non-cancer health problems. In addition, the life time cancer values for all trace es Environmental Protection Agency, except he tolerable range. Furthermore, the total sum est concentration was observed using kerosene y. The use of kerosene and charcoal stove were for the cooking of *Wot*.

lth risk assessment | fuel type

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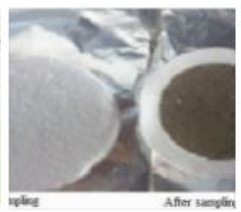

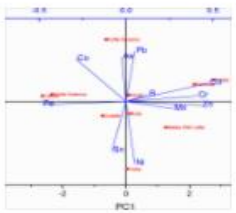

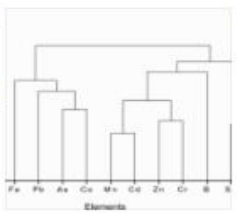

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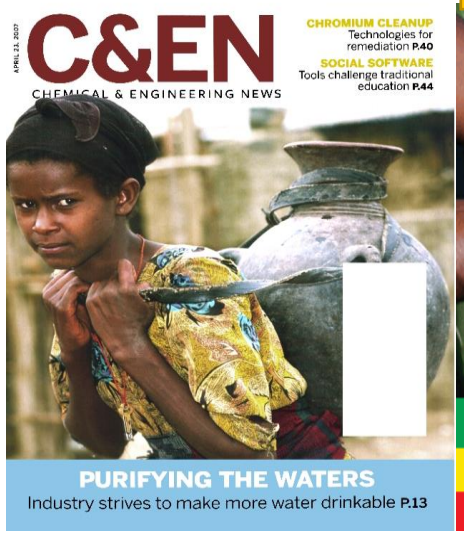
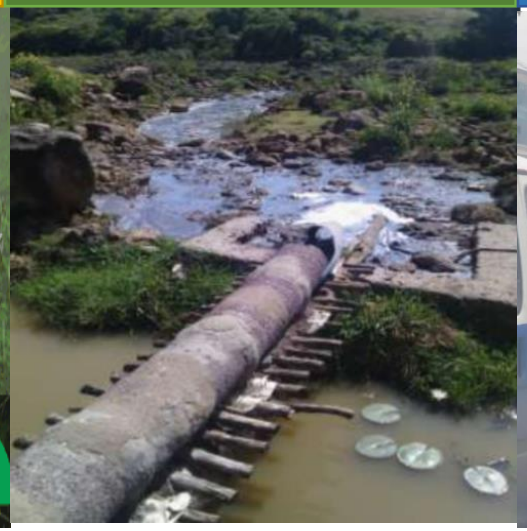
Environment and Public Health

Water Stress	Water Quality	Industrial Discharge	Chronic Air Pollution	Solid waste



Agr. Nutrient run off Koka dam lake

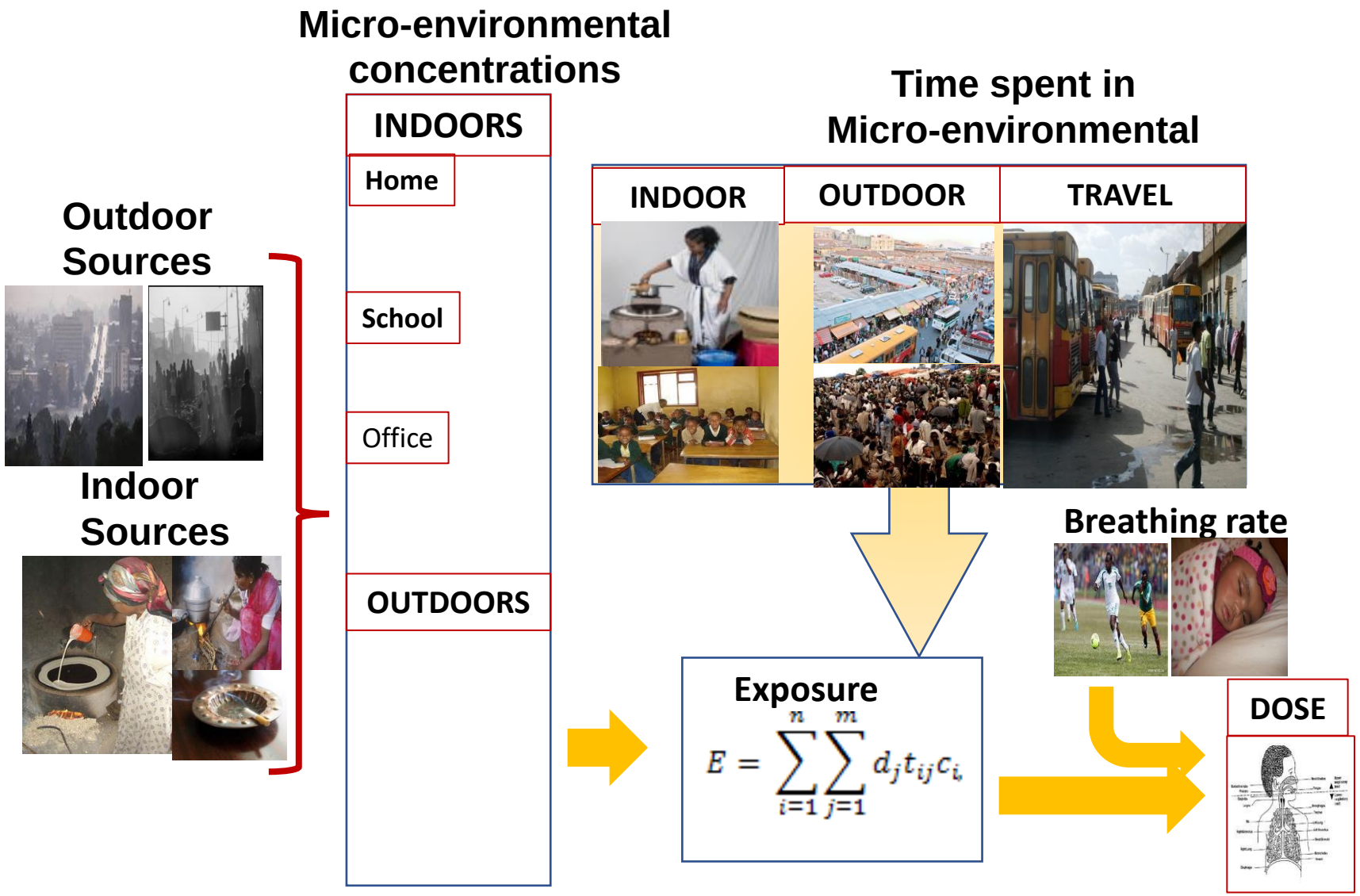


Tannery effluent – Bahir Dar

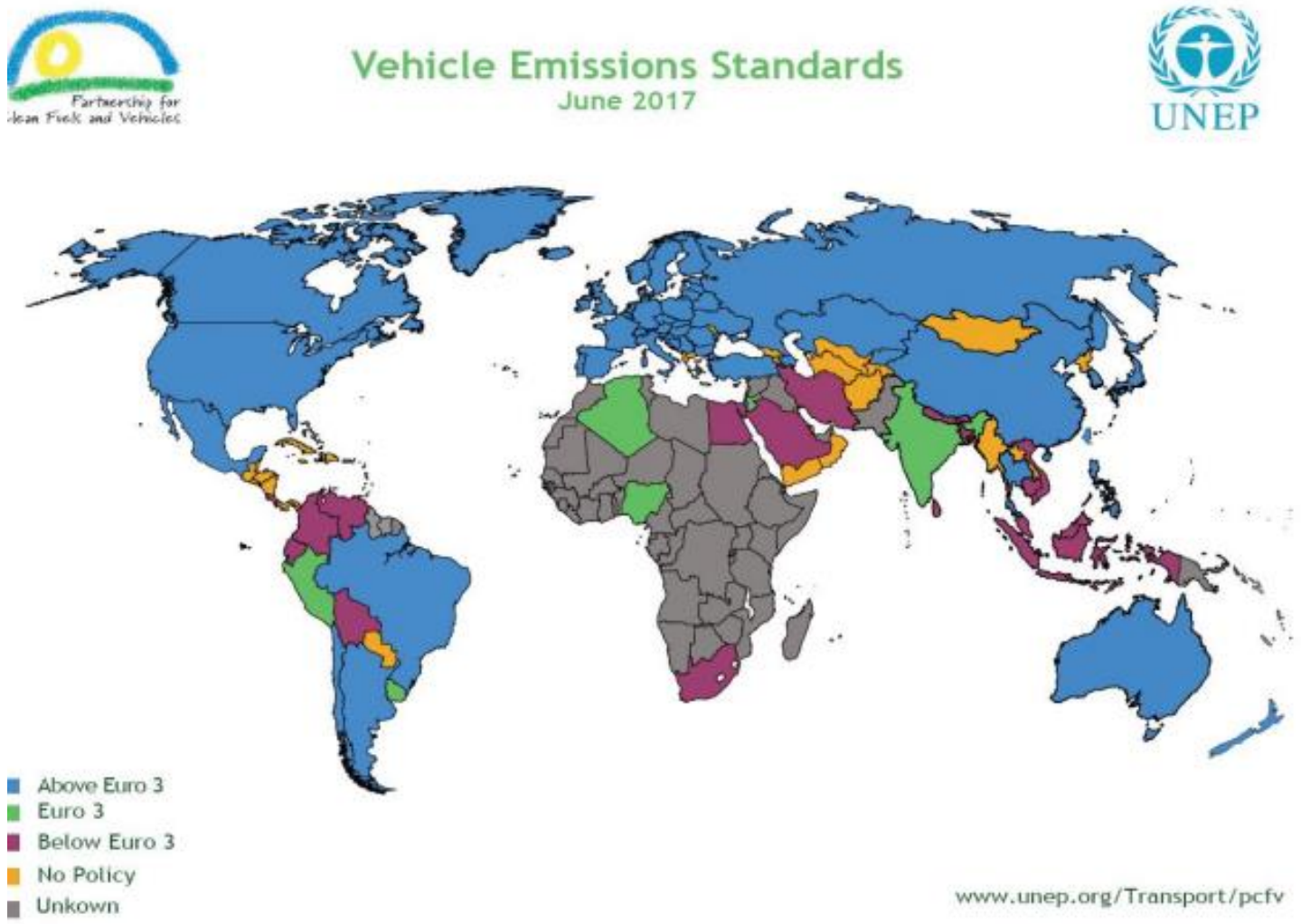
Addis Ababa

- Water supply, industrial and municipal pollution,
- Wastewater treatment, Vector control
- Urban air quality management and
- In-door pollution from biomass fuels stoves
- Prevention and control of land pollution – recycling, reuse, converting solid waste to energy

Human Exposure and Dose Simulation Model for Air Pollutants



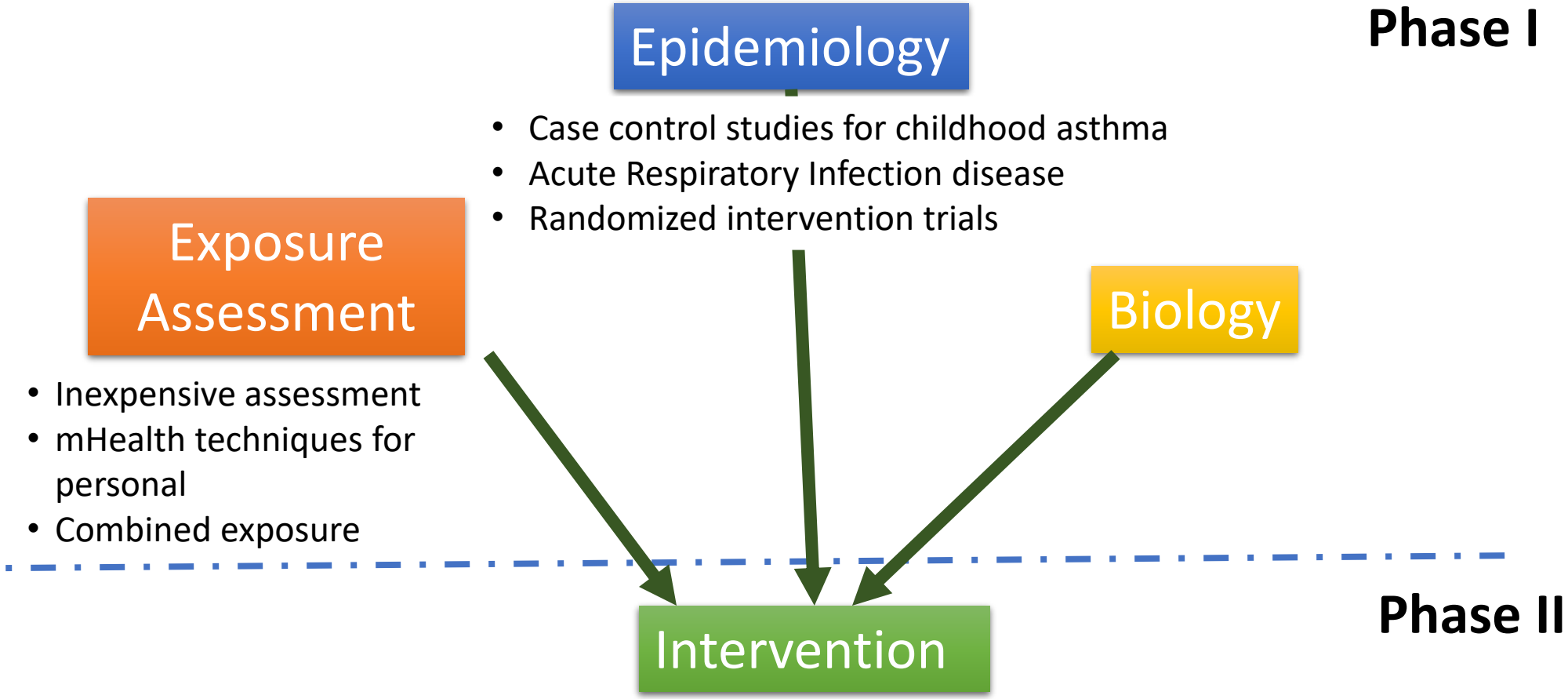
The need for more air quality data



The Clean Air Initiative Sub-Saharan Africa (started 1998)

1. Raise awareness of the dangers of urban air pollution, and its relation to vehicle and fuel choices,
2. Identify the population at highest risk (children and their mothers, street vendors, and pedestrian commuters);
3. Measure baseline vehicle emissions, air quality, pollution exposure, and pollution effects;
4. Identify the most cost-effective measures targeting changes in vehicles, fuels, and traffic management;
5. Design, implement, and monitor the impacts of Air Quality Action Plans to reduce pollution, including clear, measurable, and enforceable goals for reducing pollutants; and
6. Strengthen local expertise on air pollution and vehicle and fuel performance

Research Framework



Thank you