Health Impact Assessment from Long-term Exposure to Outdoor Air Pollution in Thailand

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JITMM 2018

Bangkok, Thailand

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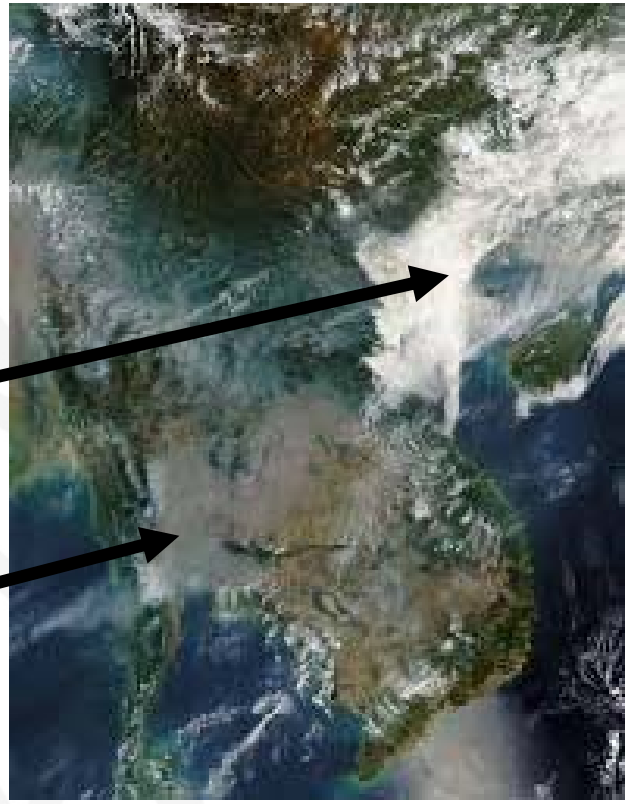
Background

- Ambient air pollution ($PM_{2.5}$ & O_3) is estimated to cause 4.5 million deaths globally per year[1]

- High concentrations of O_3 and PM in Thai cities from road traffic and industrial emissions[2,3]

- Exacerbations from agricultural burning and forest fires (haze)[2]

http://www.komchadluek.net/news/regional/261402



https://earthobservatory.nasa.gov/images/87758/smoke-and-fire-in-the-indochina-peninsula

1. Landrigan *et al.*, 2018
2. Vichit-Vadakan & Vajanapoom, 2011
3. Pinichka *et al.*, 2016

Research Questions

1. *What are the long-term air pollution trends in Thailand?*

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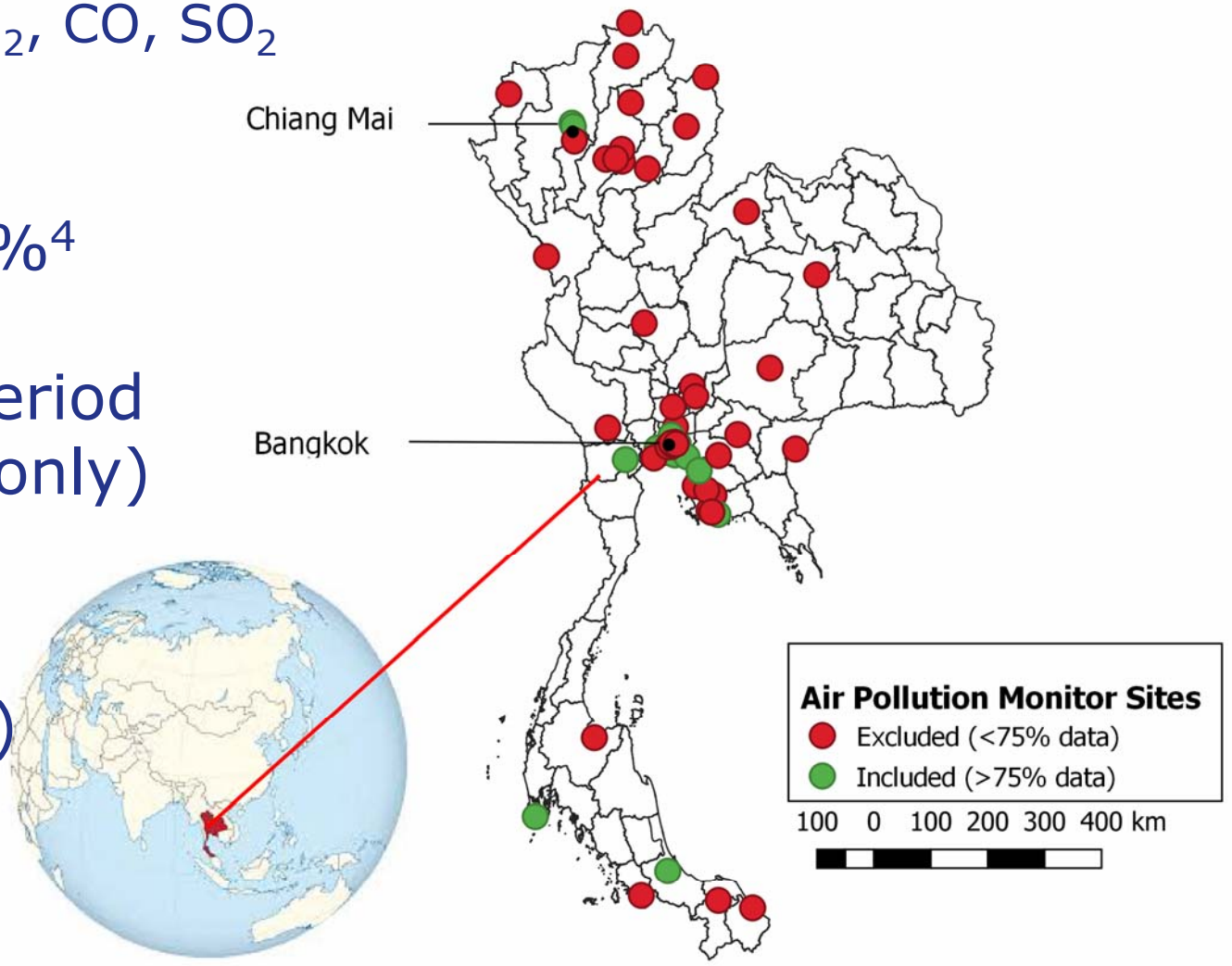
2. *What are the population health impacts in 2020 associated with long-term exposure?*

Air Pollution Data

- Thai Pollution Control Department (PCD) have ambient monitoring data (n=63) during 1996-2017:
  - PM_{10}, $PM_{2.5}$, O_3, NO_2, CO, SO_2
- Monitors with ≥75%[4] non-missing data during the study period (background sites only)
- Mean $PM_{2.5}$: PM_{10} ranged (0.55-0.72)



4. Wong *et al.*, 2008

Bangkok, Thailand

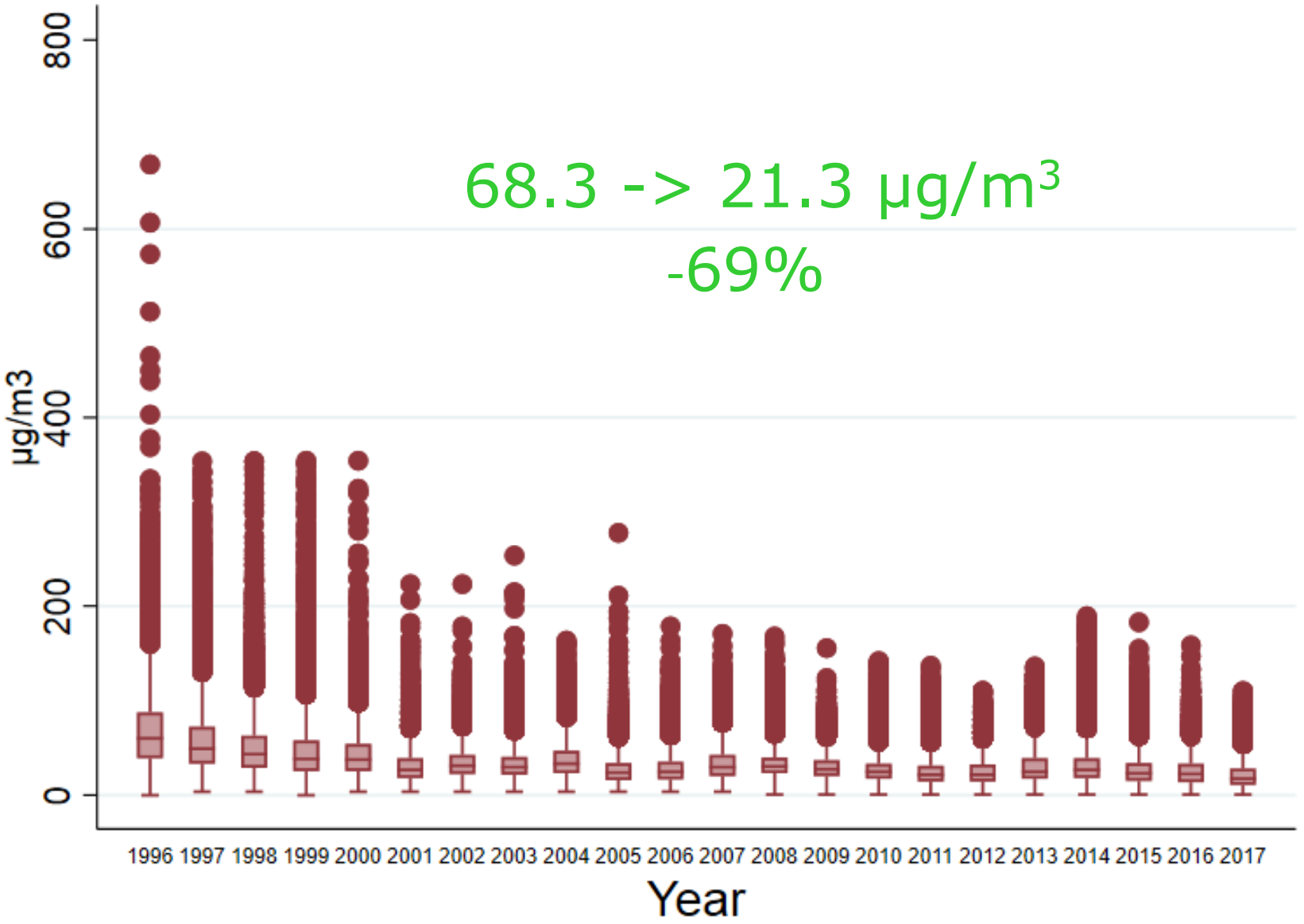
- Bangkok Metropolitan Region:
  - Population in 2015 = 12.6 million
  - Vehicles on the road = 10 million[5]

- Government policies affecting transport emissions[5]:
  - First car buyer incentive (2011/12)
  - Eco car phase 1/2 (2009-15)
  - Oil Plan 2015
  - Fuel an Engine Quality Standard Enforcement (by 2020)

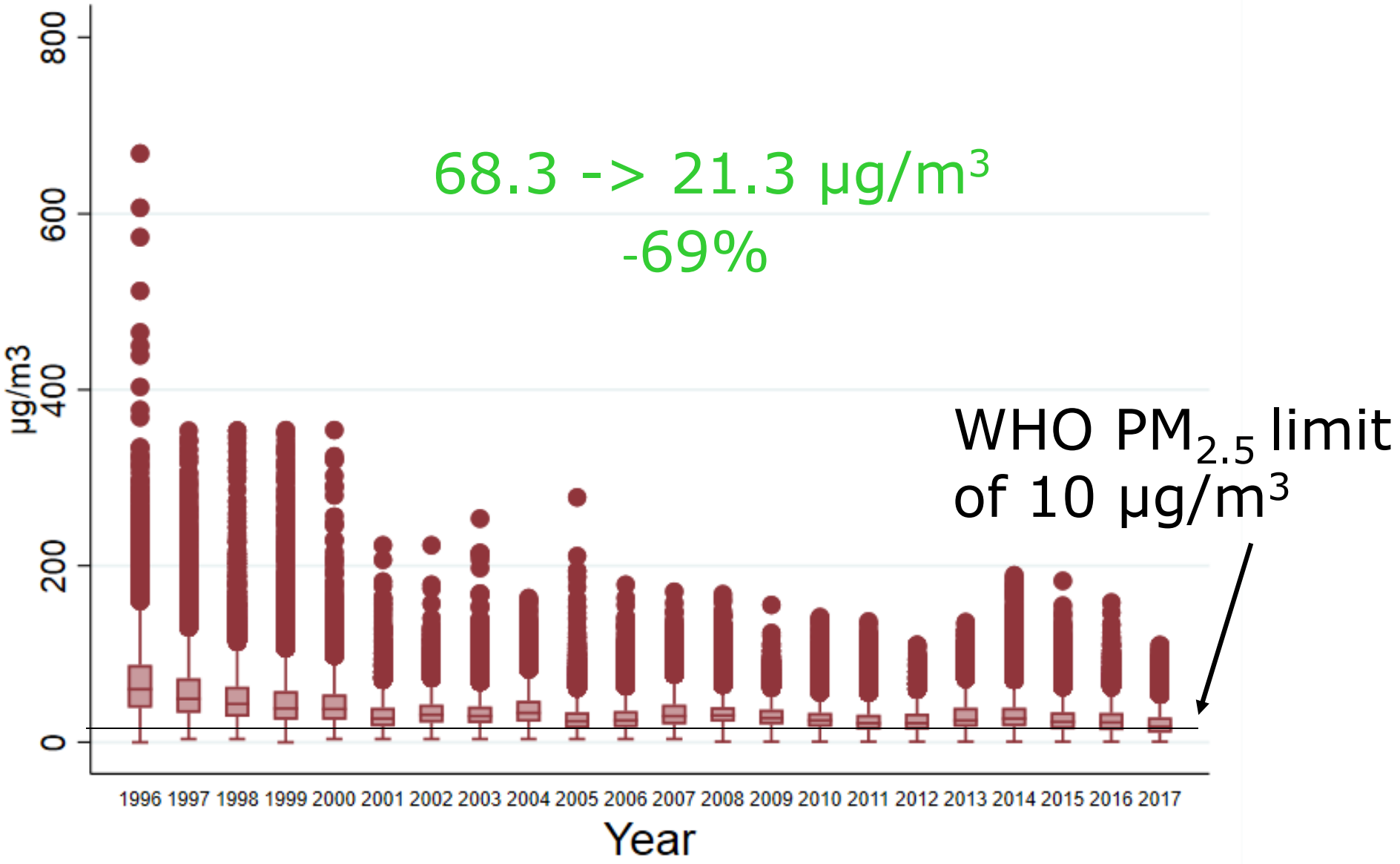
5. Cheewaphongphan et al., 2017

https://commons.wikimedia.org/wiki/File:Bangkok_at_night_(8272985716).jpg

$PM_{2.5}$ in Bangkok: 1996-2017



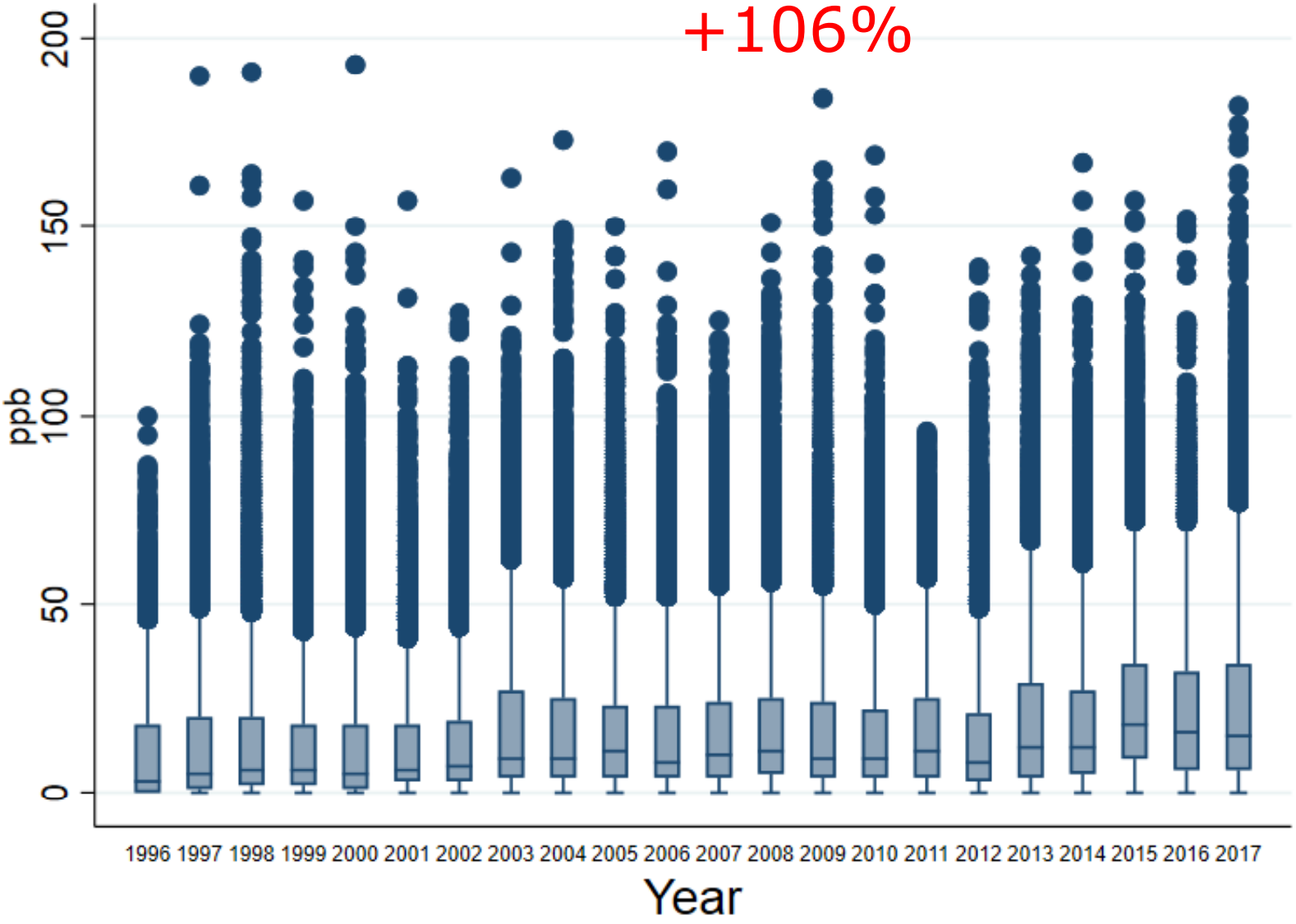
$PM_{2.5}$ in Bangkok: 1996-2017



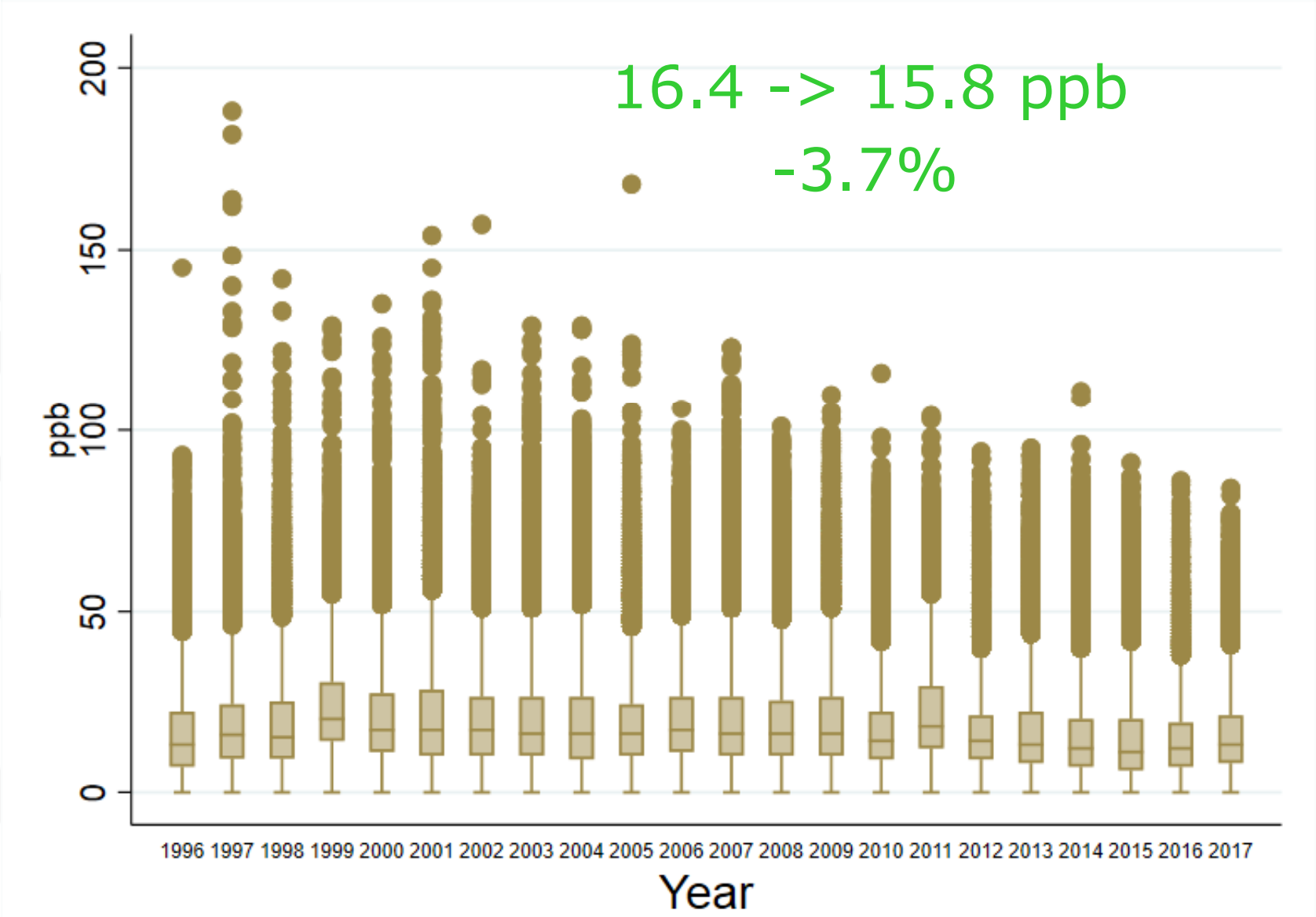
O_3 in Bangkok: 1996-2017

11.4 -> 23.5 ppb

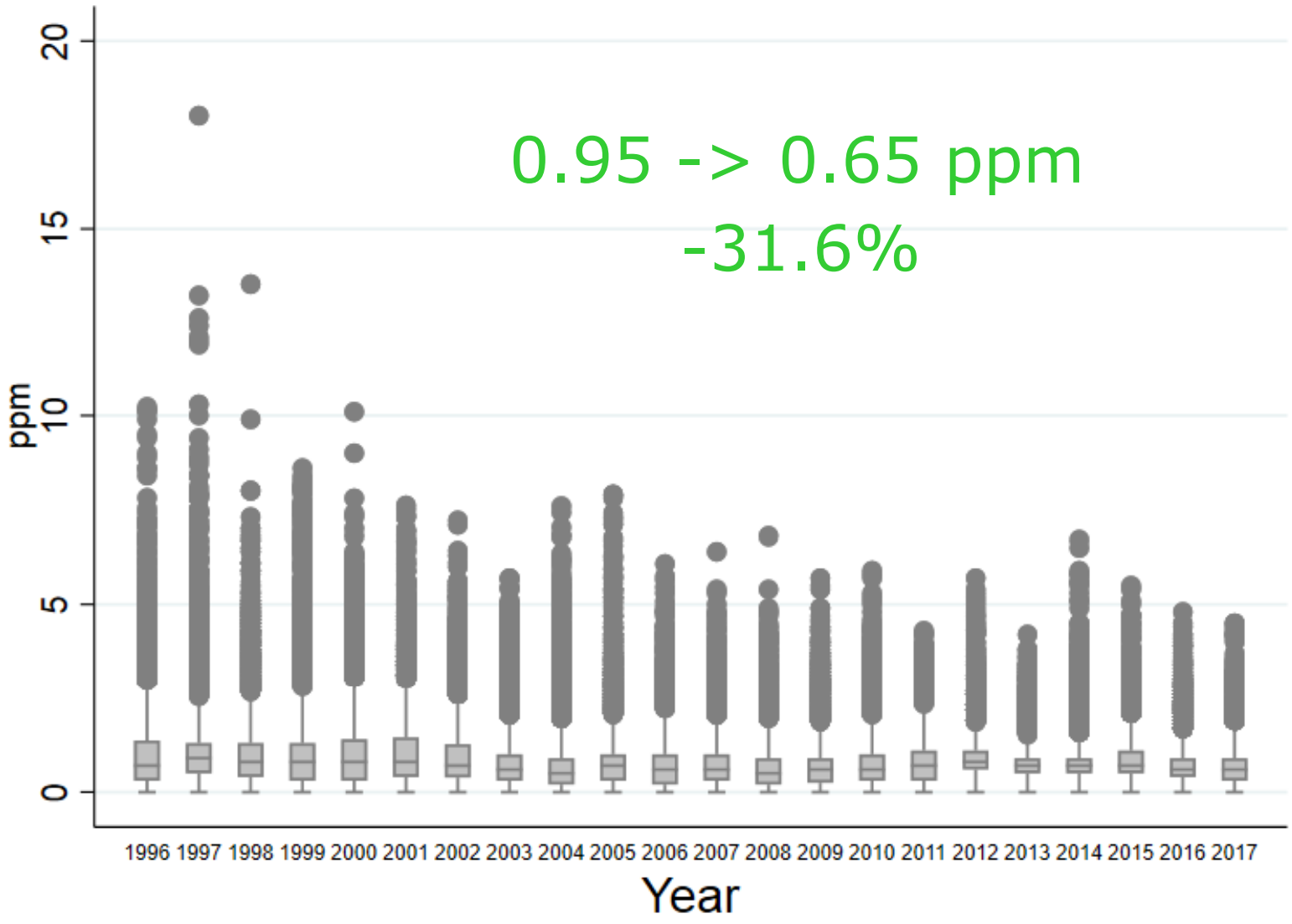
+106%



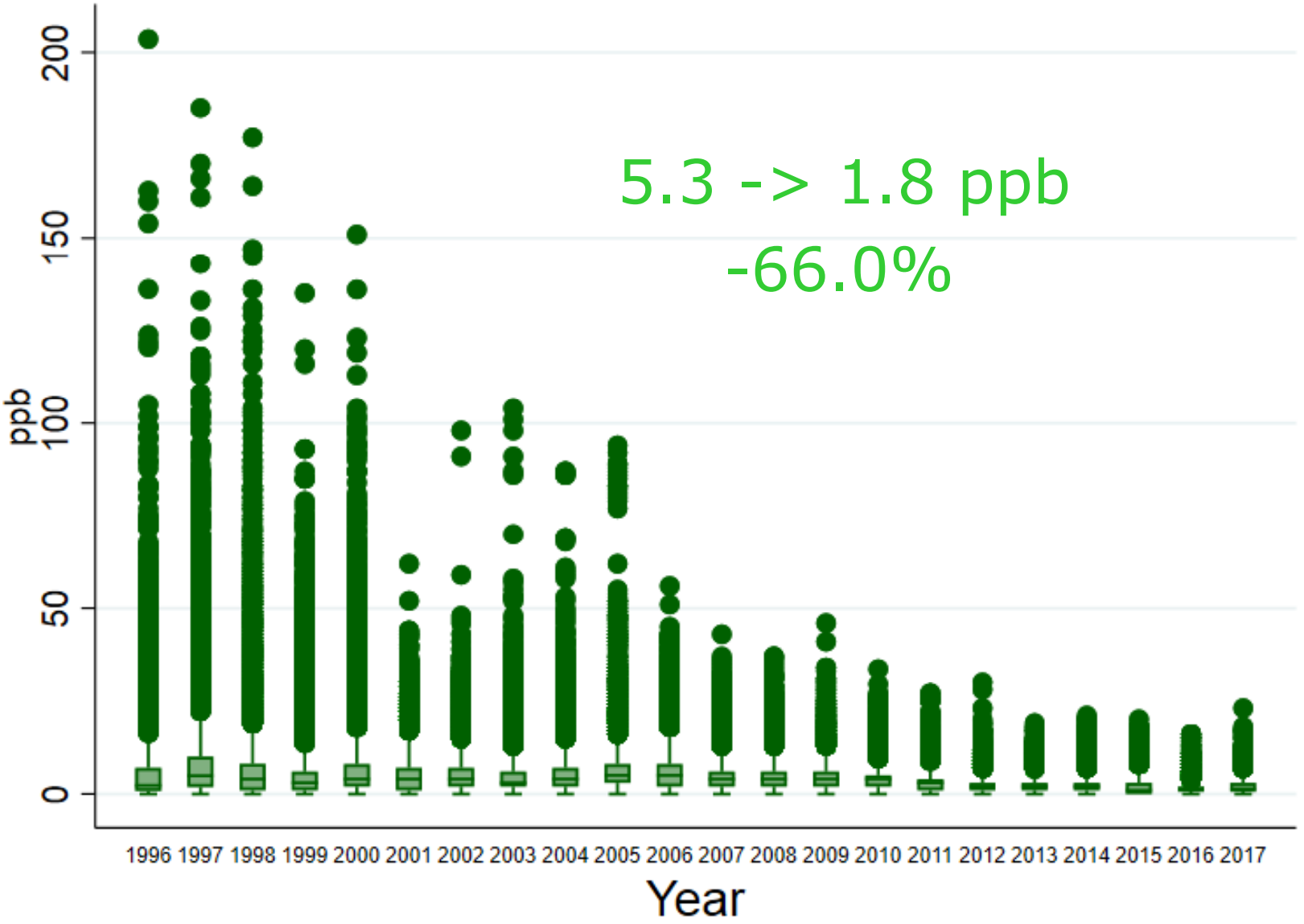
NO_2 in Bangkok: 1996-2017



CO in Bangkok: 1996-2017



SO_2 in Bangkok: 1996-2017



Health Impact Assessment: Air Pollution in Thailand

- Four key inputs needed for HIA:
  1. Exposed population
  2. Change in exposure
  3. Baseline rate of disease, e.g. mortality or morbidity
  4. Exposure-Response Function
- BenMAP HIA software (US EPA) for calculations

Health Impact Assessment: Air Pollution in Thailand

1. Exposed population:
   - Population of Thailand aged 30+ years projected to 2020 = 45.1 million

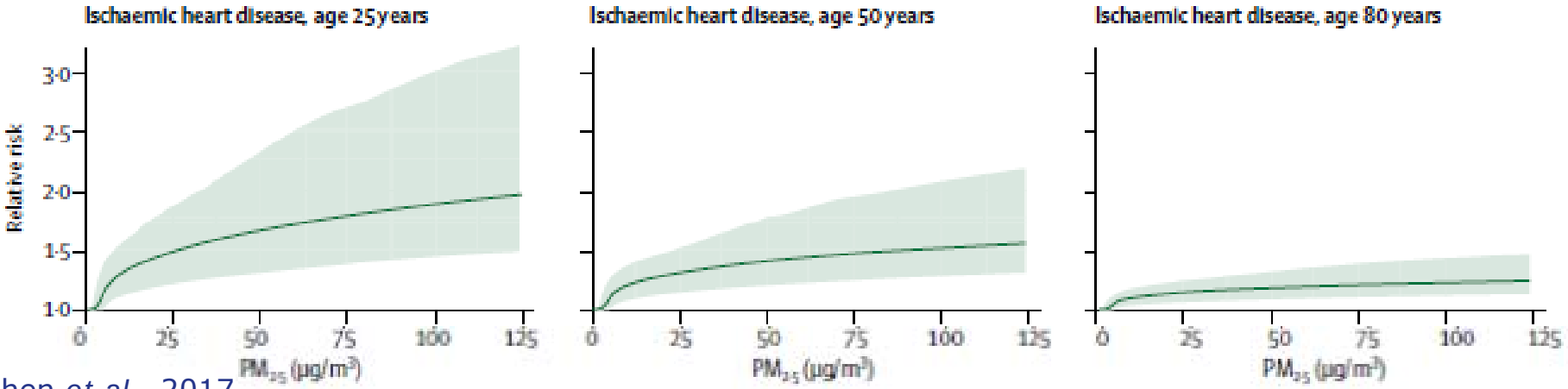
2. Change in exposure:
   - Mean $PM_{2.5}$ and O_3 from PCD monitor data and interpolated across all provinces
     $PM_{2.5}$ [19.0 – 39.4 µg/m^3] O_3 [26.4 - 53.7 ppb]
   - Counterfactuals:
     - $PM_{2.5}$ = 5.5[6] µg/m^3 O_3 = 35 ppb[7]

6. Cohen et al., 2017
7. WHO, 2006

Health Impact Assessment: Air Pollution in Thailand

3. Baseline rate of disease (per 100k):
   - Lung cancer = 31.4
   - COPD / Lower respiratory disease = 23.9
   - Ischaemic Heart Disease = 78.8
   - Cerebrovascular disease = 116.3

4. Concentration-Response Functions:
   - Integrated Exposure Response Function[8]

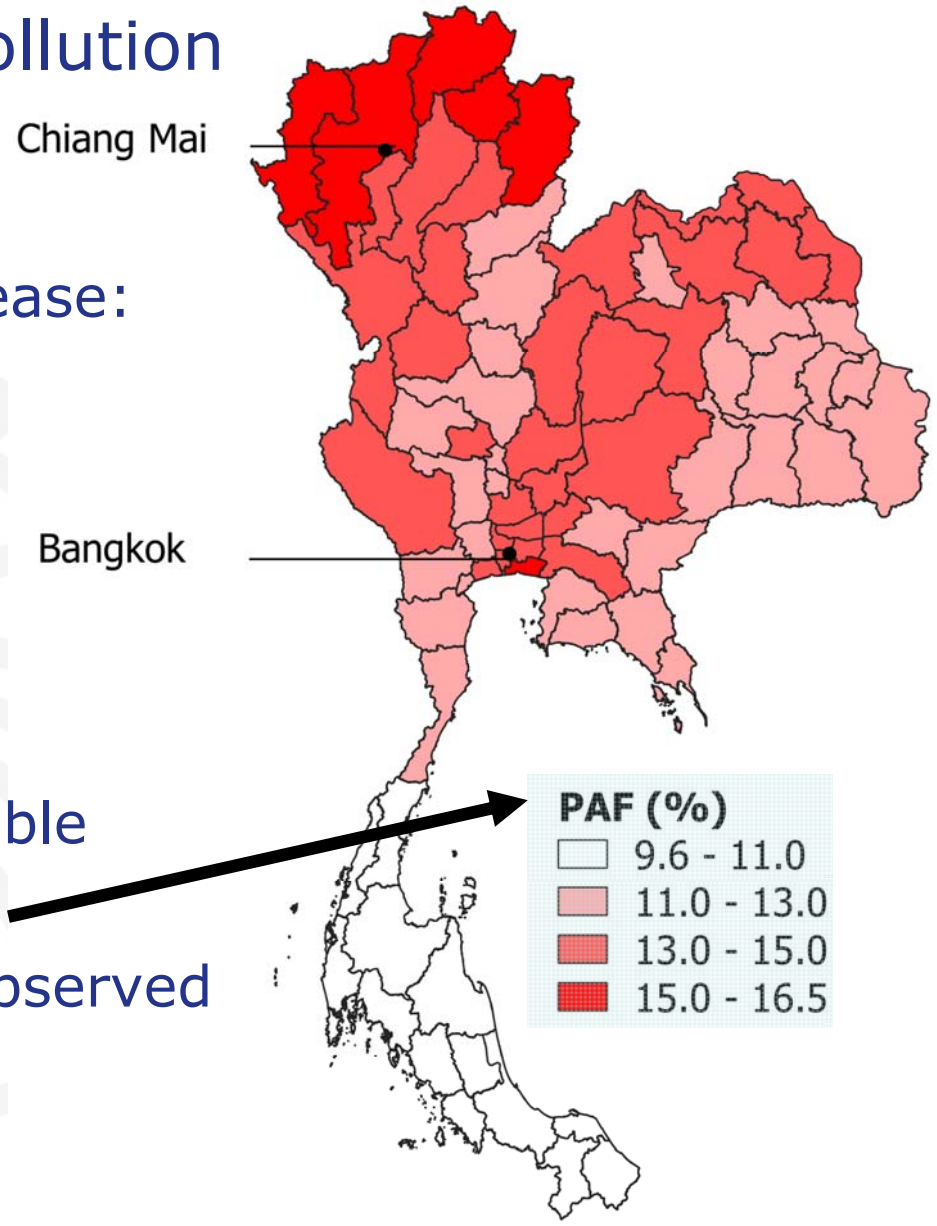


8. Cohen *et al.*, 2017

Health Impact Assessment: Results: Thailand (Bangkok)

- Deaths in 2020 from Air Pollution
  - Lung cancer:
    1,850 (295)
  - COPD/Lower respiratory disease:
    2,210 (125)
  - Ischaemic Heart Disease:
    2,940 (387)
  - Cerebrovascular disease:
    3,360 (387)

Population Attributable Fraction (PAF)[9]
(Observed-Expected)/Observed



9. Mansournia & Altman, 2018

Next steps…

- Expand HIA to other health outcomes, such as:
  - Type II Diabetes
  - Neurological disorders, e.g. Alzheimer's, Dementia
  - Low birth weight & preterm birth
  - Other cancers
- Incorporate modelled air pollution data for rural areas
- Questionnaire and personal monitoring campaign to model indoor & outdoor exposures

Thank you!

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