

Uncertainties of Estimated PM_{2.5}- and O₃-Related Health Impacts in China due to Emissions



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Futu Chen^{1,2}, Min Zhong^{3,4}, Eri Saikawa^{1,3}

¹Rollins School of Public Health, Emory University, Atlanta, GA, USA

²Now at Boston Medical Center, Boston, MA, USA

³Department of Environmental Sciences, Emory University, Atlanta, GA, USA

⁴Now in the Department of Environmental Engineering, Texas A&M University-Kingsville, TX, USA



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Goal: To provide quantitative analysis of how emissions and other model input parameters influence PM_{2.5}- and O₃-related health impacts calculations in China.

Conclusions:

- Concentration-response functions (CRFs) and present emissions, which are usually considered as single-value inputs in health risk studies, are the largest source of uncertainty in mortality estimates in China
- Conducting more epidemiological studies and constraining present emissions are essential for air pollutant-related health projection in China

Methods

Adverse Health Impact Calculation

$$\Delta H = P_{2050} \times r \times (e^{\beta \Delta x} - 1)$$

ΔH : the change in the number of deaths due to air pollution

P_{2050} : the population exposed to the pollution in 2050

r : baseline incidence of the health endpoint

Δx : differences between population weighted air pollutant concentrations in 2050 compared to 2008

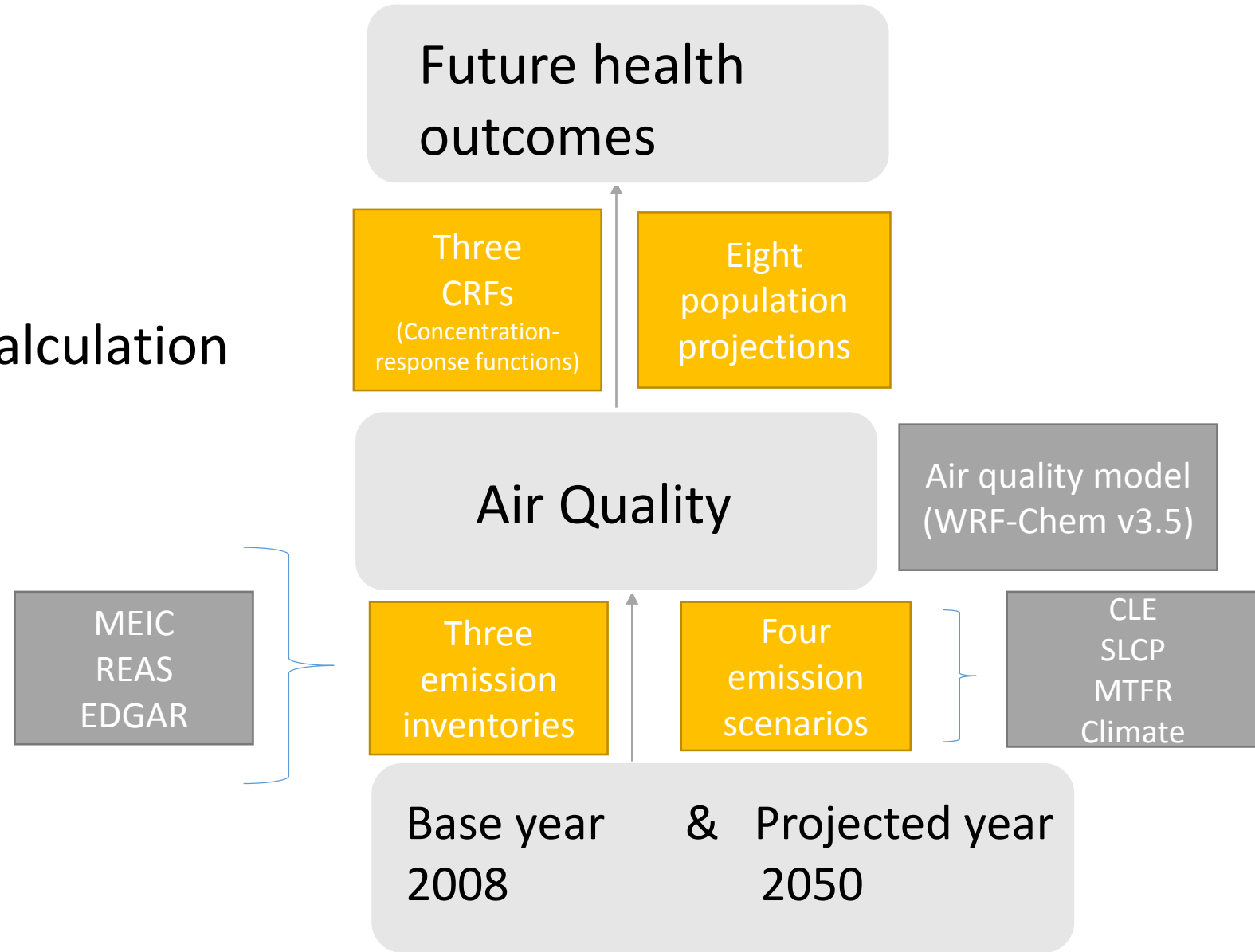
β : CRF coefficient

Health Endpoints

- Total mortality
- Cardiovascular mortality
- Respiratory mortality

Methods

- Air Quality Simulation
- Adverse Health Impact Calculation
- ANOVA Analysis



ANOVA results for PM_{2.5}-related mortalities

Input parameters and their interactions	df	Percentage of total Sum of Squares (%)		
		Total mortality	Cardiovascular mortality	Respiratory mortality
Present emissions	2	23.05	29.00	14.22
Future emissions	3	7.23	8.90	4.16
CRF	2	53.10	47.54	62.74
Present emissions × CRF	4	11.33	9.40	13.12

ANOVA results for O₃-related mortalities

Input parameters and their interactions	df	Percentage of total Sum of Squares (%)		
		Total mortality	Cardiovascular mortality	Respiratory mortality
Present emissions	2	22.99	35.48	17.44
Future emissions	3	20.82	31.86	15.29
CRF	2	27.89	15.50	35.59
Present emissions × CRF	4	14.31	8.34	17.77
Future emissions × CRF	6	12.71	7.19	15.20

*influence less than 5% is not included here

Summary

- Our work highlights the importance of better constraining China-specific CRF coefficients, which is a major source of uncertainty in the PM_{2.5}-related health outcome estimation in China.
- Our study also demonstrates that current and present emissions are equally important for the estimation of O₃-related health outcomes. Future work should focus on improving emission inventories especially estimating the precursors of O₃ and PM_{2.5}.

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