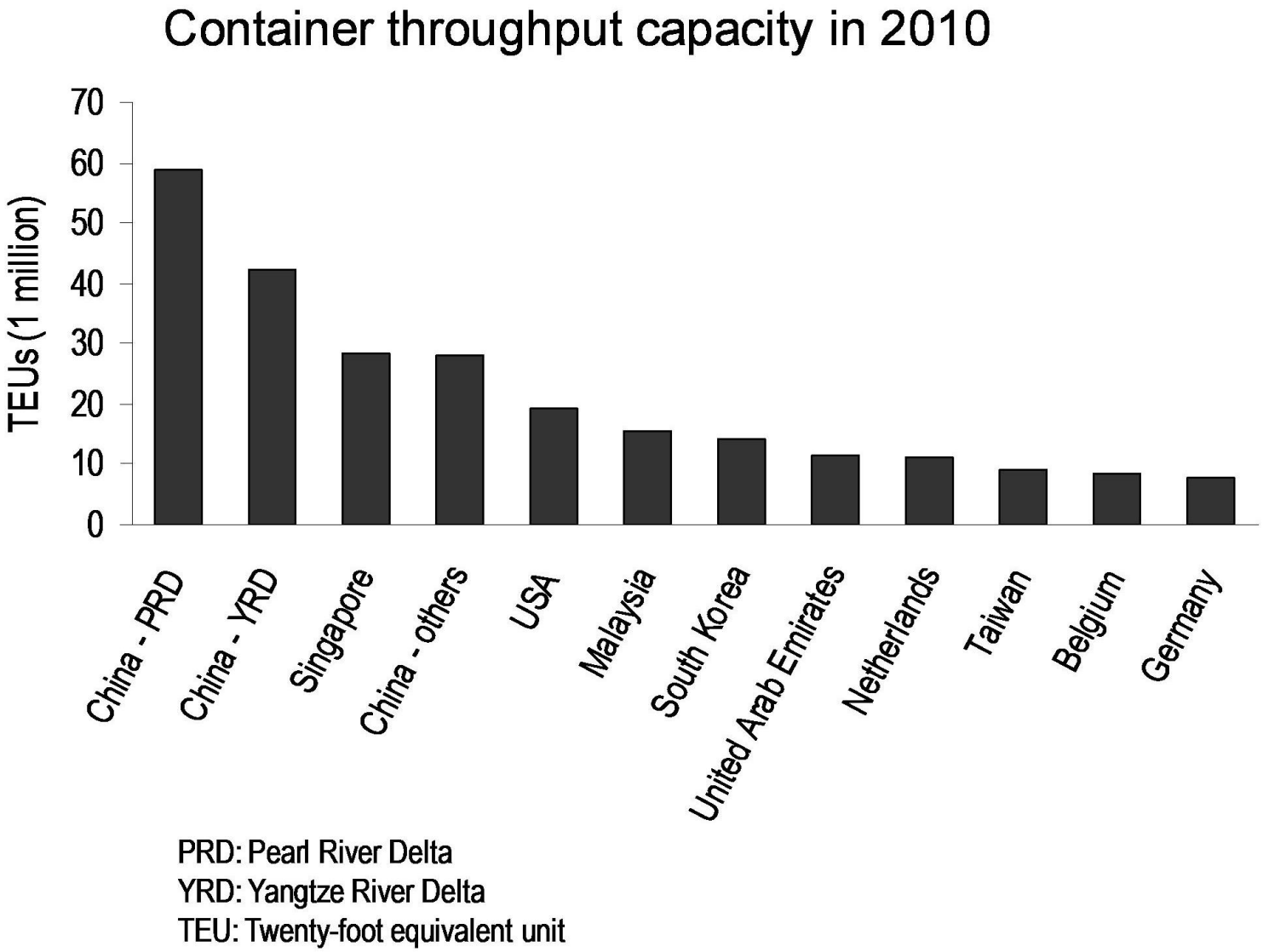
Health impact assessment of marine emissions in Pearl River Delta region

Dr. Hak-Kan Lai
Department of Community Medicine
School of Public Health
The University of Hong Kong

Introduction

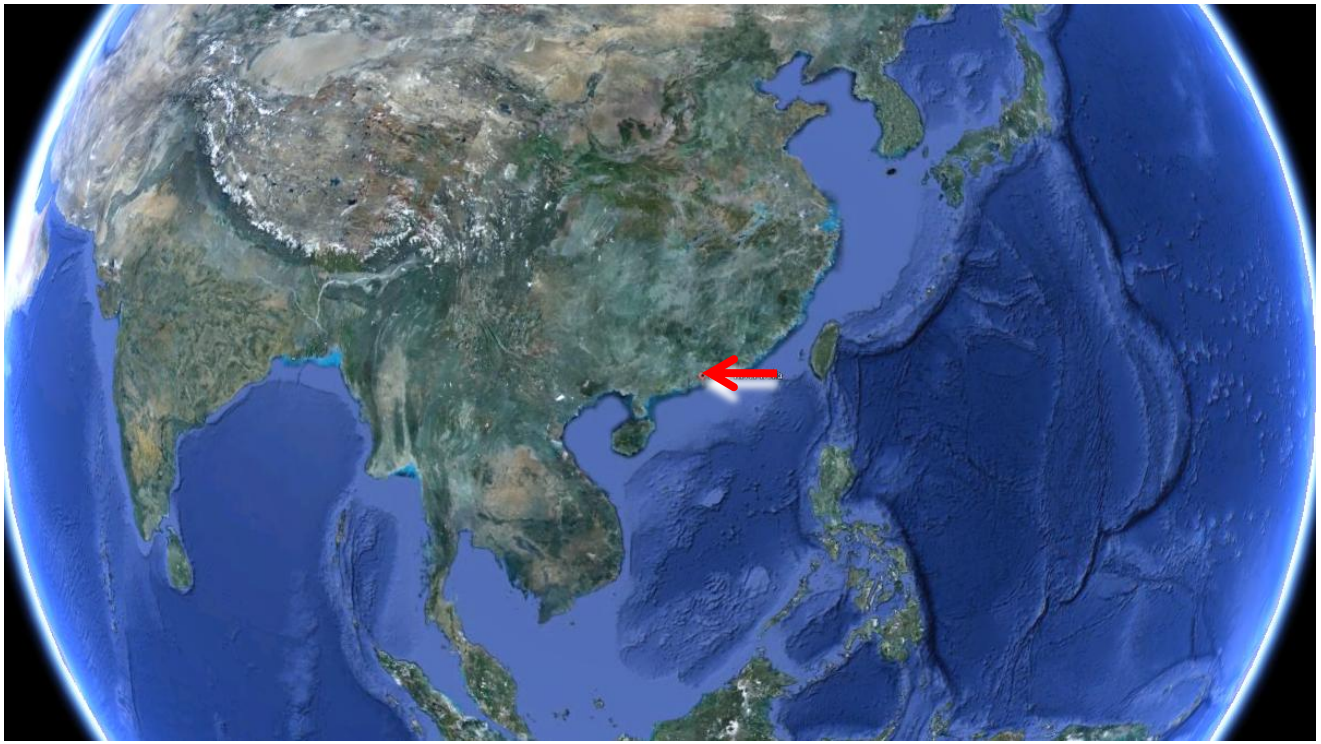
- Global marine vessels emissions are adversely affecting **human health** particularly near the coastline in southeast Asia.
- The Pearl River Delta (PRD) in south China is the worst affected as it is a region with the largest shipping container capacity in the world.



Reference: HKMD, 2010. Hong Kong Marine Department. Ranking of Container Ports of the World. 2010. (http://www.mardep.gov.hk/en/publication/pdf/portstat_2_y_b5.pdf)

Introduction

- But the health burdens from both ocean- and river-going vessels in Pearl River Delta (PRD) regions are not quantified.

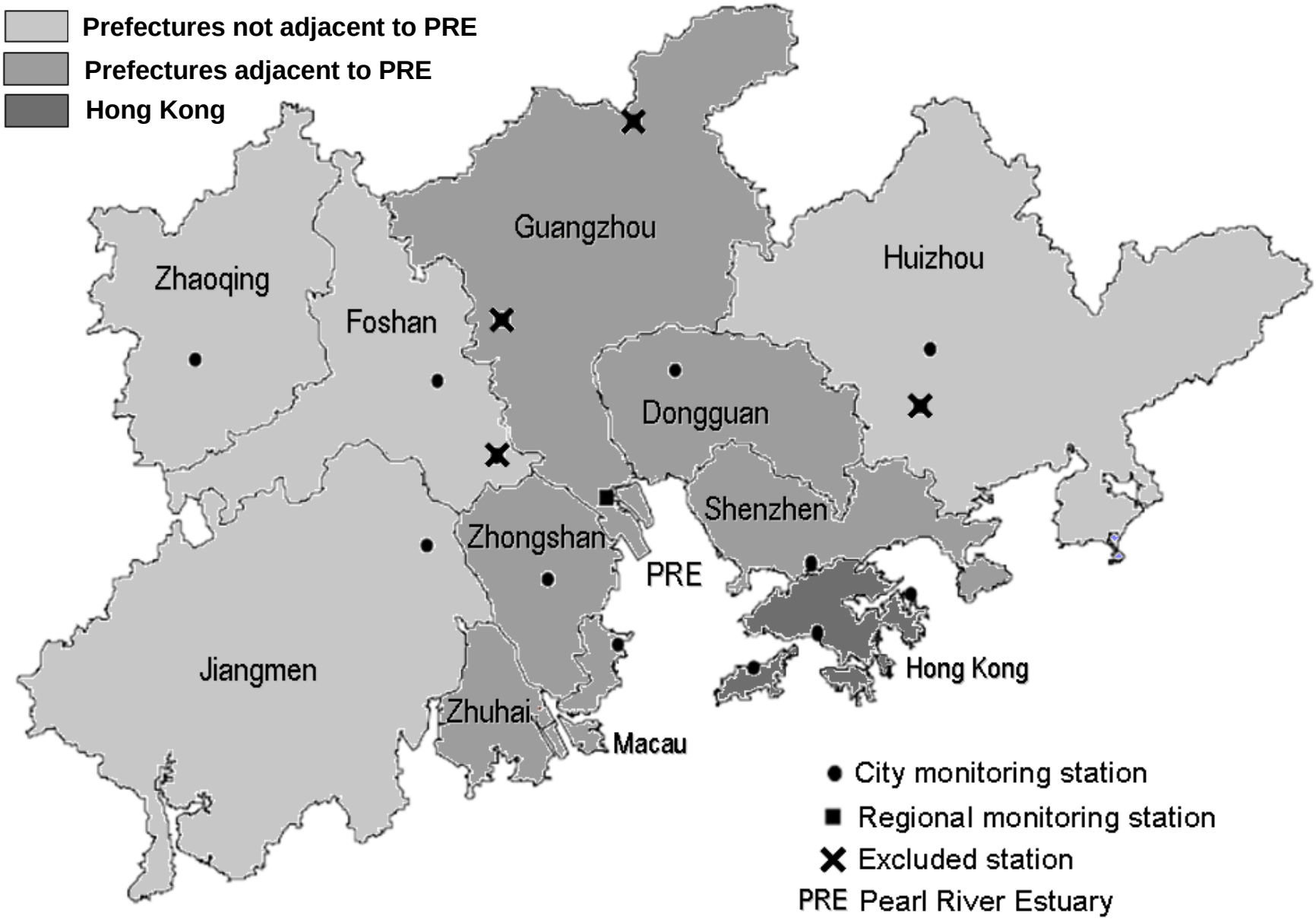


Aim of this study

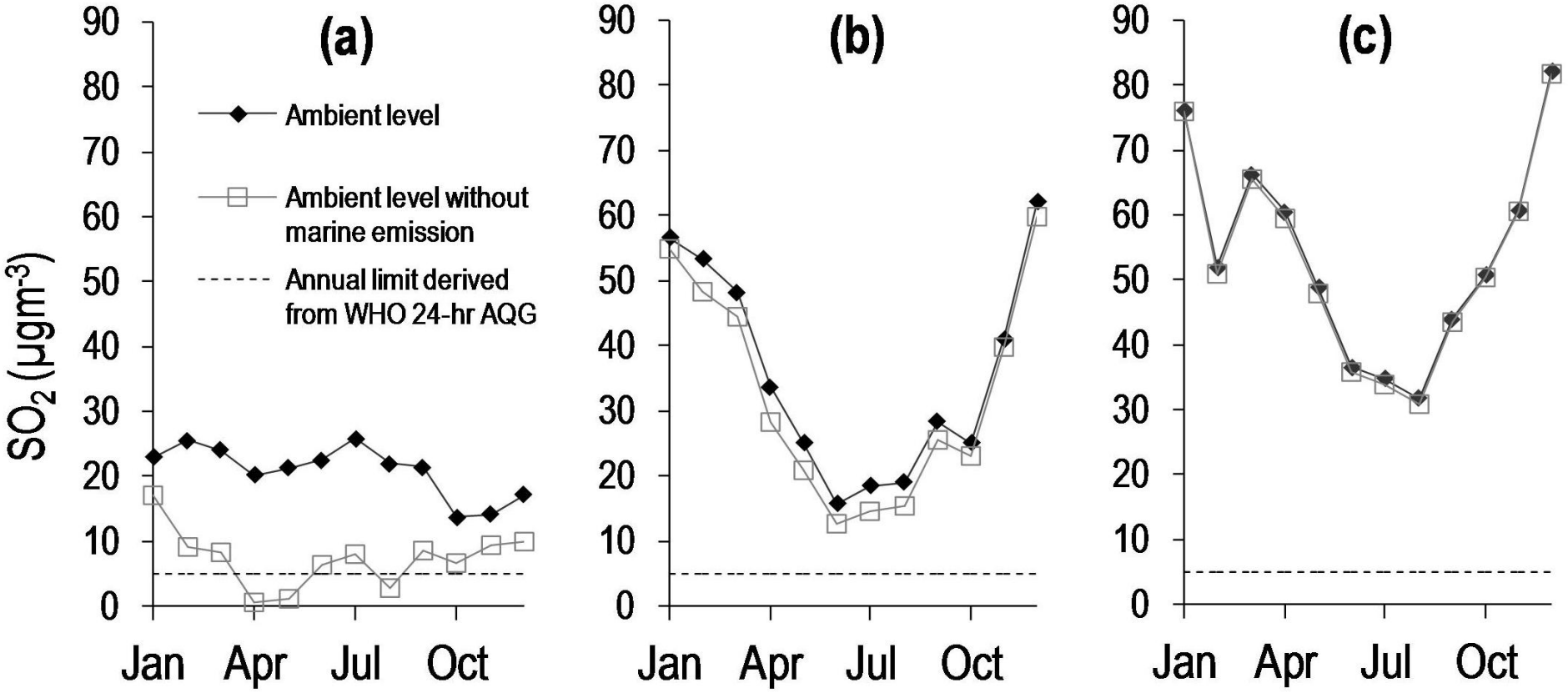
- To assess the public health impacts attributable to marine emissions in PRD regions including Hong Kong, Macau and nine prefectures in Guangdong

Methods

- Pooled health effect estimates representing Chinese populations using meta-analysis.
- Based on modeled SO_2 concentration due to ocean vessel emissions in PRD regions.
- Applied the ratio of total vessel capacity between river- and ocean-going vessels.
- Based on ratios of other modeled pollutant concentrations (NO_2, PM_{10} and O_3) due to marine emissions and the ambient data.


Prefectures not adjacent to PRE
Prefectures adjacent to PRE
Hong Kong
Guangzhou
Huizhou
Zhaoqing
Foshan
Dongguan
Shenzhen
Zhongshan
PRE
Jiangmen
Zhuhai
Macau
Hong Kong
City monitoring station
Regional monitoring station
Excluded station
PRE Pearl River Estuary

Results



(a) Hong Kong; (b) PRD regions adjacent to Pearl River Estuary (PRE) included Macau, GZ, SZ, ZH, DG, and ZS; (c) PRD regions not adjacent to PRE included FS, JM, ZQ, and HZ.

Results

Demographic	HK	PRD regions adjacent to PRE	PRD regions not adjacent to PRE
Population	6,985,200	14,923,500	14,789,899
Aged 0-14 (%)	12.9	16.7	20.6
Aged 15-64 (%)	74.3	74.3	70.8
Aged 65 or above (%)	12.7	8.9	8.6
Female	52.7	48.9	49.2
Male	47.3	51.1	50.8
No. of deaths in 2008			
All natural causes	39,799	67,069	86,041
Estimated annual average pollutant concentration (μgm^{-3}) due to ocean and river vessels emissions			
1. PM_{10}	31.6	7.5	1.6
2. NO_2	12.9	3.1	0.7
3. SO_2	13.6	3.2	0.7
4. O_3	18.1	4.3	0.9

Results

(per 1 million people)	HK	PRD regions adjacent to PRE[1]	PRD regions not adjacent to PRE[2]	Total
Annual deaths (all causes, all ages)	**5,698**	**4,494**	**5,818**	**5,257**
Excess deaths (all causes, all ages) due to four pollutants from ship emission				
SO_2	55.1	6.2	2.8	14.1
NO_2	102.7	11.6	5.2	26.4
O_3	41.6	4.9	2.2	10.8
PM_{10}	49.5	6.3	2.8	13.1
Combined effects of the 4 pollutants	172.1	20.3	9.1	44.7
Proportion of the total number of excess deaths in PRD regions				
Excess deaths (combined effects)	73%	19%	8%	

Conclusion

- Marine emission control measures could contribute a large reduction in mortality and hospital admissions in PRD regions especially in Hong Kong.
- In 2008, there were 1,202 excess deaths attributable to air pollution from both types of vessel emissions.
- This amounts to 40% of the total annual numbers with the exposure as represented by the same pollutants as estimated by the Hedley Environmental Index (hedleyindex.sph.hku.hk).