

Heat Wave in Guangdong Province, China: Health impact and vulnerability analysis

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Introduction of Guangdong Province

Guangdong Province

Location: South China

Area: 179.8 thousand km²

Population: 104.3 million

Climate: Typical sub-tropical
& Humid & monsoon

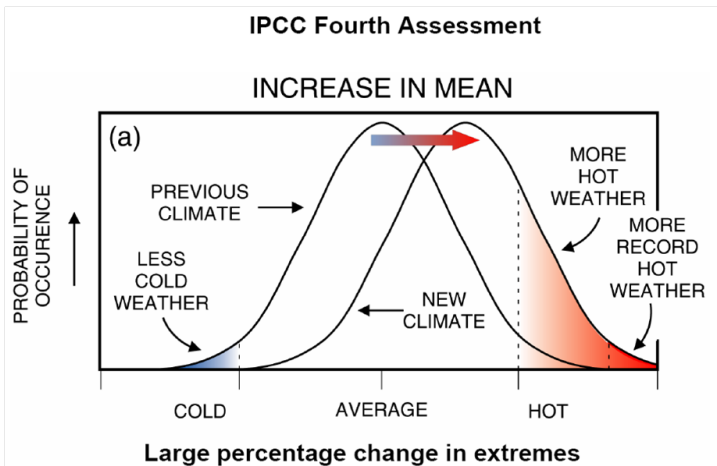
Annual average

Temperature: 22.9 °C

Precipitation: 1,777 mm



Climate change



Heat wave impacts human health

1981, Portugal

1995, Chicago

2003, Europe

20 000 excess deaths

1906 excess deaths

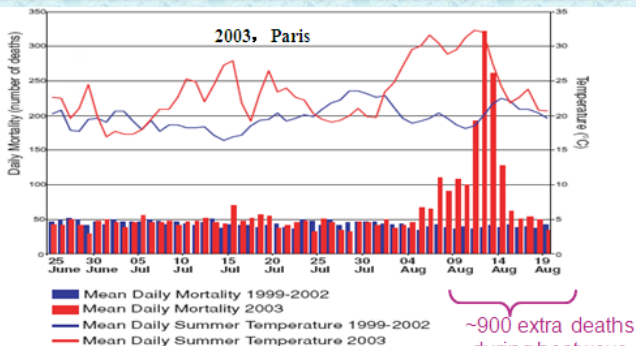
700 Excess deaths

France: 15000

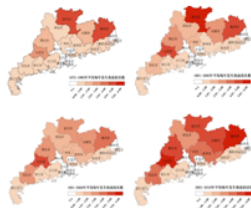
Portugal: 1317

Britain: 2091

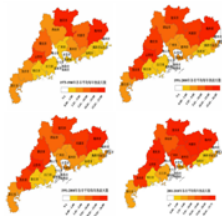
A Silent
killer



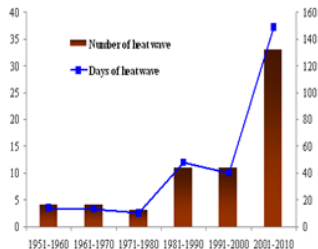
Trends of heat waves in Guangdong



Heat waves frequency trends in Guangdong, 1975-2010

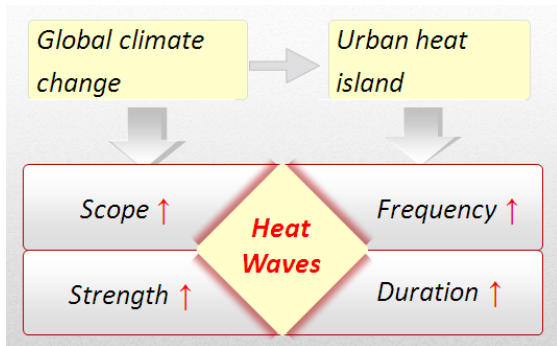


Heat waves duration trends in Guangdong, 1975-2010



Decade trend of heat wave during the last 60 years in Guangzhou, Guangdong

Trends of heat waves in Guangdong

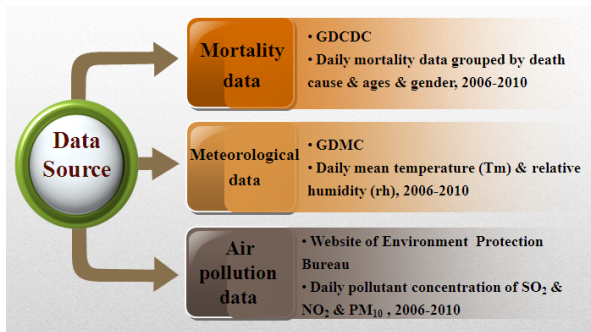


The current study

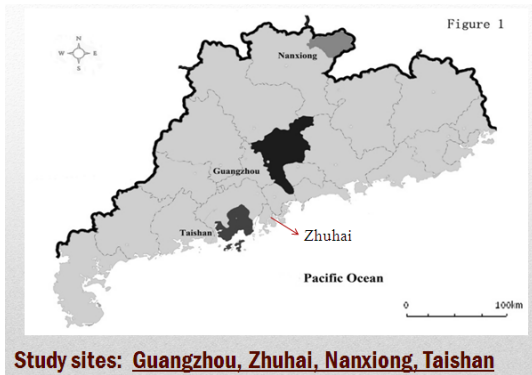
Part I: Impact of heat waves on mortality;

Part II: Health vulnerability assessment of to heat waves.

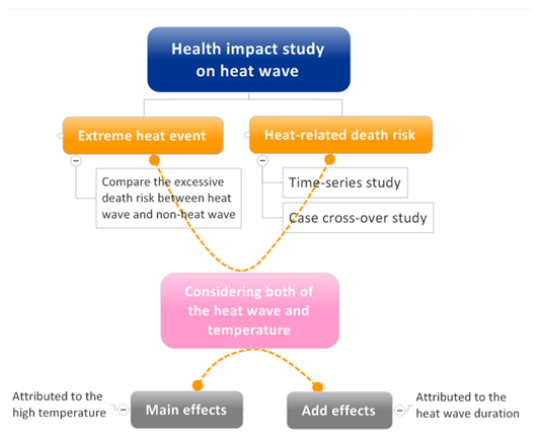
Part I Materials



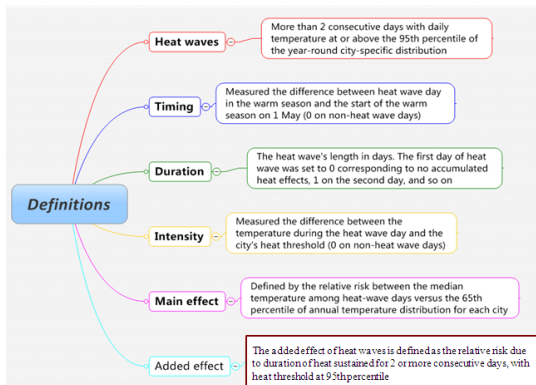
Part I Study area



Part I: Effects of heat waves



Part I Definition



Statistical analysis

We used the following Poisson regression formula

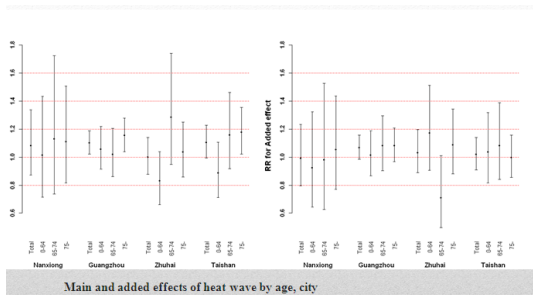
$$\text{Log}E[Y_i^c] = \alpha + NS(RH_i^c) + NS(Time_i) + NS(Season_i) + \beta^c DOW_i + m(I_i^c) + w(I_i^c)$$

Results

Estimated heat wave main and added effects on daily mortality

City	Lag0 (95%CI)	Lag0-5 (95%CI)	Lag0-10 (95%CI)
<i>Nanxiong</i>			
Main effect	22.3(0.9-48.3)	-15.4(-36.2-12.3)	-15.4(-41.3-22.0)
Added effect	-5.9(-19.6-10.1)	39.3(0.8-92.4)	17.8(-25.6-86.3)
<i>Guangzhou</i>			
Main effect	13.6(6.1-21.7)	19.9(9.1-31.8)	15.1(2.2-29.6)
Added effect	4.4(-1.9-11.0)	1.6(-8.7-13.2)	0.5(-13.1-16.2)
<i>Zhuhai</i>			
Main effect	1.0(-10.5-14.0)	-0.5(-16.3-18.2)	1.0(-19.0-25.8)
Added effect	8.1(-3.4-21.1)	0.7(-18.1-24.0)	3.8(-21.7-37.5)
<i>Taishan</i>			
Main effect	26.0(15.2-37.8)	8.7(-4.2-23.4)	-1.5(-15.4-14.6)
Added effect	-2.9(-10.6-5.4)	13.8(-1.4-31.3)	9.3(-9.3-31.7)
<i>Overall</i>			
Main effect	15.1(4.6-26.7)	6.6(-5.7-20.5)	4.1(-7.1-16.5)
Added effect	1.8(-3.4-7.2)	7.6(-1.8-17.9)	4.4(-5.9-15.8)

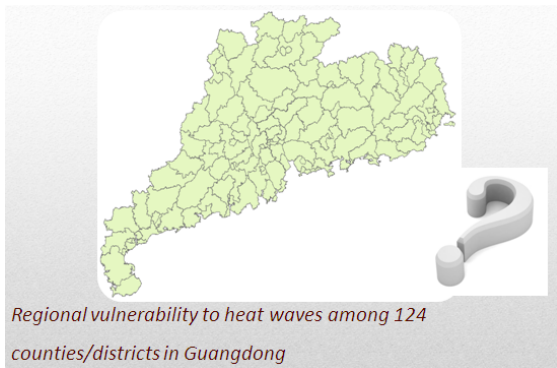
Results



Part II: Vulnerability analysis

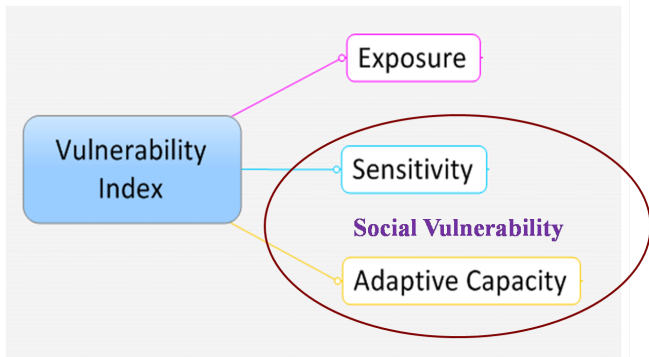
- Vulnerability basically is responses to risks of environmental hazards, human exposure, and human sensitivity or adaptive capacity on individual or community levels;
- The main purpose of vulnerability assessment is to identify adaptation strategies that are feasible and practical to protect and mitigate the potential risk;
- Adaptation refers to a process, action in a system (household, community, group, sector, region, country) to better cope with, manage or adjust to some changing condition, stress, hazard, risk;

Regional vulnerability to heat waves in Guangdong?

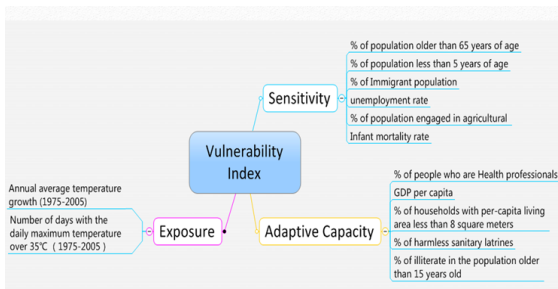


Vulnerability index

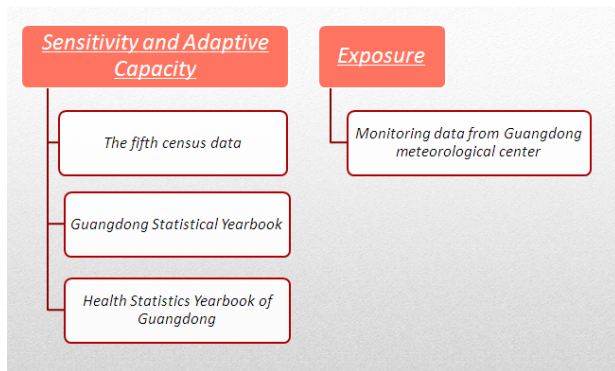
- Vulnerability index seeks to provide relative vulnerability levels for countries, regions or communities;



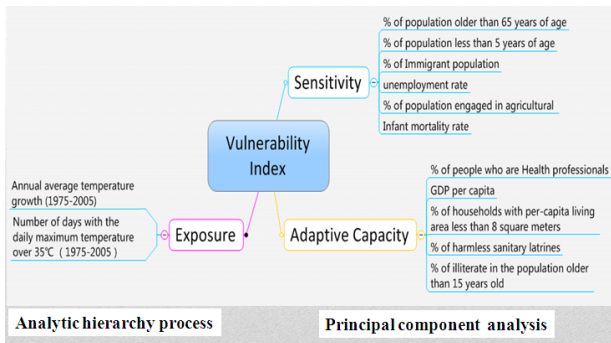
Indicators choice



Data source



Weighting of indicators



Weighting of exposure indicators

The weight of exposure indicator						
Indicators of Exposure	Weight given by each expert					Average weight
	A	B	C	D	E	
Number of days with the daily maximum temperature over 35 °C	0.83	0.86	0.80	0.80	0.83	0.835

Weighting of social indicators

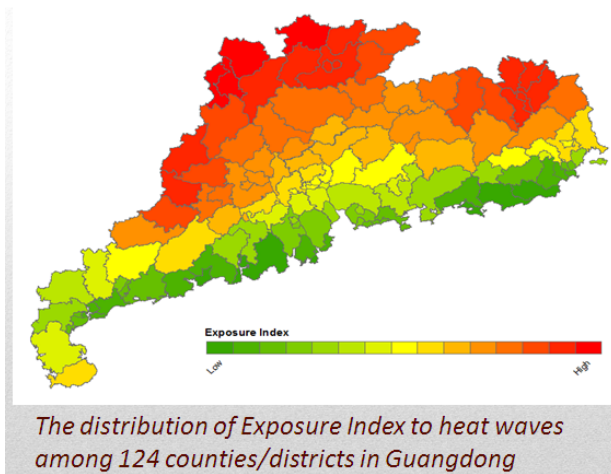
The weight of each indicator in dimension Sensitivity and Adaptive Capacity				
Indicator	Rotated Component Matrix			Weight
	C1	C2	C3	
% of Immigrant population	0.903	0.169	0.238	0.31
% of population engaged in agricultural	0.885	0.282	-0.125	0.27
% of population less than 5 years of age	0.879	-0.144	0.160	0.23
% of illiterate in the population older than 15 years old	0.781	0.323	0.116	0.28
% of people who are Health professionals	0.750	-0.113	-0.346	0.13
% of population older than 65 years of age	0.563	0.441	0.510	0.30
GDP per capita	0.494	0.194	0.277	0.21
% of households with per-capita living area less than 8 square meters	-0.192	0.822	-0.044	0.09
Infant mortality rate	0.300	0.694	0.007	0.20
% of harmless sanitary latrines	0.575	0.611	0.135	0.28
unemployment rate	0.007	-0.079	0.937	0.28

Developing the index

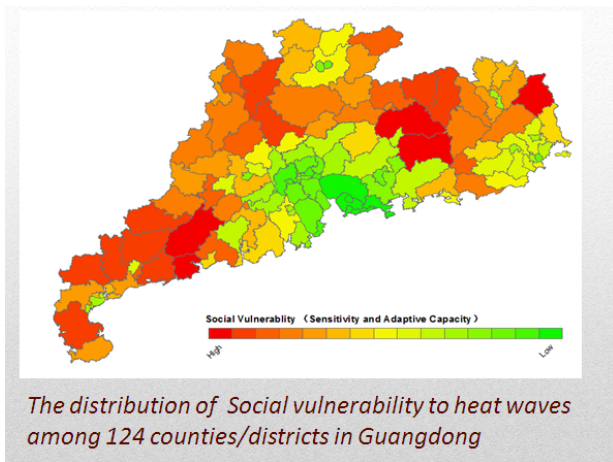
Vulnerability Index (VI)

$$VI = EI * (SI + 1 - AI) / 2$$

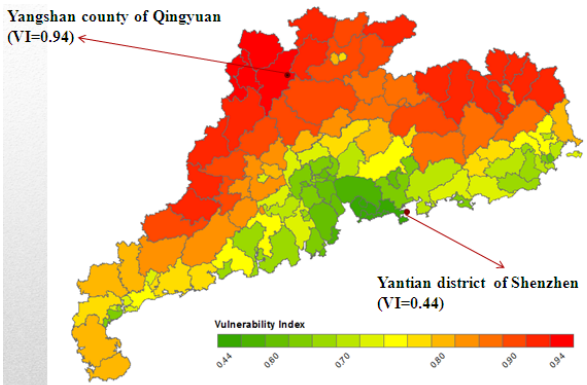
Distribution of Exposure Index



Distribution of Social vulnerability

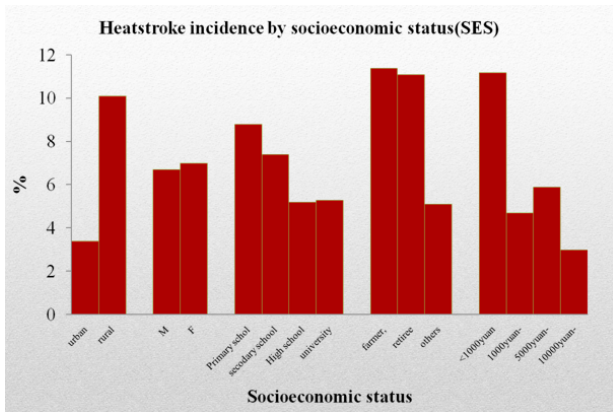


Distribution of overall vulnerability



The distribution of Vulnerability to heat waves among 124 counties/districts in Guangdong

Social-economic status and vulnerability



Conclusions

- Heat wave increased mortality risk in Guangdong;
- Low socioeconomic status regions such as the west, north and east of Guangdong Province are vulnerable regions to heat waves;
- The elderly, females, population with respiratory diseases and population with low SES are vulnerable population.

Recommendations

- Enhancing health impacts assessment of climate change;
- Improving climate change related surveillance system that integrates meteorological data into health data;
- Developing heat wave related early warning system based on health outcomes;
- Involving stakeholders to protect vulnerable population in vulnerable regions;
- Strengthening health risk communication of climate change in the public to improve automotive adaptation behaviors.

Acknowledgements

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- My colleagues in GDCDC and many others.

Thank you