

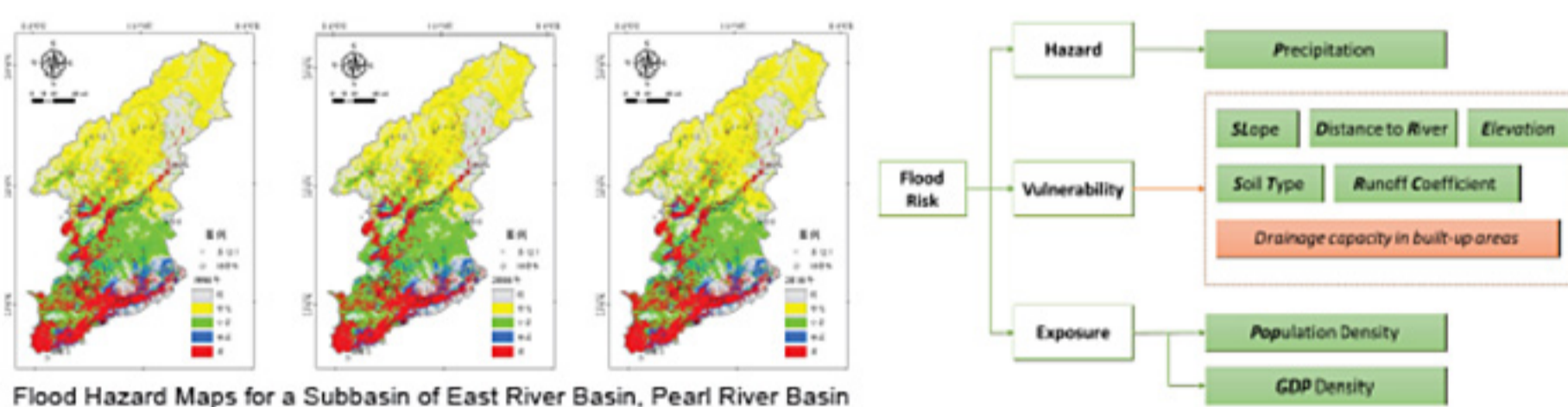
Evaluation of Natural Catastrophe Impact on the Pearl River Delta (PRD) Region - Flood Risk

Flood Disasters in the PRD Region

- Historically, the key factors contributing to major flood events in the PRD region are flooding of the upstream river reaches, intense rainfall within the PRD, high astronomical tides and storm surges.
- The long-term annual mean precipitation in Guangdong province ranges over 1,600-2,600 mm, 85% of which occurs during April to September.
- Extensive protective measures have been built over the last two decades to protect the PRD cities against riverine floods. However, surface water flooding has become more frequent in recent years due to rapid urbanization and aging urban drainage systems.
- Climate change (e.g., sea level rise, change in tropical cyclone frequency and intensity), combined with economic and population growth will continue to impact the PRD region.
- This project aims to develop a flood risk ranking for the cities in the PRD region.

Flood Risk Evaluation and Ranking

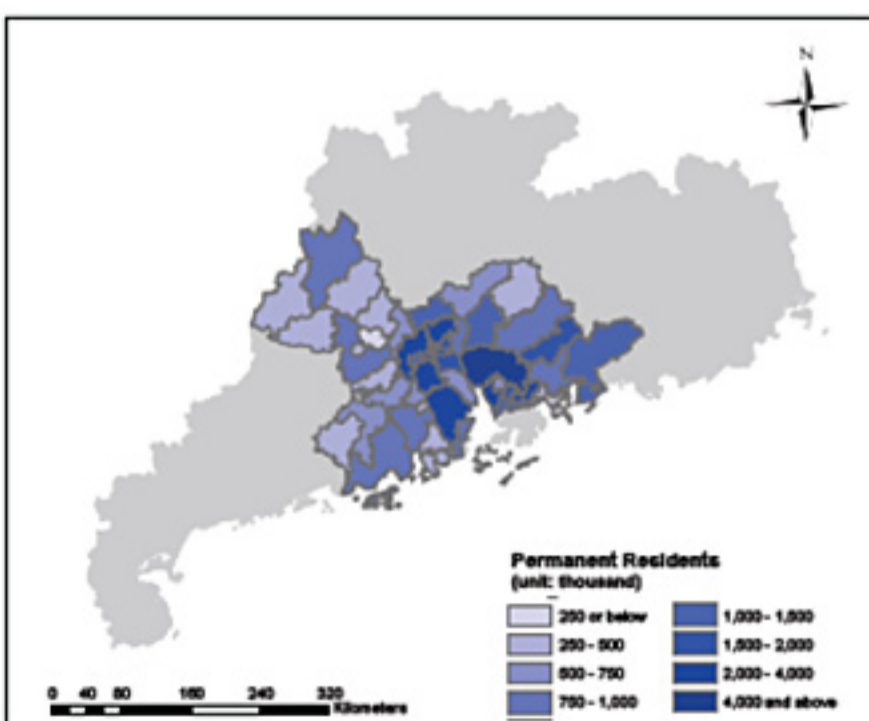
- GIS based fuzzy comprehension evaluation method is used.
- Pilot study of flood hazard assessment on a subbasin of East River Basin (area: 27,200 km²) had been conducted by SCUT.
- This is being extended to the whole PRD region (area: approx. 54,800 km²) and will include spatial differences in critical rainfall intensities and drainage design standards across the region.
- Modelling and analyses for risk ranking will be based on hazard, vulnerability and exposure indicators over 1 km grids.



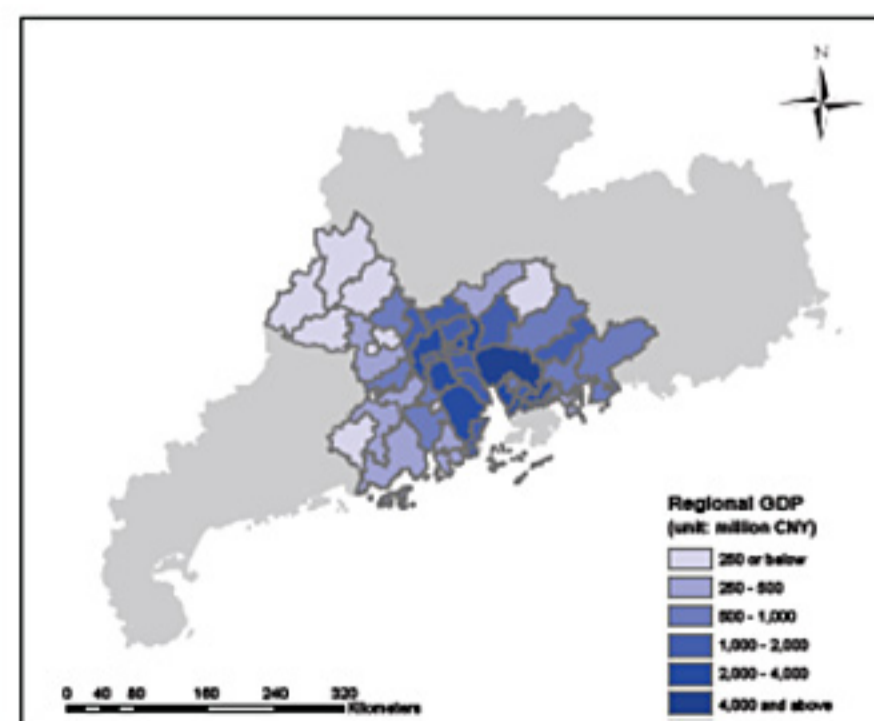
Flood Hazard Maps for a Subbasin of East River Basin, Pearl River Basin

Development of Exposure Indicators

The PRD region is one of China's main economic centres, generating 11% of China's GDP and home to over 100 million inhabitants. A large portion of this high exposure density are located in the low-lying coastal zones and floodplains that are most vulnerable to flooding.



Permanent Residents in PRD Cities (2016)
Source: Statistical Yearbooks 2016



Regional GDP of PRD Cities (2016)

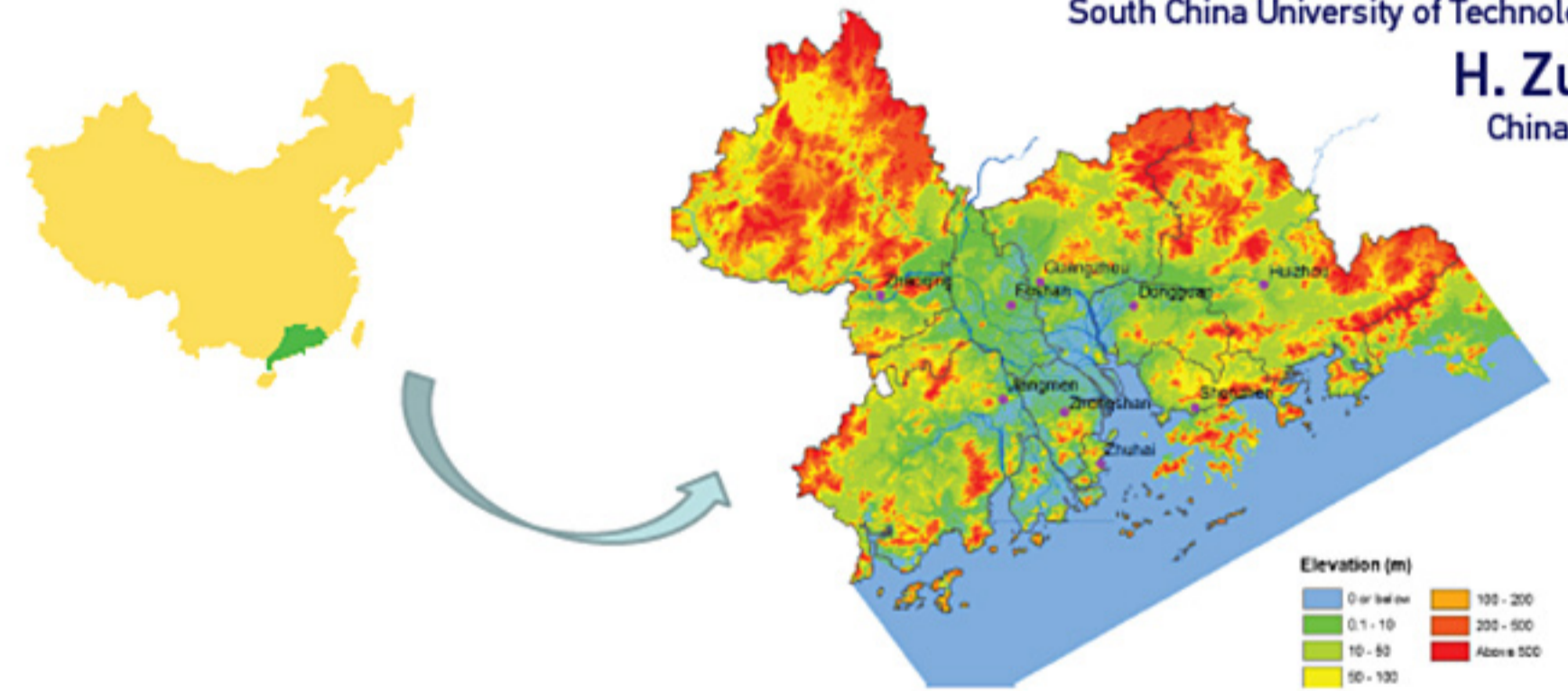
T.C. Pan, E. Lo, W. Jian
Institute of Catastrophe Risk Management, NTU, Singapore

A. Switzer
Asian School of the Environment, NTU, Singapore

L. Li
Earth Observatory of Singapore, NTU, Singapore

C. Su, X. Cheng, Z. Wang, C. Lai
South China University of Technology

H. Zuo
China Re

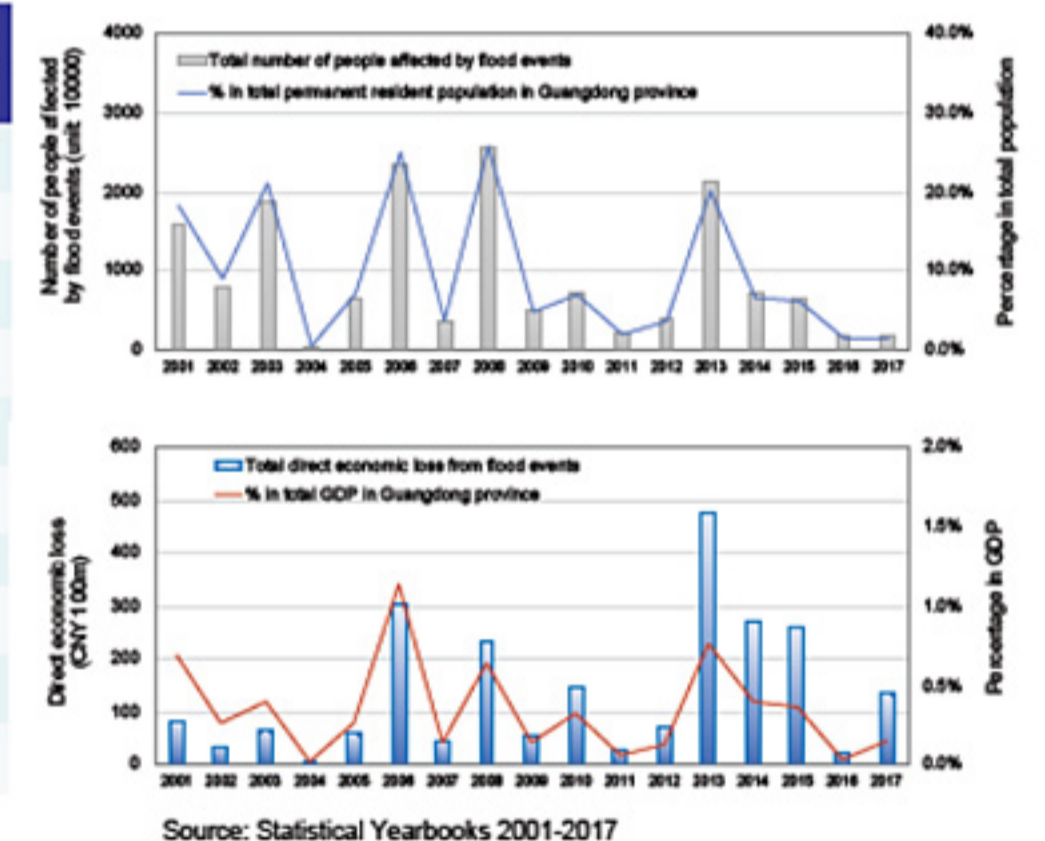


Historical Flood Loss Catalogue

- Compilation of flood event catalogue for Guangdong province, which comprises major historical events from 1915-2000 and more detailed event database for 2001-2017.
- Reported annual average flood loss per regional GDP in Guangdong province is approximately 0.4% for 2011-2015.

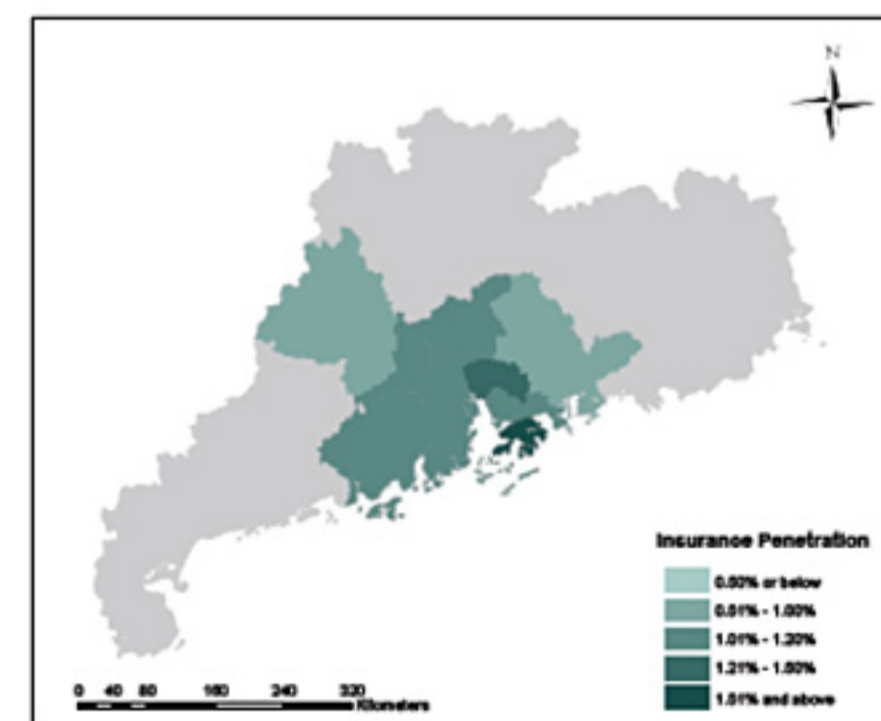
Ranking	Year	Flood Event	Total Direct Economic Loss* (billion CNY)
1	2015	Typhoon Mujigae (1522)	23.8
2	2013	Typhoon Usagi (1319)	23.1
3	2013	Typhoon Utor (1311)	16.7
4	2008	Severe Tropical Storm Bilis (0604)	15.2
5	2014	Typhoon Rammasun (1409)	13
6	2017	Typhoon Hato (1713)	11.9
7	2008	Typhoon Hagupit(0814)	11.4
8	2014	Typhoon Kalmaegi (1415)	8.2
9	2006	Typhoon Prapiroon (0606)	7.0
10	2008	Dragon Boat Wet Season (May)	6.5

*Note: all monetary loss are the original values reported in their respective year of occurrence.
Source: Statistical Yearbooks 2001-2017



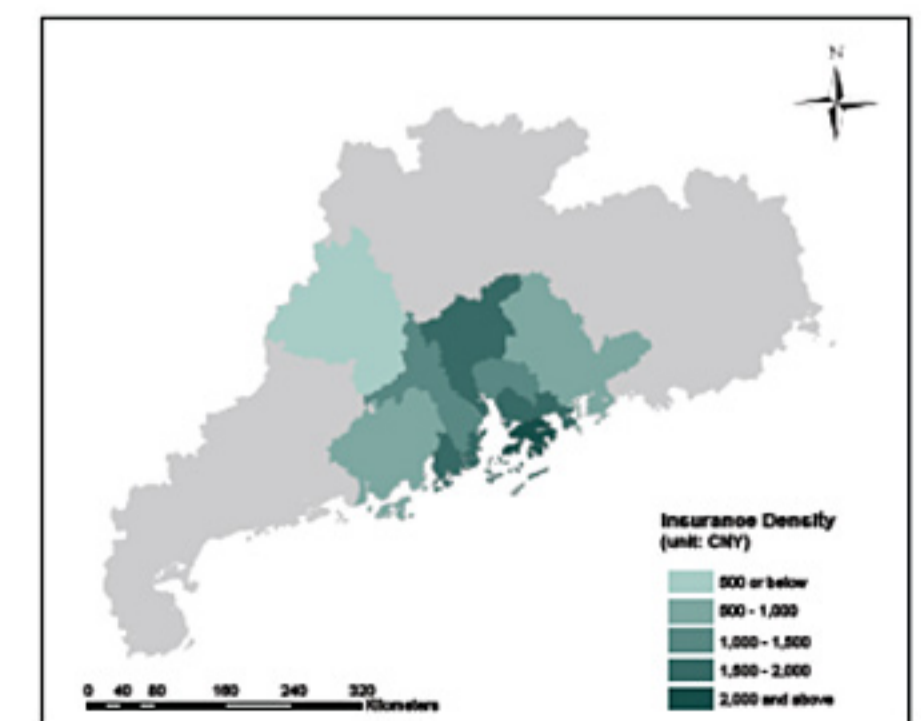
Source: Statistical Yearbooks 2001-2017

Regional Insurance Penetration



Insurance Penetration in the PRD Region (2015)
Insurance penetration is the percentage of insurance premium (in \$) to GDP (in \$)

Data courtesy: China Reinsurance P&C



Insurance Density in the PRD Region (2015)
Insurance density is the ratio of insurance premium (in \$) to total population.