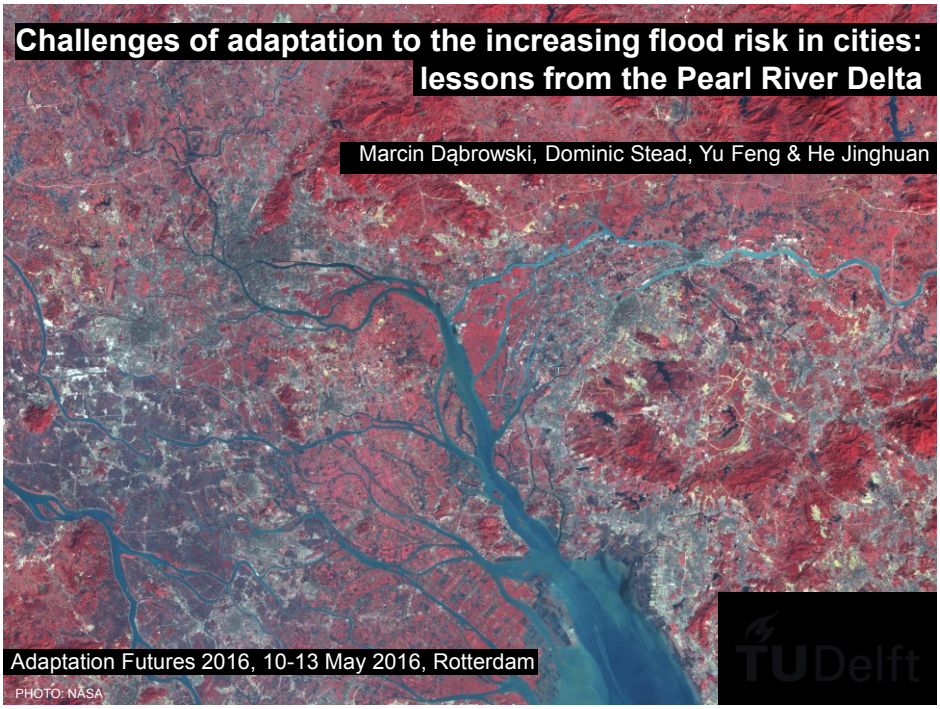


- Cities are key **perpetrators** of climate change but also their main **victims** and part of the **solution**
- **Delta cities**, particularly **vulnerable** to climate change impacts (flooding)
- A problem that is both **global and local** in nature ('glocal') → responses at **multiple administrative levels** (Gupta, 2007)
- A **particularly complex problem** → **integrated policy** (water, planning, housing, health, disaster management, research, etc.)
- Urban climate change adaptation as a **multi-level governance challenge**: **vertical** (cross-level) and **horizontal** (international, inter-jurisdictional, cross-sectoral)
  (Corfee-Morlot et al., 2009; Bulkeley and Betsill, 2005, OECD, 2010)

Table 1 | City ranking by risk (AAL) and relative risk (AAL in percentage of GDP) for 2005.

	Ranking by AAL (US$ million)				Ranking by relative AAL (percentage of city GDP)			
	Urban agglomeration	100 year exposure	AAL, with protection (US$ million)	AAL, with protection (percentage of GDP)	Urban agglomeration	100 year exposure	AAL, with protection (US$ million)	AAL, with protection (percentage of GDP)
1	Guangzhou	38,508	687	1.32%	Guangzhou	38,508	687	1.32%
2	Miami	366,421	672	0.30%	New Orleans	143,963	507	1.21%
3	New York—Newark	236,530	628	0.08%	Guayaquil	3,687	98	0.95%
4	New Orleans	143,963	507	1.21%	Ho Chi Minh City	18,708	104	0.74%
5	Mumbai	23,188	284	0.47%	Abidjan	1,786	38	0.72%
6	Nagoya	77,988	260	0.26%	Zhanjiang	2,780	46	0.50%
7	Tampa—St. Petersburg	49,593	244	0.26%	Mumbai	23,188	284	0.47%
8	Boston	55,445	237	0.13%	Khulna	2,073	13	0.43%
9	Shenzen	11,338	169	0.38%	Palembang	1,161	27	0.39%
10	Osaka—Kobe	149,935	120	0.03%	Shenzen	11,338	169	0.38%
11	Vancouver	33,456	107	0.14%	Hai Phòng	6,348	19	0.37%
12	Tianjin	11,408	104	0.24%	N'ampo	507	6	0.31%
13	Ho Chi Minh City	18,708	104	0.74%	Miami	366,421	672	0.30%
14	Kolkata	14,769	99	0.21%	Kochi	855	14	0.29%
15	Guayaquil	3,687	98	0.95%	Tampa—St. Petersburg	49,593	244	0.26%
16	Philadelphia	22,132	89	0.04%	Nagoya	77,988	260	0.26%
17	Virginia Beach	61,507	89	0.15%	Surat	3,288	30	0.25%
18	Fukuoka—Kitakyushu	39,096	82	0.09%	Tianjin	11,408	104	0.24%
19	Baltimore	14,042	76	0.08%	Grande_Vitória	6,738	32	0.23%
20	Jakarta	4,256	73	0.14%	Xiamen	4,486	33	0.22%

A comparison with a ranking by exposure is proposed in the Supplementary Information.

Source: Hallegate et al. 2013

Climate change programmes and strategies in place

- Recognition of the need to take adaptation measures at the national level, trickling down to the provincial level, but no local response:
  - **National Plan for Coping With Climate Change 2011-2020**
  - **Provincial Climate Change Adaptation Strategy**, **2010** – not taken up by the cities
  - **Guangzhou Water White Paper 2013** – climate change not mentioned
  - **Sponge City Programme**, 2014 – Shenzen as a pilot city, also in Guangzhou
- **Growing flood risk resulting from climate change not recognised** by planners and urban designers in Guangzhou and Shenzen – emphasis on rapid urban and economic development, increasingly on pollution
- However, at the local level, **some water management and urban development projects could tick the box of urban climate change adaptation**, but are not labeled as such

Combining urban redevelopment
with flood protection on the South bank
of the Pearl River in Liwan district, Guangzhou

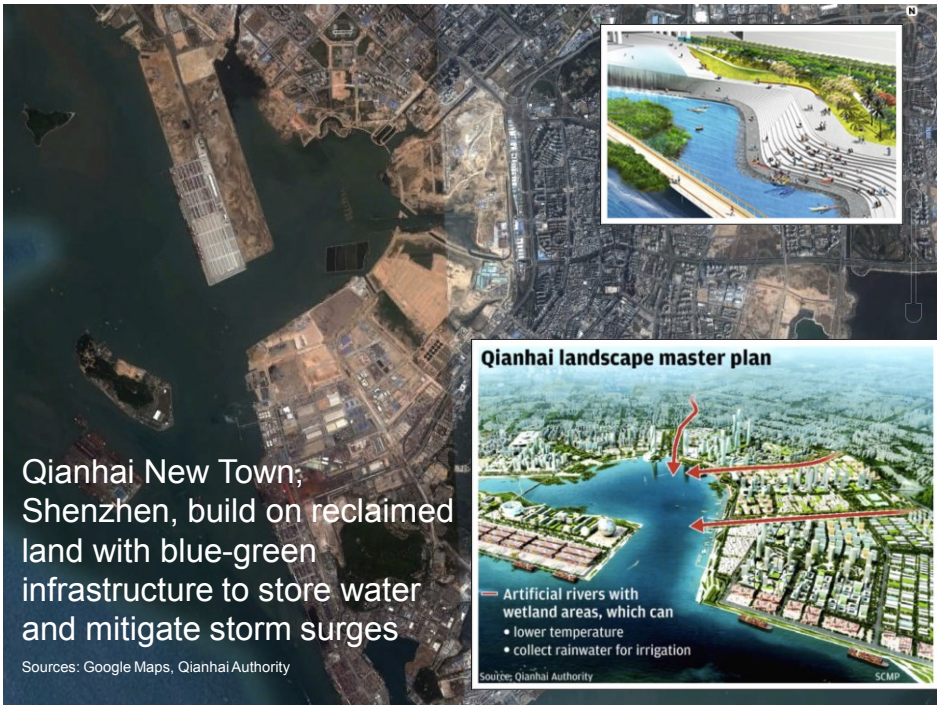
Photo: Marcin Dąbrowski

Reopened canals combine heritage protection, with enhancing liveability and resilience to surface flooding in Liwan district, Guangzhou

Photo: Marcin Dąbrowski

Haizhu lake – a (flawed) hydrological project with a key role in the future development of Guangzhou's city centre (extension of the 'Axis')

Photo: Marcin Dąbrowski

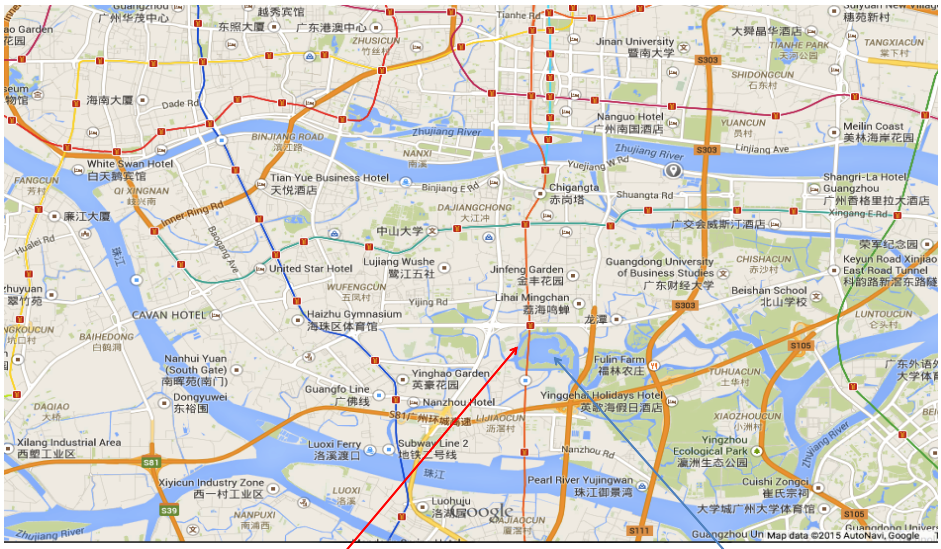


Qianhai New Town, Shenzhen, build on reclaimed land with blue-green infrastructure to store water and mitigate storm surges

Sources: Google Maps, Qianhai Authority

Barriers: institutions

- **No continuity of urban policies** – **Mayors 'parachuted'** from elsewhere to be later promoted to the provincial or national level - focus on the short term and 'prestige' projects
- **Vertical coordination** – in theory, a hierarchical policy transmission belt from central to local level, in practice the **central government has little means of enforcing implementation of national policies locally**
- **Horizontal coordination** - in theory, different municipal bureaus coordinate actions to ensure flood safety, in practice **complete silo-mentality and lack of coordination** with counterproductive results



Barriers: ideas

- **Living with water is in the local DNA**, however, the ancestral knowledge in with water management has been lost
- **Short-term thinking** is the norm – legacy of the rapid economic transformation; built environment not made to last
- **Typhoons and the related flooding seen as normal** - focus on draining the excess water and warning systems rather than on preventing storm surge flooding
- **No awareness or even dismissal of climate change impacts** - cities expand rapidly into extremely vulnerable areas (e.g. Nansha New Area in Guangzhou or Qianhai in Shenzhen)
- **'Accidental' climate adaptation measures** that are not framed as climate change adaptation and not based on assessment of future risks – the objective is to create a beautiful urban landscape ('every Mayor wants a lake in his district')

Barriers: interests

- **Urbanisation at break-neck speed and at all cost** - **flood risk management is not a priority** (developing real estate is) and lags behind, resulting in very low level of flood protection
- **Limited availability of rural** land that can be converted in to urban justifies the **expansion** of the cities **onto reclaimed land**
- **Interest in boosting the value of real estate** dictate the use of multi-functional flood-protections and Low Impact Development solutions rather than environmental or climate adaptation concerns
- **Peculiarity of the assessment of local officials in China** – focus on GDP as the main indicator of performance guaranteeing promotion to upper tiers of government
- Potential positive development – **Sponge City** programme makes better water management a national priority, which may galvanise

Conclusions

- **Administrative system** and **national institutional characteristics are fundamentally important** factors determining how cities and urban regions address the climate change challenge
- **Acknowledging the interdependencies across scales** is essential for explaining why climate change risks are addressed (or not) by them and how
- Cross-level, inter-jurisdictional and cross-sectoral **governance challenges and accountability gaps** constrain climate adaptation capacity
- Efforts to raise awareness of climate change risks among planners and urban designers are critical to build support for investment in adaptation
- Framing climate adaptation measures as an **opportunity to improve spatial quality and attractiveness of the city** could stimulate the development of adaptation measures - the question is **who benefits** then?

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