Global human exposure to urban riverine floods and storms

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Introduction and approach

Urban floods and storms

- Exposure is vast and grows rapidly
- No high-resolution spatial assessment is available
- Major policies exist, such as
  - Sendai Framework of Disaster Risk Reduction
  - UN climate change policies
  - UN Sustainable Development Goals

Relevant data infrastructure

- Grows very rapidly
- Is under-utilized
- Is mentioned in many recent review papers but not yet tapped

Materials and methods

- Geospatial analysis (GIS)
- EU Data Hub's GHSL (Global Human Settlement Layer) data + supplementary data
  - All urban areas with > 50,000 inhabitants in 2015 (13,136)
  - 40 years: 1975-2015
  - 1.78 b in 1975 → 3.54 b in 2015 (doubled)

We wanted to learn

- Global spatial patterns
- Relation to development and income level
- Trends
- Policy & science implications

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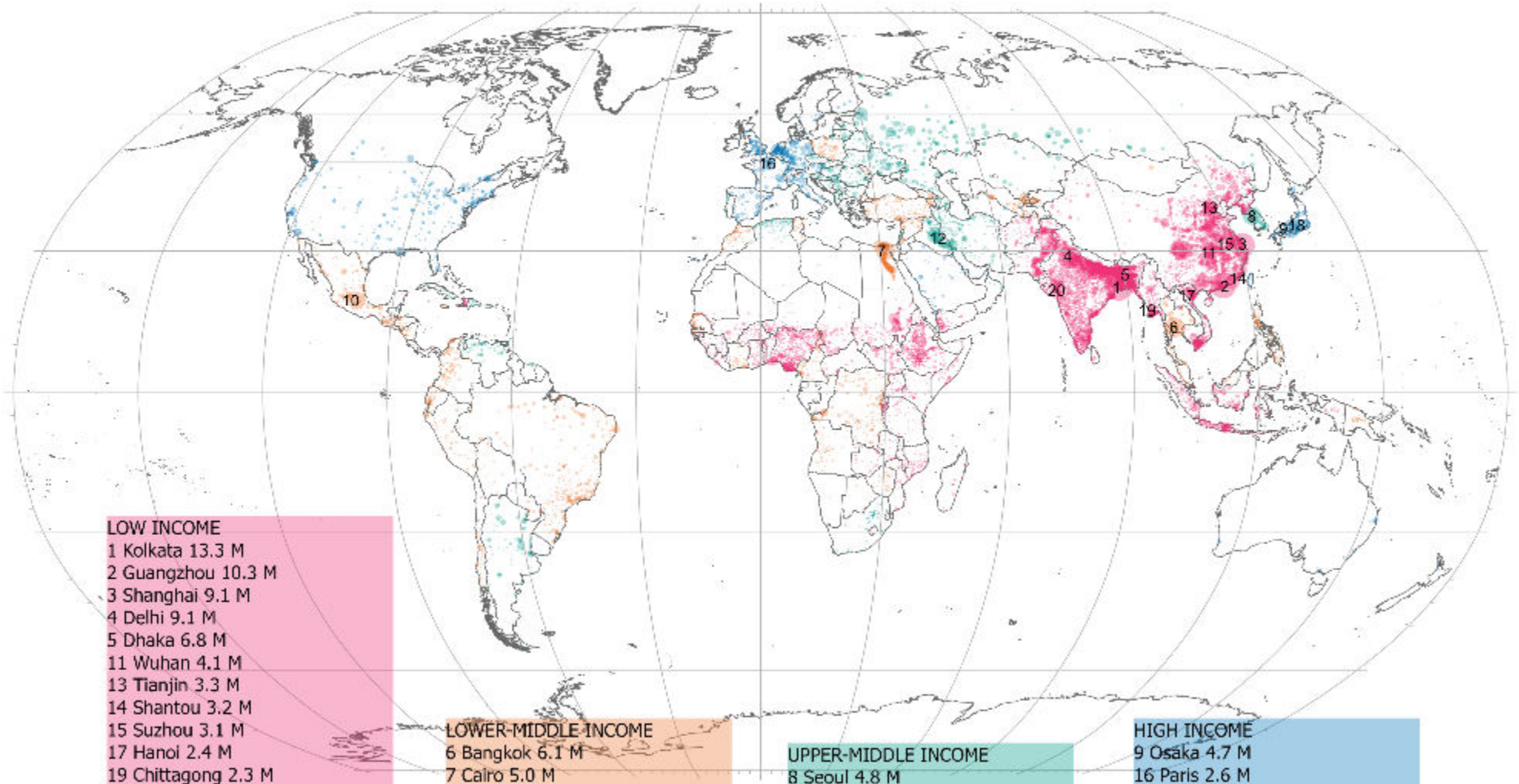
WORLD'S URBAN POPULATION
Exposure to Riverine Floods 1990



LOW INCOME
1 Kolkata 13.3 M
2 Guangzhou 10.3 M
3 Shanghai 9.1 M
4 Delhi 9.1 M
5 Dhaka 6.8 M
11 Wuhan 4.1 M
13 Tianjin 3.3 M
14 Shantou 3.2 M
15 Suzhou 3.1 M
17 Hanoi 2.4 M
19 Chittagong 2.3 M
20 Surat 2.2 M

LOWER-MIDDLE INCOME
6 Bangkok 6.1 M
7 Cairo 5.0 M
10 Mexico 4.3 M

UPPER-MIDDLE INCOME
8 Seoul 4.8 M
12 Baghdad 3.4 M

HIGH INCOME
9 Osaka 4.7 M
16 Paris 2.6 M
18 Nagoya 2.3 M

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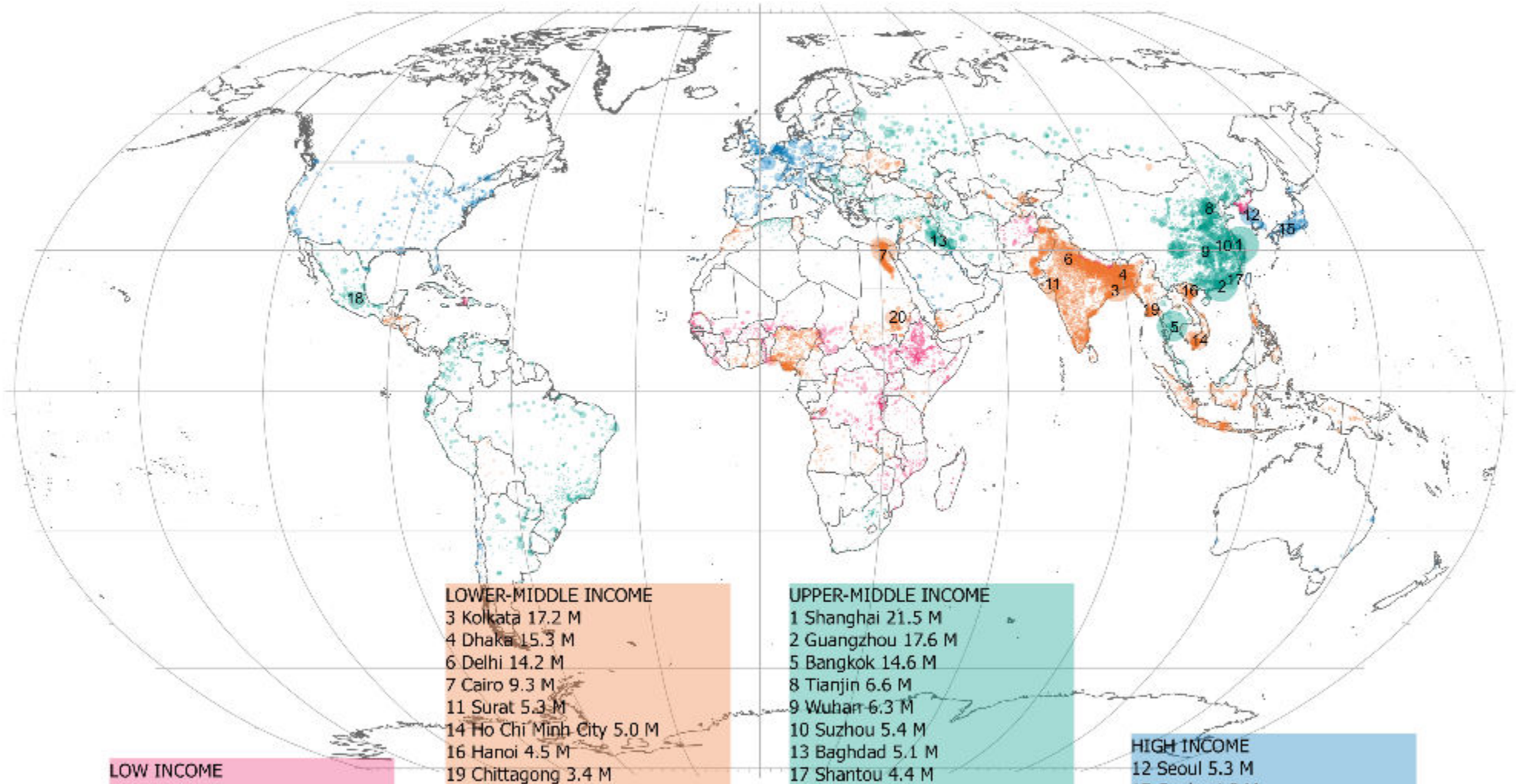
WORLD'S URBAN POPULATION
Exposure to Riverine Floods 2015



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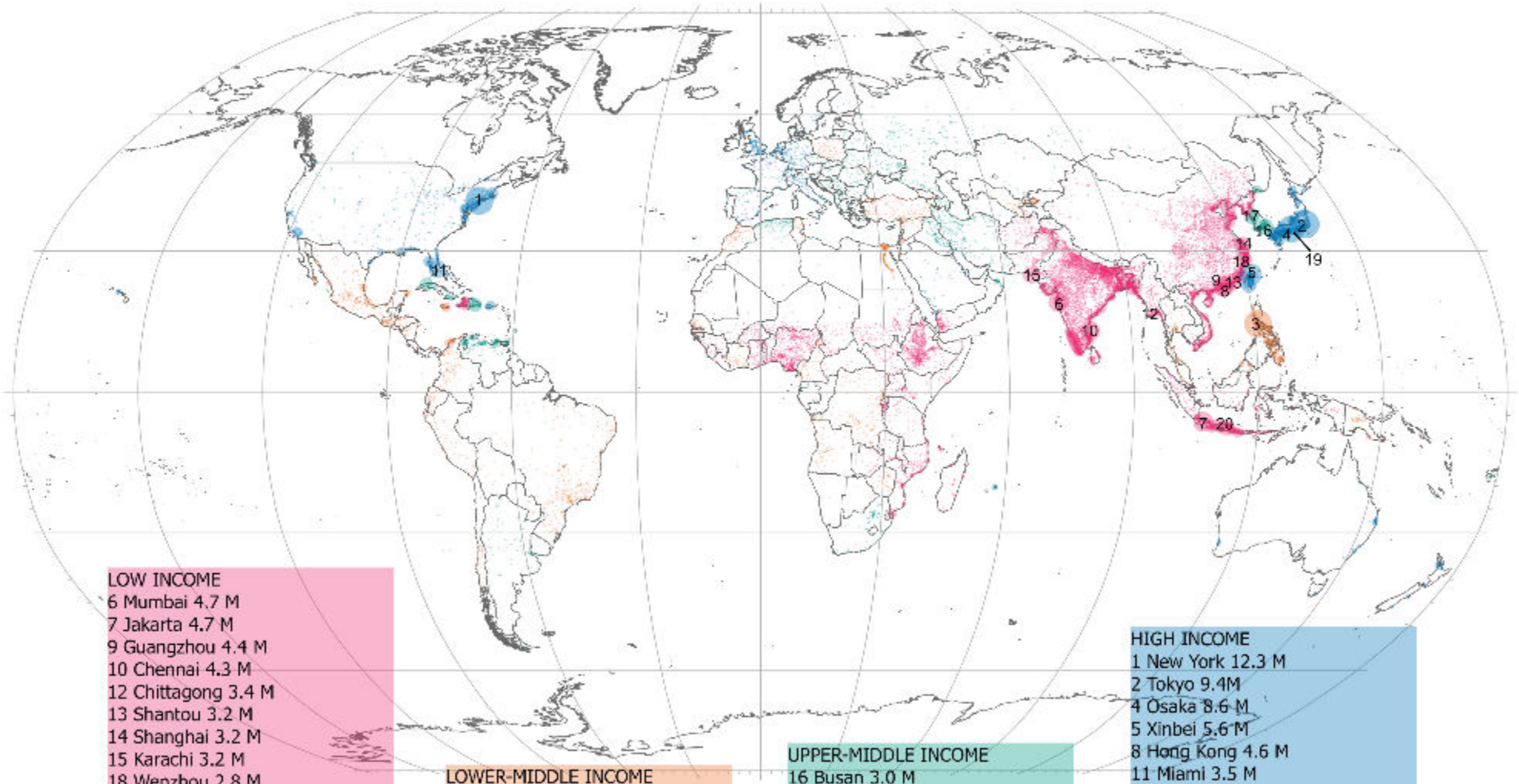
WORLD'S URBAN POPULATION
Exposure to Tropical Storm Surges 1990



LOW INCOME
6 Mumbai 4.7 M
7 Jakarta 4.7 M
9 Guangzhou 4.4 M
10 Chennai 4.3 M
12 Chittagong 3.4 M
13 Shantou 3.2 M
14 Shanghai 3.2 M
15 Karachi 3.2 M
18 Wenzhou 2.8 M
20 Surabaya 2.6 M

LOWER-MIDDLE INCOME
3 Manila 9.1 M

UPPER-MIDDLE INCOME
16 Busan 3.0 M
17 Seoul 2.9 M

HIGH INCOME
1 New York 12.3 M
2 Tokyo 9.4M
4 Osaka 8.6 M
5 Xinbei 5.6 M
8 Hong Kong 4.6 M
11 Miami 3.5 M
19 Nagoya 2.6 M

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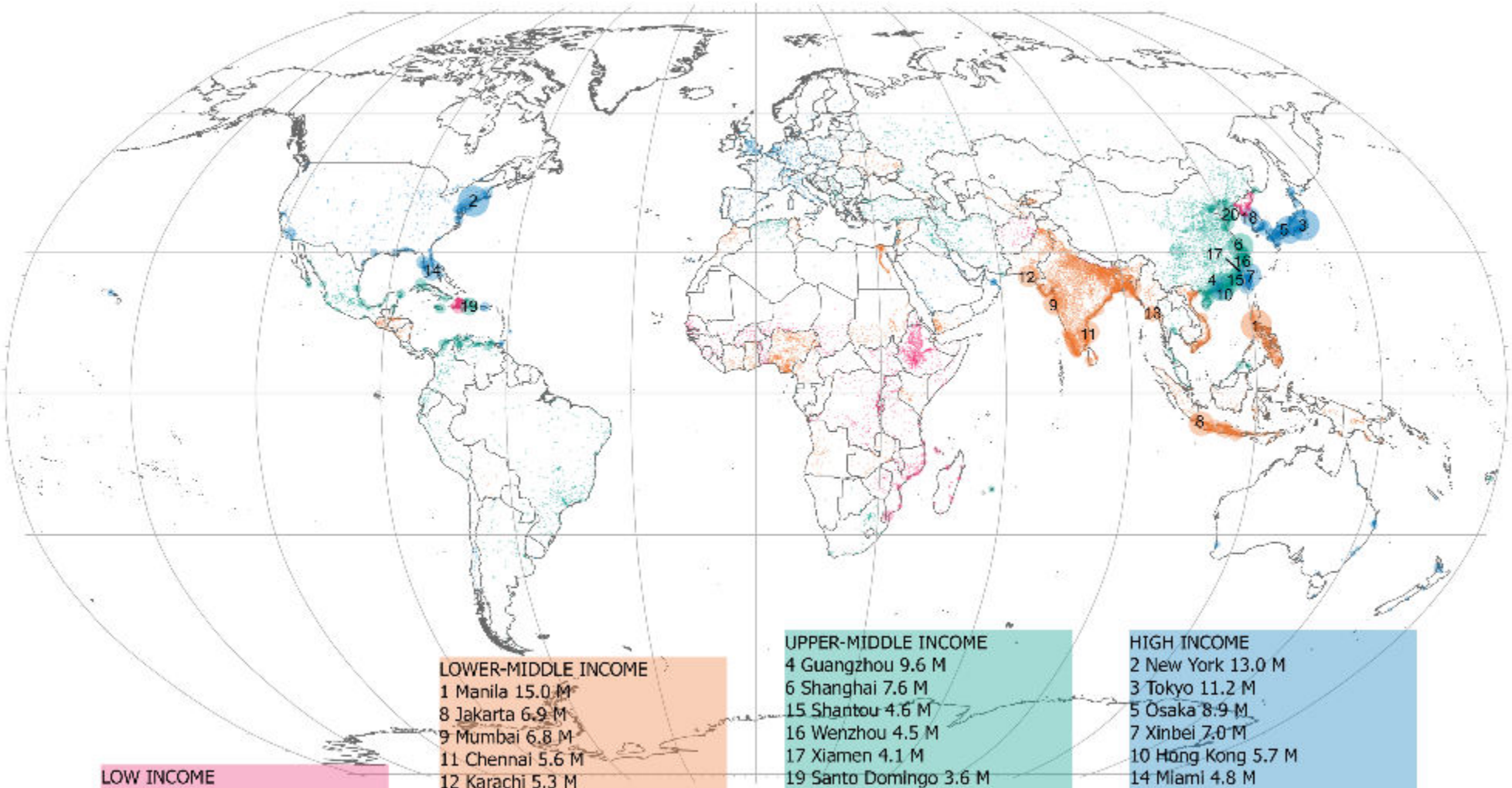
WORLD'S URBAN POPULATION
Exposure to Tropical Storm Surges 2015



LOW INCOME
n/a

LOWER-MIDDLE INCOME
1 Manila 15.0 M
8 Jakarta 6.9 M
9 Mumbai 6.8 M
11 Chennai 5.6 M
12 Karachi 5.3 M
13 Chittagong 5.1 M

UPPER-MIDDLE INCOME
4 Guangzhou 9.6 M
6 Shanghai 7.6 M
15 Shantou 4.6 M
16 Wenzhou 4.5 M
17 Xiamen 4.1 M
19 Santo Domingo 3.6 M
20 Dalian 3.4 M

HIGH INCOME
2 New York 13.0 M
3 Tokyo 11.2 M
5 Osaka 8.9 M
7 Xinbei 7.0 M
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14 Miami 4.8 M
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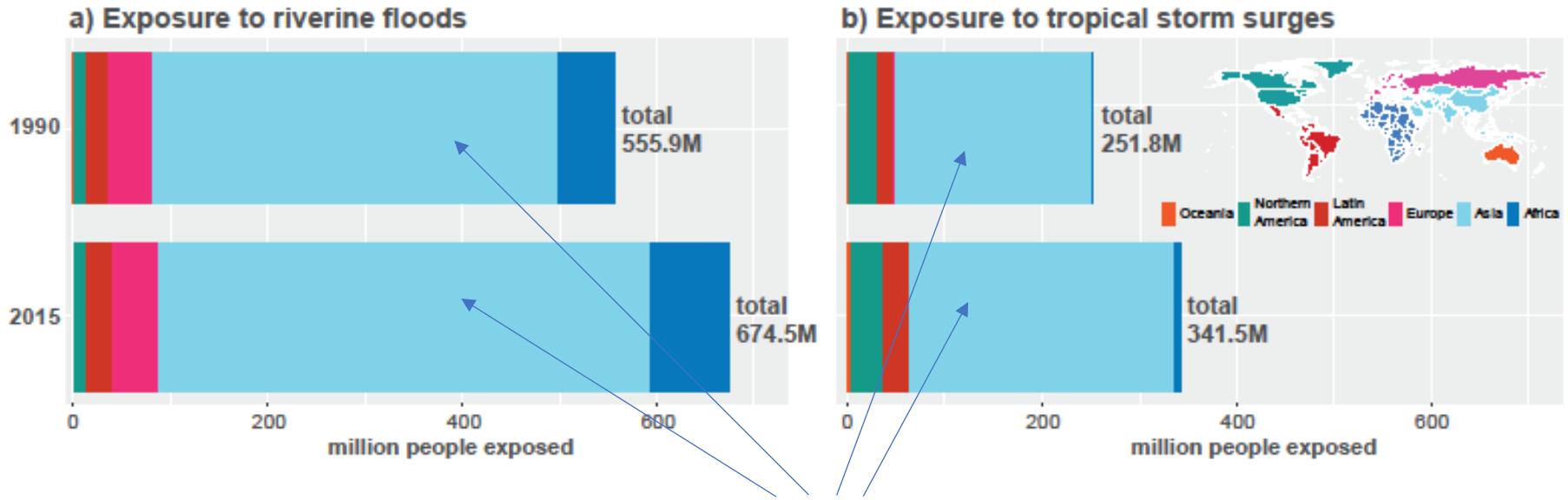
Urban exposure by continent



Asia

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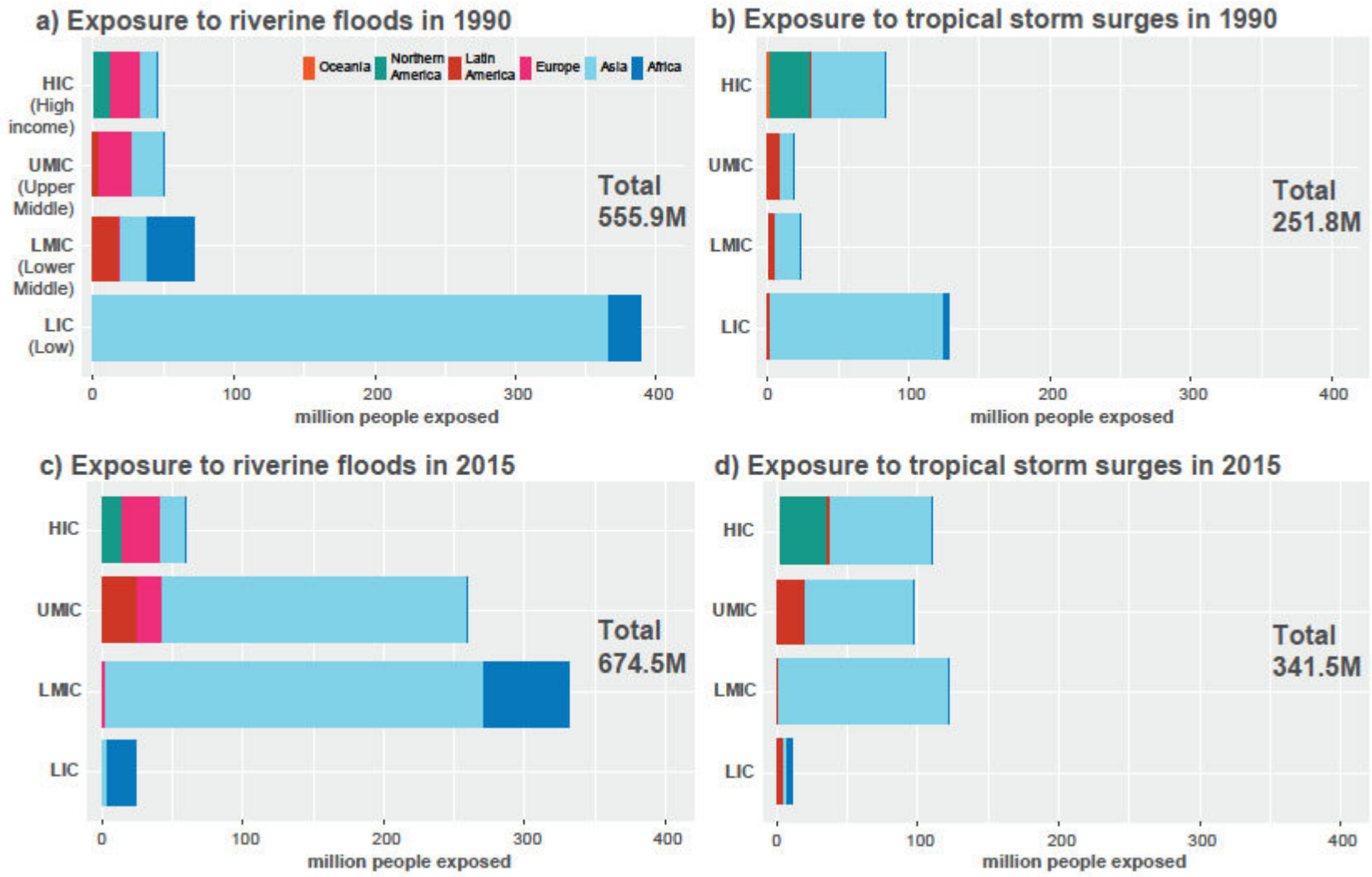
Urban exposure by income category



1990

2015

Floods

Storm surges

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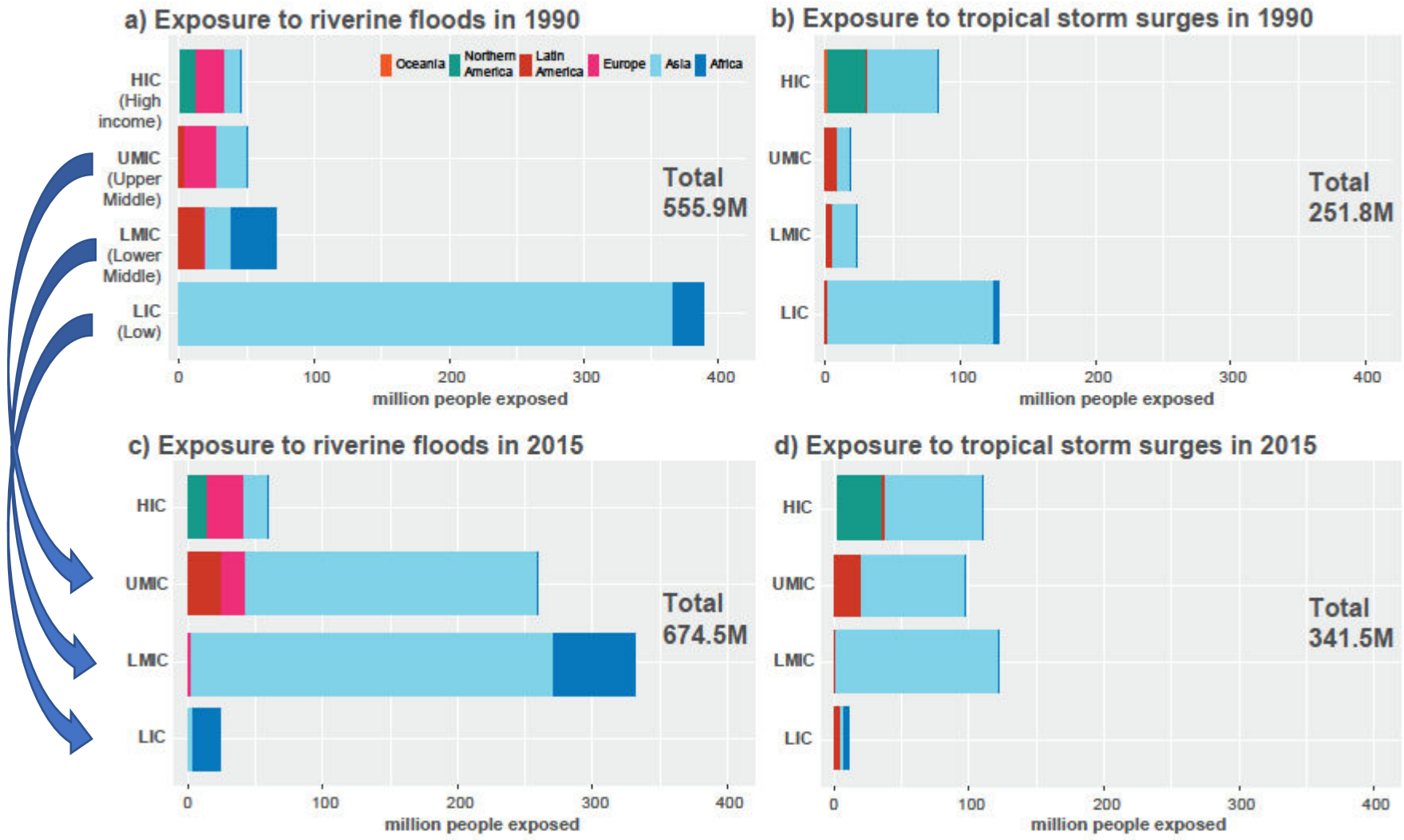
Urban exposure by income category



1990

2015

Floods

Storm surges

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Conclusions

Global spatial patterns

- **Asia** dominates
  - 60% of the world's **population**
  - 75% of world's urban **exposure to floods**
  - 80% of world's urban **exposure to storm surges**
- Proportion of urban people exposed has not changed much on any continent

Relation to development, income level

- Shift **from low to middle-income** areas
  - Floods: Low-income countries: 1990: **70%** → 2015: **4%**
  - Storm surges: Low-income countries: 1990: **50%** → 2015: **3%**
- **Massive growth in middle-income countries**
  - 88% of those flood-exposed in 2015

Science implications

- Spatial analysis → much potential
- Numerous excellent datasets available, not used much by scholars
- Excellent time to investigate how different rapidly emerging economies address flood & storm surge disaster management

Policy implications

- Go beyond simplistic rhetoric such as
  - "…especially in developing countries…", etc
- Scrutinize more what can be learned from the policies of the past decades
  - especially from various middle-income countries

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Thank you – 谢谢

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RESEARCH ARTICLE

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Global human exposure to urban riverine floods and storms

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[2]School of Interdisciplinary Studies, University of Glasgow, Glasgow, UK

Abstract
The world's urban population is soaring, with an increasing number of people exposed to urban natural hazards such as riverine floods and storm surges. The global quantification of their extent is, however, still blurred. The ongoing