

Institute of Catastrophe **Risk Management** 

# **Using Macro-Level Exposure Indicators for Future Disaster Risk Assessment in Megacities**

## Background & Aim

- Following the rapid urban growth in recent years, exposure could be considered as the most dynamic component in risk assessment processes.
- Estimation of spatiotemporal change of exposure is a critical and intricate task especially for megacities which are complex systems with high loss potentials.
- The conventional loss estimation approaches require a detailed inventory database of structures. Alternatively, macro-level socio-economic exposure indicators are used, relying on regularly updated data.
- This study aims to project the natural disaster loss based on the spatiotemporal variability of exposure, assuming a direct relation between losses due to physical damages and business interruption, and the economic productivity of a region.

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## **Urban Growth Modelling**



## What is Risk?

## Methodology



HAZARD The likelihood, probability, or chance of a potentially destructive phenomenon



# **VULNERABILITY**

The likelihood that assets will be damaged or destroyed when exposed to a hazard event



#### **EXPOSURE** The location, attributes, and values of assets that are important to communities

**RISK = HAZARD x VULNERABILITY x EXPOSURE** The composite of the impacts of ALL potential events

## **Urban Growth Prediction - 2030**



- As an initial step before the loss estimation, the change in built-up area at seismic risk and flood risk were obtained using the urban growth model projections for selected megacities, namely Istanbul, Jakarta, Metro Manila and Shenzhen.
- For this purpose, hazard maps obtained from different sources and built-up area from past, today and future are overlaid.





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## Flood Hazard Level 11 (2% High Relatively high 8 (2%) Relatively low VII VIII 1 (989 $(\mathrm{km}^2)$ Jakarta

## Built-up Area at Risk

- Built-up Area at Seismic Risk was obtained for 10% Probability of Exceedance in 50 years for Jakarta, Metro Manila and Istanbul.
- Built-up Area at Flood Risk was obtained for Shenzhen.



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## **Conclusions and Future Work**

- SLEUTH Urban Growth Model was used to assess the spatiotemporal change in built-up area at risk for selected megacities considering different types of natural disasters.
- It was observed that each city is unique and shows different trends from past to future. However, the increase of built-up area in hazardous regions should be assessed carefully for disaster risk reduction.
- Following the built-up area prediction for future, grid-based population and GDP are planned to be • used for future loss estimation of selected megacities considering deterministic and probabilistic seismic hazard analysis approaches.

References:

- Open data for resilience initiative field guide, GFDRR (2014)

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- Wald DJ, Quintoriano V, Heaton TH and Kanamori H. 1999 Relationships Between Peak Ground Acceleration, Peak Ground Velocity, and Modified Mercalli Intensity in California Earthquake Spectra 15 557-564