Coastal flood risks in the Bangkok Metropolitan Region, Thailand: combined impacts of land subsidence, sea level rise and storm surge

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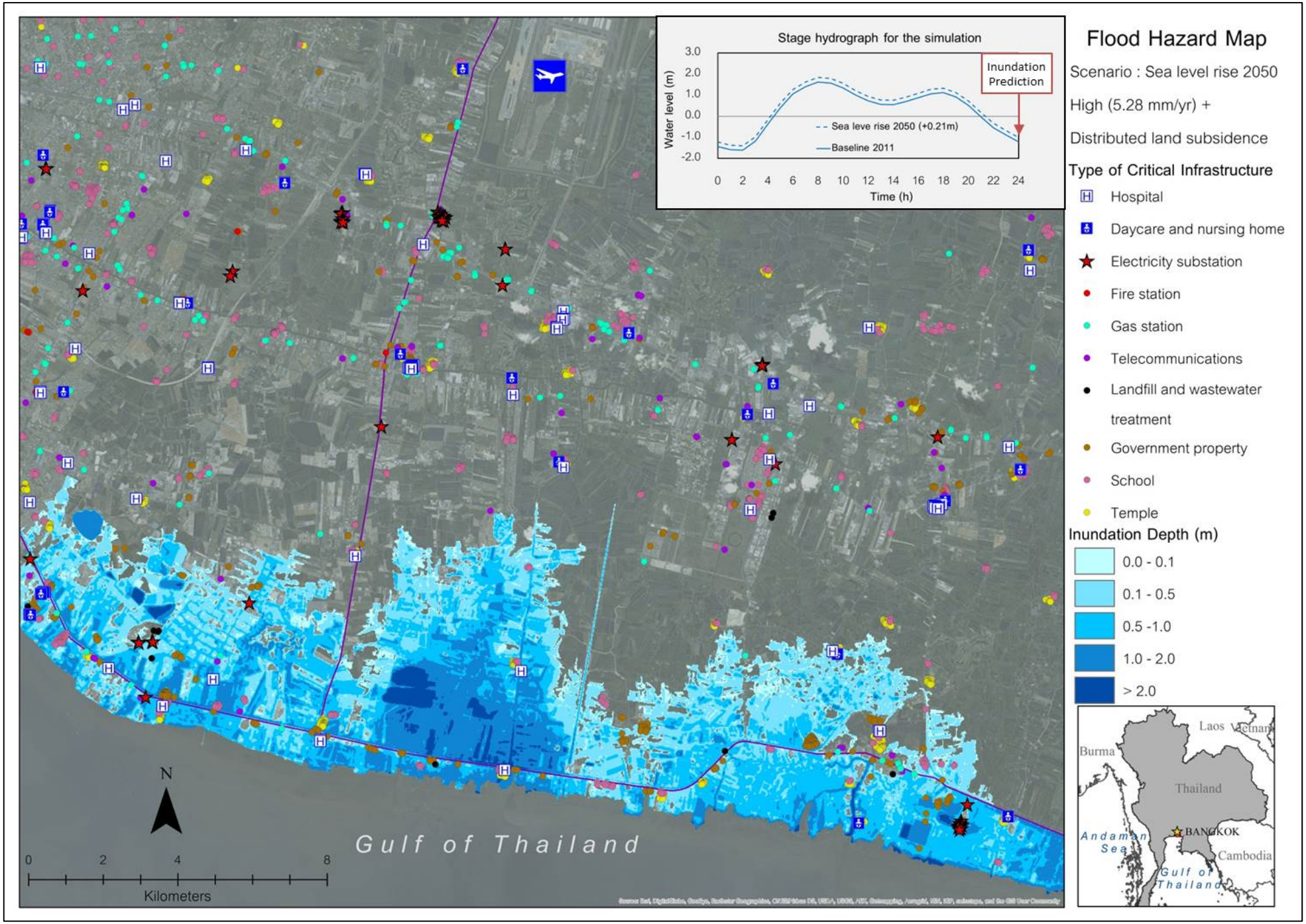
Abstract:

Due to the fast-changing climatic and anthropogenic conditions at coastal regions, many coastal mega-cities are becoming increasingly vulnerable to internal and external risks. The risk is particularly high for low-lying coastal cities in developing nations, with Southeast Asia recognized as a hotspot of vulnerability due to the increasing population density, rapid change of natural landscape associated with urbanization and intensified hydrological and atmospheric conditions at the coastal front in an uncertain climate future.

The Bangkok Metropolitan Region is one of the largest coastal megacities in Southeast Asia that are challenged by the potential impacts due to climate change and anthropological variability in the coming decades (Organization for Economic Co-operation and Development; OECD). Climate-related risks in this region are associated with its relatively low-lying nature of the terrain and adjacency to the coast. Coastal inundation due to high tides from the sea occurs annually in the area close to the seashore. This is set to increase given a projected rising sea level and the sinking landscape due to groundwater extraction and urbanization. The aim of this research is therefore to evaluate the vulberability of the city to sea level rise, land subsidence and storm surge. Distributed land subsidence rate, projected sea level rise and existing structural features such as flood defences are taken into account. The 2011 flood in Thailand is used as a baseline event. Scenarios were designed with projections of land subsidence and sea level rise to 2050s, 2080s, and 2100s. A two-dimensional flood inundation model (FloodMap, Yu and Lane 2006) is used to derive inundation depth and velocity associated with each scenario. The impacts of coastal flood risk on critical infrastructures (e.g. power supply, transportation network, rescue centers, hospitals, schools and key government buildings) are evaluated (e.g. Figure 1). Results suggest progressively increased but non-linear risks of coastal flooding to key coastal infrastructures into 2050s, 2080s and 2100s. The understanding gained through this study may inform decision makers with useful information to undertake appropriate adaptation measures for dealing with the potential flood risks.


Stage hydrograph for the simulation
Water level (m)
3.0
2.0
1.0
0.0
-1.0
-2.0
0 2 4 6 8 10 12 14 16 18 20 22 24
Time (h)
Inundation Prediction
Sea leve rise 2050 (+0.21m)
Baseline 2011
Flood Hazard Map
Scenario : Sea level rise 2050
High (5.28 mm/yr) +
Distributed land subsidence
Type of Critical Infrastructure
Hospital
Daycare and nursing home
Electricity substation
Fire station
Gas station
Telecommunications
Landfill and wastewater treatment
Government property
School
Temple
Inundation Depth (m)
0.0 - 0.1
0.1 - 0.5
0.5 -1.0
1.0 - 2.0
> 2.0
N
0 2 4 8
Kilometers
Gulf of Thailand
Laos
Vietnam
Burma
Thailand
BANGKOK
Andaman Sea
Cambodia
Gulf of Thailand