

Flood exposure in Rotterdam's unembanked areas from 1970 to 2150: sensitivities to urban development, sea level rise, and adaptation

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Abstract

Uncertainties in the rate of sea level rise, coupled with ongoing urban expansion, are a challenge for city planners designing flood risk adaptation strategies. This study quantifies flood exposure in Rotterdam's unembanked areas from 1970 to 2150. We modelled flood hazards for 10-, 100-, and 1000-year return periods under both low- (RCP2.6) and high-emission (RCP8.5) scenarios while assessing exposure using historic and planned urban development data. Temporal variations in exposure rates are attributed to three factors: urban development, sea level rise, and the construction of the Maeslant storm surge barrier. Without adaptation measures, flood exposure in Rotterdam's unembanked areas is projected to increase. Under RCP8.5, exposure rates for 10-year flood events are expected to increase 7-fold by 2150 compared to 2020. For RCP2.6, a 3-fold increase is projected for 10-year events, reflecting uncertainties in long-term sea level rise. A retrospective analysis reveals a decrease in flood exposure: exposure levels observed in 2020 were approximately half those observed in 1996, due to construction of the Maeslant barrier. Exposure rates are primarily influenced by the Maeslant barrier, followed by sea level rise and urban development. Understanding the interplay of these three factors is crucial for urban planning and flood risk management in delta cities.

Keywords

climate change adaptation, housing market, physical climate risk, risk labels

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