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Flood risk and adaptation strategies in Indonesia: a probabilistic analysis using globally available data

Sanne Muis (1), Burak Güneralp (2), Brenden Jongman (1), Jeroen Aerts (1), and Philip Ward (1)

(1) VU University Amsterdam, Institute for Environmental Studies, Water & Climate Risk, Amsterdam, Netherlands, (2) Department of Geography, Texas A&M University, College Station, USA

In recent years, global flood losses are increasing due to socio-economic development and climate change, with the largest risk increases in developing countries such as Indonesia. For countries to undertake effective risk-management, an accurate understanding of both current and future risk is required. However, detailed information is rarely available, particularly for developing countries. We present a first of its kind country-scale analysis of flood risk using globally available data that combines a global inundation model with a land use change model and more local data on flood damages. To assess the contribution and uncertainty of different drivers of future risk, we integrate thousands of socio-economic and climate projections in a probabilistic way and include multiple adaptation strategies.

Indonesia is used as a case-study as it a country that already faces high flood risk, and is undergoing rapid urbanization. We developed probabilistic and spatially-explicit urban expansion projections from 2000 to 2030 that show that the increase in urban extent ranges from 215% to 357% (5th and 95th percentile). We project rapidly rising flood risk, both for coastal and river floods. This increase is largely driven by economic growth and urban expansion (i.e. increasing exposure). Whilst sea level rise will amply this trend, the response of river floods to climate change is uncertain with the impact of the mean ensemble of 20 climate projections (5 GCMs and 4 RCPs) being close to zero. However, as urban expansion is the main driving force of future risk, we argue that the implementation of adaptation measures is increasingly pressing, regardless of the wide uncertainty in climate projections. Hence, we evaluated the effectiveness of two adaptation measures: spatial planning in flood prone areas and enhanced flood protection. Both strategies have a large potential to effectively offset the increasing risk trend. The risk reduction is in the range of 22-85% and 53-95% for spatial planning and flood protection, respectively. With this contribution, we demonstrate that globally available data can be used successfully for probabilistic risk assessment and the evaluation of adaptation strategies in data-scarce areas.