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Holistic flood risk assessment using agent-based modelling: the case of Sint Maarten Island

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Floods in coastal regions are regarded as one of the most dangerous and harmful disasters. Though commonly referred to as natural disasters, coastal floods are also attributable to various social, economic, historical and political issues. Rapid urbanisation in coastal areas combined with climate change and poor governance can lead to a significant increase in the risk of pluvial flooding coinciding with fluvial and coastal flooding posing a greater risk of devastation in coastal communities. Disasters that can be triggered by hydro-meteorological events are interconnected and interrelated with both human activities and natural processes. They, therefore, require holistic approaches to help understand their complexity in order to design and develop adaptive risk management approaches that minimise social and economic losses and environmental impacts, and increase resilience to such events.

Being located in the North Atlantic Ocean, Sint Maarten is frequently subjected to hurricanes. In addition, the stormwater catchments and streams on Sint Maarten have several unique characteristics that contribute to the severity of flood-related impacts. Urban environments are usually situated in low-lying areas, with little consideration for stormwater drainage, and as such are subject to flash flooding. Hence, Sint Maarten authorities drafted policies to minimise the risk of flood-related disasters on the island. In this study, an agent-based model is designed and applied to understand the implications of introduced policies and regulations, and to understand how different actors' behaviours influence the formation, propagation and accumulation of flood risk. The agent-based model built for this study is based on the MAIA meta-model, which helps to decompose, structure and conceptualize socio-technical systems with an agent-oriented perspective, and is developed using the NetLogo simulation environment. The agents described in this model are households and businesses, and policies on spatial planning rules are implemented. Preliminary results demonstrate the evolving nature of flood risks and describe the effectiveness of different planning policies to reduce risk and increase resilience.