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Modelling Future Urban Flood Exposure: The Combined Role of Socioeconomic Pathways and Climate Scenarios

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Rapid urbanization and climate change jointly shape future flood exposure in coastal cities, particularly in the Global South, where urban growth rates are high and adaptive capacity is often constrained. While scenario-based frameworks such as the Shared Socioeconomic Pathways (SSPs) and Representative Concentration Pathways (RCPs) provide consistent narratives of socioeconomic and climatic change, their integration into spatially explicit urban growth modelling and flood exposure analysis remains limited.

This study applies the SLEUTH urban growth model to project high-resolution (30 m) urban expansion trajectories up to 2050 for nine coastal urban agglomerations across Africa, Asia, and Latin America under SSP1, SSP2, and SSP5. SSP-based urban population projections were translated into scenario-specific SLEUTH parameters, enabling consistent representation of divergent socioeconomic pathways. Model calibration was supported by harmonized historical settlement data from the World Settlement Footprint and enhanced through a kernel density–based zonation and spatial tiling approach to capture heterogeneous urban–rural growth dynamics across large study areas. Projected urban extents were overlaid with RCP-based coastal, fluvial, and pluvial flood hazard maps to assess future flood exposure at the 50th and 83rd percentiles for a 100-year return period.

Results reveal pronounced inter-city and inter-scenario variability in both urban expansion and flood exposure. Four cities (Dar es Salaam, Ho Chi Minh City, Khulna, and Surat) are projected to expand by more than 50% by 2050 under SSP1 and SSP5. Flood exposure is driven by the combined effects of climate forcing and urban development patterns: high radiative forcing scenarios amplify hazard extent, while socioeconomic pathways strongly influence where and how cities expand into flood-prone areas [1]. In several cities, newly developed urban areas exhibit disproportionately higher exposure than existing settlements, particularly for fluvial and pluvial flooding. However, exposure patterns are highly city-specific, underscoring the limitations of generalized assumptions.

The findings demonstrate that future urban flood exposure cannot be explained by climate change alone, but emerges from the interaction between climate scenarios and socioeconomic pathways shaping urban growth. By combining SSP/RCP frameworks with spatially explicit urban growth modelling across multiple cities, this study provides comparative insights relevant for

scenario-based urban planning and flood risk management in rapidly urbanizing coastal regions of the Global South.

[1] Bachofer, F., Wang, Z., Huth, J., Eisfelder, C., Reimuth, A., & Kuenzer, C. (2026). Urban growth prediction along Shared Socioeconomic Pathways (SSPs) for future flood exposure risk assessment: a cross-continental analysis of coastal cities. *Anthropocene Coasts*, *9*(1). https://doi.org/10.1007/s44218-025-00109-6