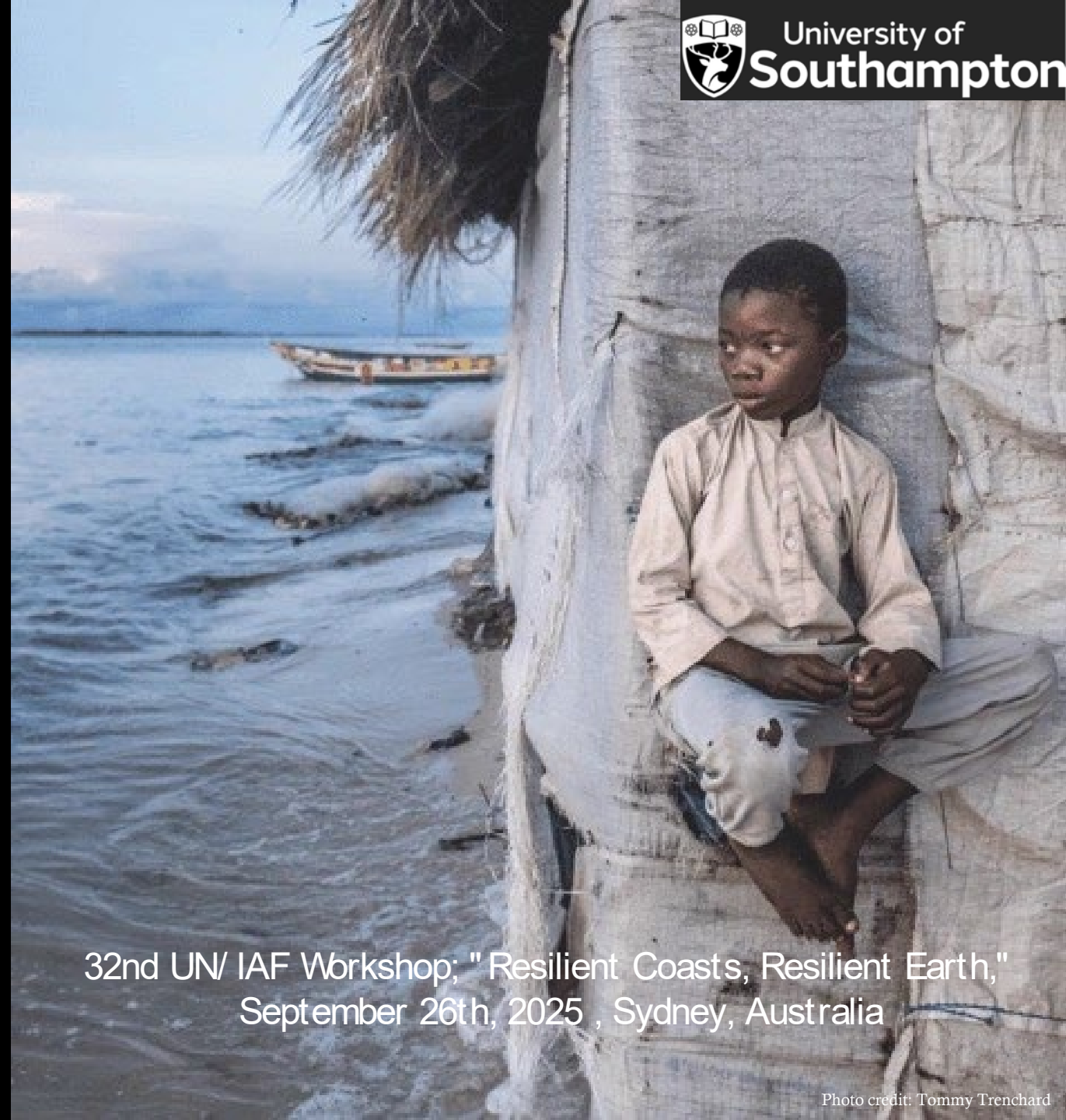


Mapping Coastal Risk from Orbit: Sea-Level Rise in Western Area, Sierra Leone

Rapid urbanisation and climate change are intensifying coastal vulnerability in West African cities like Freetown, where limited data and planning tools hinder effective disaster risk management. This study addresses that gap by leveraging satellite technology to map sea-level rise hazard, exposure, and multi-hazard risk to support evidence-based resilience planning.

Unis Musu Lebbie,
*Research Technician in Remote Sensing,
Geography and Environmental Science,
University of Southampton*

Email; U.M.Lebbie@soton.ac.uk



32nd UN/ IAF Workshop; "Resilient Coasts, Resilient Earth,"
September 26th, 2025 , Sydney, Australia



Multi-Hazard Risk Framework

- Based on studies by Tosić et al., van Westen et al., and others.
- Combines hazard, exposure, and vulnerability layers.



Sea-Level Rise Hazard Mapping

- IPCC AR6 projections (AOGCMs for 2100 (1.5°C and 2°C warming limits))
- Highest Astronomical Tidal heights (+3.5 m), EPA-SL (2015)
- Modified bathtub model using DEM



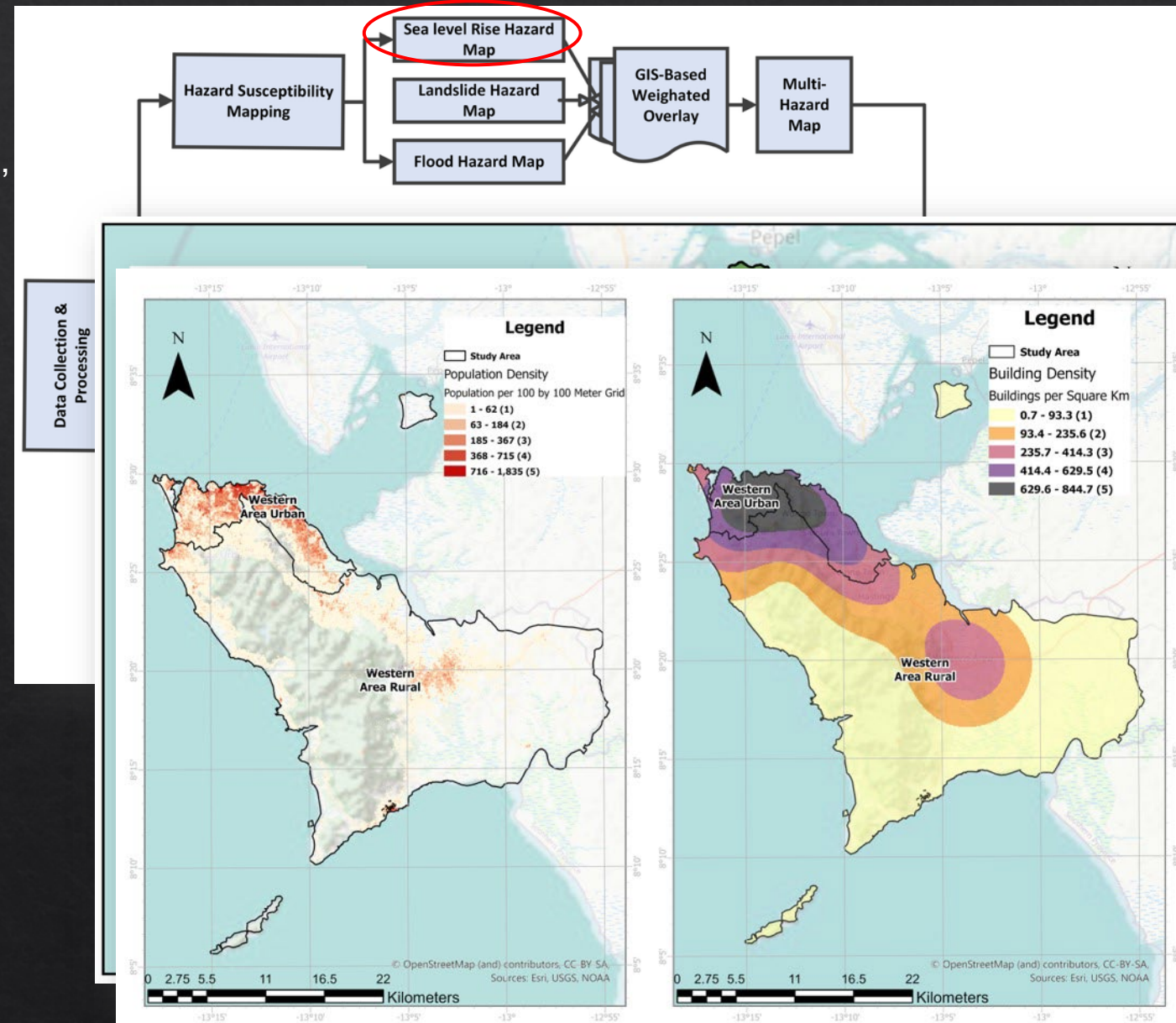
Exposure & Vulnerability

- Population & building footprints (WorldPop, OSM)
- GRID3 socioeconomic vulnerability index



Multi-Hazard Integration

- Landslide & flood susceptibility via AHP
- GIS-based overlay to produce composite risk map





Coastal Exposure & Risk: Who Is at Stake & What Comes Next?



Sea-Level Rise Hazard, Exposure & Risk

- 16.2% of the area ($\approx 112.6 \text{ km}^2$) is highly susceptible.
- Risk zones: wetlands, sandy beaches, Tasso Island.
- 60,013 people and 6,294 buildings exposed in coastal hotspots
- Moderate to high risk covers 1.6% of study area ($\approx 11.3 \text{ km}^2$).



Multi-Hazard Exposure & Risk

- 20% of population exposed to ≥ 2 hazards.
- 18% of buildings in multi-hazard zones.
- High multi-hazard risk: $< 1\%$ of study area ($\approx 5.6 \text{ km}^2$). Moderate multi-hazard risk: 3.6% of study area ($\approx 24.8 \text{ km}^2$).
- Risk concentrated in urban coastal zones



Impact & Collaboration

- Supports evidence-based disaster planning in West Africa
- Identifies priority zones for resilience investment
- Limitations: DEM accuracy, lack of hydrodynamic modelling, coarse vulnerability grids
- **Let's collaborate** to build coastal resilience

