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Geospatial Technologies for Global Mangrove Conservation under Urbanization and Climate Change

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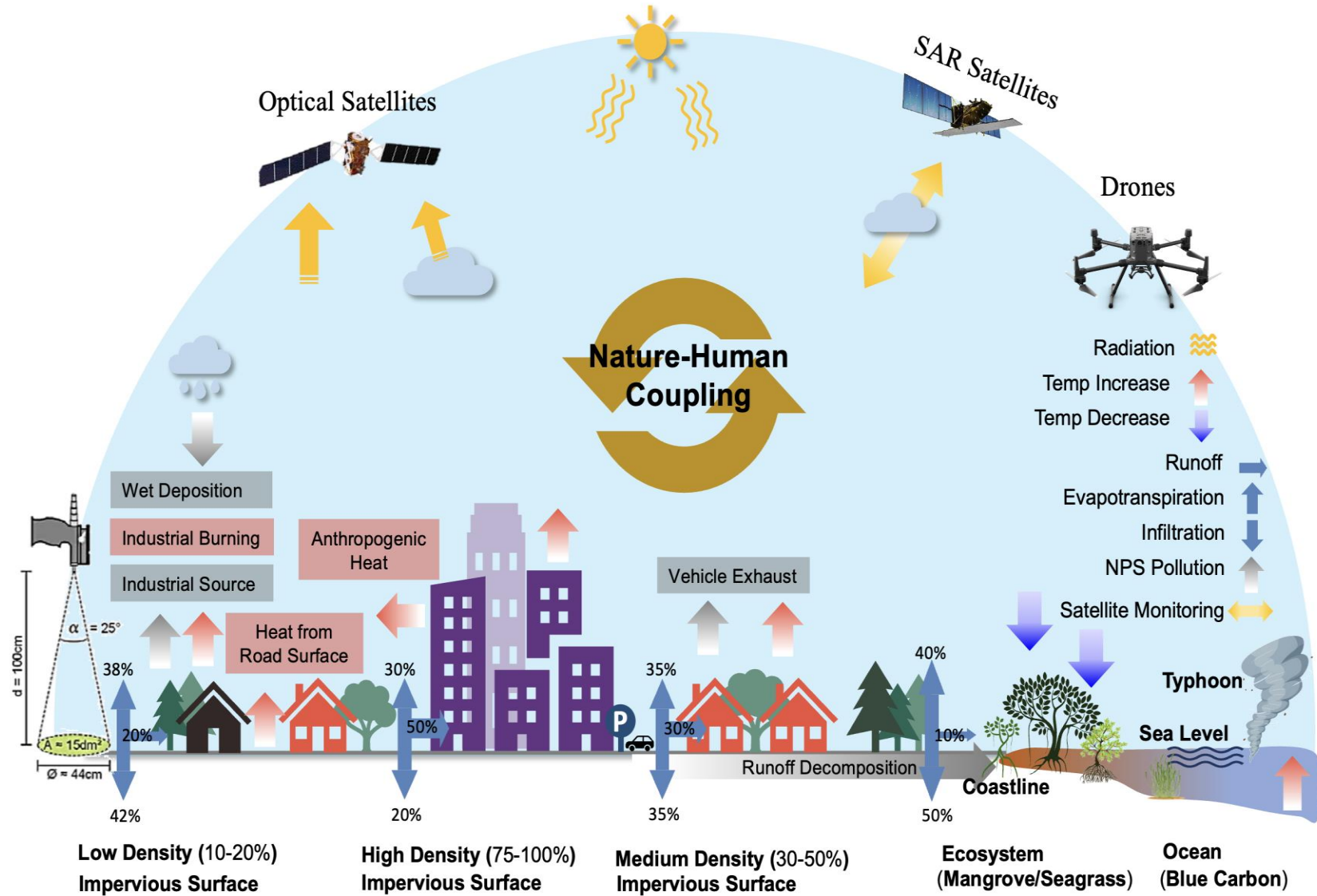
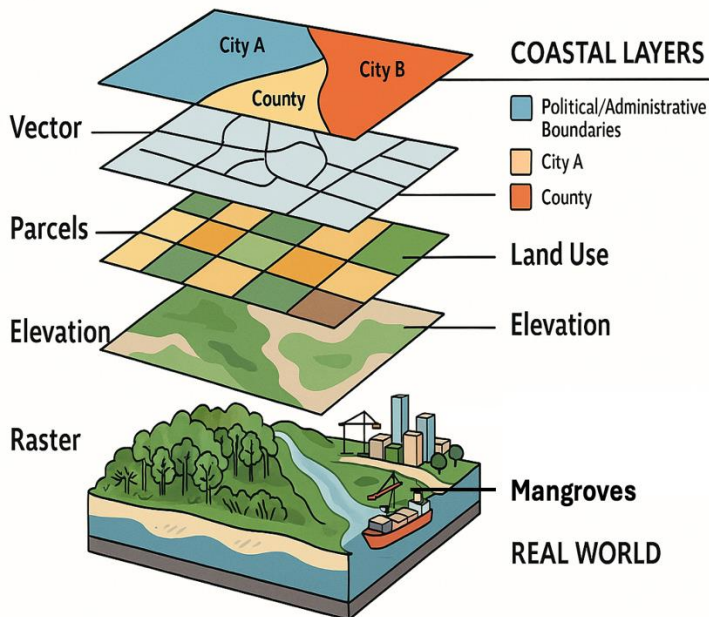


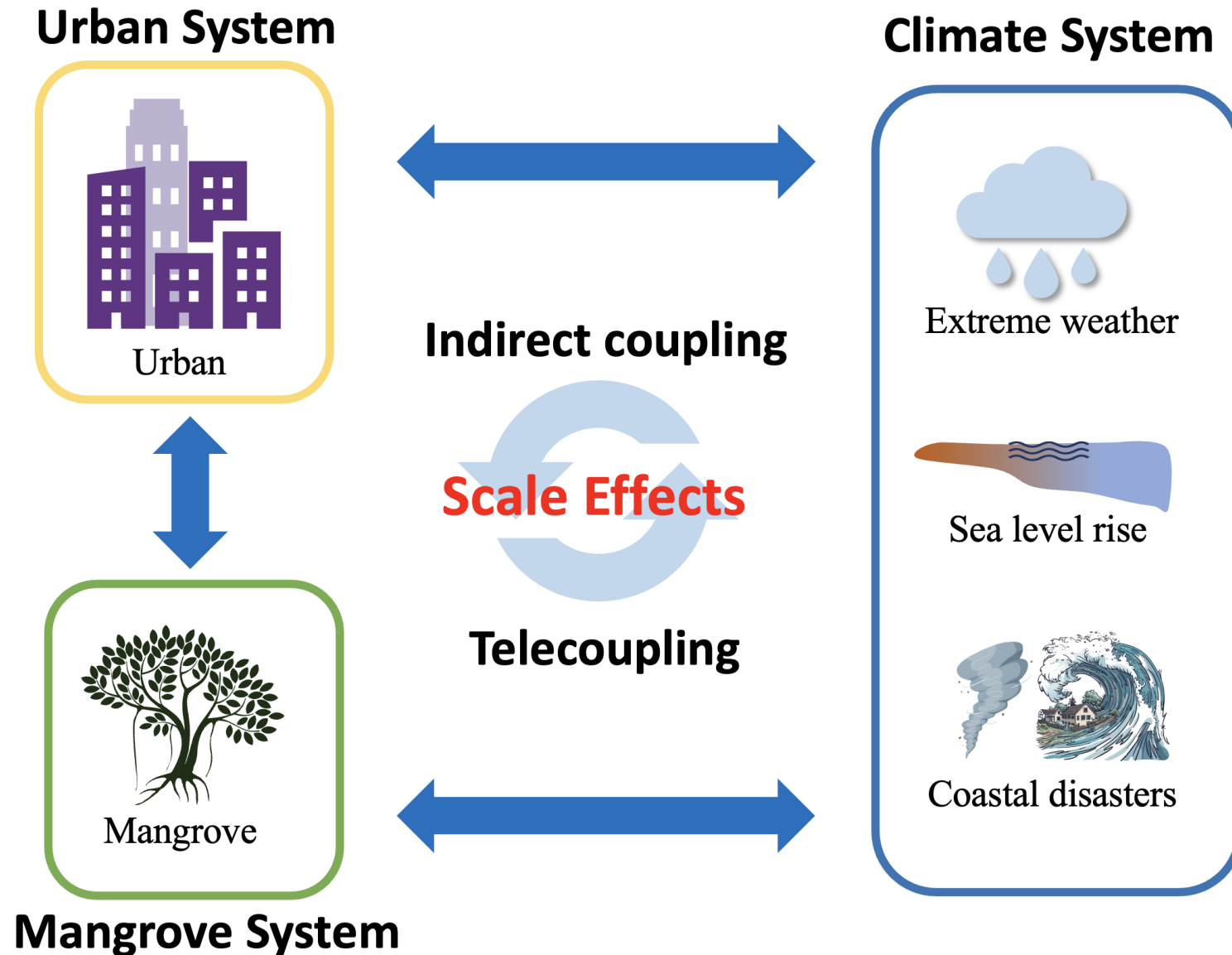
- **Geospatial technologies for coastal sustainability**
- Sea level rise simulations under climate scenarios
- Coupled urban-climate-mangrove (UCM) system

Coastal Geospatial Technologies



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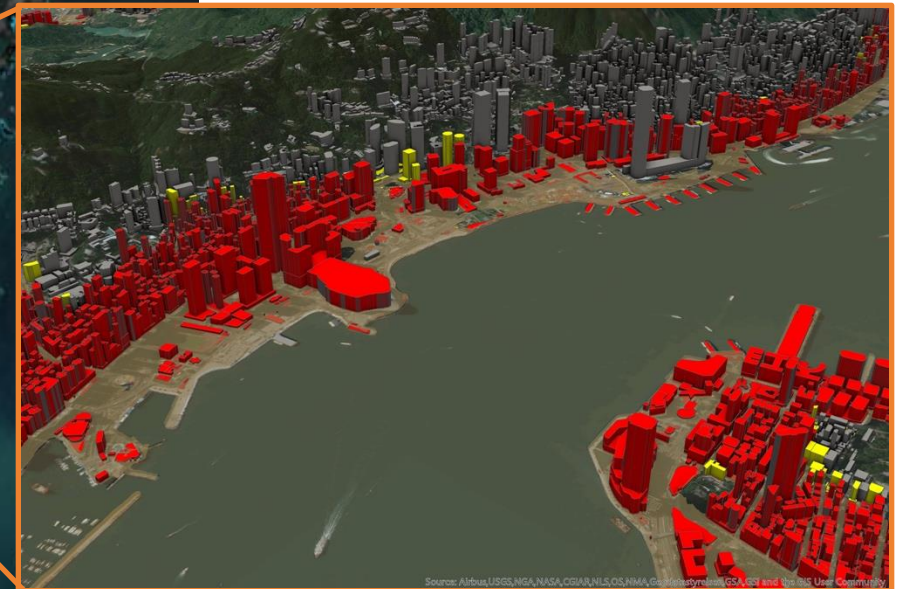
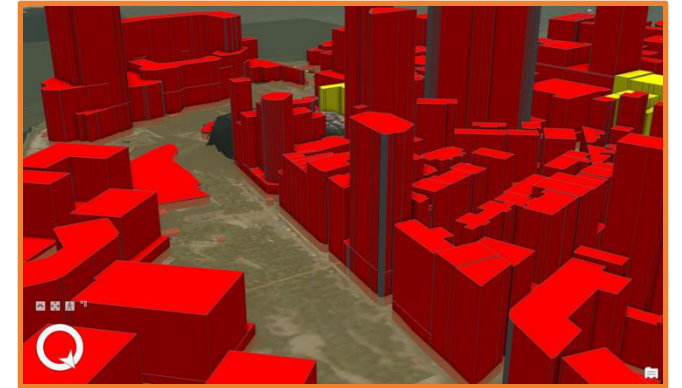
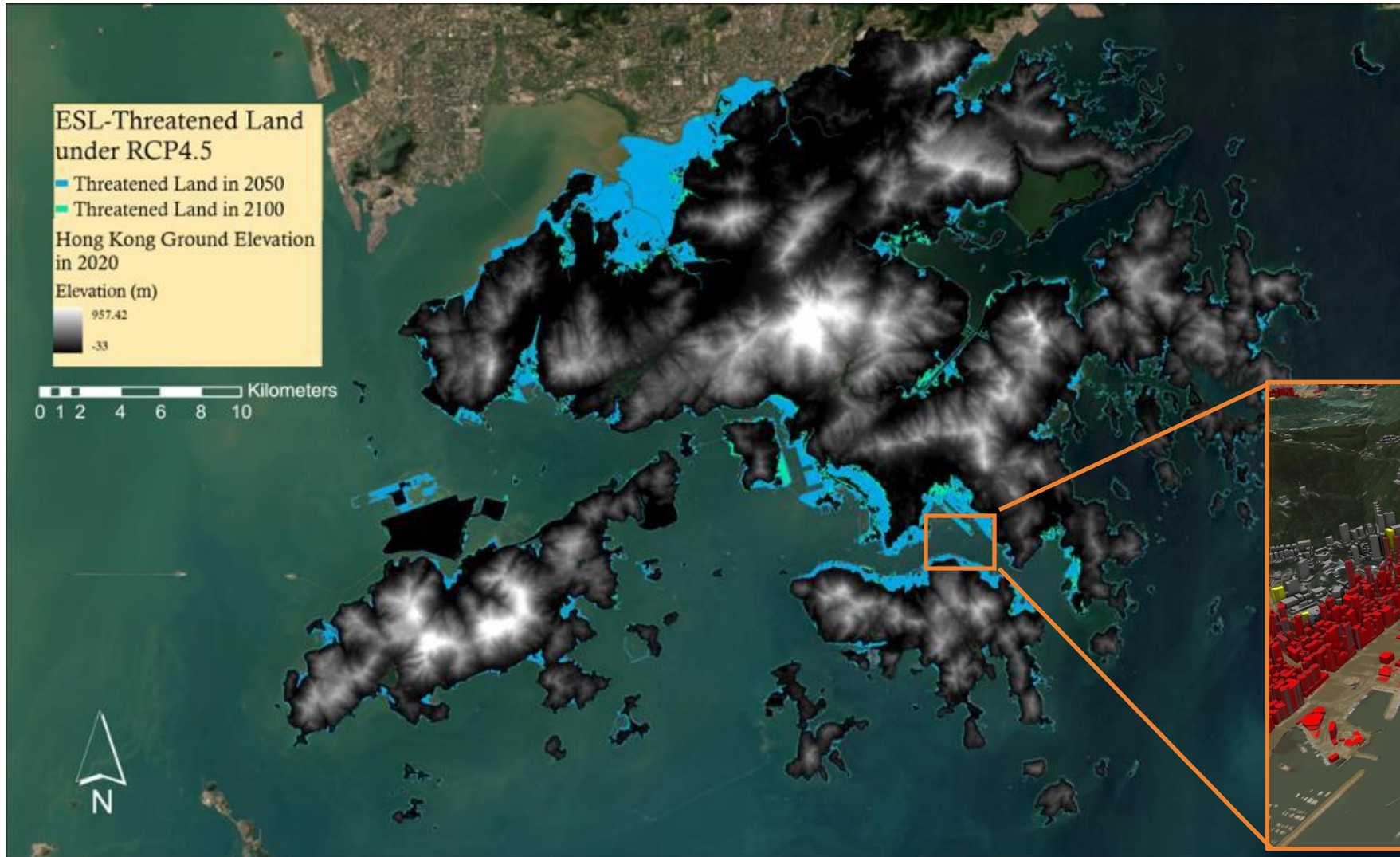


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Sea Level Rise simulation in Hong Kong



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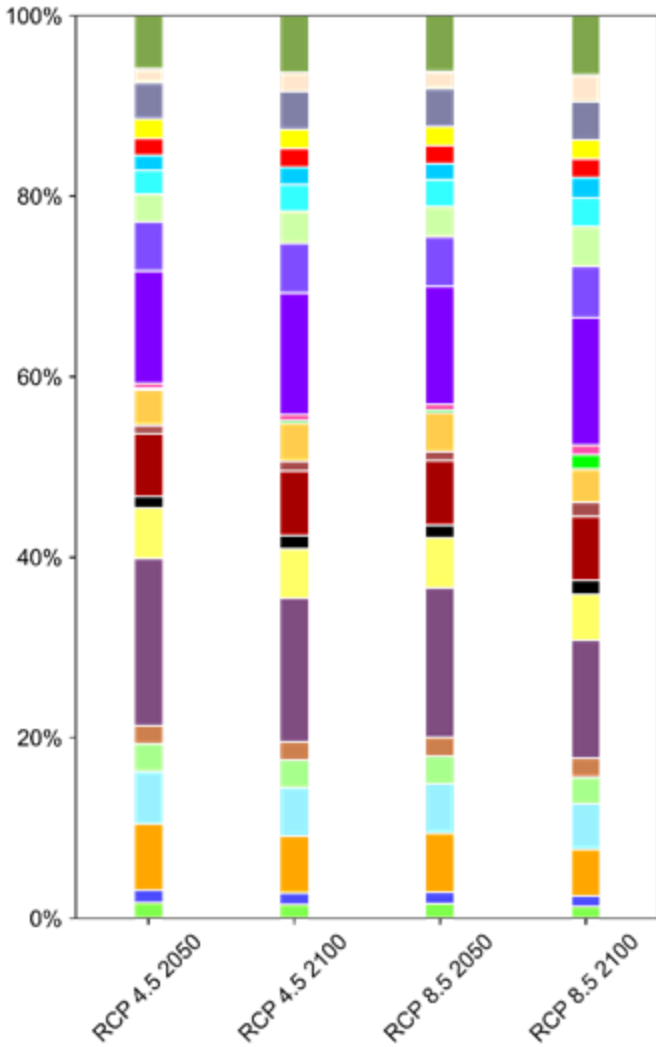


Chen, Z., Zhang, H.*, et al.. *Scientific Reports*

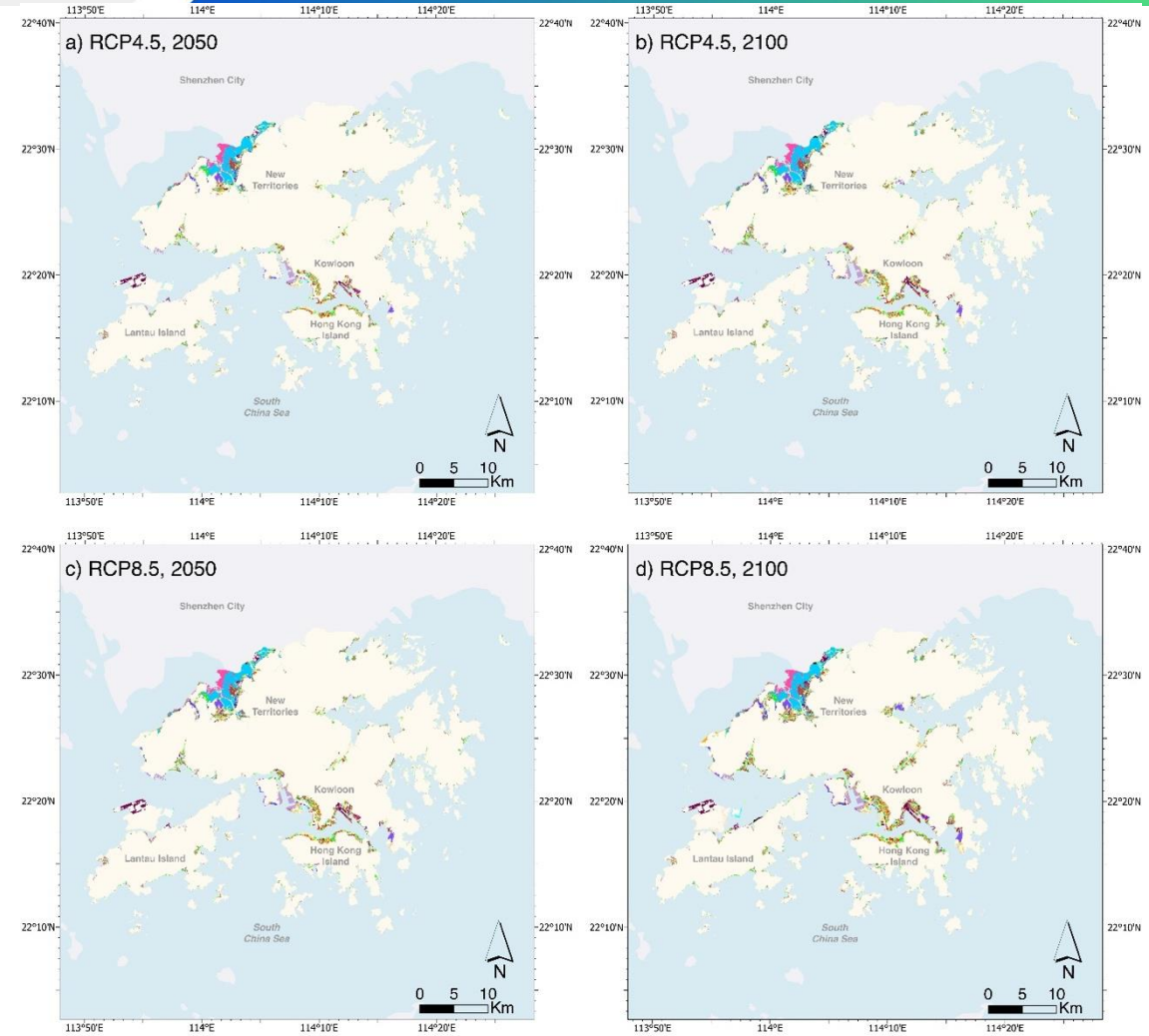
Sea Level Rise simulation in Hong Kong



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- Landuse Class**
- Private Residential
 - Public Residential
 - Rural Settlement
 - Commercial/Business and Office
 - Industrial Land
 - Industrial Estates/Science and Technology Parks
 - Warehouse and Open Storage
 - Government, Institutional and Community Facilities
 - Open Space and Recreation
 - Roads and Transport Facilities
 - Railways
 - Airport
 - Port Facilities
 - Cemeteries/Funeral Facilities
 - Utilities
 - Vacant Land/Construction in Progress
 - Others
 - Agricultural Land
 - Fish Ponds/Gei Wais
 - Woodland
 - Shrubland
 - Grassland
 - Mangrove/Swamp
 - Badland
 - Rocky Shore
 - Streams and Nullahs

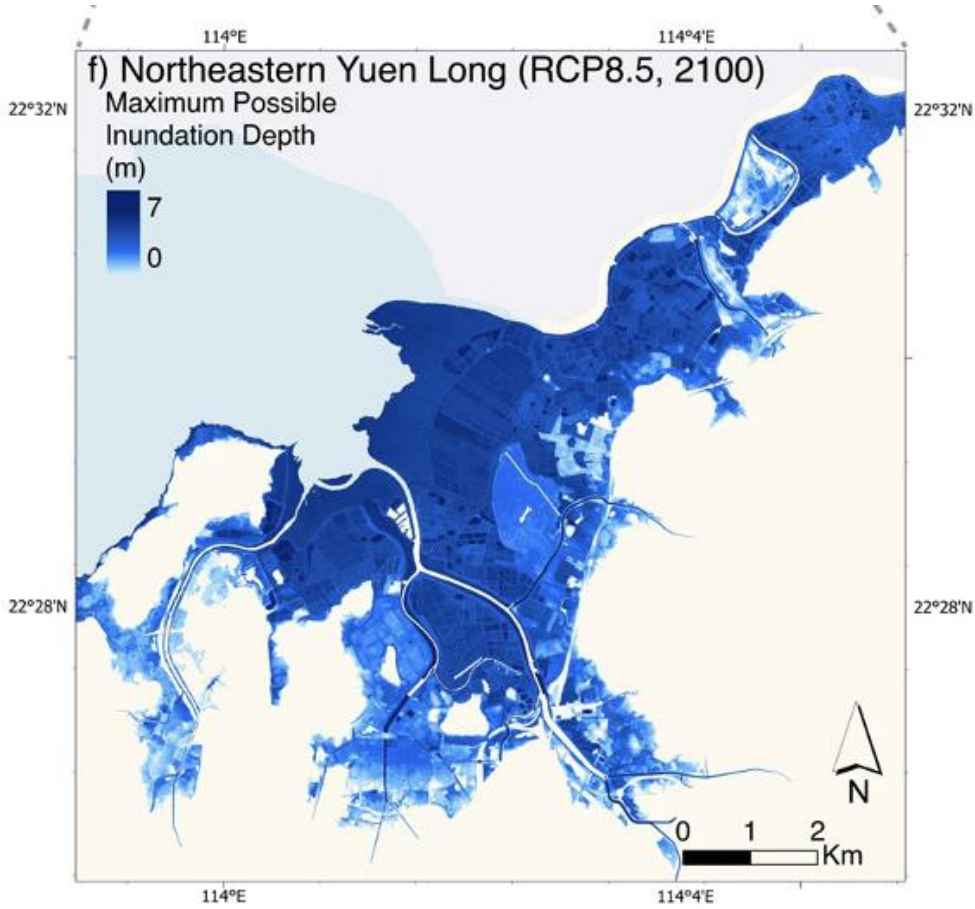


- Land Use Composition in the ESL-Threatened Area**
- Agricultural Land
 - Airport
 - Badland
 - Cemeteries/Funeral Facilities
 - Commercial/Business and Office
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Sea Level Rise simulation in Hong Kong

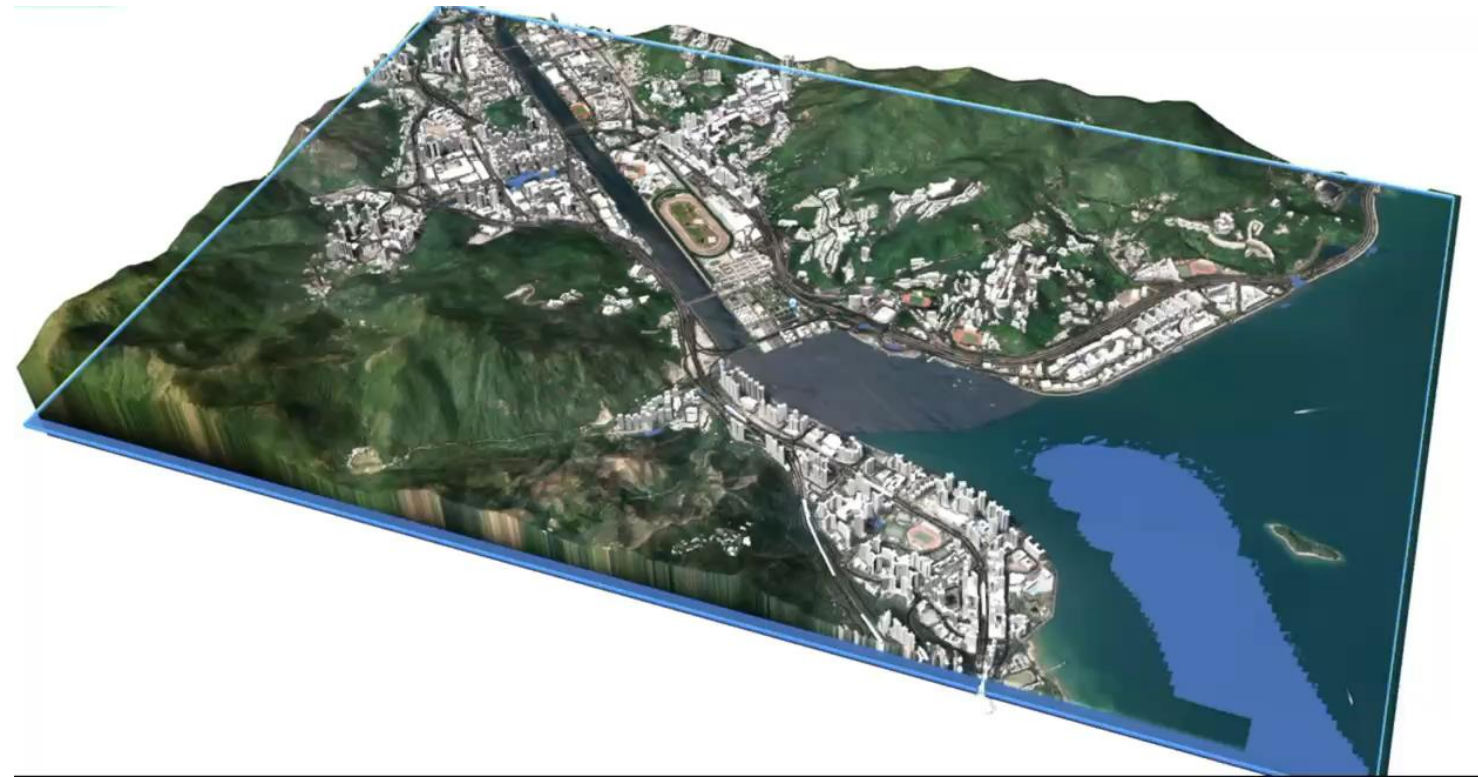


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Sea Level Rise at the Deep Bay

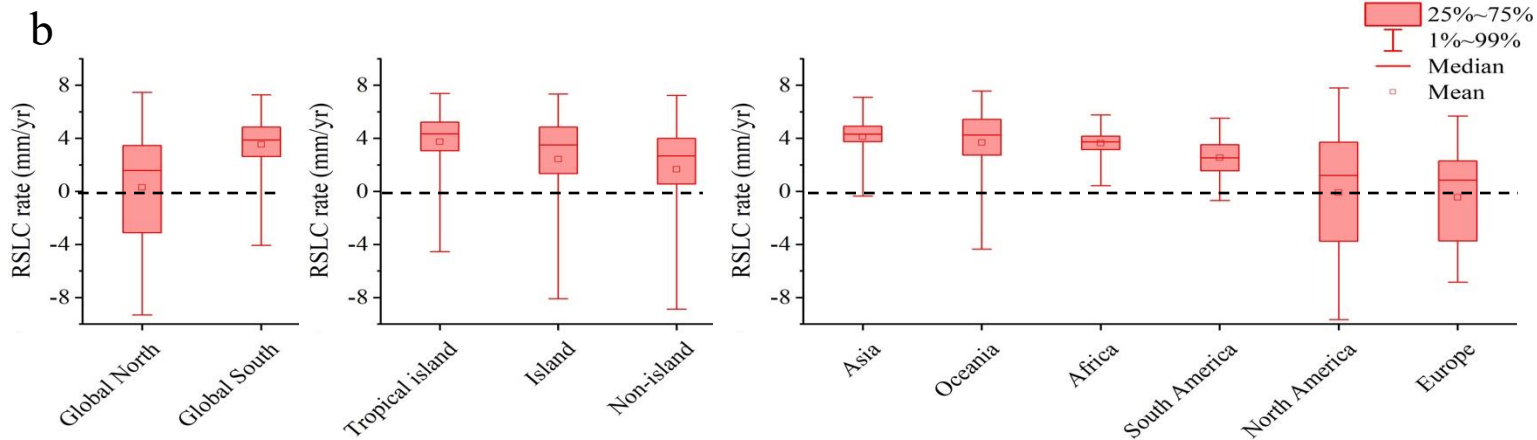
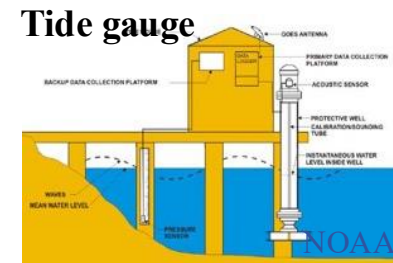
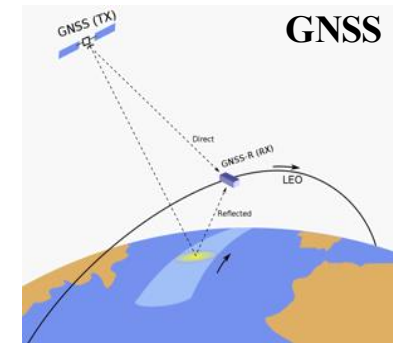
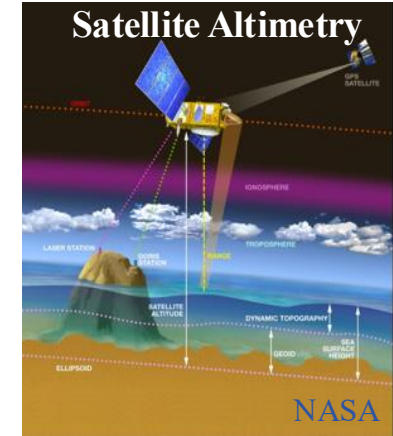
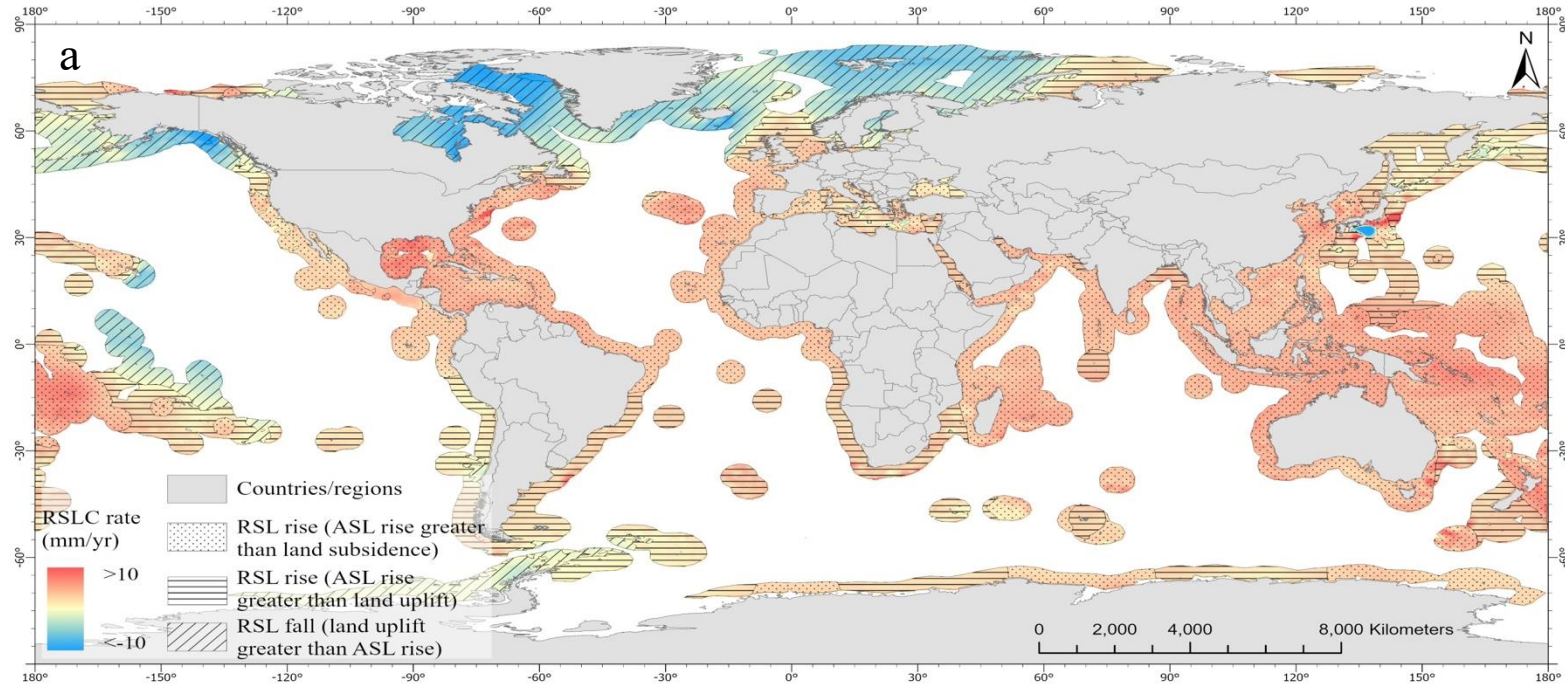
Sea Level Rise at the Tolo Harbour



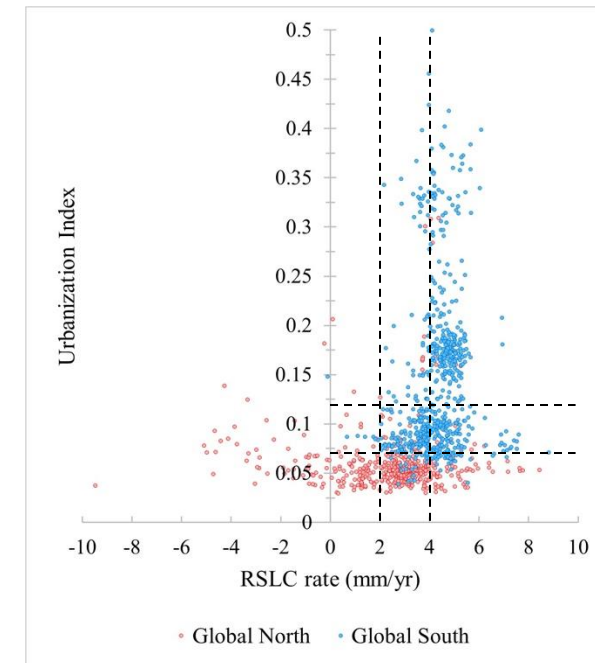
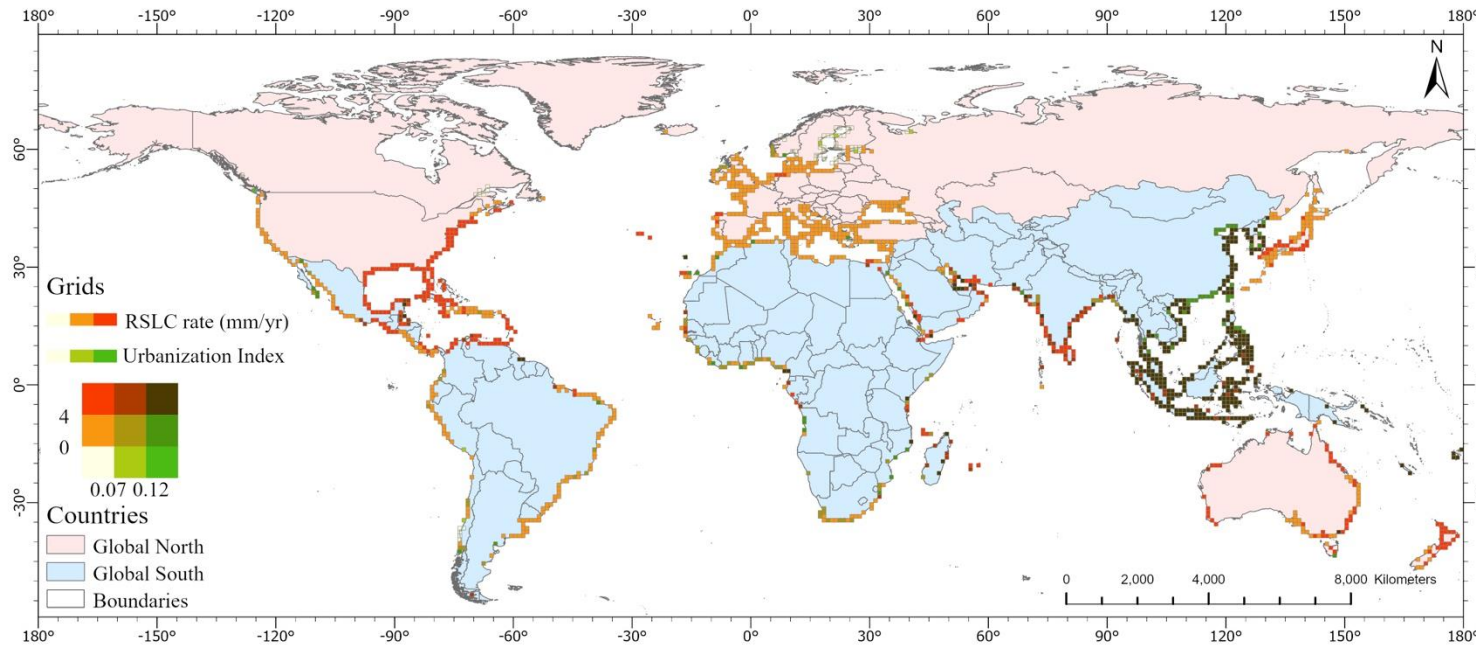
Global Sea Level Rise and Urban Impacts



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Global Sea Level Rise and Urban Impacts



		Global North	Global South
High-intensity urbanization	High RSLR rate	3.79%	77.46%
	Moderate RSLR rate	2.68%	15.40%
	Low RSLR rate	0.45%	0.22%
Moderate-intensity urbanization	High RSLR rate	3.13%	33.93%
	Moderate RSLR rate	8.26%	47.54%
	Low RSLR rate	2.01%	5.13%
Low-intensity urbanization	High RSLR rate	24.61%	5.72%
	Moderate RSLR rate	48.01%	5.72%
	Low RSLR rate	15.25%	0.69%

(Urbanization Index) $UI = P_{norm} + G_{norm} + B_{norm}$
 where P, G and B represent normalized population, GDP, and built-up area growth rates respectively.

How does the spatial heterogeneity of the coupling between RSLC and socioeconomic development allocate climate risks globally?



- Geospatial technologies for coastal sustainability
- Sea level rise simulations under climate scenarios
- **Coupled urban-climate-mangrove (UCM) system**

Theoretical framework

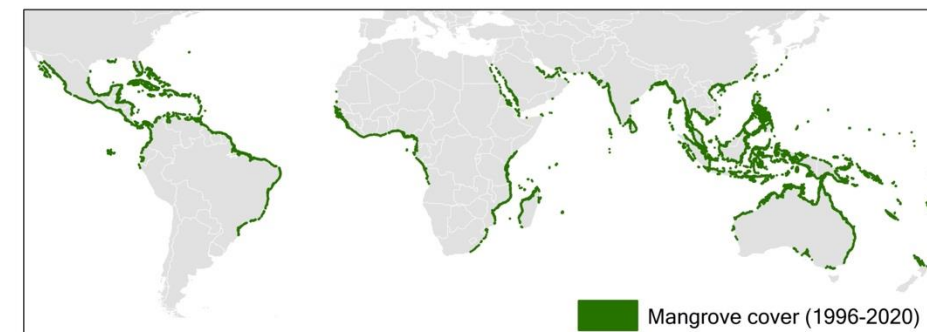
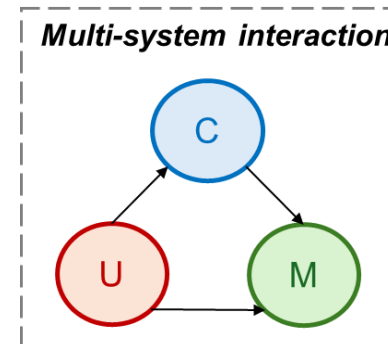
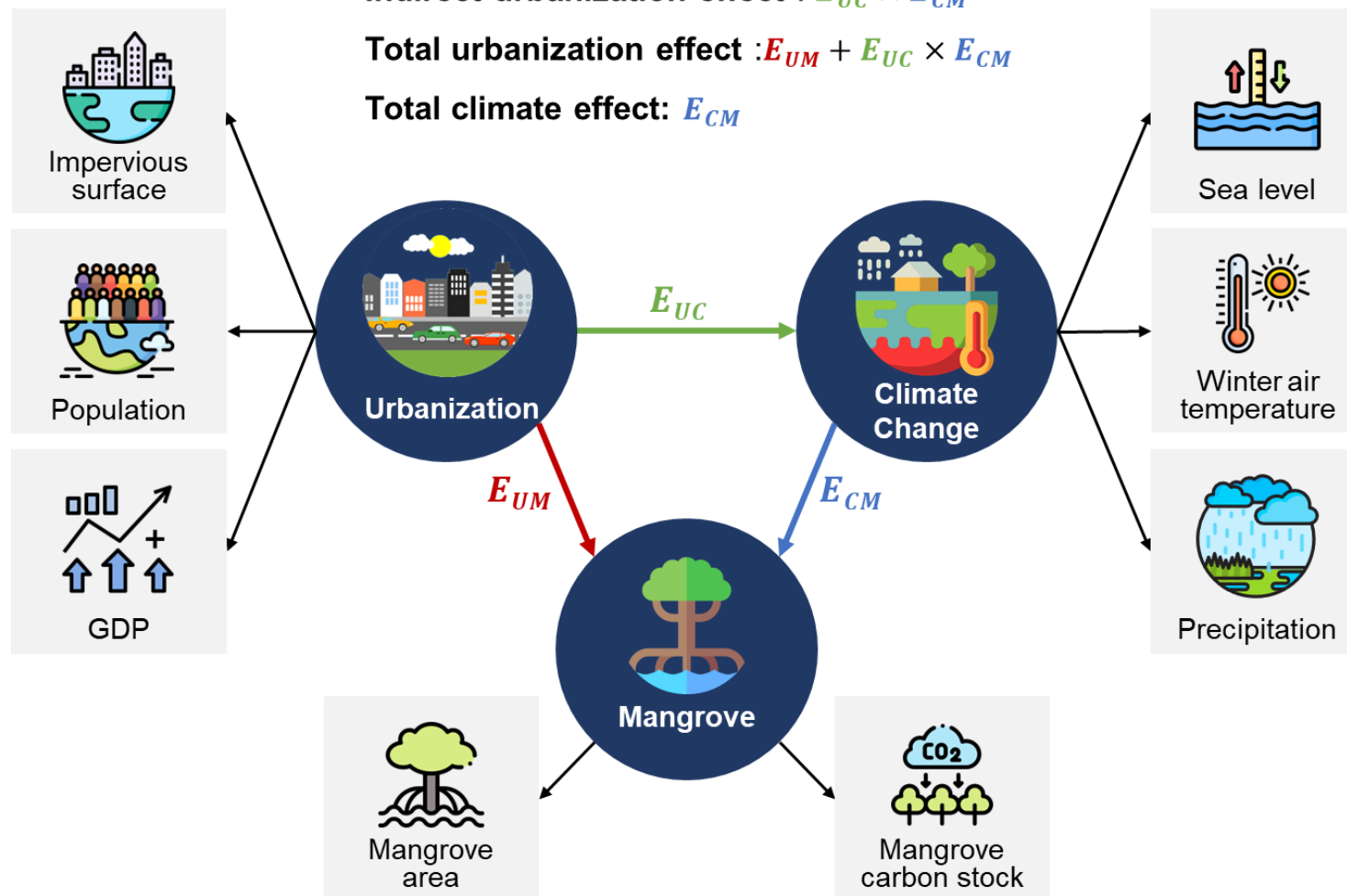


Direct urbanization effect: E_{UM}

Indirect urbanization effect : $E_{UC} \times E_{CM}$

Total urbanization effect : $E_{UM} + E_{UC} \times E_{CM}$

Total climate effect: E_{CM}



Framework of Urbanization-Climate Change-Mangrove (UCM) model

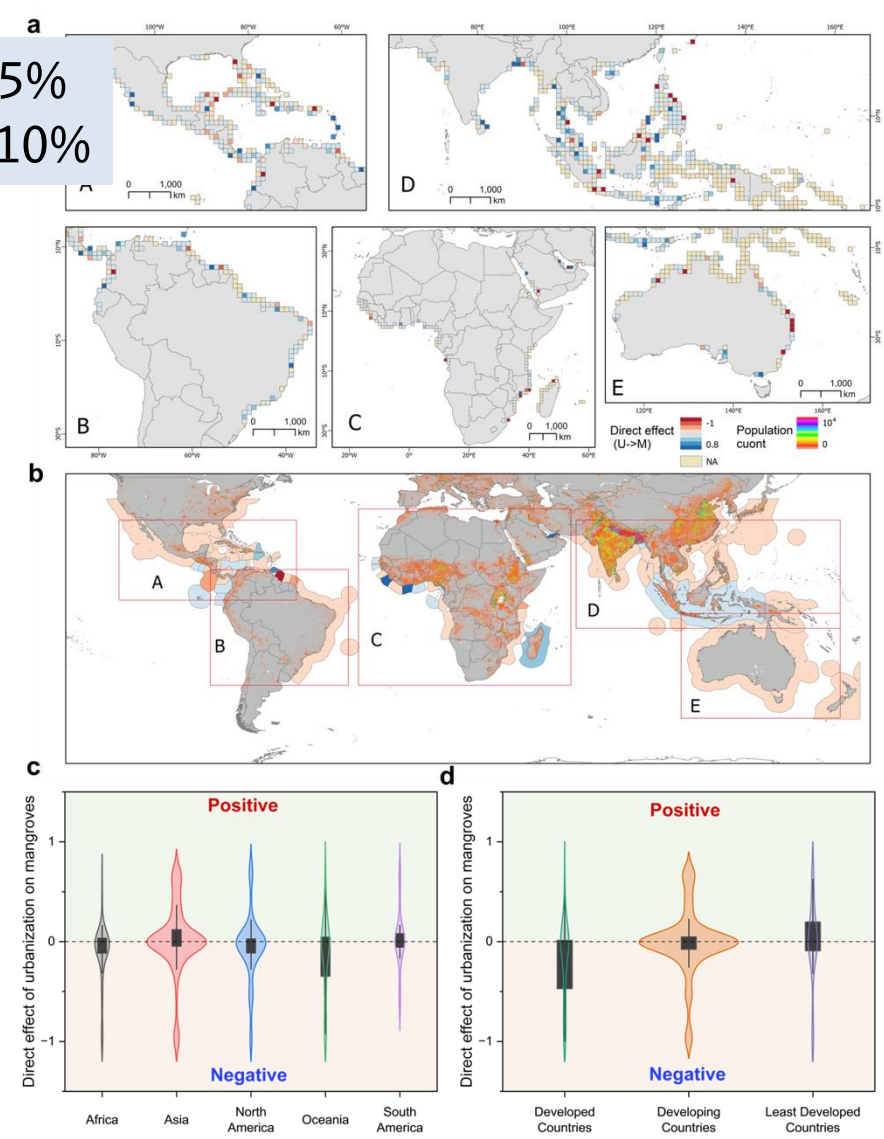
Impacts of urbanization on mangroves globally under climate change



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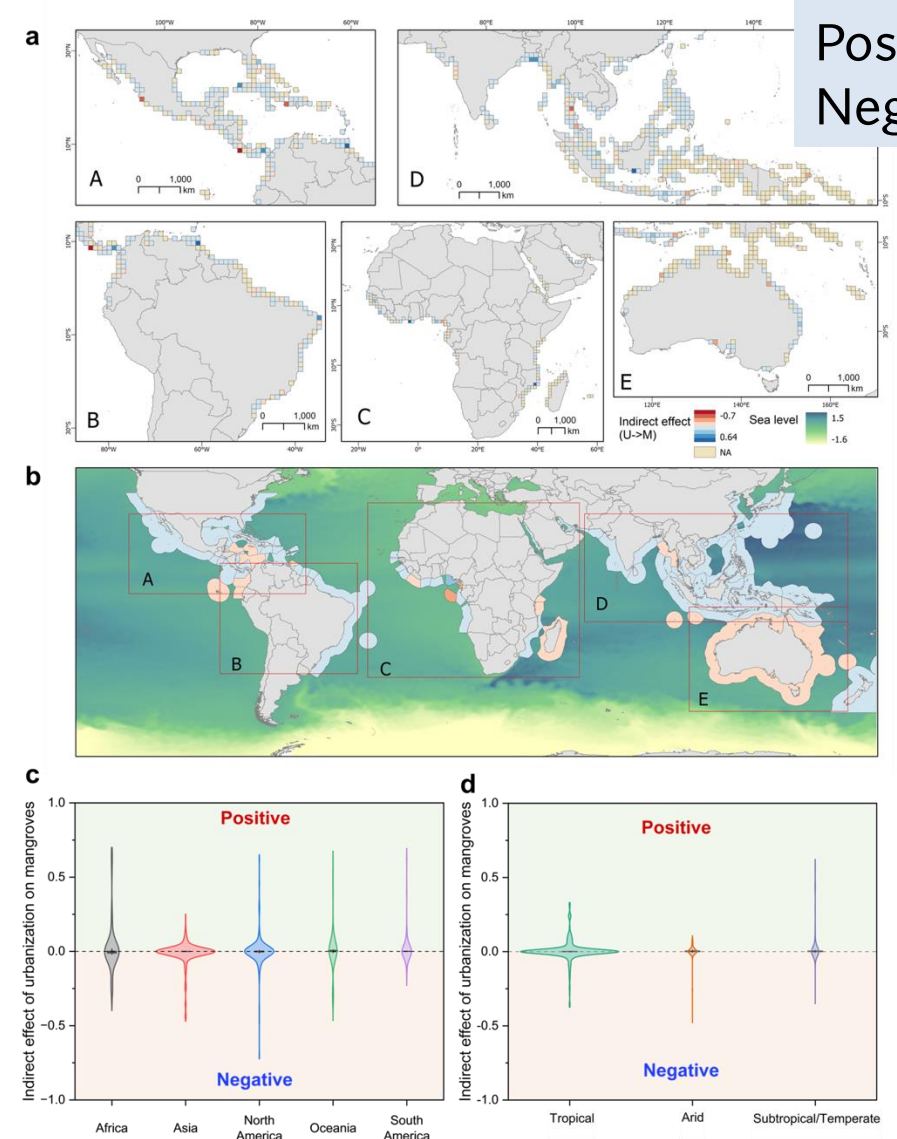


Positive: 45%
Negative: 10%



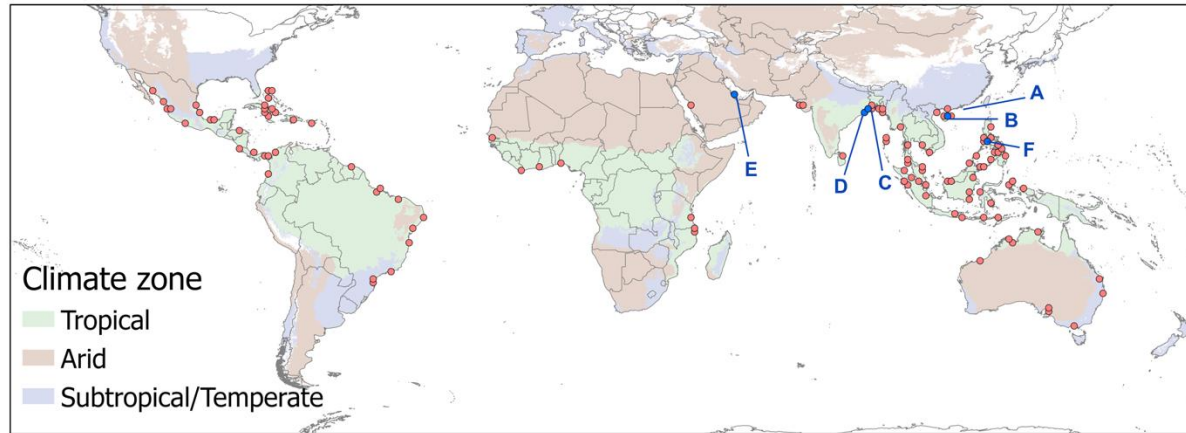
Direct effects of urbanization on mangroves

Positive: 28%
Negative: 27%



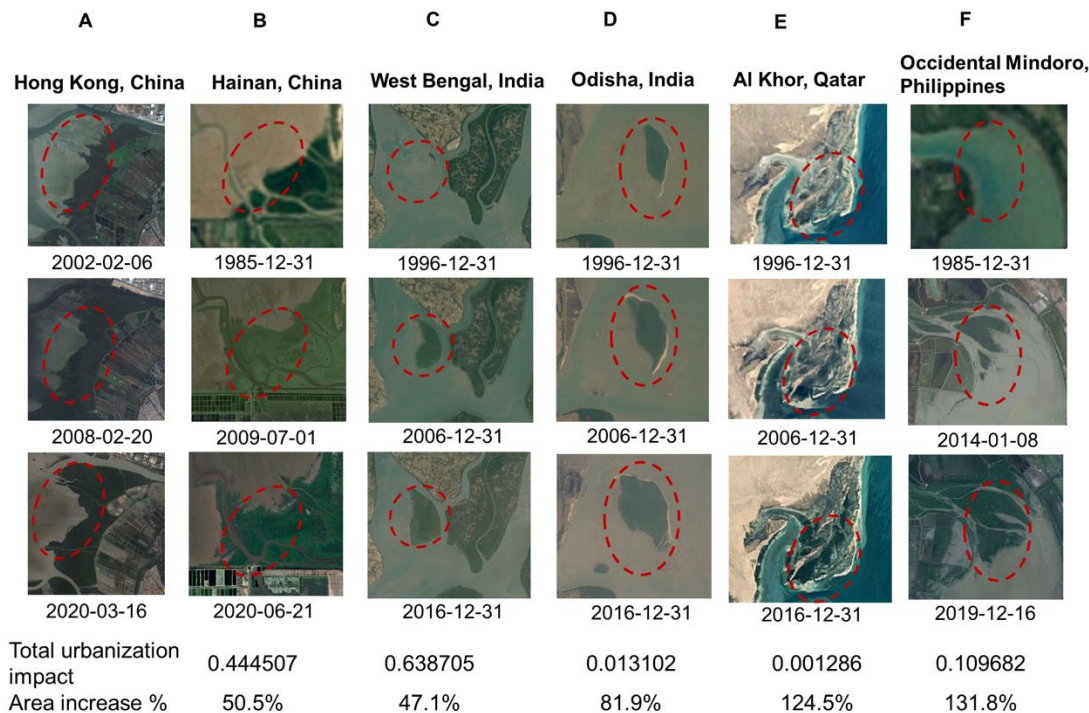
Indirect effects of urbanization on mangroves

Examples of mangrove expansion & positive urbanization impacts



Reasons for positive urbanization impacts:

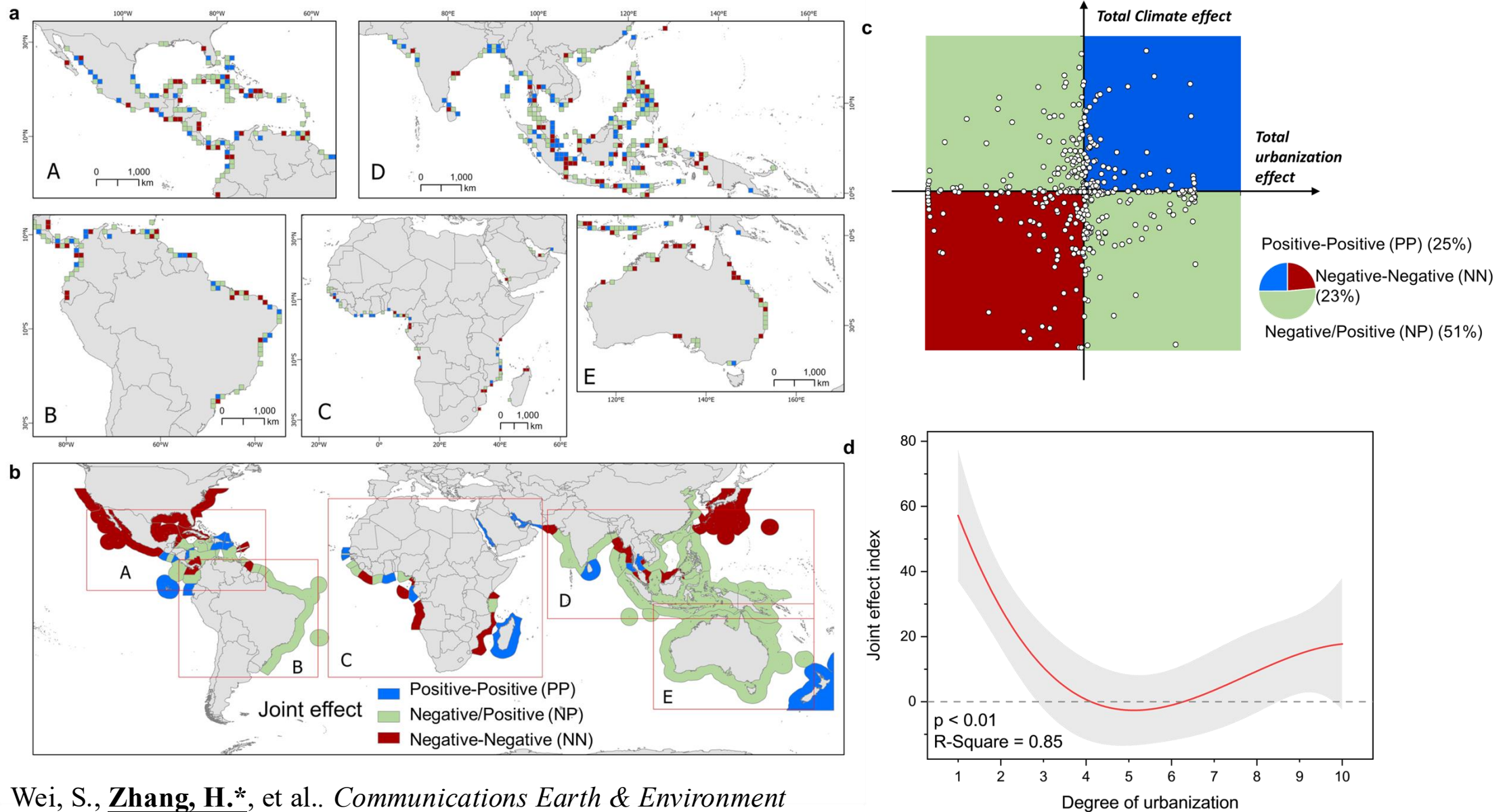
1. Indirect path:
Urbanization > climate > mangrove
2. Urbanization > increased sediment load > mudflat formation > mangrove colonization and expansion
3. Urbanization > restoration, urban space planning, increased protection awareness



Joint effects of urbanization and climate on mangroves



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Conclusions



- We present a fine-scale global assessment revealing the hidden impacts of urbanization on mangroves, mediated by climate (sea level, temperature, etc.).
- Urbanization can positively affect mangrove growth and carbon stock in certain regions.
- Subtropical and temperate mangroves benefit indirectly from urbanization through improved local climate conditions.



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Thank You!



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