
Water Research Laboratory
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School of Civil and Environmental Engineering
Holistic management of estuaries under climate change requires accurate modelling tools
Danial Khojasteh; A/Prof William Glamore; Dr Stefan Felder; Dr Valentin Heimhuber

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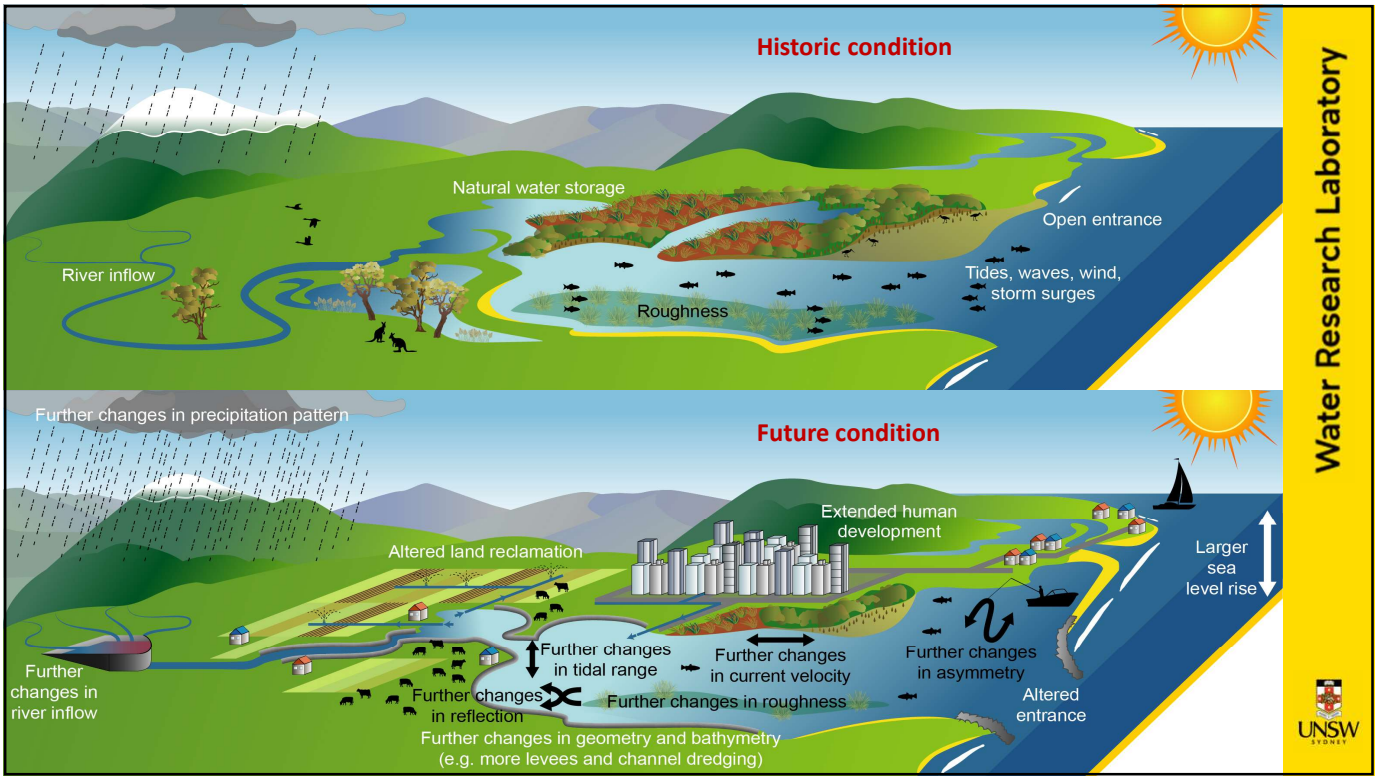
Historic condition
Natural water storage
River inflow
Roughness
Open entrance
Tides, waves, wind, storm surges
Future condition
Further changes in precipitation pattern
Extended human development
Altered land reclamation
Larger sea level rise
Further changes in river inflow
Further changes in tidal range
Further changes in current velocity
Further changes in asymmetry
Further changes in reflection
Further changes in roughness
Altered entrance
Further changes in geometry and bathymetry (e.g. more levees and channel dredging)
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Why should we care?

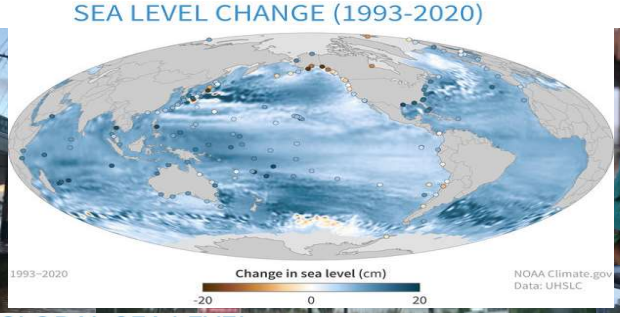
Source: NSW Estuary Tidal Inundation Exposure Assessment

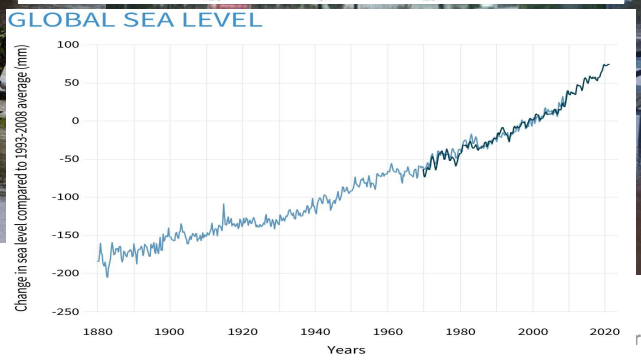
Coastal Properties

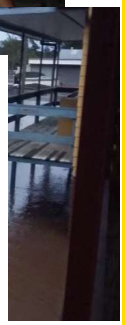
Now: 250
2100: 3,300

Estuary Properties

Now: 8,500
2100: 50,700







r.com.au/
https://www.abc.net.au/news/

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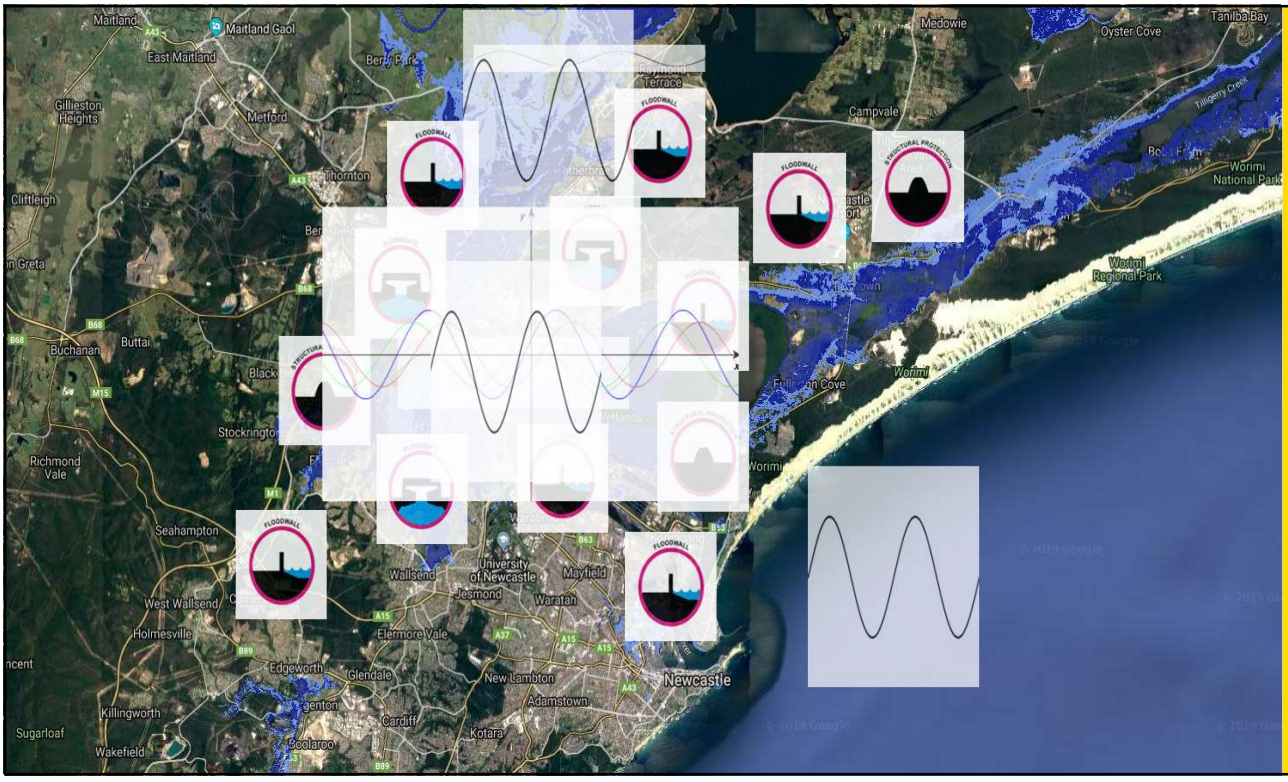

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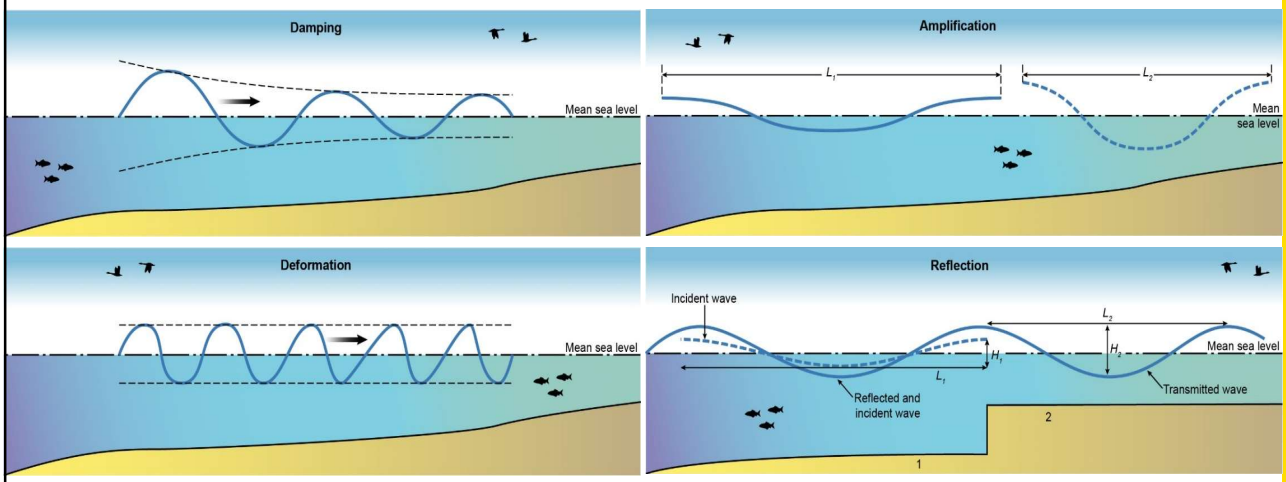
Tidal processes are dynamic!



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Idealised hydrodynamic models

Prismatic

Converging

Restricted entrance

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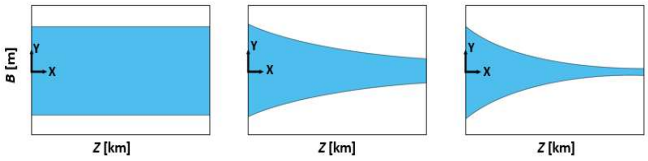
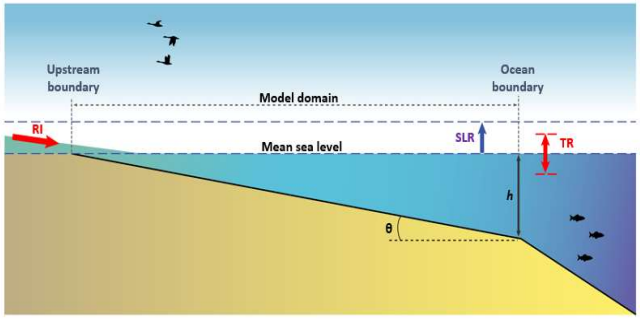
Estuarine tidal dynamics under sea level rise





Parameter	Value
Estuary length (Z) [km]	40, 80, 160
Estuary depth (h) [m]	5, 10
Estuary width (B) [m]	1000
Estuary width convergence length (L_c) [km]	80, 160
Tidal period (T) [hour]	12.42
Tidal range at the mouth (TR) [m]	0.5, 1, 4
Restriction width (RW) [%]	0-80
Manning's coefficient (n) [$s/m^{1/3}$]	0.015, 0.03, 0.09
River inflow/Tidal prism (RI/TP) [%]	0, 1, 5, 10
Bed slope (θ) [°]	0, 0.002, 0.004, 0.007
Sea level rise (SLR) [m]	0, 1, 2

Number of runs: ~2000

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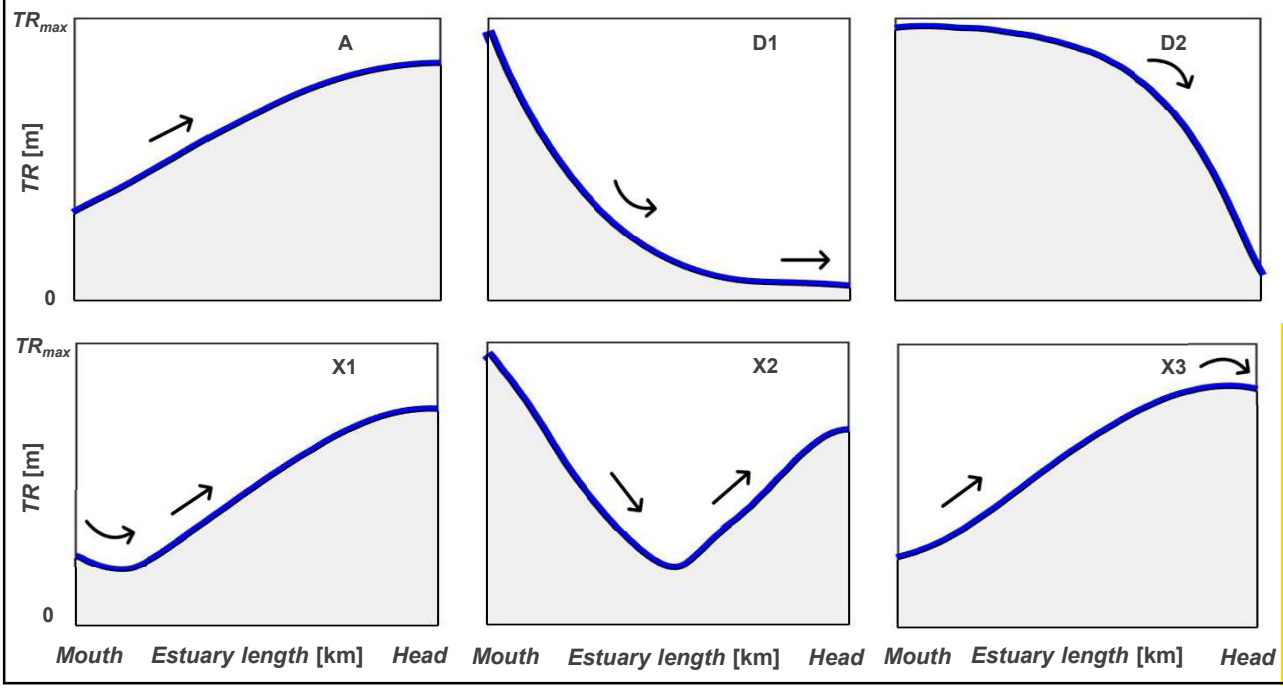
Estuarine tidal range dynamics



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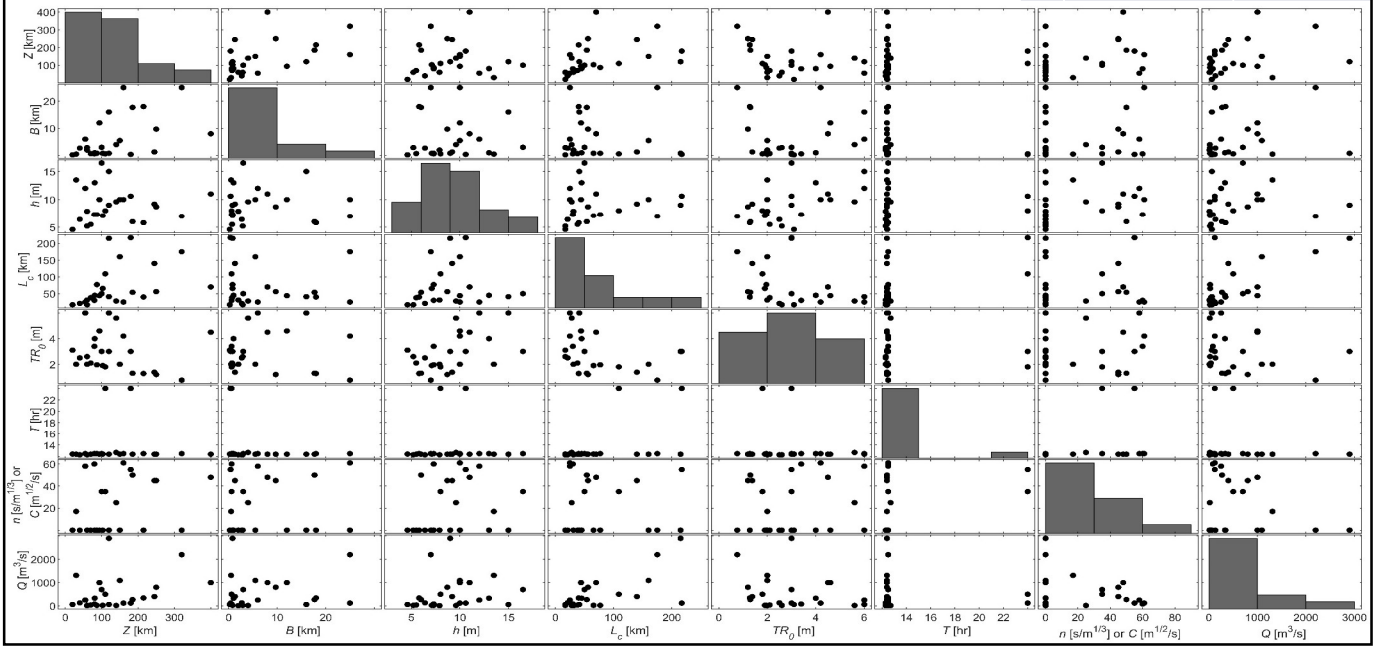
Application of an idealised method in real-world estuaries

No	Estuary	Country
1	Bernam River	Malaysia
2	Chao Phraya River	Thailand
3	Chesapeake Bay	USA
4	Clarence River	Australia



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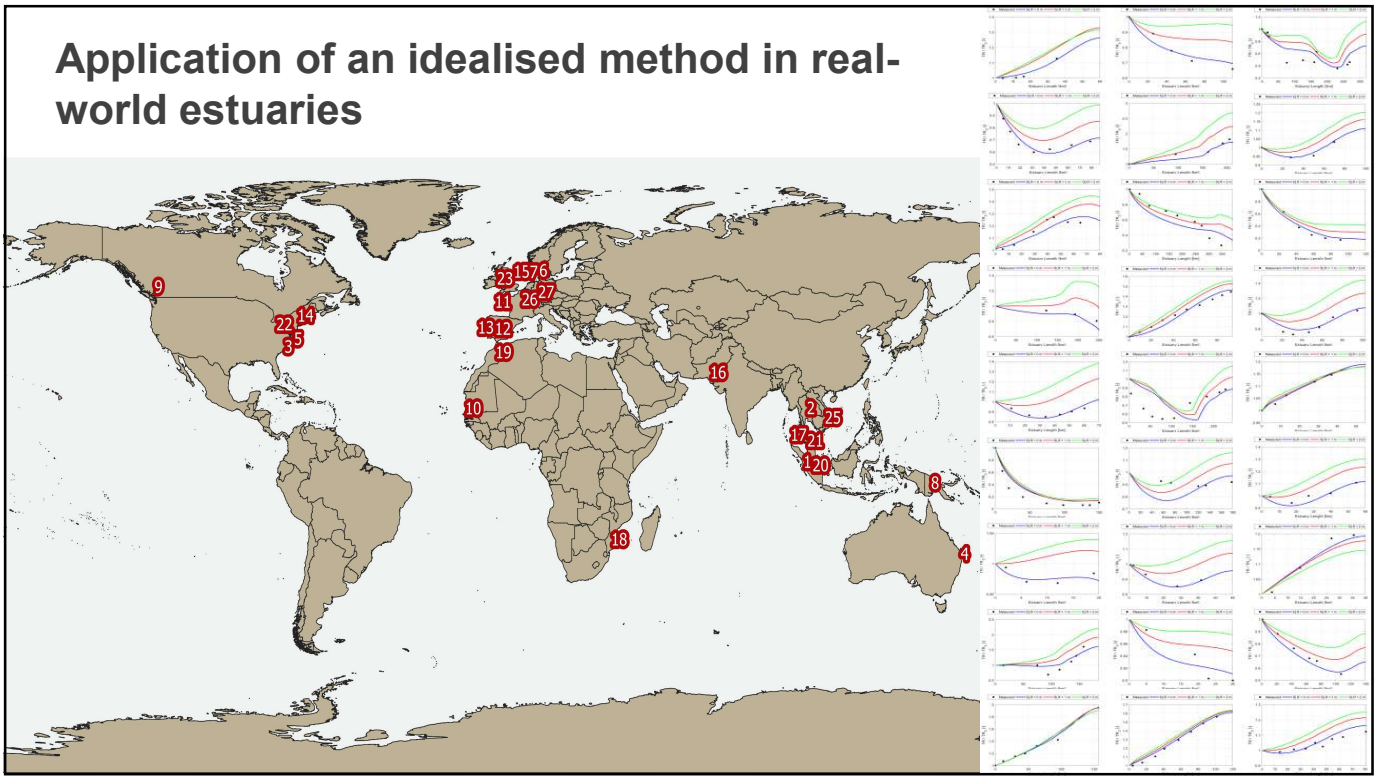
Application of an idealised method in real-world estuaries



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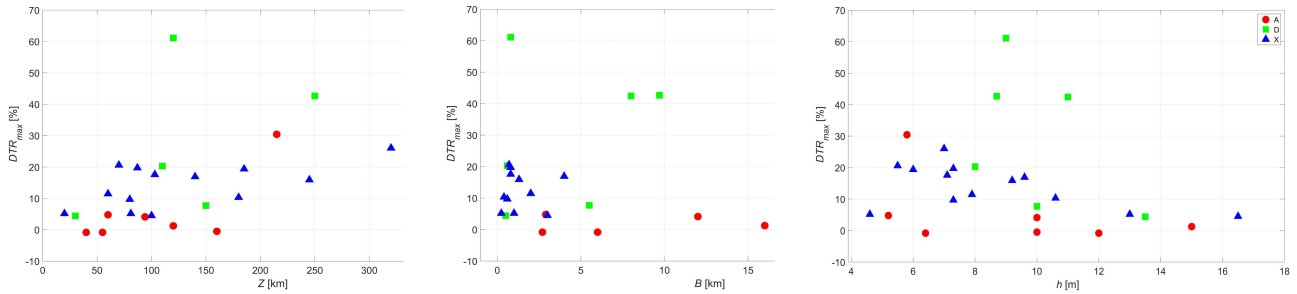
Application of an idealised method in real-world estuaries



SLR impacts to tidal range dynamics of different estuaries largely depend on their present-day tidal range pattern and boundary conditions:

- Present-day pattern "amplification" → 1m of SLR insignificantly changes tidal range (±5%)
- Present-day pattern "mixed" → 1m of SLR increases tidal range (up to 26%)
- Present-day pattern "dampening" → 1m of SLR increases tidal range (up to 61%)

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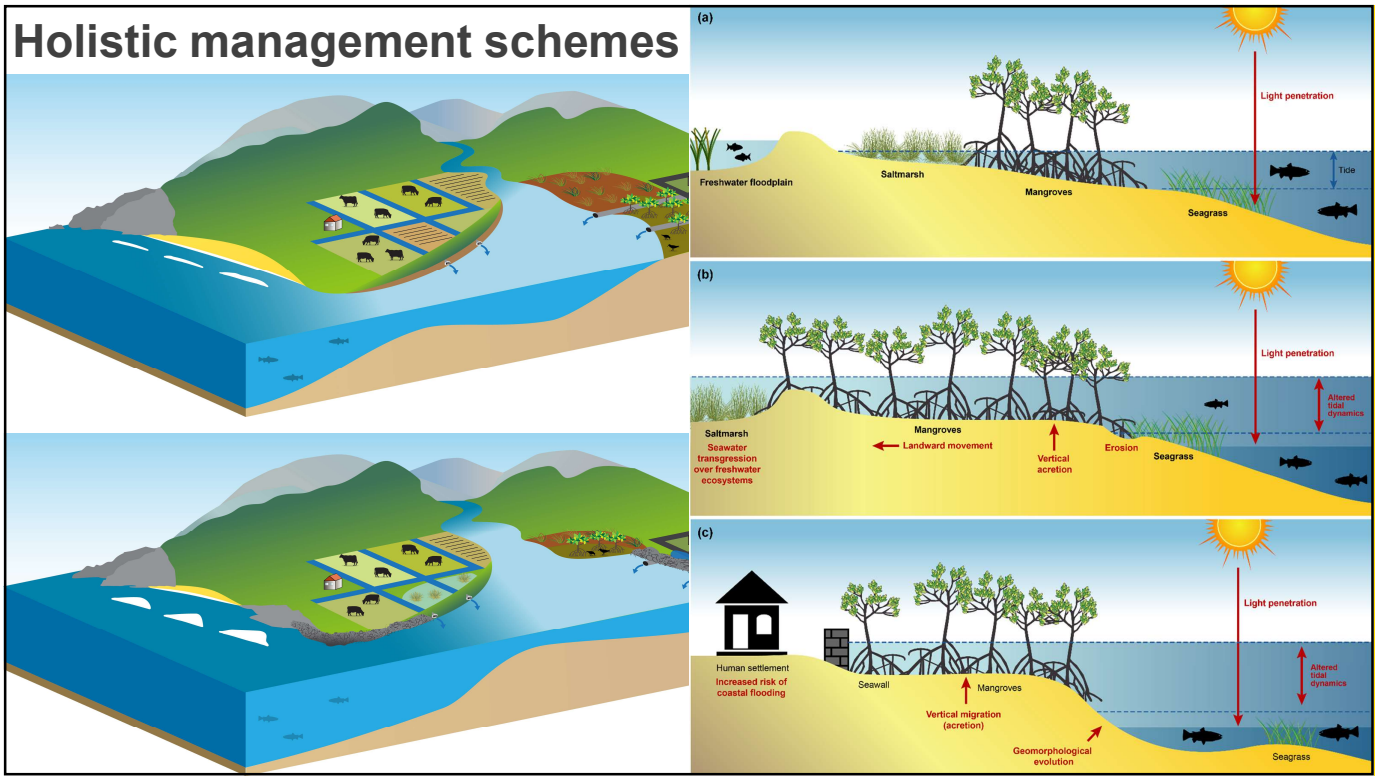
Holistic management schemes



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About Research Education

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Integrating management with ecosystem ecology to ensure a sustainable future

Kamay (Botany Bay) is an ecologically diverse and culturally and economically important region that is under intense urbanisation pressures.

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Thank you!

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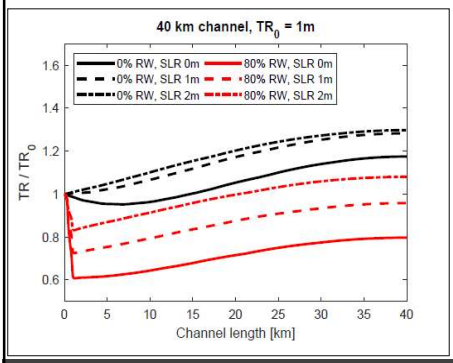
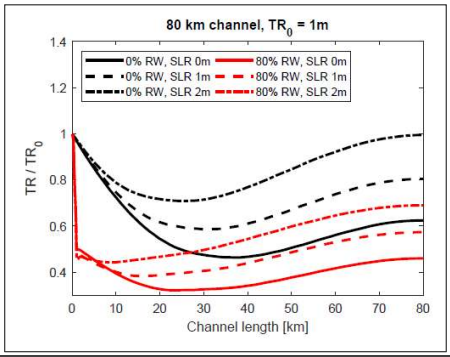
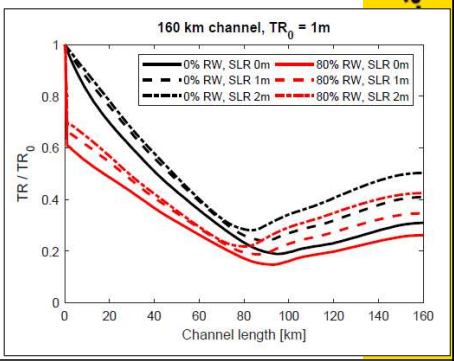
Reflection, resonance & dampening

40 km estuary *80 km estuary* *160 km estuary*







*Short estuaries are dominated by **reflection***

Larger tidal amplification observed for estuaries close to resonance

*Longer estuaries are dominated by **friction***

SLR decreases friction

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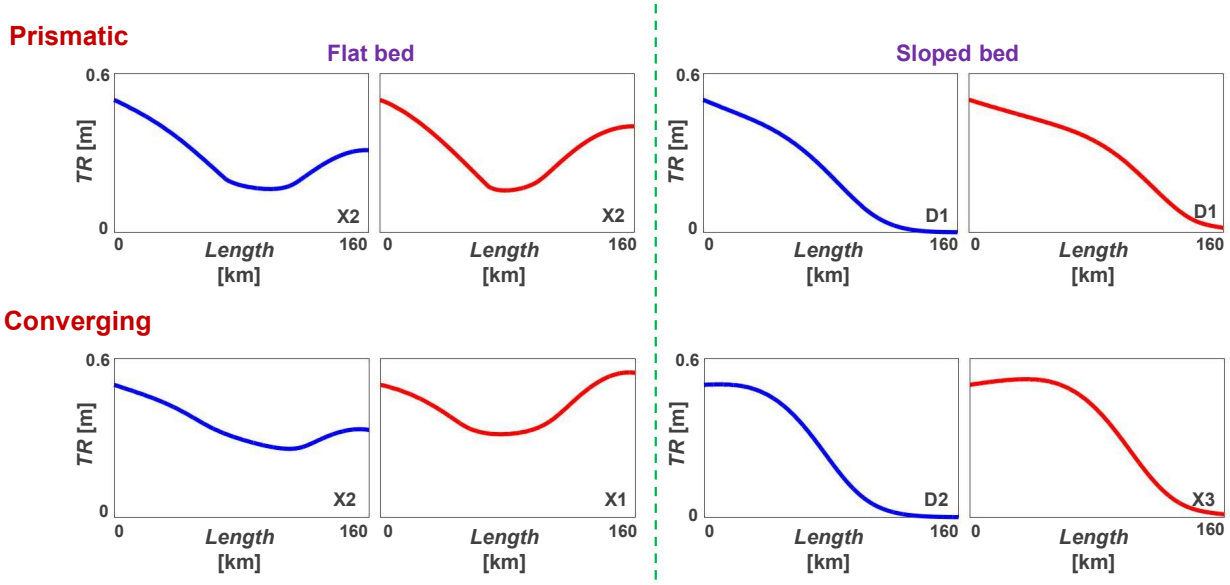
Estuarine tidal range dynamics under SLR



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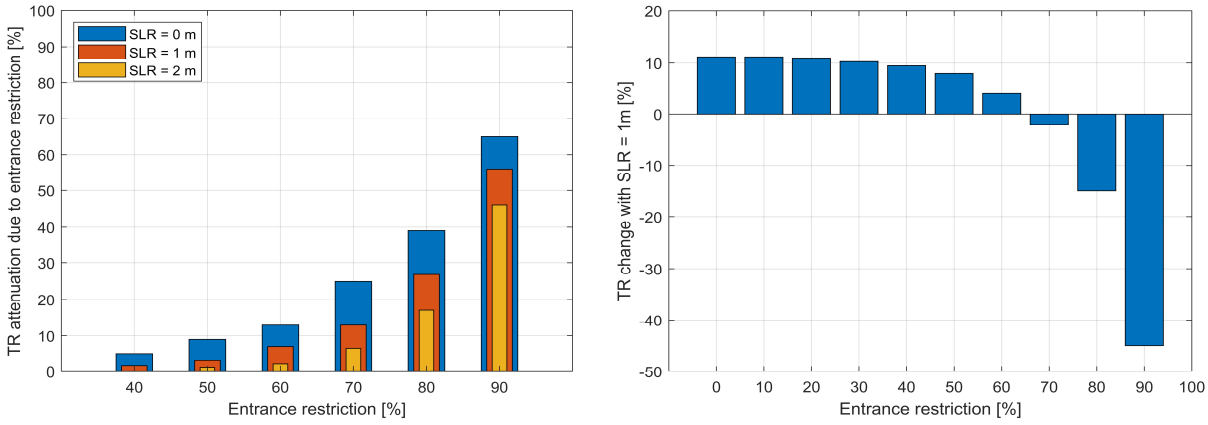
Mitigating sea level rise induced tidal amplification



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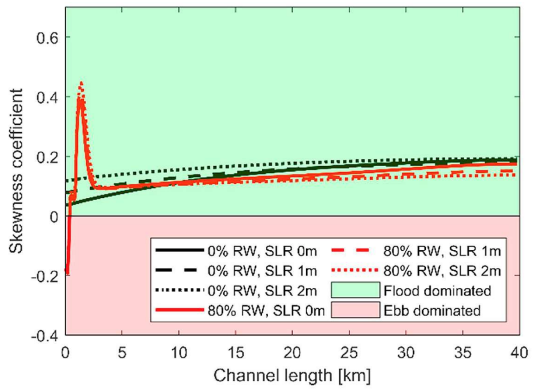
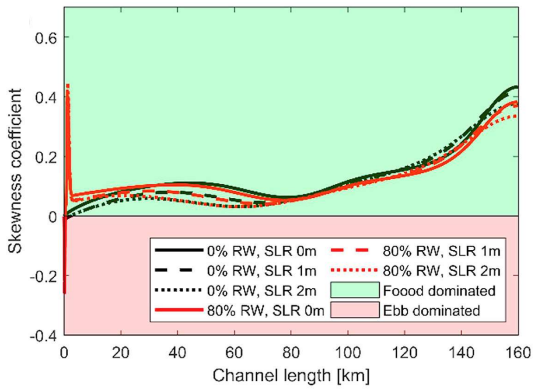
Tidal current velocity and asymmetry





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