EAST COAST
NRM CLUSTER

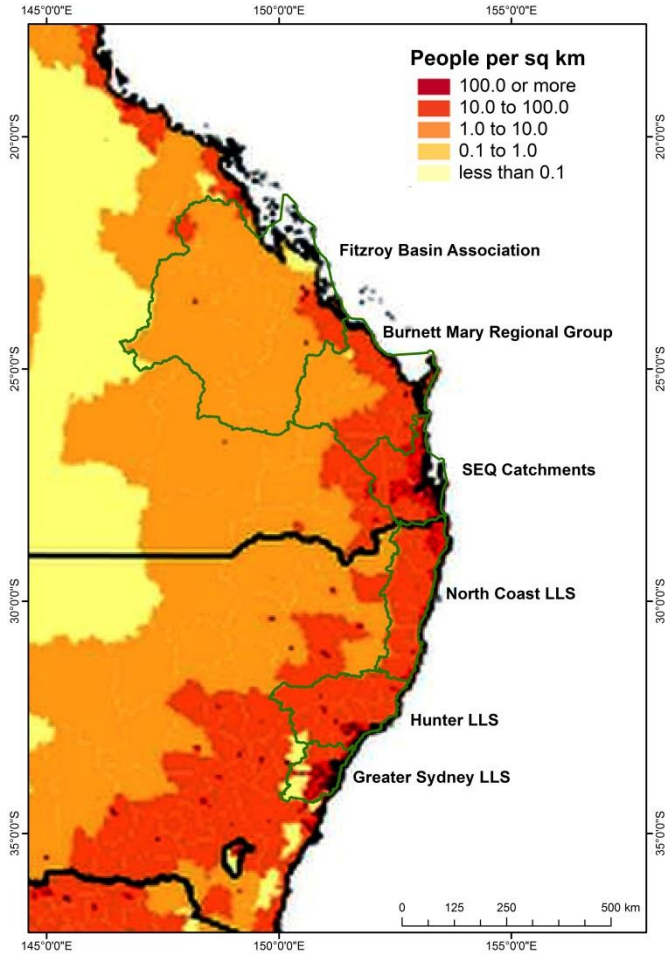
CLIMATE CHANGE IN AUSTRALIA

IMPACTS & ADAPTATION
INFORMATION
FOR AUSTRALIA'S NRM REGIONS

An integrated framework for first order assessment of the risk of estuaries to climate change in the east cost NRM cluster

Background

The coastal zone of the east coast NRM cluster is highly contested. Coastal planners and managers need to plan for sea-level rise in the 21st century to improve resilience and minimise impacts.



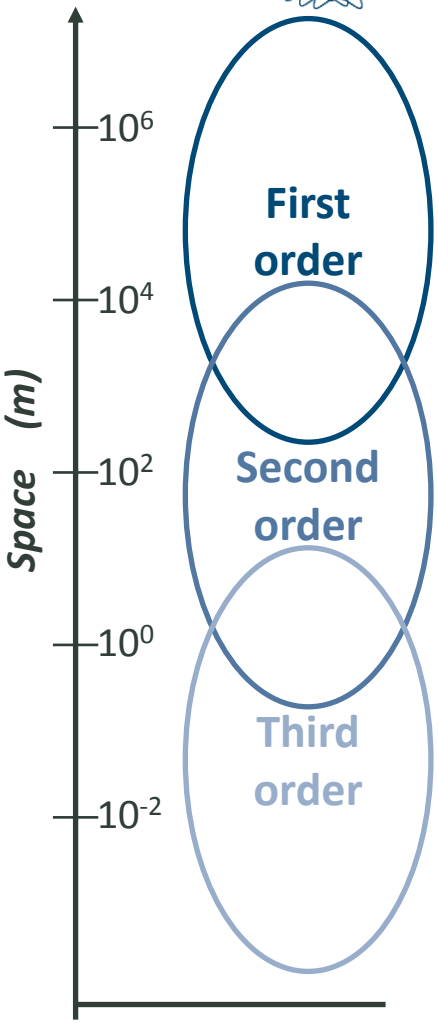
The east coast NRM has some of the highest population in coastal Australia. Pressure on the coastal zone associated with increasing urbanisation and development are substantial. Climate change, particularly sea-level rise, is an additional pressure on these highly contested coastal landscapes.

However with a considered approach to assessing the vulnerability of communities and ecosystems to climate change, and appropriate planning to improve resilience, adaptation of communities and ecosystems can be enhanced.

Name	Area (km^2)	Population
Fitzroy Basin Association	142 700	230 000
Burnett Mary Regional Group	56000	300 000
SEQ Catchments	23 000	2 600 000
North Coast LLS	32 120	na
Hunter LLS	33 000	670 000
Greater Sydney LLS	12 747	4 400 000

Background

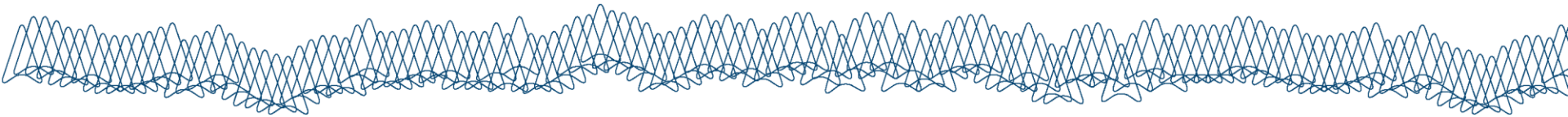
Resources for high resolution assessments of vulnerability are limited. First pass assessments of vulnerability, based on sound scientific data, can be used for prioritisation of areas for targeted vulnerability assessments.



- Scale dependent approaches to vulnerability assessment are ideal for prioritizing areas for high resolution analysis of vulnerability and adaptive capacity (Sharples et al. 2008).
  - First order assessments are broad in spatial scale and utilize readily available datasets with large spatial coverage
  - Second order assessments may be system focused and utilize higher resolution data
  - Third order assessments require fine resolution data, that is derived from empirical datasets, and are typically small in spatial scale.
- First order assessments are intended to capture the vulnerability of a region and are ideal for prioritizing areas within the east coast NRM for high resolution analyses of vulnerability.
- First order assessments of biophysical vulnerability can be integrated with socio economic information to provide a more holistic first pass assessment of the vulnerability of communities, landscapes and ecosystems to climate change.

Aim

To develop a framework for undertaking first order assessment of climate change impacts on estuary geomorphology in the east coast NRM.

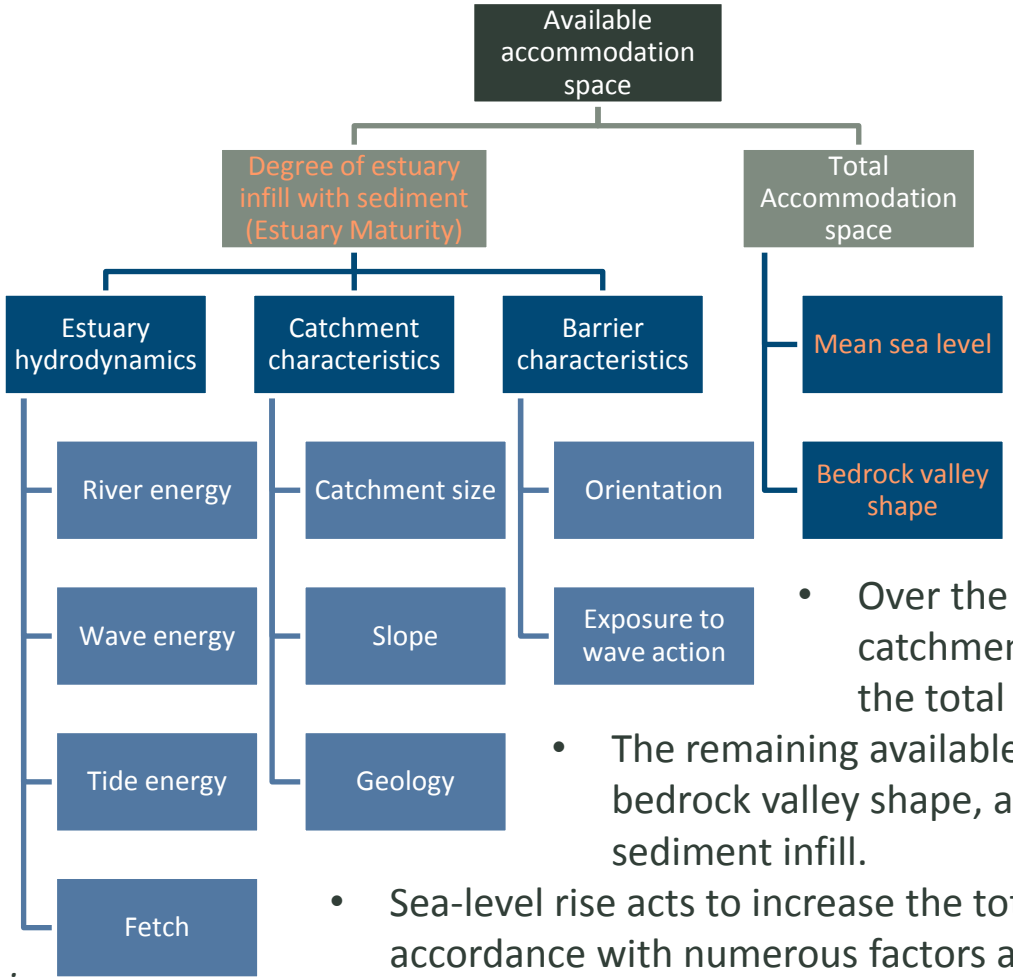


Methods

- Develop a geomorphic framework of the Holocene response of estuaries to sea-level rise.
- Integrate the geomorphic framework with a framework for vulnerability assessments to capture the geomorphic vulnerability of estuaries to future sea-level rise.
- Identify spatial datasets that could be applied within the framework for a first order vulnerability assessment.

Geomorphic framework

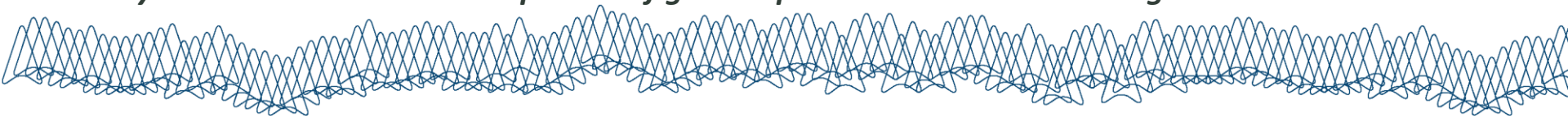
The geomorphic history of an estuary over the Holocene, which was characterised by rapid sea-level rise ~7000 kpa, provides an indication of the future response of an estuary to climate change. Over this period estuaries behaved as a sediment sink.



- The volume of sediment that an estuary can potentially hold is commonly termed 'accommodation space'. The total accommodation space is dependent upon the shape of the bedrock valley and the elevation of hydrological influence, which equates to highest astronomical tide and correlates with mean sea level. Deeper valleys have more accommodation space than shallow valleys; broad valleys have more accommodation space than narrow valleys (Rogers and Woodroffe 2012).
- Over the Holocene sediment has been delivered from catchments and marine sources to estuaries and infilled the total accommodation space (Roy et al. 2001).
- The remaining available accommodation space is upon sea level and bedrock valley shape, as well as factors that influence the degree of sediment infill.
- Sea-level rise acts to increase the total and available accommodation space in accordance with numerous factors as detailed in figure X.

Geomorphic framework

The primary indicators of the response of an estuary to sea level rise is the available accommodation space, which is influenced by sea level, estuary maturity (the degree of infill) and bedrock valley shape. Estuary zonation indicates the exposure of geomorphic units to climate change drivers.



Available accommodation space is a function of estuary maturity and bedrock valley shape.

Estuary maturity (or stage of infill) is an artefact of sediment budgets occurring over the Holocene; mature estuaries received markedly more sediment than they exported; immature estuaries received slightly more sediment than they exported. Immature estuaries have more available accommodation space and are less sensitive to changes in total accommodation space, but evidently do not have a history of high sediment delivery and adaptation to sea-level rise. Mature estuaries have less available accommodation space; the resulting depositional units are low-lying and intensively used for farming and developments. This land is particularly sensitive to inundation. They do exhibit an extended history of sediment delivery over the Holocene and adaptation to sea-level rise.

Bedrock valley shape indicates the potential volume of sediment within an estuary. Mature broad valleys have proportionally more low lying land that is vulnerable to inundation, and also require greater volumes of sediment for adaptation. Mature narrow valleys have restricted areas of low-lying land and require less sediment volume for adaptation to sea-level rise.

Estuary zonation indicates the exposure of depositional units to different climate change drivers. Marine zones are preferentially exposed to marine drivers such as storm surge and sea-level rise. Alluvial zones are preferential exposed to terrestrial climate drivers such as rainfall/run/off. Estuarine zones are moderately exposed to both marine and terrestrial drivers.

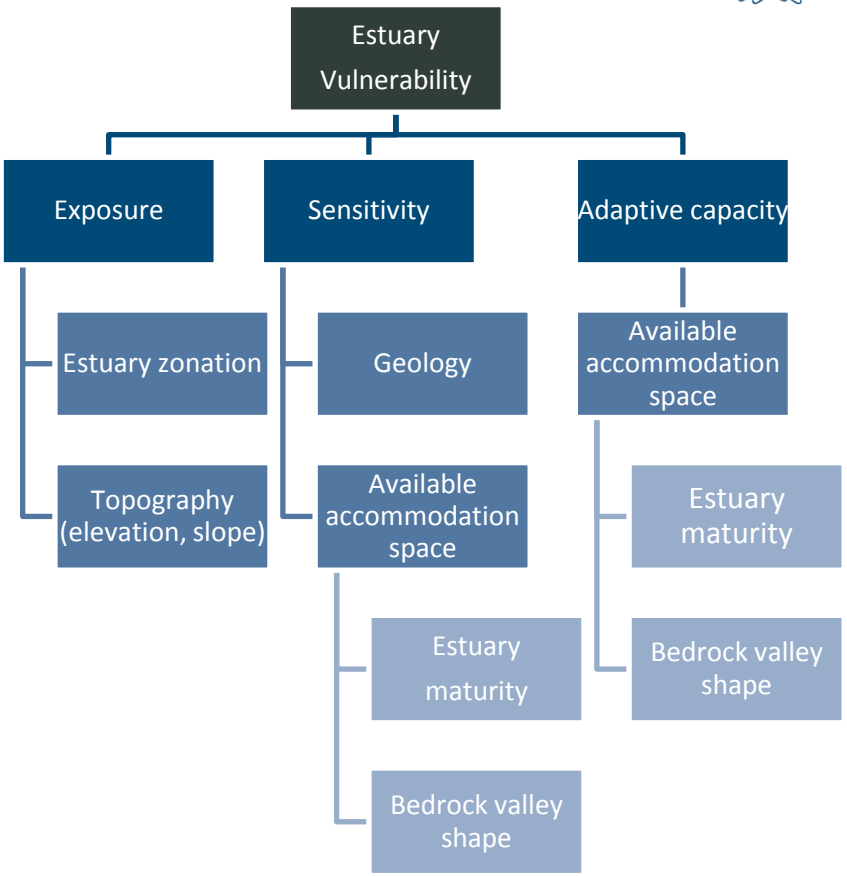
Estuary vulnerability framework

Vulnerability can be described in terms of the exposure and sensitivity of a system to climate change drivers, and the capacity of that system to adapt to climate change drivers (Parry et al. 2007). This can be integrated with estuary geomorphology to indicate the future vulnerability of an estuary to geomorphic change.

Exposure is indicated by estuary zonation and topography. Marine zones are influenced by marine drivers and alluvial zones are influenced by terrestrial drivers. Low lying areas are preferentially exposed to inundation. Steep alluvial areas are preferentially exposed to erosion following rainfall event.

Sensitivity is indicated by geology and available accommodation space. Un-lithified sediments are more sensitive to erosion than bedrock. Estuaries with less available accommodation space are sensitive to inundation.

Adaptive capacity is indicated by available accommodation space. Estuaries with less available accommodation space exhibit strong history of adaptation to sea-level rise and erosion by processes that enhance infill.



Spatial indicators of available accommodation space

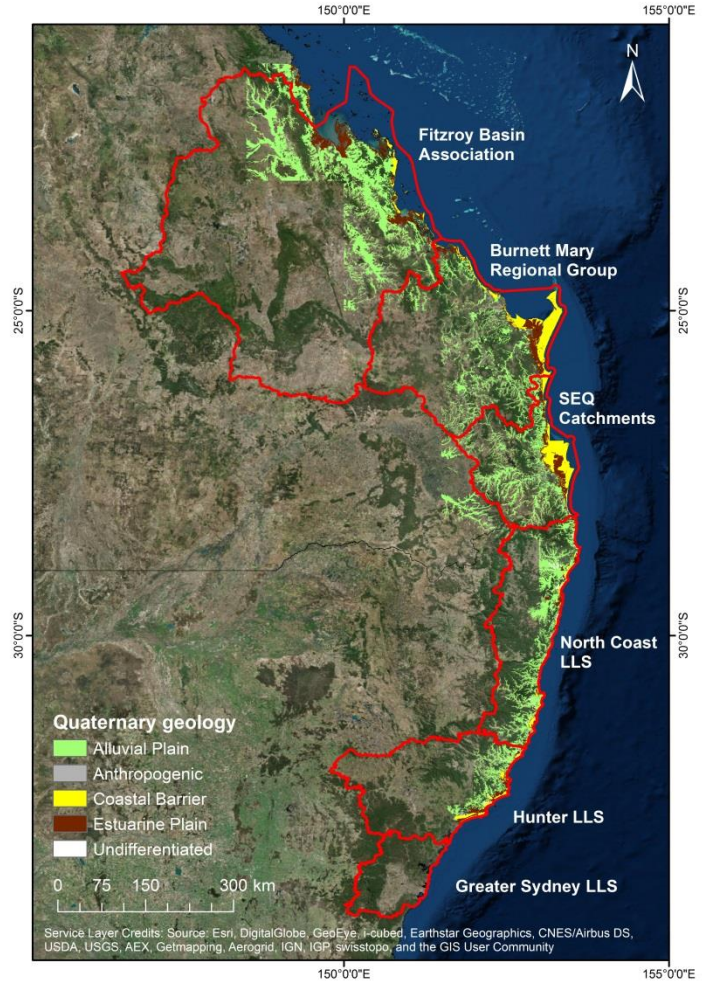
First order assessments require readily available datasets that have broad spatial extent. These datasets need to describe the indicators of estuary exposure and sensitivity to climate drivers and adaptive capacity.

Exposure: Quaternary depositional units (alluvial, estuarine or coastal) provides an indication of the spatially explicit exposure of estuaries to climate drivers that cause inundation and erosion. Digital elevation models provide an indication of exposure to erosive wave action and flooding, and erosion from rainfall/run-off.

Sensitivity: Un-lithified and bedrock geology provides an indication of the spatially explicit sensitivity of estuarine landscapes to erosion.

Adaptive capacity: Elevation of un-lithified geology provides an indication of the capacity of estuarine landscapes to adapt to Holocene sea-level rise.

Ideal datasets for first order assessment are bedrock geology, un-lithified Quaternary geology and digital elevation models.



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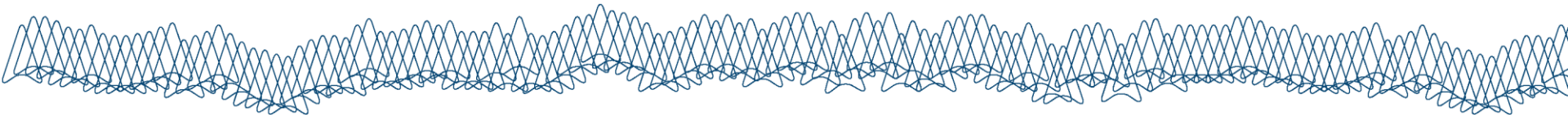
Thank you

From the East Coast Cluster



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