



EAST COAST
NRM CLUSTER



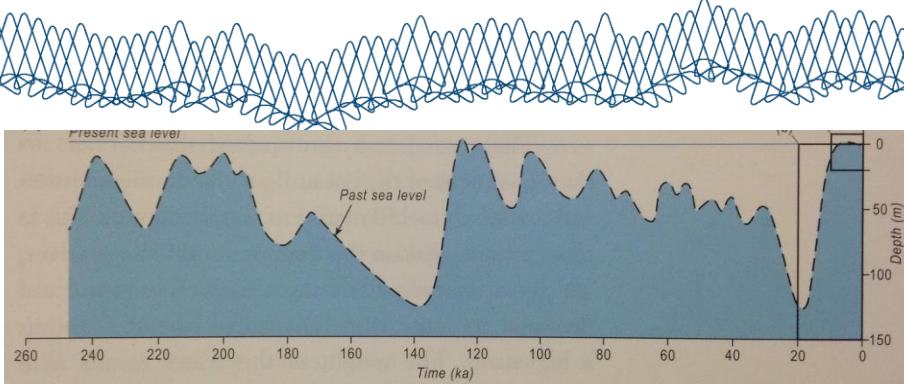
IMPACTS & ADAPTATION
I N F O R M A T I O N
FOR AUSTRALIA'S NRM REGIONS



Scale dependence of estuary response to
sea-level rise: towards a framework for
vulnerability assessment

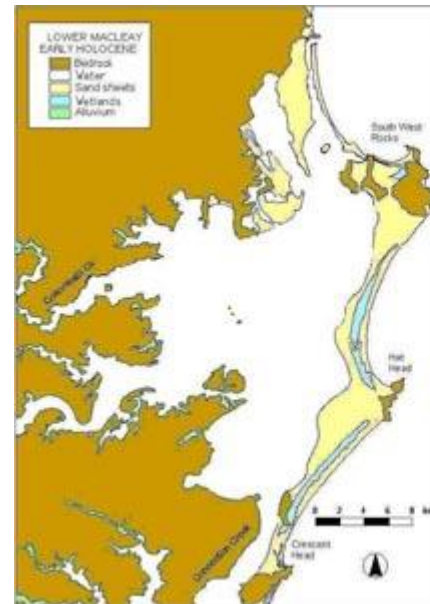
Background

Coastal ecosystems have a long history of development, which is tightly coupled with sea-level rise over the past 7000 years. Perturbations of short duration, such as storms, may also have a significant affect on their morphology and ecology.



- The current morphology of the east coast NRM reflects a history of rapid sea-level rise over the past 7-5kpa. This was followed by a period of relatively stable sea level conditions (Roy 1984).

- As sea level rose rapidly, sediment was delivered onshore to coastal embayments and large barriers formed at the entrance to embayments. As sea level stabilised, the embayments behind these barriers became mixing zones where saline and freshwater mixed; and are now known as estuaries.
- Under stable sea level conditions, estuaries behave as sinks that gradually infill with sediment and organic material. The rate of infill is dependent upon the volume of sediment and organic material imported from marine and terrestrial sources or created in situ, and the volume of sediment and organic matter exported through the entrance of the estuary. Under stable conditions, the rate of sediment infill asymptotes towards the elevation of hydrological influence.



Background

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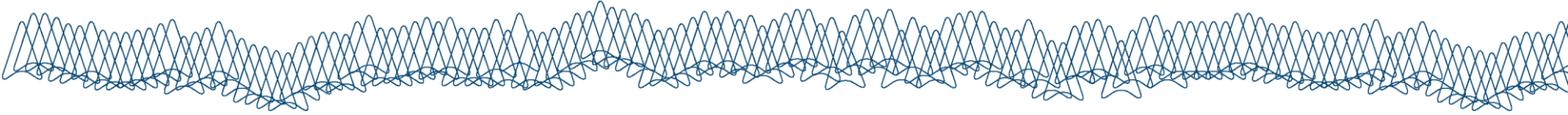
- Short-term perturbations interrupt this longer-term trend of infill. For example, storms can cause significant erosion and export sediment from barriers and estuaries (REFXXX). Alternatively, storms may delivery additional sediment from catchments for deposition within estuaries.
- Rogers et al. (2014) demonstrated the influence of longer-term infill and short-term ENSO related climatic variability on coastal wetland geomoprhology.
- The current coastal geomorphology is not only an artefact of long-term infill over the Holocene, but is also shaped by short-term perturbations.
- Projecting future coastal geomorphology requires approaches that capture both the influence of both long-term trends and short-term perturbations.



Hail damage to *Avicennia marina* on the Hawkesbury River.

Background

Planning for coastal adaptation to sea-level rise requires a considered approach to vulnerability assessment that captures all the processes influencing coastal geomorphology. This requires considerable investment.



Aim

To develop a systematic approach to coastal vulnerability assessment that maximises planning outcomes.

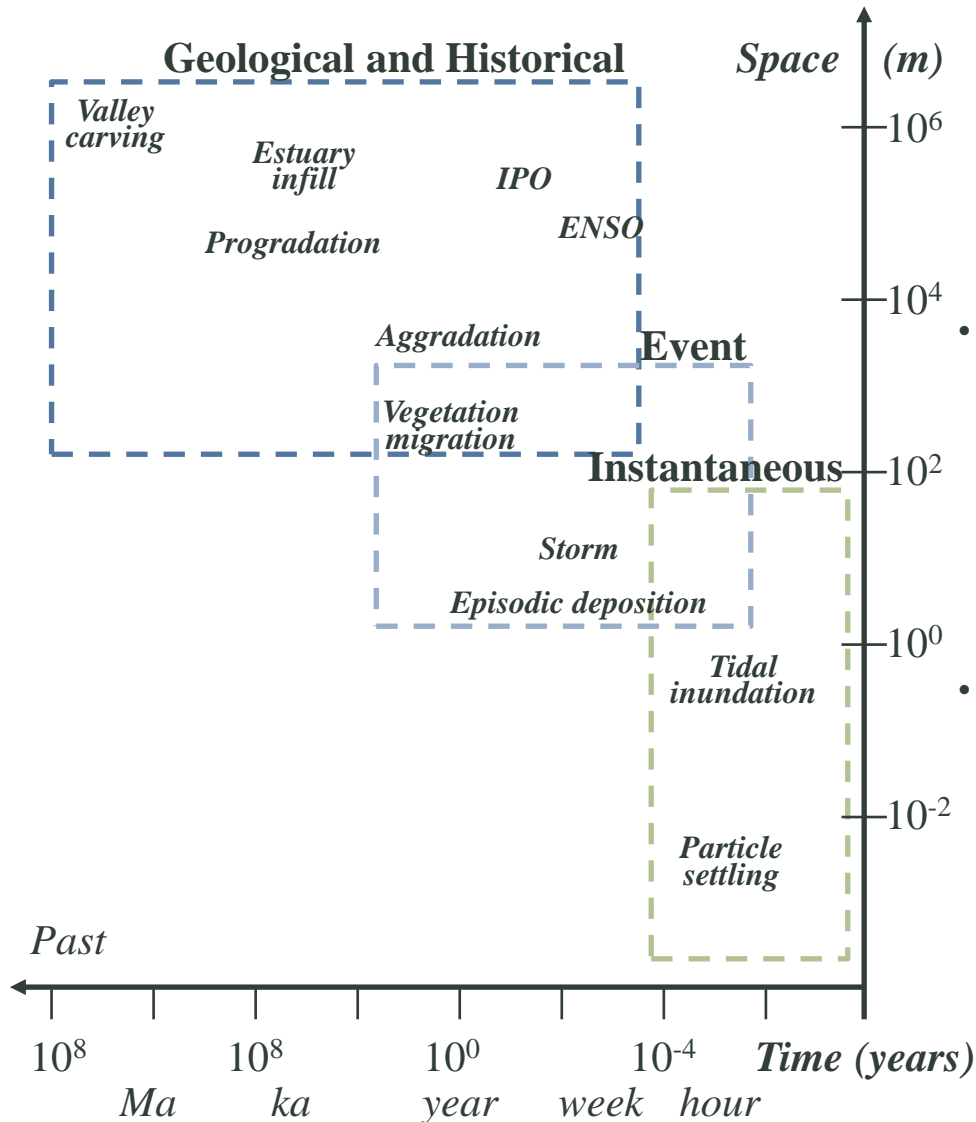
Methods

Review available literature regarding the spatial and temporal variability in coastal geomorphic response to short-term perturbations and longer term trends.

Develop a framework for conceptualizing these changes. The framework can be used for prioritising coastal vulnerability assessments.

Spatial and temporal scales

Coastal processes operate at a range of temporal and spatial scales.

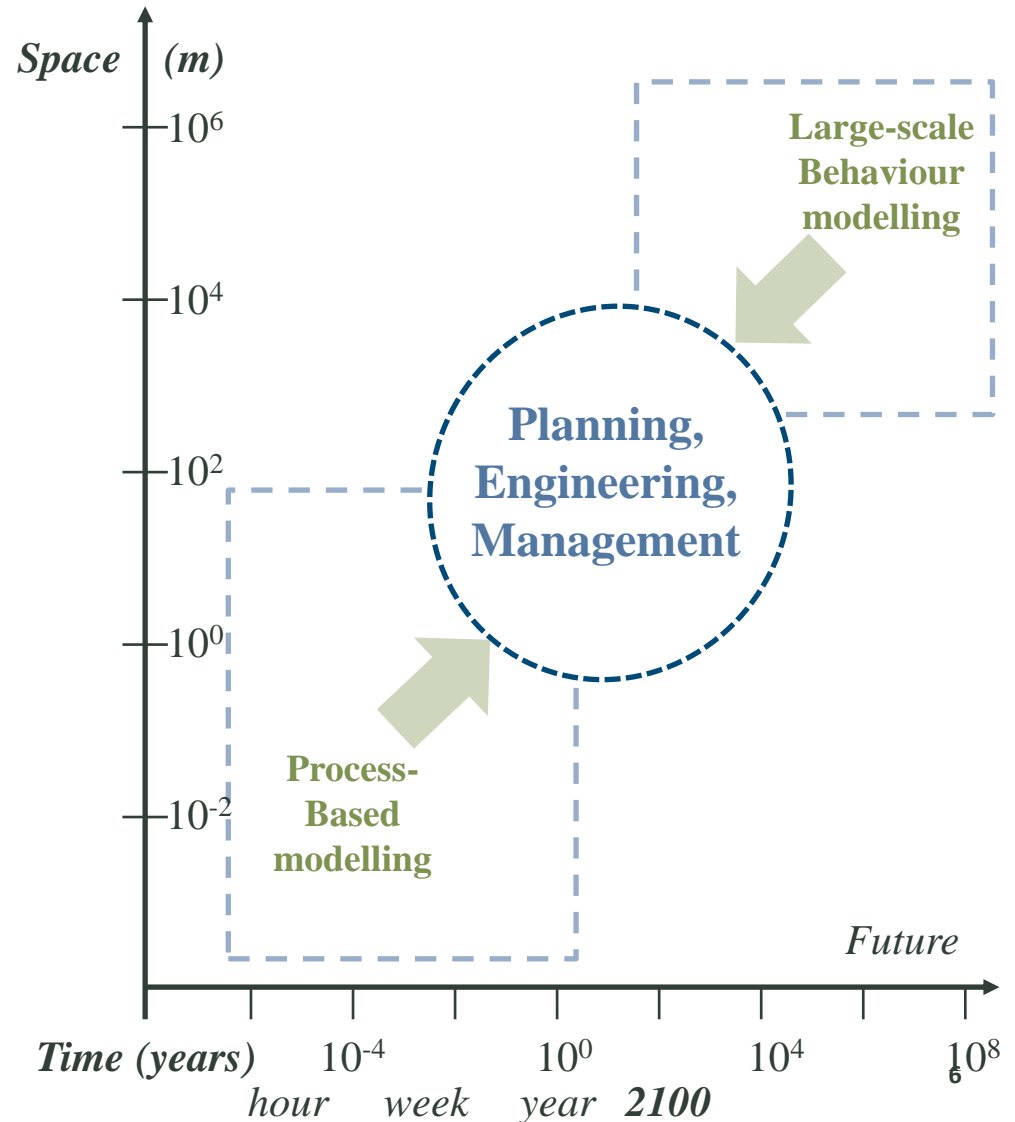


- Processes that influence coastal morphology occur at a range of spatial and time scales. Relationships and feedback between these processes ensures that coastal evolution is time dependent. However, the random nature of driving processes, such as storms, ensures that coastal evolution is non linear and difficult to project (Cowell and Thom, 1994).
- Cowell and Thom (1994) proposed a spatial and temporal framework for conceptualising coastal behaviour at timescales of decades to millennia, and spatial scales of metres to hundreds of kilometres. Figure XX is an adaptation of this framework for processes relevant for estuarine landforms.
- The premise of this framework is that large-scale coastal behaviour, such as estuary infill in response to sea level rise, are relatively consistent over longer-term scales and large spatial scales; and projection of these processes over large spatial and temporal scales is somewhat reliable. Similarly, instantaneous processes, such as tidal inundation, can be projected for a similar scale event with reasonable reliability.

Spatial and temporal scales

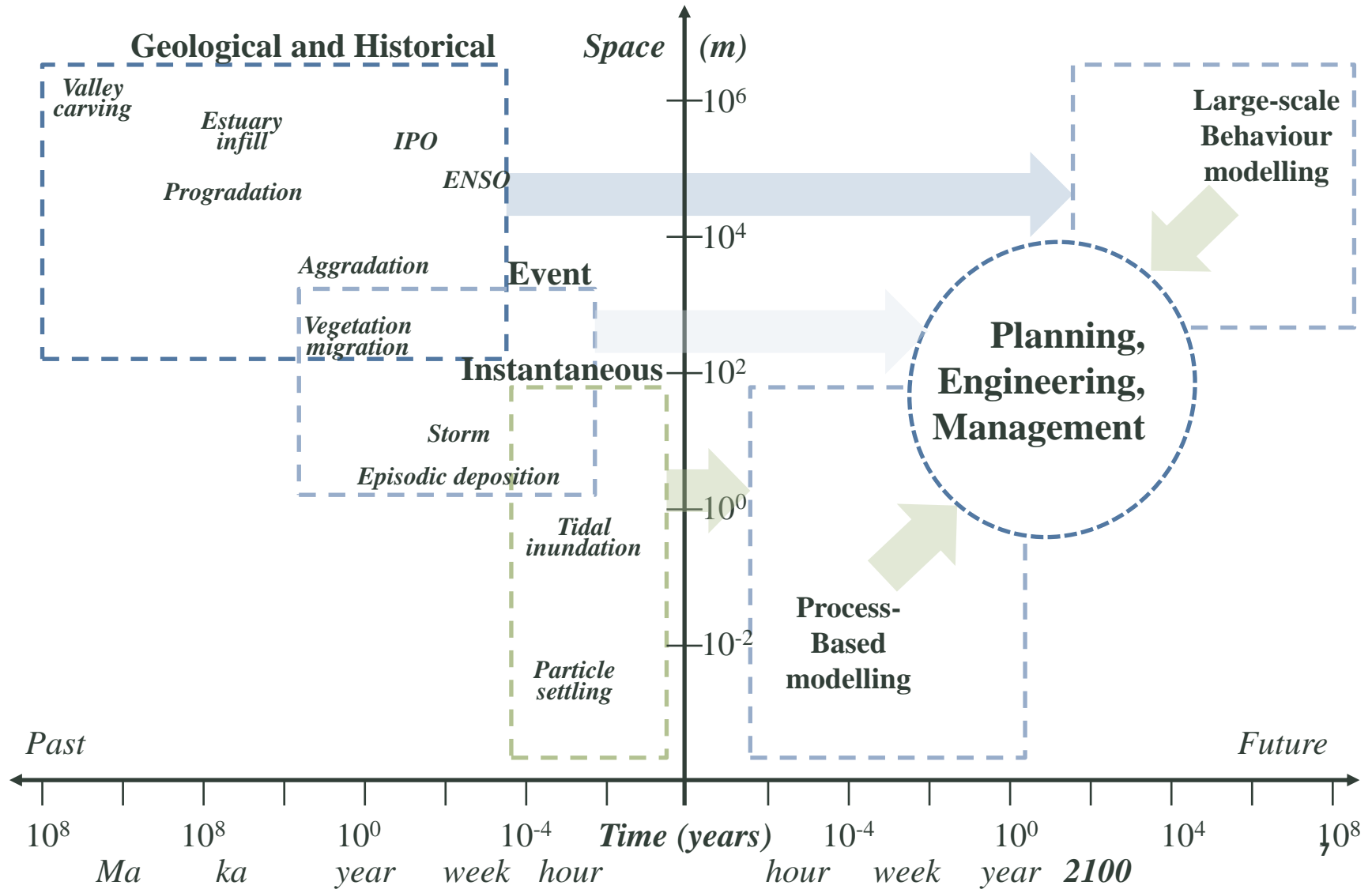
Coastal processes operate at a range of temporal and spatial scales. Coastal vulnerability assessments need to be scale sensitive. An ordered approach will facilitate prioritization of areas for high resolution assessment.

- The complexity of projections lies in capturing the processes relevant to the spatial and temporal scales for management.
- Planning, engineering and management requires information projected at scales of tens to a few hundred years. This is a period that matches sea level projections by the IPCC and is commonly used for asset planning.
- This timescale requires an integrated projections of large-scale coastal behaviour and process based modelling. Integrating this information is key to improving the accuracy of climate change vulnerability projections.



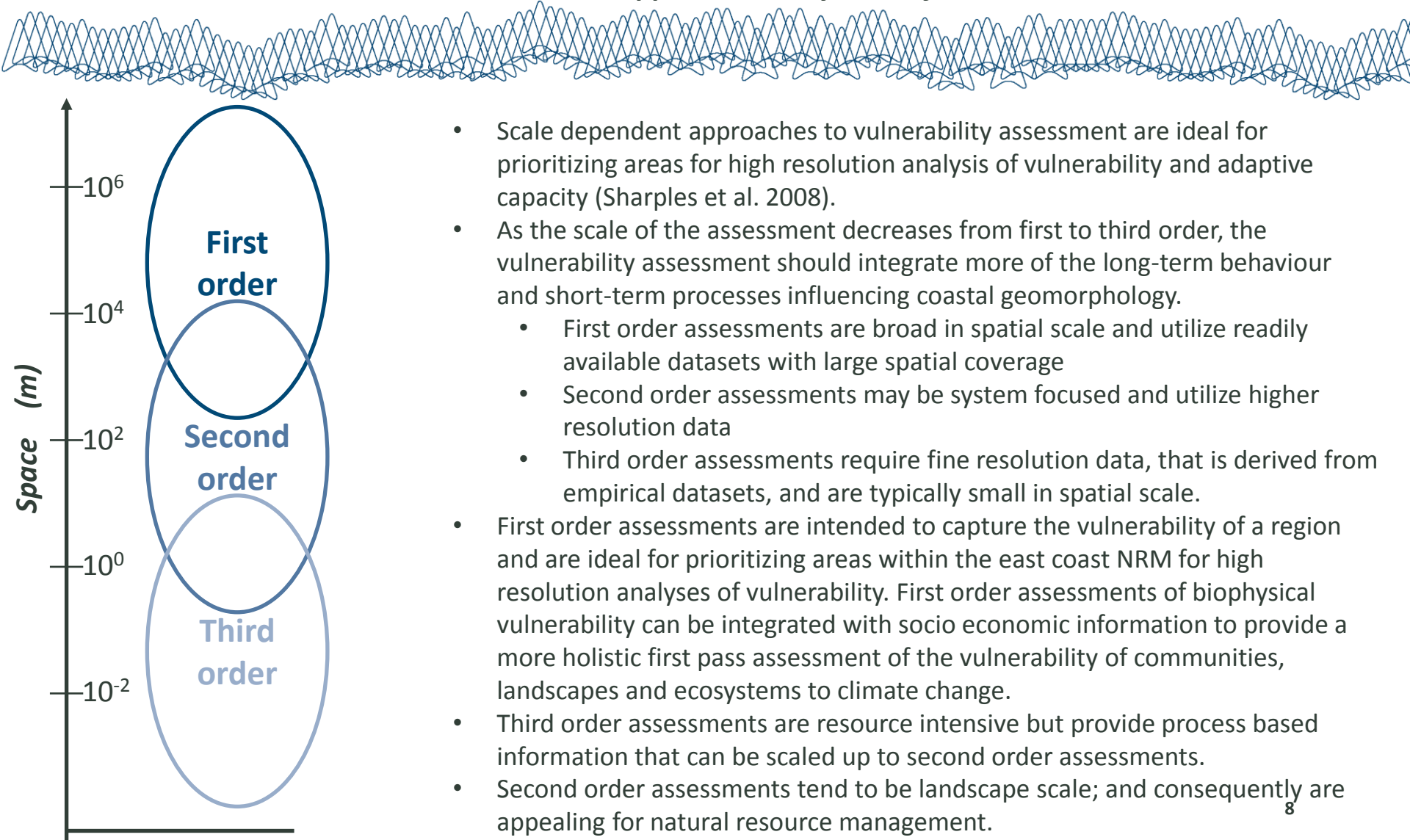
Spatial and temporal scales

The past is a guide to the future vulnerability of coastal landforms (Woodroffe and Murray-Wallace 2012). Coastal vulnerability assessments that are sensitive to the planning, engineering and management timescale need to account for both long-term processes and short-term perturbations.



Scaled approaches to vulnerability assessment

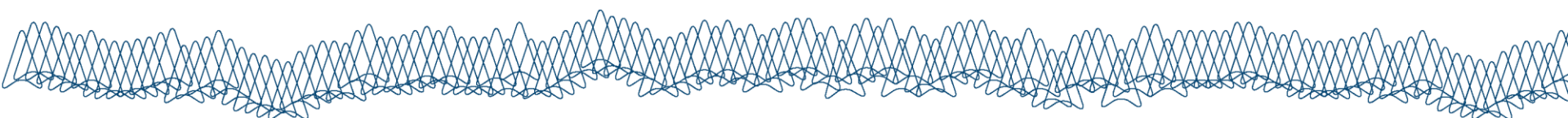
Coastal vulnerability assessments that are sensitive to the planning, engineering and management timescale need to account for both long-term processes and short-term perturbations. They also need to be sensitive to resource limitations. Scaled approaches may be useful.



References

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Thank you

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