APPLICATIONS OF A SEDIMENT CELL HIERARCHY AND LANDFORMS TO COASTAL EROSION MANAGEMENT AND MODELLING

Tanya Stul, Damara WA Pty Ltd, tanya.stul@damarawa.com
Matthew Eliot, Damara WA Pty Ltd, matt.eliot@damarawa.com
Ian Eliot, Damara WA Pty Ltd, ian.eliot@damarawa.com

Landform analysis has an integral and often understated role in coastal engineering. The strength of a hierarchical approach derives from a capacity to simultaneously consider change at a wider variety of scales and to focus on processes that are characteristic to each scale. A hierarchy of sediment cells and landforms provides potential for refined evaluation of coastal erosion hazard.

Decision-making for erosion management, including identification of setbacks or design of coastal defenses, typically considers several future decades. This time scale presents challenges when using numerical modelling to provide forecasts, because of the reliance on often conceptual oceanographic-sediment process relationships and potential for dynamic coastal behavior to diverge from existing trends or historic behavior. Analysis of coastal morphology in a hierarchical approach may provide a basis for (i) refined modelling, (ii) identification of strategic monitoring effort and (iii) improved interpretation of model outcomes for coastal management.

REFINE MODELS

Landform analysis may be used to refine modelling by verifying the conceptual relationships underpinning the models, improving the representation of dynamic sediment exchanges, and providing a factual basis for validation of existing processes. Application to the Australian coast has demonstrated the potential diversity of coastal dynamics and the need to refine concepts of alongshore and cross-shore sediment movement. Key outcomes included the importance of coast-estuarine sediment exchange on a floodplain coast and the potential role of underlying geological structure to control compartmentalization. A two-dimensional hierarchy of sediment cells, built upon analysis of key sediment pathways and controls at multiple spatial scales, have been identified as an efficient means of refining the spatial distribution of coastal sediments. Furthermore, the hierarchy may support upscaling or downscaling of information across a range of sources relevant to coastal change.

IMPROVE MONITORING PROGRAMS

Improved understanding of landform dynamics and the patterns of sediment exchange supports the targeted identification of where and how coastal change is likely to occur. Understanding of the relationships between landforms enables strategic coastal monitoring to be undertaken at indicator sites, with results upscaled through the cell hierarchy to provide a wider picture of coastal change. This approach has been applied to develop a monitoring program across a length of 300km, using simple low-cost monitoring integrated with low frequency remote sensing. The monitoring is also intended to be used for triggers to change coastal management strategies.

IMPROVE COASTAL MANAGEMENT

Application of model outcomes to coastal management has increasingly acknowledged the uncertainty associated with forecasting, particularly the impacts of sea level rise. Use of conservative scenarios for change is ultimately impractical, as it leads to reduced ability to distinguish relative sensitivity along the coast. This potentially results in a breakdown of the principle of intelligent siting to avoid coastal hazards. Landform analysis may be used to refine model outcomes, specifically through downscaling from model scales down to decision-making scales. In application, landform attributes that have been weakly represented in regional models include updrift retention by rock formations, and the influence of nearshore bars and spits.

The importance and usefulness of a sediment cell hierarchy and landforms to coastal erosion management decision-making is demonstrated across a range of applications on the Australian coast. Hierarchical sediment cell frameworks and landform analysis are proposed as a robust means to facilitate an appropriate level of complexity in erosion impact assessment and prediction of coastal response.