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Systems Thinking and Modelling for Coastal Zone Management and Climate Change Adaptation

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Abstract Coastal areas are complex interconnected systems combining hydrodynamics processes, fragile ecosystems and human settlements. This combination can create complicated socio-environmental problems often resulting in uncertain management solutions, in particular in the light of climate change.

Systems thinking and modelling, considering natural, social and economic aspects, have become popular in the last decade as a way to provide a better understanding of coastal areas and climate change elements, connections and behaviour. Systems thinking is a methodological approach that aims at breaking down interlinked elements which can directly or indirectly influence one another. Systems-based methodologies place emphasis on understanding and describing the nature of these elements and relationships, resulting in a conceptual model of the system. Systems modelling is the process of turning conceptual models into computer models ready for simulations. This quantification provides a numerical tool that can be used to understand or predict how a system will respond to changes.

With the support from the Griffith Climate Change Response Program, the Systems Thinking and Modelling Group was recently formed to gather expertise in systems thinking and modelling within Griffith University, to provide a better understanding of socio-environmental systems in coastal areas under the impacts of climate change. A range of research activities has been carried out by the group members, developing or combining techniques which often rely on stakeholder contribution as a starting point for more sophisticated modelling, for instance:

- To identify adaptation options and adaptive capacity determinants for South East Queensland coastal settlements
- To identify and assess a range of climate change and coastal hazards options for Surf Life Saving in Australia assets and operations, including the analysis of the stakeholders networks
- In eliciting quantitative stakeholder driven scenarios as an output for use in interdisciplinary modelling for offshore aquaculture development in California
- In modelling adaptation to sea level rise combining spatial data with system dynamics simulations.
- In identifying coastal management indicators (Sano & Medina, 2012) and, in particular, in modelling stakeholder mental models of relationships between coastal issues in Egypt.

The outcomes of these experiences show that systems approaches are able to provide a better understanding of coastal systems in a changing climate by gathering different views and mental models from stakeholders and producing quantitative analysis and outputs. This information can be practically used to support decisions and indirectly employed to foster dialogue and create consensus within stakeholders groups.

Keywords: *Systems Thinking, Systems Modelling, Coastal Zone Management, Climate Change Adaptation*