NUS National University of Singapore | Department of Biological Sciences, Faculty of Science

SEMINAR

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Creating a shared model of climate change effects on reef and island carbonate budgets



By ***Nicola Browne***

Curtin University, Perth, Australia

My research focuses on carbonate production, transport and removal in inshore coastal waters. Corals are typically the major reef carbonate producer, hence understanding how corals with respond to both global climate change as well as chronic declines in water quality is critical in determining long-term reef growth and stability. I have worked on coral reefs in Australia, Asia and Africa, largely focusing on inshore turbid zone reefs, and has written a review on the occurrence, composition and growth of inshore reefs of the Great Barrier Reef. I also spent a couple of years in Singapore investigating the impact of ship-wake induced sediment resuspension on near-shore coral reefs which involved an assessment of spatial and temporal variations in water quality in relation to changing coral physiology and growth. In 2013, I moved to Perth where I was heavily involved in teaching for 4 years and course co-ordination of the Coastal and Marine Science degree. My current research projects focus on carbonate budget modelling in Exmouth, reef growth and accretion in Borneo and ecological modelling coral physiological response to dredging events.

Carbonate reefs provide a number of critical ecological and geomorphic functions, as well as provide the carbonate sediments that build and maintain low lying islands. Global warming, ocean acidification and rising sea level threaten these geo-ecological functions and the stability of carbonate reefs and low-lying islands, and as consequence human populations and flora/fauna living on these islands. Reefs and their islands represent a complex and coupled dynamic system, each with unique characteristics that influence their function and future stability. Yet, current methods that aim to monitor and assess the current state of these carbonate structures have yet to fully consider all ecological, chemical and physical processes and typically rely on non-site specific data to determine future trajectories. To more accurately model carbonate structures, a detailed model that incorporates all known processes and has the flexibility to include both site-specific data and environmental change is required. We developed an expert elicitation, shared modelling method to generate a complex carbonate model involving 25 marine scientists. These marine scientists, grouped into six disciplinary areas (calcification, bioerosion, sediment production, sediment transport, island growth, cyclone and bleaching impacts) were tasked with developing individual micro-models using a suite of reef, island and environmental variables. Individual micro-models were combined to create six shared micro-models that were the focus of a workshop designed to refine the micro-models and identify quantifiable relationships and data gaps. The micro-models were combined to create a shared complex carbonate model, which is currently being developed into a quantitative data-driven dynamic model. This novel approach has produced a model that considers all known processes and identifies dominant relationships, while also reducing individual bias. We anticipate that this shared carbonate model will provide a key platform to assess future stability of carbonate reefs and their associated islands in Australia and globally.