Drivers of pCO_2 variability in two contrasting coral reef lagoons: The influence of submarine groundwater discharge

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The drivers behind pCO_2 variability in coral reefs need to be elucidated in order to properly assess the impacts of ocean acidification. We show that commonly occurring submarine groundwater discharge (SGD) processes can be a significant source of CO_2 to two contrasting coral reef ecosystems. In Rarotonga (Cook Islands), SGD was dominated by a steep hydraulic gradient and fresh groundwater inputs high in pCO_2 (5,501 matm). In Heron Island (Great Barrier Reef), SGD was driven by the tidal pumping of seawater into the permeable island and saline groundwater recirculation with a lower pCO_2 (1,397 matm). Both lagoons were net sources of CO_2 to the atmosphere (3.00 and 9.67 mmol CO_2 m^{-2} d^{-1}). SGD derived CO_2 fluxes were at least 3-fold higher than the atmospheric fluxes, and enough to lower the average pH to 7.96 in Rarotonga and 8.04 in Heron Island. The relationships between water column pH and aragonite saturation state (W_{Ar}) and radon (^{222}Rn) concentrations indicate that SGD may enhance the local acidification of some coral reef lagoons. Studies measuring the carbon chemistry of coral reefs (e.g. community metabolism, calcification rates) may need to consider SGD-derived CO_2.

Richness and abundance enhanced in anthropogenically modified systems despite high concentrations of toxic contaminants

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Distinguishing the effects of anthropogenic stressors from other drivers requires multiple lines of evidence and experimental studies to interpret ecological patterns. We measured the composition, richness and abundance of sediment infauna in relation to anthropogenic and natural stressors within seven estuaries. We observed increases in the richness and abundance of polychaete worms in contaminated estuaries and evidence that organic enrichment may be driving these patterns. We also deployed field-collected sediments from the surveyed estuaries at a single site in a clean estuary, but observed no effects of sediment characteristics (toxic or enriching) in the small-scale experiment. Furthermore, invertebrate recruitment instead reflected the low diversity and abundance observed during field surveys of this estuary. This has implications for the interpretation of regional monitoring studies in which the spatial scale of the impact is an important factor in explaining the observed patterns and similar impacts may not occur in smaller-scale manipulations.

Productive capacities of tropical seagrasses communities at three locations along the East Coast of Queensland and their potential for carbon sequestration

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Intertidal and subtidal meadows feed into oceanic nutrient cycles and significantly contribute to carbon sequestration, though this can vary markedly between locations and species. Measuring productivity rates of seagrass meadows provides a tool to assess their prospective input to marine primary productivity and how this may be influenced by future environmental and habitat change. Seagrass abundance, growth rates, reproductive capacity and community structure were investigated in different seagrass community types at three different locations along the east coast of Queensland to estimate above and below-ground productivity and carbon assimilation. Results indicated that net primary productivity (g C m^{-2} day^{-1}) in the Torres Strait was moderately higher than that of tropical coastal seagrasses studied in Gladstone Harbour and substantially higher than the most southern location studied at Abbot Point. Variation in rates of leaf growth (g DW $shoot^{-1}$ day^{-1}) and rhizome extension (mm $shoot^{-1}$ day^{-1}) were strongly seasonal and may indicate a trade-off in resource allocation. For leaf replacing species in the Torres Strait, production at the rhizome meristem (growing tip) was generally much higher than for production in the leaf shoot, adding significantly to the total production and carbon assimilated by seagrasses. The results of these studies will be synthesised to provide a broad-scale depiction of the productive capacity of three different seagrass community types and the potential of each for carbon sequestration.