Benthic Cover in Coral Reef Environments under Influence of Submarine Groundwater Discharges

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Abstract : Changes in benthic cover of coral dominated systems to macroalgae dominance are widely studied worldwide. Watershed pollutants are potentially as important as overfishing causing phase shift. In certain regions of the world most of the continental inputs are through submarine groundwater discharges (SGD), which can play a significant ecological role because the concentration of its nutrients is usually greater that the one found in surface seawater. These stressors have adversely affected coral reefs, particularly in the Caribbean. Measurements of benthic cover (with video tracing, through a Go Pro camera), reef roughness (acoustic estimates with an Acoustic Doppler Current Velocity profiler and a differential GPS), thermohaline conditions (conductivity-temperature-depth (CTD) instrument) and nutrient measurements were taken in different sites in the reef lagoon of Puerto Morelos, Q. Roo, Mexico including those with influence of SGD and without it. The results suggest a link between SGD, macroalgae cover and structural complexity. Punctual water samples and data series from a CTD Diver confirm the presence of the SGD. On the site where the SGD is, the macroalgae cover is larger than in the other sites. To establish a causal link between this phase shift and SGD, the DELFT 3D hydrodynamic model (FLOW and WAVE modules) was performed under different environmental conditions and discharge magnitudes. The model was validated using measurements of oceanographic instruments anchored in the lagoon and forereef. The SGD is consistently favoring macroalgae populations and affecting structural complexity of the reef.

Keywords : hydrodynamic model, macroalgae, nutrients, phase shift

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