Effect of pH variability and flow on the response of corals and coralline algae to ocean acidification

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Natural variability in pH, from microscales to reef scales, could potentially modulate the response of reef organisms to ocean acidification. However, little is known on the effects of environmental variability on the physiology of corals and coralline algae exposed to present and future pH conditions. We designed two separate laboratory experiments to investigate the role of pH variability at two spatial scales. The first experiment was performed on the coral *Goniopora* sp. and the coralline alga *Hydrolithon reinboldii* collected from one site with near constant pH and one site with large daily pH (1.4 units per day) and O_2 fluctuations in the Kimberley, Western Australia. The response of their physiological rates was investigated under 4 experimental treatments approximating the pH and O_2 conditions at the 2 sites (constant vs. fluctuating) today and under an ocean acidification scenario. There was no effect of pH treatment on calcification of *H. reinboldii* from the constant environment, or for *Goniopora* from either habitat. But for *H. reinboldii* from the fluctuating environment calcification rates were highest under the ambient fluctuating treatment, equal in both constant treatments, and lowest in the ocean acidification fluctuating treatment. The second experiment was designed to investigate the combined effect of water velocity and light, because they can drive biological (photosynthesis vs. respiration) and physical (thickness) modifications of the diffusive boundary layer. Corals and coralline algae from Rottnest Island, Western Australia, were incubated under two flow velocities, two pH, and two light intensities in a custom-made 12 flumes experimental system. The effects on calcification, photosynthesis, respiration, and chemistry in the diffusive boundary layer were investigated. Results from these two studies will provide important information regarding the role played by pH variability in the bulk seawater and in the diffusive boundary layer on the response of reef organisms to ocean acidification.