Quantitative Decomposition of the Biogeochemical "Heartbeat" of a French Polynesian Atoll

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The ability to resolve the biogeochemical impacts of ocean acidification from the complex and dynamic chemical environment of a coral reef is essential in identifying the early signs of reef dissolution and managing the impacts of ocean acidification in reef ecosystems. In an effort to capture the fine temporal changes in reef chemistry that result from increasing ocean acidification, we built a reef observation network on Tetiaroa Atoll, a pristine reef ecosystem in French Polynesia. Temporal variability in the dissolved oxygen concentrations and carbonate system chemistry in the waters bathing coral reefs has long been used to reveal the biogeochemical "heartbeat" of these ecosystems over a variety of timescales. However, the extent to which *spatial* variability (in bathymetry, residence time of waters, etc.) in coral reef ecosystems affects the biogeochemical "heartbeat" needs to be evaluated for proper interpretation of this signal. Furthermore, complementary measurements of reef oxygen and carbonate system components are typically used to independently constrain ecosystem productivity and calcification, respectively. Rarely are both sets of measurements used to test for a Redfield-like closing of the seawater oxygen/carbon budget on reefs.

Using data from a three-year old campaign of autonomous and discrete sampling stations across a range of reef environments, including different flow conditions and different benthic communities, we quantitatively separate physical and biological factors influencing the biogeochemical "heartbeat" of the reef. We also report on the state of net calcification/production; the comparison between measured $\Delta O_2/\Delta$Dissolved Inorganic Carbon (DIC) ratios and Redfield Ratios; and applicability of 1D Langrangian vs Eulerian models of biogeochemical cycling for atoll systems. Using the data analysis and modelling framework developed at Tetiaroa, we hope to improve our ability to detect shifts in reef biogeochemistry for atolls across the planet.