Corals at the breaking point

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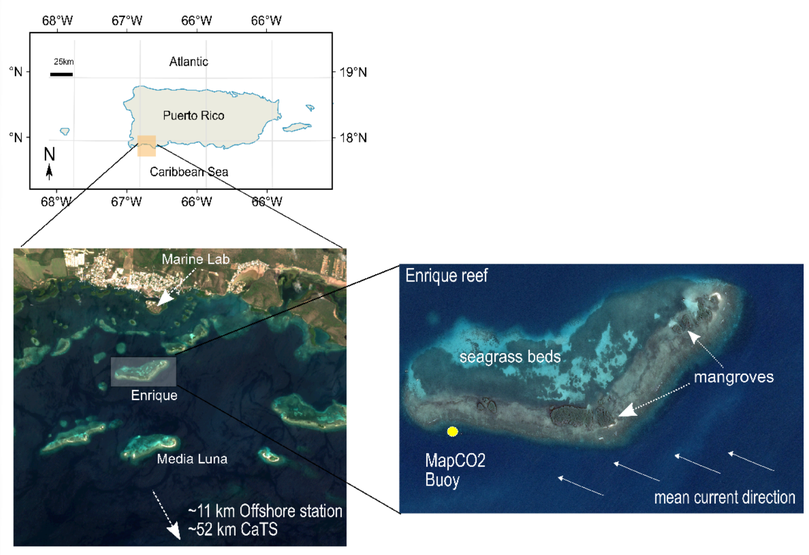
NOAA OCEAN ACIDIFICATION PROGRAM

1. Introduction

- The reef carbonate materials are dissolving faster than expected.
- La Parguera reef sediments & the marine cements (glue) are currently experiencing dissolution during the winter months.
- This make the reef easier to break during storms & high waves events.
- As a consequence, their effectiveness as a first line of coastal protection is diminishing.
- These effects may trigger multi-million-dollar spending in artificial shoreline protection & may result in the loss of tourism.

2. La Parguera Buoy



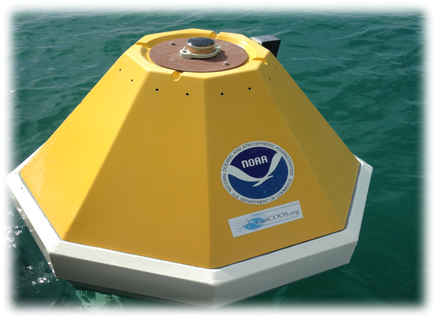


Fig.1: The MapCO_2 buoy at Enrique forereef off La Parguera town in Lajas, Puerto Rico

The buoy provides:

- Seawater temperature, salinity, CO_2, & pH. It also measures the air CO_2.

3. Modeling approach

The model is assumed to provide an integrated assessment of net changes in observed buoy $CO_{2,sw}$ (pCO_{2OBS}) throughout the water column directly above Enrique forereef. The individual processes controlling the variability of seawater CO_2, are explained in the box model diagram below.

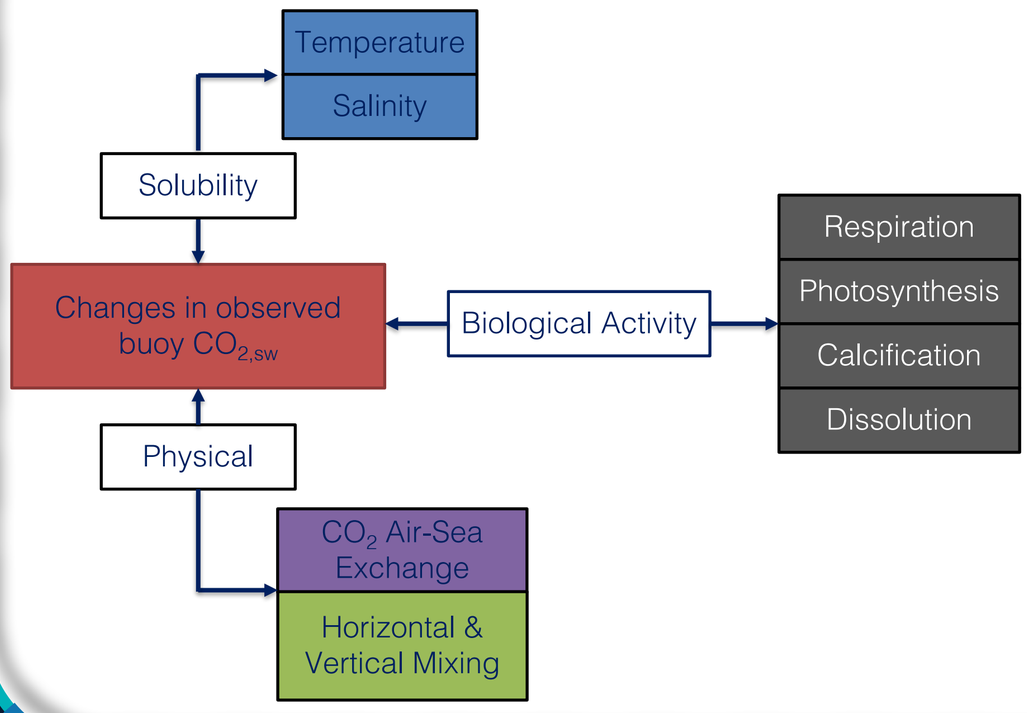


Fig. 2: Cumulative seasonal change in observed buoy $pCO_{2,sw}$ (red) are based on contributions from solubility (blue), physical (green & purple), & biological processes (black).

4. When is it dissolving?

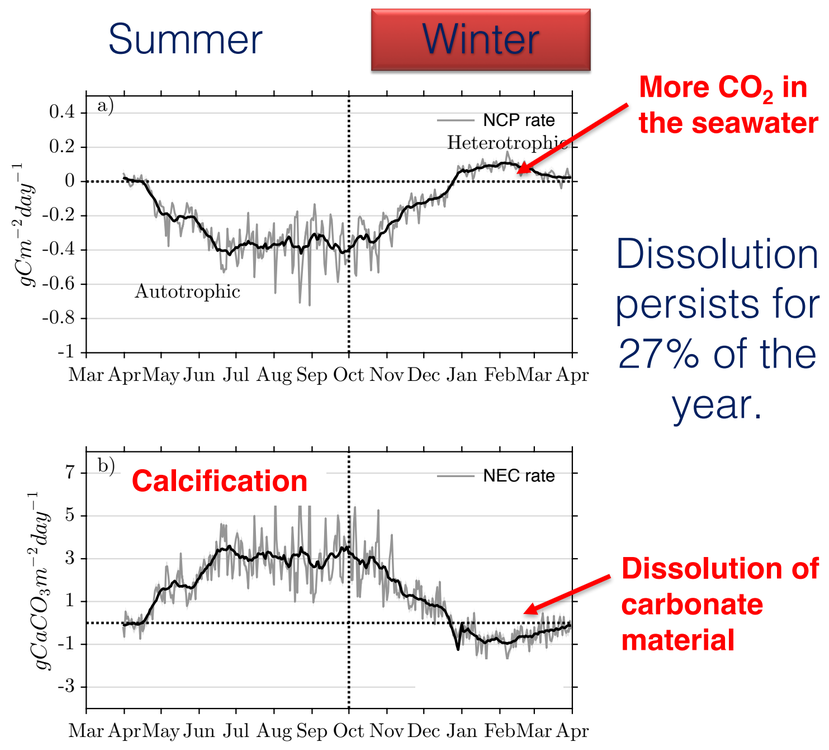


Fig. 3: Seasonal variability of **a)** net ecosystem production (g C m^{-2} day^{-1}) & **b)** net ecosystem calcification rates (g $CaCO_3$ m^{-2} day^{-1}).

Heterotrophic (high CO_2) & dissolution conditions dominated from January to mid-April (winter).

5. Future projections

More erosive as $CO_{2,sw}$ increase.

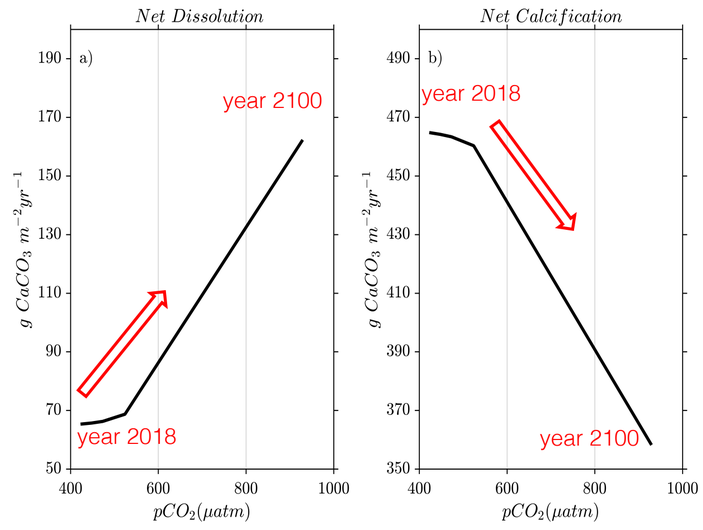


Fig. 4: **a)** Net dissolution & **b)** net calcification rates projections as a function of current observed trends at Enrique buoy.

Dissolution may outpace calcification at Enrique reef when $CO_{2,sw}$ levels > 900 µatm.

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6. Where it could be worse?

The Bioluminescent Bay, the inshore channels & the reef adjacent to these areas

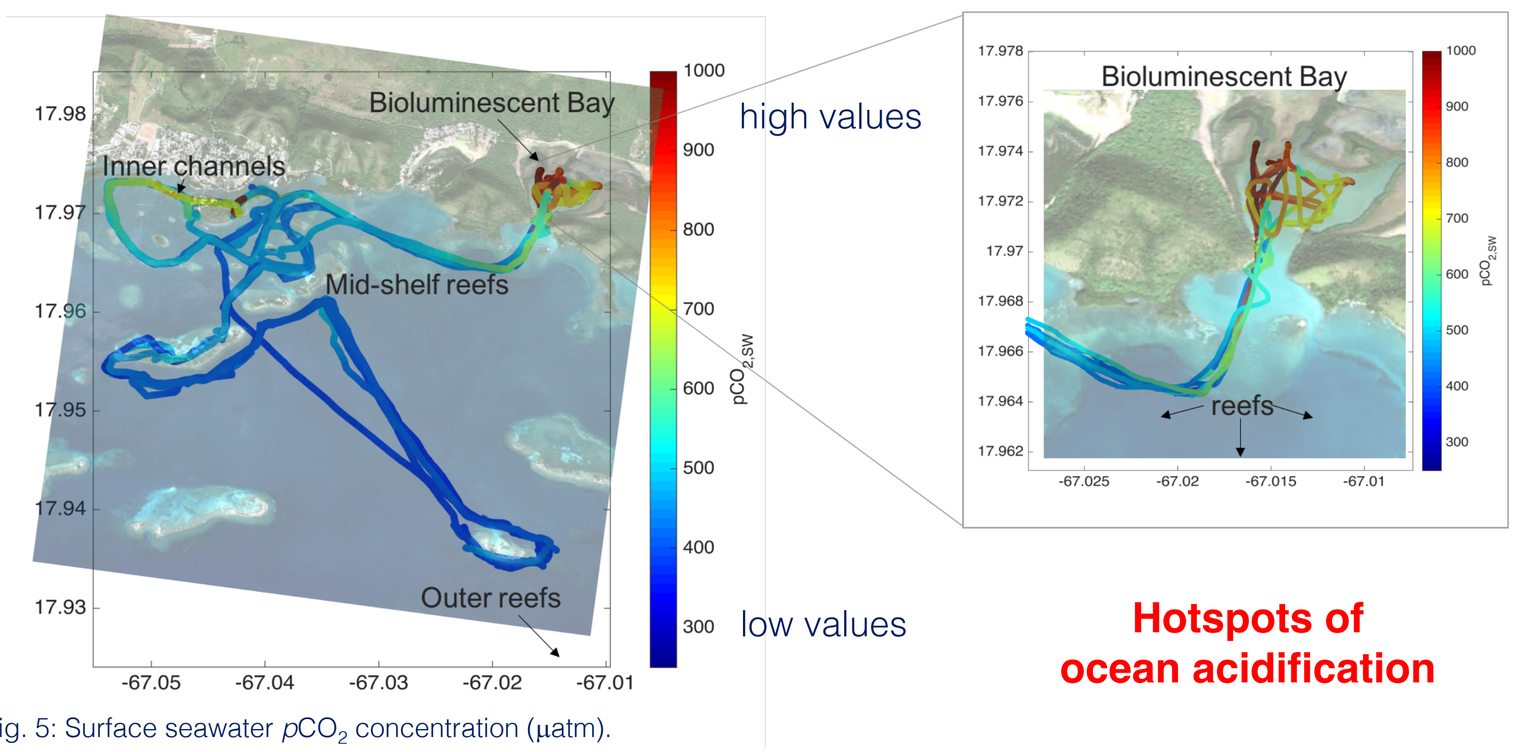

Fig. 5: Surface seawater pCO_2 concentration (µatm).

- The seawater CO_2 values were >1000 µatm, suggesting that near-shore areas presently exceed the calcification tipping point for Enrique reef (Fig.4).
- These natural environments exhibit CO_2 conditions projected for the near future.

7. Management strategies

Our results demonstrated that current capabilities of La Parguera CO_2 buoy could be used to:

1. Detect when conditions are favourable for coral transplantation or farming.
2. Identify periods of high respiration rates (high CO_2) for management of sediment transport & herbivore protection.
3. Identify periods of vulnerability (dissolution) to regulate tourism visitations.

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