NOAA Coral Reef Watch
Reef Metabolic Index

Coral reef ecosystems are under threat from a wide range of physical, biological, and chemical stressors, stemming from both human-induced and natural disturbances. Over the past few decades these sensitive ecosystems have been subjected to mounting stresses, largely driven by coastal settlement development, that include a worldwide increase in coral disease, settlement runoff, pollution and overfishing. These local and immediate threats to coral ecosystems occur against a background of what may prove to be the more consequential impacts related to a changing climate. Projected increases in global sea surface temperatures (SSTs) are expected to increase the incidences of mass coral bleaching events, such as those observed throughout the Greater Caribbean in 2005, Australia in 2002, and globally in 1998. These bleaching events can further contribute to outbreaks of coral diseases and mortality, compounding the local impacts. In addition, recent estimates indicate roughly half of the anthropogenic CO_2 released since the industrial revolution has been absorbed by the surface waters of the world's oceans, resulting in probably the most dramatic decrease in ocean pH for the past 400,000 years. Mounting evidence indicates that this process of ocean acidification could reduce coral calcification rates by more than 30% over the next century, resulting in weaker skeletons, reduced extension rates, increased erosion and diminished capacity to maintain against rising sealevel.

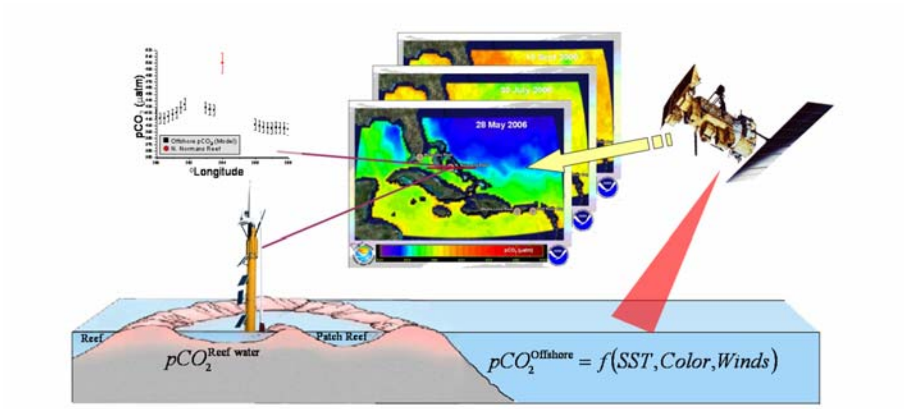

Figure 1. Concept of the Reef Metabolic Index (RMI). Offshore pCO_2 modeled from satellite-derived sea surface temperature, ocean color and winds is compared to reef water pCO_2 measured *in situ* at selected coral reef communities where oceanographic data collected at deployed stations can be transmitted daily via GOES satellite to NOAA/NESDIS.

NOAA Coral Reef Watch (CRW) is developing a network of carbon-based coral reef observing systems that will serve as a new tool to identify early indicators of changes in coral ecosystems. As a consequence of either chronic (e.g., climate change) or acute (e.g., bleaching) disturbances, reefs can undergo a "coral-algal phase shift" whereby coral cover is reduced in favor of fleshy macroalgae (seaweed). These two types of ecosystems affect the surrounding CO_2 system differently. The NOAA CRW Reef Metabolic Index (RMI) will track changes in the system-level metabolic performance by measuring how the seawater CO_2 system in proximity to a reef differs from its offshore state. *In situ* autonomous pCO_2 measurements from sensors deployed at Coral Reef Early Warning System (CREWS) monitoring stations are compared against regionally specific, offshore sea surface pCO_2 fields modeled from remotely sensed data: sea surface temperature, QuikSCAT wind vectors and ocean color (Figure 1). A 'proof of concept' study was conducted between May and September, 2005, at North Normans Reef, Bahamas. Elevated RMI values (Figure 2) coincided with the onset of thermal stress that preceded the Caribbean 2005 bleaching event. While this data is yet preliminary, it is consistent with previous studies that have demonstrated a CO_2 increase in the waters overlying bleaching reefs and may be related to increased respiration rates. Efforts have begun to establish a long-term RMI station at La Parguera, Puerto Rico, which will serve as the first in a series of networked observatories throughout the Greater Caribbean.

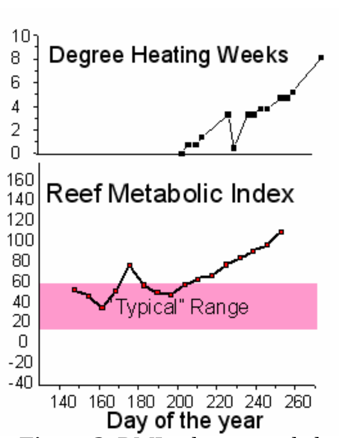

Figure 2. RMI values recorded at N. Normans Reef, Bahamas from May to September, 2005

For more information, please contact Dwight Gledhill, dwight.gledhill@noaa.gov.
http://coralreefwatch.noaa.gov/caribbean2005