



July 2013

What Is Ocean Acidification?

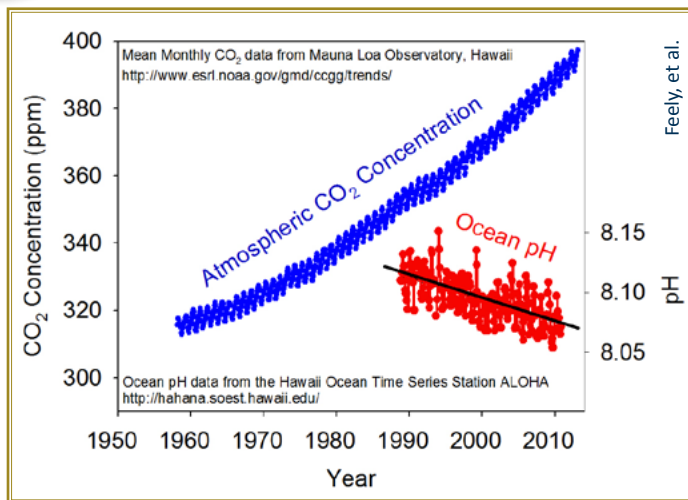
Ocean acidification refers to an increase in the acidity of Earth's oceans, as measured by pH. This change in acidity drives a number of other changes in ocean chemistry, such as reduced availability of shell-forming minerals (carbonate ions), with potential effects on marine ecosystems.

What Causes Ocean Acidification?

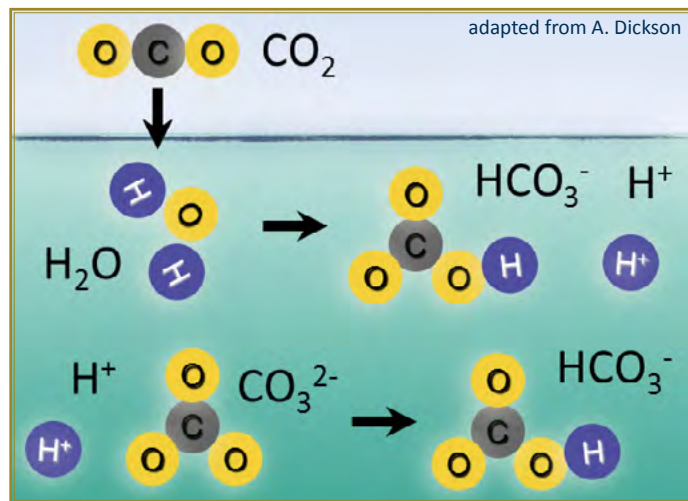
Human activities have increased the concentration of carbon dioxide (CO₂) in the earth's atmosphere. When CO₂ dissolves in seawater, it produces more hydrogen ions (lowering pH) and fewer carbonate ions (CO₃²⁻). The US West Coast is particularly susceptible to ocean acidification because local circulation patterns and prevailing winds cause deep, colder waters with greater acidity to periodically upwell into shallow waters.

While ocean acidification is primarily driven by atmospheric CO₂ inputs, scientists are exploring whether local influences, such as nutrient inputs from land activities, contribute to the problem. Excess nutrient inputs can fuel algal blooms, which create more dissolved CO₂ when the algae die. Discerning the relative importance of these and other local factors will require additional research.

CO₂ dissolution in water produces hydrogen ions (H⁺). In addition to increasing acidity, excess hydrogen ions react with free carbonate ions (CO₃²⁻) forming more bicarbonate (HCO₃⁻).



Long-term observational data from Hawaii show increasing atmospheric carbon dioxide (CO₂) concentrations and increasing ocean acidity (declining ocean pH).



What Are the Effects?

Shell-forming organisms require carbonate ions (CO₃²⁻) to build their exoskeletons, and ocean acidification reduces the availability of these ions in ocean waters. The shellfish industry was one of the earliest to suffer ocean acidification effects; fewer mature oysters are produced because the larvae have difficulty forming shells and surviving to adulthood.

Changes in ocean carbon chemistry have the potential to affect many other physiological and ecosystem processes beyond shell formation. Organisms at risk from a high-CO₂ environment include some corals that build critical reef habitats and certain types of plankton that form the base of the marine food web.

SCCWRP plays an important regional role in improving monitoring capacity for the US West Coast and evaluating the role of different acidification causal factors.

Monitoring Network

SCCWRP participates in the California Current Acidification Network (C-CAN), an interdisciplinary collaboration dedicated to advancing the understanding of ocean acidification and its effects on biological resources along the US West Coast. C-CAN is currently working to standardize ocean acidification monitoring and data management practices to ensure data comparability and quick public access.

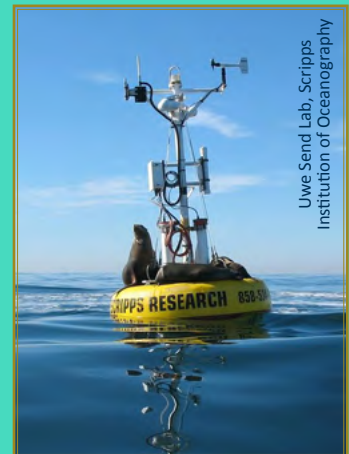


A 2010 ocean acidification workshop at SCCWRP led to the formation of C-CAN.

Monitoring Technology

As a pilot effort during the 2013 Southern California Bight Regional Monitoring Program (Bight '13), SCCWRP will apply C-CAN protocols to improve ocean acidification monitoring. More advanced monitoring capacity will allow compilation of data sets that describe trends in both physiochemical ocean patterns and biological outcomes.

Bight '13 will use this type of mooring for ocean acidification monitoring.



Investigating Causal Factors

SCCWRP is gathering data to help scientists determine the relative contribution of local and global factors to acidification. Critical to causal model development, these data characterize rates of algal nutrient uptake, algal decay, and nutrient cycling. SCCWRP is also coordinating a workshop to facilitate the coupling of physical and biogeochemical ocean models.



SCCWRP staff members process water samples to study how nutrient-rich wastewater affects ocean ecosystems.

Management Applications

While ocean acidification is a global phenomenon, SCCWRP's research and monitoring activities will help determine if local actions can be taken to mitigate effects in the Southern California coastal region. In addition, the California Ocean Protection Council recently formed an expert panel that includes two SCCWRP scientists. The panel will review the available science and provide technical guidance for statewide policy development.