Researchers investigate increased ocean acidification

August 3 2015, by Christopher Packham

Credit: Tiago Fioreze / Wikipedia

The primary cause of global ocean acidification is the oceanic absorption of CO_2 from the atmosphere. Although this absorption helps to mitigate some of the effects of anthropogenic climate change, it has resulted in a reduction of oceanic pH levels, with its own set of environmental consequences. Coral bleaching, algae loss, and decreasing oceanic oxygen levels are all attributable to the reduced pH of the oceans.

Additionally, acidification poses a threat to human industry with projected declines in commercial fisheries, the breakdown of food webs, and a decline in tourism as ocean ecosystems and the natural environment suffer degradation. The current pace of acidification is greater and faster than at any time in the last 300 million years, and bears close scrutiny.

Because of the lack of data about basin-wide pH changes at varying depths, an international group of investigators conducted a study of decadal acidification in Atlantic Ocean water masses, and compared the results to existing climate models. They've published their conclusions in the *Proceedings of the National Academy of Sciences*.

Earth climate models project that in the last decade alone, ocean acidity has exceeded cyclic changes in historical analogs. The current study tracked pH levels across two decades and data collected from three cruises in 1993, 1994, and 2013. The observations correspond closely with the model predictions of pH changes in the near surface and upper waters. "For the first time, to our knowledge," the authors write, "our observations confirm the major role of mode and intermediate waters at the basin scale in the acidification of the ocean interior, which was also evidenced in the climate models."

The highest pH waters were found in South Atlantic Central Water and upper North Atlantic Central Water. The lowest pH (highest acidity) was found in the Antarctic Intermediate Water layer of the equatorial region. The researchers note that, although some degree of pH reduction is attributable to natural causes, all of the observed changes in surface water pH had anthropogenic origin, a finding that corresponds closely with climate modeling.

In mode waters and intermediate waters, natural components and anthropogenic inputs are of the same order of magnitude, "indicating that changes in ocean circulation and biological activity contributed significantly to pH variability in the subsurface waters of the Atlantic Ocean over this time period," the authors write.

Mode waters, vertically homogenous water masses caused by deep vertical winter convection, have a lower buffering capacity than surface waters because they have a lower temperature, and because their alkalinity-to-carbon ratios are lower, making them more sensitive to increases in oceanic carbon. Additionally, mode waters have greater exposure to the atmosphere than deeper water, enabling higher uptake of CO_2 and consequently higher levels of acidity.

The authors conclude, "Based on projections of future increases in atmospheric CO_2 and the associated penetration of (anthropogenic change) into intermediate and deep waters, the contribution of anthropogenic forcing to the acidification of subsurface waters will increase with time and eventually will exceed natural variability and trends."

More information: "Decadal acidification in the water masses of the Atlantic Ocean." PNAS 2015 ; published ahead of print July 27, 2015, DOI: 10.1073/pnas.1504613112