Modest CO2 cutbacks may be too little, too late for coral reefs

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How much carbon dioxide is too much? According to United Nations Framework Convention on Climate Change (UNFCCC) greenhouse gases in the atmosphere need to be stabilized at levels low enough to "prevent dangerous anthropogenic interference with the climate system." But scientists have come to realize that an even more acute danger than climate change is lurking in the world's oceans—one that is likely to be triggered by CO2 levels that are modest by climate standards.

Ocean acidification could devastate coral reefs and other marine ecosystems even if atmospheric carbon dioxide stabilizes at 450 ppm, a level well below that of many climate change forecasts, report chemical oceanographers Long Cao and Ken Caldeira of the Carnegie Institution's Department of Global Ecology in the journal *Geophysical Research Letters*.

The researchers' conclusions are based on computer simulations of ocean chemistry stabilized at atmospheric CO2 levels ranging from 280 parts per million (pre-industrial levels) to 2000 ppm. Present levels are 380 ppm and rapidly rising due to accelerating emissions from human activities, primarily the burning of fossil fuels.

This study was initiated as a result of Caldeira's testimony before a Congressional subcommittee on Fisheries, Wildlife and Oceans in April of 2007. At that time he was asked what stabilization level would be needed to preserve the marine environment, but had to answer that no such study had yet addressed that question. Cao and Caldeira's study

helps fill the gap.

Atmospheric CO_2 absorbed by the oceans' surface water produces carbonic acid, the same acid that gives soft drinks their fizz, making certain carbonate minerals dissolve more readily in seawater. This is especially true for aragonite, the mineral used by corals and many other marine organisms to grow their skeletons. For corals to be able to build reefs, which requires rapid growth and strong skeletons, the surrounding water needs to be highly supersaturated with aragonite.

"Before the industrial revolution, over 98% of warm water coral reefs were surrounded by open ocean waters at least 3.5 times supersaturated with aragonite" says Cao. "But even if atmospheric CO_2 stabilizes at the current level of 380 ppm, fewer than half of existing coral reef will remain in such an environment. If the levels stabilize at 450 ppm, fewer than 10% of reefs would be in waters with the kind of chemistry that has sustained coral reefs in the past."

For the ecologically productive cold waters near the poles, the prospects are equally grim, says Cao. "At atmospheric CO_2 levels as low as 450 ppm, large parts of the Southern Ocean, the Arctic Ocean, and the North Pacific would experience a rise in acidity that would violate US Environmental Protection Agency water quality standards." Under those conditions the shells of many marine organisms would dissolve, including those at the base of the food chain.

"If current trends in CO_2 emissions continue unabated," says Caldeira, "in the next few decades, we will produce chemical conditions in the oceans that have not been seen for tens of millions of years. We are doing something very profound to our oceans. Ecosystems like coral reefs that have been around for many millions of years just won't be able to cope with the change."

Source: Carnegie Institution