

Ocean acidification: the little-known impact of CO₂ emissions

By Michael Amdi Madsen



(Photo: M. Madsen/IAEA)

“Recognizing that billions of people are dependent on a healthy ocean for their well-being and economic development is the first step.”

— Alexandre Magnan, *Institute for Sustainable Development and International Relations*

Ocean acidification, like global warming, is a serious consequence of rising carbon dioxide (CO₂) emissions and a growing threat to coastal communities. Scientists and economists alike are calling for ocean acidification mitigation and adaptation plans to be included in any future international climate change agreement, arguing that doing so would make any such agreement stronger and facilitate its implementation. The IAEA uses nuclear techniques to measure ocean acidification and has been providing objective information to scientists, economists, and policymakers to make informed decisions.

“Recognizing that billions of people are dependent on a healthy ocean for their well-being and economic development is the first step,” said Alexandre Magnan of the Institute for Sustainable Development and International Relations in Paris at an IAEA workshop this year. Acknowledging in the legal text of a climate deal the threats facing the oceans could open the door for coastal communities affected by ocean acidification to benefit from financing available under a climate change agreement, he said. This would enable them to adapt to changing social and economic circumstances, improve understanding of the ecological and biophysical changes expected, and pressure

further concrete actions by governments, he added.

There has been a 26 per cent¹ increase in ocean acidity since pre-industrial levels as a result of the release of CO₂ into the atmosphere, and the current rate of ocean acidification is over ten times faster than that of any other period in the last 55 million years², data show.

The annual Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP), held in Lima, Peru, in December 2014, made significant progress towards a new multilateral agreement, but the challenges facing the oceans and coastal communities dependent on marine ecosystem services remained essentially absent, experts have said.

¹INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, “Social, economic and ethical concepts and methods” and “Drivers, trends and mitigation”, *Climate Change 2014: Mitigation of Climate Change, IPCC, Cambridge University Press, New York (2014) Ch. 3 and Ch. 5*

²HÖNISCH, B., et al., *The geological record of ocean acidification, Science 335 (2012) 1058, 1063.*

A system in decline

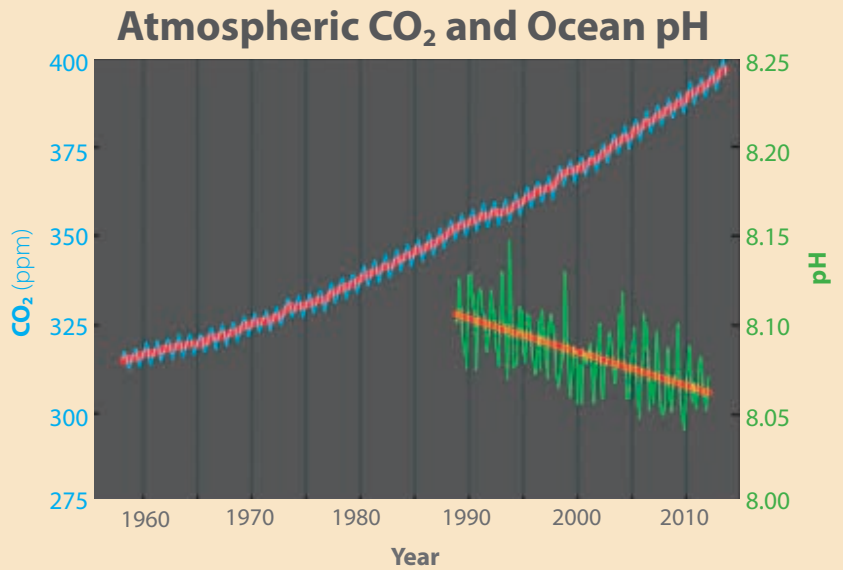
Some effects of ocean acidification and global warming are already apparent, said Ove Hoegh-Guldberg of Queensland University's Global Change Institute. Australia's Great Barrier Reef, which provides a protective barrier during storms, is a tourist attraction, and acts as a nursery for fish, has declined in size by as much as 50 per cent in the last 30 years, Hoegh-Guldberg explained, adding that it is not yet clear how much reef can be lost without wider consequences.

Hoegh-Guldberg and his colleagues are developing models to show how ocean acidification and reef loss will have an impact on the wider ecosystem and people, in order to guide policymakers towards a decision.

For many, the next frontier in ocean acidification research is to study its effects on ecosystems. Examining individual species in isolation does not provide enough information to establish the amount of CO₂ oceans can absorb without major harm to their flora and fauna, said Sam Dupont, a researcher at the University of Gothenburg's Department of Biological and Environmental Sciences. "We need to look at entire mechanisms, not just species."

The role of nuclear science

Nuclear science has a role to play in understanding the effects that climate change and ocean acidification have on the oceans. The IAEA's Ocean Acidification International Coordination Centre, based in Monaco, uses nuclear techniques to understand processes and changes in the marine environment. The use of radioisotopes, such as calcium-45 and carbon-14, provides important



Observations of CO₂ (parts per million) in the atmosphere and pH of surface seawater from Mauna Loa and Hawaii Ocean Time-series (HOT) Station, Aloha, Hawaii, North Pacific.

Source: Adapted from Richard Freely (NOAA), Pieter Tans, NOAA/ESRL (www.esrl.noaa.gov/gmd/ccgg/trends) and Ralph Keeling, Scripps Institution of Oceanography (scrippsco2.ucsd.edu)

information on the rate and impact of ocean acidification. The Centre implements international activities and facilitates global communication in order to make the most effective use of science.

"Nuclear techniques are used by many research centres around the world to provide very specific data, underpinning the scientific community's growing understanding of the severity and impacts of ocean acidification," said David Osborn, Director of the IAEA's Environment Laboratories. "This is key to anticipating economic and social impacts."

What is ocean acidification?

Some of the CO₂ released into the atmosphere gets absorbed by the oceans. The CO₂ reacts with water molecules (H₂O) to form carbonic acid. Carbonic acid is a weak acid, but even slight changes in ocean acidity can have dramatic impacts on some organisms and cause knock-on effects throughout the food chain. These knock-on effects can affect humans too, with impacts on the livelihoods and food security of billions of people.

