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RESEARCH SPOTLIGHT

Highlighting exciting new research from AGU journals

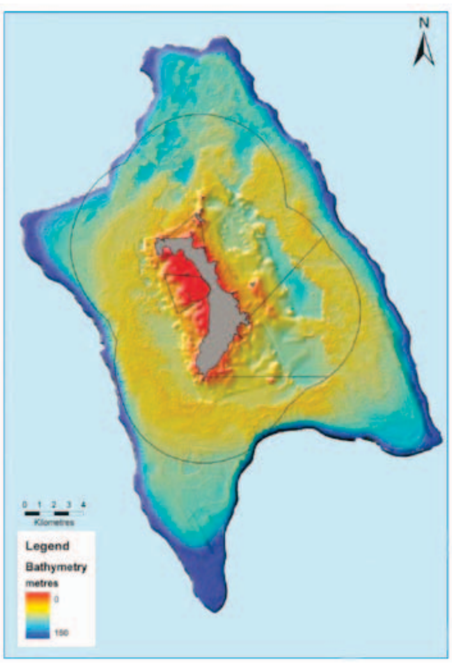
Extensive relict coral reef found in southern Pacific

Coral reefs are sensitive to climate change and have a direct correlation to sea level. New observations show that an extensive coral reef existed in the southern Pacific Ocean thousands of years ago. *Woodroffe et al.* used multibeam sonar, coring, and dating to examine a relict reef discovered in water about 20–25 meters deep around Lord Howe Island in the southern Pacific Ocean.

They found that the reef thrived from about 9000 to 7000 years ago and covered an area 20 times larger than the modern reef, which is the southernmost Pacific coral reef. About 7000 years ago, the reef was drowned, probably due to abrupt sea level rise, and then shrunk to its modern size.

The observations show the extent to which reefs grew 9000 years ago. Today coral reefs exist mainly in shallow seawater with sea surface temperatures greater than 18°C, at latitudes near the equator. The relict reef shows that corals previously existed at southern latitudes farther from the equator.

The researchers note that as ocean temperatures warm due to climate change, the relict reef could become a substrate for new coral reef growth. (*Geophysical Research Letters*, doi:10.1029/2010GL044067, 2010)



Lord Howe Island in gray, the modern reef in red, and the fossil (7000- to 9000-year-old) reef in orange/yellow. The black lines demarcate the boundary of the marine park.

How does emissions mitigation policy affect ocean acidification?

The anthropogenic release of carbon dioxide (CO_2) has increased significantly in recent years. Some of this CO_2 is absorbed by the ocean, increasing its acidity (lowering its pH). Studies have shown that since 1750 the absorption of CO_2 has caused a decrease of 0.1 in the ocean's pH level. The biological impact of this increasing acidity is uncertain, but scientists believe that increasing acidity could adversely affect marine organisms and degrade ocean habitats.

To investigate the effects of climate mitigation policy on ocean acidification, *Bernie et al.* ran simulations to find out how the timing and rate of CO_2 emissions reduction could affect future pH levels.

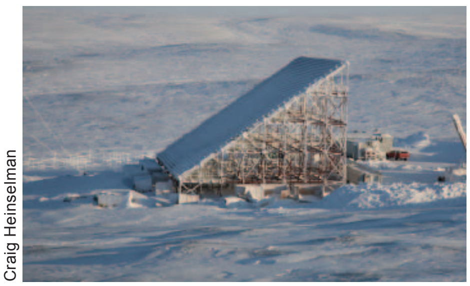
According to the study, the global mean ocean surface pH in 2100 will be strongly influenced by the year in which emissions peak and by postpeak reduction rates. For instance, the researchers found that a large reduction starting soon, with emissions peaking in 2016 and decreasing by 5% per year thereafter, would limit the minimum pH to 8.02 by 2100, down from today's level of about 8.07. Without any mitigation, pH is projected to fall to between 7.67 and 7.81 by 2100. The study showed that over the next 500 years, minimum pH will be mainly dependent on the long-term level of CO_2 emissions. (*Geophysical Research Letters*, doi:10.1029/2010GL043181, 2010)

Landmass geometry constrains Arctic sea ice extent

Arctic sea ice has retreated significantly in recent years, reaching a record low in September 2007. It is known that the seasonal cycle in Arctic sea ice extent is not symmetric—seasonal ice retreat proceeds gradually during early summer and then accelerates toward end of summer; in winter, ice growth is rapid at first and then slows later in the season. Scientists have observed that ice cover has retreated far more rapidly in September than during other times of the year.

Some scientists have suggested that this seasonal asymmetry is due to factors such as temperature change. However, *Eisenman* has found that the seasonal differences in rate of ice growth or retreat are caused by the geometry of the landmasses surrounding the Arctic Ocean. Because the Arctic Ocean is surrounded mostly by land, coastlines block the southward extent of sea ice growth during the winter, but coastlines have little effect on the extent of ice during the summer.

The author suggests that to better interpret changes in Arctic sea ice, instead of considering sea ice areal extent, scientists should track the line marking the latitude of the Arctic sea ice edge, averaged zonally over locations where the edge is free to move. He found that this line moves northward or southward at a steady pace over the course of the year, with no seasonal asymmetry. In recent years, this line has been migrating northward at a rate of about 8 kilometers per year, consistent with overall ice loss. The study explains some aspects of the seasonal Arctic sea ice cycle and could help scientists better interpret sea ice evolution in the future. (*Geophysical Research Letters*, doi:10.1029/2010GL043741, 2010)



Craig Heinselman

The Resolute incoherent scatter radar, located in Canada, used to measure the ionosphere.

Interplanetary magnetic field direction affects the ionosphere

Electron density variations in the ionosphere are important for understanding space weather because they affect the Global Positioning System and radio communications. *Bahcivan et al.* used some of the first measurements from the U.S. National Science Foundation's Resolute incoherent scatter radar in Resolute Bay, Canada (near the geomagnetic pole), to investigate the highly structured polar cap ionosphere.

They compared the ionospheric measurements with measurements of the interplanetary magnetic field (IMF), which is the magnetic field of the Sun that is carried toward Earth by the solar wind. The researchers found that the appearance of patches of enhanced ionospheric electron density corresponded to times when the IMF was oriented southward. They also observed some internal structures within the patches of enhanced electron density. The study contributes to scientists' understanding of how solar wind variations affect the ionosphere and could lead to improved forecasts of ionospheric conditions. (*Geophysical Research Letters*, doi:10.1029/2010GL043632, 2010)

—Leslie Ofori and Ernie Tretkoff, Staff Writers