Cloud brightening to cool seas can protect coral reefs

July 10 2013

The seeding of marine clouds to cool sea surface temperatures could protect threatened coral reefs from being bleached by warming oceans. Research, published in *Atmospheric Science Letters*, proposes that a targeted version of the geo-engineering technique could give coral a fifty year 'breathing space' to recover from acidification and warming.

"Coral bleaching over the last few decades has been caused by rising sea temperatures and ocean acidification," said Dr Alan Gadian, from Leeds University. "Our research focuses on how Marine Cloud Brightening (MCB) could quickly lower sea temperatures in targeted areas."

There is a strong association between warmer-than-normal sea conditions and cases of coral bleaching. Bleaching is most likely to occur when a 1?C temperature rise over a prolonged period, typically a 12-week period.

To brighten clouds unmanned vehicles are used to spray tiny seawater droplets, which rise into the cloud, thereby increasing their reflectivity and duration. In this way, more sunlight is bounced back into space, resulting in a cooling sea surface temperature.

While MCB was originally envisaged to be a global counter measure against warming, in principle the technique could be more targeted. In 2012 Dr. Gadian wrote how the use of MCB in the Atlantic could tame hurricanes.

The new modeling study focuses the impact of seeding marine stratocumulus clouds over the Caribbean, French Polynesia, and the Great Barrier Reef. The study shows how the projected increases in coral bleaching, caused by rising CO^2 levels, were eliminated while sea surface temperature cooled to pre-warming levels.

Mild and severe coral bleaching events were projected over a 20-year period for the three target regions. Without MCB the amount of coral bleaching was seen to be severe; however, simultaneous deployment of MCB eliminated the risk of extra bleaching.

"We estimate that MCB would have an annual cost of $400 million, however political, social and ethical costs make a true figure difficult to estimate, said Gadian. "Whatever the final figure, it will be less expensive than the damage the destruction of coral would wreck on neighboring countries, the local food chain and global biodiversity."

Public and political skepticism of geo-engineering projects remains a hurdle to their development; however, as the least disruptive form of Solar Radiation Management, the authors believe small-scale use of MCB for conservation would be unlikely to generate public opposition.

The authors propose field-testing of MCB on a scale of 100 square metres, which could demonstrate its use, without producing significant climate effects. Aside from cost, the main disadvantage of this technique is that it would not tackle ocean acidification, a direct result of CO^2 emissions.

"Reducing and removing atmospheric CO^2 remains the long term solution to acidification and warming oceans, however, even if this process began tomorrow the coral may be destroyed by the time we see the results," concluded Gadian. "Our results show that targeted use of cloud brightening could offer a short term breathing space, which could

be vital for countries which rely on corals for their livelihoods."

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