

# Marine Cloud Brightening

**POINT OF INTERVENTION**



**OVERVIEW**

Marine Cloud Brightening (MCB) refers to manipulating cloud cover to reflect more sunlight back to space. It is a proposed Solar Radiation Management (SRM) technique. MCB could reduce the temperature of the atmosphere and oceans because they would absorb less of the sun's energy, but it would not reduce levels of greenhouse gases. Proponents of MCB aim to create whiter, more reflective clouds by shooting particulates (salt from seawater droplets or bacteria) into clouds and increasing cloud condensation nuclei (the tiny particles around which clouds form). One proposal involves spraying seawater from land or via many thousands of robotic boats into

marine clouds.<sup>1</sup> However, MCB, like all SRM, will have impacts on weather patterns. Who would decide where to put these possibly drought or flood-causing clouds?

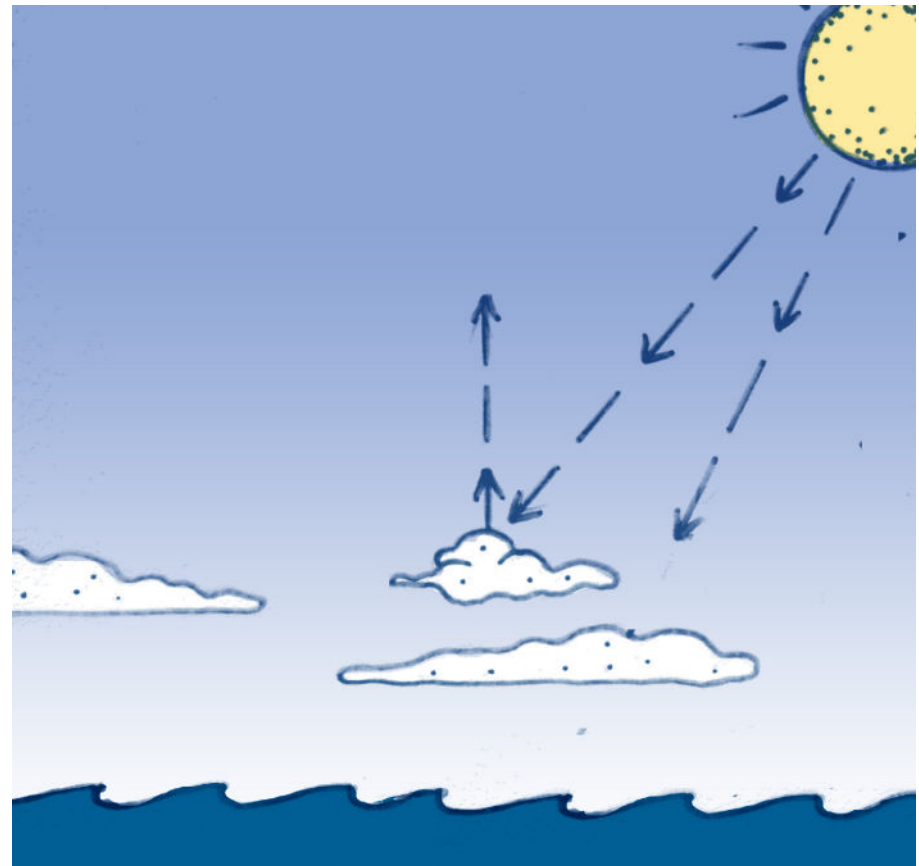
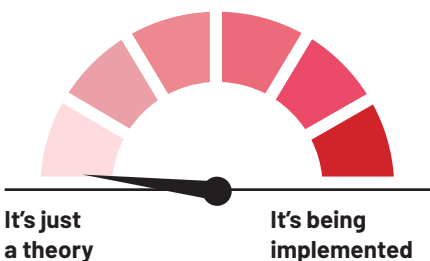
**ACTORS INVOLVED**

The most prominent advocates of MCB are John Latham from the National Center for Atmospheric Research at the University of Colorado and Stephen Salter from the University of Edinburgh. Salter has promoted protecting sea ice by seeding clouds that move from the

Arctic from the Faroe Islands. There is no indication that this experiment is moving forward. Another proponent, Phil Rasch of the Pacific Northwest National Laboratory, has argued that based on "very artificial" models that assume "perfect cloud condensation nuclei," engineers could offset warming substantially, so long as they seeded the clouds above an astonishing quarter to half of the world's oceans.<sup>2</sup>

The first major open-air experiment was to be overseen by the Silver

**REALITY CHECK**





Reflecting sunlight into space on a mass scale could disrupt global weather patterns and create geographic winners and losers, opening the door to weaponization and the use of Cloud Brightening and similar technologies as an implement of geopolitics.

Lining Project in San Francisco. David Keith and Ken Caldeira (prominent geoengineering researchers and proponents) steered some support from the Bill Gates-funded FICER fund<sup>5</sup> to develop the

nozzle for ships that would fire tiny saltwater particles into the clouds, and in 2010 a large-scale experiment involving 10 ships and 10,000 km<sup>2</sup> of ocean was announced. But after media reported on the experiment,

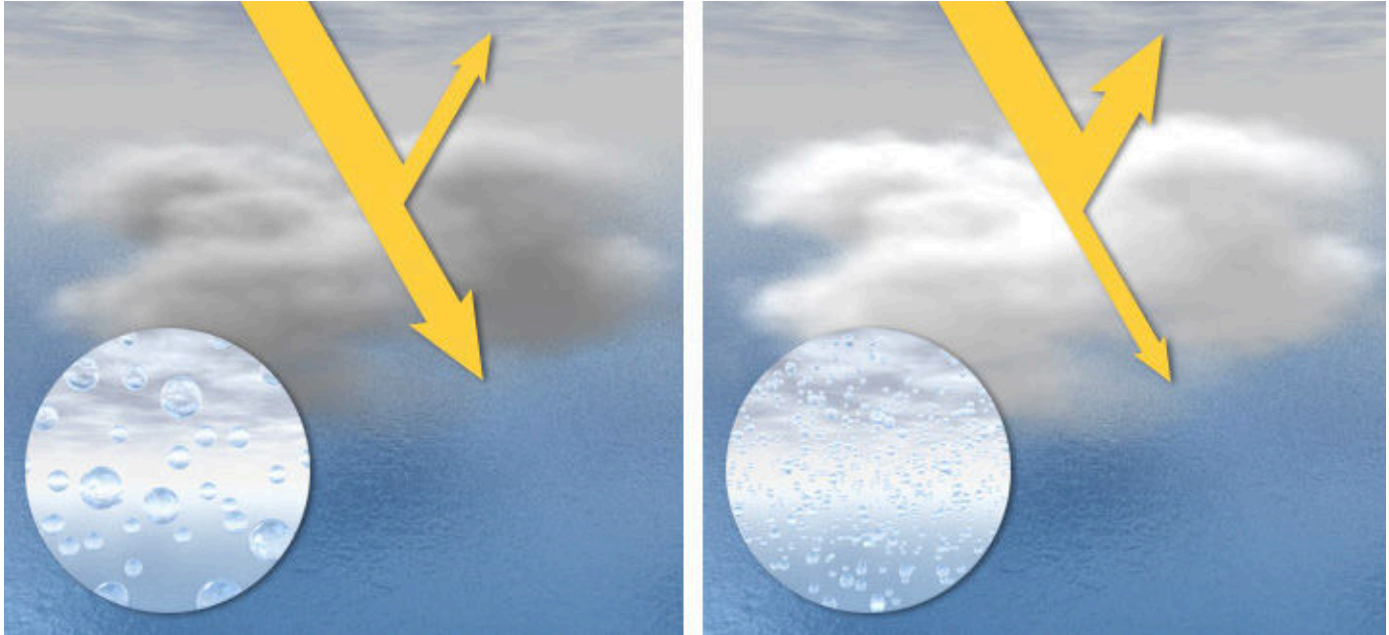
all traces of the project and its scientific collaborators disappeared from the Silver Lining Project's website.<sup>4</sup>

A few years later, the Silver Lining Project resurfaced as the Marine Cloud Brightening Project.<sup>5</sup> With support from the University of Washington, their first land-based field experiment is scheduled in Monterey Bay, California. They will set up nozzles on shore and spray clouds as they roll in, observing if they are whitened, while sensors on land will assess if this has led to a reduction of incoming solar radiation. They have already conducted wind-tunnel testing of a prototype nozzle in California. They then plan to move experimentation to sea, propelling droplets from a small ship.<sup>6</sup> Initially scheduled for the summer of 2017, the experiment has been delayed for lack of funding.

The Ocean Technology Group at the University of Sydney is also proposing Marine Cloud Brightening experiments to save the Great Barrier Reef from bleaching.<sup>7</sup>

**IMPACTS OF THE TECHNOLOGY**

While modelling results predict that MCB would reduce average global temperatures, they also show that it could have considerably varied and potentially detrimental impacts in different parts of the world.<sup>8</sup> For example, global mean precipitation is modelled to decrease along with temperatures – One study shows that



Marine Cloud Brightening attempts to make clouds brighter, with more, smaller droplets. Image: NASA

precipitation could decrease up to 2.3%. South America is predicted to become warmer and dryer with MCB.<sup>9</sup> Substantial rainfall reduction over the Amazon basin is predicted,<sup>10</sup> which would be an ecological

decreases.<sup>11</sup> Although researchers have optimistically suggested that precipitation changes “could be circumvented by not seeding in a particular area,”<sup>12</sup> these studies show the extent to which geoengineering is likely to have major unintended consequences, and how poorly understood those consequences still are.

termination of the geoengineering, e.g. a rapid increase in temperatures, would therefore only worsen as time went on.<sup>13</sup> A recent study has highlighted how sudden SRM termination would significantly increase the threats to biodiversity from climate change, owing to these rapid and unprecedented temperature changes.<sup>14</sup>

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disaster. Another study predicts a massive 7.5% increase in runoff over land, primarily due to increased precipitation in the tropics, even though global mean precipitation

**//** The models also show that once you start cooling the Earth with MCB (and indeed all other SRM approaches), you must do even more of it to keep achieving the same effect. For MCB, this would mean further cloud modification, in terms of increasing both the regions where clouds were modified and the amount by which they were modified. The problems created by a sudden

Researchers have also pointed out the vulnerability of MCB to physical attack, given that spray vessels would be in the open oceans. If many or all the cloud-spraying vessels were prevented from operating, there would be a rapid rise in global temperature, with all the accompanying changes in weather patterns and other adverse consequences.<sup>15</sup> If we can imagine a dystopian future where

geoengineering is widely deployed, then the threat of conflict over its deployment and its impacts does not seem far-fetched.

It has also been suggested that MCB could be deployed alongside other geoengineering techniques (“cocktail geoengineering”), such as Stratospheric Aerosol Injection (SAI) or microbubble ocean whitening (see corresponding [fact sheets](#)<sup>16</sup>) with MCB used to “fine tune” on a more localised level. It could even be used to create localised warming via seeding, to “optimise this fine tuning.”<sup>17</sup>

**REALITY CHECK**

So far, no outdoor experiments have been conducted with this particular technology, although it is conceivable that this will happen in the near future given sufficient funding.

**FURTHER READING**

ETC Group and Heinrich Böll Foundation, “Geoengineering Map.” <https://map.geoengineeringmonitor.org/>

The Big Bad Fix: The Case Against Climate Geoengineering, <http://etcgroup.org/content/big-bad-fix>

**SOURCES**

1. University of Washington, “Could spraying particles into marine clouds help cool the planet?” *Science Daily*, 2017, <https://www.sciencedaily.com/releases/2017/07/170725154206.htm>

2. Philip Rasch et al., “Global Temperature Stabilization via Cloud Albedo Enhancement Geoengineering Options to Respond to Climate Change,” Response to National Academy Call, 2009

3. The Keith Group, “Fund for Innovative Climate and Energy Research,” Harvard University, <https://keith.seas.harvard.edu/FICER>

4. ETC Group, “Geoengineering Experiments Contested at UN meeting in Nairobi,” 2010, <http://www.etcgroup.org/content/geoengineering-experiments-contested-un-meeting-nairobi>

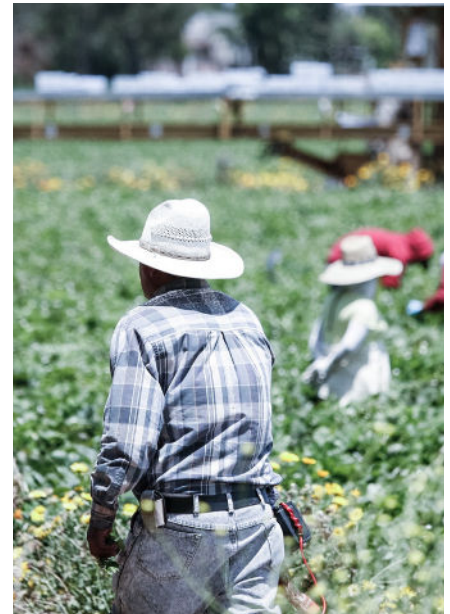
5. Lisa Krieger, “Cloud brightening experiment tests tool to slow climate change,” *The Mercury News*, 2015, <http://www.mercurynews.com/2015/07/11/cloud-brightening-experiment-tests-tool-to-slow-climate-change/>

6. Hannah Hickey, “Could spraying particles into marine clouds help cool the planet?” Washington University, 2017, <http://www.washington.edu/news/2017/07/25/could-spraying-particles-into-marine-clouds-help-cool-the-planet/>

7. Fiona Ellis-Jones, “Great Barrier Reef: Making clouds brighter could help to curb coral bleaching, scientists say,” ABC News, 2017, <http://www.abc.net.au/news/2017-04-25/cloud-brightening-could-help-cool-great-barrier-reef/8469960> and Alister Doyle, “Scientists dim sunlight, suck up carbon dioxide to cool planet,” Reuters, 2017, <https://www.reuters.com/article/us-climatechange-geoengineering/scientists-dim-sunlight-suck-up-carbon-dioxide-to-cool-planet-idUSKBN1AB0J3>

8. Andy Jones et al., “Climate impacts of geoengineering marine stratocumulus clouds,” *J. Geophys. Res.* Vol. 114, 2009

9. Andy Jones et al., “A comparison of the climate impacts of geoengineering by stratospheric SO<sub>2</sub> injection and by brightening of marine stratocumulus cloud,” *Atmos. Sci. Let.*, Vol. 12, 2010, pp. 176–183



Marine Cloud Brightening could have negative effects on regional farming, such as strawberry cultivation.

10. Andy Jones et al., 2009

11. Govindasamy Bala and Nag Bappaditya, “Albedo enhancement of marine clouds to counteract global warming: impacts on the hydrological cycle,” *Climate Dynamics*, 2010

12. John Latham et al., “Marine cloud brightening,” *Phil. Trans. Royal Soc. A*, Vol. 370, 2012, pp. 4217–4262

13. Andy Jones et al., 2010

14. Christopher Trisos et al., “Potentially dangerous consequences for biodiversity of solar geoengineering implementation and termination,” *Nature Ecology & Evolution*, Vol. 2, 2018, pp. 475–482

15. John Latham et al., 2012

16. See Geoengineering Monitor, “Stratospheric Aerosol Injection” and “Microbubbles” Technology [Fact Sheets](#), April 2018.

17. Ibid.