AMS Policy Statement on Geoengineering the Climate System
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Human activities have very likely caused most of the well-documented change in global climate over the last half century. Unchecked future greenhouse gas emissions, particularly of carbon dioxide from the burning of fossil fuels, will almost certainly lead to additional climate impacts such as further global warming, continued sea level rise, greater rainfall intensity, more serious and pervasive droughts, enhanced heat stress episodes, ocean acidification, and the disruption of many biological systems. The resulting inundation of coastal areas, severe weather impacts, and loss of ecosystem services will likely cause major negative impacts for most nations.

Three strategies could potentially help reduce the risks of climate change: 1) reduce emissions (*mitigation*), 2) moderate impacts by increasing our capacity to cope with them (*adaptation*), and 3) deliberately manipulate large-scale physical, chemical, or biological aspects of the climate system to counteract the climate effects of increasing greenhouse gas emissions (*geoengineering the climate system*). This policy statement addresses geoengineering.

Geoengineering could conceivably offer targeted and fast-acting options to reduce acute climate impacts and provide strategies of last resort if abrupt, catastrophic, or otherwise unacceptable climate change impacts become unavoidable by other means. However, geoengineering must be viewed with great caution because manipulating the Earth system is almost certain to trigger some adverse and unpredictable consequences. Furthermore, these impacts would almost certainly be distributed unevenly among nations and people, raising serious ethical issues. Research to date has not determined that there are large-scale geoengineering approaches for which the benefits would substantially outweigh the detriments.

Geoengineering proposals fall into at least three broad categories: 1) managing atmospheric greenhouse gases (e.g., ocean fertilization and atmospheric carbon capture and sequestration), 2) cooling the Earth by reflecting sunlight (e.g., putting reflective particles into the atmosphere, putting mirrors in space to reflect the sun's energy, increasing surface reflectivity, and altering the amount or characteristics of clouds), and 3) moderating specific impacts of global warming (e.g., efforts to limit sea level rise by increasing land storage of water, protecting ice sheets, or artificially enhancing mountain glaciers).

Geoengineering proposals differ widely in their potential to reduce impacts, create new risks, and redistribute risk among nations. For example, reflecting sunlight would likely reduce the Earth's average temperature but could also change global circulation with potentially serious consequences such as changing storm tracks and precipitation patterns throughout the world. As with inadvertent human-induced climate change, the consequences of such actions would almost certainly not be the same for all nations and individuals, thus raising legal, ethical, diplomatic, and even national security concerns.

Exploration of geoengineering strategies also creates potential risks. Developing any new capacity will require resources, possibly drawn from more productive uses. The possibility of quick and seemingly inexpensive geoengineering fixes could distract the public and policy makers from critically needed efforts to reduce greenhouse gas emissions and build society's capacity to deal with unavoidable climate impacts. Geoengineering technologies, once developed, may enable short-sighted and unwise deployment, with potentially serious unforeseen consequences.

Even if reasonably effective and beneficial overall, none of the geoengineering approaches proposed to date would alleviate all of the serious impacts from increasing greenhouse gas emissions. For example, enhancing solar reflection would not alleviate direct effects of the rise in CO_2 concentration such as ocean acidification or changes to the structure and function of biological systems.

Still, the threat of climate change is serious. Mitigation efforts so far have been limited in magnitude, tentative in implementation, and insufficient for slowing climate change enough to avoid potentially serious societal impacts. Not all of the expected climate change impacts can be managed through adaptation. Thus, it is prudent to consider geoengineering's potential, to understand its limits, and to avoid rash deployment.

Therefore, the American Meteorological Society recommends:

1) Enhanced research on the scientific and technological potential for geoengineering the climate system, including research on the unintended as well as intended environmental responses.
2) Additional study of the historical, ethical, legal, political, and societal aspects of the geoengineering issues.
3) Development and analysis of policy options to promote transparency and international cooperation in exploring geoengineering options along with restrictions on reckless efforts to manipulate the climate system.

Geoengineering will not substitute for either aggressive mitigation or proactive adaptation. It could contribute to a comprehensive risk management strategy to slow climate change and alleviate its negative impacts, but the potential for adverse and unintended consequences implies a need for adequate research, appropriate regulation, and transparent consideration.