INTERNATIONAL ASSOCIATION OF METEOROLOGY AND ATMOSPHERIC SCIENCES

STATEMENT ON RADIATION MANAGEMENT CLIMATE ENGINEERING

Approved at the Executive Committee Meeting on July 11, 2013

Greenhouse gas (GHG) emissions are increasing, leading to multi-decadal increases in global average temperature. This is contributing to driving widespread melting of snow and sea ice as well as intense drying episodes and more extreme precipitation events. These and other impacts will be detrimental to humanity and to Earth's biodiversity with its provision of ecosystem services.

To avoid very detrimental impacts to nations around the world, aggressive actions must be taken to reduce CO_2 and other greenhouse gas emissions. This must be done to maintain the climate in a state suitable for ensuring sufficient agricultural production, ecological services for society and sustainable development, as called for in the UN Framework Convention on Climate Change. Sharply cutting emissions of CO_2 and other greenhouse gases is required to reduce long-term future warming, and can be achieved by increasing energy efficiency, reducing deforestation, switching to renewable energy sources, and other measures. Cutting emissions of shorter lived species such as methane, absorbing aerosols and compounds that lead to tropospheric ozone formation will not only slow global warming, but also improve air quality, human health, and energy efficiency. Adaptation to future changes in climate must also be pursued, but cannot, without emissions reductions, prevent serious impacts such as the coastal inundation that would come from rapid melting of polar ice sheets.

A suggested supplementary approach could be *climate engineering* (or *geoengineering*), which is defined as the deliberate manipulation of the Earth's physical, chemical or biological processes to counteract deleterious effects of climate change. Evidence from our planet as well as other planets shows that radiation and greenhouse gas concentrations are major factors in determining the climate. *Radiation Management* (RM) represents a subset of climate engineering approaches that attempts to counter-balance the warming effect of greenhouse gases by reducing the amount of solar or infrared radiation warming the Earth. Proposed RM techniques include those designed to: 1) reflect more sunlight back to space, for example by injecting sulfate aerosols into the stratosphere or increasing the reflectivity of low clouds over the ocean; and 2) reduce the optical depth and extent of thin cirrus clouds that prevent longwave radiation escaping to space.

Given our current state of understanding of clouds, aerosols, precipitation and other processes and their interactions within the climate system, the relative risks and benefits of RM cannot be determined with enough confidence to make this a viable option for shaping policy decisions. For example, stratospheric approaches may well endanger the ozone layer. In addition, RM could induce changes in the latitude of storm tracks, weather patterns and regional precipitation that would not necessarily cancel those caused by increased GHGs emissions. Both greenhouse gas induced warming and climate engineering have major socio-political, legal, economic, and ethical implications that have to be considered.

In addition to the potential risks of climate engineering applications, there are also major concerns that the development of RM strategies might be seen as an alternative to emissions reduction strategies. For several reasons, RM cannot substitute for GHG emissions reduction strategies: 1) other deleterious impacts of GHGs such as ocean acidification are not prevented, 2) the induced spatial and temporal precipitation modifications may worsen conditions in some areas, 3) once started, RM would likely need to be continued for many decades to centuries to sustain its offsetting effects, and (4) the maximum amount of greenhouse gas warming that can be offset is limited.

The International Association of Meteorology and Atmospheric Science recommends:

- That further research be pursued to better understand the fundamental science and possible efficacy of radiation management approaches;
- That climate engineering research be conducted in an open and independent manner that encourages public engagement;
- That the potential risks involved in climate engineering be assessed relative to those associated with global warming without climate engineering; and
- That research activities include studies of the human impacts, ethics, and the legal, economic, and political implications of climate engineering.

In summary, climate engineering cannot be considered a viable alternative or substitute for aggressive emissions reductions. IAMAS supports conducting research to improve the basic understanding and to explore the possibility that climate engineering may eventually be part of a broad risk management strategy aimed at temporarily reducing some of the dangerous impacts of climate change until emissions reductions are sufficient.