

Terraforming Techniques Begin on Terra

A region's variation in temperature, humidity, atmospheric pressure, wind, precipitation, and atmospheric particle count over a period of time is referred to as the region's climate. The set of all regions climates on the Earth is our global climate. Measurable sustaining change across the globe is global climate change. The current trend in global climate change is predominantly termed global warming.⁽¹⁾

Negative changes in the amount and pattern of precipitation distributed globally is one of several perceived effects of global warming. Growth of deserts situated in the best livable latitudes, the subtropics, is another proposed effect but due to adjacent geographical structures such as mountain ranges this is highly unlikely in the majority of cases. Fractional millimeter increases in global sea level that even a tortoise can out walk is another effect of global warming and is one measure used to validate the existence of global warming. A persistent fractional millimeter rise in sea level should not be a major concern for most coastal cities. Any coastal city without inclined beaches and cliffs along its edges might have more reason to keep a watchful eye. Coastal Cities that are subject to non-persistent rises such as floods and hurricanes should concentrate engineering resources towards preventing damage from these sources not small sea level rises. If all of the ice in the frigid regions melted at once, the damage inflicted would be greater in the cities that exist in the frigid region and less so to cities within the subtropics and tropics. Our race, humanity, is adaptable. If climate change necessitates it, agricultural techniques that could be considered small scale terraforming such as the farming in the desert region of the Imperial Valley should be implemented. Research into developing methods that produce lasting beneficial climate changes to a region, a sub class of terraforming, should be

encouraged. One such promising method is the artificial injection of SO_2 into the upper atmosphere.⁽²⁾

SO_2 is injected naturally into the stratosphere along with other aerosols from volcanic eruptions. The resultant aerosol formed from the chemical reaction between SO_2 and water vapor increases the reflection of radioactive particles from the Sun back into space. This effect cools the troposphere and heats the stratosphere thus cooling the Earth's surface. Artificial seeding of the stratosphere with SO_2 could counter the effect and impact of temperature rises caused by an abundance of CO_2 . Due to the highly acidic nature of SO_2 and H_2SO_4 , the aerosol mentioned above, the SO_2 must be deployed in the stratosphere. A test run should be conducted using an amount of SO_2 expected only to affect the local area. The local area should be either the Arctic or Antarctic where human population is minimal. The resulting effect on the ice should be monitored. A baseline of local change should be monitored for the previous month prior to the stratospheric injection. The delivery method should be by aircraft, since this method has the least probability of failure or untimely deployment and is the most controlled method available during all stages leading to the artificial seeding of the stratosphere. Seasonal considerations should also be taken into account for time of deployment to minimize effects on any nearby fishing or any other local international economic endeavors.⁽³⁾⁽⁴⁾⁽⁵⁾

Economically, SO_2 is produced in high quantities already as a preservative and a refrigerant among other uses. The Council on Foreign Relations estimates that the use of only a few kg of SO_2 would be necessary to see results. Prior to action taken regarding the artificial seeding of the stratosphere, a formal proposal to do so should be written and presented before the United Nations. The proposal should require ratification in accordance with Chapter IV of the United Nations Charter. The media of all nations should be informed of the proposal, so that the

entire human race has a chance to be informed of this terraforming effort. These procedures should be followed prior to the test scenario and again followed prior to any subsequent action prompted by the results of the experiment. ⁽⁶⁾

Artificial seeding of the stratosphere in general and using SO₂ are methods that may be valuable to future generations if ever humanity endeavors to live beyond our birth planet. This procedure could be one of many processes in terraforming moons and planets such as Titan and Mars. A task of someone whose life passion is related to the science, technology, engineering, and mathematics fields is to bring what is currently in the realm of science fiction into reality. The risks involved in the implementation of artificial stratosphere seeding are worth the advancement of our current ability and understanding in geoengineering. Science Fact and Fiction writer Ben Bova advocated for humanity being able to control the weather and illustrated how that ability could save lives in two of the short stories (one fact, one fiction) in the collection *Prometheans*. Humanities ability to control and change the climate may as well have the potential to save lives. ⁽⁷⁾

References:

- 1 <http://en.wikipedia.org/wiki/Climate>
- 2 http://en.wikipedia.org/wiki/Global_warming
- 3 <http://en.wikipedia.org/wiki/Volcanoes>
- 4 http://en.wikipedia.org/wiki/Sulfur_dioxide
- 5 [http://en.wikipedia.org/wiki/Stratospheric_sulfate_aerosols_\(geoengineering\)](http://en.wikipedia.org/wiki/Stratospheric_sulfate_aerosols_(geoengineering))
- 6 http://en.wikipedia.org/wiki/Chapter_IV_of_the_United_Nations_Charter
- 7 Benjamin William Bova, *Prometheans*, Tor, 1986.