

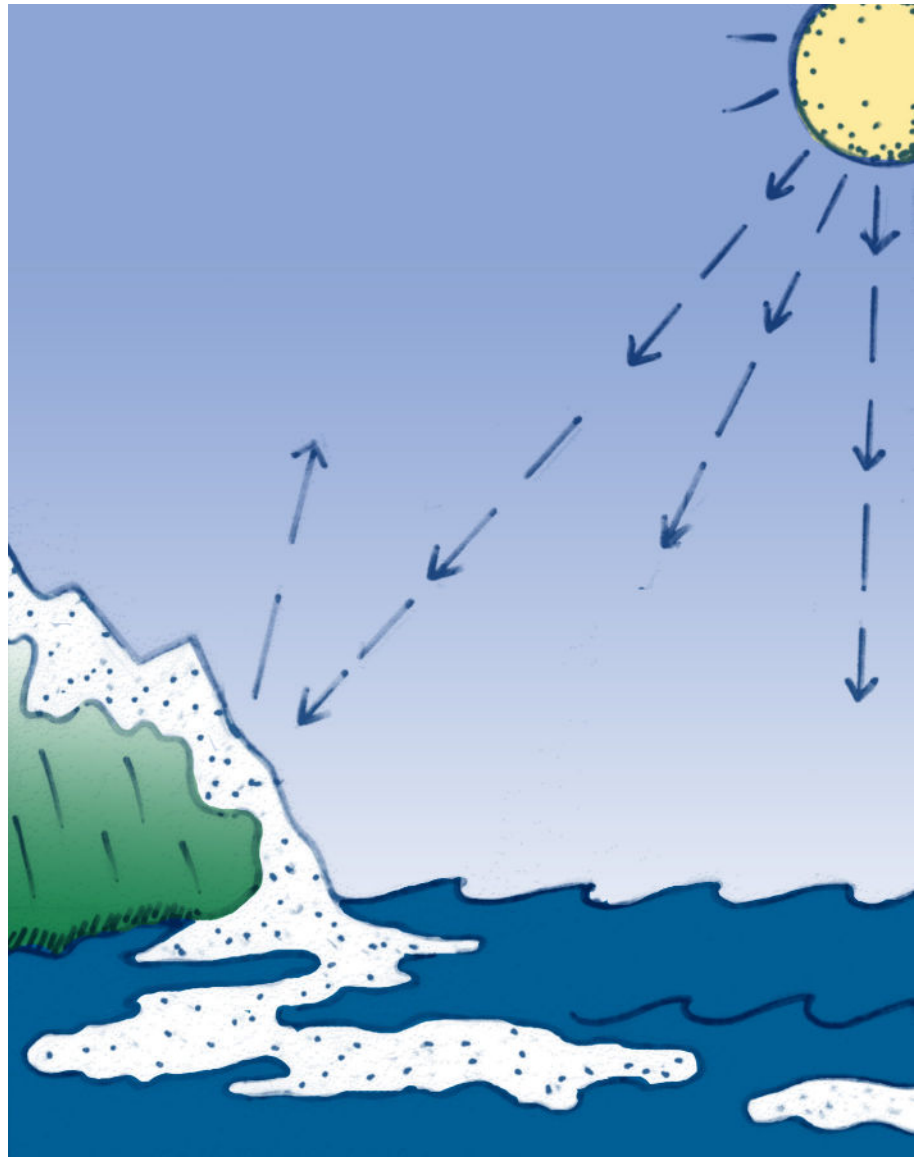
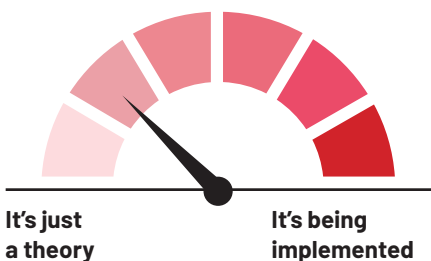
# Surface Albedo Modification

**POINT OF INTERVENTION**



Various proposals suggest that growing crops that reflect more light (either new genetically-engineered crops, or high-albedo varieties of existing crops) could cool the atmosphere by reflecting more solar radiation back into space. Others suggest clearing forests in areas that are snow-covered for a large part of the year, which would increase the amount of light reflected back into space by the flatter, brighter snow. Using genetically modified crops or trees carries all the biosafety and land use impacts of these plantations, including soil erosion and heavy use of contaminating agrochemicals. Clearing forests to create white deserts would seriously and negatively impact biodiversity and climate.

**REALITY CHECK**



Surface Albedo Modification refers to a number of techniques that aim to reflect light back into space by modifying land surfaces like deserts, farmland, or ice.

**HIGH ALBEDO CROPS:** Researchers are proposing to genetically engineer crop plants in major agricultural areas to give the plants more reflective leaves.<sup>1</sup> Little is known

about the potential risks of increased reflectivity for the nutritional content of the plants, their photosynthetic capacity or on surrounding soil. Genetically engineered plants

could spread their “reflectivity” to other relatives, with unknown consequences.

**DESERT COVERING:** More than a decade ago, entrepreneur Alvia Gaskill laid out a scheme to cover a significant portion of the world’s deserts with white, polyethylene film to reflect sunlight and lower surface temperatures.<sup>2</sup> Deserts have plants, animals and people living in them, and it is difficult to imagine

life continuing in a plastic-covered ecosystem. Desert dust, which will be hindered by plastic coverings, is essential for the global climate because it influences solar radiation, cloud formation and even ocean cooling.<sup>3</sup> Cooler desert temperatures may also bring unexpected changes. Like many geoengineers, Gaskill suggests if there are too many political, ecological or weather challenges (the plastic has to be kept in place for several hundred years,

for example), the projects could be local. However, local applications would have a minimal climate effect and would not justify the expense and disruption.

**ICE COVERING:** Similar to desert covering, coatings – perhaps a nanotech film or small glass beads – would be applied to Arctic ice as a “reflective band aid” to insulate rapidly melting snowpack and glaciers.<sup>4</sup> An experimental project championed by Leslie Field, an engineer at University of California, Berkeley, with a resumé that includes work for Chevron and Hewlett Packard, has used regular plastic garbage bags, among other materials, to do this in Canada and California. She has set

up a crowd-funding site to expand the project.<sup>5</sup> Possible negative effects, for example to weather, water temperature and biodiversity, and the environmental impact of the covering material itself, appear not to have been considered.

**WHITE BLANKETS (ROOFS AND PAVEMENTS, PLUS MOUNTAINTOP PAINTING):** In 2010, the World Bank famously awarded a small research grant to the winner of a “100 Ideas to Save the Planet” competition so that he could paint a Peruvian mountaintop white.<sup>6</sup> Painting mountaintops would negatively affect fragile ecosystems, flora and fauna, and seems unlikely to proceed. In academic circles, Hashim Akbari, a civil engineer at Concordia University in Montreal, has promoted the idea of government grants to cover rooftops and tarmac with white paint.<sup>7</sup> Painting roofs could have some local cooling effects, though a Royal Society report states that “the overall cost of a ‘white roof method’ covering an area of 1% of the land surface would cost about US\$300 billion/year, making this one of the least effective and most expensive methods considered.”<sup>8</sup>

**SNOW FOREST CLEARANCE:** Another idea, also adapted from engineering models, is to clear the planet’s remaining areas of boreal forest (largely in Russia and Canada) to boost reflectivity. Studies by forestry schools at Yale, with partial funding from the US Department



The use of monocultures of crops genetically modified to reflect more light could exacerbate land grabs and forced displacement.

of Energy, indicated at least local cooling effects, though these “white deserts” could destroy Subarctic



Snow Forest Clearance would involve removing vast swaths of boreal forest.

ecosystem productivity, affecting the caribou, migrating birds and other fauna, as well as the plants and people that depend on them.<sup>9</sup>

Eliminating forest would negatively affect the regulation of regional and local climates. Carbon contained in forest would also be lost. Proponents admit that there are many complexities. There would also be a one-time (and final) bonanza for timber companies.<sup>10</sup>

**ACTORS INVOLVED**

Studies and measurements on crop albedo are being carried out at Bristol University, UK. The studies suggest that by choosing high-albedo crops, summer temperatures could be reduced, and manipulating the waxiness of crops through traditional breeding techniques or genetic modification should raise their albedo by about 20%.<sup>11</sup> Studies on forest albedo are also being carried out at Dartmouth College,

USA. The research looks further into interactions between forests and the atmosphere, focusing on their surface reflectivity.<sup>12</sup>

// **Proponents admit that there are many complexities** //

**REALITY CHECK**

Most of these ideas are just theories, although some are much technologically simpler to implement than others. Snow forest clearance is one obvious example, with added (short-term) profits for forestry companies. Research into high-albedo crops aligns with global efforts to engineer the



Forest clearance in Boreal areas would mean more reflective snow – but less forest! (Derrick Midwinter/Flickr)

world's food supply, so this idea may therefore gain attention. All these proposals are clear examples of the narrow-minded, reductionist mentality that characterizes geoengineering, which ignores the profound value of biodiversity and overlooks the multifunctionality and interconnectedness of ecosystems.

**FURTHER READING**

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

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See also Alvia Gaskill, Jr. and Charles E. Reese, "Global Warming Mitigation by Reduction of Outgoing Longwave Radiation Through Large-Scale Surface Albedo Enhancement of Desert Using White Plastic Polyethylene Film - the Global Albedo Enhancement Project (GAEP)," 20 August 2003. <https://www.slideshare.net/AlviaGaskillJr/theglobalalbedoenhancementproject-53664037>

3. Andrew Goudie and Nicholas J. Middleton, *Desert Dust in the Global System*, 2006. <https://www.springer.com/la/book/9783540323549>

4. Daniel McGlynn, "One big reflective band-aid," Berkeley Engineering Blogpost, 17 January 2017, <http://engineering.berkeley.edu/2017/01/one-big-reflective-band-aid>

5. See Field's IndieGoGo campaign here (now closed): <https://www.indiegogo.com/projects/ice911-preserve-arctic-ice-to-slow-climate-change/>

5. Dan Collins, "Can painting a mountain restore a glacier?" BBC News, 17 June 2010, <http://www.bbc.com/news/10333304>

7. For a list of publications by Hashem Akbari see: <http://concordia.academia.edu/HashemAkbari>. See also David Biello, "Cool Roofs Might Be Enough to Save Cities from Climate Overheating," *Scientific American*, 14 February 2014, <https://www.scientificamerican.com/article/cool-roofs-might-be-enough-to-save-cities-from-climate-overheating/>

8. The Royal Society, *Geoengineering the climate: Science, governance and uncertainty*. September 2009, [https://royalsociety.org/~media/Royal\\_Society\\_Content/policy/publications/2009/8693.pdf](https://royalsociety.org/~media/Royal_Society_Content/policy/publications/2009/8693.pdf)

9. Xuhui Lee et al, "Observed increase in local cooling effect of deforestation at higher latitudes," *Nature*, Vol. 479, No. 17, 2011.  
See also: Yale University, "Deforestation Causes Cooling, Study Shows," Blogpost at Phys.org, 16 November 2011, <https://phys.org/news/2011-11-deforestation-cooling.html>

10. Nikhil Swaminathan, "More Trees, Less Global Warming - Right? Not Exactly," *Scientific American*, 10 April 2007, <https://www.scientificamerican.com/article/tropical-forests-cool-earth/>.  
See also Bryan Walsh, "How (Some) Deforestation Might Slow Warming," *Time Magazine* (online), 16 November 2011, <http://science.time.com/2011/11/16/how-some-deforestation-might-slow-warming/>

11. See Crop Albedo entries on ETC Group and Heinrich Böll Foundation's Map of Geoengineering Experiments: <https://map.geoengineeringmonitor.org/Solar-Radiation-Management/crop-albedo/>

12. See Forest Albedo entries on ETC Group and Heinrich Böll Foundation's Map of Geoengineering Experiments <https://map.geoengineeringmonitor.org/Solar-Radiation-Management/forest-albedo/>