

Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences

rsta.royalsocietypublishing.org

doi: [10.1098/rsta.2011.0639](https://doi.org/10.1098/rsta.2011.0639)Phil. Trans. R. Soc. A **13 September 2012** vol. 370 no. 1974 **4263-4300**

Lifting options for stratospheric aerosol geoengineering: advantages of tethered balloon systems

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↵* Author for correspondence (cjb@eng.cam.ac.uk).**Abstract**

The Royal Society report 'Geoengineering the Climate' identified solar radiation management using albedo-enhancing aerosols injected into the stratosphere as the most affordable and effective option for geoengineering, but did not consider in any detail the options for delivery. This paper provides outline engineering analyses of the options, both for batch-delivery processes, following up on previous work for artillery shells, missiles, aircraft and free-flying balloons, as well as a more lengthy analysis of continuous-delivery systems that require a pipe connected to the ground and supported at a height of 20 km, either by a tower or by a tethered balloon. Towers are shown not to be practical, but a tethered balloon delivery system, with high-pressure pumping, appears to have much lower operating and capital costs than all other delivery options. Instead of transporting sulphuric acid mist precursors, such a system could also be used to transport slurries of high refractive index particles such as coated titanium dioxide. The use of such particles would allow useful experiments on opacity, coagulation and atmospheric chemistry at modest rates so as not to perturb regional or global climatic conditions, thus reducing scale-up risks. Criteria for particle choice are discussed, including the need to minimize or prevent ozone destruction. The paper estimates the time scales and relatively modest costs required if a tethered balloon system were to be introduced in a measured way with testing and development work proceeding over three decades, rather than in an emergency. The manufacture of a tether capable of sustaining the high tensions and internal pressures needed, as well as strong winds, is a significant challenge, as is the development of the necessary pumping and dispersion technologies. The greatest challenge may be the manufacture and launch of very large balloons, but means have been identified to significantly reduce the size of such balloons or aerostats.

[geoengineering](#) [climate change](#) [tethered balloons](#) [stratospheric particle injection](#)

Footnotes

One contribution of 12 to a Discussion Meeting Issue 'Geoengineering: taking control of our planet's climate?'

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Articles citing this article

Geoengineering: taking control of our planet's climate?
Phil Trans R Soc A September 13, 2012 370 1974 4163-4165
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