A NEW APPROACH TO GEOENGINEERING
an L1 positioned dust cloud to mitigate global warming

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This project aims to investigate the possibility of using a cloud of dust placed at the gravitational equilibrium point between the Earth and the Sun (L1 point) as a method of geo-engineering for the mitigation of climate change. For this to be achieved the dynamics of the dust cloud around the L1 point must be analysed to determine its stability. A captured near-Earth asteroid is identified as a suitable source as well as a possible gravitational anchor for the dust cloud.

What is Geo-engineering?
Geo-engineering is the manipulation of the Earth’s climate to counteract global warming. This can be achieved in space by reducing the amount of sunlight that reaches the Earth. Previous research has suggested placing solar reflectors or refracting disks in between the Sun and the Earth. The disadvantage of this method is that a large amount of mass must be either manufactured terrestrially before being launched into position or be manufactured in-situ. An alternative solution is to position clouds of dust generated from captured asteroids in between the Earth and Sun at the L1 equilibrium point. Although this method will likely require a larger overall mass the scale of engineering required is greatly reduced. To offset the 2°C temperature increase predicted over the next century the solar constant must be reduced by 1.7%.

Deployment Methods
To deploy the dust cloud from the asteroid several methods must be considered to enable the best to be selected. These methods include using solar collectors to focus the sunlight onto a small spot on the surface of an asteroid. The surface material will then reach very high temperatures and sublimate. The asteroid can be spun so that the rotational forces overcome the low gravitational attraction of the asteroid and surface material will no longer be bound. Finally a robotic device can mine material from the surface and then eject it using a mass driver.

Results
The method presented here has been shown to be effective in offsetting climate change. As opposed to other proposals suggested in literature this technique requires significantly less launch mass making it considerably cheaper and more feasible. Below the results of a simulation propagating a dust cloud at the L1 point over a period of 60 days are presented.

Particle Motion
To determine the feasibility of this new approach the stability of the L1 point must be analysed. This is achieved by linearising the equations of motion around the equilibrium point. A transition matrix is then created with which a particle position after time, t, can be found given the initial position. Using this method the useful lifetime of the dust cloud can be determined.

Solar Radiation Model
To determine the reduction in the solar constant for a certain cloud a solar radiation model is created. This model divides the Earth and Sun into segments and for the path from each Sun node to each Earth node calculates the fraction of the path that is within the cloud. Using this and the dust radius and number density the solar energy reaching each Earth segment can be calculated using the Beer-Lambert law.