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Effects of marine cloud brightening on polar regions and the meridional heat flux

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Marine cloud brightening is one of several proposed solar radiation management geoengineering schemes designed to avert some of the undesirable effects of climate change (Latham et al. 2008). Such changes include ice loss, desertification and increased sea levels. Polar sea ice fraction has been recorded by satellite data for the last 40 years. This data shows a general long term reduction in sea ice thickness and area and this reduction has been attributed to climate change. Changes in climate have been argued to be disproportionately larger in polar regions.

The HadGEM1 (UK Met Office Climate Model, V6.1) is a fully coupled climate model. It is used to project changes in polar ice cover and temperatures as a result of increasing carbon dioxide and geoengineering using marine cloud brightening scenario. The meridional heat flux is the mechanism for moving energy from the tropics to the polar regions. The results show that for a comparison between a control ($\sim$ 2020 carbon dioxide concentrations) and a double pre-industrial carbon dioxide simulation, the maximum meridional heat flux is found to change from 5.8 PW to 6.1 PW. With three region seeding of marine stratocumulus, this is reduced to 5.7 PW. The annual North Polar sea ice cover, initially 11.5 x10^6 sq km, is reduced by 3.6 x10^6 sq km as a result of the increased carbon dioxide. Application of a three region seeding scenario, results an increase in sea ice cover of 0.20 x10^6 sq km above the initial values.

Reference:
Latham J. et al.. (2008) Global temperature stabilization via controlled albedo enhancement of low-level maritime clouds. Phil. Trans. R. Soc. A doi:10.1098/rsta.2008.0137.