Marine could brightening

John Latham[1,4,*] , Keith Bower[4] , Tom Choularton[4] , Hugh Coe[4], Paul Connolly[4] , Gary Cooper[7] ,Tim Craft[4], Jack Foster[7], Alan Gadian[5], Lee Galbraith[7] Hector Iacovides[4] , David Johnston[7] , Brian Launder[4], Brian Leslie[7] , John Meyer[7], Armand Neukermans[7], Bob Ormond[7], Ben Parkes[5] , Phillip Rasch[3], John Rush[7], Stephen Salter[6], Tom Stevenson[6], Hailong Wang[3], Qin Wang[7] & Rob Wood[2]

[1] National Centre for Atmospheric Research, Boulder, CO.
[2] U Washington, Seattle, [3] PNNL, Richland, WA., [4] U Manchester,
[5] U of Leeds, [6] U of Edinburgh, [7] Silver Lining, CA.

The idea behind the marine cloud brightening (MCB) SRM geoengineering technique is that seeding marine stratocumulus clouds with copious quantities of roughly monodisperse sub-micrometre seawater particles could significantly enhance the cloud droplet number concentration thus increasing the cloud albedo and longevity – thereby producing a cooling, which computations suggest could be adequate to balance the warming associated with a doubling of atmospheric carbon dioxide.

More specifically, GCM computations using two world-class models indicate that – subject to defined caveats – MCB could maintain the Earth's average surface temperature and polar sea-ice coverage at roughly current values, at least until the CO2-doubling point. We are investigating the possibility that spray dissemination would be from wind-powered, unmanned, satellite-guided Flettner vessels.

In our paper we review recent research on a number of critical issues associated with MCB: (1) general circulation model (GCM) studies, which are our primary tools to evaluate globally the effectiveness of marine cloud brightening and to assess its climate impacts on rainfall amounts and distribution, as well as on polar sea-ice cover and thickness: (2) high resolution modeling of the effects of seeding on marine stratocumulus, which are required to understand the complex array of interacting cloud processes involved in MCB: (3) microphysical parcel-modeling sensitivity studies examining the influence of seeding amount, seed-particle salt-mass, air-mass characteristics, updraught speed and other parameters on cloud-albedo change: (4) controlled sea-water spray production via supercritical water instability, and by micro-fabrication lithography: (5) computational fluid dynamics studies of possible large-scale periodicities or instabilities in Flettner rotors: and (6) the planning of a three-stage limited-area field research experiment, which has the

objective of developing our fundamental knowledge of marine stratocumulus clouds, testing the technology developed for the MCB geoengineering application, and ultimately, if deemed justifiable, field-testing the idea quantitatively, on a limited (perhaps 100km) spatial scale.

[*Corresponding Author: John Latham <latham@ucar.edu>]