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How would the ocean carbon cycle be affected by radiation management geoengineering?

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Human emissions of carbon dioxide to the atmosphere is unequivocally causing global warming and climate change (IPCC, 2013). At the 21st United Nations Framework Convention on climate Change (UNFCCC) Conference of the Parties it was agreed to limit the increase in global average temperature to 2˚C above pre-industrial levels. We have used the Norwegian Earth System Model (NorESM1-ME) and applied radiation management (RM) methods in order to bring the future radiative forcing change in the RCP8.5 CO_2 emission scenario in line with that of the RCP4.5 CO_2 emission scenario. Three different RM methods, with varying effects on atmospheric physics, were used in these experiments: stratospheric aerosol injection (SAI); marine sky brightening (MSB); and cirrus cloud thinning (CCT). Here we will present how the different methods affect the ocean carbon cycle, which is a well-known and important feedback on climate change. In particular, we focus on changes to the ocean primary production, which are known to be spatially and temporally complex. We show that while the global mean temperature when applying RM is similar to that in the RCP4.5 scenario, no RM method produce similar ocean primary production as in the RCP4.5 scenario. Our simulations indicate that when it comes to the ocean primary productivity there will be regional winners and losers. The different RM methods also produce spatially very different results, partly linked to how the different RM methods affect clouds.
The results of this work does nothing to diminish the complexity of climate impacts on primary production, but rather highlights that any change in ocean primary production is driven by a combination of several parameters, which all change in different ways. The experiments highlight the, at present, uncertain changes to ocean productivity in the future and highlights the caution necessary before additional human perturbations to the Earth system is attempted.