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Impacts of radiation management techniques on the North Atlantic Oscillation

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The effectiveness of various climate engineering techniques in limiting the global warming signal to reasonable levels has been the topic of state-of-the-art research on climate change. Using an Earth system model, we show that these techniques have the potential to bring down the high CO_2 concentration climate in RCP8.5 to a moderate climate similar to RCP4.5 in terms of global temperature. Nevertheless, their influence on the regional aspects of atmospheric circulation is not clear. The regional circulation patterns in the atmosphere are largely characterized by the natural variability modes, such as the North Atlantic Oscillation (NAO). In this study, we assess the impacts of three radiation managment techniques, namely, Stratospheric Aerosol Injection (SAI), Marine Sky Brightening (MSB) and Cirrus Cloud Thinning (CCT), on the structure and features of the NAO.

The results indicate an east-northeastward shift as well as intensification of the NAO spatial pattern in the global warming scenarios of RCP4.5 and RCP8.5, with the signal being most intense in the latter. The climate engineering forcings when applied to the RCP8.5 case tend to reduce the strength of the NAO with little impact on its position. The CCT case appears to have the maximum effect on the NAO signal. The patterns of cloud radiative forcing, expressed as the difference between net radiative forcing at TOA under average conditions and clear sky conditions, reveal a northeastward shift of the radiative heating in the north Atlantic region. This implies a possible link between the changes in the NAO signal and the cloud radiative forcing.