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Africa's Climate Response to Marine Cloud Brightening

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Climate intervention through solar radiation modification is one proposed method for reducing climate risks from anthropogenic warming. Marine Cloud Brightening (MCB), one such approach, proposes to inject sea salt aerosol into a regional marine boundary layer to increase marine clouds' reflectivity. This study assessed the potential influence of four MCB experiments on the climate in Africa using simulations from the Community Earth System Model (CESM2) with the Community Atmospheric Model (CAM6). Four idealised MCB experiments were performed with the CESM2(CAM6) model under a medium-range background forcing scenario (SSP2-4.5) by setting cloud droplet number concentrations to 600 cm^{-3} over three subtropical ocean regions: (a) Northeast Pacific (MCB_{NEP}); (b) Southeast Pacific (MCB_{SEP}); (c) Southeast Atlantic (MCB_{SEA}); and (d) the combination of these three regions (MCB_{ALL}). The CESM2(CAM6) model reproduces the observed spatial distribution and seasonal cycle of precipitation and minimum and maximum temperatures over Africa and its climatic zones well. The results suggest that MCB_{SEP} would induce the strongest global cooling effect and thus could be the most effective in decreasing (increasing) temperatures (precipitation) and associated extremes across most parts of the continent, especially over West Africa, in the future (2035-2054) while other regions could remain warmer or dryer compared to the historical climate (1995-2014). While the projected changes under MCB_{ALL} are similar to those of MCB_{SEP}, MCB_{NEP} and MCB_{SEA} could result in more warming and, in some regions of Africa, create a warmer future than under SSP2-4.5. Also, all MCB experiments are more effective in cooling maximum temperature and related extremes than minimum temperature and related extremes. These findings further suggest that the climate impacts of MCB in Africa are highly sensitive to the deployment region.