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Marine Sky Brightening - preliminary results.

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Objective: RCP8.5 \rightarrow RCP4.5 via climate engineering.



Marine Sky Brightening

- Following method of Alterskjær et al. (2013).
- Increasing emissions of accumulation mode sea salt aerosols.
 - Dry number modal radius 0.13 μm, geometric standard deviation 1.59, corresponding to dry effective radius 0.22 μm.
- Increasing emissions of SS_A2 between 45°S and 45°N, to draw upon direct effect of aerosols.
- Increasing emission area from ±30° lat increases ERF by ~1/3.
- Starting in 2020, until year 2100.

Effective radiative forcing estimates from fixed SST runs



Effective radiative forcing estimates from fixed SST runs.



Change in net TOA fluxes (FSNT-FLNT) from fixed SST runs with same emission increases.



Global annual mean TOA net fluxes (RTMT).



RTMT difference SAI and MSB minus RCP4.5



RCP8.5 (red), RCP4.5 (green), MSB (blue), SAI (pink).

Global annual mean near surface air temperature (TREFHT).



RCP8.5 (red), RCP4.5 (green), MSB (blue), SAI (pink).

Global annual mean precipitation rate (PRECT) (mm/day)



NorESM1-ME global annual mean precipitation rate

MSB (blue), SAI (pink). Area averaged increase in total sea salt emissions (kg m⁻ ² s⁻¹) between 45S and 45N.

Global annual mean sea salt concentration (kg m⁻³) at 997 mb.



Column burden sea salt (g m⁻²) (c_ss).



Column burden sea salt (%)



Near surface air temperature change (K)



-1.34K

0.20K

Annual zonal mean Latent Heat Flux (Wm⁻²) LHFLX.



Change in Latent Heat Flux (Wm⁻²)



Change in Precipitation rate (mm/d)



Global: -0.123 mm/day Land: -0.031 mm/day Ocean: -0.149 mm/day Global: -0.065 mm/day Land: 0.053 mm/day Ocean: -0.128 mm/day

Change in Precipitation minus Evaporation P-E (mm/day)



Global annual mean cloud droplet number concentration, CDNC (cm⁻³), at 970 mb.



Change in CDNC (cm⁻³), mean over lowest 3 levels

MSB - RCP8.5 CDNC (cm⁻³) annual mean lowest 3 levs MSB - RCP4.5 CDNC (cm⁻³) annual mean mean lowest 3 levs



Change in CDNC (%), mean over lowest 3 levels



Change in Zonal mean CDNC (cm⁻³)



Change in Zonal mean CDNC (%)



MSB-RCP8.5 Annual sea ice difference (%)



Sea Ice

MSB-RCP_{4.5} Annual sea ice difference



Sea Ice

Summary

- Reducing radiative forcing from RCP8.5 to RCP4.5 possible in model using marine sky brightening between ±45° lat.
- Seems transport of sea salt larger than when emission area is ±30° lat.
- Overcooling of low lats and residual warming cf. RCP4.5.
 - \rightarrow still some sea ice losses.
- «Monsoon effect» on precipitation, with decreases over oceans and increase over subtropical land, as seen in earlier studies.