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Detection and attribution of climate engineering

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Climate engineering (CE) options may be part of a portfolio of measures, complementing mitigation, to limit global mean temperature increase to the 2 ° C warming target agreed upon within the Paris Agreement. Proposed climate engineering methods distinguish between solar radiation management that alter the Earths radiative balance, for example via stratospheric aerosol injection (SAI), and carbon dioxide removal strategies, for example via artificial ocean alkalinization (AOA) that alters the seawater buffer capacity and thereby increases the ocean carbon sink. However, the potential impacts, risks, and effectiveness of individual CE measures can only be evaluated, if CE signals can be detected against anthropogenic forcing and internal variability and attributed to their cause, which may be further complicated in the case of a combination of different CE methods. Here we use the fully coupled Max Planck Institute Earth System Model (MPI-ESM) with prognostic carbon cycle to compare AOA and SAI experiments forced by CO_2 emissions according to the Representative Concentration Pathway 8.5 (RCP8.5). In the AOA experiment, atmospheric CO_2 concentration is brought to RCP4.5 levels via global homogeneous enhancement of total alkalinity. In the SRM experiment, the net radiative forcing follows the RCP4.5 trajectory via enhancement of stratospheric aerosols by sulphur injection. We assess the spatio-temporal detectability of the forced climate response within AOA and SAI experiments using regularised optimal fingerprinting. Preliminary results reveal global, regional and local varying detectability of key variables of the climate system between AOA and SAI.