

Hydroclimate State response to SRM Warming constraints in Northern Africa

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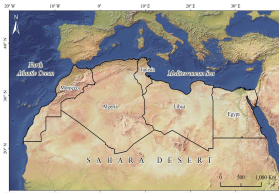
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Introduction

- North Africa is a climate change hotspot
- Temperature rise is above global average
- Rising frequency and intensity of extreme events – heatwaves, droughts, flooding
- Observed and projected increase in extremes is attributed to global warming
- The region suffers from water scarcity, agricultural losses, ecosystem degradation, heat stress, among others
- Need for effective adaptation and mitigation measures
- SRM is aimed at temporarily cooling the Earth by reflecting a small fraction of incoming sunlight back into space
- However, it not clear how temperature and precipitation respond to this intervention.
- This is the question that this research answers.

Area of Study

- Lies within 18°W to 36°E longitude and 19°N to 37°N latitude
- It encompasses: Morocco, Algeria, Tunisia, Libya, and Egypt
- Atlantic Ocean and Mediterranean Sea to the north and the Sahara Desert to the south
- Arid and semi-arid climate



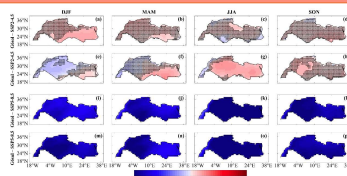
Data and Methods

- Precipitation (mm) and near-surface air temperature (°C)
- Five GeoMIP6 and CMIP6 models: CESM2-WACCM, CNRM-ESM2-1, IPSL-CM6A-LR, MPI-ESM1-2-LR and UKESM1-0-LL
- Provide complete G6solar, G6sulfur, SSP2-4.5 and SSP5-8.5 simulations

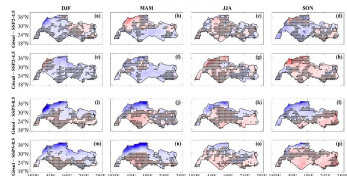
- Regidded onto a common 1° × 1°
- Baseline period: 1980–2014 (35 years)
- Projection period: 2020–2099 (near-future [2020–2054] and far-future [2055–2099])
- Effectiveness of SRM using efficacy index (not shown)
- ETCCDI – TXx, TXn, TNx, TNn, TX5p, TX5p, TN5p, TN5p

Results

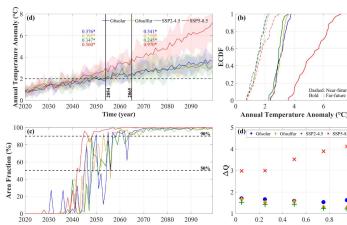
- Temperature anomalies (°C) for the far-future period (2065–2099), relative to the corresponding SSP baseline



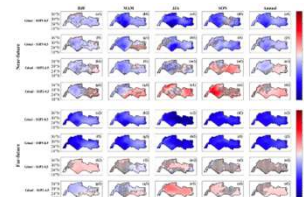
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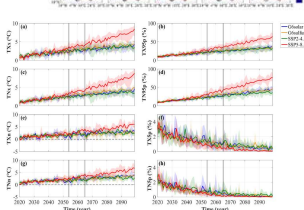
- Temporal evolution and distribution of regional near-surface air temperature anomalies from SRM and GHG forcing scenarios



- Seasonal and annual changes in TX5p (%) from SRM scenarios relative to GHG pathways



- Temporal evolution of annual temperature extreme indices from SRM and GHG pathways



Conclusions

- SRM, implemented under an SSP5-8.5 emission pathway to stabilise temperatures at SSP2-4.5 levels, substantially reduces regional warming by the end of the century
- Precipitation responses remain heterogeneous and do not scale proportionally with temperature reductions
- SRM suppresses the intensification of warm temperature extremes relative to SSP5-8.5
- SRM produces a distinct, scenario-dependent climate that differs from both high-emission and mitigation pathways
- Further research will focus on drought respond to SRM, as well investigate how agriculture will respond if temperatures fall but sunlight is reduced.