

Egbebiyi et al. investigate the impacts of climate warming overshoot scenarios on African climate, focusing on temperature extremes, precipitation variability, and surface moisture availability, while assessing the potential role of stratospheric aerosol injection (SAI) as a climate intervention strategy. Using CESM2-WACCM6 simulations, the authors compare high-emission and overshoot pathways with SAI scenarios targeting 1.5°C and 2.0°C warming levels. The study finds widespread increases in temperature extremes during overshoot, while precipitation responses are more spatially heterogeneous. SAI effectively reduces temperature-related extremes but produces complex regional precipitation and moisture responses that depend on the background forcing scenario. The manuscript addresses an important and timely question regarding the regional implications and reversibility of climate impacts during warming overshoot pathways.

However, the manuscript would have to address these concerns before I can recommend it for publication.

Major Comment 1: Clarify the motivation and relevance of overshoot and SAI scenarios for Africa

The manuscript addresses an important topic; however, the motivation connecting climate overshoot scenarios to SAI and their relevance for Africa needs to be strengthened.

- Scientific justification of scenarios: The authors should better explain why studying high-end overshoot and SAI scenarios is valuable despite their lower likelihood under current mitigation pathways. These scenarios can serve as stress tests to understand potential climate risks, reversibility, and adaptation challenges under extreme forcing conditions.
- Positioning within existing literature: Statements implying that African climate impacts are largely unexplored should be revised. While regional research gaps remain, there is an expanding body of work investigating African climate change impacts. The authors should acknowledge these efforts and clarify what specific knowledge gap this study addresses.

Major Comment 2: Improve the regional framework for interpreting impacts

The manuscript evaluates impacts using geopolitical regions; however, the study focuses on agriculture, ecosystems, and water resources, which may be better represented through climate and ecological zones.

- Use of agro-ecological regions: The authors should consider whether an agro-ecological classification (e.g., Sahara, Sahel, savanna, tropical forest regions) would provide a more physically meaningful interpretation than political boundaries.
- Link to impacts: Such a framework would allow more targeted discussions of SAI impacts on vulnerable systems, since climate responses are strongly controlled by factors such as aridity, vegetation, soil properties, and hydrological regimes.

Major Comment 3: Clarify interpretation of the surface moisture budget and water availability

The manuscript appears to equate changes in (P-E) with changes in surface water availability, which may overextend the conclusions.

- Distinguish moisture budget from water availability: The surface moisture budget provides information about precipitation inputs relative to evaporative losses but does not directly quantify available water resources.
- Consider missing hydrological processes: Surface water availability also depends on runoff, infiltration, groundwater recharge, soil moisture storage, drainage, and human water use. Therefore, conclusions regarding preservation of water availability should be qualified.
- Clarify the role of runoff: Neglecting runoff may be acceptable for a climatological atmospheric moisture analysis; however, the authors should acknowledge that a complete terrestrial water balance involves terms such as (P-E-R-D).

Also, the moisture budget analysis requires additional methodological clarification.

- Resolve inconsistencies in reported values: The manuscript reports moisture budget values of approximately 1–1.5 mm/day, while seasonal decomposition shows peaks of 4–4.5 mm/day. The authors should clarify whether these represent different quantities, averaging periods, or units.
- Define seasonal decomposition: The authors should explain whether values represent daily means, monthly averages, seasonal totals, or outputs from a decomposition method.
- Provide quantitative trends: Statements describing increasing or decreasing trends should be supported with numerical trend values, particularly where differences between SSP and SAI scenarios are difficult to discern.

Major Comment 4: Better highlight the novelty and strengths of the study

The manuscript provides a detailed discussion of limitations, but the methodological strengths and unique contributions are less clear.

- Highlight contributions: The authors should emphasize what aspects of the modeling framework, scenario design, or analysis provide new insights compared with previous studies.
- Balance limitations with strengths: A stronger discussion of the study's methodological advantages would improve the positioning of the manuscript and ensure that the contribution is recognized beyond the limitations discussed.

Specific Comments

Lines 51-65: The authors comment on climate overshoot; however, how are they tying it in to SAI and its impacts? The paragraph seems somewhat disjointed from the next paragraph.

Line 63: "Despite the policy ..." I think this is not an accurate description of the current state of the science. There are quite a number of researchers working to understand this topic over the region. The expertise may not be from the region, but there are definitely quite a number of research studies being conducted over the region. This should be acknowledged.

Line 80: Change to Pinto et al and Egbebiyi et al demonstrated that ..

L88: "These studies collectively underscore the need for targeted." ---> more targeted assessments. There are some studies, but more would be better.

L93–95: The authors should further clarify the relevance and applicability of this work for the African region, particularly given that the scenarios considered may represent relatively unlikely future pathways under current mitigation trajectories. The manuscript would benefit from a stronger discussion of the rationale for examining these high-end overshoot and SAI scenarios. Specifically, the authors should emphasize that, despite their lower likelihood, such scenarios provide valuable insights into the potential magnitude, spatial variability, and reversibility of climate impacts under extreme forcing pathways, serving as important stress tests for climate resilience, adaptation planning, and risk assessment.

L112: The authors do a good job of localizing the analysis by considering geopolitical regions. However, given that the study focuses on climate impacts relevant to agriculture, water resources, and ecosystems, it may be more appropriate to consider a subdivision based on agro-ecological zones rather than, or in addition to, geopolitical boundaries. An agro-ecological framework would likely provide a more physically meaningful basis for interpreting regional responses, as climate impacts and vulnerabilities are strongly tied to environmental characteristics such as aridity, vegetation type, and hydrological regimes. This approach would also allow the authors to make more targeted statements regarding the implications of SAI, for example, distinguishing responses in the Sahara, Sahel, savanna, and humid tropical regions rather than broader regions such as North Africa. This could improve the clarity and relevance of the discussion for climate adaptation and resource management.

L153: b should not be capitalised.

L 155: b should not be capitalised

L165: ETCCDI is already defined elsewhere before this.

L214: These indices plateau begin → indices plateau and begin to

L284–285: The statement that SAI shifts tropical rainfall patterns through stratospheric heating and suppresses evaporation requires further clarification and stronger support from the cited literature. The cited study (e.g., [DOI: 10.1029/2019GL085758]) appears to primarily discuss circulation and seasonal changes at higher latitudes rather than directly demonstrating tropical rainfall shifts or evaporation suppression. Therefore, this statement may overstate the current evidence. I suggest revising this discussion to provide a more general overview of the potential impacts of SAI rather than attributing the specific changes observed in this study to these mechanisms without further analysis. At present, the extent to which SAI modifies tropical rainfall distributions or suppresses evaporation remains uncertain and may depend on the background climate state, regional processes, and also the model in use. Additionally, the phrase “shift tropical rainfall patterns” is ambiguous. Please clarify whether this refers to changes in the spatial location of precipitation, changes in seasonal timing (e.g., onset/cessation), or changes in rainfall intensity and variability.

L286: Citations Neimeier et al 2013 and Simpson et al 2019 not found in the references.

L295-299: What would this mean for precipitation? Does it mean SAI could lead to higher rainfall/extreme rainfall days compared to the other climate scenarios?

The sentence implies that SAI would preserve surface water availability through the century. Is this good or bad?

Also, the final sentence appears to extend beyond what is directly supported by the analysis. While the surface moisture budget provides valuable information on the balance between atmospheric water inputs and losses, it does not directly quantify surface water availability, which is additionally controlled by processes such as runoff, infiltration, groundwater recharge, soil moisture storage, and human water use. Therefore, the conclusion that SAI could preserve surface water availability appears stronger than the evidence presented. The authors should either qualify this statement or provide additional analyses or supporting literature that establish a clear link between changes in P–E and surface water availability, particularly in West Africa. Given that this is a climatological analysis, neglecting runoff (R) may be reasonable for evaluating broad atmospheric moisture balance; however, it should be acknowledged that actual surface water availability depends on the full hydrological balance, including terms such as runoff and drainage (P–E–R–D).

L301-303: Can the trend values be quantified? It is hard to see the "increasing trend" for some of the scenarios like SSP3.4-OS and the SAI scenarios.

L304: Are these monthly averages, monthly totals, seasonal totals or daily averages?

The seasonal decomposition results appear to be inconsistent with the values presented earlier in the manuscript. Specifically, the moisture budget is reported to range between approximately 1.0 and 1.5 mm day⁻¹, yet the JJA seasonal values are stated to peak at approximately 4.0–4.5 mm day⁻¹. If these represent seasonal means of the same variable, such values would not be mathematically possible, suggesting either a difference in the quantity being analyzed (e.g., seasonal accumulation versus seasonal mean), a change in units, or a different processing methodology. Please clarify how the seasonal decomposition was performed, what quantity is being presented, and whether the reported units are correct. If these values are derived from a decomposition algorithm rather than a simple seasonal average, this should also be explicitly stated to avoid confusion.

Figure 6: Check figure units

L331-332: Beneficiary relative to what?

L371-373: citation needed "From an agricultural perspective"

L393-395: The higher moisture levels... This work does not show this result, hence the authors would need to back up this claim.

L401–409: This paragraph appropriately discusses the methodological limitations of the study, which provides useful context for interpreting the results. However, it would also be valuable for the authors to highlight the methodological strengths and innovations that underpin the contribution of this work. In particular, the manuscript would benefit from a discussion of what aspects of the experimental design, modeling framework, or analytical approach provide new insights beyond existing studies. Placing such a discussion after the limitations paragraph would help balance the presentation by emphasizing not only what the study cannot address, but also the robustness of the framework and the unique contributions it makes to understanding climate responses under overshoot and SAI scenarios. This would strengthen the positioning of the manuscript and better convey its novelty and significance.

References need to be alphabetised.

Figures 2, 5, A1 and A3: The font size of legends and labels is too small. Also, the figures pixelate when zoomed in for details.