

Review

Title: Quantifying atmospheric and land drivers of hot temperature extremes through explainable Artificial Intelligence

Authors: Arnau Garcia Mesa, Lluís Palma, Markus Donat, Stefano Materia, Bruna Gràvalos Tallo, and Raúl Marcos Matamoros

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General:

Summary:

This work studies the impact of land and atmospheric drivers of hot extremes, specifically taking into consideration the modulation and contribution of CO₂ as an anthropogenic driver. To this end they combine pre-established deep learning and explainability methodologies with brought data sources (reanalysis and observation data) and input variables, into a novel and transparent framework. In various experiments, the authors dissect the contributions of atmospheric circulation, regional CO₂ signal and soil moisture impact, in line with previous findings and relaying novel insights.

Evaluation Criteria

- 1) Scientific significance:** The manuscript and corresponding work present valuable contributions to the climate community. While the authors mainly leverage established methodology, the combination of data sources, network approach and explainability method facilitates detailed scientific analysis of extreme weather drivers and can be framed as a novel diagnostic tool progressing insights on future warming.
- 2) Scientific quality:** The paper presents grounded and thorough research. All findings are sufficiently supported by rigorous statistics and used methodologies are statistically validated and robust. I also appreciate the extent of the experiments. According to the author response letter and marked changes, the author's also appear to have addressed previous review remarks in depth.
- 3) Presentation quality:** With the exception of few and very minor technical errors, the manuscript is well-written and clearly structured. All figures and tables are presented in a concise way and aid the readers understanding of the findings and relayed methods. I added some minor

suggestions in the technical comments. However, I am not requiring the suggested changes for a manuscript publication.

Technical corrections:

- Line 79: section 2 -> Sect. 2
- Line 103: section 2.4 -> Sect. 2.4
- Line 132: sec 3 -> Sect 3.2
- Line 188: change to “we trust the class imbalance by training the model with a weighted loss function.”
- **Figure 3:** Reader would profit from an improvement. Include details of the ConvNeXt. Currently the written description is only of limited value due to its complexity.
- Line 304: higher-latitude? Is Lyon considered high latitude?
- Line 462: uper -> upper
- Line 467: analysied -> analysed
- Line 479: “We also analyse two case studies to further study the explainability technique” This to me is a misleading formulation since the case studies are meant to provide further insight on the networks predictive behaviour rather than on the explanation techniques used to analyse the predictions.