Author comments (AC) **(in bold and blue)** to the referee comments (RC) **(*in bold and italics*)**

Shortly about myself to better interpret my review: I am an agricultural economist postdoc fellow, working in the interdisciplinary field of agricultural trade, food security, with application of econometrics and machine learning, mostly interpretable. I have no in-depth background in climate change.

AC: We thank referee 2 for reviewing our manuscript. His/her field of expertise is important for our work, because we used historic climate data to predict impact on crop yield variability using machine learning algorithms. Although Climate Change is a critical challenge, we have not addressed it directly in our manuscript. As a response to this comment, we will make sure to thoroughly review the manuscript to make sure that the aspect of climate change is better explained.

Summary:

The paper uses the Climatic Impact-Driver (CID) approach to evaluate the impact of climate risks on food security, focusing on maize and soybeans in Brazil. The authors use data-driven methods and machine learning models to identify the most relevant climate indices and their thresholds that increase the impact probability. They found that mean precipitation is a key CID, with specific thresholds indicating increased risk of crop yield losses. The study emphasizes the relevance of both extreme and mean climate indices in assessing climate risk on agriculture, contributing to decision-making and policy development in response to climate change.

AC: We thank referee 2 for summarizing our work and providing the key aspects of what we've done. While we are happy that we were able to convey a clear message, we would benefit from learning more about his/her technical judgment about our manuscript.

Introduction

I find the introduction comprehensive and insightful, providing a clear overview of the challenges associated with predicting crop yield variability in response to climate extremes. The emphasis on the importance of considering multiple weather variables and employing models that incorporate sector-specific vulnerability and exposure adds depth to the discussion, highlighting the complexity of agricultural risk assessment. The introduction's exploration of machine learning algorithms, particularly decision tree algorithms like random forest models, offers innovative possibilities for improving predictive accuracy despite data availability constraints.

Furthermore, I like the idea of using model interpretability techniques in the modeling framework to address the limitations of existing approaches. The integration of the CID framework promises a solid foundation for contextualizing climate in decision-making, aligning with the need for localized solutions in agricultural systems. Overall, the introduction effectively sets the stage for a research endeavor that holds significant potential for informing critical decisions and strategies aimed at enhancing food production resilience in the face of climate variability.

AC: We thank you again for the comment from referee 2. We truly value the feedback and will make sure to take the suggestions into account during our review process.

Methodology

This methodology section presents a comprehensive approach to investigate the impacts of climate extremes on soybean and maize crop yields in Brazil, which is of paramount importance for agricultural research and policy-making. The modeling framework outlined, with its emphasis on data filtering, variable selection, and threshold determination, offers a systematic way to analyze the complex relationships between climatic variables and crop yields. By integrating different interpretable machine learning techniques, the study ensures both predictive accuracy and interpretability, crucial for gaining trust of people who will later use the proposed modelling-framework.

The delineation of the study area and selection criteria for municipalities provide a clear understanding of the geographical scope and rationale behind the dataset selection. Moreover, the detailed description of data collection and processing, including the handling of outliers and missing values, enhances the reliability and reproducibility of the study's findings. Additionally, the inclusion of soil data enriches the analysis by considering the influence of soil properties on crop productivity.

However, while the methodology appears robust and well-structured, some sections could benefit from further clarification. As a non-expert in climate change, I could benefit from an explanation regarding the application of climate indices and their relevance to crop yield analysis. Providing more insights into the selection process of specific indices and their interpretation within the context of agricultural impacts would enhance the understanding of the wide audience. Overall, this methodology sets a solid foundation for investigating climate extremes' impacts on food production, contributing valuable insights to the field of agricultural economics.

AC: We thank referee 2 for the feedback. We selected the framework of climate impact-drivers (CID) from IPCC to increase the standardization of our work. Nonetheless, we have not evaluated explicitly the impacts of climate change on crop yields using (CIDs). The main idea of the work is to use explainable machine learning algorithms to select the most relevant CIDs for the crops selected in different geographic regions of Brazil. This process can be used to help decision makers to select climate indicators for impact modeling and monitoring. The applications can be

extended for crop yield losses forecasts, parametric insurance design and risk analysis. I am not really sure how referee 2

Results and Discussion

The chapter is clear and summarizes the article very well.

AC: We thank referee 2 again for taking time to review our manuscript. The comments are mostly summarizing the main idea of the paper and pointing out the aspect of climate-change in the methodology. We understand that climate change plays a fundamental role in risk analysis for crop yields, however, evaluating long term projections was not the main goal of our paper. We focused on using a data-driven method with historic climate data and crop yield data to select climate impact-drivers (CID).