First of all, we want to express our gratitude to the reviewers for their painstaking revision. We truly appreciate them because we believe they significantly improve the quality of the proposed work and its readability.

Report #1

This study applied three statistical downscaling methods (Delta method, Quantile mapping, and regression trees) on CMIP6, the newest climate change scenario. It estimated total precipitation and the number of rainy days, and conducted frequency analysis for testing results of the downscaling methods. However, this study has lacks some fundamental aspects. Firstly, it exhibits numerous issues related to paper formatting and writing errors. Furthermore, it fails to differentiate itself from related research and omits any discussions about the results. Since there are too many things to be fixed, only the most critical problems about the paper are presented as follows:

Question 1) The terminology lacks consistency. When employing abbreviations, they should be introduced initially, and these same abbreviations should be consistently used for referring to the corresponding terms.

Answer 1) Thank you for your comment. We fixed this issue by adjusting the abbreviations and reporting them in a table, as shown hereafter:

- AIDS: Artificial Intelligence DownScaling techniques
- ANNs: Artificial Neural Networks
- CMhyd: Climate Model Hydrology
- CMIP6: Coupled Model Intercomparison Project Phase 6
- DDS: Dynamic DownScaling
- DM: Delta Method
- GCMs: General Circulation Models
- GEV: Generalized Extreme Value
- GP: Genetic Programming
- Hidroweb: Hydrological Information System
- IPCC: Intergovernmental Panel on Climate Change
- KGE: Kling-Gupta Efficiency
- LM: Linear Methods
- MCG3: Model Coupled Global of third generation
- MCGs: Model Coupled Global
- NSE: Nash-Sutcliffe Efficiency
- QM: Quantile Mapping
- RCMs: Regional Climate Models
- RD: Number of Rainy Days
- RFA: Rainfall Frequency Analysis
- RMSE: Root Mean Square Error
- R: Pearson Correlation Coefficient
- RMBH: Metropolitan Region of Belo Horizonte
- SDS: Statistical DownScaling
- SSP1-2.6: Shared Socioeconomic Pathway 1 - 2.6 W/m2
- SSP5-8.5: Shared Socioeconomic Pathway 5 - 8.5 W/m2
- SVM: Support Vector Machine
- TP: Total Precipitation

Question 2) When listing references in the sentence, they should be arranged chronologically, from the most recent to the earliest. However, this paper's reference are currently presented in a disorganised manner.

Answer 2) Apologies for the inaccuracy, we corrected the reference orders as follows:

- *(Eekhout et al., 2018; Nashwan & Shahid, 2022; G. Wang et al., 2020)* was corrected to *(Nashwan & Shahid, 2022; G. Wang et al., 2020; Eekhout et al., 2018);*

- *(Semenov & Stratonovitch, 2010; Weschenfelder et al., 2019)* was corrected to *(Weschenfelder et al., 2019; Semenov & Stratonovitch, 2010);*

- *(Hassanzadeh et al., 2014; Niazkar et al., 2022; Sachindra, Ahmed, Rashid, et al., 2018)* was corrected to *(Niazkar et al., 2022; Sachindra, Ahmed, Rashid, et al., 2018; Hassanzadeh et al., 2014);*

- *Hashmi et al. (2011), Li et al. (2010), Mahla et al. (2019), Sachindra et al. (2014), Sachindra et al. (2018), Sachindra et al. (2018), Salehnia et al., (2019) and Wang et al., (2016)* was corrected to *Mahla et al. (2019), Salehnia et al., (2019), Sachindra et al. (2018.a), Sachindra et al. (2018.b), Sachindra et al. (2014), Wang et al., (2016), Hashmi et al. (2011) and Li et al. (2010)*.

- *Authors such as Hashmi et al. (2011), Hassanzadeh et al. (2014), e Ghasemi Tousi et al. (2021)* was corrected to *Authors such as Ghasemi Tousi et al. (2021), Hassanzadeh et al. (2014) and Hashmi et al. (2011)*

- *(e.g. Golkar Hamzee et al., (2019); Salehnia et al., (2019), Salehnia et al., (2020); Ullah et al., (2018))* was corrected to *(e.g. Salehnia et al., (2020), Golkar Hamzee et al., (2019); Salehnia et al., (2019), Ullah et al., (2018));*
- *... developed by Cannon et al. (2015), Enayati et al. (2021) and Heo et al. (2019).* was corrected to .... *developed by Enayati et al. (2021), Heo et al. (2019) and Cannon et al. (2015).*

Question 3) The rationale for conducting this study in the introduction is not clearly established, and the presentation of past related researches are overly succinct.

Answer 3) Thanks for this useful comment. As suggested, the literature review was extended to better illustrate the state of the art on the proposed topic, and consequently, to better identify the motivation and novelty proposed by this contribution. Specifically, some additional contributions were discussed in the introduction and the scope of this work was highlighted. The list of the new included contribution is reported along with the corresponding considerations.

- Rastogi, Deeksha, Shih-Chieh Kao, e Moetasim Ashfaq. 2022. "How May the Choice of Downscaling Techniques and Meteorological Reference Observations Affect Future Hydroclimate Projections?" Earth's Future 10(8):e2022EF002734. doi: 10.1029/2022EF002734.

  In this research, the authors conclude that the choice of DownScaling technique and the reference information significantly influences the downscaled data. They

evaluated two types of techniques, Dynamic and Statistical DownScaling. The results showed that Statistical downscaling preserved the GCMs' climate change signal but tended to overestimate the frequency of extreme heat events.

- Yang, Yi, Jianping Tang, Zhe Xiong, Shuyu Wang, e Jian Yuan. 2019. “An Intercomparison of Multiple Statistical Downscaling Methods for Daily Precipitation and Temperature over China: Present Climate Evaluations”. Climate Dynamics 53(7):4629–49. doi: 10.1007/s00382-019-04809-x.

  This study evaluated four DownScaling techniques: bias-correction and spatial downscaling (BCSD), bias-correction and climate imprint (BCCI), and bias correction constructed analogues with quantile mapping reordering (BCCAQ), and the cumulative distribution function transform (CDF-t) method. The results indicate that the BCSD method surpasses the others in relation to the distributions of daily temperature, precipitation and extreme precipitation indices. The methods based on quantile mapping demonstrate better performance in the reduction of seasonal scale and extreme precipitation in comparison with the CDF-t method. On the other hand, the CDF-t method significantly overestimated the consecutive days of chuva and the indices of extreme chuva, producing many days of mild chuva based on absolute or relative limits. It has been shown that there is no single DownScaling technique that is better than the others. The accuracy of the techniques depends on the specific purpose.

- Onyutha, Charles, Hossein Tabari, Agnieszka Rutkowska, Paul Nyeko-Ogiramoi, e Patrick Willems. 2016. “Comparison of different statistical downscaling methods for climate change rainfall projections over the Lake Victoria basin considering CMIP3 and CMIP5”. Journal of Hydro-environment Research 12:31–45. doi: 10.1016/j.jher.2016.03.001.

  In this study, three statistical downscaling (SD) methods were compared using daily rainfall data from 9 meteorological stations in the Lake Victoria basin (LVB) in Eastern Africa. The results showed that the three SD methods performed well in capturing monthly rainfall patterns. However, differences were observed in their projections of rainfall quantiles, highlighting the importance of choosing the SD method based on specific study objectives.

  Additional information about the scope and novelties of the proposed study are explained in Answer 7.

Question 4) Every choice made in the study must be supported by evidence. However, there is no clear rationale for the selection of the three downscaling methods or choosing RMBH as the study area, etc.

Answer 4) The choice of the study area was justified in the text, as shown below:

The study area encompasses the Metropolitan Region of Belo Horizonte (RMBH). The choice of this region is grounded in the fact that, as indicated by Nunez (2018), a significant portion of this area is directly or indirectly experiencing the consequences of extreme rainfall events. Between 1928 and 2000, 200 floods were recorded in Belo Horizonte, with 69.5% of these events occurring in the last two decades analysed, as

reported in a study conducted by Champs (2012). Furthermore, over 37 flood events were reported between 2000 and 2020.

Within this context, this study aims to contribute to the development of future research that assesses the impacts of extreme events based on CMIP6 projections.

Nunes, D. A. A. (2018). *Tendências em eventos extremos de precipitação na Região Metropolitana de Belo Horizonte: Detecção, Impactos e Adaptabilidade* [Tese, Universidade Federal de Minas Gerais]. https://repositorio.ufmg.br/bitstream/1843/BUOS-B3VGXU/1/tese_alinenunes.pdf

In addition, the use of Delta Method (DM), Quantile Mapping (QM) and Regression Trees (RT) has been selected as well-known state-of-the-art methods for downscaling belonging to both statistical and machine learning methods. For this purpose, the comparison of their results and the selection of the most suitable method for downscaling CMIP 6 precipitation is as a interesting argument of analysis.

Question 5) There is a lack of understanding of the concepts and methodologies used in this study. Firstly the commonly used Markov chain methods, nonlinear methods for introducing statistical downscaling methods are not presented. Futhermore, a minimum of 30 years is necessary for the frequency analysis, but this study set as 20 years. The important aspect in applying machine learning method is to appropriately define parameters. However this study just used default values provided by the program.

Authors) Sorry for the lack of description about Regression Trees training. The optimisation of hyperparameters was conducted using the automatic hyperparameter optimisation function available in the 'fitrtree' function in Matlab. The automatic optimisation process included a maximum of 40 iterations. The training procedure is included in the revised manuscript.

On the other hand, to fully leverage the available pluviometry data, we have revised our criteria. Initially, we considered stations with a minimum of 20 years of consistent records. However, according with your valuable indications, we have now chosen to focus exclusively on stations with a minimum of 30 years of consistent data. As a result, we will exclude the data from stations 01944055, 02044012, and 02044020 in our analysis.

Question 6) When presenting the results as figure, the range of axes on the figures varies from one figure to other. This inconsistency could lead the reader to misinterpret the results. The results were presented; however, there was no discussion regarding the underlying reasons for these outcomes.

Answer 6) Thank you for the comment. We agree that using the same axis range for all the plots can help to evaluate and compare the different results. We fixed it also adding a proper discussion section regarding both single-method performance and comparison.

Question 7) The major problem lies in the lack of novelty compared from related papers. This type of paper has been previously explored and merely applying CMIP6 does not constitute novelty.

Answer 7) Thank you for this comment. We would like to better explain the scope and the distinctive features of this work by clarifying it in the introduction.

The main intention of this contribution is to evaluate three state-of-the-art downscaling techniques in terms of amount and frequency in order to assess the most suitable method of adjusting precipitation. The majority of studies have evaluated downscaling methods in terms of seasons and total annual precipitation, but not a deeper analysis of downscaling method selection for precipitation has been proposed. As shown in the second point, the choice of downscaling technique could have an influence on the results. In this context, it is necessary to ensure the use of a representative downscaling technique for downscaling historical and projection CMIP6 data. Side new effects are also the type of data analysed, i.e. CMIP6 precipitation, and application region, Minas Gerais, Brazil.

To sum up, the aim of the study was to evaluate whether common downscaling techniques are a suitable option when the objective is to assess possible alterations in frequency analysis within the context of climate change. In this way, our study contributes to supporting the selection of the appropriate downscaling method for CMIP6 precipitation.

Report #2

The manuscript compared three downscaling techniques, i.e., the Delta Method (DM), Quantile Mapping (QM), and Regression Trees (RT), in downscaling CMIP6 climate model simulations in a region of Brazil. Downscaled precipitation was used to estimate total precipitation, the number of precipitation days, and precipitation quantiles, which were compared against observed data. The results suggest using Regression Trees for precipitation frequency analysis, while using Quantile Mapping for estimating multi-year total precipitation and precipitation days.

The major problem of the manuscript is lacking innovative points, since it only compared three well-developed techniques and didn't propose any new modifications. Downscaling climate models based on gauge data is also an old problem that has been investigated by many studies. The conclusion does not seem to provide new insights into the current research field. Also, the manuscript has lots of writing and formatting issues that need to be revised. Here are several comments:

Question 1) The title included "assess changes to rainfall amounts and frequency in climate change text," but I didn't find content related to evaluating changes in precipitation due to climate change. The downscaling methods didn't incorporate nonstationarity as well. This manuscript focused on evaluating the performance of downscaling techniques in downscaling climate models. Therefore, the title needs to be adjusted to match the main content.

Answer 1) We agree with the comment. In fact, the objective of the manuscript was to evaluate the performance of downscaling techniques in terms of precipitation quantiles, the estimation of total precipitation, and the number of rainy days per hydrological year. Therefore, we will eventually adjust the title to reflect the content, such as "Statistical and Machine Learning Methods to Downscale Rainfall Amounts and Frequency in Climate Change Context- CMIP 6 in Minas Gerais - Brazil".

Question 2) In line 205, "the multiannual level" needs to be clarified. Please clearly state that the precipitation metrics were computed over multiple years. In line 235, you seemed to mention that the number of years is the same as the period of station record. Please move this description to the methodology section.

Answer 2) The text was correct, as shown below:

Line 205: In addition to the annual evaluations, total rainfall and the number of rainy days were computed over multiple years using a percentage error calculation, as described below.

Line 235: The text was moved to the methodology.

Question 3) In Figures 2 and 3, the plot axis has a different range for each downscaling method, which makes it very difficult to compare. Including results from all the stations makes it more complicated to read. I suggest computing the average metrics from all the stations and comparing the three methods' results in the same plot.

Answer 3) Thank you for the advice. We agree that using the same axis range for all the plots can help to evaluate and compare the different results. Also, including the average of the various stations can support the overall understanding of the different downscaling methods. We think that including other types of plots can serve to assess the behaviour of the different methods, such as comparing the distributions of reference observation and methods outputs.

Question 4) The manuscript should add a discussion section to interpret and discuss the results. One potential topic is to discuss the reason why a certain downscaling technique performs better. For example, it is reasonable that regression trees and quantile mapping performed better in correcting precipitation quantiles because it is designed to correct the precipitation distribution. In contrast, the delta method only applied a multiplication factor to the precipitation amount and led to greater bias in precipitation quantiles.

Answer 4) Thank you for the valuable comment. We agree that the results are poorly discussed, and we intend to enlarge the discussion about the different results in downscaling both the amount of precipitation and the number of rainy days. The reasons for the different performances are analysed, including the average performance indicators of distribution, e.g. quantiles and variance.

Question 5) Lots of sentences need to be rephrased to improve clarity. Here are some places:

Line 51: "However, in practice, the main approaches employed are Statistical DownScaling techniques (SDS) and Dynamic DownScaling, however, into the SDS we found:…"

Line 177: "It was decided to train and validate the model based on the observed and simulated precipitation quantiles since it was not evident temporal correlation between the magnitudes of rainfall events;"

Line 214: "For total precipitation and the number of rainy days per hydrologic year, the high RMSE, low NSE and KGE, and R less than 0.6 and greater than -0.6 show that there is no temporal correlation between total precipitation and the number of rainy days per hydrologic year…"

There are many more places to revise. Please reduce the length of many long sentences and correct the grammar.

In Line 60, "Neural Networks (ANNs)" should be "Artificial Neural Networks (ANNs)". "Vector Support Machine" should be "Support Vector Machine."

Answer 6) Thanks for the carful indications. We intend to improve the readability and grammar of the text with careful English proofreading.