Response to the referee 1

MS No.: nhess-2023-63

We sincerely thank the reviewer for the positive evaluation and valuable comments of our manuscript. We are also very grateful for your recommendations for minor revisions which we believe will greatly enhance the quality and clarity of our paper. Accordingly, the revised manuscript has been improved with new information and additional interpretations. Below we describe our responses (in normal font) point-by point to each comment (in bold text). In addition, we indicate revisions in the updated manuscript by a yellow highlighter together with the line number.

Line 25: You define a new acronym for the Mediterranean Basin, but in the abstract, you define an acronym for the Mediterranean Region - are these the same thing? If so, just stick to one acronym. It would also be a good idea to define the region in terms of the latitude/longitude bounding box.

Thank you for your insightful comment. Indeed, our intention was to refer to the same geographical entity, which inadvertently led to the use of both "Mediterranean Basin" and "Mediterranean Region". We recognize the confusion this may have caused and have revised our manuscript to use a consistent terminology. To avoid ambiguity, we have stuck to the term "Mediterranean Region" (MedR) throughout the manuscript.

Regarding the definition of the region, we agree that providing an approximation in terms of latitude/longitude could help give readers a clearer understanding of the geographical extent of the study. However, it is important to note that the boundaries of the Mediterranean region are not strictly defined, as they can vary depending on the specific context and criteria used. In the context of our study, we roughly considered the Mediterranean region to encompass an area between 30°N to 46°N in latitude and 5°W to 40°E in longitude. This approximation includes key countries that have a Mediterranean climate, covering the southern European coast, the northern African coast, and the eastern Mediterranean countries. Nonetheless, we acknowledge that this is just an approximation, and the precise boundaries may vary.

In response to your proposition, we have added the coordinates to the caption of figure 1 to visually represent the spatial extent of our study area. The revised caption reads now as follows:

Line 112: "Figure 1: Topography of the Mediterranean Region, approximately defined by 30°N to 46°N in latitude and 5°W to 40°E in longitude."

Line 25: Plurality disagreement between "this kind" and "climate events" - suggested change: adaptation to this kind of climate event has been"

Thank you for your comment. We agree with your observation about the plurality disagreement. the sentence has been revised considering your suggestion (line 29).

Line 29: Need a comma after "For these reasons", and "Hotspot" doesn't need to be capitalized

Thank you for your comment. We have inserted the recommended comma and corrected the capitalization of "hotspot" in the revised manuscript.

Line 37: You should cite something about desertification and biodiversity loss

Thank you for your comment. We agree with the reviewer's suggestion. We have now added relevant citations that discuss desertification and biodiversity loss.

Line 40-42: "This will surely lead to irreversible biodiversity loss and diminish the capability of semi-arid Mediterranean ecosystems to function as effective carbon sinks in the future ==(Valentini et al., 2000, Briassoulis, 2017; Zeng et al., 2021)==."

Line 38: The sentence ends abruptly with "forthcoming".

Thank you for your attentive observation. We agree that the sentence in question ends abruptly and does not fully convey our intended meaning. Here's the revised sentence: Lines 40-42: "==This will surely lead to irreversible biodiversity loss and diminish the capability of semi-arid Mediterranean ecosystems to function as effective carbon sinks in the future (Valentini et al., 2000, Briassoulis, 2017; Zeng et al., 2021)=="

line 38: This sentence is awkward: "All these conditions exacerbate water stress that enhances in turn the probability of wildfire." Suggested change: These conditions exacerbate water stress, which, in turn, enhances the probability of wildfire."

Thank you for your suggestion. We agree that the recommended revision significantly enhances the readability and comprehension of the sentence. As such, we have incorporated your proposed change into the revised manuscript.

Line 42: "==These conditions exacerbate water stress, which, in turn, enhances the probability of wildfire (Turco et al., 2017a)==."

Line 84: Latter should be later

We agree with your observation. This was an oversight on our part, and we have rectified this in the updated version of the manuscript. Your feedback is greatly valued, thank you.

Line 94: Focus should be focuses

Thank you. This was corrected in the revised manuscript.

Line 197: No need for the "if"

We agree with your comment. We have duly made this modification in the revised version of the manuscript.

Line 198: Suggest changing "this figure tends to" to "which is expected to"

Thank you for your suggestion. We have incorporated this revision into the updated manuscript at line 232.

Line 482: resources shouldn't be plural

Thank you for pointing out this error. The necessary correction has been implemented in the updated manuscript at line 521.

Lines 602-604: Could you expand on this thought a bit? I find it to end a bit ambiguous. Could you maybe describe some of the biases that exist in some of the models that would warrant exclusion from using them in the MEDR?

We appreciate your request for further clarification on the selection of the most skilled GCMs ensembles and their respective biases which would warrant their exclusion in the MedR. Here's a more detailed explanation:

In the context of drought prediction, selecting the most skilled GCM ensembles for the MedR involves a careful assessment of their ability to simulate the large and synoptic scale atmospheric and land-surface conditions associated with drought development. This includes evaluating their performance in terms of temperature, precipitation, pressure patterns, and other critical parameters associated with drought phenomena in the region. There are inherent biases in GCMs that could lead to their exclusion. For instance, some GCMs may have a systematic overestimation or underestimation of key meteorological variables such as temperature or precipitation. In the MedR, which is characterized by a unique mix of continental and maritime climates, some models might struggle to accurately capture the spatial and temporal variability of these climatic factors, leading to poor drought predictions. Furthermore, biases can arise in simulating the complex topography of the region, its diverse land cover and land use characteristics, and the interactions between land and atmosphere. We would like to draw attention to the choice of the MME that have demonstrated superior performance in reproducing these conditions and thus provide more accurate drought forecasts in the MedR. However, the task is challenging and necessitates rigorous validation exercises for each GCM candidate, as well as continuous monitoring and updating of selected ensembles in line with the advancements in modeling technology.

In the revised manuscript, we now have a subsection entitled Multi-Model Ensemble where we explicitly detail this explanation. Lines 669-672: "By prioritizing ensembles that adequately capture the region's distinct climate characteristics, spatial-temporal variability, and land-atmosphere interactions, the MME forecasts can mitigate biases related to key meteorological variables such as temperature or precipitation and significantly improve the precision and reliability of drought predictions (Li et al., 2023; Ahmed et al., 2019)."

Section 5: You only mentioned one study (Bağçaci et al. 2021) that looked at CMIP6 GCMs. Are there more out there that you could review or is this a deficiency in the literature? If it is a deficiency in the literature, definitely drive that point home.

Thank you for your valuable comment. Indeed, the citation of Bağçaci et al. (2021) was meant to illustrate one of the recent and comprehensive analyses conducted on CMIP6 GCMs. There was a growing body of literature examining CMIP6 GCMs which has not been referenced in the manuscript. This was not meant to suggest a deficiency in the literature but rather to focus on the selected study due to its comprehensiveness and relevance to the topic at hand. However, we appreciate your recommendation to clarify this point in the manuscript. We have reviewed and incorporate additional relevant studies on CMIP6 GCMs.

Lines 718-725: "In a study conducted by Cos et al. (2022), the authors compared climate projections from CMIP5 and CMIP6 models to assess the impacts of climate change in the MedR. The findings reveal a robust and significant warming trend across all seasons, with CMIP6 models projecting stronger warming compared to CMIP5. While precipitation

changes show greater uncertainties, a robust and significant decline is projected over large parts of the region during summer by the end of the century, particularly under high emission scenarios. Seker and Gumus (2022) use 22 global circulation models from CMIP6 to project future precipitation and temperature changes in the MedR. The MMEs outperform individual GCMs in simulating historical data, and the projections indicate a decrease in precipitation by 15% for SSP2–4.5 and 20% for SSP5–8.5''.

Lines 644-645: You may want to explain what SSPs are. This is the first introduction of them and in the previous section you really only mention the RCPs from CMIP5.

Thank you for your insightful comment. We agree that the introduction of Shared Socioeconomic Pathways (SSPs) in the text could have been more clearly explained, and we appreciate your suggestion. Indeed, adding this explanation as a footnote could serve to provide necessary information without interrupting the flow of the main text. Here is how the footnote could be added:

Page 20, line 706.

[1] SSPs are the latest climate change scenarios used in CMIP6. They not only incorporate greenhouse gas emissions scenarios like their predecessor, RCPs from CMIP5, but also integrate socioeconomic factors, such as population growth, economic development, and technological progress. Essentially, SSPs provide a more holistic view of possible future climate scenarios by considering both environmental and societal changes.

References

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