Revision of manuscript **egusphere-2025-621**
*"Gridded Intensity-Duration-Frequency (IDF) curves:
understanding precipitation extremes in a drying climate"*
Responses to Reviewer 02

Cristóbal Soto-Escobar, Mauricio Zambrano-Bigiarini,
Violeta Tolorza, and René Garreaud

August 27, 2025

We would first like to express our sincere gratitude to the handling editor, Prof. Thomas Kjeldsen, and to the three anonymous reviewers for their valuable comments and suggestions, which have helped us to substantially improve the quality and clarity of our manuscript.

We hereby submit our detailed responses to the comments provided by Reviewer 02 regarding our article entitled "*Developing Intensity–Duration–Frequency (IDF) curves using sub-daily gridded and in situ datasets: characterising precipitation extremes in a drying climate*".

The main revisions introduced in the manuscript are as follows:

1. **New title**: following a comment made by Reviewer 01, the title of the manuscript was changed from "*Gridded Intensity-Duration-Frequency (IDF) curves: understanding precipitation extremes in a drying climate*" to "*Developing Intensity-Duration-Frequency (IDF) curves using sub-daily gridded and in situ datasets: characterising precipitation extremes in a drying climate*".

2. **Incorporation of reviewers' suggestions**: We implemented several of the proposed improvements, with the aim of enhancing clarity without unnecessarily increasing the manuscript length.

3. **Revisions to figures to improve clarity and conciseness and reduce redundancy**:

   - Figure 3: Number of subplots reduced from 25 to 5.
   - Figure 5: Combines the previous Figures 5 and 7, retaining only the most representative results.
   - Figure 6: Merges the previous Figures 6 and 8, reducing the number of subplots from 40 to 8.
   - Figure 8: Integrates the previous Figures 9 and 10, decreasing the total number of subplots from 16 to 8.
   - New Figure 7: Introduced to present a scatter plot comparing intensities derived from stationary and non-stationary models.

4. **Expanded bibliography**: Additional references have been included, following the reviewers' suggestions as well as our own evaluation, to strengthen the scientific context of the study.

5. **Updated supplementary material**: The supplementary files were revised to include metadata of the rain gauge network and several new figures. Furthermore, some material originally in the supplementary section has been incorporated into the main manuscript to improve accessibility of key information. The new supplementary material can be found on `https://doi.org/10.5281/zenodo.16956066`.

In the following sections, we provide a point-by-point response to all comments raised by Reviewer 02. We hope that our detailed explanations will satisfactorily address all concerns.

REVIEWER 2

R2C0: Currently, much of the relevant material is included only in the supplementary section. As a suggestion, rather than presenting the full set of figures (i.e., stationary Imax, non-stationary Imax, and their differences) for every dataset, it may be more effective to focus on the most representative or significant datasets. For these selected cases, a single composite figure showing the stationary, non-stationary, and difference plots side by side could be included in the main manuscript. This approach would enhance clarity, reduce redundancy, and allow for the inclusion of more illustrative results in the main document without overwhelming the reader.

Thank you very much for your suggestions. To improve clarity, reduce redundancy, and include relevant information directly in the main manuscript, we made several changes to the manuscript. First, we redesigned Figure 3 to enhance its visualisation, reducing the original 25 subplots to 5, as noted in response to R1C10. Additionally, we merged the content of the previous Figures 5 and 7, Figures 6 and 8, and Figures 9 and 10 into the new Figures 5, 6, and 8, respectively. These changes reduced the number of subplots and helped to easily focus on the main message of each figure, as illustrated below:
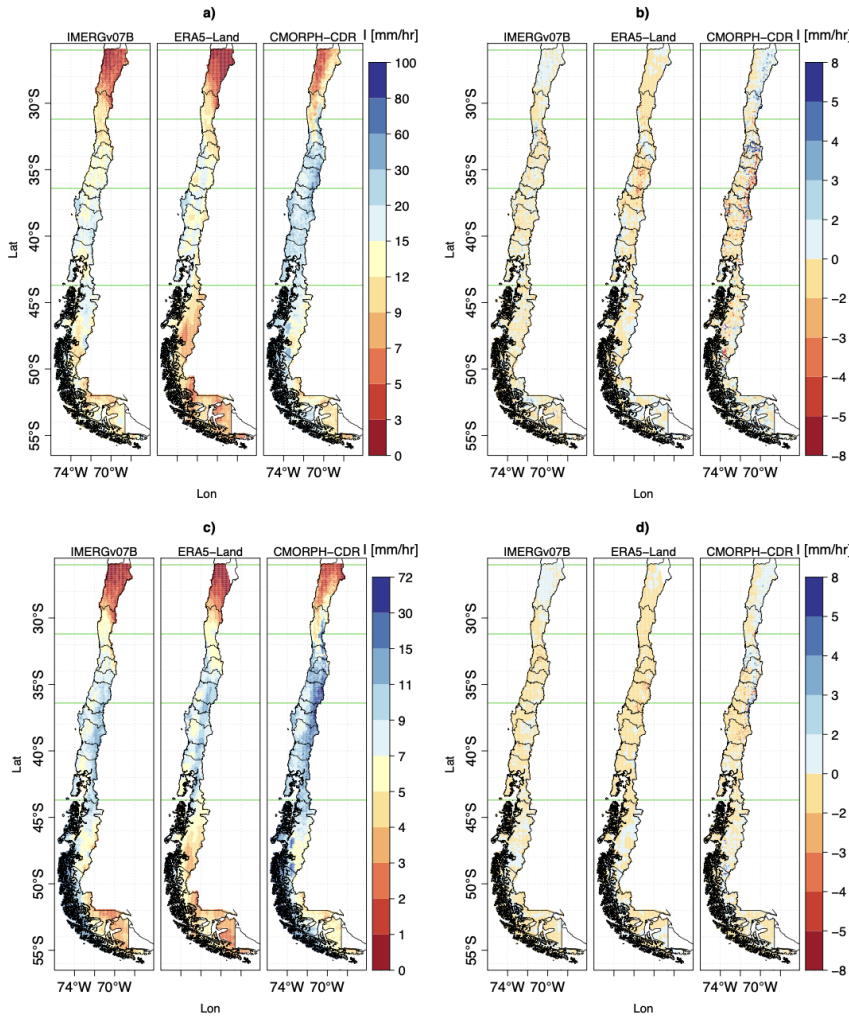
Figure 5. Panels a) and c) display maps of I_{max} derived from the stationary model for the IMERGv07B, ERA5-Land, and CMORPH-CDR, for a 50-year return period: panel a) shows results for the 2-hour duration, and panel c) for the 12-hour duration. Panels b) and d) present maps of the differences in I_{max} between the non-stationary and stationary models for the same datasets and return period, with 2-hour duration in panel b), and 12-hour duration in panel d).

25
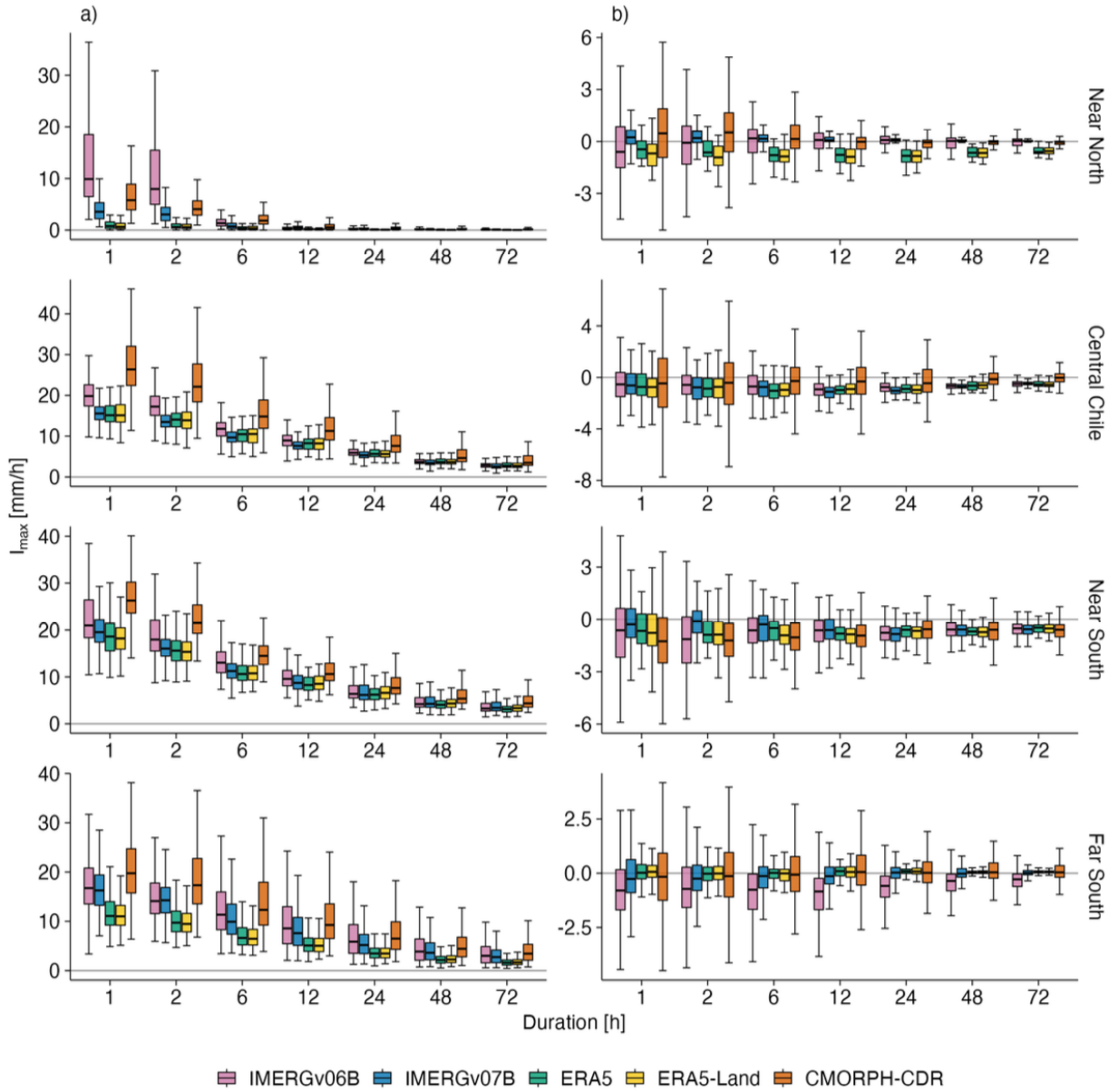
Figure 6. Boxplots of I_{max} for all gridded datasets and climatic macrozones, corresponding to a 50-year return period and durations of 1, 2, 6, 12, 24, 48, and 72 hours. Panel (a) shows the values derived from stationary models, while panel (b) presents the differences in I_{max} between non-stationary and stationary models, for the same datasets, climatic macrozones, and durations.
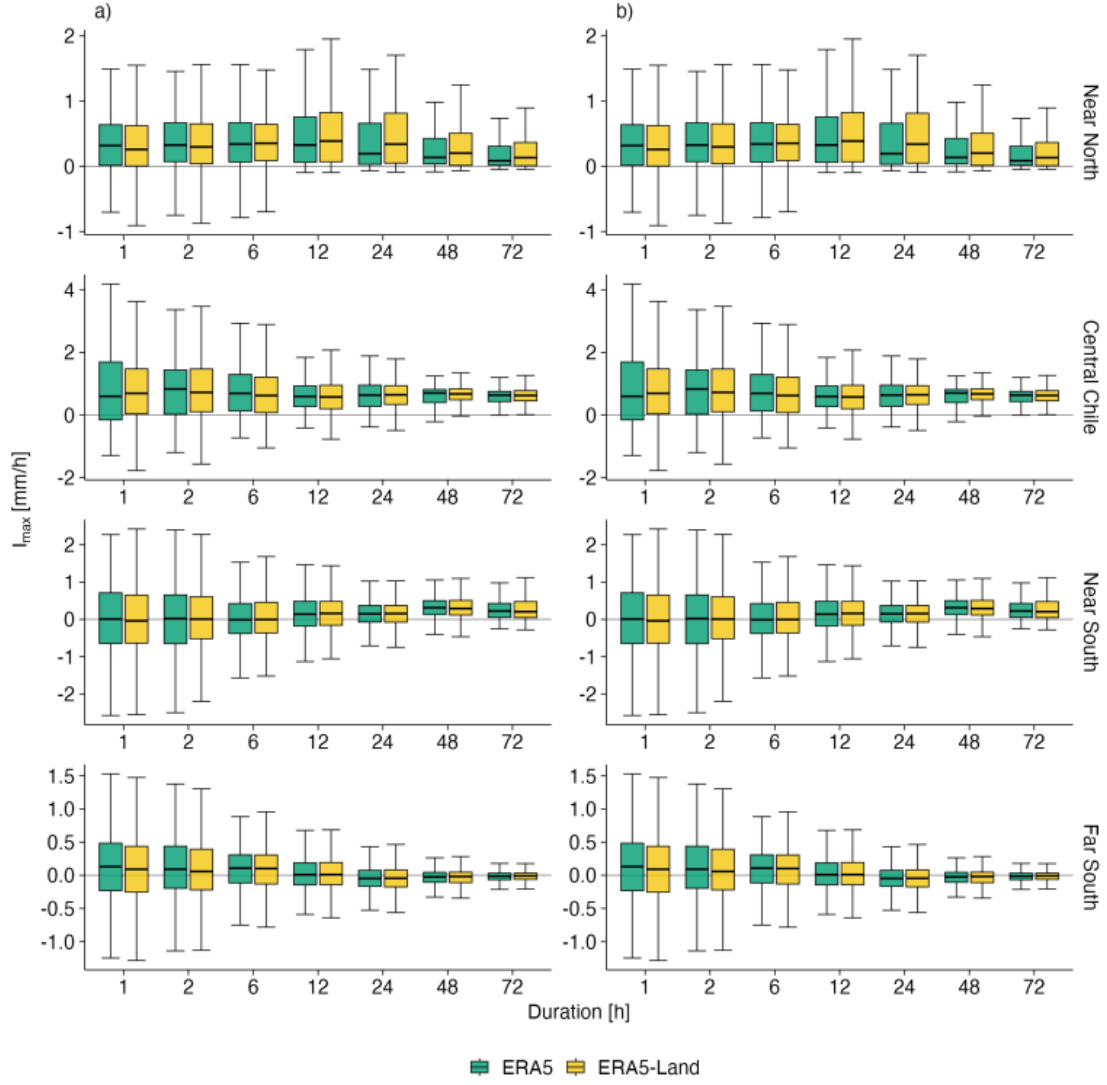
Figure 8. Panel of boxplots summarising differences between I_{max} derived from stationary and non-stationary models, estimated using data series of 40 and 20 years ($I_{max,40years} - I_{max,20years}$), for ERA5 (green colour) and ERA5-Land (yellow colour), considering a 50-years return period and durations of 1, 2, 6, 12, 24, 48, and 72 hours. From top to bottom, each panel corresponds to a different macroclimatic area. Column a) shows results obtained using the stationary model, while column b) shows results from the non-stationary model.

R2C1: Regarding the sections 4.6 the details currently provided in the supplementary material could be incorporated into the main text, at least one example per case, to enhance clarity and support interpretation.

Thank you for your suggestion. In Section 4.6 we have created a new Figure 9 to support the interpretation and discussion about the Gumbel parameters, which is depicted below:
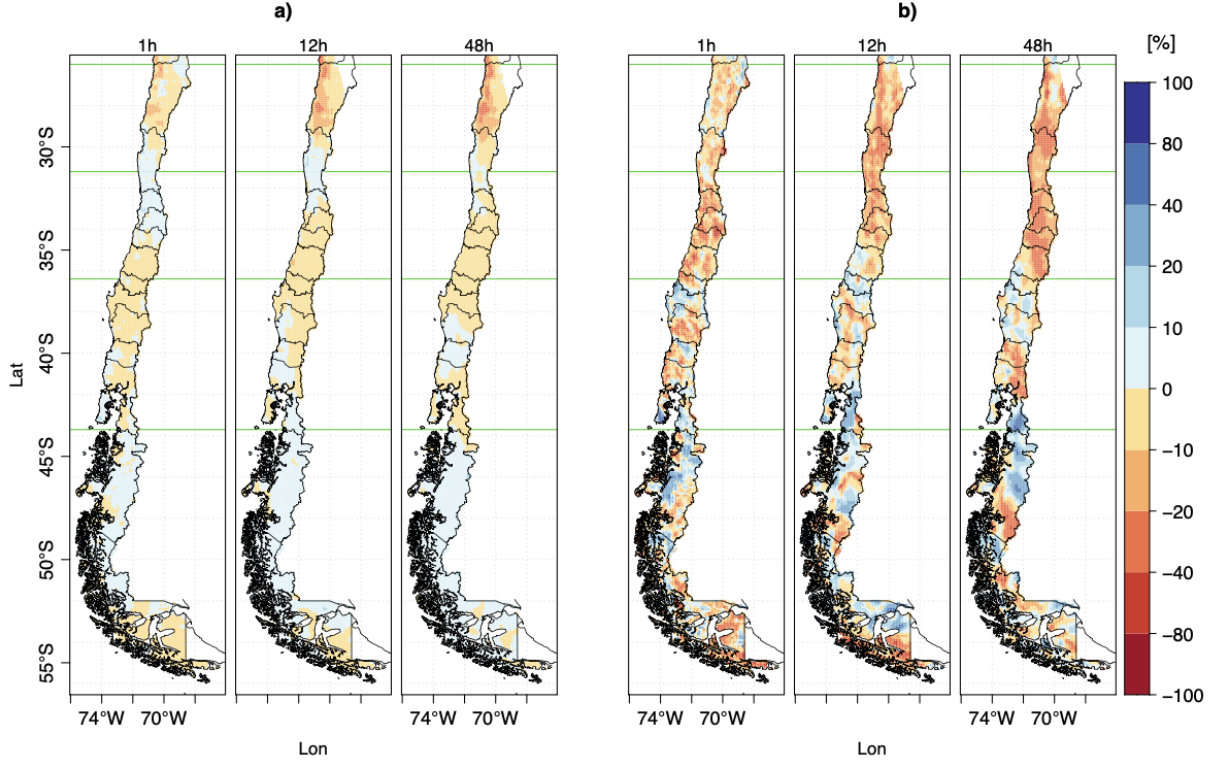
Figure 9. Maps displaying, in panel (a), the percentage difference in the Location parameter between the periods 1981–2021 and 2001–2021 for the ERA5-Land dataset, and in panel (b), the percentage difference in the Scale parameter between the same periods for the ERA5 dataset. Results are shown for durations of 1, 12, and 48 hours.

R2C2: The content and purpose of Figure 7 are not entirely clear, as there is an apparent inconsistency between the figure caption and the explanation provided in the main text. A clearer alignment between the figure, its caption, and the accompanying discussion is recommended to improve reader comprehension.

Thank you for pointing out this inconsistency. A new Figure 5 now combines the previous Figures 5 and 7, retaining only the most representative results (as mentioned in our response to R2C0 and R3C4). The alignment between this new figure, its caption, and the accompanying discussion was checked and improved.
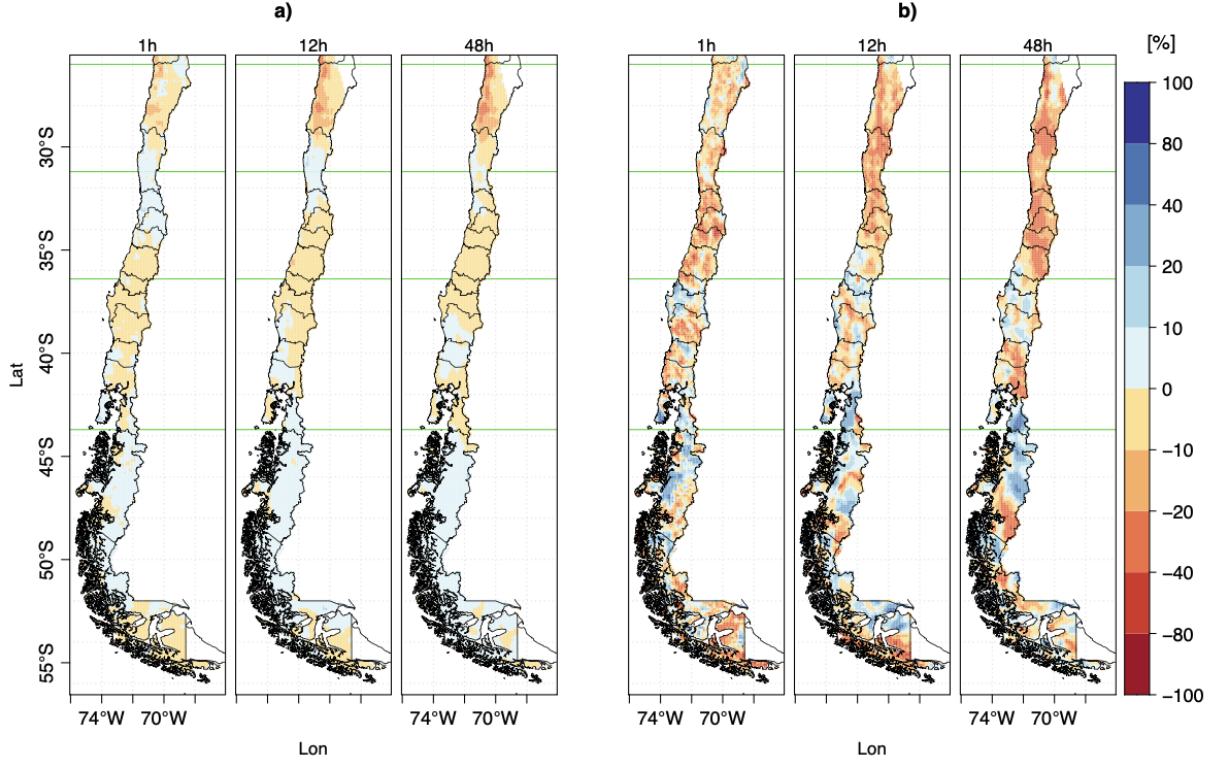
Figure 9. Maps displaying, in panel (a), the percentage difference in the Location parameter between the periods 1981–2021 and 2001–2021 for the ERA5-Land dataset, and in panel (b), the percentage difference in the Scale parameter between the same periods for the ERA5 dataset. Results are shown for durations of 1, 12, and 48 hours.

R2C3: Title of Figure 9: Could you please revise this in English to make it more polite?

Thank you very much for pointing out this error. In the current version of the manuscript this figure was replaced (see our response to R3C4), with careful consideration about the usage of English language.

R2C4: Page 18 - Trends in Imax: It is unclear which specific results from the Mann-Kendall trend test are being referred to; clarifying this would strengthen the interpretation. To better support the statement that the results of the trend analysis were similar, it would be helpful to include representative Kendall's tau values in the text. This would also aid in clarifying the patterns shown in the subsequent figures.

Thank you for your comment. We have rewritten the text as follows:

" *Figure 4 shows that IMERGv07B presents isolated increasing trends for both 2- and 12-hour durations in the Near North (τ values of [0.2, 0.68]), and decreasing trends in the Valparaíso and Metropolitan regions in Central Chile (τ values of [−0.2, −0.5]), with a larger area with decreasing trends as the duration increases, which similar for all durations. In the Near South, IMERGv07B shows almost no trend for the 2-hour duration, a pattern that remains similar for durations up to 8 hours; for 12 hours and longer, it presents decreasing trends (τ values of [−0.2, −0.7]). In the Far South, only isolated increasing trends are observed for all durations. On the other hand, ERA5-Land shows decreasing trends in the Near North for the 12-hour duration (τ values of [−0.1, −0.4]), a behaviour that is also observed for durations between 6 and 72 hours. For all durations from Valparaíso to the Biobío regions*

(32–38° S), decreasing trends are observed (τ values of [−0.3, −0.68]), and there are no significant trends for any duration south of 38° S. Finally, CMORPH-CDR displays decreasing trends for all durations and across the entire continental area of Chile (τ values of [−0.2, −0.78]). "

R2C5: Figure 3: To enhance clarity, the distinction between the red and black lines in the boxplots should be clarified in both the text and the figure caption.

We thank you comment. To reduce redundancy, we decided to eliminate the red line that highlighted the median values and completed redesigned this figure, as described in the response to R1C10.

R2C6: Page 13 - Stationary Max : While the GEV location parameter μ is often informally linked to central tendency measures such as the mean or mode, it is more precisely interpreted as a proxy for the mode.

Thank you very much for the accurate suggestion. We rephrased this text as follows:

" where μ is the location parameter, that is often informally associated with central tendency, is formally linearly related to the mean, and only coincides with the mode if $\xi = 0$. "