Thank you very much for your feedback. I hope the responses are satisfactory and help improve our work

Referee #1:

Referee: *I consider that this is a valuable work. On one side, it gathers many historical data, and this is something that in my opinion is extremely important since it implies data preservation, control and also their digitalization, which is a complex task considering that some of the records had flaws and damages. So, this is a key contribution of this work.*

I also find it valuable the identification of the eclipses together with the ionosonde data for the corresponding periods. Even if most of them are not adequate for analyzing the effect of the eclipses on the ionosphere parameters as the authors intended to.

Another valuable aspect, is the analysis focusing on the effect on the critical frequencies (foE, foF1 and foF2) of the maximum darkness of each eclipse, instead of the effect of the different degrees of obscuration within a given eclipse. This is novel to me.

Based on all this, I consider that this work should be accepted for publication but it needs a major revision. Following are my comments and suggestions:

Major comments:

(1) In the Abstract it is written "Regression analysis was performed exclusively on critical frequencies, revealing a nearly linear decrease of foE with increasing solar obscuration"

This looks like you analyze the dependence with the obscuration along an eclipse. And this is not what is done in this work. Or at least what I understood. You analyze the dependence with the maximum obscuration of an eclipse.

I think this should be stated clearly in the abstract. In fact, this is the novelty of the work, in addition to the valuable work of collecting the data. Even though the results obtained, in my opinion, lack statistical significance, and a more clear explanation of the method and exclusion of events and data are needed.

Authors: Thank you for your comments. We agree with your observation, and the corresponding changes have been made to improve the clarification of the analysis performed (new text in Abstract and line 67-68 of Introduction)

Referee: *(2) In the Introduction, the authors mention that the "purpose of this work is to characterize the response of the Concepción (36.79°S, 73.03°W) ionosphere under solar eclipse conditions over several solar cycles, so that its response can be associated with parameters such as the amount of darkness, season, time of day, etc., in order to predict the response for future eclipses." but you do not do all this because the limitations in the data.*

In fact, the effect you analyze is of the maximum obscuration per eclipse over ionospheric

parameters.

I do not see either the analysis of this effect in terms of time or solar cycle phase.

In Figure 4 I see all the four events selected without any discrimination.

I think that either you can mention that this was the initial purpose, before gathering the data, and explain then that the work is more like a compilation of data during eclipse events (which is very valuable, even if the data are not well suited for the analysis you do), or state from the beginning what is made in this work. And also mention clearly that you analyze not the effect of the obscuration degree within a given eclipse but of the effect of the maximum obscuration per eclipse.

I understand that this is not an easy task, since precisely, you have to gather data of many events, which are not so frequent.

Authors: We agree with the reviewer that the original objective stated in the Introduction is too broad given the limitations of the historical data. Following your suggestion, we revise the Introduction to clearly state that the primary focus of this work is the analysis of the effect of maximum obscuration per eclipse on the ionospheric parameters, rather than the progression of obscuration within a single event (new lines 62-65)

Furthermore, regarding the analysis itself, we have expanded our study to address the lack of discrimination mentioned in Figure 4. We have now incorporated an analysis based on the time of day and separated the events according to solar activity levels to provide a more robust statistical interpretation (new text in Figure 4 and lines 203-210)

Referee: *(3) From 21 periods, only 4 are analyzed. Statistically this means something. First you discard those eclipses without data. But then you select 4 within those with data, which show an effect.*

Those not included means something to your statistics. If you have for example 10 eclipses and only in 4 you detect the effect, the phenomenon detected has also a percentage of occurrence. Which in the case of being 4 to 10, it will be 40 %. With which the significance of your regression coefficients are even lower.
Authors: You are right. We discuss this point in the Discussion section. In addition to the requested modifications, we performed a more detailed analysis of the dataset and identified two additional points suitable for the regression analysis. Their inclusion improved the statistical significance of the regression lines presented in the revised manuscript (new lines 205-216, new Figure 4 and Table 2).

Referee: *(4) I think that you choose one single point of foE, foF1 and foF2 for each of the four selected eclipses. Do you think that the time resolution of the data may have some influence? Since it is not the same if you choose an foE data, for example, from a time series with 5 minute resolution, than if you have a 15 minute resolution. Unless the variability of the percentage of*

darkness within an eclipse around the maximum darkness, varies very slowly. Please explain this.
Authors: We agree with your observation. Since multiple sampling frequencies are used, we include a paragraph discussing the impact of time resolution on the analysis (new lines 273-278)

Referee: *(5) About Figure 4. What are the statistical significance of these regressions? You have very few points; only four.*
Authors: We include this information in the revised version (new lines 253-260)

Referee: *(6) In the Conclusion: "This work analyzed the response of the Concepción/Chillán ionosphere to 16 selected solar eclipses ..." You did not analyze all them. You have gathered the data, and presented them. But you have analyzed only 4 events. Unless you discuss also the events which you do not include in the regression analysis.*

I think that you should clearly mention which are your valid results, and also explain the difficulties on carrying a study like this.

For example, that even if you have the data, they have many times gaps which prevent the study, or due to the analysis has to be based on high temporal resolution data, the disturbances are more notorious and blur the eclipse effect, for example. I assume you may have more arguments.

Or may be I am wrong. So please, elaborate on this.

Authors: We explain this aspect more clearly in the Results and Discussion section (new lines 291-300) and Conclusion (320-323), including its relation to the events that were not included in the analysis.

Referee: *(7) A data availability section is missing, which I think is very important. You should say where are the data available, or at least how anyone can have access to them.*

Authors: We agree. A repository is created for this purpose, together with the corresponding instructions (new lines 328-332)

Referee: *Minor comments:*

(1) In the abstract: "Concepción (36.79°S, 73.03°W/Chillán (36.64°S, 71.99°W)" should be" Concepción (36.79°S, 73.03°W)/Chillán (36.64°S, 71.99°W)"

(2) h'F2/F ? Shouldn't it be just h'F2 ?

(3) Line 47: Smith and King, 1981; Bremer, 1992; Ortiz de Adler et al., 1997; Jarvis et al., 1998; Foppiano et al., 1999 ... The years should go between parenthesis.

(4) Line 91: "(1957–1994," should be "(1957–1994),"

(5) Line 101: "Software de Corrección de Ionogramas (SoCIo)". Which is it source ? or reference ?

(6) Figure 1: In the panel showing Eclipse on 13-11-2012 the dashed line indicating maximum darkness is missing, since it coincides with the End time. What does this mean? Why isn't there a period after maximum darkness of recovery?

(7) 18-3-87 is also missing the dashed line indicating maximum darkness. In this case I can see it coincides with the beginning. Why this happens?

(8) Figure 4: I think the the last panels correspond to delta F2. Please check.

(9) Line 181: Which are the four selected events? You should mention them clearly

(10) Line 206: "This degradation reflects the additional variability introduced by diurnal, seasonal, and solar cycle variations in baseline foE values" In the case of percentage values you can assume that you are kind of independent of hour or solar cycle phase, since you are dividing the difference in each parameter by the median value. So I would expect an effect when you consider the absolute difference, not the relative. Please explain.

Authors:Authors: Overall minor comments response:

(1)(3)(4) Thank you. All these minor comments related to writing corrections are addressed in the revised version.

(2) With respect to h'F2/F or simply h'F2, this is mainly a matter of historical notation. During nighttime conditions the parameter is denoted as h'F, whereas during daytime it is denoted as h'F2 because the F region is separated into two layers.

(5) A GitHub repository containing the source code of SoCIo is now provided.

(6)(7) Regarding the eclipse on 13-11-2012 in Figure 1, the vertical dashed line representing maximum darkness is absent because the maximum obscuration occurred after local sunset. Consequently, no recovery phase is observed because the Sun was already below the horizon and the photoionization source for the ionospheric layers was no longer present. The same situation occurs for the 29-03-1987 eclipse, but before sunrise.

(8) In the last panel of old Figure 4, you are correct; it corresponds to ΔfoF2 (historical notation difference).

(9) The selected events are 1966, 1973, 1979, and 2020. This information is now included in the revised version (Table 2).

(10) There is a wording error. This has been corrected in the revised version.

Referee #2:

Referee: This paper reports the results of an investigation into ionospheric effects that occurred during the passage of solar eclipses over Chile, using historical data of ionosonde observations between 1957-2024. Specifically, this paper examines the absolute and relative changes in a number of scaled ionospheric parameters (foE, foF1, foF2, h'E, h'F1, and h'F2) for various solar eclipse cases with varying level of solar obscuration over the ionosonde station. Using best fit linear regressions, the paper makes statistical predictions of the expected reduction in foE, foF1, and foF2 for an upcoming solar eclipse event which will take place on 6 February 2027. The paper also highlights the importance of salvaging older ionogram records (e.g. on films) and converting them into digital format that would be easier to preserve in long-term archive for future uses.

Below are a number of questions and suggestions.

Authors: Thank you very much for the review. We hope the manuscript has been improved following your suggestions.

Referee: The various instances of solar eclipse over Central Chile from 1957 to 2024 generally happened at different phases of the solar cycles with different solar flux (different f10.7 solar flux index values). These differences in f10.7 can be expected to affect the background foE, foF1, and foF2 values --- and hence the ΔfoE, ΔfoF1, and ΔfoF2 reduction values due to the solar eclipses. Have the authors considered leveling/compensating the background foE, foF1, and foF2 values (as well as the ΔfoE, ΔfoF1, and ΔfoF2 reduction values) at these various solar eclipse events based on the corresponding f10.7 values to make them "equivalent" despite their happening at different phases of the solar cycles?

Authors: We agree that the expected impact on the ionospheric parameters is related to the solar flux levels and the different phases of the solar cycle. However, we consider that this compensation is already implicitly addressed through the calculation of the percentage deviations (%ΔfoE, %ΔfoF1, and %ΔfoF2), which normalize the variations relative to the background state. For greater clarity, we include a Table 2 detailing the events considered in the linear regression analysis together with their corresponding F10.7 solar flux indices (Table 1, and new Figure 4).

Referee: A similar point with regard to the local times of these solar eclipse events: have the authors considered leveling/compensating the background foE, foF1, and foF2 values (as well as the ΔfoE, ΔfoF1, and ΔfoF2 values) based on the local times of the solar eclipses?

Authors: We appreciate the suggestion. Nevertheless, as with the previous point, we consider that the normalization regarding local time is already implicitly incorporated by expressing the results as percentage deviations relative to the reference median values at the corresponding local time. To better illustrate this aspect, we include a new figure (new Figure 4) showing the distribution of the selected events as a function of local time and solar cycle phase.

Referee: Different solar eclipses generally also have different trajectories. Over Chile, the variation of solar eclipse trajectories may include whether or not the solar eclipse crossed the equatorial ionization anomaly (EIA) crest --- and how the EIA was crossed if it did. Perhaps the authors should address this aspect in the manuscript due to potential complexity this may cause in the variability of the data points.

Authors: We completely agree with your observation. We recognize that the different eclipse trajectories, particularly their passage across the Equatorial Ionization Anomaly (EIA) crests, may introduce additional complexity to the observed variability. We expand the Discussion section in the revised manuscript to address in greater detail the potential influence of eclipse trajectories crossing the EIA region (new lines 261-268).

Referee: In the Introduction section (lines 35-44), I believe the authors can and should include more references from the literature to solidify the background information provided in the section.

Authors: We appreciate your comment. We carefully review the Introduction section (lines 35–44) and expand the literature review by including recent and highly relevant references, thereby strengthening the theoretical background of the study (new references in lines 36-54).

Referee: In the manuscript text, please make sure that all abbreviation (e.g. VLF, GNSS, TEC) are defined on their first use.

Authors: Agreed. We thoroughly review the manuscript to ensure that all abbreviations (e.g., VLF, GNSS, TEC) are correctly defined at their first appearance in the text.

Referee: Line 131: "Reference day values were obtained from monthly median parameters of each eclipse event..." I think the authors should clarify here whether the eclipse-day was excluded from the median value calculation.

Authors: We use the monthly medians extracted from our historical records (both physical and digital) as reference values. The day of the eclipse is indeed included in the calculation; however, we choose to use the monthly median because of its statistical robustness against outliers, minimizing any potential bias introduced by the eclipse effect. In cases that hourly monthly median values were unavailable, the previous day was used as the reference condition. In two particular cases, neither the hourly monthly median values nor the previous day provided suitable reference conditions during the eclipse interval. In these cases, IRI 2020 model was used.

All ionospheric parameters are calculated strictly following the standards established by Piggott and Rawer (1972). We clarify this methodological aspect and add the corresponding reference in the revised text.

PIGGOTT, W. R. & RAWER, K. 1972. U.R.S.I. Handbook of Ionogram Interpretation and Reduction. U.S. Department of Commerce National Oceanic and Atmospheric Administration-Environmental Data Service, Asheville, North Carolina, USA, 326pp.

Referee: Table 1: I believe it would beneficial to clarify if the start, maximum, and end times of the eclipse are at ground level or at some representative ionospheric altitude.

Authors: Indeed, the start, maximum, and end times of the eclipse correspond to ground-level observations. We modify the caption of Table 1 to explicitly state this information.

Referee: Figures 1-3: It may be useful to mention in the caption that the date is given in dd-mm-yyyy format.

Authors: We appreciate the suggestion. We update the captions of Figures 1 to specify that the dates are presented in the dd-mm-yyyy format.