We would like to thank the first referee for his time, valuable feedback, and comments. The authors' comments and response (in red), and the changes will be in the new version of the manuscript (in red).

Review of "Measurement report: Influence of the Antarctic Ozone Hole in Southern Brazil: Conceptual model for 42 years of analysis the atmospheric dynamics on ozone"
Gabriela Dornelles Bittencourt et al.

Unfortunately the resubmitted manuscript did not contain the significant changes I would have expected to see in response to the referees' comments, and therefore very major revisions are still required before this work might be considered acceptabçe for publication.
The authors thank you for your understanding, and a new version of the manuscript will be presented with all the requested explanations and suggestions.

I found it very difficult to follow even the basic steps of the analysis. The writing style is still very unclear. Often a great manu words are used without conveying much information but then the key details are missing. (At least, I couldn't find them).
The text will be remodeled and rewritten for better understanding.

This meant I couldn't really understand what had been done in the different steps in the analysis in sufficient detail and in particular, how the conclusions had been arrived at. This is particularly so for the ″conceptual model‶ which seems to be unconnected to the rest of the manuscript and not supported by the results presented.
More information and details will be included in the new version

I also note that a lot of the analysis conters on the ″24.1 – 28 km‶ height range, even though this is higher up in the stratosphere than the ozone depleted region of the ozone hole (approximately 12-22 km). Perplexingly though, the authors' conceptual model (Figure 14) shows the low-ozone air arriving at the latitude of Santa Maria in the mid-troposphere (700-500 hPa). The SABER data presented in Figures 4, 8 and 9 only goes down to 20 km so it is very hard for me to see how ozone variations in these very different height levels relate to each other (and to variations in total ozone) and how any of the data shown supports the conceptual model.
The initial idea of this manuscript was to present the dynamic behavior of the atmosphere, in mid-latitude regions, with the arrival of events influenced by the Antarctic Ozone Hole, in regions different from its initial position. For this, reanalysis data (ECMWF ERA5) was used with a database of 42 years of data (1979 - 2020), a period that coincides with the total ozone column database for Santa Maria. With this, the objective was to show the stratospheric dynamics, with the potential vorticity fields, and tropospheric dynamics with vertical cutoff fields of the atmosphere in order to identify the behavior of the jet streams, and the possible connection between the entratosphere and the troposphere based on these phenomena of big scale.
Another objective of this work, after identifying the events that influenced mid-latitude regions with the arrival of ozone-poor air masses, was to show the preferred altitude at which these decreases occur for the latitude and longitude of SM. For this objective, data from the SABER satellite was used, which provides 19 years of data (2002 - 2020), where the unit of the vertical ozone profile was in mixing ratio (ppmv). The use of this unit explains the most intense decreases above 30 km, going against what is shown in figure 8, since the mixing ratio depends on the concentration of the O_3 content and the concentration of the air.
Although the results differ, the consistency of the satellite vertical profiles shows that the arrival of this poor O_3 content in mid-latitudes is around 26 km (according to the figure below in partial pressure of O_3). Regarding the model, where only reanalysis data is used, the objective was to show a standard, but not unique, behavior of the atmosphere in the mid-latitude region, specifically Santa Maria, during the active period of the AOH between the months of August to November.

The analysis needs to be made much more coherent and the different sections all clearly linked back to the starting point, which was observed events of low total column ozone.

Specific comments

(The text needs a very thorough re-writing to improve the fluency of the English. I have not attempted to list all the places where this is required. Most sentences should be shortened or deleted and the selection of individual words improved).

Lines 13-26 You don't mention SABER in the abstract.
Okay. The abstract was rewritten.

Line 34 Decreasing temperature doesn't "trigger" polar night
Okay. The sentence was rewritten.

Line 44 220 DU is the definition of the ozone hole.
Okay.

Line 91 OMI is not part of the "new generation" in 2023.
Okay. The sentence was rewritten.

Line 127 "Part of the South Pole" – probably you mean Antarctica – the South Pole is a single point.
Okay.

Lines 145-159 This section is very long and repetitive.
Okay. The section has been reorganized.

Line 158-159 You don't say why you've chosen 700 K rather than a lower level in the atmosphere.
Line 158-159 I can't find where you have actually stated the PV criterion for your identification of 'AOH-influenced' events. In line 208 you just say 'Based on the APV examination'

In section 2.1.4 the data used is presented, as well as the reason for analyzing potential vorticity fields, which provide information about the trajectory of trace gases, such as ozone. A decrease (increase) in potential vorticity refers to the polar (equatorial) origin of the air mass, thus, it can be identified whether the event has content from the Antarctic Ozone Hole region for mid-latitude regions.

Line 187 You seem to be saying that, outside the sub-tropics, dynamics only influence ozone at certain times of the year, which is not correct.
The sentence was better rewritten.

Lines 189-191 You seem to be saying that, outside of STE events, meridional temperature gradients do not drive jets.
The sentence was better rewritten.

Lines 190-191 You need to distinguish between ozone variations on the daily timescale, where the position of jets is relevant, and longer-term variations.
The sentence was better rewritten.

Lines 193-195 I don't see the relevance of this work – the seasonal cycle of ozone in the southern hemisphere subtropics has been known since at least the 1960s.
The reference was removed.

Lines 208-209 You don't provide any evidence that your identification method works.
The sentence was better rewritten, as the methodology using PV was described in item 2.1.4.

Line 228 By radiosonde, I assume you mean ozonesonde, but ozonesondes have not been mentioned until this point, and figure 4 shows SABER data.
The sentence was rewritten.

Lines 228-229 An important point that you don't address is that there is a lot of ozone (in Dobson Units) located below 22 km. How do you know the main variation isn't lower down?
Through the analyzes carried out in this work, it was possible to identify that the greatest decreases occur above 22 km, since satellite data below that shows significant differences. The SABER database, during the 19 years analyzed here, showed significant decreases in O_3 content between 24.1 and 28 km, considering only visual analyzes of the vertical profiles in the identified events.

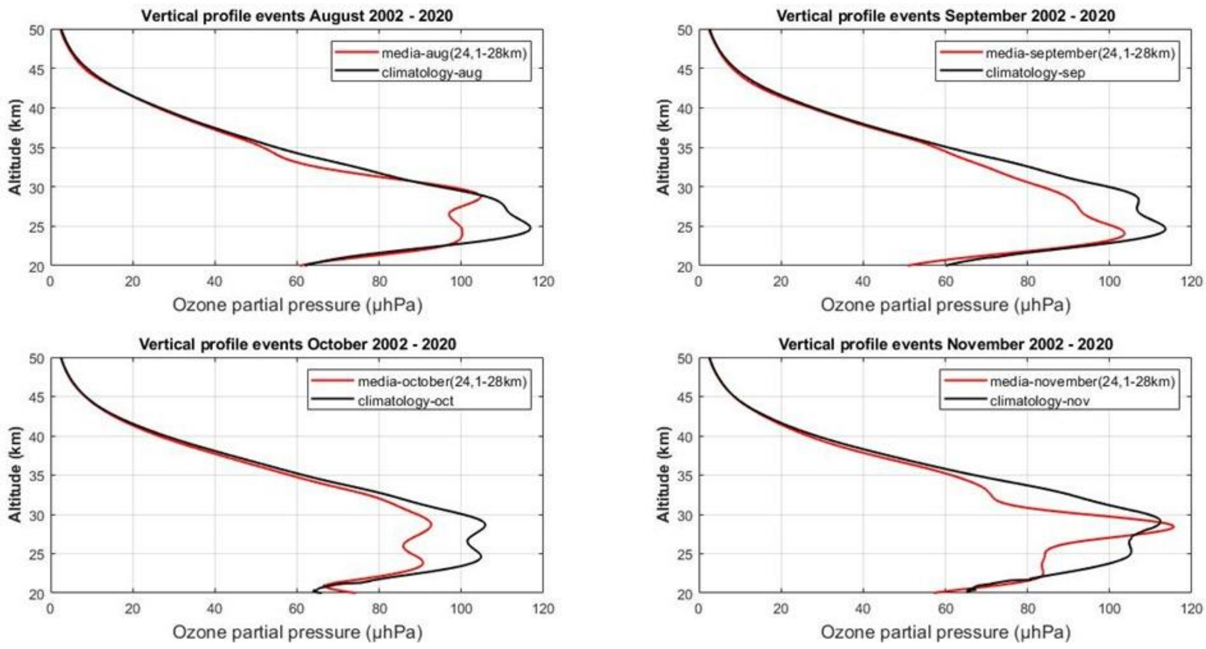
Lines 246-255 Is this section needed?
The paragraph was rewritten and reorganized.

Lines 256-270 Is this section needed? Perhaps all this background is intended to support your use of PV to identify Antarctic influence? If so, you should be more explicit.
The paragraph was rewritten and reorganized.

Lines 271-284 In my opinion, this whole section is hampered by the discussion being in terms of features which exist in the climatological mean but not necessarily on a single daily slice of the real atmosphere, which is always more complicated and doesn't necessarily fit into the idealized concepts. In figure 6A, very strong westerlies are obviously present in the stratosphere at about 40 degrees south. I don't think your statements can be justified.
The authors thank you for the suggestion. The paragraph was remodeled for better clarity of the facts. The objective is to show that these AOH-influenced events reach mid-latitude regions, going against what is expected in climatology. In figure 6, which represents the behavior of the atmosphere in a vertical section at the longitude of SM, the connection between the stratospheric and tropospheric jet streams is observed, helping to transport this content from below O_3, from the AOH region in Antarctica to mid latitudes, such as SM.

Line 313 I thought you had identified your events by the combination of low total ozone and PV (from reanalysis), not by "ground-based and satellite-based instruments"?
This preliminary analysis of the events of decrease in the total O_3 content is carried out by first analyzing the TCO database (ground-based – Brewer Spectrophotometer, and satellite – TOMS and OMI), according to figure 2 which presents the monthly climatology from TCO to SM with the different databases, and according to equation 1. With the “possible days of events” identified, the PV analysis is carried out (reanalysis data – ECMWF ERA5) to identify the origin of the mass ozone-poor air. In short, the satellite data, only from TCO and not the vertical profile data, serves to complement the Brewer database, to obtain the most continuous basis possible.

Lines 320-323 You need to check whether the reductions in ozone mixing ratio between 24 and 28 km add up to decrease seen in total ozone. 28 km is quite high.
As mentioned above, vertical profile analyzes by SABER were presented in O_3 mixing ratio (which considers air concentrations and O_3 content). The figure below shows the monthly vertical profile between 2002-2020 in SM between 24.1-28 km altitude, with the average number of events identified per month, in relation to the monthly climatology for the 19 years in black, in partial pressure units of O_3 (μhPa).



Lines 323-329 This discussion is much too vague. You need to be more specific about the variability at different height levels at the latitude of Santa Maria. Depleted ozone in the Antarctic ozone hole is below 20 km.
The paragraph has been rewritten.

Lines 330 You need to explain your method more clearly.
According to the histogram shown in figure 7, the altitude groups were separated to better visualize these events. During the 19 years analyzed, and according to the events identified and presented in table 2, 43 event profiles were analyzed. Visually, these profiles showed a different behavior in each event, and thus groups were established to identify the greatest decreases, above 30%, in relation to the climatology that was established with the data used. Thus, the "group" with the greatest decreases was between 24.1 – 28 km, with a peak preferably at 26 km.

Line 352 The implication is Bittencourt 2022 first documented the fact the polar vortex "reaches its maximum intensity in later winter and early spring".
The reference was misplaced in this sentence and will be removed in the new version of the manuscript.

Line 370-373 Now you are talking about stratosphere-troposphere exchange, but in the previous section it was all about ozone above 20 km. This section seems completely irrelevant to everything up to this point. The paper seems to change direction very abruptly.
The sentence was removed.

Lines 380-445 The first two paragraphs consist of background and then some very general statements. The "conceptual model" is introduced in line 396 but without any justification, I can't see that you have really provided any support for it at all. At the start of the fourth paragraph, you talk about filaments of low ozone coming away from the vortex – this is what is suggested by the PV maps you have shown such as Figures 5, 10 and 11 – however I can't see that you have made any connection between the PV at 700 K and your conceptual model.
The section has been rewritten, with a more concise and clear description.

Lines 415-452 The conclusion is mostly a repetition of older results followed by a leap to the "conceptual model", again without any real support as far as I can see.
The conclusion was rewritten in the new version of the manuscript.

Figures 1-5 are clear but appear to be based on previous work that has already been published.
They present the initial representation of the work with a new reanalysis database (ECMWF ERA5), for example, in addition to a longer period of data than other works published to date.

Figure 5 shows PV on the 700 K isentropic surface but confusingly, Figure 6 doesn't even reach 700 K and the focus of the discussion is on tropospheric jets. The figures don't seem to be connected to each other.
Figure 5 shows the stratospheric dynamic behavior through the potential vorticity fields, at 700 K potential temperature. While figure 6 shows the dynamic behavior of the atmosphere, through the vertical cut at the longitude of SM (53.7ºW), where stratospheric jets are observed - polar vortex (between 100 to 5 hPa) and tropospheric jets - polar and subtropical jet (around 200 – 250 hPa) in the purple shaded regions, decreasing the wind speed in the color scale. They complement each other as they show the behavior of the atmosphere on the day of the recorded event, according to the methodology applied.

I can't understand what has been plotted in Figure 7 – how have these 'events' been determined? Is there a separate criterion for each height range?
The objective of figure 7 is to show a simple histogram, separated by groups of vertical altitudes analyzed through SABER data in the 43 identified profiles, according to table 2 of events. Altitude groups were selected where the decrease in height was greater than or equal to 30% in relation to climatology.

The caption for Figure 8 says '24.1 -28 km' altitude but the plots show a vertical profile extending well above 28 km. The big anomalies are all at very high altitudes – above 30 km – how is this connected to the changes in total ozone?
The legend corresponds to what is observed when analyzing satellite data in ozone partial pressure units, which corresponds to this more pronounced decrease between altitudes of 24.1 - 28 km. According to the figure shown above.

How can this be in any way connected to the Antarctic ozone hole, if the ozone anomaly is above 35 km?
As already mentioned above, the vertical profile analyzes are in ozone mixing ratio units. When these graphs were first created, it was decided to analyze the profiles in ozone partial pressure, which better characterizes the AOH region, at lower altitudes, even considering other constituents. Bresciani et al. (2018) presents a multi-instrumental analysis using vertical profile data on ozone partial pressure, in mid-latitude regions.

I can't understand what is being said in the caption of Figure 9 and it seems inconsistent with Figure 8.
Figure 9 shows the percentage differences of events in relation to climatology for each month from 1979 - 2020, with SABER data analyses. This figure shows the most intense decreases in the months of September and October, in the layer between 24.1 and 28 km, considering the calculation of percentage differences, equation 2 in the manuscript:

$$RD\,(z) = 100 * \frac{OMR_d(z) - \overline{OMR}_m(z)}{\overline{OMR}_m(z)}$$

Its calculation is based on the difference between the OMR of the day of the event ($OMR_d(z)$) and the corresponding multi-year monthly averaged OMR ($\overline{OMR}_m(z)$).

Figures 10 and 11 are clear.
Okay.

For Figure 12 I believe from the caption you've plotted the climatology of the zonal wind for August to November and not the anomaly for your identified events?

Yes, correct, it's just the climatology all the period data analysis (1979-2020).

The caption for Figure 13 says it's the average for the identified events but doesn't look very different to Figure 12. Regardless of whether I have understood the captions correctly, the essential point is you need to show the difference in what the zonal wind looks like when there is a low ozone event in Santa Maria compared to when there is not.
Figure 12 presents the monthly climatological behavior for the entire period of data analyzed with reanalysis (1979 - 2020), to observe the zonal behavior of the wind, position, and intensity of the jet streams. On the other hand, figure 13, despite presenting the climatological average, represents the average zonal and jet stream behavior for AOH-influenced events in the SM region during the same period.

Figure 14 doesn't match figure 13 at all which confuses me greatly.
In figure 13 there is only one tropospheric jet and it is centered on a latitude of about 35 degrees. Santa Maria appears on the equatorward edge of this jet.
In figure 14 there are two distinct tropospheric jets centered on approximately 55 degrees and 25 degrees. The "conceptual model" seems to have no connection to the earlier results.
Figure 13 presents, based on the results obtained with ECMWF ERA5 data, the average behavior of the zonal wind during the recording of AOH influence events over mid-latitude regions. It is observed that the jets connect, on average, during these events, which dynamically explains how masses of air poor in O_3 reach regions of medium latitudes, see case studies presented in the manuscript, and the other 100 events identified from the analysis of the total ozone column for Santa Maria.
The representation of the conceptual model considers the standard behavior of the atmosphere, where two tropospheric jet streams (polar and subtropical) and the stratospheric jet stream, known as the polar vortex, are observed.

Additionally, Figure 14 shows ozone poor air ending up at subtropical latitudes between 700 and 500 hPa, that is, the middle troposphere. This seems completely unconnected to the rest of the work. This point was raised in the initial review but has not been addressed by the authors.

The representation of the conceptual model has been changed, and the new version presents a model between 500 and 5 hPa. Since the other analyses, climatology, and case studies, show similar behavior to what was presented in the average of all identified events (figure 13) and, for the entire data period (1979 - 2020), through the analyzes carried out with the ECMWF ERA5 reanalysis.