Thank you to the authors for the revised manuscript and their responses to the comments. Some of the comments have been resolved. However, after reviewing the revised manuscript, I find that it still contains several issues that need to be addressed. Some explanations in the results section are not really convincing, and there are noticeable discrepancies between the textual analysis and the figures, with several obvious errors. Additionally, many sentences are redundant or have syntax errors, and there are several typos throughout the text. The quality and color of the figures also need improvement. Therefore, I cannot recommend the manuscript for publication, and major revisions are still required. I strongly urge the authors to carefully proofread and revise the manuscript before the next submission, as it should not be the reviewers' responsibility to identify all obvious and elementary errors.

Main:

1. **Some explanations in the results section are not entirely correct or convincing.**
    - Line 219-220, Line 228: The description is inconsistent and could easily lead to misunderstanding. Line 219 mentions that summer is "less intense in the Atlantic Forest," while Line 228 states "negative net fluxes in February, particularly in the Atlantic Forest." These statements seem contradictory.
    - Figure 4b and 4c: Why does Figure 4b show the Atlantic Forest as red (positive), while in Figure 4c, the site clearly shows significant negative values during the day, which exceed the positive values at night? If the monthly average of the NEE from Figure 4c is calculated, would it still be positive as shown in Figure 4b?
    - Line 268-269: The small absolute value of the PDJ observation-simulation bias is due to the small CO_2 signal at this site. If the goal is to discuss or compare the simulation performance with the IAG site, a more reasonable approach would be to look at the relative error, e.g., signal-to-bias, rather than directly concluding that "model predictions are more accurate at PDJ."
    - Section 3.3.1: Line 271-277: As far as I know, in WRF-Chem, background, anthropogenic, and biogenic emissions are three separate variables (CO2_BCK, CO2_ANT, CO2_BIO) in the output netcdf files. The authors can simply display them individually or sum them to achieve the desired result, without the need to rerun simulations with different "emission scenarios" as stated. Did the authors modify some part of the model that requires re-simulation?
    - Line 346 and Figure 7h: The authors say, "This highlights the role of both biogenic and meteorological processes in shaping CO_2 variability at this site," but from Figure 7h, the increments for biogenic and anthropogenic emissions appear to be similar, and it seems that the increase is due to the rise in background concentrations. How does this align with the authors' statement?

- Section 3.3.2, in Line 361-363: Actually, I believe the analysis in Lines 349-363 is meaningless, especially the conclusions in Lines 361-363. When comparing observations and simulations, of course, the simulation values should consider anthropogenic, biogenic, and background emissions together, as this more closely reflects real-world conditions. Isn't this something that should be done? It's common sense. Why conduct so much analysis just to conclude that "simulating with only one factor leads to larger discrepancies with observations, while considering all three factors improves simulation performance"? If the authors' goal is to analyze the individual contributions of the three factors, then Figures 6 and 7 already serve that purpose.
- Line 371-372: Figure B4 shows that the evening rush hour for traffic occurs before 19:00, not after. How do the authors explain this?

2. **There are several discrepancies between the textual analysis and the figures, with several obvious errors.**
    - Line 264: The simulated PDJ values are higher than the observed values. Why do the authors say "underestimated vehicular emissions in these areas"?
    - Line 328 and Figure 7a: From Figure 7a, it appears that the IAG site has no observation data for February 21 and 22!
    - Line 322 and Line 339: The IAG site has a model-to-observation difference of 8 ppm in February (Line 322) and 13 ppm in August (Line 339). The error in August is larger than that in February. Why do the authors say in Line 339 "only 13 ppm, i.e., a closer approximation compared to February"?
    - Line 341-342: observation is 412 ppm, model is 412 ppm in the text. Why do the authors say that the observation is surpassing the simulation?
    - Line 351-352: This is a clear mistake! It should be February, not August. Also, it's not Figure 7c, and it should be a positive bias, not a negative bias.
    - Line 356-357: clear mistake! Figure B7 shows that the PDJ for only Anthropogenic emissions does not have the poorest RMSE.
    - Line 358: clear mistake! Figure B7 shows that IAG with anthropogenic sources in August does not have the highest RMSE.
3. **Many sentences throughout the manuscript are redundant or have syntax errors. I recommend that the authors read through the entire text and remove redundant sentences. Please see some examples bellows:**
    - Line 44-47: "Coupled VPRM" and "integrated VEIN" are parallel in structure, but the sentence is too long. The intended meaning is that the VEIN model is integrated into the VPRM model. I suggest rewriting the sentence for clarity.
    - Line 67-70: You can directly state "CO_2 initial and boundary conditions" instead of repeating it twice "initial and boundary conditions" in the sentence.

Additionally, I recommend using "CO_2" instead of "chemical," also change it in Table 1.

- Line 83-84: "EDGAR lacks temporal variability" and "inventory does not provide hourly profile" are repetitive.
- Line 87: “as a flux input” and “as input data” are repetitive.
- Line 171-172: syntax errors, incomplete sentence.
- Line 251-252: The term "PDJ" appears twice in the same sentence, making it redundant.
- Line 267-268: The expression is redundant, as the parts before and after "and" convey the same meaning.

4. **The quality and color of the figures are not visually easy to get information.**

- The color scheme in Figure 1 is not visually appealing and makes it difficult to identify the stations. Additionally, I recommend using (a), (b), etc., instead of referring to "first panel" and "second panel" to improve clarity. Similarly, see Line 278 to avoid unclear descriptions.
- Why are the figure numbers in the supplementary material not assigned in the order in which they appear in the manuscript?
- Line 213 and Figure 4c: Figure 4c shows hourly data, not daily data, right?
- Figure 4a: Figure 4a shows the monthly mean NEE, not the "monthly mean diurnal cycle" as stated in the caption. How can the diurnal cycle be observed from Figure 4a?
- Figure 6: Why use a discrete colorbar instead of a continuous one? This makes it difficult to distinguish values like 6 ppm in Line 280 and 8 ppm in Line 295. Based on the current colorbar, one could also interpret the value as 4 ppm, right?
- Figure B4 and B5: Please include the latitude and longitude. Additionally, there is no need to display different months as it is difficult to discern any significant differences. It would be better to show just one figure of spatial distribution and use other types of charts to present the monthly emission totals. Moreover, the caption for Figure B5 is not accurate, e.g., “daily mean”? which sectors from EDGAR?
- Figure 9: redundant in caption “Daily mean concentrations of CO2 observed concentrations”

Specific:

- Line 48: What does “smoothed” XCO2 mean? How is the XCO_2 from WRF-Chem smoothed?
- Section 2.1.1: What is the total anthropogenic emission for the region? Why did the authors only consider emissions from vehicles, energy, and industry? What about other emission sources in the region? What are the proportions of emissions from different anthropogenic sources?
- Line 80: No need to use “In contrast”.
- Line 83: What are “interpolation techniques” that were used from 0.1° to 3km? Based on Figure B5, it appears to be bilinear interpolation?
- Line 119: "surface model evaluation" is not accurate and could lead to ambiguity. Please rephrase the sentence.
- Line 138: typo “January to 2015”, delete “to”.
- Line 240: It is the location of the site that has an impact, not only the latitude of the observation site.
- Line 256-260, Line 321-322: The current description, such as “this figure was somewhat compromised”, makes it difficult to understand how the observations and simulations are being compared. Were missing values removed during the comparison?
- Line 301-302: This sentence does not contribute to the analysis and explanation in the manuscript since the authors only used EDGAR's energy and industry emissions, without incorporating urban area emissions.
- Line 312: I mentioned last time that 09-17h local is not only mid-afternoon but daytime. The author replied and made changes, but did not.
- Line 332: suggest change “for the study period” to “in February” to improve clarity.
- Line 334: it should be “at PDJ”, not “in PDJ”.
- Section 3.3.3: Why does the XCO_2 data for February and March not included in the analysis?
- Line 341: add “observed” to “the monthly average concentration stood at 412 ppm” to improve clarity.
- Line 347-348: This sentence appears suddenly. When the authors say "Figure 4 illustrates more positive CO_2 fluxes". They compare the "more" to what?
- Line 401: it should be “Figure 10b and 10c”, not “Figure 10b”.
- Proper nouns should be written in full with their abbreviations in parentheses when they first appear. After that, only the abbreviation should be used throughout the rest of the manuscript. This issue appears multiple times in the manuscript. For example:

  a) "MASP" in Line 4, Line 32, and Line 72.

  b) "VPRM" in Line 7, Line 45, and Line 86.

  c) "WRF-Chem" in Line 4, Line 44, and Line 57.

d) "VEIN" should first appear in Line 46 instead of Line 73.

I recommend that the authors standardize the use of abbreviations accordingly.

- Line 5 and Line 59: Letter case for METROCLIMA or Metroclima.
- The letter "F" in "Atlantic Forest" is sometimes capitalized and sometimes lowercase in the manuscript. Please ensure consistent capitalization throughout the text.