

# Response to reviewers for essd-2021-216

We are very grateful for the many comments and suggestions from the reviewers that contributed to improve the manuscript. We appreciate the time they spent to evaluate our work. All reviewers' comments were taken into account and were individually addressed. Note that answers are in blue and sentences added/adjusted in the manuscript are in quotation marks . Lines and figures numbers are to be understood in reference to the first submitted manuscript, so as to be consistent with the reviewer's comments.

## Responses to Reviewer #1.

**R. Line. 26:** Capital letter for Chile

**A:** Changed as suggested

**R. Lines 31-34:** It is not clear in abstract how CO<sub>2</sub> shows this. I assume it is because the EF are the same? If so, I recommend adding that here.

**A:** Indeed it's because the EF are very similar, we appreciate the reviewer's comment and have added a sentence to clarify this. The sentence now reads: "Although both inventories use similar emission factors, differences in CO<sub>2</sub> emissions between both inventories also points to biases in the quantification of the activity."

**R. Lines 40-42:** I would recommend including the standard here so readers can easily have an idea of concentrations.

**A:** Changed as suggested.

**R. Line 68:** I recommend defining what a communal level is as it is something I at least am not familiar with.

**A:** We've added a footnote with the following text explaining what a commune is: "The commune is the smallest administrative and territorial unit in Chile , and is equivalent to what is known in other countries as a municipality.". More information is provided in the study area subsection.

**R. Lines 68-69:** I would recommend adding one more sentence to be explicit on what is missing spatially and temporally. For example, are these just annual totals with no spatial information?

**A:** The previous sentence provides the information on why the inventories do not provide the necessary information for air quality. The two sentences have been modified to clarify this.

**R. Lines 87-90:** I recommend checking on style of the journal if chemical compounds should be capitalised.

**A:** All chemical compounds are now not capitalised because they are not within the journal's list of words that should be capitalized and we follow other published articles of the journal.

**R. Line 106:** period is missing.

**A:** Period has been added as suggested.

**R. Lines 143-144:** Does this mean differences between regions or differences within regions between the different sources of data?

**A:** The statement refers to differences between the datasets within several regions. The sentence has been modified and now reads: “However, significant differences in wood consumption between these datasets are found within several individual regions.”

**R. Lines 195-197:** I think there is a lot of detail in these two sentences. It may help to expand this description. I see that you get vehicle number per region from official statistics. But then here are you assuming fuel use per year for a vehicle and then calculating the number of vehicles using that and fuel sales? I would think that would introduce quite a lot of uncertainty. I recommend this explanation is expanded a little.

**A:** The original sentence “Total fuel consumption of registered vehicles was estimated and compared to real fuel sales for each region. Thus, the number of active vehicles in a region was inferred and the number of vehicles per region was adjusted accordingly”, has been changed for the following explanation: “Estimates of total fuel consumption from registered vehicles was compared to real fuel use for each region, using information on sales of diesel and gasoline for the transportation sector, by political region, provided by the Electricity and Fuel Superintendence (SEC, [www.sec.cl](http://www.sec.cl)). A correction factor to the total number of registered vehicles in each region is applied, to make these two fuel consumptions equal, correcting for those vehicles that are registered but do not contribute to actual driving activity. Thus, the number of active vehicles in a region was inferred and adjusted accordingly.”

**R. Lines 219-220:** For modelling some speciation would be needed. I would recommend this is highlighted as a limitation in the data provided and a future research need.

**A:** Although we agree that this is something that needs to be further developed, we prefer not to highlight it as a limitation. We believe that it is already an achievement to have an estimate of total VOCs and to be documenting it; it’s always better to have one estimate than none at all. Furthermore, pre-processing emission tools such as the one used in CHIMERE (EmiSurf) can apply pre-defined speciation to given industries to derive VOC speciation from total estimates. The need for speciation for VOCs was added in the conclusions to the text highlighting the aspects that needed further development in the inventory.

**R. Lines 221-231:** Is it possible to provide some information on which industries are not included/reporting? This would be of interest to people who do not know this sector well in Chile - does this cover most industry? Are there still large gaps?

**A:** The following text has been added to indicate which industries are not obliged to declare their emissions: “Agricultural emissions, thermoelectric plants that are a part of cogeneration processes, and other activity sectors not mentioned explicitly above or that don’t meet one of the above criteria, are not obligated to declare unless they are in a geographical zone with an existing atmospheric decontamination plan.”

**R. Line 237:** Were any quality control needed on the emissions provided?

**A:** Neither the Ministry of Environment nor this work conduct a quality control on the provided emissions. As the estimates represent self-declared emissions, quality control is certainly needed, however it was not within the scope of this work to conduct this needed quality control on the data. These provided estimates could be interpreted as a lower emission limit and represent a first step towards a revised emission inventory. The following text was added to the manuscript at line 118: “No verification nor quality control of the declared emission estimates are conducted by the Ministry nor

in this work. Although self-reported emissions estimates could have strong biases, they are currently the sole estimates of industrial emissions and are therefore used in this work. This limitation will be considered when analyzing and discussing the results. “

**R. Lines 237-242:** I recommend this sentence is re-written as I am a little confused. I think my confusion is in the first half. I believe the sources weren't included as separate/new point sources, but rather these emissions were added to sources within the commune. So for non-located sources, the commune was still known? Also, is this then making a distinction of how they were handled between the gridded emission inventory and commune totals?

**A:** Correct, for unlocated sources the commune was still known, along with company name, activity type, and description, which was enough information to find them online. Those who were manually geolocalized were considered as if they had always had their location known. The rest of the point sources that lack location were distributed in the available points for their corresponding sector and commune. The paragraph has been rewritten to be clearer and now states:

“This database includes more than 8324 point sources along the territory, most of which have associated coordinates, however a large number of sources exist in the database where only the commune of emission is known (along with additional information such as their address, company name, activity type, description) and not their coordinates. Approximate coordinates of these sources without a specified location, and whose contribution to their respective commune was larger than 20%, were obtained by pinpointing them on google earth using the facilities names and the address provided in their declaration. The remainder of the point sources without a geographic location were not explicitly included in the inventory, however, their emissions were distributed among the located sources (including those manually geo-referenced). For a given species, sector and commune, the spatial distribution of the emissions of located sources was scaled to fit the total (located + non-located) emissions.”

**R. Lines 248-250:** Are residential emissions similar across socio-economic class? Using population density in this way assumes that everyone uses fuel similarly. How well does that reflect fuel usage in Chile? I realize some assumption has to be made in the absence of information, but am just wondering about how robust of an assumption this is. I would recommend just noting that here.

**A:** Thanks for the observation, indeed it's important to note this assumption. We've added the following sentences to clear this point. “We used the population density to distribute the emissions with the assumption that firewood is consumed similarly among the population despite the limitations it presents. This, due to not having information available at the census block scale that would allow to make a finer spatial disaggregation according to population characteristics such as income. Furthermore, the CDT15 database reveals that households with higher incomes have higher firewood consumption levels per capita, but less dwellings use firewood for heating and cooking, being difficult to establish a clear relationship between income and firewood consumption.”

**R. Lines 255-259:** Does this capture most of the road network? Also, are all these roads paved? I think resuspended dust (from paved and non-paved roads) and emissions from non-paved roads are not included in transport emissions, correct? The exclusion of these could be added to the paragraph 185-189. For the non-paved roads, for me, I recommend adding something about how prevalent they are (if there is data for that) just to help understand what emissions might be needed and where further work is needed.

**A:** The following sentence has been added in line 185-186: “Resuspended dust from paved and non-paved roads are not considered in this analysis. Approximately 60 % of the national roads in

Chile are non-paved, so an interesting area of research would be to estimate this source of emissions in future work”.

**R. Lines 265:** I recommend a section is added here describing the method that was used in the uncertainty analysis (results in section 4).

**A:** As suggested, we've added a subsection 2.6 to detail the methodology for the uncertainty analysis.

**R. Line 268:** For transport I see that activity data were available for every year (i.e. 2015, 2016, 2017). For industry, was emissions available every year as well? I don't see that stated above. For fuel usage, activity data were once-offs numbers correct? If so, how were the individual years estimated? If I am incorrect in saying they were once-off, then that might need more clarification in the section above as I missed it. I am asking about this to better understand the trends discussed at start of results.

**A:** The same is true for industry, activity data are declared every year and thus emissions are estimated by RETC for each individual year. This has been included explicitly in the section to avoid any confusions.

**R. Lines 270-272:** These trends are very hard to see on current scale. I recommend exploring other ways to show these data so the trends are clearer. Would a log scale help? What about a table that presents the totals (as the figure shows the amount per sector)? These are just some ideas for the authors to consider.

**A:** For a better comprehension of the figure, and the results, we have cut the y-axis of these pollutants with a high participation of the residential emissions. Also table B1 was added on Appendix B displaying the total emissions (kt/annum) by year and sector for each pollutant of INEMA represented in figure 4.

**R. Line 277:** This is a large jump. What happened? Did more smelters come on-line? Also, there doesn't seem to be a similar increase in combustion emissions from this sector (i.e. NO<sub>x</sub>). So is this increase in SO<sub>2</sub> from a change in sulfur content? I recommend a sentence or two is included here as this is a large jump in emissions.

**A:** We should've been more precise with what happened that year, so we really appreciate the reviewer's observation and have added the missing explanation to the article. Starting in 2016, 7 additional copper smelters started declaring their emission to RETC due to changes in the regulatory framework driving an increase in SO<sub>2</sub> emissions from 2015 to 2016 that is sustained in 2017.

**R. Line 279:** I recommend the authors check on capitalization to ensure it is consistent (i.e. energy not capitalized here, but is on line 275) and is consistent with the journals style guidelines.

**A:** As suggested, capitalization is now consistent with the journal's style guidelines and now all emission sectors are not capitalized.

**R. Lines 280-281:** Why was it not included? Lack of data or just not focus of this EI? I don't think it is a problem that it wasn't included, but I think the explanation would help to provide more context for the next sentence (i.e. that it is needed). Also, I recommend adding a reference for the statement that agriculture dominates these emissions - how do you know without estimating it? I assume that is from global emission inventories. But as noted in this manuscript, those have uncertainties. Even within these uncertainties would ag emissions dominate these do you think?

**A:** The information to clarify this has been added and the text now reads: “We highlight that the agriculture sector is not included in this inventory due to the lack of high resolution data allowing to

spatially distribute this sector's emissions on the INEMA's grid and therefore not reflected in emissions of CH<sub>4</sub> nor NH<sub>3</sub>. In general, the agriculture sector dominates NH<sub>3</sub> (Muñoz et al., 2016) and CH<sub>4</sub> (according to MMA, 2017, more than half of CH<sub>4</sub> emissions in Chile come from agriculture) emissions and for any future study on these species, these sectors would need to be estimated."

References of (Muñoz et al., 2016) and MMA (2017) have been added to support the claim that CH<sub>4</sub> and NH<sub>3</sub> emissions are dominated by the agricultural sector.

**R. Lines 287-288:** I recommend adding in some information on population or population density per region as the general reader may not know this (i.e. geography and location of Chile's cities). I think a map or table could help to convey this information

**A:** Additional information regarding population has been added on figure 1.

**R. Line 298:** Is it tons or kilotons as in Figure 4 and Table 3

**A:** A: Changed as suggested.

**R. Line 310:** Is this unit correct? The total national PM<sub>2.5</sub> are ~150 kt/annum. This is more than that. Also, I recommend being very precise in the usage of units. I recommend using kt/annum when that is the correct unit and stating which year.

**A:** Indeed it was incorrect. We've unified the emission units used throughout the manuscript to kt/annum and tonnes/annum.

**R. Lines 310-312:** Is this average across the three years or just one year? Is this number within the metropolitan area itself? Just confirm as from residential it seems that there are many sources of pollution in the outskirts, so just checking if this is within the metro itself or if it considers those other surrounding areas.

**A:** The numbers indicated are just for the emissions of 2017, but the results still stand if the average across the three years is used instead, because the PM<sub>2.5</sub> emissions are consistent throughout the years. The numbers in the last sentences, about the transportation sector, are just for the metropolitan area. The sentence was modified to clarify these points.

**R. Line 328:** EDGAR is also for 2015, correct? I would explicitly state this so it is clear.

**A:** A: Changed as suggested.

**R. Line 337-339:** Does one inventory include these and another doesn't? Is that what this is pointing out?

**A:** After a more in depth revision of the study behind the local emission factors used in this study for residential emission, we cannot support the claim that these EFs actually include the condensable PM and we have therefore removed the sentence from the manuscript.

**R. Lines 339-340:** I recommend explicitly stating here that the EF in EDGAR do not account for this.

**A:** The sentence has been modified to highlight the fact that EF in EDGAR does not account for wet firewood and combustion with poor operation conditions.

**R. Lines 383-385:** To confirm, are these the parameters from the household surveys that you have to determine this weighted EF as described in sentence before? Also, do these Efs then have a seasonal variation (e.g. perhaps related to the humidity)? This weighting of EFs is an interesting approach, I would recommend expanding then on the results of the these weighted EFs that were used. I While

Figure 10 is helpful to show these aspects of emissions, this information is already well-stated in the text. A figure showing the results of this weighting would provide some really interesting insight into the variation of the EFs used across the zones/communes. As these EFs have such large uncertainty, I think a table with the input EFs (i.e. those from literature) and the weighted ones would be really interesting to see.

I see, they are in an Appendix! Sorry about that! I am keeping my comments above, as it might be helpful to see what I was thinking as I was reading this (and missed that they were in the appendix!). I think that the tables in the appendix are really interesting, and would recommend that the authors consider moving them to the main part of the text. Or at least the table should be referred to in this section.

**A:** In effect the parameters described on these lines are those that have to be determined for the weighted EF, the sentence has been rewritten to improve the comprehension.

The EFs don't have seasonal variation, because they are for specific conditions of humidity, operation conditions and appliance type. The optimum would be to have activity level with seasonal variation, that could reproduce the variation of the wood humidity between other relevant components. Unfortunately, it is not possible to have activity with this level of temporal disaggregation due to the lack of reliable information.

As the reviewer recommended, both tables are referenced in this section.

**R. Lines 435-436:** How would the absence impact on this? Are the data used here collected very irregularly?

**A:** In effect, the data used in INEMA's inventory for firewood consumption comes from independent and one-time studies that we can't be sure when or if they will be repeated. The older the data get, the less valid they will be for any future emission estimate of the residential sector, thus the need for an official database characterizing the firewood consumption.

**R. Table 1:** There is a missing space after the "3" and PM2.5 and PM10 aren't subscripted.

**A:** **A:** Changed as suggested.

**R. Table 2:** I am confused by the figure caption. Which year is this for? It says 2015-2017, is that total? Average of the three years? This can't be total over those three years as Pm2.5 in Figure 4 per year is ~150. I recommend that this figure and its caption is updated to clarify this issue. Also, are the units kt per year?

**A:** **A:** Changed as suggested.

**R. Figure 1:** I recommend the zones use a color other than gray as it is hard to see the zones versus the land shape on the west of the south zone that are also in gray.

**A:** Figure 1 has been improved as suggested. We've also added some information about population in each region following a previous comment.

**R. Figure 3:** The version that I downloaded the map of Santiago is blurry. Is it possible to improve the resolution?

**A:** Yes, it can be improved to some extent because the resolution of the map is limited by the resolution of the tiles. The resolution of the image has been improved as much as possible.

**R. Figure 4:** I recommend adding labels to y-axes. I see kt/annum is noted in the figure caption, but I still do recommend adding labels to figures. For NO<sub>x</sub>, is it emissions of NO<sub>x</sub> presented as ktNO<sub>2</sub>/a? Similarly for VOC and NMVOC, it is kt of what?

**A:** Following the reviewer's recommendation we've added labels to y axes noting that the unit is emissions on kt/annum. Emissions of NO<sub>x</sub> correspond to emission of NO<sub>2</sub>+NO and thus the units are ktNO<sub>x</sub>/yr. Regarding VOC, we apply the same emission factor used in EMEP and based on Petersson et al. (2011). This emission factor represents the emission of approximately 28 species of VOC and thus the emissions of NMVOC correspond of ktNMVOC/annum. A sentence has been added at the beginning of section 2 to clarify this: "In this work, the emissions that are presented will correspond to annual fluxes. Furthermore emissions of NO<sub>x</sub> correspond to emission of NO<sub>2</sub>+NO and thus the units are ktNO<sub>x</sub>/annum while for VOC and NMVOC the corresponding unit is ktVOC/annum and ktNMVOC/annum."

**R. Figure 5:** Why are three regions combined here? Or is it only two (is the bottom one part of south?). If it is two, then why are two combined?

**A:** It's two regions combined because during the period of the inventory these 2 regions were one. The Ñuble region was created in 2018, and to avoid misleading and to deliver better information for each region of the actual administrative division of Chile we've added a specific chart for each region in these figures.

**R. Figure 5:** I recommend using PM<sub>2.5</sub> and not spelling out particulate matter.

**A:** **A:** Changed as suggested

**R. Figure 5:** In the north in particular, but also for the others, it is very hard to see the different colours on the grid. The pie charts are helpful, but I just can't see much from the gridded. Is there another way to display the gridded information?

**A:** Indeed, it's difficult to see the gridded information. Different options have been explored on how to improve this aspect of the figure on a single figure. Precisely to show in some way the detail of the gridded information is that we included figure 6 in the manuscript with a zoom on three selected cities..

**R. Figure 6:** I recommend that the location of these are indicated on Figure 5 (or another earlier map).

**A:** That's a great idea, we've added the location on figure 5 as the reviewer recommend

**R. Figure 7:** I recommend expanding the label of the y-axis to be more precise and descriptive of what is shown. Something like "Normalised emissions" would highlight that these are not emissions.

**A:** **A:** Changed as suggested.

**R. Figure 9:** What units are the y-axis in? Is the ratio of total emissions per year from one set of assumptions to the present estimations? So CO was up to 3x greater using different inputs? Is that correct? But in the text it states that there is a range up to a factor of 84 for VOC, but on Figure 9a it is ~4. I recommend this section is update to clarify this.

**A:** As the reviewer correctly noted, the unit is the ratio of the total 2017 emissions from one set of assumptions to the INEMA estimate. For each species, the vertical bar represents the range in ratios for the 8 possible combinations examined to assess the uncertainty of the estimate. For VOC, one of these combinations reveals emissions 24 times larger than in INEMA while another combination results in a ratio of 0.3 with respect to INEMA, hence the former is 80 times larger than the latter

representing the uncertainty range associated with VOC emissions. The figure was updated considering VOC and CO emission estimation and an explanation on how to read the figure was included.

**R. Figure 9:** I recommend indicating on Figure 9b which bar was used in this study. Something as simple as a star above the bar would help to highlight it. Also, which year was this for?

**A:** We've added the star and have indicated what it means on the caption, as well as indicated what year it represents (2017).



## Responses to Reviewer #2.

### **Main revision:**

**Reviewer:** The use of the term "sectors" both in the manuscript and in the title, I think it can lead to confusion. For the IPCC, and therefore for the nomenclature used by the EDGAR database (see lines 94, 331, Table 1), the sectors are Energy; Industrial Processes and Product Use (IPPU); Agriculture, Forestry and Other Land Use (AFOLU); and Waste. According to the mentioned nomenclature, what in this work are called sectors are categories and subcategories within those sectors. In particular, the work includes emissions from road transportation, residential biomass burning, energy and manufacturing industries, disaggregating from the latter those from metal industries.

**A:** We appreciate this comment but we prefer to follow Crippa et al. (2018) and refer to the activities as "sectors" as is done in EDGAR. We've added the following sentence to the beginning of section 2: "Throughout this paper we will follow the EDGAR nomenclature and use the term "sectors" to refer to emission activities. ". However, we've changed the title and replaced "sectors" with "activities".

**R. Line 100-101:** "The atmospheric emissions for each sector and pollutant are obtained by weighting the total fuel consumption (activity level) by an emission factor (EMEP / EEA, 2016), as shown in eq. (1)." The activity level is not always related to fuel consumption. This inventory includes emissions from industrial processes such as mining and other activities from the IPPU sector that are not represented by this sentence.

**A:** We appreciate the observation, and have rewritten this sentence focusing in the concept of activity level to avoid any confusions.

**R. Line 179-183:** Although it is clear why the authors do not apply the IPCC tier 1 EFs, the guidelines contain other reference factors for different technologies, and it would be advisable for the authors to compare their results with published values. For example, the values reported in Table A1 (please add units) for wet firewood in cook stoves, conventional stoves and catalytic stoves are of the order of non-catalytic ones in the IPCC guidelines. Does this technology represent the average conditions of residential combustion in Chile? In addition, and as far as I can see, the cited study USACH 2014 reports correction factors for particulate matter emissions from wet firewood combustion. It is suggested that the authors add a justification for this choice for species other than PM here.

**A:** We have to admit that we do not fully understand the first part of the question. Non-catalytic stoves do not represent the technology used in Chile, in fact most of the stoves are catalytic. Furthermore, we couldn't find any EF for PM from residential combustion in IPCC (2006). The EF considered in this work includes aspects related to local conditions of stove usage and the humidity of the fuel.

Contrary to USACH (2014), we do not apply correction factors for PM residential emissions but we did originally apply one on VOC and CH<sub>4</sub> as stated by the reviewer. However, we have changed this and in the current version we no longer apply a correction factor for VOC and CH<sub>4</sub> residential emissions.

**R. Table 1:** The authors are comparing what they have called Residential sector with the IPCC category 1A4b: Residential and other energy sectors. Are you including emissions from Commercial/Institutional and Agriculture/Forestry/Fishing/Fish Farms?

**A:** According to IPCC (2006) 1A4 is Residential and other energy sectors, while 1A4b is just Residential sectors, we've fixed that on the table that said "Residential and other sectors" to "Residential". As the reviewer noted, we estimated just the residential emissions from firewood combustion on this inventory, so a sentence has been added on this part and in the residential methodology to clarify this.

**R. Section 2.2:** The estimation of residential emissions from sources other than biomass burning is not detailed in this section. I consider it of great importance for this work to clarify this aspect. If these emissions have been estimated, this should be mentioned and detailed in the methodology. If they have been omitted, the authors should mention it in this section, adapting the rest of the work to what has been done: results, discussion, conclusions, etc. For example, the authors compare their results with those of the EDGAR database without discussing how the aforementioned affects this comparison, or they mention in the conclusions that "future development of this inventory should consider, for instance including the agriculture sector", when it would be more relevant to work on the completeness of the residential emissions inventory.

**A:** In effect, the residential sector of the INEMA's inventory considers only emissions from firewood combustion of households. In accordance with the reviewer's observation, we've declared this in the methodology section and have provided some discussion on the potential biases and implications that could result from the omission of emissions from other fuels sources. Also, a sentence has been added in the conclusions about the need for future development on the completeness of residential emissions inventory.

**R. Section 2.4:** In addition to downloading this information from the RETC, did the authors do some quality control of it? By applying what methodology were these emissions estimated? Are the results consistent with other national reports? Are they consistent with each other within the database?

**A:** Neither the Ministry of Environment nor this work conduct a quality control on the provided emissions. As the estimates represent self-declared emissions, quality control is certainly needed, however it was not within the scope of this work to conduct this needed quality control on the data. Companies are obliged to provide either an estimate of their emissions or the activity data as well as all additional information necessary for the RETC to estimate the emissions. The following text was added to the manuscript at line 118: "No verification nor quality control of the declared emission estimates are conducted by the Ministry nor in this work. This limitation will be considered when analyzing and discussing the results. "

In addition to that, a comparison of CO<sub>2</sub> emissions from RETC was conducted against the estimate from the Chilean national GHG inventory. Both estimates are conducted independently and can therefore serve as some sort of verification for CO<sub>2</sub> emissions. This comparison however does not provide an assessment of the worth of the estimate for criteria pollutants. Although self-reported emissions estimates could have strong biases, they are currently the sole estimates of industrial emissions of criteria pollutants and are therefore used in this work. Nevertheless, these estimates could be interpreted as a lower emission limit and represent a first step towards a revised emission inventory.

**R. Lines 270-271:** for several of these species the variation is very small in the 3 years analysed, or unclear as for SO<sub>2</sub>, to affirm that these are increasing and decreasing trends. PM<sub>10</sub> from industries decreased in the period analysed, while CO<sub>2</sub> and NH<sub>3</sub> from the sector increased. To what do the authors attribute these results? Is there an increase in industrial activity? Was there any relevant change in the fuels used in that short period?

**A:** The first sentence of the results was rewritten to smooth the description of the emissions trajectory during the study period. Regarding the emissions of PM10, CO2 and NH3, we have that the decrease in PM10 emissions are driven mostly by changes in the manufacturing industry while for NH3, the increase is mainly due to the forestry industry, and for CO2, it is the forestry along with manufacturing industry. Some other industries that present minor changes so that in general the activities mentioned are what trigger the behavior seen for each pollutant.

**R. Lines 277-278:** I think that they do not reflect what is seen in Figure 4. The peak in SO2 emissions in 2016 is more attributed to industrial emissions, while those from mining contribute to an increase that is sustained in 2016 and 2017. This peak is not observed in industrial emissions of other species. In addition, it is observed that emissions from energy decrease in the period. To what do the authors attribute these results?

**A:** The peak in SO2 emissions is attributed to increases in both the mining and the industry sector. For the mining sector the increase in SO2 emissions is because starting in 2016, 7 additional copper smelters started declaring their emission to RETC due to changes in the regulatory framework driving an increase in SO2 emissions from 2015 to 2016 that is sustained in 2017. For the industry sector, the peak in 2016 is due to increases in emissions from the manufacturing and nonferrous metal industry. This information has been added to the manuscript.

**R. Line 310:** "1480 Kt are emitted" that magnitude seems to be higher than the national total.

**A:** The unit has been corrected, it was tonnes.

**R. Section 3.1:** I suggest reviewing this section in detail. Based on what is reported in Table 2 and the EDGAR database for Chile, I do not obtain the same results as the authors in terms of differences between datasets. In addition, I find discrepancies between what is seen in Figures 4, 7 and 8, in Table 2, and what the magnitudes that the authors describe in the paragraph (e.g. lines 334, 342, 349, conclusions).

Have the authors obtained the EDGAR base biomass burning residential emissions in a separate way from those reported by EDGAR under 1A4b (which also include fossil fuel burning and commercial and agricultural activities)? If not, I suggest adapting this section considering the discrepancies this may introduce. Just as an example, it would be wrong to state that the "differences can partly be explained due to the use of different emission factors in both inventories" (line 336) without highlighting the main discrepancies.

**A:** We greatly appreciate pointing this out and we have changed the manuscript (results and conclusions) to highlight this difference. In addition we changed the caption of figure 7 by adding the following sentence: "We note that the residential sector from EDGAR corresponds to category 1A4 from IPCC. This category, in addition to residential emissions, also includes emissions from commercial, agriculture, forestry, fishing and fish farms."

**R. Lines 339-340:** However, although the authors claim to have applied correction factors to the EFs of CH4 and VOCs, they report lower emissions than the EDGAR base. This is expected due to the non-inclusion of fossil sources in residential emissions, however it is not clarified or discussed.

**A:** The correction factor for residential emissions was initially only applied to CH4 and VOCs but this is no longer the case (see response to reviewer above on this matter). For both species we report larger emissions than EDGAR due to larger activity levels in residential combustion. This is now mentioned in the manuscript and the corresponding figures have been updated.

**R. Section 4:** This section does not seem entirely integrated into the rest of the work. It is suggested to reorder it by adding a subsection in section 2 detailing the methodology used for this analysis (which is not clear here), and including in section 4 only the most relevant results. If the authors consider that this analysis is disproportionate in length within the work, they may choose to include what they consider as Supplementary Material.

**A:** A subsection 2.6 detailing the methodology used for the uncertainty analysis has been added and now section 4 focuses on the results as suggested by the reviewer.

**R. Section 6:** Based on the aspects mentioned in this review, it is suggested to adapt the conclusions of the article.

**A:** The conclusions of the article have been adapted to the many changes made in the different sections.

### **Minor revisions**

**R.:** It is suggested to unify the way of expressing units: for example, tons appear as tones, tonnes, Kt and tons. Also note that k for kilo should not be capitalized.

**A:** The units have been unified along the text to tonnes and kilotonnes and fluxes are expressed as kt/annum or tonnes/annum.

**R.:** It is suggested to unify the use of the thousands separator in the work, the use of “,” or “.” for decimals, and unify the significant figures that are presented within, for example, the same table or section (for example, see the Table A1).

**A:** We've eliminated the use of thousands separator throughout the text and use the “.” for decimals. Significant figures have also been unified as suggested.

**R. Line 20:** “The estimated total annual national emissions of PM10 and PM2.5 are...”, do these magnitudes correspond to the emissions of a particular year or are they the annual average?

**A:** It's the annual average between the three years of the studied period. The sentence was rewritten to clarify this point.

**R. Line 28:** “uncertainty in activity data also”.

**A:** Changed as suggested.

**R. Line 48:** “air quality - and greenhouse gases (GHG)”.

**A:** Changed as suggested.

**R. Line 64:** “estimates from the residential and transport sectors”.

**A:** Changed as suggested.

**R. Line 87:** "Carbon Dioxides (CO2), Nitrogen Oxides (NOx), Sulfur Dioxides (SO2)" should be carbon dioxide (CO2), nitrogen oxides (NOx), sulfur dioxide (SO2).

**A:** Changed as suggested.

**R. Table 1:** the content of the column "IPCC sector" does not correspond to IPCC sectors but to different categories of the Energy and Industrial Processes and Product Use (IPPU) sectors. As a suggestion, the column title could be “IPCC categories”.

**A:** A: Changed as suggested.

**R. Lines 195-197:** It is suggested to expand the explanation provided in these two sentences.

**A:** The original sentence “Total fuel consumption of registered vehicles was estimated and compared to real fuel sales for each region. Thus, the number of active vehicles in a region was inferred and the number of vehicles per region was adjusted accordingly”, has been changed for the following explanation: “Estimates of total fuel consumption from registered vehicles was compared to real fuel use for each region, using information on sales of diesel and gasoline for the transportation sector, by political region, provided by the Electricity and Fuel Superintendence (SEC, [www.sec.cl](http://www.sec.cl)). A correction factor to the total number of registered vehicles in each region is applied, to make these two fuel consumptions equal, correcting for those vehicles that are registered but do not contribute to actual driving activity. Thus, the number of active vehicles in a region was inferred and adjusted accordingly.”

**R.:** Equation 3: There is an extra \*.

**A:** Changed as suggested.

**R. Line 277:** "This activity drives the increase in SO<sub>2</sub> emissions from 2015 to 2016", add a reference.

**A:** The text has been expanded to explain this increase in SO<sub>2</sub> emissions. Starting in 2016, 7 additional copper smelters started declaring their emission to RETC due to changes in the regulatory framework driving an increase in SO<sub>2</sub> emissions from 2015 to 2016 that is sustained in 2017.

**R. Line 293 (caption table 2):** Clarify that these are "annual" emissions and that the units are kilotons "per year".

**A:** Changed as suggested.

**R. Line 297:** According to Table 2, this magnitude corresponds to kilotons.

**A:** Changed as suggested.

**R. Figure 8:** it is suggested to unify the order of the categories of the abscissa axis and of the series.

**A:** The abscissa axis and the series have been unified as suggested.