February 12th, 2016

Anonymous referee #2

Report on the review of the article from N.Chandra, S. Lal, S. Venkataramani, P.K. Patra, and V. Sheel entitled « Temporal variations in CO$_2$ and CO at Ahmedabad in western India ».

Scientific significance: Good

Scientific quality: Fair

Presentation quality: Fair

=> Major revisions recommanded before publication in ACP

General comments :

This paper adresses temporal variations of atmospheric CO$_2$ and CO in an urban site in western India. There are not so many studies on greenhouse gases in urban environments. Furthermore, such study is rare in countries in development. This work is interesting to be published and is fully within the scope of ACP.

The authors adress the seasonal and the diurnal scales, as well as CO/CO$_2$ ratios from which they infer information on the anthropogenic vs natural sources of CO and CO$_2$. They also propose a calculation of CO emissions for the studied city using such ratio and CO$_2$ emissions from inventory, ad well as a short model/observations comparison.

I acknowledge the large amount of work provided by the authors and interesting information issued from this study. However, there are also some major issues to be addressed and reviewed before publication in ACP. These issues concern :

1/ The form : the text is quite difficult to read and needs to be synthetized, especially the introduction, the seasonal study and the diurnal study. Some sentences are even repeated twice.

2/ The content given on the emissions and the conclusions on the trafic sector vs the cooking and industrial one : there is a lack of information on the studied region and on the relative role of the different emission sectors, that should be given quantitatively, with proper references. Especially, the part of emissions due to residential and slum cooking is almost not discussed, while the available litterature explains that this emission sector is responsible for a large amount of atmospheric CO (less in CO$_2$). The conclusion on the strong influence of trafic given in sector 4.4 is not convincing according to Table 1. But it is then used as acquired in the following sections (e.g. 4.5 and 4.6), that should also be reviewed in function, taking into account especially the cooking sector, which is another anthropogenic source (nor a natural nor a fossil one), as well as the industrial one (as the authors mentionned there are several industries in the studied area).

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3/ The validation of the data : the quality on the CO dataset is poorly explain, and the data treated with a single calibration standard while no test is given on the instrumental linearity for this species. The data treatment should thus be better reported and these specific points precisely addressed.

4/ The question of entertrainment of air on top of the PBLH is not addressed, and the PBLH seems to be considered as mixed at anytime of the day. The CO/CO2 ratio diurnal variability should take this into account, a point that carefully needs to be studied at different time windows.

After these majr revisions, I am convinced that this work will be of very good quality for publication in ACP.

Specific comments :

Abstract :

A sentence on your objectives should be given after the first sentence. What is the reliability of the CO2 emissions inventory ?

Introduction

Much too long. Remove detailed information

p. 32187

> Remove lines 8-11 (too long)

> Line 14 : a country can be very small or very large so give rather km (100-1000 km2 for the regional scale generally)

> Line 21 : different… = this sentence is very unprecise

> Line 28 : not only traffic but also industry etc

p. 32188

> Lines 2-8 : too long

> Line 9-29 : too detailed info

> Remove most of these lines, and focus more on urban studies.

p.32190

> Objectives not clear, reformulate please.

Section 2

> Lines 15-27

> What is the height of the sampling height above ground level ?

The information given on the emission sectors should be improved. It is a key point of your argumentation next. Please quantify here and give numbers on the relative role of the different CO2 and CO emission sectors in Ahmedabad (there are several sources to compare, here is one : http://www.indiaenvironmentportal.org.in/files/file/Air-Pollution-in-Six-Indian-Cities.pdf).

p.32191

Line 17 and line 21 : check months consistency.

Section 3

This section generally lacks of precision on the procedures.

p.32193

lines 1-2 : do you mean the CRDS instruments in general, or yours ? Your instruments should be discussed here, each CRDS instrumental is specific and needs to be validated (although this is right that they are usually within WMO recommandations).

p.32194

Lines 1-12 : this part is critical. The CO dataset is calibrated with one single tank from Linde UK. Is it linked to the WMO scale ? Despite this single cal tank, no linearity tests are reported for CO. How can you make sure your CO dataset is not biased by an instrumental drift ? Also, you need to report the accuracy of your measurements (both CO2 and CO).

Section 4

p.32195

This part are interesting but too long.

Lines 23-26 : please reformulate

p.32196

Lines 22-23 : what is the demonstration for this argument ?

p.32197

Remove lines 1-2

Lines 9-11 : not clear

Lines 11-18 : synthezise

Lines 17-20 : how much of the data coverage does this step represent ?

p.32200

Lines 1-4 : reformulate

p.32202

Lines : 15-20 : reformulate

p.32203

Define the baseline and background terms.

How sensitive is your 5th percentile method ? This was for example assessed against MACC fields in Ammoura et al ACPD 2015 (a new method...). Give clues.

p.32204

The role of cooking (poor combustion => large co/co2), other FF sources etc should be considered here.

p.32205

Be careful here at hours when the PBLH evolves (see general)

Lines 17-20 : this is critical. I do not agree with your argumentation. Table 1 does not show that the observed ratios (30-50 ppb/ppm) are much lower than the domestic sources (52.9-98.5 ppb/ppm). You can not conclude that this is driven by gasoline emissions. And several solutions exist. You could have a mix of emissions from trafic and domestic sources for example. At what time do people have diner in Ahmedabal ? Same time than rush hours or not ? Etc. This section needs to be thought more and the different options argued to drive to a solid conclusion.

p.32206

Remind the question of the entrainment pb in the morning for example (check my general comments).

p.32207

It would be interesting to try to give an explanation about this. What emissions is EDGAR missing then ? Is it a sector or is it underestimated on all sectors ? What about emissions from slum /residential cooking for example ? You might found this paper interesting on the CO emissions from New Delhi : http://aaqr.org/VOL15_No3_June2015/36_AAQR-14-07-TN-0132_1137-1144.pdf

Lines 14-15 : following my remarks above, I do not agree with your argument on the large role you attribute to CO emissions from fossil fuels incomplete combustion only. Other sectors are still on the race as long as you did not demonstrate the contrary.

Lines 27-28 : this was not clearly demonstrated as well.

p.32208

Lines 4-6 : very surprising, aren't people cooking at this time ? 47 ppb/ppm is more than gasoline and in between gasoline and biofuels/coal.

Line 13 : same, no solid argumentation given for this

Lines 26-27 : I do not agree here as well. I do not think this is true to say that the other sources do not emit CO. What about wood burning, cooking etc again. These are not natural but anthropogenic.

p. 32209

Lines 1-13 : this part should be fully rewritten according to the comments above.

Line 19 : rewrite with 1 time « component », not 3 times ; remove « diurnal amplitude » ; add « s » to observation.

Lines 24-26 : give reference

p.32211

Line 23 : this part is vague about the tracers you used. Please give more clues to the reader.

p.32212

5 Conclusions

Lines 2-4 Transition with CO should be improved.

Lines 7-10 : yes, this is an excellent remark !

Lines 20 : here again you mix seasons and climate features. Please modify.

p.32214

Line 2 : remove (fossil fuel) unless you manage to demonstrate it correctly

Lines 7-9 : These lines should be changed (see remarks p.32208)

Technical corrections :

Define ppm as part per million

Do not mix season and climate regime (ex winter and monsoon => winter and summer)

CO should be expressed in ppb (to be defined) and not in ppm, for consistency with the tables.

Do not mix noon (12h) and afternoon.

Add « the » before model or before CASA model. You can also replace model by modeling framework to avoid repetitions.

Title :

« in CO2 and CO » should be replaced by « of atmospheric ».

The short title « CO2 over urban region » requires as well the keywords CO and India.

Abstract

Line 25 : replace variations by ones

Introduction

p.32157 Line 18 : remove (such as the Kyoto Protocol)

Section 2

p.32191 line 9/10 : already said p.32190 line 17.

Section 3

Lines 12-26 : check English style please (First… the second…)

p.32194 Line 23/24 : remove for the model simulations

Section 4

p.32196 Line 19 : In the first approach (Fig.4a),…

5 Conclusions

p.32212

> Line 12 : remove « The unique flow of ».
>
> Line 20 : is « transported » the right term ?
>
> Lines 23-24 : remove « seasonal… season) » and replace by activity (do not explain such process in your conclusions)

p.32213

> Line 12 : replace effects of by undergo

p.32215

> Line 3 : validity is a bit strong… You could say we assessed independently, which is more neutral.

Tables

Table 4 : the legend does not seem appropriate to the table.

Figures

Figure 1 : « from the EDGAR… »

Figure 2 : does the pump belongs to the CRDS analyzer ? Then make a box of both items together. Replace analysis system by « experimental set-up ».Replace « in » by « upstream of ». Remove the from « from the ambient air ». Replace « the calibration mixtures (three)» by « Three calibration mixtures ».