

Reviewer #1:

The authors have satisfactorily addressed most of my concerns. In particular, the authors have greatly streamlined the manuscript by combining figures and moving figures/tables that are not directly related to the presented arguments to the supplement. The only remaining concerns I have with the abstract are seemingly minor:

Reply: We would like to thank reviewer #1 for their comments in the first round that helped to improve the manuscript as well as their further comments here.

Abstract (Lines 49-50): less sensitive than what? significantly better than what?

Reply: We have changed the text to highlight that the improvement is relative to the XCO<sub>2</sub> measurements (without station pairing).

Abstract (Lines 51-53): I think this "conclusion" regarding the FF signal should be removed from the abstract. The authors do not actually make measurements that are indicative of FFCO<sub>2</sub>, this finding is purely based on prior assumptions in the model. I'm fine with them discussing this in the text but don't think it should be touted in the abstract.

Reply: Line 51 clearly states that this conclusion is based on the modelling framework, from which we conclude that this type analysis is 'potentially' useful. This seems to be a very non-contentious statement, even if "only" based on our model, which was shown to agree reasonably well with observations.

Reviewer #2:

### General Comments

This revision has significantly improved the manuscript. I found a few small typos and had a few minor questions about Figure 9 and the text referring to that figure, see the specific comments below. After these are addressed, I would recommend the manuscript for publication.

Reply: We would like to thank reviewer #2 for their comments in the first round that helped to improve the manuscript as well as their further comments here.

### Specific Comments

Ln 77: The “12’000” has an apostrophe instead of a comma. However, maybe there just shouldn’t be any punctuation here to make it consistent with the “10000” on the prior line and other instances later in the paper that do not have thousands separators.

Reply: Removed the apostrophe

Ln 79: “emission” should be “flux”.

Reply: Changed

Ln 114-115: The word satellites is repeated unnecessarily, and there is a comma after the period at the end of the sentence. It should be: “...which will not be sampled with low-earth orbit satellites. From...”

Reply: Removed

Ln 139: The acronym “AIRPARIF” should probably be spelled out.

Reply: We have added the official name in brackets

Ln 142: Just a thought...it might be interesting to look at how emissions from airports compare between surface and column-based measurements. Column based measurements could detect emissions aloft

during aircraft takeoff & landing, although perhaps the signal would be too small to detect. No changes are needed in the manuscript, it's just a thought.

Reply: We agree with the reviewer that this is indeed an interesting topic to investigate in a future study. Especially when more data from CO<sub>2</sub> measurement by commercial aircraft will become available. (<http://www.caribic-atmospheric.com/>)

Ln 291: In Equation 3 the “s” superscript on CO<sub>2</sub>\_CHIM and CO<sub>2</sub>\_CAMS seems to be in a different place than in the text (see on lines 285 and 294).

Reply: Thanks we have corrected this formatting issue

Ln 469-489 and Fig 9: I have a few questions about this section and Fig. 9.

The first question is about the direction of the wind in Fig 9. It looks like in Fig 9 that the highest dCO<sub>2</sub> are found at 180 degrees and the lowest dCO<sub>2</sub> are at 0 degrees, but to my eyes it looks like in Fig 1 that the direction between PIS-RES is ~10 degrees, and MIT-RES is a little higher, maybe ~40 degrees. (I just looked in the supplement and see they are listed as 7 degrees and 37 degrees). Did the authors orient their analysis such that 180 degrees indicates exactly downwind and 0 degrees as exactly upwind? Maybe not...it's hard to tell given the color scale used since each color block represents 45 degrees (except for green which has two blocks and represents 90 degrees). Maybe my request would be for the authors to use a finer color scale such that every symbol represents 5-10 degrees and has a unique color. It's not necessary, but it would certainly help out an interested reader to figure out what exactly is going on.

Reply: Unfortunately, changing to more colours does not really improve this figure and we hope the current representation will be convincing to the readers of ACP. Concerning the orientation – we consistently use meteorological directions in the manuscript. So optimal downwind/upwind is e.g. 187deg.

The second comment is that in the text the authors list the slope of the line, but the explanation could be slightly improved. I would suggest that the sentence on 474-475 be reworded to say that the line is between the modeled vs observed gradient between PIS-RES (or MIT-RES). Here is a suggested rewording: “We find that the modelled vs observed dXCO<sub>2</sub> of PIS relative to RES generally falls along the

1:1 line with a slope of  $1.07 \pm 0.09$  with..."

Reply: Changed as suggested

The third question is that on line 477-478 the authors say that no slope was calculated for wind directions perpendicular to the direction between the sites. However, the colors of the symbols in Fig 9 indicate winds from all directions. Were the slopes of the lines listed in this section calculated with only a subset of the data (I doubt it, but that is what the text means if taken literally)? I think this just needs a slight bit of clarification here.

Reply: We have corrected the text in the manuscript

Lastly, it might be helpful if the authors included the regression line on Fig 9. Maybe make the 1-1 line light grey so its less prominent and show the regression line as a black line?

Reply: Adding another line that is essentially the 1:1 line (within error bars) like causes more confusion than illumination.