

Interactive comment on “Validation of nine-years of MOPITT V5 NIR using MOZAIC/IAGOS measurements: biases and long term stability” by A. T. J. de Laat et al.

Anonymous Referee #1

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In this paper the authors present a validation of the MOPITT V5 NIR data, using profiles measured by aircraft in the framework of the MOZAIC/IAGOS program. A good agreement is found between MOPITT and MOZAIC/IAGOS columns. No MOPITT V5 NIR bias was identified and no long-term drift was found, on global and regional scales. MOPITT NIR measurements have proven to outperform the MOPITT a priori. The study raises the issue of the large spatial footprint of the MOZAIC/IAGOS data (200–400 km) and uses a method to take it into account in the validation. The authors use model simulations from MOCAGE to demonstrate the large variability of CO total columns along the MOZAIC/IAGOS flying path, which explains the large variability of

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the MOPITT data shown in the validation.

This study is a considerable work as it covers 9 years of data. Satellite data, airborne data and model simulations are used. The paper is well written and interesting. I found the paper clearly presented (the synthesis of the methodology is appreciated), well organized and useful for the community as the MOPITT and MOZAIC/IAGOS data are widely used. Also, I found the case study at Windhoek interesting. The supplement is useful for studies above specific airports. The subject of the paper is appropriate to AMT. I recommend the paper to be published, after addressing the minor issues I raise below.

Specific comments :

1) Regarding MOPITT :

- It is not clear why the authors use the MOPITT NIR product instead of the TIR product or the TIR+NIR product. It should be specified in the introduction or in the MOPITT section (2.1).
- In section 2.1, it is good that the authors referred to papers for details of MOPITT V5 data and retrievals. However the section should mention MOPITT as a gas correlation radiometer.

2) Regarding section 2.3.2:

The text between line 11 and 21 is not easy to understand. Some parts should be rewritten for the sake of clarity. Here are some suggestions for the modification.

- Is the contribution of 20–30% considered important?
- Does it motivate the authors to complete the MOZAIC/IAGOS profiles?
- Line 14 p 5259, “pixels” should be replaced. By “collocation pairs” for instance?
- Line 14 p 5259, the MOZAIC/IAGOS columns are the raw ones or the completed

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ones? It should be specified, to help the readers.

- Maybe a concluding sentence should be added for this part?

Completing the MOZAIC/IAGOS profiles are also mandatory if the profiles are to be smoothed by the MOPITT averaging kernels. It should be mentioned somewhere.

3) Regarding section 2.3.4:

- Line 23 p 5260: following Deeter et al. (2013) > following Rodgers (2000) or Deeter et al. (2013)

- Line 25 p 5260: change capital letter X to lower case x as it is a vector (compared to the averaging kernel matrix A)

- Line 1 p 5261: change capital letter X to lower case x

- Line 1 p 5261: add "xa is the MOPITT a priori CO profile"

- Line 2 p 5261: A is the averaging kernel > A is the MOPITT averaging kernel matrix

- Lines 2-3 p 5261: Do you mean the 10log obtained profile is calculated back to mixing ratios (10^{\wedge}), then converted in partial columns and then integrated to a total column?

- Lines 3-8: "Note that by ..MOPITT profile measurements". These two sentences are not clear. It should say that following Rodgers (2000), to account for the different vertical sensitivities of the MOZAIC/IAGOS and MOPITT measurements, the CO profile of the instrument with the higher profiling capability (MOZAIC/IAGOS) should be smoothed by the averaging kernels of the instrument with the lowest vertical sensitivity (MOPITT). This information could be added at the beginning of the section.

- Line 8 p 5261: "averaging kernel adjusted" > smoothed

- Line 10 p 5261: "less than 2.5%/3.5%/6%": % of what? The mean smoothed total column?

Other comments:

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- Add information about the 9-years (2002–2010) in the introduction. It could be repeated in section 2.3 (line 15).

- Line 9 p 5254: Add Inness et al. (2013) (see reference hereafter)

- Line 26 p 5254: "This dataset has already been used for the validation of SCIAMACHY CO measurements (de Laat et al., 2012) but can also be used for validation of MOPITT NIR measurements. Results of such a validation are presented in this paper." I would suggest: "This dataset has already been used for the validation of SCIAMACHY CO measurements (de Laat et al., 2012). Results of a validation of MOPITT NIR measurements are presented in this paper."

- Line 17 p 5256: Earth's surface and the atmosphere > Earth's surface and the atmosphere just above

- Line 17 p 5263: the comparison of all > the CO total column comparison of all

- Line 18 page 5263: if possible add the number of collocation pairs ... for the 2002-2010 period: xx collocation pairs (yy MOZAIC/IAGOS and zz MOPITT profiles)

- Fig 1 should be enlarged, it is difficult to read.

- In Fig 1a, the vertical bars indicate the range of the MOPITT CO total columns collocated to the MOZAIC/IAGOS profile path (as said in the caption). If I understand well, for one collocation, it means that the min and max of the MOPITT CO total columns are the lower and upper limit of the bar. Starting line 20 page 5263, "The variability in MOPITT CO total columns along the MOZAIC/IAGOS flight path is represented by the vertical bars in Fig. 1a. The results indicate that MOPITT CO variability is very large along the MOZAIC/IAGOS profile path relative to the CO total column range..." is not clear to me. I don't understand the "relative to".

- Lines 18 and 20 p 5264: measurements > columns

- Line 19 p 5264: The sentence "Approximately ..." is not clear.

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- Line 24 p 5264: individual measurements > individual comparisons?
- Line 14 p 5267: do not improve > improve (or “are better than the statistics”)
- Table 3 requires a number of repeated readings to be understood. I suggest another display for the table, see pdf attached. The caption should be modified accordingly.
- Line 18 p 5268: within the threshold range > within the threshold range (< Δ)
- Line 19 page 5268: (0.92-0.95) > (0.93-0.96, column 2 in Table 3)
- Line 20 p 5268: (. . . ; columns 2 and 3/4 in Table 3). > (. . . ; columns 3/4 in Table 3).
- Line 23 p 5268: outside the threshold range > outside the threshold range (> Δ)
- Line 15 p 5269: domain over Europe (Fig.5): please give the domain ([lat1 lat2], [lon1 lon2]) or indicate lat and lon labels on Fig. 5.
- Line 16 p 5270: add “(for the period investigated in the study)” at the end.
- Line 18 p 5270: concentrations > profiles
- Line 29 p 5270: (see Table 1) > (see column MMI in Table 1)
- Line 11, 12 and 13 p 5272: CO total columns > CO columns?
- In Table 1: If Deeter et al. (2013) is using the “mean” comparison, it would be worth mentioning it in the caption or in the Table: “Deeter et al. (2013) (Mean)”.
- Caption of Table 3, last line: (“+ Δ ”) > (“Range”)
- Caption of Fig. 2: The lower plot > (B)
- Caption of Fig. 4: add “(indicated under the airport name)” at the end
- Caption of Fig. 7: “partial CO total column” is not clear. It is clearly written in the caption that columns here are partial columns. Replace “total column” by “column”? (3 times in the caption)

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- Same thing for the title of Fig. 7.

Typos:

- Remove capital letters of “Carbon Monoxide”: line 2 p 5252
- Remove capital letter of “Monoxide”: line 22 p 5252, line 26 p 5257
- Line 23 p 5254: for a. Global: remove “.”
- Line 24 p5254: aircraft > aircrafts
- Line 26 p5254: aircraft > aircrafts
- Line 7 p 5258: MOZAIC_IAGOS > MOZAIC/IAGOS
- Line 26 p 5262: Michou et al., 2005. But 2004 in the references list.
- Line 4 p 5265: switch North America and Europe (to fit the display in Fig 2)
- Line 8 p 5265: de differences > the differences
- Line 21 p 5265: Fig 2f > Fig 2d
- Line 11 p 5267: the the > the
- Line 22 p 5268: MOZAIC-MOPITT > MOZAIC/IAGOS-MOPITT
- Line 9 p 5270: Jaffe et al., 2005. But 2004 in the references list.
- Line 11 p 5272: MOZAIC-IAGOS > MOZAIC/IAGOS
- Caption of Table 2: Switch North America and Europe (twice)

Inness, A., Baier, F., Benedetti, A., Bouarar, I., Chabrillat, S., Clark, H., Clerbaux, C., Coheur, P., Engelen, R. J., Errera, Q., Flemming, J., George, M., Granier, C., Hadji-Lazarou, J., Huijnen, V., Hurtmans, D., Jones, L., Kaiser, J. W., Kapsomenakis, J., Lefever, K., Leitão, J., Razinger, M., Richter, A., Schultz, M. G., Simmons, A. J., Suttie, M., Stein, O., Thépaut, J.-N., Thouret, V., Vrekoussis, M., Zerefos, C., and the MACC

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team: The MACC reanalysis: an 8 year data set of atmospheric composition, Atmos. Chem. Phys., 13, 4073-4109, doi:10.5194/acp-13-4073-2013, 2013.

Please also note the supplement to this comment:
<http://www.atmos-meas-tech-discuss.net/7/C1463/2014/amtd-7-C1463-2014-supplement.pdf>

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 5251, 2014.

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