Review of paper by Chiarella et al.

General comments:

The authors present a study on the retrieval of XCO_2 from NDACC MIR spectra. Up to now, CO_2 is not a target gas within NDACC. A CO_2 retrieval would further exploit MIR spectra recorded since a long time and would nicely extend the capabilities of the NDACC network.

The authors compared these XCO_2 data with TCCON XCO_2 data and characterized the error sources of this XCO_2 data product. The precision of the retrieved XCO_2 is sufficiently high to create a useful data set. Some details, however, like the instrumental line shape of the spectrometer or the accuracy of the pressure sensor that might affect the long-term stability of the retrieved XCO_2 data need more discussion.

Therefore, I would recommend publishing this paper after some revisions. Please also see specific comments below. The paper is well structured and fits well to the scope of AMT.

Specific comments:

The optical filter used for this study differ from the NDACC standard filter set. NDACC filter #1 covers the region from 3850–4550 cm^{-1} and does not include the 4800 cm^{-1} micro window. The filter used in this study is optional and in NDACC numbering (increasing number with increasing wavelength) something like NDACC filter #0. Therefore, it is questionable whether many sites recorded spectra with it since a long time.

Since the MIR does not include O_2 signatures pressure data have been used to calculate XCO_2. Accordingly, the quality of the XCO_2 product relies on the quality of the pressure sensor and its data. The paper would benefit from a paragraph or appendix describing the used pressure sensor and its requirements. In particular, the required precision and accuracy and any means to check and correct for drifts need to be discussed in the paper.

The paper includes an error estimate and the precision of the retrieved XCO_2 product is good. Normally, a correlation coefficient of 0.95 (Fig. 11) is quite good, too. For XCO_2 data however, it is not fully clear whether this is sufficient. For Burgos site, the correlation coefficient (0.84) is even lower.

It is certainly a good idea to include spectra from a wet site. The site used for this, however, suffers from the lack of NDACC spectra. Instead, spectra were recorded with a broadband InGaAs detector without any optical filter. In the 4800 cm^{-1} region an NDACC type spectrum recorded with a cooled InSb detector and bandwidth filter is better with respect to linearity and signal to noise ratio.

You might add the signal to noise ratio of the InSb and InGaAs spectra as shown in Figs. C1&C2. This might give a hint on the noise level although the spectral resolution differs strongly. Alternatively, did you record these spectra (C1&C2) with the same spectral resolution?

The spectral resolution of 0.005 cm^{-1} as used in the NDACC mode is probably overdone in this spectral regime at 4800 cm^{-1}. (At this spectral regime, my personnel guess would be something about 90 cm OPD or a resolution of about 0.01 cm^{-1}, respectively.) The authors tested different spectral resolutions (Appendix D) which is a very useful exercise. However, I do not see a clear

statement on the optimal resolution at 4800 cm^{-1}. I would suggest adding a plot of a CO_2 line recorded with different OPD to study the needed OPD to resolve the line fully.

In the introduction, the paper states that previously published recipes for XCO_2 retrievals does not yield XCO_2 data of sufficient quality to use the data for atmospheric research. This is correct. However, in the discussion or conclusion the results of the data set retrieved in this paper have not been compared to those previous data sets to demonstrate the improved data quality.

Furthermore, the long-term stability of a time series of this data product is not studied in detail. This should include a discussion of a possible drift of the pressure sensor. See comment above. Secondly, regular cell measurements to retrieve the ILS (Instrumental Line Shape) of the spectrometer are strongly recommended over the entire time series. Are ILS measurements made and used in this study and if so what are the ILS results? ILS parameters are also missing in the error estimate (Table 4).

While chapter 6 announces historical data from 1997 to 2018, Figs. 9, 10 and B1 just show data for the years 2016, 2017 and 2018. It seems this is limited to the availability of data from the 6300 cm^{-1} spectral region, isn't it? The NDACC type measurements at 4800 cm^{-1} started in 1997. When did the TCCON measurements at 6300 cm^{-1} started at Ny-Ålesund? It would be helpful for the reader if you add a table or columns to Table 1 listing the periods of available and used spectra for each retrieval and chapter. Also for Table 3 and Fig.7 the period covered would be helpful.

Finally, if earlier TCCON data (from before 2016) are available it would be nice to include a longer data set into the comparison. Moreover, to study the long-term stability in more detail it would be good to calculate the difference of NDACC and TCCON XCO_2 data from the beginning of these measurements and to perform a trend study on the difference.

Technical corrections:

- l. 20: validation validation
- l. 20: ofCO_2
- l. 25: sppectru, => spectrum
- l. 59: In NDACC spectra => NDACC spectra
- l. 126: Correct use of respectively?
- l. 141 and a few more times there is still a question mark
- l. 158: Ny-Ålesund around => Ny-Ålesund and around
- l. 163: following => following equation
- l. 169: when => even if?
- l. 185: => (Wunch et al., 2011a)
- l. 226: the those => those?
- l. 229: These bias => These biases or this bias
- l. 311: is and full stop are missing.
- l. 326: points. . => points.
- l. 407: Fig. D1 is missing or the number of Fig. D2 is incorrect.
- l. 412: where => were or better rephrase the sentence beginning with 'In resolution Fig D1'
- l. 445: Ny-Ålesun => Ny-Ålesund
- l. 449: One authors => One author

The list of typos is not complete. Please proofread carefully.