General comments

This paper by Qiansi Tu et al compared the atmospheric column-averaged dry-air mole fractions of carbon dioxide (XCO2) and methane (XCH4) measured with a pair of COCCON spectrometers at Kiruna and Sodankylä sites in boreal areas with model data provided by the Copernicus Atmosphere Monitoring Service (CAMS) and with XCH4 from the Sentinel-5 Precursor (S5P) satellite. In addition, the gradients of XCO2 and XCH4 (ΔXCO_2 and ΔXCH_4) between Kiruna and Sodankylä derived from CAMS model and COCCON and S5P measurements were also compared for evaluation of the capability of detecting sources and sinks on regional scales. Effects of a-priori profiles, season, albedo and viewing zenith angle on differences or ratios among these datasets were also analyzed. This work can improve current understanding regarding the compact and mobile EM27/SUN instrument is appropriate for field campaigns as well as for long-term deployment at a site with the potential to complement the TCCON network. Generally, this paper is well written, fits well in the scope of AMT, and I recommend for publication with few corrections.

Specific comments.

1) Since this work mainly focus on an inter-comparison of different datasets, personally, a title such as "Inter-comparison of atmospheric CO2 and CH4 abundances on regional scales in boreal areas derived from CAMS analysis, COCCON spectrometers and Sentinel-5 Precursor satellite observations" or similar would be better.

2) P1-line 16: "COCCON" to "Collaborative Carbon Column Observing Network (COCCON)". Should always spell out the full name of an acronym when it first appears.

3) P1-line 16: Could you point out the time series range that you compared?

4) P2-line 41: I would like to an alternative expression for "The 2018 global mean abundance relative to the year 1750 is 147%".

5) P2-line 52: Spell out the full name of SCIAMACHY.

6) P3-line 85: Spell out the full name of ESA.

7) P3-line 88: Change "COCCON (Collaborative Carbon Column Observing

Network)" to "Collaborative Carbon Column Observing Network (COCCON)".

8) P3-line90: Start a new paragraph for "This paper compares S5P observations to the ground-based observations from two COCCON spectrometers operated in the high latitude regions in Sodankylä, Finland and Kiruna, Sweden. The measurements from these two sites are highly valuable for investigating the gradients of the greenhouse gas distribution on regional scales near the Arctic Circle."

9) P3-line94: using either TROPOMI or S5P, be consistent throughout the paper.

10) P4-line100: change "CO4" to "CH4"

11) P4-line101: Spell out the full name of MAP.

12) P4-line102: The sentence "In this study, we provide an intercomparison of atmospheric CO2 and CH4 column-averaged abundances derived from ground-based COCCON spectrometers and the CAMS reanalysis dataset, and CH4 from S5P satellite within the Arctic Circle." is overlapped with previous descriptions. Remove it or re-organize the last three paragraphs in the introduction section.

13) P4-line108: Could you include a map showing the locations of this two sites. You can put it in the supplement or appendix. Or it already appeared in other study, please put a reference here.

14) P4-line115: If you already spell out the full name of ESA before, here using ESA is fine.

15) P4-line116: "The COCCON measurements at the FMI as part of this campaign started since March 2017" , you already introduced this before.

16) P4-line126: Spell out the full name of NDACC.

17) P6-line168: "FTS" to "FTIR"?, or spell out the full name.

18) P7-line213: "…..whose plots are highlight with additional red and green dots in the right corner of Figure 2", I can't see this highlight.

19) P7-line219: could you elaborate a bit more on how to judge the polar vortex using the tracer N2O? or a reference here.

20) P9-line260: could you include a table to show the comparison for XCO2 or extend table 1 to include the comparison for XCO2. Furthermore, this work presents lots

of comparison, using table to summarize the results would be better than putting all results in the text.

21) P10-line309: "the differences of XCO2 and XCH4 with respect to CAMS between Kiruna and Sodankylä…." is not clear, try an alternative expression.

22) P11-line325: move "Table A. 1 lists the statistics of S5P data coincident with COCCON data 325 when S5P overpasses both sites in one day." before "The correlation……".

23) P13-Table 1: include units of the comparison.

24) P16-Figure 3: Is it possible to roughly show the locations of this two sites in either of subplots?.

25) P21-Table A1: what does the error indicate?, and is the Nr. short for Number?