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Atmospheric Measurement Techniques Discussions

Interactive comment on "Calibration of the total carbon column observing network using aircraft profile data" *by* D. Wunch et al.

Anonymous Referee #2

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General Comments:

This paper uses several instrumented aircraft overflights from different campaigns to calibrate data derived from five TCCON sites. The aircraft instruments are WMO calibrated and the impetus is too determine and explore any biases of the FTS network data with the standard instrumentation. The primary gases are CO2, N2O, CH4 and CO. Biases in H2O are treated similarly but is determined with respect to RS92 radio sondes. The stations cover a range from north to south mid latitudes and the calibrations show no latitudinal dependence. The paper illustrates the networks degree of standardization and adds to its science applicability. The paper is recommended for publication after minor revisions.

General Comments:

P2607 L14 The albeit small decrease in atmospheric O2 is mentioned and although well below uncertainty values in gases of interest here its not stated whether it is taken into account.

P2608 L17 The airmass dependence more correctly is determined by solar zenith angle not time of day and its range is then dependent on latitude. There has been much recent work on these CO2 line parameters and are arguably better then other gases why the issue with CO2 not the other gases? (note this may be discussed in Wunch 2010 but that is not yet available.)

Table 3 Since each aircraft flight maybe different expanding table 3 to include the altitude ranges of the profiles used helps the reader know from what altitude range the compared information is derived.

P2610 L5 The averaging kernels yield what the retrieval process does to a given state vector with all its errors and approximations built into it, so it may be an interpretation 'if it were measuring perfectly' but this may be better stated to say that eg 'this is what the retrieval should return given the in situ profile'.

P2610 L6 'ie without spectroscopic errors' infers that this is the only error in the data, was 'eg' meant?

P2610 Eq 2 & 2613 L9 The importance and usefulness of the retrieval averaging kernels in comparing to the in situ profiles is well noted and used here as is their representation of the sensitivity of the measurement. These should be plotted for each gas noting the variation extent with SZA

P2612 L8 Uncertainties are mentioned here and elsewhere (Sec 5) in particular the large contribution of the unknown stratospheric apriori profile. Although error bars are given in plots 4-8 a table of estimates of the known uncertainties should be used to pull this important information together.

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P2614 L11 Its been shown recently that there is a strong correlation with the difference in total water vapor measured by two instruments and time lag between those measurements (Sussmann etal Atmos. Chem. Phys., 9, 8987–8999, 2009). What time lag do the measurements in F5 represent? Are they nearest at time of launch, after 30min? More generally the dry air mole fraction can be viewed as a weighted mean VMR. Is this useful for water vapor which so rapidly falls off with altitude?

P2614 L11 What is meant by duration of the measurements? Do the points in Figs 4-8 represent one spectrum? Or several averaged? If not the same for all data points perhaps a table should be used to show this. It is correct to assume these are a standard data product?

P2612 L13 – 2613 L13 Profiles of CH4 and N2O are qualitatively similar but not identical and also not mirror images of HF. Accounting for ascent/descent in polar regions for instance using vertical shifts where the descent is the dominant dynamical feature, is a reasonable procedure. Inferring an ascent/descent because retrieved HF is not as expected seems to rely heavily on a prior certainty in the HF column as well as its relation to CH4 and N2O and in the case of a network globally. This should be elaborated on. Using this method what range of HF shifts are seen (one example gives .8km in Fig3)? Is there a dependence by station? The uncertainty approximation determined by shifting by one km yields what column error? Also at sites which have higher resolution NDACC FTS instruments which are sensitive in the lower stratosphere – can the be used to directly measure CH4, N2O and possibly CO in that region?

Technical Comments:

P2606 L1 : should be e.g. <0.25%...

P2610 Eq 3 when going from matrix multiplication in eq2 to the vector in eq3 A changes to aT. This is not mentioned in the text nor is it necessarily standard.

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