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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "Multi-year comparisons of ground-based and space-borne Fourier Transform Spectrometers in the high Arctic between 2006 and 2013" *by* Debora Griffin et al.

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We would like to thank reviewer #1 for his/her corrections and recommendations.

**Sect 2: I understand that VMR is retrieved directly and I assume that you would have mentioned if one of the retrievals was in the log domain. If you have used direct VMR fits then everything is ok. If log(VMR) is retrieved for some instruments, then it should be mentioned and might add some complication in the inter-comparison and interpretation of averaging kernels etc.**
Yes, the VMR was retrieved directly for the ground-based instruments and the space-borne ACE-FTS and none of these used a log domain. It was therefore not mentioned



in the text.

**p7 l33 - p8 l2. I am a bit confused because I thought that the formalism for error estimation in Rodgers 1976 where the error is directly inferred from the information matrix automatically includes the smoothing error (Eq 18 in Rodgers 1976). In contrast, in Rodgers 1990 the retrieval noise and the smoothing error (called null space error in Rodgers 1990) are evaluated separately. To my understanding only the Rodgers 1990 formalism allows to evaluate the pure noise without any smoothing error component (see also Eqs. 3.19 and 3.29-3.31 in the Rodgers 2000 book; 3.31 seems to be the one reported in Rodgers 1976, and it includes the smoothing error). Please clarify which error estimation formalism has been used and verify that the smoothing error has really not been included, not even implicitly via Eq 18 in Rodgers (1976).**
This has been corrected and the reference has been updated to Rodgers (2000) instead of Rodgers (1976). The smoothing error is not included in our error estimate.

**p10 l22 and elsewhere: To judge how significant a correlation coefficient larger than 0.95 actually is, it would be necessary to also report the sample size along with the value. By the way, I suggest to mention somewhere that R is the correlation coefficient.**
We have changed the sentence to:
"The correlation is excellent for $O_3$, HCl, $HNO_3$, and CO, with correlation coefficients $R \geq 0.95$ and the slopes of the regression plot between 0.93 and 1.13 ($N = 685$ to 1623), see Table 3."

Throughout the text, the term "correlation coefficient" has been added each time $R$ was mentioned.

**p10 l29 and elsewhere: There is a trap in comparing smoothed higher-resolution profiles with coarser resolved profiles. The application of the averaging kernel (Eq. 1) has considered also for the error of the better resolved profile (i.e. multiply the groundbased error covariance matrix from the left and the right (transposed) by the averaging kernel, (Snew = ASoldAT , smoothing typically makes the errors smaller). Without consideration of the error propagation through the smoothing process, the conclusion from the comparison will be too optimistic. Please check if this propagation has been considered. This is relevant to all conclusions where the combined retrieval uncertainties are mentioned. Please verify that this error propagation of the smoothing operation is considered in the error estimates used, and mention this, because this is often forgotten.**
The error after smoothing has not been estimated in our study since the error covariance matrix is not available for all instruments used in this study, and a consistent approach has been used throughout the paper.

**Language:**

**p2 l24: "next" is ambiguous. I think it is typically understood as the one after the current (i.e. in this case the intro) but is used here for the one after the last mentioned. Perhaps "following" might be clearer.**
p4, l. 24, we have changed the wording of the sentence according to the suggestion:
"The following section focuses on the methodology and results of the ACE-FTS comparison results."

**p5 l20: "take approximately every 7 min". Here it is not quite clear to me if this**



**is the time for a single spectrum or for the resulting spectrum after co-adding.**
We have changed the wording of the sentence:
"Each measurement is recorded approximately every 7 min and consists of 20 co-added spectra (Sung et al., 2007)."

**p10 l15: I am always confused how the word DOFS is correctly used, particularly if DOFS are "large" or "many". My intuition says me that the "number of degrees..." is "large" but that the "degrees..." are "many" but I may be wrong.**
We have changed the wording of the sentence to the suggested one:
"The differences between the smoothed and unsmoothed columns are relatively large $\sim 9\,\%$ for HF, for which the total column retrievals from PARIS-IR have DOFS of approximately 1, whereas the Bruker 125HR HF retrievals have twice as many DOFS (see Table 1)."

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