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**Interactive
comment**

Interactive comment on "Ten years of atmospheric methane from ground-based NDACC FTIR observations" *by* Whitney Bader et al.

Anonymous Referee #3

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Comment on: "Ten years of atmospheric methane from ground-based NDACC FTIR observations"by W. Baader et. al

General remarks:

The paper presents 10 years long times series of Methane (CH4) of 10 NDACC sites , which is an actual topic of gran interest. The presented data have a very high quality, is well written and the paper should be published after minor corrections. Specific remarks:

1. **Title:**

   It might be nice to mention the used years "2005-2014" maybe something like: "Ten years of atmospheric methane from ground-based NDACC FTIR observa-

tions between 2005-2014"

2. **Abstract:** Some parts in the abstract could be written more concise and it might be important to mention that the work is based on total vertical **column** measurements.

3. **Retrieval:**

   Some parts of the retrieval description might be done more easier and in a more common way: 1.For most reader a matrix is multiplied from the left side $A \cdot \vec{x}$: Please write the equation instead of the form, of maybe Rodgers 1990: $\mathsf{X}_s mooth = (Xm - xa)\vec{A} + xa$ but $X_s mooth = \vec{A}(Xm - xa) + xa$(1) Rodgers 2000, as everybody else. I admit that is the same, just the AVK matrix id defined in the transposed way $A = A^T$.

4. I do not understand the section 2.2.2 information content and as far as I know is the word *INFORMATION CONTENT* used for the Shannon information measure describing the increase of the information $-log(Det(S_error)/Det(Sa))$ by Rodgers 2000, which is here slightly different used and maybe not really useful but misleading as a title, maybe "Information analysis" might be better.

5. The eigenvector analysis might be an usefull mathematical tool for many applications in OET, like transformation Sa-matrix to the identity . . . , but it might be difficult for the reader and not so easy to be understand in the more general constraint least square fitting approach which includes "Tihkonov"-regularisation. If you want to keep the eigenvectors figure, first of all you have to specify from wich matrix you calculate eigenvectors and in which units you plot it: fraction or VMR. I assume you are doing it from VMR-Averaging kernels and uses VMR. As you work with ten sites I would like to see all of them, to know if this is a more or less harmonic set of retrievals or if you have to be more careful, if altitude dependent CH4 anomalies due to dynamics, stratospheric intrusions .. or other effects will

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be seen differently, by different sites. As the ten stations are not harmonized, I would like to see a simple averaging kernel for total column (AVK_{tot}) of all ten station, either a typical or an average AVK_{tot}. If you will emphasis on the altitude resolved information of the retrieval are important for this study, I would include the mean DOF in one of the tables maybe (Tab. 2), as this gives in addition information on the strength of the constraint at each site and retrieval strategy.

"established within the NDACC Infrared Working Group that the regularization strength of the methane retrieval strategy should be optimized so that the Degrees of Freedom For Signal (DOFS) is limited to a value of approximately 2 (Sussmann et al., 2011). As a consequence, the typical information content of NDACC methane retrievals will allow us to retrieve tropospheric and stratospheric columns, as displayed in Fig. 3., a more common way to look at two partial columns would be to plot the two partial column averaging kernels and the total column averaging kernel.

6. optional: Jungfraujoch and Zugspitze, see the same pattern of annual resolved changes: Especially prominent is the huge difference between 2010 and 2011: That is really interesting and seems consistent for both the MODEL and hopefully also with the FTIR time series. Could you proof this with the FTIR-Model difference? Maybe with a model-control run using an average change, which would result in a MODEL-FTIR residual with a similar structure than the red line in figure 6.

7. Fig 2 is already included in Fig. 5 therefore I would suggest show in Fig 2 the absolute columns not anomalies, either the daily means or even the individual measurements.

8. Table 2: interference species: please defined if the gases in your list are the simultaneously fitted gases or all in addition simulated interference gases, you could replace the column with the interference gases in the main article by DOF

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of each stite retrieval strategy. Maybe provide a supplement, where you add more about the 10 retrieval strategies with exact micro windows fitted, prefitted and simulated interference gases.

9. QA/QC: Looking on the time series and the different results of the model, which explain some sites quite well and other less, I wonder if the operators might use different quality selection of spectra and retrieval results and therefore some time series show a higher scatter, as harmonisation of quality control (QC) might be too much effort at this stage, but it may be possible to include just a table which sumarise, the different QC criteria and help the reader to evaluate if only local effects will produce the heterogen image Fig. 5, or maybe also individual quality filters.

10. Table 3: Units column 7 and 8 have to be exchanged: "molec. cm- Yr-1"<->" The $molec.cm^{-2}yr\{-1$ the 2 is missing

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