Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-326-RC1, 2017

Atmospheric Measurement Techniques Discussions

Interactive comment on "Upper tropospheric CH_4 and N_2O retrievals from MetOp/IASI within the project MUSICA" *by* Omaira E. García et al.

Anonymous Referee #1

Received and published: 15 February 2017

General comments :

The paper is well structured and detailed effort has been given to the underlying theory and error estimation.

However I find that the validation exercise is based on a limited set of collocated data (36 collocations). Why are the HIPPO 2 to 4 profiles not included as well?

In addition, large differences are found between the retrieved CH4 concentrations and the 'CH4 combined with N2O' product which are not well explained. For CH4, you find CH4 vmrs higher than 1900 ppbv, and values around 2000 ppbv are not uncommon. These are issues which are not well addressed.

Specific comments :

P2, L29 : ...partly cloudy scenes... I would not make that statement. You only consider cloud-free scenes as you mentioned in Section 2.2 (P5, L16).

P4, L32 : You use a WACCM climatology averaged for the 2004-2006 period as an a priori set. How do you account for the strong trend in CH4 and N2O of the last decade ?

P5, L5 : What do you mean with 'the surface skin temperature retrieval is not constrained' ?

P5, L16: Is line mixing included ? In the paper of Razavi et al. they investigated the influence of line mixing in the ν4 spectral band around 1300 cm-1 range. They proposed to use the reduced spectral range of 1240-1290 cm-1 for the retrieval of CH4 to reduce the effect of line mixing. How do you account for the effect of line mixing ?

P5, L26: The row of the A at which altitude ?

P5, L29: It would be very interesting to see the complete A matrix (not just 1 row), to have a complete view on the sensitivity of the retrieved product.

P5, L31 : You give an estimate of the vertical resolution of around 12 km in the tropics and around 10 km in the polar regions. But what are typical values for Degrees of Freedom for Signal (DOFS) for the retrievals, as calculated from the trace of the Averaging Kernel ?

P7 : The added value of this section is not clear to me. Is that something you would you like to implement, i.e. to calculate the smoothed state for another a priori state to account for the indeed very different shape of the CH4 and N2O profile for low-, mid- and high-latitudes ?

P9 : Theoretical error estimation / Figure 3 : You give an estimate of the theoretical error for the combine product, but for the 'CH4 combined with N2O'-product you add xN2o (=xa,N2O for simplicity), as given in Equation 8. The error on xa,N2O still needs to be characterized and taken into account. Especially since the xa,N2O is a climatol-

ogy averaged for 2004-2006 dataset is used which is an underestimation of the current N2O concentrations.

P10, L16 : Why did you not include HIPPO 2, 3 and 4 ? Then you have a much larger dataset to compare. Here you compare only about 2 months of data, 36 collocations. Do you get similar results including HIPPO 2-4 ?

P11, L29: Please add the number of collocated measurements for these 88 valid aircraft profiles.

P11, L31 / Figure 6 : It seems you have quite some variability in the MUSICA N2O and CH4 concentrations (Figures a and b) especially for the latitudes 20-60° S. With unrealistic values (CH4 concentrations > 2000 ppbv). Could you consider an a-posteriori filtering to exclude these outliers ? What are the main differences in the MUSICA CH4 retrievals between these 2 periods (Jan 2009 for HIPPO1, Aug/Sep 2011 for HIPPO5). Do the IASI L2 temperature profiles which you use as a priori for the temperature retrievals have an improved version for the year 2011 (HIPPO 5) ?

P13, L9 : 'The well known seasonal cycle with higher concentrations in summer than in winter'. The seasonal cycle of methane as found by flask measurements (the GAW network) is reversed, with high concentrations in winter and low concentrations in summer. How do you explain this reversed cycle at 350-300 hPa ?

P13, L13 / Figure 8 : Could you show both CH4 and 'CH4 combined with N2O' with the same colorscale ? For CH4 you have values in the range of 1900-1950 ppbv in the Northern Hemisphere for August, which are 'reduced' to values of around 1750 ppbv for the combined product. How do you explain these large differences ? Could you show a difference plot between the 2 products and discuss this ?

P13, L26 : I am surprised by the large scatter between the METOP-A and METOP-B N2O and CH4 retrievals. What are the values for the mean difference and standard deviation of the difference between the IASI-A and IASI-B retrievals for the 3 products

?

P14, L22 : What did you use as the actual state for N2O (or XN2O) ?

Technical comments :

P1, L13 : please add, 'over the Pacific region'.

P2, L18 : ...sample only a small fraction of the whole atmosphere... When you write it like that I would think you mean a reduced altitude range of the atmosphere. Maybe put ...have limited geographical coverage.. ?

P3, L5 : will be flown

P10 , L9 : Empirical validation. You use it throughout the paper. To my knowledge, empirical means without using any scientific method or theory. This validation study seems to be based on a scientific theory, not ? I would omit empirical throughout the paper. (P1, L9; P 3, L 11; P 3, L 12; P12, L18 ;..)

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