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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Contributions of the troposphere and stratosphere to CH_4 model biases" *by* Zhiting Wang et al.

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Additional comments: 1. As explained on page 6, biases are assessed by taking the absolute difference between model and FTS. The motivation is that biases may change sign seasonally, and therefore may not show up in annual averages when positive and negative contributions cancel out. However, whether this is a good choice or not depends on the kind of bias that is investigated. Here the focus is largely on a latitudinal bias. Suppose that there is no latitudinal bias in the annual mean, but only a latitudinally varying bias in the seasonal amplitude. By taking absolute model to FTS differences across the year you would end up with a latitudinally varying bias. In this case the choice of absolute differences was clearly not appropriate. There may not be a single solution to this problem for the biases that are investigated here, but the meaning of the numbers that are summarized in the abstract and the conclusions for stratospheric and

tropospheric contribution to the bias is not clear to me. A relation with a latitudinally vaying bias is suggested, but do these numbers really reflect stratospheric and tropospheric contributions to that bias. This requires more attention, including information on how the absolute differences are calculated (on every data point like an RMS, or on monthly averages, or?).

The absolute difference between the models and FTS is only used to calculate the averaged bias over all years and all sites. The results of the absolute bias are only the numbers appearing in Page 6, line 29∼30 and in the abstract. The true bias (model-measurements) is used for all other parts of the paper, including all the plots.

2. Looking at Figure 5, the most significant differences between the models and HIPPO seem really at the highest measured altitudes. You might debate whether they are in the troposphere or the stratosphere. I wonder how important this really is. Wouldn't it be better to conclude that the problems show up most strongly at tropopause altitudes. In that case the method of separating the troposphere from the stratosphere may actually not be so appropriate. A plausible cause could be strat-trop exchange. I don't see how the results that are presented here exclude this possibility. Yet, it is not considered as an option.

Yes, the model bias indeed increase abruptly above the tropopause. However, the approach separating the troposphere from the stratosphere does not influence the latitudinal gradient in the model biases of tropospheric CH4 as show in the Fig. 1-5. Only the stratospheric model biases are sensitive to the separation method and appear large when the tropopause is defined as low as 2.5 PUV. But the stratospheric model biases did not present a consistent latitudinal gradient with the model biases in the total columns of CH4.

3. page 4, line 8: Where does the tropopause pressure come from?

In deriving tropospheric CH4 from FTS measured total columns of CH4 and N2O, the linear correlation existing between N2O and CH4 in the stratosphere is applied. In the

troposphere the N2O concentration is well known and then stratospheric N2O column is obtained through subtracting its tropospheric contributions from the total columns. Because of the correlation stratospheric CH4 column is estimated from N2O columns and finally the tropospheric CH4 column is known. In the process the tropopaue pressure is not needed.

4. page 4, line 13: What model CO2 fields are used to translate the retrieved ratios into XCH4?

The CO2 field is from the CarbonTracker model.

5. page 5, line 13: 'The NCEP tropopause ...'. It is less accurate for TM5 also, which doesn't use NCEP either (in TM3 it depends on the meteo that was used). Please reformulate to make this sentence more accurate.

We redo the analysis with the thermal tropopause derived from ERA-Interim datasets. Now, the sentence has been changed to 'The thermal tropopause calculated using the reanalysis data ERA-Interim is used in all calculations, which could not be so accurate for the TM5 and LMDz models, especially for LMDz that predicts its own meteorology fields through nudging to reanalysis data.'.

6. Page 7, line 18: 'underestimations dominate'. There are lower values elsewhere, so it is not clear that they 'dominate' in the SH.

The sentence has been changed to 'Underestimations dominate in the upper southern troposphere, consistent with the results in Fig. 4 that modeled gradients of tropospheric CH4 are biased negative as revealed by FTS and surface measurements.'.

7. Figure 3: Please add vertical lines between the columns (i.e. models). At the boundary between the models it is not so clear which bar belongs to which model.

We follow the advise of the referee, necessary modifications have been applied to the Fig. 5.

8. Page 6, line 1: It would be fair to add Monteil et al, JGR, 2013 here, since they were among the first to report a latitudinal bias.

The reference is added to the text on page 6, line2.

Technical corrections: 1. page 2, line 4: 'transport' i.o. 'transports' 2. page 2, line 19: 'increase' i.o. 'incrase' 3. page 4, line 11: 'CH4' i.o. 'CO2' 4. page 4, line 11: 'applied to' i.o. 'applied from' 5. Page 7, line 2: 'except over' i.o. 'except for over' 6. Figure 4: the dashed zero line is missing in the upper panel 7. Page 7, line 23: 'show' i.o. 'gives'

All the corrections has been incorporated into the manuscript except for the 6th. In upper panel of Figure 4 most of the values are smaller than zeros, so it is not necessary to draw a zero line there.

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