

Interactive comment on “Global stratospheric measurements of the isotopologues of methane from the Atmospheric Chemistry Experiment Fourier Transform Spectrometer” by E. M. Buzan et al.

Anonymous Referee #1

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This study presents an interesting new dataset of methane isotopes in the stratosphere retrieved from the ACE-FTS instrument. Stratospheric methane isotopes are important, not only for a better understanding of chemical methane sinks in the stratosphere. The stratosphere is a critical component of the total column, which needs to be quantified well to allow optimal use of other satellite instruments aiming at the quantification of methane emissions at the surface. As indicated by the results of this study, it is still too early to use satellite retrieved methane isotopes to improve models, but steps in this direction – such as this work - are welcomed. Overall the results look fairly consis-

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tent, except for some instrumental and spectroscopic limitations, which are adequately acknowledged and discussed. Some issues remain, as outlined below, which should receive further attention. With those problems fixed, the manuscript should be well suited for publication.

GENERAL COMMENTS

Although attempts are made to validate ACE FTS retrievals with a model and with balloon measurements, a general quantification of retrieval uncertainty is missing. Because of this it is difficult to judge to which extent the results that are obtained are in the expected range. A few quantitative statements are made, regarding the relative noise levels of dD and d13C measurements, and altitudes at which the instrument performs better or worse. However, what is missing are some key numbers, indicating retrieval uncertainty, and how it varies in space and time, what does the error budget look like, random versus systematic error components, etc. This would help not only to judge the significance of differences that are found in the comparisons, but also to identify high priority directions for further improvement.

Limited information is provided about the retrieval method. This is fine, since it is described in Boone et al (2013), except that some potentially important aspects of the retrieval do not seem to be taken into consideration. For example, how important is the a priori information that was used in the retrieval? To which extent might the latitude-height distributions reflect the prior rather than the measured spectra? When comparing the retrievals with the model, shouldn't the averaging kernels of the retrievals have been applied to the model? Some further information is needed to be able to properly interpret the comparison to the model and also to the balloon soundings.

SPECIFIC COMMENTS

Page 11178, line 10: 'pockets ... spring months' Which 'pockets' are meant here exactly? In Figure 3 I see such pockets during 'MAM' and 'SON' at ~40km elevation, but in the autumn hemisphere, rather than the spring hemisphere. Please clarify.

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Figure 4, bottom left panel: Is the dark box at 80-90S and 27km dark blue (=dD depleted) or out of the color range (=dD highly enriched). If it is the latter, please fix the contour colors.

Page 11178, line 14: 'Step function at 12 km' Actually horizontal lines are visible also at higher altitudes in the tropics.

Figure 6, bottom plots: What is the vertical line at ~70S above 30 km altitude?

Page 11179, line 23: 'These seasonal trends ...' It is worth mentioning here that for dD the model is more symmetric between the hemispheres than the measurements. The July – November enrichment is seen only in the Southern Hemisphere, which is not in the model.

Figure 9, Caption: I suppose you mean 10 ppm-1?

Page 11180, line 12: 'd13C data show more variance' It is important to distinguish variance in signal from variance from measurement uncertainty. The first should be good for a Keeling curve, the latter bad. Here presumably measurement uncertainty is meant.

Page 11181, line 21: 'If WACCM is assumed ...' If this condition is indeed satisfied, then we wouldn't need measurements anymore. However, it is sufficient to assume that tropospheric values are accurate. This is easily justified, because gradients in the troposphere are relatively small and measurements are available to confirm whether the model is indeed accurate or not. It would be worth explaining this more clearly.

Page 11185, line 2: 'Adjustment of spectroscopic parameters ...' No material has been presented in support of this conclusion. Please provide more details about the spectroscopic adjustments that were made and the impact on the retrieval, if this finding is considered important enough to be kept (which seems to be the case).

TECHNICAL CORRECTIONS

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For figures showing delta values (4,5,7,10-14) a per mil sign is needed as unit.

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