Response to anonymous referee #2

We will like to thank the referee for the valuable comments and inputs that we think are going to help us improve the paper.

Question: My major concern is the very weak error analysis. The authors claim to do it in an additional paper. But THIS is the publication on the new algorithm. Therefore at least some details on the possible errors are needed here. In particular the statement on the errors associated with AMF calculations

Answer: We are going the increment the error section, detailing the approach followed to calculate the fitting uncertainties and including a sensitivity study of the Air Mass Factors calculations.

Question: Spectral fitting: It is not clear to me which parameters (and for what reason) have been changed compared to the old retrieval. What is the impact of changed cross-sections? Common mode spectrum: What is the impact on the calculated slant columns by including this averaged residual? A correlation plot illustrating this impact should be included. Please give a meaningful physical explanation why this averaged residual is needed. Why is it calculated only between 30S and 30N? Equation 1: “ak*Xk are the terms added afterwards, including the common mode spectrum”. What else is added afterwards? Detection limit: An RMS of up to 2*10exp-3 corresponds to detection limits around 3*10exp15? Please give realistic numbers

Answer: We are going to elaborate more in the changes. In the spectral fitting the biggest change in the slant column is due to the inclusion of the O2-O2 cross sections and a better approach to the removal of spectral pixels showing of large residual fits. We are going to include a new figure showing the correlation between different molecules and formaldehyde.

The inclusion of a common mode has the impact of reducing the fitting residuals by taking into account possible systematic features not modelled in equation 1. These systematic features are assumed to have little correlation with the formaldehyde cross sections. The impact in the retrieved slant columns is therefore small. However it helps to reduce the fitting uncertainty. The new figure illustrating the correlations between different parameters of equation 1 during the fit offers support for this assumption. Since the systematic features for which the common mode accounts are assumed to be no dependent in the state of the atmosphere we it is enough to assess them in between 30S and 30N therefore speeding up the retrieval.

We should rephrase “including” since in this particular retrieval the only term added afterwards is the common mode.

We are going to revise the detection limit numbers.

Question: Post processing normalization: The users have defined the reference sector between 140W and 160W. In northern high latitudes during summer months this area is quite frequently affected by biomass burning with significant emissions of C2HO. What would be the impact of these events on the final product? Figure 8: The authors claim, that there is no large increasing trend for the new retrieval. Applying a reference sector this should be the case by definition for a region just next to it. But for the new retrieval without normalization the time series above the Pacific show a clear positive trend. Any explanation? Maybe I missed this point: But how the VCDs are estimated for the new retrieval without reference sector? The new retrieval is based on an earthshine reference and no absolute SCD can be calculated.

Answer: As the referee points out the variability in the climatology affects the value of the reference sector corrected VCDs. We are going to include a new figure, substituting figure 5, showing the average slant column retrieved over the reference sector, the reference sector climatology and the change the correction is introducing in the final reference sector corrected VCDs. The VCDs estimated without the reference sector are just the "differential VCDs" and as such should be treated. They offer the possibility to recover the slant columns and perform your own AMF calculation and reference sector correction. We are going to further investigate the increase seen over the Pacific Ocean.

Minor points/corrections

Introduction p2 l17: Give a reference to the statement on the lifetime.

We will include Anderson, L. G. et al. and Brune et al., in the as a reference for formaldehyde atmospheric lifetime.

Introduction p2 l24: Rephrase: Measurements of H2CO from satellites can be used as a proxy

Ok

Inroduction p3: Peters et al. (ACP 2012) used MAX-DOAS measurements of H2CO to validate satellite data in the Western Pacific. Please include this reference.

Ok

Introduction p3: Please include Vrekoussis et al., (ACP 2010) as a reference for H2CO observations from GOME-2.

Ok

Introduction p3, l10: Rephrase: good agreement between the two techniques

Ok

Spectral calibration p6 l16-17: What is the sense behind this sentence? BOAS and DOAS are quite similar methods to analyze spectra for absorption features. BOAS is like DOAS applying polynomials to account for low frequency features ("high-pass filtering"). And who said that smoothing is an essential step within DOAS retrievals?

We are going to remove the sentence about the difference between DOAS and BOAS.

Conclusions p15 l5: Please remove this sentence. There is no detailed description of the theoretical basis in this paper.

Ok