De Smedt and co-authors describe in great detail the theoretical basis, methods and assumptions used in the operational processor of the Sentinel-5 Precursor TROPOspheric Monitoring Instrument (S5P TROPOMI). The algorithm described with great detail here benefits from strong heritage having the co-authors lead the development of formaldehyde retrievals using measurements from previous UV space sensors. Algorithm improvements developed during the Quality Assurance for Essential Climate Variables (QA4ECV) project, funded by the European Union, are also presented since they are the basis of future updates to the operational processor. The error budget for TROPOMI formaldehyde observations is derived and discussed in the context of the Copernicus requirements. Finally validation methods and goals are discussed.

This paper should be the reference document for TROPOMI formaldehyde. Anyone using the operational product should read it to understand the meaning of the retrieved quantities, and their suitability to carry on scientific studies. The content is presented in a clear and sound way, it follows the logical steps of the algorithm and is well organized. The paper is ready to be published with minor changes that will only add to its great value. A set of recommendations to minimally expand the content of the paper is followed by some technical corrections.

Section 1. Introduction.

Some extra references should be added to support the statements describing formaldehyde chemistry in the atmosphere.

Section 2.2 Algorithm description

Why are the HCHO Meller and Moorgat (2000) cross sections used instead of the more recent and intensity corrected Chance and Orphal (2011)?

Section 2.2.1 Formaldehyde slant column retrieval

Page 11, line 233. It will be valuable to show evidence of the reduction in the correlation between formaldehyde and bromine moxide by using a two-step DOAS retrieval adding a new figure? Given the extension of the paper it is maybe not necessary, but it will be interesting to have it here.

Page 11, line 264. The text says “(3) possible row-dependent biases (stripes) are directly corrected owing to the use of one reference per detector row.” Are irradiances not recorded for each detector row? If they are, as it is done with OMI, the reason for the removal of the stripes when using radiance reference should be other than just having an irradiance reference for each row.

Page 12, line 284. Equation 5 only shows the shift (Δ_i) but line 284 mentions that this approach allows compensating for stretch and shift errors. How correlated are those? Is it not possible to treat them separately?

Section 2.2.2 Tropospheric air mass factor

An evaluation of the effect of using only one atmospheric model (US Standard) for the calculation of altitude dependent air mass factors should be included. Ozone distribution can vary significantly between tropics, polar region and season.

Another subsection could be added to discuss the role of the surface reflectance properties to complete the description since all other AMF parameters have their own (LUT of altitude dependent AMFs, cloudy scenes, aerosols, and a priori vertical profile shapes).

Section 2.2.3. Across-track and zonal reference sector correction

Page 20, line 470. "The natural background level of HCHO is well estimated from chemistry model simulations of CH_4". Actually there is evidence that models underpredict HCHO in the Pacific Ocean (http://onlinelibrary.wiley.com/doi/10.1002/2016JD026121/abstract). Add a sentence discussing this situation.

As said above, despite the paper being fairly long, it could benefit of a plot showing the process of the background correction for one orbit illustrating the changes for each step.

Section 3.1.1. Errors on the slant columns

Please add O_4 uncertainty to table 7.

Section 3.1.2. Errors on air mass factors

Page 26, Figure 9: Would it be possible to specify the geometry, surface pressure, and the rest of parameters kept fix in the calculation for each panel.

Page 26, **Surface albedo**: Kleipool et al., surface climatology has a coarse resolution (0.5^ox0.5^o) compared with TROPOMI pixels. It would be interesting to incorporate in the error analysis the uncertainties associated with subpixel inhomogeneity in the Kleipool database or at least discuss them in the text.

Page 27, **Clouds and aerosols**: In section 2.2.2 "Tropospheric air mass factor" page 17, line 403 it is said that pixels with cloud fractions below 10% are considered clear-sky pixels "to avoid unnecessary error propagation through the retrievals" given the unstable cloud retrieval for such conditions. Under that assumption, how are the AMF errors due to cloud parameters calculated?

Page 27, **Profile shape**: As for the surface climatology, would it be possible to estimate the uncertainty derived from subpixel model inhomogeneity given that model information is available in 1^o grid and TROPOMI pixels can be as small as 7x7 km^2?

Section 4. Verification

Building on the work by Lorente et al., 2017 was the AMF calculation tested using harmonized parameters.

Page 34, Table 12: The number of xx in the Earth coverage column for MAX-DOAS and Direct Sun, should it not be similar given that most MAX-DOAS instruments can also carry on Direct Sun measurements?

Page 35, after paragraph devoted to MAX-DOAS could add a little paragraph describing Direct Sun capabilities.

It will be nice to add a map of current ground-based measurements sites lined up for validation.

Section 5.4 Satellite-satellite intercomparisons

Page 36, line 861: For completeness about current and future instruments it will be good to add mentions to OMPS, GEMS, and TEMPO.

Technical Corrections:

Page 1, line 33: "Its lifetime being of the order of a few hours, …" is grammatically incorrect. What about, "With its lifetime of the order of a few hours, HCHO concentrations in the boundary layer…"

Page 2, line 43: Would you consider to add Kaiser et al., 2017 to the list of inversion studies (https://doi.org/10.5194/acp-2017-1137)?

Page 2, line 52: To complete the list of HCHO retrievals from LEO it should be added the ones using OMPS measurements (http://onlinelibrary.wiley.com/doi/10.1002/2015GL063204/abstract, https://www.atmos-meas-tech.net/9/2797/2016/).

Page 3, line 77: Is there any reference or link available to the S5P HCHO Level 2 Algorithm Theoretical Basis Document v1.0

Page 4, Table 1: What is the meaning of revisit time 24x3 hour. Since h is used in the top line it will be good to make both units consistent (h or hour).

Page 5, Figure 2: Geolocation and Time information also need to feed the HCHO climatology or TM5 daily forecast.

Page 6, line 156: "Figure 3 also" would read better if just said "Figure 3 presents"

Page 8, Figure 3 caption: Mention that these vertical columns are derived using OMI data. It is said in the text in section 2.2.1 (line 246) but the first time figure 3 is referenced in the text, section 2.2 (line 156) nothing is mention and there may be misunderstandings.

Page 14, line 337: "average" should be "addition" or "sum".

Page 14, line 341: The symbols for solar zenith angle, viewing zenith angle, and relative azimuth angle are not defined in the text. Later on they are defined in table 4 but that only happens in page 15.

Page 16, line 385: “in which a inhomogeneous” should read “in which an inhomogeneous”

Page 19, line 449: Clarify that they are OMI air mass factor for example saying “Yearly averaged OMI air mass factors…”

Page 28, line 642: “Equation (20)” should be “Equation (19)”?

Page 29, Table 9. “0.5 and 1.5x10^{15} molec.cm^{-2}” should be “0.5 to 1.5x10^{15} molec.cm^{-2}”?

Page 32, Figure 12 caption: Check “Error! Reference source not found”

Page 33, line 774: suggest to change the text between brackets to “(both for ground-based measurements and for satellite columns)”

Page 35, line 827: “measurement” should read “measurements”?

Page 37, line 871: Move comma before spectral

Page 50, line 1206: Remove sentence “A complete description of the level 2 data…” since it’s a repetition of the sentence in line 1203.