We thank all reviewers for their constructive comments, which helped to improve the paper. Below, we address all comments point-by-point.

Anonymous Referee #1,

<General Comments>
Land-coverage for CO2 measurements with existing space-borne instruments is sparse. Wide swath measurement with moderate spectral resolutions is important for global flux estimations. Spatial resolutions higher than OCO-2 and GOSAT will improve estimations of local flux. This paper describes the optimization of spectral resolution using data acquired by OCO2- and GOSAT for much denser observations. Bias and standard deviation of the retrieved CO2 density are well described. The paper is worth publishing. However, I have the following general comments. Before publishing the paper, major revisions are needed.

(1) Page 2, Line 28 "unprecedent accuracy and precision" Line 30 "XCO2 precision <0.7ppm and systematic error <0.5ppm". These requirements are challenging. How to improve accuracy and precision of existing GOSAT and OCO-2 with lower spectral resolution should be described. It is not clear that SNR and precision of XCO2 retrieval are linearly correlated.
R1-Not changed: There are many design options under discussion to improve the radiometric performance of the instrument compared to a spectrometer such as OCO-2. The manuscript focuses on one particular, major design aspect, the choice of the spectral resolution. SNR and precision of XCO2 retrieval as defined in the manuscript are NOT linearly correlated. Large part of XCO2 retrieval uncertainties are due to lightpath modification by aerosol scattering. A possible mitigation is to include a multiangle polarimeter as we discussed the conclusions of the manuscript. In this paper, we focus on the investigation of the impact of moderate spectral resolution of the main spectrometer. The joint XCO2 retrievals using measurements of the spectrometer and MAP are currently under development and a manuscript in preparation.

(2) Authors mention there are instrument specific errors in OCO-2 and GOSAT. They should be discussed in more detail. My understanding on GOSAT and OCO-2 instruments is as follows. The spectral quality with GOSAT FTS is good with symmetric instrument function and low stray light. However, SNR is lower than OCO-2. GOSAT FTS uses a single pixel detector mounted on its optical axis. Optical aberration is small and its instrument line shape function becomes symmetrical. GOSAT FTS has a common field stop for all bands and uses the modulated part of the interferogram. Theoretically stray light is low.
R2-Thanks for the detailed suggestions. We have adjusted this part and added the sentence "This can be attributed to the fact that GOSAT spectra benefit from TANSO-FTS's distinguishing features such as common field stop for all spectral bands thus can minimize stray light influence." at Page 11 line 326. Moreover, at page 4 line 106, we added the sentence "Measurements of the OCO-2 push-bloom spectrometer with high SNR includes most likely larger stray light errors than the TANSO-FTS (Thermal And Near infrared Sensor for carbon Observation - Fourier Transform Spectrometer) on-board GOSAT.".

(3) Authors mention the largest error source is aerosol and proposes an auxiliary aerosol sensor. However, aerosol related errors are not well described. "Aerosols induce a scatter" (Page 8, Line 212): "pseud-noise contribution of aerosol" (Page 11, line 324): More detailed explanations are needed. Which parameters is critical, optical thickness, size, type, or height? Why does the MAP instrument reduce uncertainty?
R3-We added a new paragraph in the section 4.1 (page 8, line 230) to explain the synthetic retrieval results and aerosol introduced errors. "….. As discussed by Butz et al. (2012), aerosol introduced errors strongly depend on the concentration, the profile and the micro-physical properties of the aerosol like size distribution and refractive index as well as on surface albedo. Although it is difficult to identify the most

critical aerosol parameter as it is finally the effect on the light path which induces the error, we see that with reduced spectral resolution MSR-d retrievals yield a similar error distribution and a global data coverage as that of the OCO-2 data product."

Moreover, we added a sentence to the conclusions to explain why the MAP instrument can reduce the aerosol induced errors (Page 12, line 356), "The multi-angle polarimeter provides valuable information on aerosol micro-physical properties and aerosol height, which exceeds the aerosol information that can be retrieved from a 3-band spectrometer such as GOSAT and OCO-2 (Mishchenko and Travis, 1997; Waquet et al., 2009; Dubovik et al., 2011; Hasekamp et al., 2011; Wu et al., 2016)."

<Specific Comments>

(1) Page 1, Abstract Brief description of the proposed spectral range, spatial resolution and coverage, and required SNR in the abstract will help readers' understanding.

R4- Thanks for the suggestion. The abstract now includes (Page 1, line 5) "The future European CO2 monitoring constellation, currently undergoing feasibility studies at the European Space Agency (ESA), is targeting a moderate spectral resolution of 0.1, 0.3 and 0.3-0.55 nm in the three spectral bands with high signal-to-noise (SNR) ratio as well as a spatial resolution of 4 km^2 and a across-track swath width >250 km.".

(2) Page 4, Lines 240, 244-245 The main reason for global bias of 6.97ppm should be discussed in more detail. Lines 244-245 are difficult to understating Detailed explanation on "different algorithm convergence" is needed.

R5-The sentence is revised to "Here, the overall data yield is very similar for the different data sets although differences may occur due to different percentage of convergence." (Page 9, line 259). The large global bias is presented in MSR type retrievals and discussed with more details at both last paragraph of section 4.2 (Page 9, line 267) and last paragraph of section 4.4 (Page 11, line 323).

(3) Page 19, Figure 5, Averaging kernel All the MSRs have similar slopes in averaging kernels. AK is quite different from the one for OCO-2. What is the main reason for the large difference between OCO-2 and MSRs? How do the authors estimate local flux quantitatively from XCO2 with sloped AK?

R6-The main reason for the different shapes of the averaging kernel is that a spectrometer with a fine spectral resolution can resolve individual lines, which are pressure and temperature dependent. With a reduced spectral resolution, this sensitivity is reduced. We included the sentence on page 10, line 303 of our manuscript "This could be due to the fact that we have reduced sensitivity to pressure-dependent line-broadening effects under coarse spectral resolutions since we do not resolve individual CO2 lines." For a classical data assimilation, the averaging kernel can be considered in the flux inversion and so the shape differences should not cause a difficulty. In the paper, we do not estimate the effect of a different AK shape but estimate the sensitivity of the local flux to errors in XCO2, which we consider in the worst case to be proportional to the XCO2 bias.

(4) Page 20, Figure 6 Observation dates should be specified.

R7-We adapted the manuscript accordingly and the observation dates are now included in the Figure.

(5) Page 21, Figure 7 Legends are not the same as those for Figure. 2 "σ= 2.87ppm" > "σa= 2.87ppm" > Is "b" global bias? Is it already subtracted?

R8- Not changed: Figure 7 is XCO2 retrievals from GOSAT reproduced spectra while figure 2 is from OCO-2. Here, b is the overall mean bias without subtraction.

<Technical Corrections>

(1) Page 6, Line 150 Sy=gSygT > Sydeg=gSygT

(2) Page 22, Table 2, “σs” What is the unit of “aerosol size parameter”?

(3) page 23, Table 5, “SD” Is it standard deviation?

R9- The aerosol size parameter σ_s is a unitless parameter. A sentence of “Here, the size parameter \$\alpha\$ is unitless.” is added at Page 4 line 98. The “SD” is replaced with “σ_a” as in Table 4.