Atmospheric
Measurement
Techniques

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Discussions

Interactive comment on "XCO₂ observations using satellite measurements with moderate spectral resolution: Investigation using GOSAT and OCO-2 measurements" *by* Lianghai Wu et al.

Anonymous Referee #1

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<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.

(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.

(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?

<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.

(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.

(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?

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

(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?

<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?