Review of Xi et al.

This manuscript contains some novelty but is generally of poor quality. However, the idea of remote sensing of CO_2 and CO in particular from a geostationary orbit is a great idea and missing in terms of planned atmospheric chemistry missions. With the scientific importance of such a mission being so high and highly capable Dr. Sander and Prof. Yung as co-authors, I believe that it is not the right decision to reject this manuscript. However, in my opinion, the manuscript covers up some important details and attempts to present an overly optimistic picture. This is acknowledged by the authors in the last paragraph, but to acknowledge this is not enough. The single-measurement precision will be larger than what the authors report if the aerosol properties are not perfectly known, yet the authors conclude that they have provided evidence that all-sky retrievals meet the measurement requirements for accurate flux inversions. There is a good deal of cleaning up of obvious and/or fundamental errors that needs to be done before this manuscript is acceptable.

General comments

There is no precision requirement on XH_2O but precise XH_2O is required for objective 3. There is no accuracy requirement for any gases, but maybe there should be. The retrieval bias for xCH_4 for all-sky conditions is larger than the precision requirement. Is that a concern?

In the shortwave, the albedo of the surface is important (as is the bidirectional reflectance distribution) and the surface emissivity is not. Clearly at 1.6 μm and in the O_2 *A* band, surface emissivity is not a factor. Yet surprisingly, the authors are able to retrieve it well given their DoF of 8.7 out of a possible 9. I am very surprised to see surface albedo missing from the state vector when it might be the most important state parameter for accurately modelling the radiance. Also, does the surface albedo vary from site to site? The range of surface albedos should be stated since this is important for understanding the influence of aerosols and clouds.

The aerosol loading for the all-sky cases are not clear. An input OD of 0.2 is mentioned in section 3.3 but the authors don't disclose the input OD for retrieval results reported in section 3.2. Rather than be quantitative, the authors state "small amount" on P5817L9 and "less than ~0.30" on p5824L23 and "small amount" again on P5826L20. This is not acceptable. Furthermore, "amount" is a vague term.

Clear-sky retrievals should include aerosol. To me, clear-sky means cloud-free, not aerosol-free.

Reading the last sentence starting on P5819, I am to understand that all nine parameters are biased by 3%, but did the authors mean only the trace gas parameters? If not, then isn't a frequency shift of 3% too large to retrieve? This would mean a shift of >300 cm^{-1} for the *A* band. Is that correct? Also, how is a 3% bias in the zero-level offset calculated?

I would like to see the Jacobians for five of these other parameters: temperature, pressure, surface emissivity, clouds, and aerosols. I would like to see the correlation coefficient for aerosols and cloud Jacobians. Also, what is the correlation coefficient between the Jacobian spectrum for pressure and each of the following Jacobian spectra: CH_4, CO_2 and H_2O.

There is only one aerosol OD parameter in the state vector but four aerosol types are used. This seems unnecessary. It would be fine with me if only sulphate aerosols are included.

The SNR should depend on the hour of the day but it does not. Either this should be changed or the last two sentences of section 3.1 should be deleted.

The Miller et al. reference is for LEO. I believe Rayner et al. is the only appropriate reference. Rayner et al. have a 3 ppm requirement for CO_2, which is more forgiving.

The authors could have explored the ability to detect the weekend effect in CO_2 or CO. Otherwise, what was the point of using two different days of the week?

The authors do not consider the 2.0 μm CO_2 band which is considered valuable for aerosol and cirrus detection.

It would be interesting to comment on the virtue(s) of an FTS rather than a grating spectrometer.

Specific comments

P5811L17 Why mention AIRS? It is quite different spectrally from GeoFTS.

P5812L2 SCIAMACHY had a revisit time of 6 days.

P5812L6 Note that OCO-2 has a smaller footprint than GeoFTS.

P5812L13 “to realize” -> “thereby promising to realize” (since GeoFTS is only a proposed mission). Perhaps the authors should state the status of the GeoFTS mission. Has it been proposed? An earlier version of this manuscript referred to it as a “proposed mission”.)

P5812L25 Given the wording of the first objective, equally important specifications are the spatial resolution and temporal frequency (along with the precision). I realize they are provided later but this seems like the more appropriate place.

P5814L12 “1-10 km” -> “10 km”. 1 km is not achievable given 2.7 km pixel length and width, but also cities are larger than 1 km^2 anyway.

P5815L1 “four” -> “at most four usable” (This is evidence of excessive optimism).

P5815L5 SNR is a measure of data quality. I suggest removing one of the two.

P5815L16 Are the aerosol profiles from GEOS-CHEM? If not, what is “realistic” (P5817L7)?

P5816L8 Convergence is stated in terms of the radiance but on P5819L12, convergence is determined in terms of the state vector.

P5816L14 “Due to computational resource constraints”. This sound phony. Some other excuse could be found or no excuse is needed at all.

P5816L22 This sentence is too simple. For example, the solar geometry and surface albedo are critical inputs to the forward model.

P5817L10 “lower stratosphere” -> “near the tropopause”.

P5818L2 “Initially, the SNR is set at 300” A period should follow this statement and it should be moved immediately before the sentence that currently precedes it (“The outputs …”). Otherwise, it sounds as if noise has been added to the forward model (2S-ESS) as well.

P5818L8 Already mentioned Lambertian surface on P5816.

P5818L16 The reference to TES can be removed.

P5820L14 “true” -> “observed”

P5821L1 Jacobian is already defined better on p5819.

P5822L7 Why is it brighter at 3 pm than at 9 pm according to the model? Are they almost equally close to solar noon? Is daylight saving time used?

P5822L23 The averaging kernel indicates that most of the elements of the retrieved state are coming from the observations. The averaging kernel does not tell you about truth. The “retrieval error” or the term I prefer, namely “retrieval bias, informs you about the closeness to the truth.

P5824L2 There is no spectroscopic issue, unless different spectroscopy is used by LIDORT and LBLRTM. This would not be a real spectroscopic shortcoming. Real shortcomings in spectroscopy can be evaluated with real measurements.

P5824L12 “stronger signals” -> “stronger absorption signals”

P5824L23 At which wavelength is OD<0.3?

P5825L4 “higher instrument noise”. For real measurements, there will be more noise at noon, but the SNR will be more favourable at noon than other local times (i.e. signal increases as well). For the simulations here, the SNR is diurnally constant (=300), so the authors need to clear this up.

P5825L7 Black carbon does not scatter conservatively so “total scattering OD” definitely needs to be reworded (“total particle OD” or “total condensed phase OD”?). Also, this implies that Rayleigh scattering has been ignored but molecular scattering could be relevant in the cores of *A* band lines.

P5825L26 “all the” -> “all of the”

P5825L27 Please elaborate on more effective pre-screening. Does this mean improved detection of optically thin clouds? I hope it does not mean that the OD threshold is lowered to <0.3.

P5826L15 (see also P5825L23) “Kuang et al. (2000)’s findings” -> “the findings of Kuang et al. (2000)”

P5826L16 “from a simulated study.” -> “using simulations.”

P5826L19 With two significant digits given in 0.30%, this implies ~330 ppm of CO_2 was used. Is that correct?

P5826L20 “slight” –>“slight in an absolute sense” (Relatively, it is a doubling).

P5828L10 This sentence belongs at the end of major scientific contribution #1.