

Review 'Remote sensing CO₂, CH₄, and CO emissions in a polluted urban environment', O'Brien et al.

The paper describes retrieval simulations for the geo-stationary instrument GeoCarb measuring CO₂, CH₄ and CO, and how these measurements lead to a reduction of uncertainty in CO₂ emissions over Shanghai. For this it mimics the behavior of the instrument as good as possible at this stage of the project. Moreover, it addresses in quite some detail the issue of aerosols and clouds that can be encountered over polluted urban environments taking Shanghai as an illustrative example of such an area.

In my opinion the manuscript is suitable for publication in this journal after addressing the comments below, in particular the major comments.

Major comments :

- Section 3.3 : For the later discussion wrt SNR and retrieval sensitivities it is important to know what surface albedos (as a function of wavelength) have been used. Please provide that info (incl. ref.), preferably in terms of a map(s) similar to Fig. 3. Also the link between what albedo and SZA (SZA could fixed to some representative value if need be) combinations correspond to which SNR as presented in Fig. 11 is needed.
- Section 5.2 prior aerosols : I did not understand the adjusted aerosol retrieval approach. Please describe what you are effectively doing.
- Section 7.1 p. 12 it is suggested that the problems encountered with the CO retrievals could be alleviated and that a code to do that is available (p.12,l.23). So why was that not done/used ?
- at the end of section 7.2 suddenly the result of other (?) error sources (other than instrument measurement noise) are mentioned leading to the provided 'actual error'. The background as to what error sources have been used here and how large these were assumed (and their functional form) remains unclear and is not explained. Only some general remarks are made (imperfect spectroscopy, incorrect optical properties aerosols). This is very unsatisfactory as in practice these errors could be dominating and are often systematic. Please elaborate on what was assumed here and what simulations were done which resulted in the errors shown in Fig. 11. (In the end it was not clear to me if only instrument meas. noise was taken into account or also other error sources in Fig. 11.)

Section 8 p.14,l.22 : concentration retrieval errors that can be expected from a **real** instrument. It remains unclear to me to what extent the full instrument behavior is simulated other than the instrum. meas. noise

error. Because if only instrum. meas. noise is accounted for in the errors presented here, it will only be a lower limit to the real errors.

Minor comments :

- Title : I would suggest a more appropriate title such as Potential of geostationary GeoCarb mission to estimate surface emissions of CO₂, CH₄ and CO in polluted urban environment. Case study Shanghai.
 - it is not totally clear to me what the main differences are with the simulations by Polonsky et al., 2014. It seems they have done quite similar simulations.
 - p.5, l. 2 what are 'sectional size bins' ?
 - p.6, l. 2 not unrealistic → not unrealistic, although somewhat lower than seen by MODIS.
 - section 3 : not explicitly mentioned which wavelength bands are used for which target molecules. Please indicate.
 - Section 5 I find it difficult to extract what all the retrieval parameters are. Please explicitly state what parameters are retrieved. Now I have to deduce that myself in some cases indirectly from the text, for example wrt meteo parameters. Is a temperature offset retrieved ? etc. Also for the aerosols. Does the standard aerosol retrieval approach mean one parameter is retrieved representing the mixing of the two types ?
- Is anything fitted wrt surface albedo ? (wavelength dependence ?)
- p.10, l. 4 : what threshold is meant here ? What is the role of the threshold ? what other filters are set in the PPF ?
 - Section 5.2 p. 8, ;. 25 what is the h₂O prior profile ?
 - p.11, l. 15 **probably** more important, I think that statement can easily be checked. Please do.
 - p.13, l. 6 monotonically
 - p.13, l. 15-17, what is meant with the remark : When analysing spectra ... for GeoCarb ? is this just a suggestion for future work or actually applied here ?
 - p. 13, l. 21 6401 flux components, is that 6400 for CO₂ and 1 constant emission factor over the whole domain for CO ?
 - Fig. 1 caption : Target area ... → Target area around Shanghai ...

- Fig. 3 somewhere it should be mentioned what the strong and weak band of CO₂ are (see earlier comment on identification of which bands are used for which targets)
- Fig. 7-10 caption : The PPF .. light grey → The light grey histograms are with PPF disabled, while the coloured histograms are obtained after applying PPF
- Fig. 11 caption : actual errors (retrieved ...) → actual errors (points with error bars, retrieved ..)
- Table 1 caption : Assignment of EDGAR → assignment (in fraction) of EDGAR
- Table 7 : should be made clear in the caption what disabled en enabled means below Cloud.