Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2021-205

Anonymous Referee #2

Referee comment on "Remote sensing of methane plumes: instrument tradeoff analysis for detecting and quantifying local sources at global scale" by Siraput Jongaramrungruang et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-205-RC2, 2021

This paper presents a synthetic study on the retrieval of methane plumes from satellites with high spatial resolution. This is a quickly developping area and a number of satellite (and aircraft) instrument have emerged that have succesfully demonstrated methane retrievals on a scale of tens of meters. Such observations will be important to detect and mitigate methane emisisons from localised emission sources. However, it is critical to put such methane satellite retrievals on a solid footing. This study addresses the question how well surface features and methane absorption can be seperated which is a key issue for instrument with lower spectral resolution. This is relevant for ongoing work with existing satellites but more importantly it provides guidance for the development of of future mission. The manuscripit is suitable for Atmos. Meas. Tech. and I recommend publishing it after addressing my comments below.

Figures: many figures in the manuscript are corrupted. This is probably simply an issue of the pdf conversation.

Instrument assumptions: The study provides a realistic model for the instrument and the measuerement noise calculation. The model makes uses of a number of instrument parameters given in Table 1. Can you please provide a justifcation of these assumptions. How does this compare to currently available systems and existing detectors. Is the assumption valid that the same parameters can be used for the two spectral range (1.6 and 2.3 micron): will detector quantuum efficienty, grating efficiency, spectral transmissivity/reflectivity of optical components not change between both ranges? Also, at 2.3 micron, I would assume that thermal emission of the optical bench will be a contributor to noise. Can you give some example values for dark current to support your assumption that this can be ignored. Finally, can you please clarify if noise has been added to the simulated spectra (Figure 8B suggest otherwise).

Surface features and polynomial degree: A key outcome of the study is the need for a

very high degree of a polynomial to sufficiently accuratly describe surface features. However, the use of a polynomial of degree 50 makes me uneasy. Can you show with a direct polynomial fit to the underlying surface albedo data of the ECOSTRESS spectral library before using it in your forward model and without any spline interpolation that such a polynomial degree is needed? I would also expect that a high polynomial degree will lead to an increased number of non-converging retrievals when not carefully choosing their a priori value and a priori covariance; can you please elaborate on your choice. As you show in the paper, a high polynomial degree will increase the retrieval uncertainty for methane. At the same time the correlation with methane will increase so that you risk that the methane absorption will be taken out by the polynomial. Did you have a look at the correlation coefficients ?

Minor comments and typos: I have included them directly in the supplementary pdf.

Please also note the supplement to this comment:
https://amt.copernicus.org/preprints/amt-2021-205/amt-2021-205-RC2-supplement.pdf