

Response to Referee #2:

We appreciate the very helpful feedback from the referee. The referee's comments are listed in *italics*, followed by our response in **blue**. New/modified text in the manuscript is in **bold**.

*1. Line 33: Do the authors mean to say 200 km swath rather than what appears to be an area? Please provide the single-dimension width.*

Upon re-checking, the swath at nadir is 260 km (not km<sup>2</sup>). The sentence at lines 32-33 in the original manuscript has been updated to reflect this:

**“MethaneSAT aims to characterize oil and gas basin-scale, diffuse CH<sub>4</sub> emissions through a wide swath of 260 km and at the same time locate and quantify large point sources within each target area that is typically 200 × 140 km<sup>2</sup> (Benmergui et al., 2020; MethaneSAT, LLC, 2020).**

*2. Line 115: Assuming that the camera images the sphere aperture (i.e. the sphere is not being used as an irradiance source), how can changing the diameter of the output port alter the sphere radiance (it will alter its irradiance)?*

The sentence at line 115 has been revised to clarify.

**“During the MethaneAIR flat field measurements, the light level was tuned from zero to just beyond detector saturation in 40 steps by adjusting the variable input aperture between the integrating sphere and the lamp.”**

*3. Line 117: The description of 'calibration curves' lacks clarity. If you're going to talk about fits you need to describe exactly what you're fitting.*

The following text has been added to line 117 for clarification.

**“This resulted in curves of spectral radiance (phot s<sup>-1</sup> cm<sup>2</sup> sr<sup>-1</sup> nm<sup>-1</sup>) vs. dark-subtracted focal plane intensity (DN s<sup>-1</sup>) for each exposure time and every active pixel. These radiometric calibration curves were fitted by fifth-order polynomials with the intercept forced to be zero.”**

*4. Line 186: Please be more specific what you mean by 'percent of total detected light.' Is this the modeled SL for a simulated input scene? Is the percentage measured relative to the useful signal at each wavelength? What does 'total detected light' mean?*

This is the percentage of stray light at the far field relative to the useful signal at each spatial/spectral position and is calculated by summing up the far-field kernel. To clarify, the sentence at line 186 has been removed, and the following sentence is added to line 177:

**“The sum of the far-field kernel is 2.4% for the CH<sub>4</sub> band and 2.1% for the O<sub>2</sub> band. This indicates that the stray light is small relative to the useful signals at each spatial and spectral position.”**

*5. Line 262: No mention is made of a radiometric correction to the ISRF. The iterative oversampling described in Section 5.1 yields empirical scale factors to 'stitch' the multiple pixels together. The scale factors remove differences in radiometric response between the adjacent spectral pixels. These differences include PRNU, which you want to remove, but also spectral response variations (because the pixels are at different wavelengths), which you do not want to remove. This latter variation needs to be included in the ISRFs before they can be used in any forward model calculation. I would expect any description of the 3D lookup table to mention how this variation is reintroduced. If the authors have concluded the effect is negligible then they should state so in the text.*

The ISRF variation in this short wavelength range is far smaller than the measurement noise. The overall spectral variation is significant but smooth across the ~100 nm range, so the variation within  $\pm 0.1$  nm or about 1 spectral sampling interval is negligible. The sentence spanning lines 196-197 has been replaced with the following for clarification:

**“The ISRF variation between spectral pixels within a small wavelength window ( $\pm 0.1$  nm) is negligible.”**