Response to Referee #4:

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 115: How was saturation defined / measured? How uniform is the saturation level across the spatial and spectral dimensions?

The following text has been added at line 115 in the original manuscript to provide this information.

"Saturated values were identified by plotting signal level as a function of exposure time and finding the "knee" where the response became nonlinear. For almost all pixels, this occurred within a few hundred counts of 10,000 DN."

2. Line 147: Why did the laser power need to be increased at long wavelengths if a gain correction was already applied?

The ISRF needs to be measured at a higher radiance level to partially compensate for the reduced signal-to-noise ratio due to QE drop. The text has been edited at original line 147:

"In the CH_4 band, the laser power was increased progressively from -3.0 dBm at wavelengths ≤ 1640 nm, up to +2.5 dBm at 1670 nm, in order to maintain high SNR as the QE decreased at longer wavelengths."

3. Fig 13: Some ISRFs are not monotonic with relative wavelength. Is this concerning and/or does it have a physical explanation? Also, are asymmetries understood?

The referenced ISRF features are at approximately the 10^{-3} level. Some of those features are inevitable residual noise that cannot be fully removed by the smoothing applied in Fig. 11. We have tried to fit analytical ISRF functions similar to the TROPOMI ISRF to mitigate those non-monotonic features, but could not find an analytical function that can adequately model all spectral and spatial positions. We do not have a physical MethaneAIR ISRF model to understand the asymmetries, which is not that significant. The following is added after the first sentence at line 257:

"**Non-smooth features at 10^{-3} level remain over some ISRF tails at log scale due to detector noise that cannot be fully suppressed.**"

4. Fig 17: How small do residuals need to meet science objectives?

The following sentence about fitting residuals is added to line 317 of the original manuscript:

“**Those fitting residuals are consistent with the signal-to-noise ratio predicted by the MethaneAIR specs. The retrieved XCH_4 will be presented in the following algorithm paper.**”

5. Line 318: In addition to retrieving changes, can any in-flight measurements be made to update ISRF in flight?

MethaneAIR does not have this capability. Further information has been added to line 319 of the original manuscript.

“Ideally, in-flight measurements from on-board lasers would be used to update the ISRF in flight, as is done for TROPOMI (van Kempen et al., 2019). MethaneAIR and MethaneSAT are not equipped with this capability, but on-orbit ISRF monitoring is being planned by looking at targets on the earth, the airglow, and the moon for MethaneSAT.