We thank anonymous referee #1 for their comments, which have helped to improve the manuscript. We have provided the referee comments in italics, with responses to each comment below.

Specific comments:

P4, L2: 'which showed overall good results and performance' This sentence is very general and does not contain useful information. There should be quantitative error estimates of the total CO column amounts, which can be used for the error analysis within the present work.

We have added quantitative information with a reference to a comparison with ground-based FTIR to this section. We have now included an uncertainty in total column in Sect. 4.7, as discussed in the comments below.

"IASI CO VCDs have also been compared against ground-based FTIR measurements, with typical differences of ~10% (Kerzenmacher et al., 2012)."

P4, L6: 'and showed an overall good performance' This part may be deleted since quantitative numbers for uncertainties of IASI NH3 total column amounts are provided subsequently.

This has been deleted

P4, sections 2.1 and 2.2: Please provide information about the vertical averaging kernel for each IR product. In general, mid-IR nadir sounding is not sensitive near the ground (with few exceptions in case there are large temperature differences between the surface temperature and the temperature of the atmospheric boundary layer). Thus, the information on the trace gas concentration in the lower layers, which is used to determine the total column amounts is mainly determined by the a-priori profile.

We agree that this information is helpful for interpreting the emissions estimates and therefore, we have added to Sections 2.1 and 2.2.

For IASI CO, sample averaging kernels for the VCD are shown in Figure 1 below. We have added the following discussion in Sect. 2.1 to address this. We accounted for this in the uncertainty estimates by applying an uncertainty of 35% to the VCDs in Sect. 4.7.

"During the fire, total column averaging kernels showed increased sensitivity at surface with values of ~0.4-0.6 CO for large VCDs greater than $3.5x10^{18}$ molec/cm^2. These large VCD measurements are taken within the smoke plume, and are the primary contributor to the emissions estimates. This is consistent with previous studies which have found increased sensitivity to surface CO for large VCDs (Bauduin et al., 2017). Yurganov et al. (2011) compared IASI VCDs with measurements from three grating spectrometers during forest and peat fires plume in Central Russia in July-August 2010. They found that the IASI VCDs were biased low compared with the ground-based measurements by an estimate of $1.61x10^{18}$ molec/cm^2 or ~35%, over a sample with a mean IASI CO VCD of $4.7x10^{18}$ molec/cm^2."

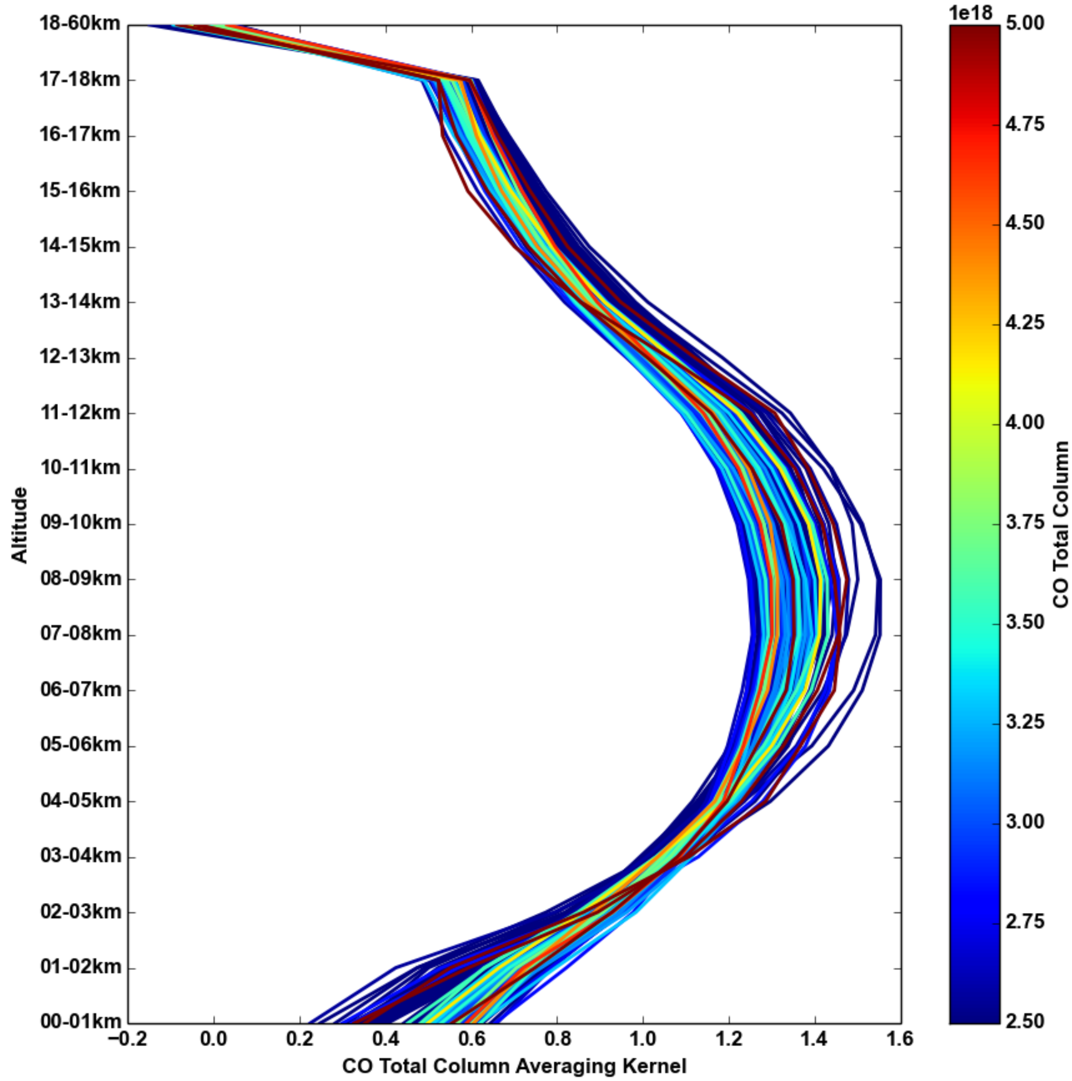

Figure 1: CO total column averaging kernels for IASI-A for daytime measurements on May 16, 2016 (as for Fig. 1 of the paper), with colour scale indicating the VCD.

For IASI NH_3, we have added the following to the text "Averaging kernels are not produced as a part of the NH_3 retrievals; however, previous studies have demonstrated good agreement with surface and FTIR measurements (e.g., Clarisse et al., 2010; Van Damme et al., 2015; Dammers et al., 2017), demonstrating that there is sensitivity to the lower layers of the atmosphere."

An example of total column averaging kernels for CrIS NH_3 VCDs are shown in Figure 2 for May 16 2016. We have added the following to Sect. 2.2 to address this: "CrIS total column averaging kernels during the fire suggest good sensitivity to NH_3 in lower layers of the atmosphere, with values of ~0.5-1.5 for the 0-3 km altitude range (not shown here). Above ~3 km, the sensitivity is very low, which is expected if ammonia concentrations are low at these altitudes (see Sect. 4.2)."

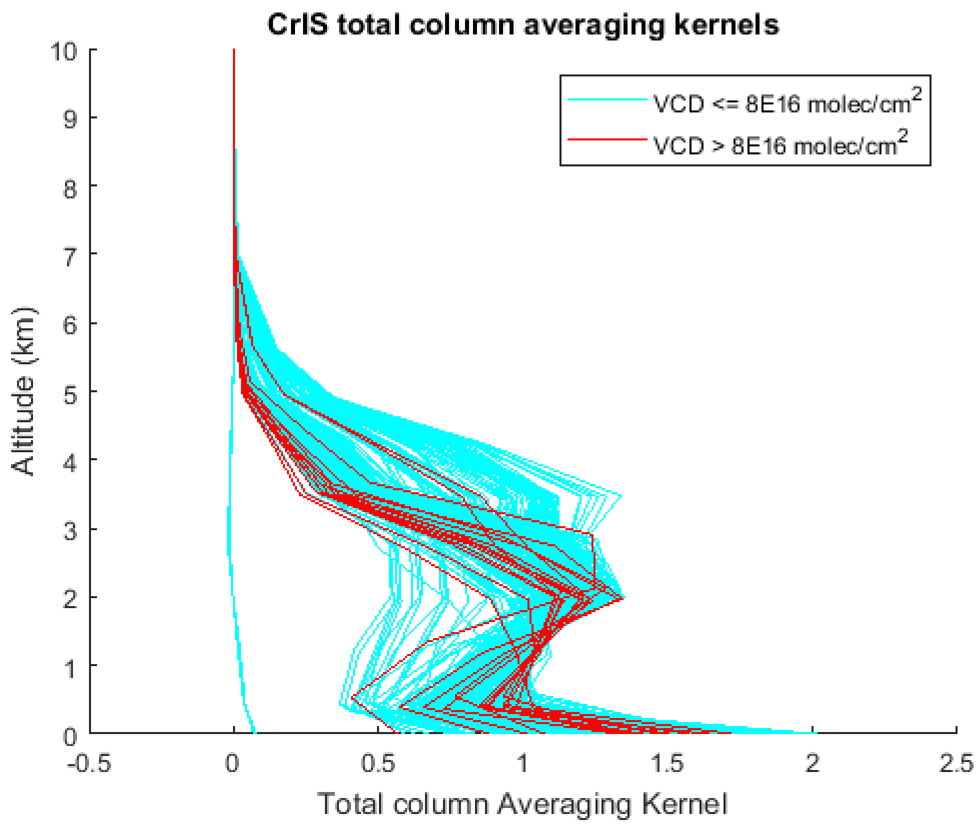

Figure 2: NH_3 total column averaging kernels for CrIS for daytime measurements on May 16, 2016 (as for Fig. 1 of the paper).

P8, section 4 and Table 1: A chapter on the uncertainties connected to the total column observations should be added.

This has been added, as recommended (see Sect. 4.7 and Table 1).

P9, L2-4: For the baseline VCDs only IASI-A morning and CrIS daytime values have been used. Why not IASI-B and evening/night data? Is there any explanation, why CrIS and IASI values of NH3 baseline VCDs differ by a factor of 10?

The description of the use of baseline VCDs was not clear in the text. We calculated baseline VCDs separately for the various measurement types (e.g., IASI-A vs IASI-B, day vs night), but were describing a subset of the baseline values as an example. We have added some detail to the text in this paragraph describing the baseline VCD calculations and have expanded the text to show baseline values for all the measurement types in order to improve clarity.

As the NH_3 background values approach the minimum detection levels of the instruments there can differences between the IASI and CrIS retrieved products. The detection limit depends on the instrument characteristics and atmospheric state, with a minimum detection limit of ~2-3 ppbv (~4-6x10^{15} molec/cm^2 for IASI (Clarisse et al., 2010) and of ~0.5-1.0 ppbv (~1-2x10^{15} molec/cm^2) for CrIS (Shephard and Cady-Pereira, 2015; Kharol et. al., 2018). Thus CrIS will be able to provide measurement information for lower baseline amounts. However, once baseline values approach respective instrument detection limits there can be differences in the reported products depending on how the non-detects are handled. Dammers et al. (2017) showed that IASI NN values in the lower range tend to be low biased (~50%), which might account for a lower computed baseline. The CrIS algorithm provides the sensitivity and ability to identify non-detects, but in this study there is no attempt to account for these non-detects, and only observations with some measurement contribution (DOFS > 1.0) are included, which can result in a high bias under conditions when there is a significant fraction of retrievals below the detection limit of the instrument, for example ~-25% shown by Dammers et al., (2017), which might account for the higher baseline.

P10, L30: 'The direction of the NH3 plume aligns best with winds between 1000-800 hPa (approximately 0-2 km), suggesting that the bulk of the NH3 plume is within this altitude range.' You should consider discussing the influence of the CrIS averaging kernel here, since it is not sensitive to the lowest layers.

As shown in the averaging kernels above, CrIS VCDs are sensitive to the lowest layers of the atmosphere (~0-3 km) and therefore this approach is reasonable.

P14, L1: 'Note that the IASI CO and NH3, and CrIS NH3 are measured at infrared wavelengths and therefore are not sensitive to the smoke plume.' This is not entirely correct. Since smoke is absorbing at mid-IR wavelengths, there should be an influence on the results in case it is not taken into account explicitly in the satellite retrieval procedure. I would be interested if there are any sensitivity calculations for IR retrievals in presence of smoke.

We have added the following text to Sect. 4.4 to address this:

"At infrared wavelengths, smoke aerosol does not have a strong effect on retrievals. Clarisse et al. (2010a) showed the impact of biomass burning aerosol on IASI retrievals in the 800-1200 cm^{-1} range and found the strongest effect for 1000-1200 cm^{-1}. IASI NH_3 is retrieved in the 800-1200 cm^{-1} range, but most of the weight is for 900-980 cm^{-1}. CrIS retrievals are performed for 650-1095 cm^{-1}, with the main NH_3 absorbing spectral region at 960-970 cm^{-1}. The effect of biomass burning for 900-980 cm^{-1} is small (Clarisse et al., 2010a) and therefore will have minor influence on the IASI and CrIS NH_3 retrievals. IASI CO retrievals are performed in the 2128-2206 cm^{-1} wavelength range, where the effect of aerosol is also weaker than in the 1000-1200 cm^{-1} range (Sutherland and Khanna, 1991). Therefore, uncertainties due to the effect of smoke on the VCDs are insignificant compared to other sources of error and were not included in the uncertainty calculations for IASI and CrIS."

Technical:

P13, L32: ‘due the’ -> ‘due to the’

P14, L22: ‘emissions’ -> ‘emission’

P16, L28: ‘then applying conversion factor’ -> ‘then applying a conversion factor’

P18, L5: ‘1.0’ -> ‘1.0 g/kg’

P18, L6: ‘3.7’ -> ‘3.7 g/kg’ and ‘3.9’ -> ‘3.9 g/kg’

These have all been corrected as recommended.