Response to anonymous referee #2

We would like to thanks the referees for their insightful comments.

Specific comments:

1. How does the width of the FTS instruments' measurement swath compare to the width of the plume? One reason the "golden day" might not work for the basic flux method described here is because the three downwind FTS instruments are only measuring a small portion of the total plume. Please add some discussion of how this may affect the uncertainty of the flux method.

We have added in the text: 'For that day, the high wind speed causes a reduction of the methane plume width across the feedlot, which may increase uncertainties on the mass-balance approach since the FTS' measurements may only detect a small portion of the total plume.'

2. Line 455, Are these the results from a Keeling plot? Or are you just looking at the variability of d13C? If you look at the enhancements and a Keeling plot, do the d13C values make sense with the notion that the methane enhancements are consistent with dairy emissions?

The values written at line 455 represent the variability of d13C measures in the feedlot. Looking at the Keeling plot for all the measurements, we obtained values around -40 ‰ (mixture of biogenic and fossil sources). However, when driving thought the feedlot with the Picarro instrument, methane enhancements associated with low d13C were recorded, especially when measuring right next to the cows. Therefore, methane emissions are found to be consistent with dairy emissions.

3. How does the length of the measurement period couple into the uncertainties of the inversion? Are three days of measurements for this size and strength of emission sufficient? Could you have gotten away with fewer, or would more have helped?

The assessment of uncertainties remains undetermined at this point and would require additional measurements to perform an independent evaluation. From the two days of data, we were able to retrieve a value that corresponds to previously published estimates. But the errors remain significant. Continuous measurements over several weeks would have provided a better estimate on the inverse fluxes by constraining the model with concentrations and meteorological fields for many different atmospheric conditions. However, results show (on Figure 10) that flux inversion obtained on two different days (the 15th and the 16th of January) lead to relatively similar results. Increasing the number of days in the inversions would reduce the confidence interval but the use of independent data (such as eddy-covariance flux tower measurements) would be needed to evaluate the performance of the system. The authors aim to demonstrate that FTS measurement network coupled with WRF-LES inversion is a powerful methodology to derive local fluxes, even using relatively small number of data.

4. Are there methane sources upwind that may contribute to the model placing methane emissions in the southeast portion of the study area? For example, how well does the LANL 16th site provide a background for the H1 16th site? If the H1 16th site sees an enhancement

in methane that is not measured at the LANL 16th site, must the inverse model place those emissions in the southeastern most section of the grid?

The source attribution problem is solved by combining various wind conditions over the one- or two-day time window (depending on the inversion case). As suggested in the question, information from observed enhancements will be attributed to specific areas depending on the downwind measurements site and the wind direction/speed. We selected two days with varying wind conditions in order to sample the entire domain at different times and with different combinations of sites (upwind/downwind). Whereas our sample size remains small, we have observed most of the wind directions (cf. wind roses in Figure 1) which suggest that our retrieved sources have been measured by more than one combination of sites. We agree though that some of our signals may be more constrained by a specific time (and therefore a specific set of sites) than others. A longer time window of observations with repeated enhancements from different wind directions would help support our findings. Here, we show that major sources can be identified across the feedlots. As an analogy, the inversion performs a triangulation of the sources assuming that our spatial coverage was sufficient. This coverage is a direct function of the wind direction variability as our sites are static.

5. Is there a way to quantify the reduction of dairies between 2010 and 2015? If so, I think this would be a good addition to help strengthen the conclusions based on comparisons with past emissions estimates.

Inventories of dairy and cow's numbers in this area are inexistent. Only previous studies within the area (Peischl et al. 2013, Wennberg et al. 2012) could be used to quantify the reduction of dairies between 2010 and 2015.