

## ***Interactive comment on “TES ammonia retrieval strategy and global observations of the spatial and seasonal variability of ammonia” by M. W. Shephard et al.***

**Anonymous Referee #2**

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This paper provides a detailed overview of the retrieval algorithm developed to treat column ammonia from TES and convert this to a representative volume mixing ratio (RVMR). As discussed in the manuscript, ammonia measurements are challenging, and TES offers an excellent opportunity to provide global observations of ammonia. The analysis quantifies some important limitations of the remote sensing of ammonia using TES: at most one degree of freedom for signal, and a minimum detectability that corresponds to a ground-based mixing ratio in the range of 1 ppbv. As it is likely that data from TES will be used in many future analyses, it is valuable to have the retrieval strategy and analysis described in such great detail. Some initial comparisons between TES retrievals and GEOS-Chem model predictions are also provided. I recommend the

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manuscript be published after consideration of the following comments and corrections:

Page 16026, Line 25, ‘initial comparisons results’ should be ‘results of initial comparisons’

Page 16028, Lines 15-21 The authors state that the retrieval for NH<sub>3</sub> is carried out after the retrievals for temperature, water vapor, ozone, methane, carbon dioxide, clouds, and surface temperature and emissivity. Is it ever the case that the ammonia signal is significant enough that it turns out to have interfered with the retrievals of the other trace gases?

Page 16028, Line 27, ‘ozone), the’ should be ‘ozone, and the’

Figure 1 – Have the 10% perturbations to H<sub>2</sub>O, CO<sub>2</sub> and O<sub>3</sub> been applied to the entire vertical profile of each gas? And is this in contrast to the NH<sub>3</sub> perturbation, which has presumably changed the relative vertical distribution? I’m not sure if this matters but perhaps another sentence in the main body of the paper would help to clarify.

Figures 5 and 6 and sections 2.1.4 and 2.2.1 – why does data only extend along the x-axis in Figure 5 down to -7 K, but down to -25 K in Figure 6, if the analyses are based on the same simulated data (Page 16032 Line 11)?

Figures 6 and 7 – remove information about who created the figure

Section 2.2.2 The effect of clouds is described here, but not the potential effect of aerosol on the retrieval. Given that agricultural regions and biomass burning areas are both high emission areas for NH<sub>3</sub> and also aerosol, it would be interesting to know if the presence of particles will influence the retrieval.

Page 16036, Lines –The authors state that, on average, the representative volume mixing ratio (RVMR) is expected to be about 30% of the in situ mixing ratio that would be measured at the ground. Is this based on GEOS-Chem output, or are there vertically-resolved observations that confirm this falloff with altitude. Given that future evaluations and comparisons of the TES product are likely to rely on surface-based observations, it

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would be useful to have a slightly more detailed discussion about the factors that might influence this ratio or scaling factor.

Page 16038, Lines 4-5 “where TES is sensitive” Can the authors be more specific? Is it restricted the places where GEOS-Chem predicts surface mixing ratios > 1 ppb, a cut off that was identified earlier in the manuscript?

Page 16038, Lines 12-13 Why are the emission databases used here different from those described in Section 2.1.4?

Page 16038 Lines 20-25, Is it possible that GEOS-Chem is converting too much of the ammonia to particle phase ammonium?

Page 16041, Lines 2-3 ‘or some strong sources have less seasonal dependence.’ should read ‘or some strong sources that have less seasonal dependence.’

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