

## ***Interactive comment on “10–year satellite–constrained fluxes of ammonia improve performance of chemistry transport models” by Nikolaos Evangeliou et al.***

### **Anonymous Referee #2**

Received and published: 27 November 2020

Overall, the paper is well written and provides new information to the literature on global NH<sub>3</sub>, which has not been well characterized previously. The paper is rather long and could condense it down to a tighter paper that is more focused on key results and conclusions.

Comparing model predictions at the coarse level presented here (2.5 degrees or 250 km) to ground monitors and discussing “hotspots” may not well represent the spatially variable nature of NH<sub>3</sub> emissions. Averages over these large cells could misrepresent key features of NH<sub>3</sub> distributions. However, the spatial resolution in Figure 4 appears to be finer than 2.5 x 1.3 degree. Was a particular plotting technique used to show

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the NH<sub>3</sub> levels that might be making gradient interpolations or is the data in Figure 4 actually 2.5 x 1.3 degree resolution?

The authors estimated emission fluxes using a lifetime parameter from the CTM. Was there some reason a traditional assimilation approach (e.g., like Alvarado is doing) was not included in this assessment? The authors should consider a comparison of the column predictions of the CTM simulation using the estimated emissions back to the IASI measurements. If the lifetime approach is accurate, the CTM should accurately predict the IASI columns when using the scaled emissions. If this was done it is not clear from the text. Further, it did not seem like the seasonal NH<sub>3</sub> lifetime estimated by the CTM provided a substantively different result than the 0.5VD constant assumption.

Ammonia has a strong diurnal profile. Does the assumption for diel profile impact any of the results presented in this paper or does the diurnal nature of NH<sub>3</sub> emissions have no impact on these products?

When taking a closer look at Figure 6, is it surprising that VD0.5, NE, and VDgrid emisisions used in a model result in very few model estimations of ammonia below 0.5 and ECG rarely has a prediction above 0.5. Some of the calculated performance metrics may suggest “good” model performance but the shape of the model-observed NH<sub>3</sub> in Figure 6 shows some features that suggest they many of these approaches can not replicate the range of NH<sub>3</sub> levels measured.

Please provide some more clarity on the vertical profile used for NH<sub>3</sub> for IASI retrievals. Is this constant and not variable with changes in altitude? Does the vertical profile conform to profiles measured as part of aircraft measurement campaigns and seem realistic?

Line 581: What are large sources of anthropogenic NH<sub>3</sub> in central USA?

Figure 8 is very hard to interpret. The authors should consider alternative colors or another way to present these results.

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