Lightning NO_2 simulation over the Contiguous US and its effects on satellite NO_2 retrievals

Response to Editor

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We thank the editor for further comments. Below we respond to the individual comments. The reviewer's comments will be shown in red, our response in blue, and changes made to the paper are shown in black block quotes.

"...and find that the switch of convective scheme reproduces day-to-day variation ..." - it's not the switch that reproduces variations but rather the model which reproduces variation after switching the convective scheme

We changed the sentence in the conclusion:

> "We first validate it by comparing against lightning observations and find that **the model reproduces day-to-day variation of lightning flashes in the southeastern US after the switch of convective scheme** and..."

I think it would also be worthwhile to state somewhere in the text or at the new figure S4 that from your work, there is (at least in my understanding) no indication that lightning NO2 has a significant impact on the AMF at the time and location you are investigating. In your conclusions, you state that "This study emphasizes the importance of including reliable lightning NO2 in a priori profiles for satellite retrievals" but the way I see it, just switching off lightning in the model would probably lead to AMF values comparable to those you determined with the updated version of the model. This is why I suggested to include the NO2 model without lightning in Fig. S4, just to demonstrate that lightning (if modelled correctly) is not relevant here.

We add it in the last paragraph of Section 3.3:

> "The corresponding a priori NO_2 profiles and scattering weights over urban and rural areas are shown in Fig. S3. **The G3/CTH parameterization has substantially more lightning than observed and thus places a large fraction of NO_2 in the upper troposphere whereas the KF/CAPE-PR has less lightning and is more consistent with observations. The resulting profiles of modeled NO_2 are more dominated by boundary layer NO_2 and less sensitive to lightning.** "

In the conclusion, we changed it to:

> "This study indicates that the erroneous representation of lightning NO_2 in a priori profiles is an important source of bias for satellite retrievals."