Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-1360-AC1, 2019
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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Impact of synthetic spaceborne $NO_2$ observations from the Sentinel-4 and Sentinel-5p platforms on tropospheric $NO_2$ analyses" *by* Renske Timmermans et al.

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Received and published: 21 July 2019

Thank you for your review of our paper. Please find below our responses to the comments in the following structure:

(1) comments from Referees, (2) author's response, (3) author's changes in manuscript.

Anonymous Referee 1 - Regarding the estimation of ground-based observational uncertainties, I wonder if this work could be useful: Thunis et al. "Model quality objectives based on measurement uncertainty. Part I: Ozone", Atm. Env. 79, November 2013,



Pages 861-868.

Thank you, this is a very useful and interesting paper, we have added this reference in the section on observational errors.

- Models description in sec. 2.1 and 2.4: it would be useful to add information on the method/source of emission splitting/speciation, which is currently missing. E.g. how NOx emissions are split in NO/NO2 or other nitrogen compounds? How the total VOCs emissions are speciated and then lumped in the model specific chemical mechanism? Also the information on chemical mechanisms used would be a useful to be added.

We understand that this would be useful information, however we believe adding all this information would unnecessarily lengthen the paper. We have therefore decided to add a little bit more information and refer to relevant model description papers and report for those interested in more details. Added text: The gas-phase chemistry in the LOTOS-EUROS model is based on a modified version of the CBMIV mechanism. We refer to Manders-Groot et al. (2016) and Manders et al. (2017) for more details on the emission speciation and corresponding lumping to the chemical mechanism species. The gas-phase chemistry in MOCAGE uses the RACMOBUS chemical scheme, a combination of the Regional Atmospheric Chemistry Mechanism tropospheric scheme -RACM- (Stockwell et al., 1997) and the REactive Processes Ruling the Ozone BUdget in the Stratosphere stratospheric scheme -REPROBUS- (Lefèvre et al., 1994).

- On the EnKF corrections: in sec. 2.5.2 are briefly explained the "parameters" that are optimized by the assimilation procedure. However, in the rest of the manuscript, only the correction to emissions is shortly discussed (Fig. 16 and related text). What about the other parameters, e.g. ozone deposition velocity and boundary conditions (or others)? A brief mention to these would be also informative.

Indeed the assimilation system also optimizes ozone deposition velocity and boundary conditions, however the changes in these parameters are more related to ozone and is small compared to the emission changes in NOx, when assimilating NO2. We added a

brief mention of the other parameters in the section where we show the adjusted emissions: . . ..which optimises the NO2 concentrations by specification of uncertainties in model parameters, as described in section 2.5.2. The parameter that is most directly influencing the NO2 concentrations is the NOx emission; other parameters such as NMVOC emissions and ozone deposition velocities are more related to ozone. As example of the change in model parameters, Figure 16 shows average NOx emission adjustments . . .. . ...

- Fig. 13: I suggest to revise the lines in the figure for improved readability. Indeed, on print the black, blue and purple look quite similar. Perhaps adding also a variation to the line style (e.g. dashed, dotted, etc.) would help.

We have changed the line colors and added dotted and dashed lines for printed versions.

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