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Atmospheric Chemistry and Physics Discussions

Interactive comment on "OMI tropospheric NO_2 profiles from cloud slicing: constraints on surface emissions, convective transport and lightning NO_x" *by* M. Belmonte Rivas et al.

Anonymous Referee #3

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The study "OMI tropospheric NO2 profiles from cloud slicing: constraints on surface emissions, convective transport and lightning NOx" by M. Belmonte Rivas et al. applies a cloud slicing technique to clouded OMI NO2 observations in order to derive a mean NO2 pseudoprofile. The study is well written and contains comprehensive analysis, which indicate (regional) model shortcomings for emissions, convection, advection, or lightning NOx, which is valuable information for the scientific community.

My main concern is that the study does not at all account for seasonality, while all involved components (NOx emissions (heating, lightning, biomass burning), NOx lifetime, convection patterns, NOx profiles, and cloud characteristics) can vary strongly

over the year. The value of an annual mean pseudoprofile is thus questionable, as the different cloud pressure levels and the corresponding NO2 columns are not at all equally distributed over the year.

Previous cloud slicing studies have considered seasonality (e.g. Liu et al. for CO and Choi et al. for NO2), and I see no reason why this study does not.

Thus, I recommend to perform the cloud slicing on a seasonal basis. If statistics is too low for 3 months, the seasons from several years can be merged. This requires major revisions, but will yield better interpretable pseudoprofile and very likely strengthen the discussion of the model comparison.

Further comments:

8022/7: Here, OMI "cloud pressure" is introduced and related to the cloud midlevel. Later (Fig. 2, section 3.1), the terms "cloud top pressure" and "cloud top" are used. Please use consistent terms.

8023/19: VMR is not a concentration.

8023/24: What is the lesson learned from the trial runs? How far are the results dependending on the chosen pressure grid? What are the reasons for choosing exactly this grid?

8024/16-19: Clarify that VCD_above is the *tropospheric* column above cloud

8025/19: Units are missing.

8028/1: Before discussing the Pseudoprofile errors, please first introduce the term Pseudoprofile in a dedicated subsection.

8028/10: model true -> model ("true")

8029/4: It is stated that the cloud modifies the profile, but how (and how strong) is not discussed. This aspect should be extended when introducing the Pseudoprofile.

ACPD

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8030/18: Why is this comparison not shown? This figure might be provided as supplement.

8036/25:

we have drawn ... classes defined according ...

-> we have defined ... classes according ...

8043/19: actualize -> update; please provide reference(s).

Fig. 5: Are there also negative VMR (over ocean)? If so, please mention & shortly discuss them.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 8017, 2015.