**Atmospheric
Chemistry
and Physics
Discussions**

Interactive
Comment

Interactive comment on "Multi-model ensemble simulations of tropospheric NO$_2$ compared with GOME retrievals for the year 2000" *by* T. P. C. van Noije et al.

Anonymous Referee #1

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General comments

The authors present tropospheric NO2 columns calculated by 17 global atmospheric chemistry models compared to three different retrievals from the Global Ozone Monitoring Experiment (GOME) for the year 2000. In order to reduce systematic differences between model and satellite data, only scenes observed by GOME are taken into account when analyzing the model output. On average, the models tend to underestimate the retrievals in the highly industrialized regions, whereas the models overestimate tropospheric NO2 columns observed in regions dominated by biomass burning during the dry season. In addition to the geographic distributions of the annual means, also sea-

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sonal cycles for selected regions are analyzed. The comparison indicates significant differences between the individual model results as well as between the different retrievals. The sensitivity to different emission data sets for biomass burning and to emissions from industry and traffic including a diurnal cycle are estimated from additional model simulations. I suggest to publish the paper in ACP after some modifications which are discussed in the following.

Specific comments

p. 2982, l. 26: The authors say "only scenes with a cloud radiance fraction lower than 0.5 for solar zenith angles smaller than $80°$" are included for the comparison of modeled data with the retrievals. It remains unclear how this is achieved for the model data. Are additional satellite data used to select scenes from the model data sets or are cloud cover and cloud optical properties calculated by models themselves? Clouds are probably a critical parameter when selecting scenes from the model data. Thus additional errors might be introduced if cloud properties within the models are not consistent with the GOME observations. Please give some more details on this issue.

p. 2983, l. 3-5: "Nevertheless, our collocation procedure corrects for most of the sampling bias of the retrievals resulting from incomplete spatial and temporal coverage of the satellite observations." Did you apply the same collocation procedure to both model ensembles, ensemble A and ensemble B? In case of the climate models (ensemble B) it probably makes no sense to select specific days of a month (e.g. every third day), as the meteorological situations for given locations are not comparable to the days with GOME observations available. Please give some information whether you treated both model ensembles the same way in your collocation procedure. If so, how did you deal with different meteorological situations (e.g. cloud cover) during the GOME observations and in the climate models?

p. 2984, l. 6-14: The sampling operator S selects scenes, that have been retrieved by GOME. How are data sampled from monthly means? In particular when using monthly

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mean cloud cover, some grid point may contain no data at all? Please add a few words on that.

p. 2986, l. 10/14: "Relatively high...", "Relatively low..." Please be more precise and give numbers or ranges on what you mean by "relatively".

p. 2986, l. 22: I suggest to specify the names of the models you mean by "higher-resolution".

p. 2986, l. 24-27 (comment): It is not surprising, that the models with a horizontal resolution between $2°$ and $5°$ cannot accurately reproduce small-scale features, which are below their grid resolution.

p. 2987, l. 8-9: In this paragraph, it is stated that the lifetime of CH4 in the models varies between 7 and 12 days. How does this comply with the statement on p. 2981, l. 12-14: "... the methane mixing ratios were specified throughout the model domain; for the year 2000 a global methane mixing ration of 1760 ppbv was assumed." Is the methane mixing ratio really specified throughout the atmosphere (model domain) or only prescribed at the surface as a boundary condition? Please check this.

p. 2988, l. 4-14: You can think of many more reasons determining the lifetime of NOx simulated by the individual models, e.g. photolysis, chemistry scheme (included reactions), convection, parameterization of various other processes such as NOx production from lightning. Please give some more details on why you think the partitioning between NO2 and NO seems to be more important than changes in lifetime.

p. 2989, l. 6-8 (comment): As the meteorological fields of climate models calculating their own meteorology do not match observations of a specific period of time, it is not surprising that additional statistical noise is introduced.

p. 2992, l. 2-6: Please reformulate this sentence e.g. by splitting into two sentences to make it clearer to the reader what is shown in Fig. 8.

p. 2997, l. 21-23: Please be more precise. What do you mean with number of days

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per month? Do you mean the number of days with observational data available?

p. 3000, l. 3-8: It is stated that the retrievals suggest the emissions of anthropogenic NOx to be higher in winter than in summer. Please give a motivation why you didn't address the seasonal cycle of the emissions first, before investigating the impact of diurnal variations.

p. 3003, l. 25/26: change "southern" to "Southern"

p. 3016, Tab. 1: Emissions from aircraft and from shipping are discussed in the text separately. Are these included in emissions from traffic in Tab. 1?

p. 3035, Fig. 8: "...together with the difference compared to the corresponding fields shown in Fig. 2, obtained from the daily model columns..." I do not exactly understand what you mean by this sentence. Please reformulate.

p. 3036, Fig. 9: The region "South Africa" is smaller than a single grid cell of the 5°x5° grid used for comparison of model and satellite data. Please check whether the results obtained for this region depend on the interpolation method applied.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 2965, 2006.

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