**Geoscientific
Model Development
Discussions**

Interactive comment on "The global chemistry transport model TM5: description and evaluation of the tropospheric chemistry version 3.0" *by* V. Huijnen et al.

Anonymous Referee #1

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General comments

This paper is a well written, comprehensive and useful description and evaluation of the TM5 model. I have numerous comments, all relatively minor clarifications, listed below. One overarching comment is that not all aspects of the model's chemistry (and transport) are evaluated (e.g., aerosols, NMHCs, etc., aren't) so I wonder if the title should be slightly refined to reflect this. (Complete evaluation in a single paper is, of course, not realistic. So this is not a plea to extend the evaluation to more areas here – the paper is useful as it is – and inclusion of more evaluation would probably make it less accessible and too long. Of course, further papers evaluating other aspects of the

model would be useful additions.)

Specific comments

P1014 l14-18 and P1014 l23-27 essentially repeat the same text.

P1016 l1: It is more usual to use 't' for time rather than 'T' (more normally temperature); I would suggest stick with convention, but possibly there is a good reason for this nomenclature.

P1019 l9: Clarify that the heterogeneous conversion of N2O5 on aqueous surfaces is included (forward reference to Section 3.3).

P1020 l4: Define AFGL.

P1020 l21: The section also describes aqueous phase chemistry, so the section title should reflect this.

P1020 l25: 'aquated', as far as I know, is not a word (although I know what you mean). Suggest change to 'hydrated' or similar. It also appears later in the text.

P1021 l3: Isn't it the total surface area (not volume) that is the important quantity (at least for heterogeneous reactions)?

P1021 l25: Strictly speaking, you are defining NOy, not the NOy budget (budget is a wider term that describes all the sources and sinks).

P1022 l2: Insert comma: 'Gas-aerosol partitioning,'.

P1023 l25: What does 'assuming an interstitial fraction of 0.3' mean? Is it that 70% instantaneously partitions into the cloud drops? Clarify.

P1023 l26 (and next page): Strictly speaking, Henry's name is used with respect to Henry's Law, rather than for particular coefficients or solubilities.

P1024 l1: Some aqueous phase reactions are pH dependent. It would be fairly straightforward to calculate pH in the model. Do you know if using a fixed pH has any influence

on your results?

P1024 l5-6: 'Using a maximum cloud fraction overlap scheme, rainfall rates are used to estimate the liquid water content, droplet radius and terminal fall velocity.' It is not obvious what this means, please clarify.

P1024 l9: What does 'standard deviation 2.0' mean? 2.0%, 2.0μm?

P1026 l2: 'This is the case when' – isn't this always the case in the model simulations described here? Or is it topography dependent? Clarify.

P1026 l13: 'fourth-order polynomial fit' – do you mean it is a fourth order polynomial function of cold cloud thickness? Clarify.

P1026 l17: 'scaled to 5 TgN/yr' – is total lightning NOx production scaled to this number every year (in multi-annual simulations), or just the first year (then allowed to vary inter-annually)? Your simulations here are for 2006, but with 2 years spin-up. Do you just repeat 2006 for 3 years, or do you run 2004-2006, and if so is the lightning total normalised to 5 TgN/yr each year?

P1029 l3: The CO burden is 354 Tg in the text, but 353 Tg in Table 9.

P1029 l27: at -> in

P1030 l6: Are the 'mean' CO values shown in Figure 5 area (or mass) weighted means?

P1030 l9-11: Clarify – is MOPITT V3 used in Shindell et al. (2006)?

P1032 l2: Delete ',CH2O' in the units for clarity.

P1033 l2: Suggest change 'also given' to 'which may also be related to'?

P1034: First two paragraphs are essentially the same.

P1034 l14-15: I'm not sure the model-data comparison in Figure 11 tells us much about the ability of the model to simulate the boundary layer. Explain why or delete.

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P1034 l18: NOy was already defined on p1021.

P1036 l18-24: The rather homogenous vertical O3 profiles in the model possibly suggest too vigorous convection?

P1037 l5: 'a slope of 0.8 with an offset of 21 ppbv' – slightly more information is needed for this to be immediately useful.

P1039 l17: Clarify that 'these' refers to the fields from the 2006 simulation described in the main text.

P1040 l5: The formula for the tropopause pressure in the text initially confused me – I suggest clarify this.

P1063, Table 8: Clarify what's in brackets (presumably SH/tropics/NH).

P1064, Table 9: Do you mean 'levels' or grid-boxes? (I think you mean grid-boxes). The trend should have units of Tg/yr, and I would say it was negative.

P1069, Figure 2: The vertical scale cannot strictly be pressure; if it were then there should be no results over the Antarctic at pressures above $\sim$800 hPa. Presumably it is some sort of hybrid level, please clarify.

P1072, Figure 5: Clarify if these are area (mass) weighted means.

P1074, Figure 7: The description of this figure in the text (p1032 l4-7) suggests what is plotted is more complicated than as described in the figure caption. Clarify.

P1075, Figure 8: Clarify that the model results shown in this figure are now sampled as per SCHIAMACHY (which is different to Figure 7).