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Atmospheric Chemistry and Physics Discussions

Interactive comment on "TransCom N_2O model inter-comparison – Part 1: Assessing the influence of transport and surface fluxes on tropospheric N_2O variability" *by* R. L. Thompson et al.

Anonymous Referee #1

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General comments

This paper investigates the role of atmospheric transport and surface emission fluxes in determining the tropospheric distribution of N2O mixing ratios using state-of-the-art chemical transport models and available in situ observations. In addition to N2O, the authors use CFC-12 and SF6 simulations to determine accuracy of modeled stratosphere-troposphere exchange (STE) and tropospheric transport. The authors find that errors in simulated atmospheric N2O distribution are mainly due to errors in surface N2O emission fluxes but errors in modeled vertical transport are also important in southern hemisphere. The article is interesting, well written and I really enjoyed

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in reading the paper. The article is suitable for publication in ACP after the authors address the following comments.

Specific comments

Page 2318, L17: The south to north gradient is not clear from Fig. 2. You may want to revise the color scale to make this feature evident in Fig. 2.

Page 2319, L4-6: Is this classification of lower and upper stratosphere also valid for the tropics where tropopause could be located above the 380 K isentrope. I would suggest adding a black line showing the tropopause height in Fig. 2 so that readers can better recognize lower and upper stratospheres.

Page 2319, L16: Reichler et al. (2003) also suggested that average lapse rate between the level (at which lapse rate becomes less than 2 K km-1) and all higher levels within 2 Km should not exceed 2 K km-1. This condition removes the probability of false tropopause detection. Did you check this condition as well? If yes, please add this information to the manuscript.

Page 2320, L13-14: Why is N2O sink larger in ACTMt42l32 while it was stated in section 2.1 (Page 2313, L16-19) that loss rates in all models are scaled such that global annual total loss of N2O was about 12.5 Tg N?

Page 2320, L18-19: Is N2O lifetime calculated as (column 4/ column 5) of Table 7? If yes, N2O lifetime in TOMCAT comes around 108 years. In addition, the lifetimes shown in Table 7 and Fig. 3 are different (e.g. blue cross in Fig. 3 says lifetime of N2O is less than 90 y while Table 7 says it is 92 y). Please check these calculations again and accordingly revise the discussion.

Page 2325, L23-24, Why does model show such a larger amplitude compared to observations at MLO?

Page 2328, L13-14: Is not this the case for PFA and ULB too? Can you please elaborate how did you conclude that modeled STT influence is stronger only at Hawaii?

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Section 3.3.2: It appears that the emission scenario BWMN04 leads to best agreement between the models and the observations. This information may be included in the abstract. Given this, please justify your choice of OCNPIC as control simulation over BWMN04. How the results presented in the previous section would have differed if BWMN04 were used as the control simulation?

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 2307, 2014.