Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-487-RC2, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Constraining N_2O emissions since 1940 using firn air isotope measurements in both hemispheres" *by* M. Prokopiou et al.

Anonymous Referee #2

Received and published: 17 November 2016

Review for the following manuscript Journal: ACP Title: Constraining N2O emissions since 1940 by firn air isotope measurements in both hemispheres Author(s): M. Prokopiou et al. MS No.: acp-2016-487 MS Type: Research Article

The paper is generally well written. I appreciate the effort the authors put in in compiling all available firn air data and make the assessment. I don't have any serious major criticisms on their scientific approach and their interpretations but I do have major suggestions for their presentation. After the major comments are taken, I recommend for publication.

Major comments: 1. Box model calculation: The model parameters that kept invarying are not stated clearly. A table that lists all time independent parameters (cross-

tropopause exchange fluxes of isotopologues, natural fluxes, and their associated isotopic signatures, N2O lifetime, etc) will be helpful. In addition, a comparison with AR5 fluxes is useful. 2. Also box model: The derived time dependent variables. A table that summarizes the derived fluxes and isotopic values (average over a certain period) will be helpful, along with comparisons with other independent work by, for example, Park et al. and AR5. 3. What's the reason(s) behind for the elevated N2O flux in year 2008? 4. What's the reason(s) for the oscillating values in source/anthropogenic delta values in Figure 4? Moreover, if I understand correctly, natural N2Os are kept constant. I then expect to see the same time variability in anthropogenic as in source in Figure 4, but apparently the two are different. This highlights the usefulness of the major comment #1. 5. In addition to isotopic values, it will be useful and more informative to have isoflux for each process considered. A plot similar Figure 4 but for the respective flux (better also break into each process considered) is recommended.

Minor comments: 1. section 2.5: define all the variables used and no need to define variables not used. For example Fsink defined but not used. Fexch used but not defined. Also is epsilon_L the same as epsilon_app? Please check carefully the variables in the this section. 2. Line 445, additional decadal variability: raised also above in the major comment #4. What are the underlying mechanisms for the variability? Agricultural activity? Use of fertilizer? 3. Line 492, d15Nˆav: use the same notation throughout. In the figure, d15N is used. 4. Line 495, Fig 5: I believed you meant Fig. 4. Do the corrections for the remaining. 5. Table 3: Is your delta_atm,pi the same as Park et al.? If not, why not compare? If the same, then say it. 6. Same table, the last column double asterisk: what is it for? 7. Line 604, d15N_sp: not defined. You mentioned in line 36, but the term not defined. 8. d15N_sp is useful, please also show the time series in Fig 4.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-487, 2016.