

***Interactive comment on “Constraints on N<sub>2</sub>O  
budget changes since pre-industrial time from  
new firn air and ice core isotope measurements”  
by S. Bernard et al.***

**Anonymous Referee #1**

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This paper presents new N<sub>2</sub>O isotope results from polar firn and ice core air samples. In contrast to modern data, the firn and ice core N<sub>2</sub>O isotopomer trends are similar, but with due consideration to the errors, this discrepancy may not be due to atmospheric changes but rather unresolved analytical errors. These future improvements will enhance the use of intramolecular <sup>15</sup>N measurements. The overall depletion of N<sub>2</sub>O over the last 300 years is attributed to the increasing use of agricultural fertilizers and compares well to bottom-up calculations - an important verification. Overall, the paper is scientifically sound, well written and should be published after some minor revisions:

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7555, 13 Please test your firn model calculations with the different diffusion coefficients for the N<sub>2</sub>O isotopes N<sub>15</sub> and O<sub>18</sub>.

7556, 18 State what results you refer to here (i.e. Fig 1 or Fig 2).

7557, 1-2 Delete 'the model can reproduce the firn and ice data quite well, especially for 15N and 18O' Rewrite as 'For NGRIP, the average difference between the model and the data is less than 0.15‰ for 15N and less than 0.20‰ for 18O'

7557, 27-28 Move the following text to Fig. 2 caption. 'The colour scale represents the probability that a given atmospheric scenario is constrained by the firn data'

7558, 3 Explain what you mean by a 'certain atmospheric age' Do you mean an exact age?

7559, 6 The kink is hard to notice at first. Please alert readers to it by stating the approximate at which the kink occurs.

7559, 12 Please define the two positions

7561, 22 Can you say why natural sources have probably remained constant, any supporting references?

7563, 9 Rewrite as 'In principle this may allow us to investigate N<sub>2</sub>O stratospheric sinks'

7564, 3 Define the 'different time periods'

7573 Please give a more complete description of the 'best scenario' and 'accepted scenario'. It is not clear whether you are referring to the agreement of your firn profile with that from the South Pole ice core and Cape Grim data or from different density and diffusivity profiles used in the firn model.

7574 Why not scale the 1d<sup>15</sup>N plot to show the Berkner Island data that are off scale? Please point out the approximate date of kinks in the plots as they are difficult to see.

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