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## Constraints on N<sub>2</sub>O budget changes since pre-industrial time from new firn air and ice core isotope measurements

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**Abstract.** A historical record of changes in the N<sub>2</sub>O isotope composition is important for a better understanding of the global N<sub>2</sub>O atmospheric budget. Here we have combined measurements of trapped gases in the firn and in ice cores of one Arctic site (North Greenland Ice core Project - NGRIP) and one Antarctic site (Berkner Island). We have performed measurements of the <sup>18</sup>O and position dependent <sup>15</sup>N isotopic composition of N<sub>2</sub>O. By comparing these data to simulations carried out with a firn air diffusion model, we have reconstructed the temporal evolution of the N<sub>2</sub>O isotope signatures since pre-industrial times. The decrease observed for all signatures is consistent from one pole to the other. Results obtained from the air occluded in the ice suggest a decrease of about -2.8, -2.4, -3.2 and -1.6 for δ<sup>15</sup>N, <sup>1</sup>δ<sup>15</sup>N, <sup>2</sup>δ<sup>15</sup>N and δ<sup>18</sup>O, respectively, since 1700 AD. Firn air data imply a decrease of about -1.1, -1.2, -1.0 and -0.6 for δ<sup>15</sup>N, <sup>1</sup>δ<sup>15</sup>N, <sup>2</sup>δ<sup>15</sup>N and δ<sup>18</sup>O, respectively, since 1970 AD. These results imply consistent trends from firn and ice measurements for δ<sup>15</sup>N and δ<sup>18</sup>O. The trends for the intramolecular distribution of <sup>15</sup>N are less well constrained than the bulk <sup>15</sup>N trends because of the larger experimental error for the position dependent <sup>15</sup>N measurements. The decrease in the heavy isotope content of atmospheric N<sub>2</sub>O can be explained by the increasing importance of agriculture for the present atmospheric N<sub>2</sub>O budget.

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