

Understanding the evolution of atmospheric nitrous oxide over the last century from the stable isotopes of the firm air at Styx Glacier, East Antarctica

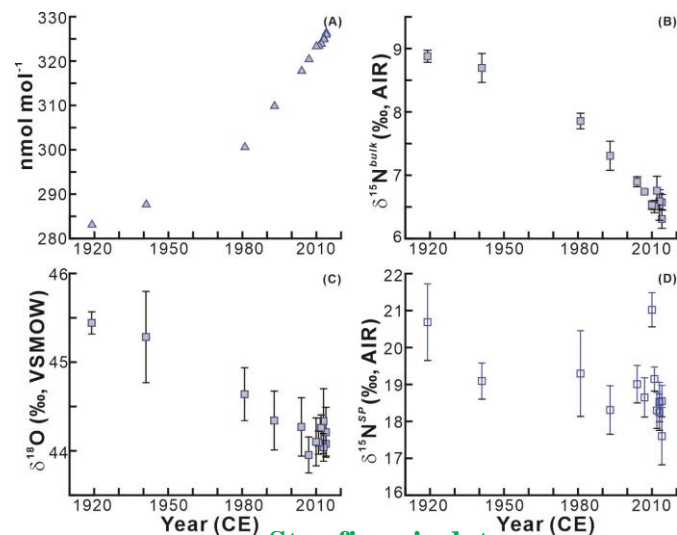
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Motivation:

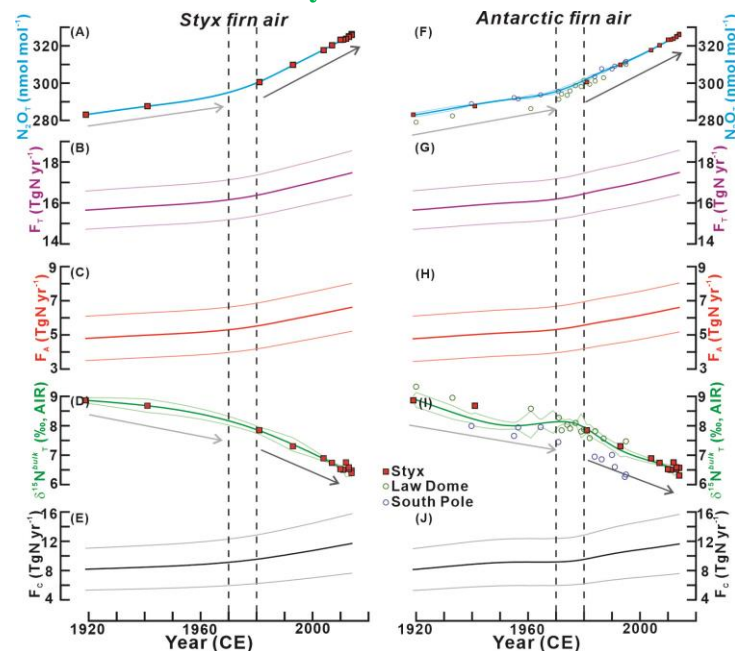
- Global warming potential of N₂O is 300 times higher than CO₂ over 100 time period.
- Destruct the ozone layer.
- Since after the industrial revolution mixing ratio of N₂O in atmosphere has grown by more than 22%
- Increased emission from the anthropogenic sources is believed to be the primary cause of this rapid growth of N₂O in atmosphere.
- However, the processes responsible for the emission and destruction of N₂O are not well constrained.

Approach:

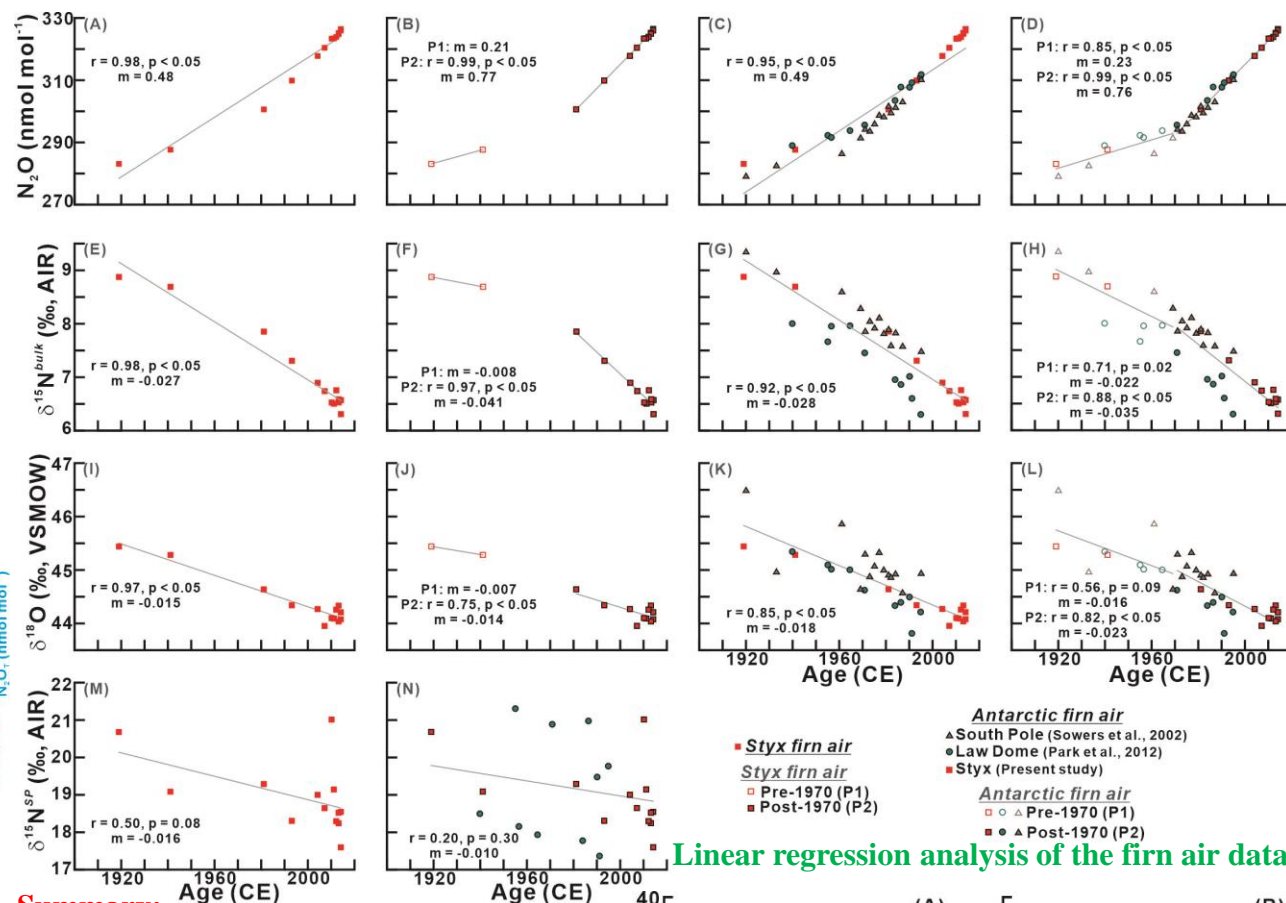
- For a continuous record over the last century, atmosphere trapped in Styx firn layers, East Antarctic has been explored.
- A two-box model (troposphere & stratosphere) has been used to estimate the total N₂O burden in atmosphere and contribution from anthropogenic vs. natural sources. Further, relative contribution from terrestrial & marine sources & from nitrification and denitrification processes.



Styx firn air data



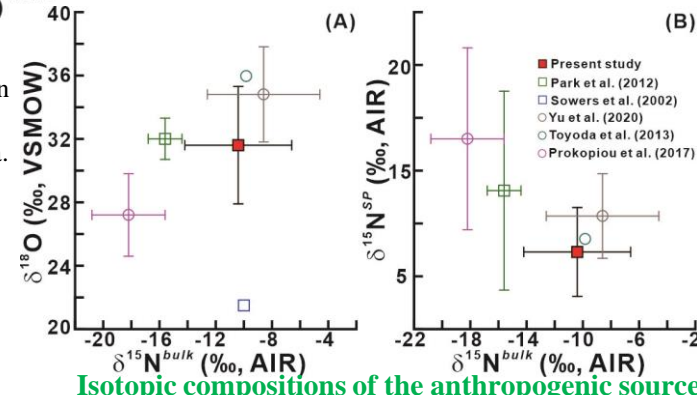
Two-box model results. F_T: total flux, F_A: anthropogenic flux, F_C: continential flux



Linear regression analysis of the firn air data

Summary:

- F_A was ca. **37.5% higher** during 2014 than 1919
- Magnitude of F_C at 2014 was ca. **43% higher** than 1919
- Emission from the **anthropogenic sources** was ca. **3.7 times higher** during post than pre -1970
- Increased use of nitrogen-based fertilizer in agricultural field regulated the global N₂O flux
- Lowering trend in δ¹⁵N^{SP} values suggests that **denitrification** was the dominant microbial processes, responsible for regulating the global N₂O emission during the 1919 to 2014



Isotopic compositions of the anthropogenic source

