Effect of maintenance liming on growing-season $\text{N}_2\text{O}$ emissions in an arable soil of SE Norway

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By liming, we could reduce mineral fertilization induced N$_2$O emissions.

Liming is usually split into bulk and maintenance application.

Bulk application is applied first to the acidic soil, and maintenance follows bulk application few years after (or moths) in order to maintain the target pH reaction of the soil.

Does this re-application of lime reduce N$_2$O emissions?
Experimental site

- SE Norway
- Boreal climate, MAAT 7°C, MAP 1083 mm
- Perennial grassland which was ploughed under in autumn 2018
- In 2014 bulk lime application, 30 t ha\(^{-1}\) marble, olivine and 24 t ha\(^{-1}\) dolomite
- In 2019 maintenance lime application 1.7 t ha\(^{-1}\) dolomite, 1.2 t ha\(^{-1}\) marble and 5 t ha\(^{-1}\) olivine
Experimental layout

- Direct comparison of CO$_2$ and N$_2$O fluxes
- Old and new limed next to each other in each plot (with only 4 min difference in time)
- Minimize spatial and temporal variability
Daily precipitation and average gravimetric water content
Soil pH

A) Dolomite

B) Marble

C) Olivine
Soil mineral N

A) Dolomite

B) Dolomite

C) Marble

D) Marble

E) Olivine

F) Olivine
CO₂ emissions

Daily average fluxes (26ᵗʰ June to 5ᵗʰ July 2019)
CO₂ emissions
Cumulated (26th June to 5th July 2019)

No significantly higher CO₂ emissions compared to control for cumulated period
N$_2$O emissions

Daily average fluxes (26$^{th}$ June to 6$^{th}$ November 2019)
N$_2$O

Cumulated emissions (26$^{th}$ June to 15$^{th}$ September)
N\textsubscript{2}O «emission threshold»

- **Dolomite**: 350 to 500 µg suppression of maintenance lime
  
  \[ R^2 = 0.094 \]

- **Marble**: 150 to 500 µg suppression of maintenance lime
  
  \[ R^2 = 0.11 \]

- **Olivine**: 350 to 500 µg suppression of maintenance lime
  
  \[ R^2 = 0.11 \]
Conclusion

- No statistical difference between bulk and maintenance lime on N₂O reduction
- Compared to control (p<0.05) both maintenance and bulk have significantly reduced N₂O emissions
- Maintenance lime suppresses the high fluxes
- No significantly higher CO₂ emissions compared to control for cumulated period and during the whole campaign, but should be repeated on bare soil
- Big potential: continuing reduction of N₂O after 5 yrs of application and highest up «just» 27% increase in CO₂
Thank you!