Geophysical Research Abstracts
Vol. 21, EGU2019-3492, 2019
EGU General Assembly 2019

Aerobic denitrification may be the pathway for N2O sink in dry and low-nitrogen soil

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Vertical profiles of N2O production and consumption within soils have not been carefully quantified and mechanism for N2O consumption also not clear. The objective of this study was to quantify the depth-dependent contributions of N2O fluxes in the soil profile to soil surface gas exchange in field and confirm the aerobic pathways for N2O consumption with incubation method.

We found that unfertilized maize-based farmland acted as N2O sinks for 2 years. N2O consumption originated from the 0–15 cm soil horizons. Specifically, we revealed that the N2O consumption at 0–5 and 5–15 cm depths accounted for 80.4 and 6.6% of the surface exchange, respectively. N2O were very weak below 40 and 15 cm depths, respectively. In conclusion, our results highlight that the topsoil (0–40 cm) plays a critical role in N2O consumption in an unfertilized maize-based farmland in Taihang mountain areas of northern China. For confirm the mechanism of N2O consumption, we extracted micro-biota from three typical upland soils with variable properties and incubated them under aerobic and anaerobic conditions, with nitrate, to investigate whether N2 production occurred via aerobic pathways and the relative importance of it when compared with the N2 production via anaerobic pathways. Our results showed that the N2 produced via aerobic pathways equated to 29–51% of that produced via anaerobic pathways. Thus N2 production via aerobic pathways may play a significant role in soil nitrogen (N) cycling, which may be the pathway for soil N2O sink.