Geophysical Research Abstracts
Vol. 20, EGU2018-570-1, 2018
EGU General Assembly 2018


# To shake or not to shake: alternative inner soil silicon tube method in $CH_4$ oxidation studies

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The laboratory incubation experiments are most common method to measure methane ($CH_4$) oxidation potential in range of soils from different ecosystems and land-use practices. However, uncertainties remain as to the way of $CH_4$ injection as well as shaking of microcosms during incubation. We proposed an alternative to a convenient microcosms' headspace $CH_4$ injection method with simultaneous shaking by the one with the delivery of $CH_4$ belowground via inner soil silicon tubes. We hypothesized (i) poor $CH_4$ solubility in water (slurry) will be overcome with the direct delivery of $CH_4$ into the soil thus demonstrate higher $CH_4$ oxidation potential if shaking is not applied; (ii) shaking of microcosms may compensate the effect of belowground $CH_4$ injection. The highest net $CH_4$ oxidation rate estimated based on 5 atom% $^{13}C$ isotope tracer was 1.6 $\mu$g C-$CO_2$ dry soil$^{-1}$ hour$^{-1}$ between the 3rd and 7th day of incubation with belowground injection and no shaking. This was 54% and 150% higher as a respective headspace injection in microcosms with and without silicone tube, respectively, thereby supporting the 1st hypothesis. As expected, shaking accelerated the rate of methane oxidation irrespectively of the injection method by 1.4-3.7 times as compared with no-shaking treatment. The cumulative methane oxidation was significantly higher in shaking microcosm than that in no-shaking microcosms at the end of incubation. However, the cumulative methane oxidation did not differ between shaking and no-shaking microcosms by using inner soil silicon tube at the end of incubation. Therefore, we conclude that direct belowground $CH_4$ injection is advantageous in the incubation experiments with static slurry, which is more relevant for the natural conditions.