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Differential response of soil CO_2, CH_4, and N_2O emissions to edaphic properties and microbial attributes following afforestation in central China

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Land use change specially affects greenhouse gases (GHGs) emissions, and it can act as a sink/source of GHGs. Alterations in edaphic properties and microbial attributes induced by land use change can individually/interactively contribute to GHGs emission, but how they predictably affect soil CO_2, CH_4, and N_2O emissions remain unclear. Here, we investigated the direct and indirect controls of edaphic properties [i.e. dissolved organic C (DOC), soil organic C (SOC), total N (TN), C: N ratio, NH_4^+-N, NO_3^--N, soil temperature (ST), soil moisture (SM), pH, bulk density (BD)] and microbial attributes [i.e. total PLFAs (Phospholipid fatty acids), 18:1ω7c, nitrifying genes (ammonia-oxidizing archaea (AOA), ammonia-oxidizing bacteria (AOB)), and denitrifying genes (*nirS*, *nirK*, and *nosZ*)] over the annual soil CO_2, CH_4, and N_2O emissions from the woodland, shrubland, and abandoned land in subtropical China. Soil CO_2 and N_2O emissions were higher in the afforested lands (woodland and shrubland) than in the abandoned land, but the annual cumulative CH_4 uptake did not significantly differ among all land use types. The CO_2 emission was positively associated with microbial activities (e.g., total PLFAs), while the CH_4 uptake was tightly correlated with soil environments (i.e. ST, SM) and chemical properties (i.e. DOC, C:N ratio, NH_4^+-N concentration), but not significantly related to the methanotrophic bacteria (i.e. 18:1ω7c). Whereas, soil N_2O emission was positively associated with nitrifying genes, but negatively correlated with denitrifying genes especially *nosZ*. Overall, our results suggested that soil CO_2 and N_2O emissions were directly dependent on microbial attributes, and soil CH_4 uptake was more directly related to edaphic properties rather than microbial attributes. Thus, different patterns of soil CO_2, CH_4, and N_2O emissions and associated controls following land use change provided novel insights into predicting the effects of afforestation on climate change mitigation outcomes.