Geophysical Research Abstracts
Vol. 18, EGU2016-16443, 2016
EGU General Assembly 2016

Effects of carbon substrate lability on carbon mineralization dynamics of tropical peat

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Extensive draining at tropical ombrotrophic peatlands in Southeast Asia has made them global 'hot spots' for greenhouse gas emissions. Management practises and fires have led to changed substrate status, which affects microbial processes. Here, we present the first data on how management practises affect carbon (C) mineralization processes at these soils. We compared the carbon mineralization potentials of pristine forest soils to those of drained fire affected soils at various depths, with and without additional labile substrates (glucose, glutamate and NO_3-N) and in oxic and anoxic conditions by dedicated ex situ experiments. Carbon mineralization (CO_2 and CH4 production) rates were higher in the pristine site peat, which contains more labile carbon due to higher input via vegetation. Production rates decreased with depth together with decreasing availability of labile carbon. Consequently, the increase in production rates after labile substrate addition was relatively modest from pristine site as compared to the managed site and from the top layers as compared to deeper layers. Methanogenesis had little importance in total carbon mineralization. Adding labile C and N enhanced heterotrophic CO_2 production more than the sole addition of N. Surprisingly, oxygen availability was not an ultimate requirement for substantial CO_2 production rates, but anoxic respiration yielded comparable rates, especially at the pristine soils. Flooding of these sites will therefore reduce, but not completely cease, peat carbon loss. Reintroduced substantial vegetation and fertilization in degraded peatlands can enrich recalcitrant peat with simple C and N compounds and thus increase microbiological activity.