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CH_4 and N_2O emissions from smallholder agricultural systems on tropical peatlands in SE Asia

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Few studies have measured GHG emissions from smallholder agricultural systems in tropical peatlands, or non-CO_2 emissions from human-influenced tropical peatlands more generally. The aim of this study was to quantify CH_4 and N_2O fluxes from agricultural landscapes on tropical peatlands in SE Asia and assess their environmental controls. The study was carried out in four peatland areas in Malaysia and Indonesia. At each site CH_4 and N_2O fluxes and environmental parameters was measured in four land use types, short rotation agricultural crops, oil palm plantation, tree plantation, and adjacent secondary/degraded forest. annual CH_4 emissions were 1.8 ± 1.2, 2.1 ± 0.8, 2.3 ± 0.4, 6.1 ± 1.2 and 105.6 ± 18.1 kg CH_4 ha^{-1} $year^{-1}$ at the degraded forest, tree plantation, oil palm, cropland and intact forest land use classes, respectively, while annual N_2O emissions were 0.6 ± 0.3, 3.3 ± 0.9, 12.5 ± 3.0, 18.0 ± 7.3 and 32.7 ± 5.8 kg N_2O ha^{-1} $year^{-1}$ at the intact forest, tree plantation, degraded forest, oil palm and cropland land use classes, respectively. CH_4 emissions were strongly determined by WTD following an exponential relationship with production of CH_4 starting when annual WTD was above –25 cm. By contrast, N_2O emissions were strongly correlated with TDN, following a log-normal relationship. The optimum TDN concentration for N_2O production was 10 mg N L^{-1} and beyond this threshold, the availability of mineral N was no longer limiting the N_2O production, with other environmental variables such as WTD, soil water content, and temperature becoming more important. The new emission factors for CH_4 and N_2O presented here should be included in country level GHG inventories to improve their accuracy. The strong impact of substrate supply on N_2O emissions shows that fertilisation practices strongly impact net emissions suggesting that policies that result in reduced fertilisation rates can directly cut emissions.