

An intensive field study on CO₂, CH₄, and N₂O emissions from soils at four land-use types in Sumatra, Indonesia

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Abstract

We measured gas fluxes of carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) from the soil surface to the atmosphere under various land uses in Sumatra, Indonesia, from September 1997. Four land-use types, i.e., old-growth forest, logged-over forest, burned site after logging, and rubber plantation site, were selected. One logged-over forest was clear-cut and burned in the middle of the experiment. An incubation experiment was also performed to measure the potential of these three gases' emissions by using intact soil cores. The ranges of flux for 1 year for CO₂, CH₄, and N₂O were 51.3–93.7 mg C m⁻² h⁻¹, -21.2–4.2 μg C m⁻² h⁻¹, and 0.74–26.34 μg N m⁻² h⁻¹, respectively. The N₂O and CO₂ fluxes were among the smallest values in all tropical regions. Clear-cutting and burning of residual trees after logging caused an increase in N₂O emissions. N₂O emissions correlated highly with the nitrification rate at 0–10 cm soil layer ($R^2 = 0.7834$, $p < 0.01$). CH₄ fluxes correlated with the clay content of 0–10 cm soil layer ($R^2 = 0.6071$, $p < 0.15$). The results of flux measurements and core incubation strongly suggest that the regeneration of vegetation reduces the impact of land-use/cover changes on trace gas emissions.