**Linking Nitrous Oxide and Nitric Oxide Fluxes to Microbial Communities in Tropical Forest Soils and Oil Palm Plantations in Malaysia in Laboratory Incubations**


## ABSTRACT

Current understanding of greenhouse gas (GHG) fluxes associated with land-use change from forest to oil palm on mineral soil is not sufficient to provide reliable estimates of emission rates or advice on GHG mitigation strategies. Monocultures of oil palm have expanded in Southeast Asia, mostly replacing tropical forests. The limited data available have indicated that the land-use conversion is associated with a potentially aggravated GHG burden, including nitrous oxide (N2O) and nitric oxide (NO) emissions, with unclear underlying biological mechanisms. In this study, we investigated N2O and NO emission potentials of tropical soils with different land-uses from Sabah, Malaysian Borneo, under laboratory incubation. Under similar controlled conditions, logged forest and oil palm soils showed high and similar potentials of N2O and NO emissions following increase in soil moisture, while the emissions were negligible in a riparian reserve soil irrespective of moisture conditions. Soil N2O and NO emission rates from logged forest soils and oil palm (OP) plantations were of similar magnitude, with average fluxes over the 35 and 22 day incubation periods, respectively, of 11.5 and 1.6 ng N g−1 h−1 (OP) and 15.6 and 6.0 ng N g−1 h−1 (logged forest). Contrarily, the riparian reserve soil did not respond to rewetting and nitrogen application and fluxes were negligible. Furthermore, N2O fluxes were on average about 10 times higher than NO fluxes. The fact that forest soils also have the potential to emit large amounts of N2O and NO, has important implications for land-use change scenarios in the tropics, especially as some scenarios suggest atmospheric N deposition is likely to drastically increase in tropical regions due to biomass burning, increased N-fertilizer use and fossil fuel consumption. Quantification of related gene transcripts implied that Proteobacterial *nirS* and AniA-*nirK* (betaproteobacterial clade of *Neisseria*) containing denitrifiers might continuously contribute to the N2O emissions, while the nitrifiers (ammonia oxidizing archaea in this study) are conditionally active to produce N2O. This study therefore provides some evidence for N2O and NO emissions associated with phylogenetically diverse groups of microorganisms, which might be of importance in modulating the GHG emissions under different land-uses and field conditions.