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Modelling N_2O emissions from tropical rainforest soils worldwide: from measurements to an global inventory

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Tropical forest soils have been identified to be - after agricultural soils - the most important terrestrial source for atmospheric N_2O. N_2O emissions from tropical rainforest soils to the atmosphere are estimated to range between 2.2 - 3.7 Tg N yr^{-1}. This is equivalent to 17 - 24% of the total atmospheric N_2O budget. Being a significant source for N_2O, tropical rainforest soils are also dominantly functioning as sinks for atmospheric CH_4. Furthermore, estimates suggest that tropical broad-leaved forest are the major source within the compilation of ecosystem specific soil derived CO_2 emissions accounting for approximately 30%. Currently only empirical estimates based on a limited number of field measurements are available to estimate the exchange of the mentioned gases between tropical ecosystems and the atmosphere and large uncertainties are obvious. Mechanistic models coupled to GIS databases are therefore seen as an option to account for the observed temporal and spatial variability in N_2O emissions and to assemble regional to global fluxes of soil N_2O emissions based on the underlying processes. In order to further improve the estimates we conducted high-resolution measurements of trace gas fluxes from tropical rainforest soils in Western Kenya and Southwest China using automatic and manual sampling devices. In conjunction with literature data the findings were used for a further validation and improved parametrization of the PnET-N-DNDC model for tropical forest ecosystems. By coupling the model to a GIS database holding all necessary environmental variables of tropical rainforest areas worldwide (e.g. soil properties, biomass and weather data) a global inventory of annual N_2O emissions from tropical forest soils was calculated for different years. We found a general agreement of the simulated flux ranges with reported N_2O emissions published in the literature. According to our simulations,

tropical rainforest soils are indeed a significant source of atmospheric N_2O but the source strength varies considerably in the tropical belt. Furthermore, our simulation results revealed a pronounced interannual variability which was found to be mainly driven by regional soil water availability.