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A new method combining soil oxygen concentration measurements with the quantification of gross nitrogen turnover rates and associated formation of N_2O and N_2 emissions

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Climate change and the expansion of land use have led to significant changes in terrestrial ecosystems. These include changes in the biogeochemical cycle of nitrogen and therewith implications for biodiversity, water cycle and pedosphere-atmosphere exchange. To understand these impacts detailed research on nitrogen turnover and fluxes are conducted at various (semi-) natural and managed ecosystems in the Mt. Kilimanjaro region. In this context, we execute 15N tracing analyses on soil samples in our stable isotope laboratory including a new experimental setup. The soils were sampled from different forest ecosystems of Mt. Kilimanjaro varying in altitude (1600 – 4500 m) and will be analyzed for gross rates of ammonification and nitrification, gross rates of microbial inorganic N uptake as well as for the gaseous losses of $^{15}N_2$ and $^{15}N_2$O using $^{15}NH_4{}^+$ and $^{15}NO_3{}^-$ tracing and pool dilution approaches. Since nitrogen turnover of nitrification and denitrification is dependent on soil oxygen concentrations we developed an incubation method which allows to adjust soil samples to different oxygen concentrations. For this purpose, soil is incubated in glass bottles with side tubes to ensure a constant gas flow over the whole incubation time. To adjust the oxygen levels in the laboratory experiment as close as possible to the natural conditions, we started to monitor soil oxygen concentrations with a FirestingO_2 Sensor (Pyroscience) connected to a timer and a datalogger (MSR 145 IP 60 E3333) at a Mt. Kilimanjaro rainforest site. The equipment is complemented with soil temperature, moisture and pressure sensors (MSR 145 IP 60). A solar panel connected to an energy source guarantees a working time for over 2 years by a measuring frequency of 20 seconds each 30 minutes. The new laboratory incubation method together with in-situ oxygen concentration measurements in soils will facilitate laboratory incubations with realistic oxygen concentrations and thus will allow for a better understanding of temporal variability of nitrogen turnover rates and associated gaseous losses.