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Denitrifier communities in tank bromeliads and prospected N2O emissions from tank substrate upon increasing N-deposition

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It is well known that tropical rainforest soils with total emissions of 1.34 Tg N/yr from the tropics, play a significant role in the global N2O emissions scenarios. Significant contributions were reported particularly for tropical rainforest soils in South and Central America due to the large areas covered by rainforest in this region. In tropical rainforests of the Americas tank bromeliads constitute a prominent group of plants and were shown to significantly contribute to the production of the greenhouse gas methane from tropical forests. It is, however, essentially unknown whether and how bromeliads may contribute to the production of N2O, another important greenhouse gas. It is also unknown whether N2O emissions relate to atmospheric N-deposition and whether an increase in emissions is to be expected upon the prospected increase in N-deposition. We studied the propensity of tank substrate of the bromeliad Werauhia gladioliflora to emit N2O and how this potential is related to the underlying denitrifier communities. In tropical forests of Costa Rica Werauhia gladioliflora is very abundant with 9.85 specimen m-2. Incubation of the tank substrate with increasing amounts of fertilizer to reflect predicted N-deposition scenarios resulted in proportionally increasing net N2O production. Based on the abundance of Werauhia gladioliflora we estimated annual emissions of 395 μg N2O-N m-2 day-1 for N-deposition levels to date which is in the range of tropical soils. At a surplus of N 70% of N2O produced were not reduced leading to accumulation of N2O which agreed well with the finding that 95% of the denitrifiers detected lacked a gene encoding a N2O-reductase and are therefore unable to reduce N2O to dinitrogen. Generally, denitrifiers were highly abundant and ready to denitrify immediately after provision of a nitrogen source because carbon is non-limiting in tank substrate. Our results suggest that tank bromeliad substrate may be a significant source of N2O in neotropical forests and that with prospected increasing future N-depositions annual N2O emissions might increase.