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Refining the paradigm of N cycling in temperate rainforests in southern Chile

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Old-growth forests ecosystems in southern Chile represent the largest reserve of pristine temperate rainforest in the world. These forest ecosystems maintain a high productivity of bio-available N, while simultaneously minimizing N losses. To understand the biogeochemical functioning of these ecosystems a process based insight into the responsible mechanisms is required. Moreover, this will also allow predicting potential susceptibility to changing environmental conditions.

A ^{15}N tracing study, including six labeling treatments (combinations of ^{15}N labeled NO_3^-, NH_4^+ and NO_2^-), was performed under controlled laboratory conditions. Gross N transformation rates were quantified with a ^{15}N tracing model in combination with a Markov Chain Monte Carlo optimization algorithm. In a second experimental step, the modeled N transformations were validated in the field via a ^{15}N pulse chase experiment over a one year time period. These experiments were carried out in an evergreen *Nothofagus betuloides* forest in Puyehue national park, southern Chile.

The results showed that this pristine rainforest could retain vast amounts of dissolved inorganic N (DIN)in the long term (1 year). DIN immobilization reactions mainly occur into soil organic matter (SOM) or into hydrophobic dissolved organic N (DON), an organic N-pool showing a high sorption affinity. N-losses from this ecosystem were low because total nitrate production was extremely low. We found that heterotrophic

nitrification (oxidation of recalcitrant organic N to nitrate) dominated ($>$95%) total NO_3^- production. The produced NO_3^- is reduced to NH_4^+ via disimilatory nitrate reduction to ammonia (DNRA), making DNRA a significant NH_4^+production pathway. Further it was indicated that hydrophilic DON losses did not originate from DIN turnover. Hydrophilic DON flows are controlled by soil dynamics that operate independent of DIN turnover. Finally, our results showed also a functional link between autotrophic NH_4^+ oxidation to NO_2^- (nitritation) and NO_2^- "detoxification" via gaseous N production and condensation reactions.