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Nitrogen cycle inferred by δ15N in larch stand in northern Mongolia

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Mongolia represents the southernmost border of boreal forests and therefore is more sensitive to climate change. In boreal regions forest grow under N-limited conditions and for this reason rely on ectomycorrhizal fungi for the uptake of inorganic and dissolved organic N from the soil solution. A drastic increase in air temperature and a decrease or almost no change in summer precipitation has led to a severe climate induced drought that is expected to impact the nitrogen cycle in this region. Until now there has been no study on the nitrogen dynamics and especially not by means of stable isotope in the entire Eurasian boreal forests. Thus, in this study we evaluate the effect of spatial and climatic characteristics on the soil-tree N exchange in three representative larch forest stands (Larix sibirica) in the forest-steppe zone of central Mongolia.

The results showed significant differences in the soil available N content and the influence that this difference exerts on the level of N fractionation from roots to leaves. In this study we observed heavier d15N in fine roots than in short roots (where the ectomycorrhizal fungi is attached) which was used as a proxy for soil available d15N. This value did not match total N d15N in any of the three sites selected for this study even though total N d15N has been used in previous studies as a proxy for available N d15N. Higher fractionation was observed in forest stands where available N was more limited indicating a heavier reliance on ectomycorrhizal fungi for inorganic N uptake. Coincidentally, the site with less available N was the southern site with the lowest precipitation. The opposite was found in the northern sites where available N was higher and thus fractionation showed lower values. Different tree tissues (fine and short-roots, stem, leaves) and litter showed multiple, intra-plant processes that influenced the isotope signal of the source-sink nitrogen dynamics.