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On the variation and trends of nitrogen isotope composition in tree rings: the potential for fingerprinting climate extremes and bushfires

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Purpose Climate extremes, such as droughts and floods, have become intensified and more frequent due to intensifying climate change. Increased atmospheric carbon dioxide (CO2) and warming-induced water limitation, as well as climate extremes, may alter carbon (C) and nitrogen (N) cycling in forest ecosystems. This provides a brief review of stable nitrogen

isotopic composition (δ15N) in tree ring in relation to climate extremes and bushfires in context of N availability and losses in forest ecosystems.

Material and methods Tree rings were extracted from four *Pinus sylvestris* and four *Larix gmelinii* sample trees, located in a boreal plantation forest of Mohe City, Heilongjiang Province, China. Tree rings were measured to obtain mean annual basal area increment (BAI), while tree ring δ15N and total N concentrations were measured on mass spectrometer at 3-year intervals. The tree ring δ15N data were related to possible climate extremes and bushfires. A brief review of the relevant literature was also undertaken to support our preliminary research findings.

Results and discussion Globally, increasing atmospheric CO2 concentration and water limitations have led to a warmer-drier climate. This has also been associated with increases of climate extremes such as drought and floods as well as bushfires. These extremes have been recorded with detrimental effects on plant and soil structures within forest ecosystems and play an important role in regulating N availability and losses in forest ecosystems. Studies of N deposition within forest ecosystems using soil and plant δ15N also showed that N losses under various climate extremes can occur through direct changes in N cycling, such as increasing soil nitrification and denitrification or leaching. It is highlighted that tree rings δ15N has the potential to fingerprint the intensity and frequency of climate extremes and bushfires in the forest ecosystems, but more such tree ring δ15N research needs to be done in diversified forest ecosystems to confirm the potential of using tree ring δ15N for quantifying the frequency and intensity of climate extremes and bushfires at both regional and global scale.

Conclusion The variation and trend of δ15N in the soil–plant-climate systems are closely linked to the N cycling in forest ecosystems, and tree ring δ15N has the great potential to fingerprint both intensity and frequency of climate extremes such as drought and floods as well as bushfires.