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Edaphic control of site-related variations in tree-ring nitrogen isotopes in French beech forests

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Understanding the causes of inter-site variations in wood nitrogen isotopic composition (d15N) is a prerequisite before being able to use this indicator in the time domain, as a bioindicator of past changes in the ecosystem N cycle. Few studies explored the patterns and causes of d15N variations over more than 10 sites. And most of these studies were conducted along very large, continental, transects, where vegetation types and species changed between sites. Here, we study the causes for such inter-sites variations in a network of 75 adult beech (Fagus sylvatica) stands in northeastern France. The sampled sites covered a wide range of edaphic conditions, both in terms of nutrient and water availability, under a homogeneous climate. d15N was measured in pools of 35 rings (6 trees x 7 years) mixed together for each of the 75 sites, after removing the most mobile nitrogen compounds by a short duration extraction. Inter-tree, within site variation was also explored in a subset of 9 sites. Wood inter-site d15N variations were analyzed by statistical comparison with a large set of soil, leaves and stand measurements made in same plots: nutrient and isotopic content (d15N and d13C) of soil and leaves, soil nitrogen potential mineralization and nitrification, soil water availability, stand productivity, vegetation community composition. It appears that wood d15N is a potentially less efficient indicator of site characteristics than leaf d15N because it is more prone to inter-tree (intra-site) variability. Variations in wood d15N correlated very poorly with soil potential mineralization or nitrification. On the other hand, they were significantly related to soil acidity conditions and, more unexpectedly, to water availability. The causes and consequences of these links will be discussed.