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Impacts of drought events on the biogeochemical cycles of a temperate beech forest.

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In the coming decades, forest ecosystems will face more intense and frequent soil drought events due to climate change. To adapt forest management to limit risks of forest decline, it is of great importance to identify the impacts such events will have on medium/long term.

Among the many studies in forest ecosystems dealing with drought events, we observed a lack of information about their impact on biogeochemical cycles, i.e., the permanent circulation of nutrients between the different components of the ecosystem. This nutrient circulation is essential for the good functioning of forests, however it can be impacted by low water availability. In fact, nutrient cycling (i.e. content, stock, flux...) can be affected through different processes within the forest ecosystem, such as a lower mineral weathering or organic matter mineralization in soil, a lower root uptake capacity, a lower foliar leaching, etc. All these effects modify the global biogeochemical cycles.

On the experimental site of Montiers located in Meuse (France), studies on natural and experimental drought events carried out on a sixty years old beech forest, have highlighted some impacts on biogeochemical cycles. The case of potassium (K) is particularly interesting as its cycling is impacted at different levels. In fact, a study of natural drought events showed that the foliar leaching of K is lower in drought conditions, reducing its return to the forest floor and its availability for trees for the next growing season. In addition, a 5 years drought-induced experiment has shown that repeated and intense drought events can create a K deficiency in beech trees. This deficiency is the probable cause of the increased sensitivity of trees to drought and the mortality increase observed on the site. This K deficiency is currently explained by an intrinsic sensitivity of this ecosystem, as it is located on a shallow soil with limited water reserve but also limited K reserve due to low stock in K-bearing minerals (i.e., limestone bedrock). Periods of intense stress like drought events are therefore highly susceptible to break the fragile balance of the K within the ecosystem.