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A design of a 3D printed Zero Tension Lysimeter for tracing percolating water and Dissolved Organic Carbon in soil forests in Belgium

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Future climate conditions involve increased temporal rainfall variability, with both increased intensity and increased frequency of high rainfall events. These changes lead to an intensification of the hydrological cycle, with higher runoff flows in the wet periods and stronger dry-out of the soils during the longer drought periods. Such alterations in precipitation patterns will cause large changes in the carbon balance of forests. In particular, hydrological conditions are the main driver of Dissolved Organic Carbon (DOC) leaching, both on intra-annual and inter-annual timescales. Longer periods of drought, and occasional strong precipitation events, could cause a more event-driven carbon export from soils through DOC losses. The importance of dissolved and gaseous export under different precipitation regimes remains largely unexplored, partly because of technical constraints to accurately measuring dissolved export fluxes, and partly due to a strong focus on greenhouse gas balances in current research infrastructures.

We have designed a leaching water collector also called Zero Tension Lysimeter (ZTL), 3D printed, which has specific characteristics that have been improved thanks to the experiences of previous studies. The ZTL has been designed to collect the percolating water at different depths with the objective to quantitatively trace the movement of DOC in the soil, without the need to model soil water drainage. This ZTL has been installed in two different ways, to study the consequences of the disturbance caused by the installation.

As the goal of the research is to study the effects of altered precipitation regimes on DOC leaching, different manipulation experiments will reproduce expected-future climate phenomena, such as strong droughts followed by heavy rain events. Also during and after those experiments water will be collected and analysed for DOC content.

Amount of water added, amount of water collected and analysed at different depths, temperature, soil moisture and soil respiration will be measured in every experimental plot. Measurements will be used to reconstruct the water cycle at two Belgian ICOS forest sites: Brasschaat (Pinus sylvestris) and Vielsalm (Fagus sylvatica and Pseudotsuga menziesii), allowing us to couple the DOC results with forest phenology and climate. This will enable us to assess whether a shift is likely to occur in gaseous vs. DOC losses with changing rain regimes.