FICHE PROJET

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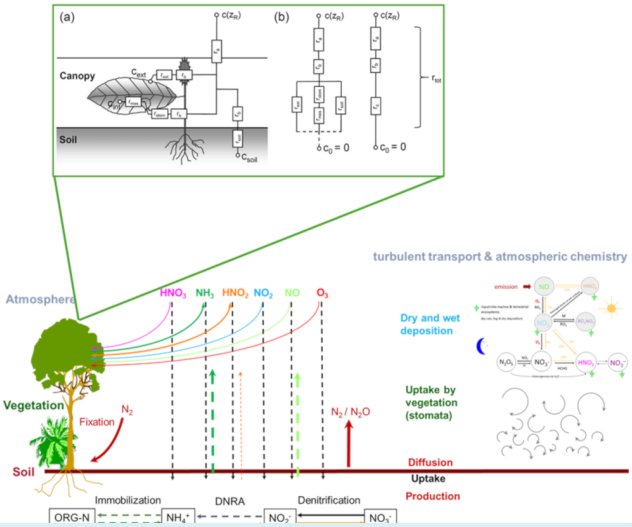
FORFUS-RT2.2

PhD project on the relationship between drought and the atmospheric deposition of pollutants to forests, part of the "Forest function under stress" doctoral training unit (FORFUS)



Inspiration

The dry and wet deposition of atmospheric nitrogen (N) in forests causes acidification, plant damage, nutrient imbalance, soil microbial community changes, and loss of biodiversity. The increase in the frequency and intensity of droughts and heatwaves will decrease the resilience of forests to cope with toxic atmospheric inputs (e.g. ammonia (NH_3) and ozone (O_3)). Dry deposition fluxes of reactive N and O_3 are controlled by foliar uptake. This implies that they are linked to transpiration and photosynthesis through stomatal uptake and release, which are the result of supply-demand interactions (net radiation, atmospheric dryness and soil moisture) and the ecophysiological response of trees.

Innovation

The main objective is to explore the signatures of stress episodes on the diurnal and seasonal variability of O_3 and NH_3 dry deposition fluxes to better understand the coupling between foliage responses and reactive trace gas fluxes in relation to supply-demand interactions.

The influence of biophysical characteristics (e.g. epicuticular processes) on the exchange fluxes and budgets will be analysed at various timescales. The doctoral candidate will combine existing state-of-the art field data sets on NH_3-O_3-CO2-H_2O fluxes, determined by the eddy covariance and aerodynamic gradient methods, with the application of big-leaf resistance models and drought indices under various meteorological conditions. Data science methods will be used to identify interacting variables contributing to uptake resistances and drought signatures in the exchange fluxes. This will be complemented by field experiments to monitor the partitioning between dry and wet deposition and their dependency on the frequency of droughts and heat stress episodes in Luxembourg, and to assess the interactive effects of changing air quality and climate on N deposition budgets and partitioning.

Impact

The increase in the frequency and intensity of droughts and heatwaves due to climate change will decrease the resilience of forests to cope with toxic atmospheric inputs. The scientific knowledge generated in this project will help to develop adapted forest management strategies with improved survival chances under future climate and atmospheric pollution conditions in Luxembourg. The understanding and methods developed as part of the project are expected to be useful for similar studies at different sites around the world, and will strengthen our ability to understand, anticipate and prevent drought and pollution-related forest decay.

Partenaires

Administration de la nature et des forêts (LU) , BOKU (AT) , Center for International Climate Research , Delft University of Technology (NL) , Groupement des Sylviculteurs a.s.b.l (LU) , INRAE (FR) , Luxembourg Institute of Socio-Economic Research (LU) , Musée national d'histoire naturelle Luxembourg , National Institute of Statistics and Economic Studies (LU) , Swedish University of Agricultural Sciences (SWE) , The National Institute for Public Health and the Environment (NL) , Université Catholique de Louvain (BE) , University Göttingen (DE) , University of Tartu (EE) , University of Naples (IT) , University of Trier (DE) , University of Edinburgh (UK) , University of Agriculture Krakow (PL)

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