EGU25-3518, updated on 23 Apr 2025
https://doi.org/10.5194/egusphere-egu25-3518
EGU General Assembly 2025

A comprehensive database for evaluating the impact of contrasting agricultural systems on soil water dynamics and agrochemical leaching

Clémence Pirlot, Caroline De Clerck, and Aurore Degré
University of Liege, Gembloux Agro-Bio Tech, Water-Soil-Plant Exchanges, Belgium (clemence.pirlot@uliege.be)

Understanding the temporal evolution of soil hydraulic properties is critical for improving agricultural sustainability and adapting to climate change. These properties drive water and solute movement, but most studies and models overlook their temporal variability, leading to poor decision-making. Furthermore, many studies focus on specific practices or surface soil layers, neglecting deeper horizons. To address these gaps, a long-term database has been established as part of the Agriculture Is Life for Water Quality project to monitor soil water dynamics, soil structure, and agrochemical leaching under innovative agricultural systems designed for sustainable production.

This database is part of the *EcoFoodSystem* project, a 16-year initiative comparing four contrasting systems with long-term 8-year rotations. These systems align with EAT-Lancet recommendations and were implemented in November 2020 to assess their compatibility or competition in terms of food security, agronomic, and environmental objectives:

- **A reference rotation** integrating livestock through flows of by-products and manure, with two variants: herbicide-only and no pesticides.
- **An integrated crop-livestock rotation** with intercrops and temporary pastures for ruminants as functional tools for pest and weed control, managed without pesticides.
- **A vegan rotation**, simulating agriculture without livestock and manure, to reflect a "zero flow" scenario.

These systems are implemented on eight loamy plots in the first and fifth years of rotation at the Faculty of Gembloux Agro-Bio Tech (ULiège, Belgium). The set-up includes 24 Teros 12 soil moisture sensors and 24 Teros 21 soil potential sensors at 30, 60, and 90 cm depth, connected to ZL6 data loggers for real-time monitoring. Soil solution sampling plates at 120 cm collect data on agrochemicals leaching. Intact soil cores are taken every three months to track bulk density and porosity, enabling the quantification of alternative practices' impacts on soil structure and nitrate, pesticides and metabolites leaching.

After four years (2021-2024), results highlight significant variations in soil water retention influenced by crop diversity, weed control, residue management and contrasting climatic

conditions, such as the 2021 floods or the 2022 drought. Different drying dynamics and resilience to climatic extremes were observed under some practices, demonstrating their potential to enhance water retention (Pirlot et al., 2024). Nitrate leaching showed seasonal patterns, with higher concentrations following fertilisation and residue incorporation, particularly in rapeseed plots. While parent pesticides were rarely detected at 1.2 m depth in the reference rotation, metabolites of previously applied pesticides persisted and gradually declined.

This database provides valuable insights into the temporal dynamics of soil hydraulic properties, soil structure and agrochemical leaching under contrasting systems. By monitoring them at multiple depths and over time, the database supports the development of sustainable practices to optimise soil water retention and manage nitrate pollution. These data can also refine models to improve their predictive accuracy. This resource is a critical tool for assessing the transition to sustainable agriculture, addressing challenges such as climate resilience, food security and environmental protection. The poster will present the database and how it can be accessed by the scientific community.