"Faidherbia-Flux": a collaborative observatory for Ecosystem Services and GHG balance in a semi-arid agro-silvo-pastoral system (Senegal)

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Tree sap flow & Root Hydraulic Redistributions:

7 Fa trees (in a range of sizes) were equipped with 65 TTD sap flow systems in the trunk (azimuthal and radial sampling), the tap and lateral roots and 20 pairs of thermocouples for direction and zero flow assessment. The goals are to quantify tree transpiration and to study root hydraulic distributions from the soil water table to the superficial layers and assess if trees uplift deep water and nutrients for the crops. Leaf water potential and girth growth is assessed on the same trees.
Do et al., 2022

Eddy Covariance for CO_2, H_2O and energy balances:

We set up 3 eddy-covariance towers above (i) the whole mosaic ecosystem (20m), (ii) millet (3m) and (iii) peanut (3m) and monitored energy, CO_2 balance and evapotranspiration since 2018, Rahimi et al., 2021, Lembrechts et al., 2020 and 2022.

Deep roots turnover and decomposition:

Six deep (8m) pits were dug down to the water table and equipped with automatic root scanners and minirhizotrons to monitor the tree and crop root growth, according to soil depth and distance to trees. In addition, crop and tree roots decomposition was studied with litterbags in pits (Siegwart et al., 2022).

Drone (UAV) & yield estimation:

We scanned the plots with VHR drone flights in visible, multispectral and thermal IR bands at 5 dates and during 5 years. Drone images confirm higher yield below or close to Fa trees, with at least 30m of influence. A simple model based on NDVI allowed to draw a plot yield map and to estimate the plot yield, Roupsard et al., AGEE (2020). In parallel, remote sensing is applied at the landscape scale (Leroux et al., 2020, 2022)

Soil GHG balance:

8 automatic gas chambers were installed in the plot under the trees or far from the trees and connected to a Picarro 5 gas analyser (CO_2, H_2O, N_2O, CH_4, NH_3). Soil respiration and plant photosynthesis are monitored all year long and GHG balances are performed. The same display was replicated in a savanna in the Ferlo. Duthoit et al., 2020.

Infiltration, vegetation cover and ecohydrology:

20 PVC tubes of 6 m depth have been set up into the soil along a toposéquence of 250 m according to the micro-topography and the Faidherbia: 10 piezometers follow hourly the static level of the phreatic aquifer (range -5 to -3m) and 10 tubes for the soil humidity survey are scanned by a TDR. The soil infiltration is measured with the automatic BEST method. Soil water balance is modelled with Hydrus 1-D. Faye et al., 2020; Diongue et al., 2022.

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