DM-TropAFS

Climate impact of tropical agroforestry. From local Data to global Models.

ABSTRACT

This proposal aims to open the way to large-scale simulation of the climate change mitigation potential of agroforestry systems (AFS) by setting a proof-of-concept. Agroforestry is identified as a nature-based solution to the climate crisis based on a multitude of local and diverse experiments. Yet, little is known on the large-scale potential of AFS to tackle climate change. The main reason for this is the gap between AFS ecosystems' complexity and variability and the modeling methods of the climate community and its Land Surface Models (LSM) relying on surface homogeneity hypotheses. In this project, we will focus on the Faidherbia parklands as a proof-of-concept tropical AFS to include horizontal and vertical heterogeneity in the ORCHIDEE LSM. First, we will upgrade the Faidherbia-flux observatory with equipment adapted to measure the microclimate under the canopy and in the open to provide validation data for the model. In the meantime, we will build a database of the main tropical agroforestry types to be described in the model with their parameters, locations, calibration and validation data. Then we will develop the model with two parallel objectives. We will parameterize the model to represent the Faidherbia AFS by setting ecophysiological parameters for Faidherbia and its associated crops pearl millet and peanut. We will merge into the model a multi-layer energy budget to calculate the vertical distribution of heat fluxes and a multi-tiling approach for plant types in an AFT to share the water column and the energy budget.
These developments will lead to the first validation of a global land surface model applied to AFS and pave the way to the evaluation of the large-scale climate potential of AFS, of relevance to inform climate and SDG policies.

Keywords : Agroforestry, Model, Carbo, Water, Energy, Senegal, Costa-Rica

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GOAL

Despite meta-analysis collating local studies from around the globe, the bridge from local data to large-scale modeling is still wide open and prevents the upscaling of AFS knowledge crucial for AFS to play its part on the climate change agenda. To this regard, global land surface models (LSM) have a lot of potential but are limited by the lack of adequacy between the AFS' complexity and their own homogeneity hypotheses. The goal of this project is to build upon plot-level AFS data to include key features of agroforestry systems in a global LSM. While model developments will be focused on implementing and testing key missing processes for our proof-of-concept Faidherbia parklands

ecosystems, AFS data will be gathered both at local and global scale to prepare for future extension to other AFS. This project will thus pave the road for a process-based assessment of the climate impact of agroforestry practices.

ACTION

WP1 : Data-mining for AFS modeling
WP2 : Model developments for proof-of-concept AFT