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## 30th Conference on Agricultural and Forest Meteorology/First Conference on Atmospheric Biogeosciences

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Using the MAESTRA model to simulate light interactions and photosynthesis in a heterogeneous agroforestry system under alternative density and pruning practices

Press Room (Omni Parker House)

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Coffee-based agroforestry systems display two heterogeneous plant layers (shade tree and coffee) both discontinuous, uneven-aged and subjected to sequential pruning. Many field experiments in coffee agroforestry research have been implemented to evaluate the impact of agricultural practices on coffee production, such as shade level, pruning management or planting density. Modeling the light interception by shade and coffee trees is a promising option to evaluate different scenarios and select some management alternatives. Due to the spatial and temporal complexity of the agroforestry system, we hypothesized that a three-dimensional individual tree process-based model such as MAESTRA was adapted to simulate light interactions and photosynthesis. To our knowledge, MAESTRA has not been tested in agroforestry applications yet. MAESTRA was parameterized here according to field inventories and other structural measurements (leaf area per tree, leaf angles, etc.), and the photosynthesis submodel was parameterized using leaf scale gas exchange measurements. The simulations of light interception (absorbed photosynthetically active radiation, APAR) and photosynthesis (Gross Primary Productivity, GPP) were verified using direct measurements at plant and plot scales.

The experiment took place in the Central Valley of Costa Rica within the Coffee-Flux platform located in the Rainforest Alliance certified, 6 km<sup>2</sup>, 1 000 m altitude, Aquires coffee farm. The climate was tropical humid with no dry season. The studied coffee plantation (Coffea arabica cv. Caturra) was grown under low density, free-growing, Erythrina poeppigiana shade trees. Coffee pruning practices was a coppice selection system type which resulted in an uneven-aged population of resprouts (1 to 6 years old). The main results presented in the paper are:

- 1) a successful validation of APAR and photosynthesis simulated by MAESTRA at the scale of coffee plants with measurements performed in situ using a transient-state whole tree chamber;
- 2) a successful validation of modeled APAR and GPP at plot scale with in situ eddy-covariance measurements;
- 3) a comparison of plot APAR and GPP under different realistic scenarios, after varying shade trees densities, and pruning practices for coffee.

Supplementary URL:

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