The CAFNET/Coffee-Flux project: evaluating water, carbon and sediment Ecosystem Services in a coffee agroforestry watershed of Costa Rica

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CIRAD[1], CATIE[2], INRA[3], Aquiares farm[4], ICE[5]



***Photo 1**: Arabica coffee agroforestry watershed in the Aquiares farm (Costa Rica), below Erythrina poeppigiana shade tree*

⇨1. Aims of the CAFNET/Coffee-Flux Project

"Coffee-Flux" is a sub-project of CAFNET (EuropAid/121998/C/G): "Connecting, enhancing and sustaining environmental services and market values of coffee agroforestry in Central America, East Africa and India". It was launched in December 2008 in Costa Rica by Cirad, CATIE, PCP and the Aquiares farm. The aim of Coffee-Flux is to assess the water, sediment and carbon **E**nvironmental **S**ervices (ES) at the scale of a coffee agroforestry coffee watershed. Experimentation, modelling and remote-sensing are combined. Coffee-Flux is a contributor to FLUXNET (http://daac.ornl.gov/FLUXNET/). The platform is wide open to new projects, scientists and of course to students.

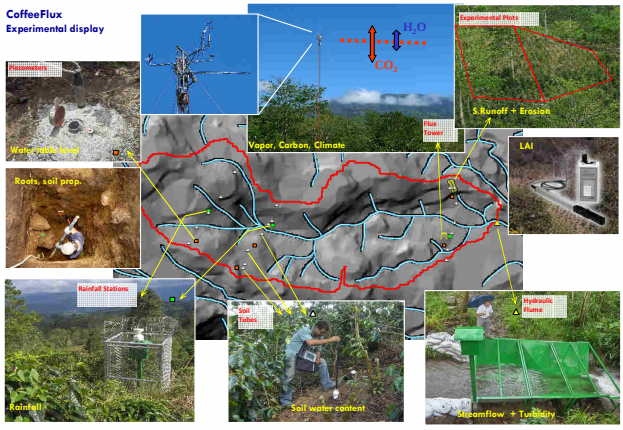


***Photo 2**: The Coffee-Flux experimental display*

⇨2. Site and infrastructure description

A 1 km^2 coffee watershed, homogeneously shaded with tall *Erythrina poeppigiana* was selected in Aquiares, one of the largest coffee farms of the country, "Rainforest" certified, located on the slopes of the Turrialba volcano, ranging from 1,020 up to 1,280 m.a.s.l., strongly influenced by the climatic conditions of the Caribbean hillside, and without strong dry spell. The watershed is instrumented with automatic flumes, pluviometers, soil moisture probes, piezometers, turbidimeters, sapflow and eddy-covariance tower (for H_2O and CO_2 gas fluxes).

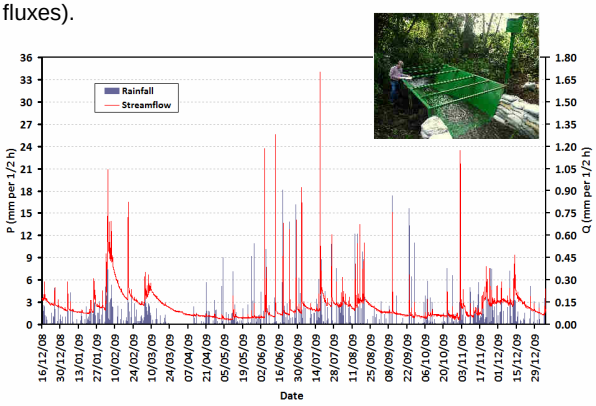


***Fig. 1**: The red line is the time-course of streamflow at the outlet of the watershed (automatic flume), showing a large contribution of the baseline (aquifer responding in terms of discharge and recharge) + episodic and rather low contribution of superficial runoff (peaks after rainfall events, in blue). This behaviour is typical of watershed with large infiltration capacity, low superficial runoff and probably low laminar sediment transport*

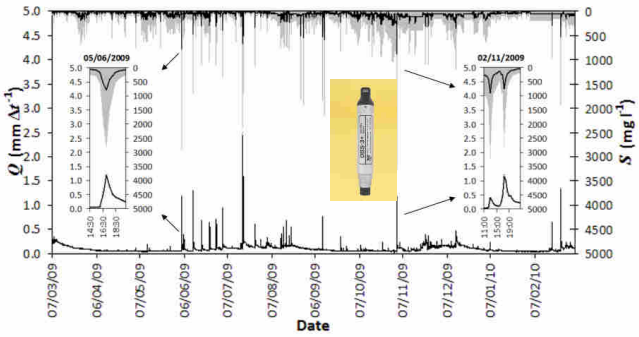


***Fig. 2**: Streamflow Q and suspended sediment concentration S (black lines, measured with automatic OBS-3 probe (photo) and calibrated) in the experimental basin for the one-year measurement period. A 95% confidence interval (grey region) is displayed around the estimated values. Average annual sediment yield is < 1 t ha^{-1}. Source Gómez-Delgado et al., AEE 2010, in prep.)*

⇨3. Results: monitoring the environmental services

Hydrological service: Coffee-Flux is monitoring and modelling the water balance partitioning (rainfall, interception, superficial runoff, infiltration, sapflow, soil water balance, evapo-transpiration, aquifer fluctuations and total streamflow), and the sediment yield from plot to watershed. Also georadar and ^{18}O isotopic tracing experiments are underway.

Carbon service: Coffee-Flux is monitoring the Net Primary Productivity (NPP: tree + coffee growth and mortality) above and below-ground (minirhizotrons), the Gross Primary Productivity or (GPP = ecosystem photoynthesis), the ecosystem + soil respiration and the Net Ecosystem Exchange (NEE) which is the ecosystem C balance, using combined eddy covariance and growth+litter monitoring

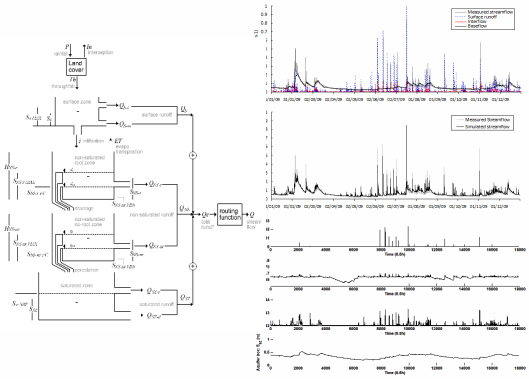


***Fig. 3**: Structure and simulations of the lumped Hydro-SVAT model for the water-balance partitioning of the Coffee-Flux watershed (Gómez-Delgado et al., HESS 2010, in revis.)*

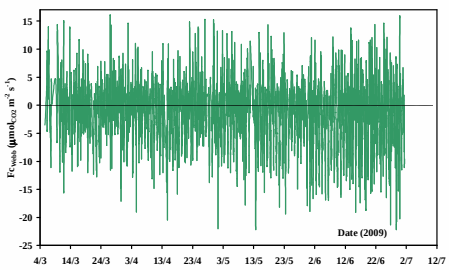


***Fig. 4**: Time-course of carbon net ecosystem exchange, and its partitioning into night C emissions (positive values) and C uptake (photosynthesis + respiration, negative values). One cycle is one day.*

⇨4. Availability of *Coffee-Flux* for collaborations:

The philosophy is to concentrate several investigations on one specific site and for a few years, to share a useful common experimental database, to develop modelling and to publish results in highly-ranked scientific journals. *Coffee-Flux* is a platform with infrastructure, easy access from CATIE and good security conditions, ready to welcome complementary scientific investigations and collaborations. The project is wide open to complementary projects, scientists and of course to students.

⇨Web site: http://www.montpellier.inra.fr/ecosols/recherche/projets_de_recherche_finances/coffeeflux; **email: roupsard@cirad.fr**

Collaborators

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