



FluxLetter

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Highlight FLUXNET site Puechabon

Experimental Site of Puechabon, South of France
by Laurent Misson

History- In 1984, pioneer researchers François Romane started long-term ecological studies in a *Quercus ilex* forest next to the village of Puechabon near Montpellier, south of

system that could extract water at more than 5-m depth. *Quercus ilex* is a strong terpenoid emitter, with VOC production accounting for 1 to 2% of GPP. This species covers millions hectares

attracted many researchers for decades.

First, studies at Puechabon focused on forest structure, biogeochemical cycles and post-disturbance recovery. In the



Photo 1: General view of the experimental site of Puechabon

France (Photo 1). *Quercus ilex* forests have been long ago considered as a paradigm for Mediterranean ecosystems growing on hard limestone karstic soils. It's a highly adapted species to unpredictable environments characterized by long summer droughts, storm events acting as resource pulses, and strong and frequent disturbances such as fire. *Quercus ilex* life history-strategies include some of the most prominent found in such ecosystems: it's an evergreen species with thick sclerophyllous leaves; it has a diffuse-porous wood of high density providing resistance to cavitation; and it's a resprouter allocating vast amount of reserve carbohydrates to an overdeveloped root

around the Mediterranean sea. As such it's a fascinating research subject and the functioning of *Quercus ilex* ecosystems have

early nineties, with questions concerning global change arising, detailed functional studies started to understand the effects of climate on the vulnerability of



Photo 2: Flux tower at Puechabon

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Mediterranean forests. With the 1997 Kyoto protocol, European countries have been committed to report precise carbon accounting. Since 1998, Puechabon is one of the reference sites of the European network for measurements of carbon and energy exchanges between the atmosphere and the land surface, through the Medeflux (1998-1999), Carboeuroflux (2000-2004), and Carboeurope-IP (2004-2009) projects. In 2003, several manipulative experiments started with the MIND project financed by the European Union. Rain exclusion and thinning were applied to study the effects of changing precipitation amounts and management practices on forest-atmosphere carbon and water exchange. These experiments culminate in 2007 with a new project testing the effects of extreme seasonal drought in spring and fall on the vulnerability of Mediterranean forest ecosystems (Drought+ project, French National Research Agency).

Infrastructure- The infrastructures at Puechabon include several experiments. First, an eddy-flux tower and two meteorological stations record CO₂, water and energy fluxes between

the forest acted as a net carbon sink of -250 g C m⁻² yr⁻¹. Extreme events such as spring droughts (2005, 2006), insect-induced canopy defoliation (2005), and in a smaller propor-

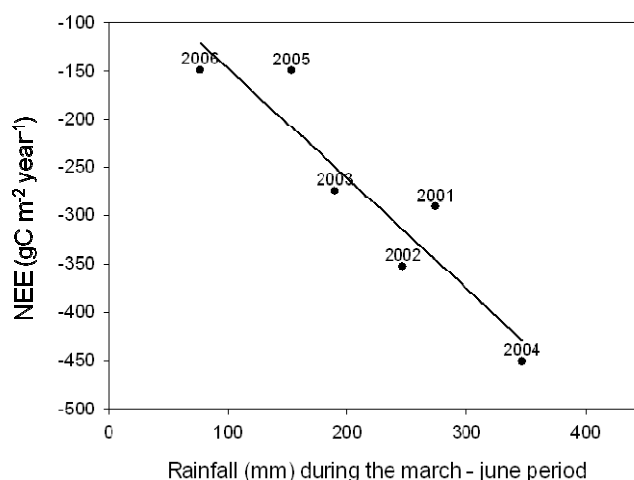


Figure 1: Relation between ecosystem annual NEE sum and rainfall during spring (March to June)

the atmosphere and the forest continuously since July 1998 (Photo 2). A new paper reports analyzes of seasonal and annual variation of carbon exchange (Allard et al. 2008). On average

tion the 2003 heat-wave, have the effects of greatly reducing this sink capacity (Fig. 1).

Second, a series of long-term continuous manipulative experiments started in 2003. These included 4 treatments: a control, a throughfall exclusion, a thinning, and a throughfall exclusion x thinning treatment. Throughfall exclusion was achieved using gutters under the canopy, with the aim to exclude 30% of the throughfall continuously (Limousin et al. 2008) (Photo 3). Thinning reduced the basal area by half. Scaffolds allow researchers to have access to two levels in the canopy for ecophysiological measurements of sun and shaded leaves (Photo 4).

Third, in 2007 a new manipulative experiment has been

“The database includes long-term ecological data on forest growth, above-ground and belowground biomass, regeneration, litterfall, functional traits and phenology”

designed to simulate the effect of an extreme climatic event on the functioning and the vulnerability of this ecosystem. A rainfall shelter was installed above the canopy in order to simulate extreme drought seasonally (Photo 5). The rainfall shelter is mobile and move on two 60-m rails that are 15-m apart. Four plots are defined: an early drought plot on the south side (spring drought) and, a late drought plot on the north side (fall drought), a standby plot in the middle, and a control plot nearby. The roof will stay over the standby plot when it is not raining to avoid disturbing the



Photo 3: Continuous rain exclusion experiment: control and dry plot



Photo 4: Second level of the scaffold in the continuous rain exclusion experiment

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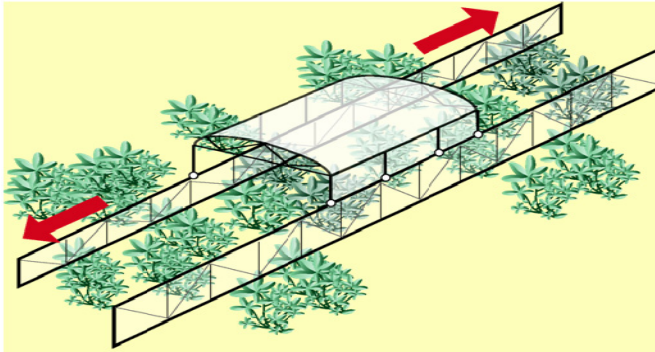


Photo 5: Mobile rainfall shelter for simulation of seasonal drought (DROUGHT+ project)

micrometeorology of the drought plots.

Data- The database at Puéchabon is huge and goes back to the 1980's. It includes long-term ecological data on forest growth, aboveground and belowground biomass, regeneration, litterfall, functional traits and phenology. Data on the main biogeochemical cycles include eddy-covariance CO₂ fluxes, soil and organ-level gas exchange data. Measurements for the

water cycle include all the main fluxes, the top soil water content and discrete measurements of soil water storage across 5-m depth since the 1990's. Dry and wet nitrogen deposition started in 2007 as a companion site of the NitroEurope UE project. Organs, soil and litter chemistry and biochemistry have been described semi-continuously. Detailed ecophysiological data and organ level VOC emission

have been measured discontinuously since the 1990's.

For further information see:

<http://www.cefe.cnrs.fr/fe/puechabon/index.htm>

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Literature

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Photo 6: Puechabon team