
AOI ECCOREV 2014

LINKING CO_2 AND H_2O FLUXES WITH GROWTH AND XYLEM CONDUCTIVITY IN MEDITERRANEAN ECOSYSTEMS

Axe de rattachement 2 : Vulnérabilités des écosystèmes terrestres et aquatiques		
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Global change will likely trigger major changes in plant functioning, forest productivity and distribution (Boisvenue & Running, 2006; Heimann & Reichstein 2008; Lenoir et al., 2008), and will greatly affect regional water resources (García-Ruiz et al. 2011). For this reason, it is crucial to properly understand how plants will modify their functioning in response to temporal variability of climate and to the interaction of climatic factors with other biotic and abiotic factors.

The general objective of this project was to investigate how carbon allocation to the tree bole to secondary growth relates to ecosystem productivity and associated CO_2 fluxes. This was achieved by developing a collaboration with different laboratories, some within ECCOREV (INRA, Avignon; IMBE-CRNS, Aix; and CEFE-CNRS, Montpellier). The project relied from data already existing from monitoring stations including measurements of CO_2 fluxes. Additionally, dendrochronological field data was collected and lately processed at the laboratory in IMBE. With these data combined, we achieved our objectives by developing a process-based model on two different evergreen Mediterranean species (Figure 1). We could develop the model by profiting of these multiproxy data and successfully modeled carbon and water fluxes within these forests. Particular emphasis was put to analyze temporal long-term variability of forest functioning, including acclimation to water stress of different functional traits. We fulfilled different objectives included in the original proposal including:

(i) Increasing the understanding on the role of Mediterranean forests on carbon and water fluxes and the relation between forest performance, distribution and climate;
(ii) Modeling the relationship between carbon allocation to the stem to build the xylem architecture in response to variability in transpiration and climate;
(iii) Analysing the mechanistic relationship between photosynthesis, transpiration and carbon allocated to annual growth through the use of a mechanistic model specifically developed to be used with dendrochronological data.

The results of this project focus on two sites. It constitutes the first step towards a bigger project in which we currently expand the analysis performed to the regional level with a greater spatio-temporal scale. G. Gea-Izquierdo currently develops this research and the ECCOREV project has helped him to find funding (from the Spanish National Science Foundation) to continue developing his scientific career. With this research we will

generate projections of species response to global change with special emphasis on the increase of water stress expected for the Mediterranean Region and the negative impact that this climatic change might have on the transformed landscape encountered in the region. The model developed and the multiproxy methodology used to calibrate the project has been shown to be a useful tool both for researchers to understand ecosystem response to global change but also to managers as a tool to project forest development in a changing world. We have also provided complementary information that helps to understand evergreen Mediterranean forest functioning under climate change.

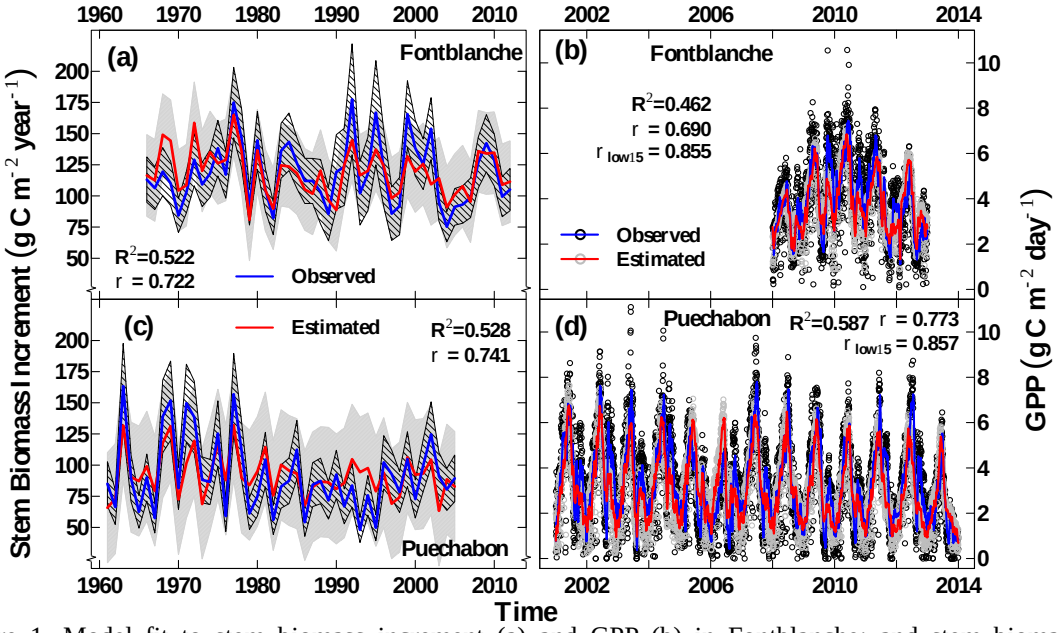

Figure 1. Model fit to stem biomass increment (a) and GPP (b) in Fontblanche; and stem biomass increment (c) and GPP (d) in Puechabon. R2=coefficient of determination; ρ=linear correlation between estimated and observed data, ρlow15=linear correlation between estimated and observed data smoothed with a 15 year low-pass filter (blue and red lines in (b) and (c)). Polygons behind the estimated values in (a) and (c) correspond to confidence intervals of the mean: solid grey polygons for estimated values and dashed polygons for observed stem biomass increment values.

Production related to the project

Publications

Gea-Izquierdo G, Guibal F, Joffre R, Ourcival J-M, Simioni G, Guiot J. 2015. Modelling the climatic drivers determining photosynthesis and carbon allocation in evergreen Mediterranean forests using multiproxy long time series. Biogeosciences 12, 3695-3712.

Communications to international conferences

Gea-Izquierdo G, Guibal F, Joffre R, Ourcival JM, Simioni G, Guiot J. Modelling the climatic drivers determining secondary growth in Mediterranean forests using a process-based model