*AGU 2013 American Geophysical Union's 46th annual Fall Meeting. San Francisco, California, December 9-13, 2013*
*SESION: EP023. Using Predictive Models to Inform River Management and Restoration*

# Predicting the impact of water demand and river flow regulation over riparian vegetation through mathematical modeling

Alicia Garcia-Arias[(1)], Cecile Pons[(2)] and Felix Frances[(1)]

*1: Research Institute of Water Engineering and Environment, Universitat Politècnica de València, Spain. (algarar2@ upv.es)*
*2: École des Ponts Paris Tech, Marne-la-Vallée, France*.

The vegetation of the riversides is a main part of the complex riparian ecosystems and has an important role maintaining the fluvial ecosystems. Biotic and abiotic interactions between the river and the riverbank are essential for the subsistence and the development of both ecosystems. In semi-arid Mediterranean areas, the riparian vegetation growth and distribution is especially controlled by the water accessibility, determining the limit between the lush riparian bands and the sparse upland. Human intervention can alter the river hydrology determining the riparian vegetation wellbeing and its distribution and, in consequence, affecting both riparian and fluvial ecosystems. Predictive models are necessary decision support tools for adequate river management and restoration initiatives. In this context, the RibAV model is useful to predict the impact of water demand and river flow regulation on the riparian vegetation. RibAV is able to reproduce the vegetation performance on the riverside allowing the scenarios analysis in terms of vegetation distribution and wellbeing.

In this research several flow regulation and water demand scenarios are proposed and the impacts over three plant functional types (PFTs) are analyzed. The PFTs group the herbaceous riparian plants (HRV), the woody riparian plants (WRV) and the terrestrial vegetation (TV). The study site is the Terde reach at the Mijares River, a 539m length reach located in a semi-arid Mediterranean area in Spain. The scenarios represent river flow alterations required to attend different human demands. These demands encompass different seasonality, magnitude and location. The seasonality is represented as hydroelectric (constant all over the year), urban (increased during the summer period) and agricultural demands (monthly seasonality). The magnitude is varied considering the 20%, the 40% and the 80% of the mean daily flow. Two locations are considered, upstream or downstream the study site. To attend the demands located downstream, different volumes of a theoretical upstream reservoir are analyzed. In these scenarios the dam operation is determined by the demands and the reservoir capacity.

The criterion for the PFTs absence/presence prediction is based in the Water Use Efficiency paradigm and an evapotranspiration index ($E_{idx}$) that relates each PFT actual and potential evapotranspiration. This $E_{idx}$, allows in addition the analysis of each scenario impact on the vegetation wellbeing by comparison to natural conditions.

The results show that upstream human water demands (constraint flow scenarios) favor the extinction of a part of the riparian vegetation, its replacement by terrestrial vegetation and the limitation of the remaining riparian vegetation wellbeing. Downstream demands supplied by upstream dam operation (altered flow regime scenarios) tend to favor the riparian plants increasing slightly their presence and improving, at least maintaining, their wellbeing in the short term.