

Street ecohydrology: A project to study street tree water use strategies and their consequences for managing tree cooling effects

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Key Words

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Summary

Water availability is widely recognized as being an essential factor for tree survival, growth and for maximizing their ability in mitigating urban heat islands (UHI) through evapotranspiration. In areas where urban trees are not regularly irrigated and impervious surfaces reduce precipitation infiltration in soils, trees may face an increased water stress. It is also generally predicted that trees in urban sites have higher water losses than trees in natural forests due to increased evapotranspiration. As there have been few studies on transpiration of urban trees, there is currently insufficient data to generalize the physiological responses of trees to the complex urban environment, especially water stress and its effects on tree health, and their consequences on ecosystem services such as UHI mitigation. To further investigate these issues, we are implementing a project that will span from December 2014 to November 2016 and that will use street tree plantations in Paris, France, as a case study using a pluridisciplinary approach. The project is structured as follows.

In the first work-package (WP1), the age of 80 street *Tilia tomentosa* Moench, selected along an 1-70 year chronosequence, will be estimated using core samples and the health situation of each tree will be visually assessed according to the « Visual Tree Assessment », analysis in temporal dynamics of non-structural carbohydrates and a Picus® acoustic tomograph. Current water stress will be assessed by heat sap flux measurements. The water stress history of trees will be studied through $\delta^{13}\text{C}$ signature in tree-rings, which will provide an estimate of tree water-use efficiency (WUE) at intra- and interseasonal scales. The chronosequence design will enable a comparative approach of trees of different ages, which will be used to assess whether chronic water stress is influenced by tree age and climate history.

In the second work-package (WP2), tree water-use strategies will be investigated. First, the diversity of potential water sources will be assessed using $\delta^{18}\text{O}$ signature at different time-scales. Then, the hypothesis that trees take advantage of night lighting to modulate the circadian patterns of photosynthesis will be tested during an intensive one month field campaign. Stomatic conductance and water potential will be measured as a proxy of photosynthetic activity and leaf content of proline and abscisic acid will serve as a proxy for stress. Potential modulation of evapotranspiration will be estimated from heat sap flux measurements.

In the last work-package (WP3), the effect of irrigation on tree health and cooling effect of individual trees will be studied. In a field experiment, an irrigation system will be implemented on sites selected on the basis of the results of WP1 and WP2. The experiment will show whether irrigation improves tree health and tree cooling effect.

The proposed poster will outline the project and detail the employed methods and sample design. It will also provide the first results of WP1 that will have been already acquired by June 2014.