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Spatial and temporal variations of water balance components due to a bottomland hedgerow

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Wooded linear structures in general, and hedgerows in particular, were formerly very abundant in the European landscape, but have undergone a considerable decline in their density in the past decades, before being stabilized. Currently, we observe locally an increase due to the multiple advantages offered by these structures and the effect of agricultural policies. The aim of the present study was to quantify spatially and temporally the impact of an oak hedgerow (Quercus robur) on the various terms of the water balance. This study was carried out at the plot scale by focusing on aspects related to water transfer in the soil and aquifer. From the results obtained on a local scale, we proposed a functional scheme that allowed us to represent the role of hedge trees in water cycle. In this study, groundwater level and soil-water potential were monitored continually at various distances from the hedgerow along two 28 m length transects, at a spacing of 10 m, enabling us to obtain fine-scale information on the functioning of the soil-groundwater system. We evaluate tree transpiration from sap flow density measurements.
Functional scheme were proposed illustrating the role of hedgerow, which can then be used for integrating the impact of the hedge trees into hydrological models. For the period when oak trees had their leaves (leafed period), the determining processes that need to be represented are the rainfall interception, tree transpiration and capillary rise. Other terms of the water balance, such as drainage, are directly affected by the presence of the hedgerow. Drainage is strongly reduced under the hedgerow, and decreases significantly at a certain distance from the hedgerow, when capillary rise increased under the hedgerow and decreased far away.
Our results show that the impact of a bottomland hedgerow on water balance components can be highly variable according to the climatic conditions. Hedge tree transpiration increased for a wet year when soil-water content is not limited and can exceed the potential evapotranspiration. Spatial and temporal variations of water balance components is highly related to climatic conditions
Such research suggests that the impact of the destruction of the wooded linear structures on the water cycle and water resources had been underestimated. Moreover, these results support the urgent need to improve hydrological models to predict the impact of climatic changes on water cycle by including the impact of land use and land cover.
Keywords: spatial and temporal variations, climatic context, hedgerow, water balance, transpiration, drainage, capillary rise.