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Evapotranspiration of a maritime pine forest estimated by eddy covariance and sap flow methods

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Forests extend over large areas and therefore have a major contribution to total energy and mass fluxes. Many studies have been conducted to evaluate these exchanges. However forests have often been considered as a whole and the contribution of the understorey has rarely been separated from the forest canopy, whereas the fluxes from the bottom layers may constitute a significant part of the overall forest fluxes.

In this study CO_2 and water vapour fluxes were measured above and below a maritime pine forest canopy in South West of France. The understorey is mainly constituted of *Molinia coerulea* (L.) Moench grass and represents up to 40% of the total leaf area index. Since 2001 fluxes have been measured by eddy covariance at 7 and 41 m above ground. Sap flow measurements have also been performed continuously on 8 trees, simultaneously to the flux measurements, over a total of 3 years.

The aim of the present study is twofold: (i) compare sap flow measurements with the difference in turbulent fluxes as measured from the two levels, (ii) quantify the relative contribution of the trees and the understorey to the overall evapotranspiration.

The time changes in transpiration, as estimated from sap flow and eddy covariance measurements respectively, appear qualitatively similar. However the sap flow method, based on an initial estimate of the sapwood area, turns out to underestimate by at least 40% the tree transpiration deduced from eddy-correlation measurements. The latter therefore provide a means to calibrate the sap-flow technique. The data analysis shows that the understorey canopy is responsible for a variable part of the water vapour exchanges between the forest and the atmosphere, depending on the climatic conditions and the phenological and physiological status of the two components of the ecosystem. It may be as large as 50% during periods with significant soil water deficit.