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Water table as a relevant source for water uptake by a Scots pine forest : evidences from a one-year monitoring of water fluxes in the soil-plant-atmosphere continuum.

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The forest tree vegetation, because of its longevity, high biomass turnover and high evaporative capacity, has a great influence on the water and element cycling : it can transpire about 80 % of the potential evapotranspiration under high evaporative demand. Besides its influence on the hydrological cycle and surface water movement, forest vegetation can also absorb and recycle a considerable amount of nutrients as well as of radionuclides (Thiry et al., 2000 ; Goor and Thiry, 2004) when compared to the soil bioavailable pool. On that basis, and to contribute to the construction of a lumped biosphere model for large scale performance assessment in a deep disposal scenario, we measured the water fluxes and ecophysiological variables such as roots density and Leaf Area Index (LAI) in a Scots pine stand during the 2005 growing season. One particular task was to identify the sources of water used by trees (precipitation *vs* groundwater) by calculating differences between cumulative precipitation and cumulative actual transpiration at daily and seasonal time scale. Effectively, the stand is installed on a podzol with a shallow water table (50 cm deep in winter) which demonstrates strong seasonal fluctuations within the rooted zone.

The stand evapotranspiration (ET, evapotranspiration of pines and understorey and rain interception) was measured from mid-April to mid-November and reached 540 mm, which represents 75 % of potential evapotranspiration (PET). The pine trees transpiration (T) contributed to 20 % of ET. This was calculated from sapflow measurements monitored every 30-min. Besides a 3.5 week period with no rain in June, no

strong transpiration limitation was observed : a very good correlation between T and PET was found. Still, the pines did not respond greatly quantitatively : daily transpiration never exceeded 1.6 mm and T/PET was always below 0.20. This is partly explained by the strong competition induced by the well developed understorey (pine maximum LAI was 4.5 and the understorey LAI was 3). By the use of a closed chamber, understorey evapotranspiration (ETu) was measured. It reached values of 2.6 mm in summer and was estimated to contribute to 33 % of stand ET. To understand better the sources of water used by the vegetation, soil volumetric water content measurements and water table level measurements were performed continuously. The water uptake from the soil horizons was calculated from those measurements and compared to the transpiration results. It was proved that from mid-April to mid-November, the water table contributed to 26 % of the stand transpiration fluxes. During the drought period in June, it contributed to 99.6 % of the water use by the forest. Moreover, strong correlation between hourly pines sap flow and water table daily variations were found. Those results suggest a strong relationship between forest functioning and soil water and will be used to implement a coupled water-elements-biomass model for further radionuclides uptake estimation in a deep disposal scenario. An example of valorization of theses results will be showed by the calculation of the stable chloride uptake by the forest through the 2005 growing season.