Influence of soil type and precipitation level on the water balance in a forest ecosystem

G. KIRCHEN*[1], P-O. REDON[2], A. GRANIER[3], M-P. TURPAULT[1]

[1]BEF-INRA, Centre de Nancy, 54280 Champenoux, France
(* correspondence : gkirchen@nancy.inra.fr)
[2]Andra, Centre de Meuse/Haute-Marne, 55290 Bure, France
[3].EEF-INRA, Centre de Nancy, 54280 Champenoux, France

At constant vegetation cover and under same climate, the soil type has a strong influence on water cycling in the forest ecosystem. The objective of this study is to evaluate the impact of much contrasted soils (their water holding capacity ranging between 84 and 177 mm) on the water balance of a beech forest over contrasted years (the annual precipitation ranging between 875 and 1338 mm) by water balance modelling.

The experimental site of Montiers corresponds to three plots of different soil types (Rendzic Leptosol, Eutric Cambisol and Dystric Cambisol) under an equivalent stand (same age and same management). Each plot consists of three replicates equipped with bulk precipitation, throughfall and stemflow collectors to sample the aboveground solutions. Soil moisture was measured daily in each soil layer by TDR probes at several depths. Meteorological data were measured on a nearby meteorological station. The rooting profiles, physicochemical properties and water retention curves of the studied soils were determined.

The results displayed the impact of vegetation on water fluxes, the forest canopy intercepting 15% the mean annual precipitation and tree transpiration representing >30% of incident precipitation during the leafed period. This study also showed that the decrease of soil water reserves during summer was accentuated in the dry year; water stress duration was of 83 days in the deepest soil and of 106 days in the shallowest soil. The bedrock colonization by roots in the shallow soil could be an adaptation to this water stress. The water balance model BILJOU implemented in our study allowed to quantify drainage fluxes below each experimental plot and to estimate the depth at which root water uptake takes place throughout the year.

The opportunity to monitor water fluxes over contrasted years permits to anticipate the behavior and the adaptation of such forest ecosystems faced to changing climatic conditions.