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Hydrology and variability of soil properties and tree characteristics on a forested slope : Methodology

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Introduction

On a forested catchment, structural and hydrodynamic properties of soil as tree characteristics vary spatially and temporally. Some of the relations explaining this variability are misunderstood. For example, the slope influences these characteristics but is used imperfectly in many models. With climate change it seems really interesting to predict water fluxes and availability with a hydro-forestry model taking into account these variations.

Objects

This study aims to characterize, understand and conceptualize along a slope :

- the vertical and the horizontal heterogeneity of physical characteristics of a forested soil.
- the water flow repartition within the horizons.
- the forest growth characteristics.

Finally, the variability will be included in a physical hydrological model.

Location

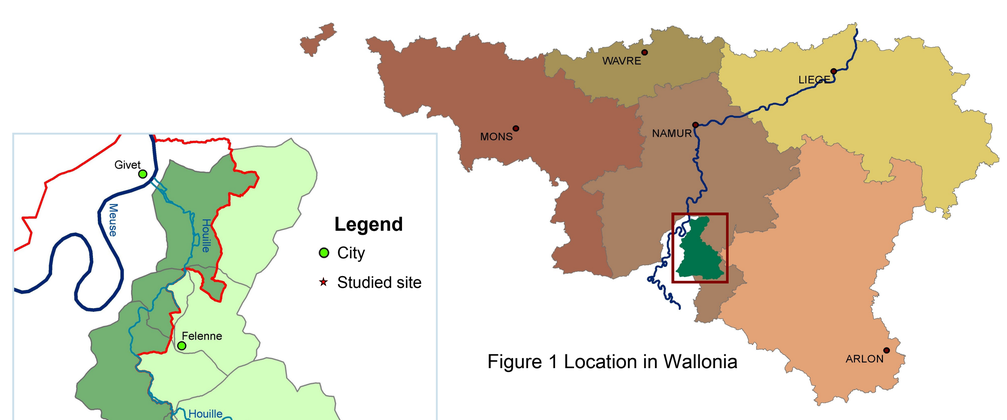

Figure 1 Location in Wallonia

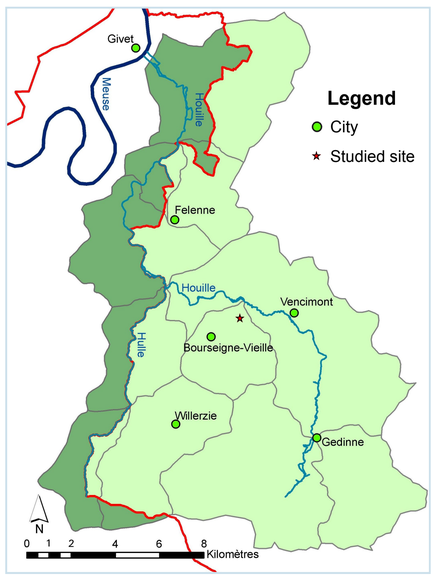

Figure 2 Location on Houille catchment

Figure 3 Douglas stand fir

The studied site is located in the Western Belgian Ardenne, in the Houille catchment under a Douglas fir stand (*Pseudotsuga menziesii* (MIRB.) FRANCO) (Figures 1, 2 and 3). The catena is 170 meters long and the average slope is 25%. The soil is quite stony and shallow (between 20 and 70 centimeters depth)

Material and methods

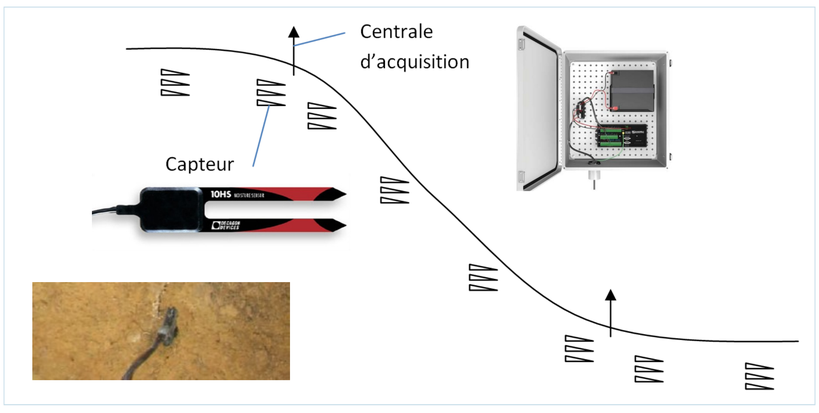

Figure 4 Slope instrumentation

The determination of the slope effect on soil vertical and horizontal heterogeneity involves soil sampling along this slope. Structural and hydrodynamic properties (e.g. infiltration rate, porosity, granulometry) will be measured for each soil layer.

Soil moisture will be recorded for eight places on the slope (Figure 4). Depending on soil depth and layers, two or three capacitive sensors will be placed by plot. Some TDR sensors will complete the instrumentation.

Each sensor has to cover the maximum of pedological and topographical variability.

To characterize the water flow repartition within the horizons in the bottom of the slope we will carry out a dye tracing test. An experimental devices collecting subsurface water from each soil layer will be implemented down the slope (Figure 5). The dye will be applied to the surface at the top of the slope.

Figure 5 Dye tracing experimentation

Figure 6 Hemispherical picture and stem core

We will describe the variability of the forest cover along the slope by measuring tree characteristics. Leaf Area Index will be evaluated from hemispherical picture for different periods of the year. We will also take stem samples for a dendrochronologic study, and measure stem circumference.

The collected data will serve to improve a physical hydrological model by integrating the slope effects on the soil properties, the water fluxes and the tree characteristics.

Prospects

Such a model would improve water resources modelling and help water management. From the point of view of the climate change, it would e.g. determine the best adapted species to each forest site.