Geophysical Research Abstracts
Vol. 17, EGU2015-7372, 2015
EGU General Assembly 2015

Stand age, tree location and depth impacts on the hydrophobicity of forested dune soils

Richard Walsh, Iain McCreath, Mike Ogden, and Paul Hallett

University of Aberdeen, Institute of Biological and Environmental Sciences, Aberdeen, United Kingdom (paul.hallett@abdn.ac.uk)

The hydrology of a forest is one of the key mechanisms needed for its productivity. Paradoxically, biomass from forests such as decomposing needles and soil micro-organisms, may result in hydrophobic substances that impede water flow and decrease water retention. At the same time, the decomposition of plant biomass may alter soil pore structure to improve flow and retention of water. Although water repellency has been widely reported in boreal forests, including in unlikely locations in northern maritime climates, the effect of stand age and soil location in relation to trees has not been investigated. In this study it was hypothesised that water repellency would increase with stand age, and would be greater at the interface between the litter layer and soil than in the subsoil or the litter layer itself.

Measurements were conducted with soil from Culbin Forest, which is located on the northeast coast of the UK. The forest was planted in phases, starting over 100 years ago, as a means to stabilise eroding sand dunes that were initially highly hydrophilic. Soils were sampled from the litter layer, at the interface between the litter and sand and in the subsoil at locations under the tree, in the drip line and outside of the tree. Field replicated areas planted with Scots Pine in 1888, 1925, 1969, 1992 and 2000 were selected to provide a chronosequence. A series of tests were carried out both in the field and the laboratory to determine the influence that the age of Scots pine trees have on the water repellency of the soil. These included the water drop penetration test and infiltration measurements within the field, while a modified Wilhelmy plate test and capillary rise measurements were measured in the laboratory.

The soil was found to possess non-significant water repellency features within the field, likely due to high water content levels of the soil at the time of testing. But after drying, the soil was highly water repellent. The contact angle or repellency did not display any significant difference between stand ages (P=0.347; P=0.393). There was a difference between the repellency (P=0.001) of the different soil depths but not the contact angle (P=0.142), with the repellency index mean for organic material of 1.75, interface of 2.43 and sand of 2.17. The distance from the tree also did not display any significant differences between contact angle (P=0.898) with the mean advancing contact angle for the organic material 97°, interface layer 92° and the sand layer of 89°. The Scots pine did contribute to influencing water repellency through the build-up of an organic layer which constrained water retention properties.