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Branching Out

2018

from the Canadian Forest Service - Laurentian Forestry Centre

Forest soils: so important, yet so misunderstood

Forest soils represent a major carbon pool across the globe. Forest management and climate change can alter the size of this carbon pool, but the effects of these alterations remain misunderstood and difficult to foresee. With that in mind, researchers with the Canadian Forest Service (CFS) have developed a new experimental set-up. The goal is to document the effect of variations in the quantity and sources of vegetation biomass on the dynamics of organic matter in soils, including carbon sequestration and the availability of nutrients for plants. More specifically, this experimental set-up will help clarify questions concerning the sustainability of forest biomass harvesting for energy purposes.

A network spanning over half a century

In 2016, a team of technicians, biologists, and researchers from the forest soil laboratory of the CFS's Laurentian Forestry Centre established a DIRT (Detrital Input and Removal Treatments) research set-up near the city of Québec. The site was selected for its uniformity (approximately 30-year-old plantation of white pine, flat topography, and little undergrowth). Thus, the homogeneous characteristics of the area would interfere very little with the treatments undertaken, enabling researchers to detect the most minor of changes. This experimental set-up is part of the international DIRT network, which includes numerous set-ups established around the world since 1956 in various climates and ecosystems (https://dirtnet.wordpress.com/).

The set-up comprises 32 plots, which are spread out randomly. Measuring 240 x 180 cm, each plot is divided into 12 subsections (60 x 60 cm). The first sampling activities are set for 2020. The soil of nine of the plots will undergo destructive sampling, at the rate of one quadrat every 5 years. Two quadrats will be used for soil gases and water sampling, while the last quadrat will be kept in reserve.

Brief description of the set-up

Location
The CFS's Serge-Légaré Arboretum is an experimental sector used for the establishment of experimental set-ups to conduct research on forest genetics

Average temperature
4.2°C

Average precipitation
900 mm rain and 303 cm snow

Bioclimatic domain
Basswood-sugar maple forest

Collaborators
Researchers with the CFS's Great Lakes Forestry Centre and Canadian Wood Fibre Centre, Oregon State University, University of Michigan, Allegheny College, and University of Toronto

Photos: NRCan

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An array of treatments

In order to study the different variables that have an impact on soils, researchers apply various treatments to the 32 DIRT plots.

	Treatment and description	Objectives
	**Double litter** All sources of aboveground litter (leaves, needles, twigs, fruits) are doubled using the litter intercepted in another treatment.	Understanding the importance of aboveground litter as a source of organic matter for soils. Documenting the impact of variations in the quantity of aboveground litter. This variation can be caused, for example, by forest management choices (e.g. planting rapid-growth tree species), natural disturbances, or climate change.
	**No litter** All aboveground biomass is intercepted using a litter trap. A screen catches the aboveground litter, which is then transferred to the double litter treatment.	Understanding the contribution of aboveground litter as a source of organic matter, and the impact of reduced aboveground litter as a result of forest management, natural disturbances, or climate change.
	**Addition of woodchips** Addition of 4 to 30 mm white pine woodchips every 3 years, at a rate of twice the quantity of litter that will fall on the ground.	Understanding the contribution of deadwood to the soil's organic matter, carbon sequestration, and the availability of nutrients for trees. Studying the impact of reductions in the quantity of deadwood on the ground (for example, in the case of an intensification of biomass harvesting for energy purposes).
	**Fertilization** Nitrogen (NH_4NO_3) input of 20 kg/ha/year, which represents approximately twice the natural atmospheric nitrogen content.	Evaluating the impact of adding nitrogen to the soil. Nitrogen affects the productivity of vegetation, as well as transformations and organisms in the soil.
	**Addition of ashes** Adding 20 t/ha of ashes produced by a forest biomass boiler (provided by Resolute Forest Products), which is the equivalent of 5 t/ha of lime.	Quantifying soil transformations, the effects on soil organisms, and the effects on organic matter decomposition produced by the addition of ashes. The goal is to simulate the increased use of forest biomass. Indeed, if more biomass is removed, there remains less in the forest; can the addition of ash from the biomass boiler offset the removal of biomass?
	**No roots** A 1-m-deep trench was dug, and a membrane was installed to prevent further tree-root colonization and underground litter input.	Quantifying the impact of underground litter on soil, particularly on the accumulation of carbon in the soil. This is an extreme simulation of the effects of poor forest regeneration. Note that the roots and mycorrhizae that are associated with them "construct" the soil.

Virtual visit

Would you like to learn more, or perhaps visit the DIRT–Valcartier set-up? Why not try a virtual visit – it is only one click away!

➔ **http://visitesvirtuelles.partenariat.qc.ca/dirt**

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