Secteur des Sciences et Technologies

Invitation à la soutenance publique de thèse de

Monsieur François STEVENS

Licencié en sciences physiques

Pour l'obtention du grade de Docteur en sciences agronomiques et ingénierie biologique

« Towards a better understanding and prediction of the spatial distribution of organic carbon in cropland soils»

qui se déroulera

le jeudi 22 novembre 2018 à 16h30

Salle Jean-Baptiste Carnoy

Place Croix du Sud, 4-5

1348 Louvain-la-Neuve

Membres du jury :

Prof. Patrick Bogaert (UCLouvain), supervisor
Prof. Bas Van Wesemael (UCLouvain), supervisor
Prof. Bruno Delvaux (UCLouvain), chairperson
Prof. Marnik Vanclooster (UCLouvain), secretary
Prof. Kristof Van Oost (UCLouvain)
Prof. Gerard Heuvelink (ISRIC – World Soil Information, Netherlands)

UCLouvain

Soil organic matter (SOM) consists of plant and animal residues at various stages of decomposition and substances synthesized by soil organisms. Soil organic carbon (SOC) is the content of carbon in SOM. It plays an important role in multiple soil functions such as contributing to soil stability and fertility. Besides, adapting land use and land management practices is viewed as a solution to increase the content of SOC stored in soils and is therefore contributing to climate change mitigation. In this thesis, the focus will be made on cropland soils.

The concentration of SOC at a given location is the result of an equilibrium between inputs generally in the form of plant and root residues or amendments and outputs due to the decomposition by microorganisms (with production of carbon dioxide). Soil relocation due to tillage or water erosion may also be important factors of SOC inputs and outputs in cropland soils. This equilibrium is influenced by many soil and environmental factors, resulting in a large variability of SOC at multiple spatial scales. Better understanding the spatial distribution of SOC is needed to assess and predict the response of soils to climate change, to build and monitor carbon sequestration policies, to improve soil quality and cultivation practices and to explain and model soil processes.

The objective of this thesis is to identify and quantify the effect of the factors controlling the spatial variability of SOC concentration and stock as well as the influence of the spatial scale at which these factors are acting. We also aim at determining how the prediction of spatial variation is useful for the estimation of the total SOC stock over a study area. Using different approaches from the framework of digital soil mapping and geostatistics, we quantify the influence of different soil and environmental factors such as texture, topography and land management. Using a spatial filtering method, we also demonstrate that the spatial distribution of SOC has typical ranges of variations and that components with different ranges are specifically related to different factors. Finally, we propose a decision tree that recommends the most cost-effective methodology of total SOC stock estimation according to SOC spatial dependence and data availability in the study area. Through the different applications, we also analyze the potential, limitations and pitfalls of different formats of data types such as SOC images from airborne hyperspectral sensing and legacy data of historical surveys is Belgium.